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Digital Cash-to-Cash Transformation and Organizational Resilience: Evidence from Working-Capital Buffer Configuration

Gang Wei
Henan University
Yu Cao
Henan University
Peng Liu
liupeng@henu.edu.cn
Henan University

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Abstract

Digital transformation is increasingly important for firms seeking to remain resilient under conditions of uncertainty, yet less is known about how digital technologies strengthen resilience when they are embedded in specific operating routines. This study examines whether digital cash-to-cash transformation, the digital redesign and operational integration of inventory, receivables, and payables routines, enhances organisational resilience. Using Chinese listed firms from 2012 to 2024, we construct a large-language-model-based textual measure from annual reports that distinguishes substantive digital transformation in working-capital processes from generic digital disclosure. The results show that digital cash-to-cash transformation is positively associated with a multidimensional measure of organisational resilience. This finding remains robust to alternative measures, instrumental-variable estimation, propensity score matching, double machine learning, and shock-based tests. Mechanism analyses indicate that the resilience benefits of digital transformation arise primarily through working-capital buffer configuration rather than simple cash-cycle compression. Specifically, digital transformation is associated with higher inventory, receivables, and payables postures, each of which is positively related to resilience. The effects are stronger among more focused firms and firms pursuing differentiation strategies. These findings suggest that the resilience value of digital transformation lies not merely in adopting digital technologies, but in embedding them in cash-to-cash routines that improve information visibility, coordination, and the flexible deployment of working-capital resources.

Introduction

Digital transformation has become an important means through which firms respond to increasingly uncertain business environments. Yet firms differ substantially in their ability to translate digital technologies into greater organisational resilience. Some firms continue operating and recover relatively quickly when disruptions affect demand, supply and financing, whereas others experience prolonged operational and financial difficulties. Understanding why digital transformation strengthens resilience in some firms therefore requires looking beyond whether firms simply adopt digital technologies and examining where and how those technologies become embedded in everyday organisational routines.

This study focuses on one such domain: working-capital management. Inventories, accounts receivable and accounts payable connect a firm's operating activities with its short-term financial resources and jointly shape the cash conversion cycle. They also become particularly important during periods of disruption. Supply interruptions may require firms to maintain additional inventories; temporary financial difficulties among customers may make flexible trade credit valuable; and tighter external financing may increase the importance of managing payment obligations to suppliers. Working-capital management is therefore more than a routine accounting function. It represents an important set of cash-to-cash processes through which firms coordinate procurement, production, sales, collections, payments and liquidity.

Digital technologies have considerable potential to reshape these processes. Integrated information systems, real-time monitoring, data analytics, automated credit assessment, electronic invoicing and digitally enabled workflows can provide managers with more timely information about inventory conditions,

customer payments, supplier obligations and liquidity requirements. Existing research shows that digital technologies can improve information processing, organisational coordination and adaptation (Mithas et al., 2012; Bharadwaj et al., 2013; Nambisan et al., 2019), and recent studies suggest that digital transformation can strengthen firm resilience under adverse conditions (Copestake et al., 2024; Fu et al., 2025). Digital transformation has also been associated with improvements in production efficiency, financing conditions and product quality (Kong et al., 2026). However, much less is known about the specific financial and operational routines through which digital transformation contributes to organisational resilience.

This gap is important for two reasons. First, widely used indicators of digital transformation often capture broad technological investment or the frequency with which firms discuss digital technologies. Such measures cannot necessarily distinguish substantive changes in organisational processes from symbolic disclosure. A firm may frequently refer to artificial intelligence, big data or digital platforms without integrating these technologies into the processes through which operating and financial decisions are actually made. The economic consequences of digitalisation should depend not only on the technologies a firm possesses, but also on whether those technologies change how the firm monitors conditions, coordinates decisions and allocates resources.

Second, the conventional efficiency view of working-capital management may not fully explain its role under disruption. Research commonly associates effective working-capital management with a shorter cash conversion cycle and reduced capital tied up in inventories and receivables. Such efficiency is valuable under normal conditions, but disruption creates a different problem. Firms may deliberately maintain inventory to reduce the risk of production interruptions, extend trade credit to preserve valuable customer relationships, or adjust payment timing to protect internal liquidity. Accordingly, resilience may depend less on uniformly minimising working capital than on a firm's ability to determine where buffers are needed and to reconfigure them as conditions change.

Building on this reasoning, this study introduces the concept of digital cash-to-cash transformation, defined as the digital redesign and operational embedding of routines governing inventories, receivables and payables. Drawing on dynamic capabilities theory (Teece et al., 1997; Teece, 2007) and organisational information-processing theory (Galbraith, 1973; Lee et al., 1997), the study proposes that digitally embedded cash-to-cash routines enhance organisational resilience in two complementary ways. They increase information-processing capacity by improving the timeliness, detail and cross-functional visibility of working-capital information, and they enhance reconfiguration capacity by allowing firms to adjust inventories, customer credit and payment arrangements more effectively when operating conditions change. Digitalisation can therefore enable working capital to function as an adaptive buffer system, rather than simply as a target for efficiency improvement.

China provides an informative setting in which to examine this argument. Chinese firms have experienced rapid digitalisation alongside substantial variation in institutional development, policy support and competitive conditions. At the same time, strong policy and market attention to digital transformation creates incentives for firms to signal technological progress, making it particularly important to distinguish

substantive digital implementation from general digital rhetoric. The Chinese setting therefore provides both considerable variation in firms' digital transformation and a useful context in which to examine whether technologies are genuinely embedded in operational routines.

To capture this distinction empirically, the study develops a text-based measure of digital transformation in working-capital management using the annual reports of Chinese listed firms from 2012 to 2024. Rather than counting general digital keywords, a large-language-model-assisted procedure identifies disclosures indicating that digital technologies have been incorporated into inventory, receivables and payables processes. The resulting measure is designed to capture substantive routine embedding rather than generic digital disclosure. Organisational resilience is measured using a multidimensional index incorporating financial, operational, strategic and market dimensions. The baseline sample contains 15,902 firm-year observations from 2,506 listed firms.

The empirical results show a positive association between digital cash-to-cash transformation and organisational resilience. This relationship remains robust across alternative measures and a range of approaches designed to address endogeneity and model dependence, including instrumental-variable estimation, propensity-score matching and double machine learning. More importantly, the mechanism results point to working-capital buffer configuration rather than simple cash-cycle compression. Digital cash-to-cash transformation is associated with higher inventory, receivables and payables postures, and these working-capital positions are in turn associated with stronger resilience. The benefits are also stronger among focused firms and firms pursuing differentiation, whereas cost leadership does not provide a comparable pathway. These findings suggest that digitalisation contributes to resilience not primarily by minimising working capital, but by improving firms' ability to position and redeploy liquidity-related resources when conditions become uncertain.

This study makes three main contributions. First, it adds to research on digital transformation and organisational resilience by identifying a specific routine-level mechanism through which digital technologies can generate resilience. Rather than treating digitalisation as a broad organisational characteristic, the study shows how its incorporation into inventories, receivables and payables processes can strengthen the firm's capacity to process information, coordinate decisions and reconfigure resources under disruption. This provides a more concrete explanation of how digital transformation becomes operationally consequential.

Second, the study extends research on working-capital management by distinguishing an efficiency logic from a resilience logic. Existing research has largely evaluated working capital in terms of cash-cycle compression and liquidity efficiency. The evidence presented here suggests that, under uncertainty, inventories, receivables and payables can also function as adaptive buffers. Their value depends not simply on whether their levels are high or low, but on whether firms possess the information and coordination capabilities needed to position and redeploy them appropriately. This perspective connects short-term financial management with the broader literature on organisational adaptation and resilience.

Third, the study contributes methodologically to research on digital transformation by developing a routine-specific, large-language-model-based textual measure. Generic digital keyword counts may combine

substantive transformation with aspirational or symbolic disclosure. By identifying whether digital technologies are explicitly connected to working-capital processes, the proposed measure provides a more targeted approach to assessing the operational embedding of digitalisation. The study thereby illustrates how large-language-model-assisted textual analysis can be used to measure organisational processes that are difficult to observe directly in large samples.

Taken together, the findings suggest that the resilience value of digital transformation lies not simply in adopting more digital technologies, but in embedding them in the recurring processes through which firms manage economically important resources. In the working-capital domain, digitalisation enables firms to obtain better information about liquidity conditions, coordinate decisions across organisational functions and adapt the configuration of inventories, receivables and payables as circumstances change. Digital cash-to-cash transformation can therefore turn working-capital management from a predominantly efficiency-oriented function into an important source of organisational adaptability and resilience.

Theoretical Background and Hypotheses Development

Digital transformation changes not only the technologies firms use but also the routines through which information is processed, decisions are coordinated, and resources are deployed. This distinction is important for understanding organisational resilience. Firms frequently acquire similar digital technologies, yet their ability to withstand and recover from disruption varies considerably. The value of digitalisation therefore depends not simply on technological adoption, but on whether digital tools become embedded in organisational processes that matter when firms encounter uncertainty.

We examine this issue in the context of working-capital management. Inventories, receivables, and payables are conventionally treated as balance-sheet items or components of the cash conversion cycle. In practice, however, they arise from recurring decisions about procurement, production, customer credit, collections, supplier payments, and liquidity allocation. These decisions connect financial management directly to operating activity and become particularly consequential when firms experience disruptions to demand, supply, or financing. We therefore conceptualise digital transformation in working-capital management as the digital redesign and operational embedding of routines governing inventories, receivables, and payables. Rather than asking whether a firm is broadly “digital”, our interest lies in whether digital technologies alter how the firm manages its cash-to-cash processes.

Our theoretical argument combines dynamic capabilities theory with organisational information-processing theory. Dynamic capabilities theory explains how firms respond to changing environments by sensing changes, seizing opportunities for response, and reconfiguring resources and routines (Teece et al., 1997; Teece, 2007). Organisational information-processing theory complements this perspective by emphasising the need for firms to increase their information-processing capacity as uncertainty and interdependence increase (Galbraith, 1973; Lee et al., 1997). Taken together, these perspectives suggest that digitally embedded working-capital routines can strengthen resilience by improving visibility over short-term resource positions, reducing coordination frictions, and allowing firms to adjust the configuration of inventories, receivables, and payables as conditions change.

This reasoning also implies an important distinction between working-capital efficiency and working-capital resilience. Conventional approaches often regard a shorter cash conversion cycle and lower working-capital commitments as desirable. Under disruption, however, minimising working capital uniformly may leave firms vulnerable. Inventory can protect production against supply interruptions; trade credit can sustain valuable customer relationships; and the management of payables can preserve liquidity when external financing becomes constrained. What matters for resilience is therefore not simply whether working capital is high or low, but whether firms can identify where buffers are valuable and reposition them when circumstances change. Digital transformation may make precisely this form of selective configuration possible. This distinction between mechanical cash-cycle compression and adaptive buffer configuration lies at the centre of our theoretical framework. The original manuscript similarly distinguishes working-capital efficiency from continuity-oriented buffer management.

Digital working-capital transformation and organisational resilience

Organisational resilience refers to a firm's capacity to maintain operational continuity and restore performance when adverse events disrupt normal business conditions (Ortiz de Mandojana and Bansal, 2015; Williams and Shepherd, 2016; DesJardine et al., 2019). Resilience therefore requires more than financial slack. It depends on the firm's ability to recognise emerging problems, coordinate responses across organisational functions, and redeploy resources before temporary disruption develops into persistent deterioration.

Digital transformation can strengthen each of these capabilities when technologies are embedded in cash-to-cash routines. Working-capital decisions are information intensive. Managers must continually assess inventory availability, customer payment behaviour, supplier obligations, projected cash flows, and financing needs. During disruption, these tasks become more difficult because conditions change more quickly and decisions become increasingly interdependent. A reduction in supplier reliability, for example, may require simultaneous changes in inventory policy, cash forecasting, procurement, payment timing, and customer fulfilment.

Digital technologies can improve the firm's ability to manage such interdependence. Integrated systems, real-time dashboards, automated monitoring, analytics, and digitally enabled workflows can shorten the time between changes in operating conditions and managerial recognition of those changes. Greater information granularity can make emerging inventory shortages, unusual receivables delays, supplier exposures, or liquidity pressures visible earlier. Digital connectivity can also reduce information fragmentation among finance, procurement, production, sales, and operations, enabling managers to evaluate the consequences of working-capital decisions across functional boundaries.

Dynamic capabilities theory provides one explanation for why these improvements matter. Digital working-capital routines strengthen sensing by providing more timely information about changes in liquidity and operating conditions. They strengthen seizing by allowing managers to act on those signals through adjustments to replenishment, customer credit, collections, or supplier-payment policies. They support reconfiguration because digital workflows and integrated information systems enable changes in resource allocation to be implemented more rapidly and consistently (Teece et al., 1997; Teece, 2007).

Organisational information-processing theory leads to a similar prediction from a different starting point. As uncertainty rises, organisations face greater demands for timely, accurate, and coordinated information (Galbraith, 1973). Digital working-capital routines increase information-processing capacity by combining previously fragmented data, reducing reporting delays, and making exceptions easier to identify. In doing so, they help firms match their information-processing capabilities to the heightened demands created by disruption.

Crucially, these benefits should depend on routine embedding rather than digital adoption alone. Digital technologies that remain peripheral to operating decisions may improve a firm's technological image or external disclosure without materially changing how managers respond to disruption. By contrast, when those technologies are incorporated into the routines governing inventory, trade credit, collections, supplier payments, and liquidity, they become part of the firm's adaptive infrastructure. This distinction is particularly relevant because common measures of digital transformation based on expenditure or broad digital terminology cannot always distinguish substantive process redesign from symbolic or aspirational digitalisation. The original manuscript likewise emphasises the difference between technological adoption and the incorporation of digital tools into recurring cash-to-cash routines.

Existing research provides broader support for this argument. Digital technologies have been shown to improve information visibility, organisational coordination, and process redesign (Mithas et al., 2012; Bharadwaj et al., 2013; Nambisan et al., 2019), while more recent studies associate digitalisation with greater organisational flexibility and resilience under adverse conditions (Copestake et al., 2024; Fu et al., 2025; Lee et al., 2025; Lee and Park, 2026). We extend this reasoning to a more specific organisational domain. When digital technologies are embedded in the routines governing short-term operating resources, firms should be better able to identify emerging pressures, coordinate responses, and preserve continuity during disruption.

Accordingly, we propose:

H1. *Digital transformation in working-capital management is positively associated with organisational resilience.*

Resilience-oriented working-capital configuration

The preceding argument explains why digitally embedded working-capital routines may improve resilience, but it does not identify how those capabilities become reflected in firms' actual resource positions. We argue that an important mechanism is resilience-oriented working-capital configuration.

Traditional working-capital management places considerable emphasis on efficiency. From this perspective, inventories and receivables tie up capital, whereas longer payment periods can reduce immediate financing needs. A shorter cash conversion cycle is therefore often interpreted as evidence of more effective liquidity management (Kieschnick et al., 2013). This logic remains useful under relatively predictable conditions. During periods of disruption, however, the objective of working-capital management changes. Firms must

balance liquidity efficiency against continuity, flexibility, and the preservation of commercially important relationships.

Inventory illustrates this trade-off. Lean inventory policies may reduce carrying costs when supply is dependable, but additional inventory can become valuable when transport interruptions, supplier failures, or input shortages threaten production. Receivables involve a similar tension. Aggressive collection can improve cash flow, yet extending trade credit may help strategically important customers survive a temporary liquidity shock and thereby preserve future demand. Payables likewise represent more than a financing choice. Adjusting payment timing can protect internal liquidity, although excessive payment delays may damage supplier relationships or weaken supply continuity.

These examples indicate that there is no universally optimal level of working capital under disruption. Instead, firms must determine where additional buffers are warranted, which counterparties merit support, and which resources can be released without increasing operating risk. Resilience-oriented working-capital management is therefore fundamentally a problem of configuration, not simple minimisation.

Digital working-capital transformation can improve this configuration process in several ways. First, greater visibility allows managers to distinguish strategically useful buffers from inefficient accumulation. Real-time inventory information, for example, can help identify which products or inputs warrant additional stock and which do not. Second, improved analytics can support more differentiated credit and collection decisions by identifying customers whose temporary liquidity problems differ from persistent credit deterioration. Third, integrated cash-flow and payment information can help firms balance liquidity preservation against supplier continuity. Finally, digital workflows facilitate rapid adjustment as information changes, allowing buffers to be repositioned rather than fixed in advance.

The theoretical implication is that digitalisation need not enhance resilience by shortening the cash conversion cycle. Its greater value under uncertainty may lie in enabling firms to selectively hold, release, and redeploy working-capital buffers. In this view, apparently higher working-capital positions need not represent inefficiency if they are purposefully configured to absorb shocks, maintain relationships, or protect operating continuity.

Accordingly, digital working-capital transformation should contribute to resilience partly because it improves firms' ability to configure short-term operating resources in response to changing conditions. We therefore predict:

H2. *Resilience-oriented working-capital configuration mediates the positive relationship between digital transformation in working-capital management and organisational resilience.*

Strategic contingencies: focus, differentiation, and cost leadership

The resilience value of digital working-capital transformation is unlikely to be identical across firms. Digital technologies are embedded within broader organisational systems, and their value depends partly on how well they complement a firm's strategic priorities. Research on generic competitive strategies distinguishes among focus, differentiation, and cost leadership, each of which entails different patterns of resource

allocation, organisational coordination, and competitive emphasis (Dess and Davis, 1984; White, 1986; Miller, 1988; Hill, 1988; Campbell-Hunt, 2000). These differences should influence how digital cash-to-cash capabilities are used and, consequently, how strongly they contribute to resilience.

Focus strategy

Focused firms concentrate their resources and managerial attention on relatively narrow product, customer, or market domains. Such concentration produces both vulnerability and potential advantage. On the one hand, dependence on a narrower domain may increase exposure to shocks affecting core customers, suppliers, or markets. On the other hand, concentration can make granular information and targeted intervention particularly valuable because managerial attention is directed towards a smaller set of economically important relationships.

Digital working-capital routines complement such a strategy. Better information on inventories, customer credit exposure, collection patterns, and supplier payment conditions allows focused firms to monitor the financial-operational health of their core domain closely. When conditions deteriorate, managers can identify where inventories should be protected, which customers require temporary credit support, and which supplier relationships are most critical to continuity. Digital systems can therefore make the resource concentration associated with focus more manageable by improving the precision with which scarce liquidity and working-capital buffers are deployed.

For diversified firms, comparable digital information may be distributed across a broader and more heterogeneous portfolio of businesses, products, or markets. The same digital capabilities can still be useful, but their benefits may be less concentrated. We therefore expect the resilience payoff from digital working-capital transformation to be greater when firms follow a stronger focus strategy.

H3a. *The positive relationship between digital transformation in working-capital management and organisational resilience is stronger for firms with a higher focus strategy orientation.*

Differentiation strategy

Differentiation rests on creating value through attributes such as quality, reliability, responsiveness, service, innovation, and customer relationships rather than competing primarily on cost. These features make the continuity of customer- and supplier-facing processes especially important. A differentiated firm's competitive position may be damaged not only by an inability to produce, but also by delayed fulfilment, deterioration in service, or disruption to relationship-specific commitments.

Digitally embedded working-capital routines can reinforce differentiation because many of the resources supporting differentiated offerings are closely connected to cash-to-cash processes. Inventory availability affects delivery reliability; receivables policies influence customer relationships; supplier payments can affect access to critical or specialised inputs; and coordinated cash-flow management enables firms to maintain these commitments when conditions become difficult. Digital systems improve the visibility and coordination required to manage these interdependencies.

The relationship may also operate through strategic alignment. Firms with stronger digital cash-to-cash capabilities can support differentiated offerings more effectively because they are better able to coordinate order-to-cash and procure-to-pay processes, tailor credit decisions, manage critical inventories, and preserve key supplier relationships. In turn, differentiation can support resilience by strengthening customer attachment, protecting demand, and providing firms with greater flexibility to preserve value during disruption.

Accordingly, we propose:

H3b. *Digital transformation in working-capital management is positively associated with differentiation orientation, which in turn is positively associated with organisational resilience.*

Cost leadership

Cost leadership rests on a different organisational logic. Firms pursuing this strategy seek advantage through efficiency, standardisation, tight cost control, and disciplined resource use. These characteristics can enhance performance when operating conditions are predictable. However, they may be less compatible with resilience when disruption requires temporary slack, flexible resource deployment, or the preservation of buffers that appear inefficient under conventional performance criteria.

Working-capital policy represents an important part of this tension. Strong cost discipline commonly favours lower inventories, tighter customer credit, standardised payment practices, and reductions in capital tied up in the operating cycle. Digitalisation can reinforce such efficiency by improving forecasting, monitoring, and control. Yet the resilience logic developed here requires something different: the ability to maintain or expand selected buffers when their continuity value exceeds their carrying cost.

A strong cost-leadership orientation may therefore limit the degree to which firms use digital working-capital capabilities for adaptive buffering. Managers operating under strong efficiency pressures may be reluctant to maintain additional inventory, tolerate greater receivables flexibility, or preserve supplier arrangements that increase short-term costs. Thus, although digital technologies themselves can improve efficiency, the particular form of digital cash-to-cash transformation examined here—one oriented towards flexible buffer configuration—may be less naturally aligned with strict cost leadership.

We therefore expect digital working-capital transformation to be negatively associated with cost-leadership orientation and, within the resilience framework examined here, cost leadership to be negatively associated with organisational resilience.

H3c. *Digital transformation in working-capital management is negatively associated with cost leadership orientation, and cost leadership orientation is negatively associated with organisational resilience.*

Business development posture as a realignment channel

Digital working-capital transformation may also influence resilience by changing how managers approach business development. Expansion requires commitments of financial and operating resources before many

of its benefits are realised. Rapid growth can increase inventory requirements, extend receivables, place greater demands on suppliers, and increase the need for external or internal financing. The cash-to-cash consequences of expansion are therefore often substantial.

Digitally embedded working-capital routines make these consequences more visible. Improved cash-flow forecasting can reveal the liquidity implications of additional sales or new market entry. More granular customer-credit information can show whether growth is being achieved by assuming greater collection risk. Inventory monitoring can reveal whether expansion is creating inefficient stock accumulation, while integrated supplier and payment data can identify pressures arising from increased procurement commitments. Greater visibility therefore strengthens managerial discipline by exposing the short-term financial demands associated with aggressive development.

This suggests that digital cash-to-cash transformation may encourage a more cautious development posture. Managers with better information about the working-capital consequences of expansion may be less willing to pursue growth whose liquidity requirements exceed the firm's capacity to absorb them. Digitalisation, in this sense, does not necessarily stimulate expansion; it may instead improve the firm's ability to distinguish sustainable growth from growth that creates excessive short-term financial strain.

Yet an aggressive development posture can itself contribute to resilience. Exploration and expansion can broaden the firm's strategic options, create new customer and supplier relationships, diversify demand channels, and accelerate organisational learning (March, 1991; Ferrier, 2001). Firms that pursue new opportunities may possess a wider range of alternatives when existing markets or relationships are disrupted. This creates an important theoretical tension. Digital working-capital transformation can strengthen resilience directly through better liquidity governance while simultaneously discouraging aggressive development that might otherwise broaden the firm's adaptive options.

This tension does not imply that digital transformation is detrimental to resilience. Rather, it identifies a potential realignment channel through which improved financial-operational visibility changes managerial development choices. We therefore expect digital working-capital transformation to be associated with a more conservative development posture, while more aggressive development remains positively associated with resilience.

H4. *Digital transformation in working-capital management is negatively associated with an aggressive business development strategy relative to a conservative strategy, and a more aggressive business development strategy is positively associated with organisational resilience.*

Data and Measurement

Sample

The emergence of big data as a strategic asset can be traced to September 2008, when *Nature* featured a cover story titled “Big Data”, signaling its rising prominence in scientific and technological discourse. Beginning in 2009, the term gained widespread traction within the internet technology sector. In June 2011,

McKinsey & Company published a seminal report, *Big Data: The Next Frontier for Innovation, Competition, and Productivity*, which positioned big data as a foundational resource in the digital economy, on par with traditional factors such as human and physical capital. Motivated by these developments, we define our sample period from 2012 to 2024 to capture the diffusion and maturation of data technologies in working capital management.

Our empirical analysis focuses on industrial firms listed in China with sufficient data to construct all relevant variables. To ensure data integrity and exclude abnormal cases, we remove firms designated as ST, ST*, or PT, which indicate financial distress or irregular operations. After applying additional data availability criteria based on the CSMAR database, our baseline sample consists of 15,902 firm-year observations from 2,506 firms, each with complete data on all key variables used in the analysis.

Proxy of Digital Transformation in Working Capital Management

We construct a text-based index for digital transformation in working capital management (DTWCMI) by applying LLMs to annual reports. This approach allows us to capture how firms describe concrete digital initiatives in receivables, payables, and inventory processes, going beyond simple counts of technology-related words. Compared with manual coding or dictionary methods, the LLM-based measure is scalable, context-aware, and better able to distinguish substantive process redesign from superficial references to digitalization (Mithas et al., 2012; Bharadwaj et al., 2013; Zhu and Yu, 2024). Our measurement strategy proceeds in three steps.

Stage 1: LLM-assisted sentence labeling. We first identify candidate sentences related to digital transformation in working capital management by applying a domain-specific keyword filter to annual reports (keyword list in Appendix A). These sentences are then evaluated by Alibaba's Tongyi Qianwen-Max model against a predefined rubric that distinguishes substantive digital working-capital initiatives (e.g., automated receivables, digital supplier-finance platforms, real-time cash dashboards) from generic or symbolic mentions. Each sentence is scored multiple times and a majority-vote rule is used to assign a final label. A light manual review is conducted to correct obvious misclassifications and ensure that the training data align with our conceptual definition of DTWCM. Figure 1 summarizes this labeling workflow.

Stage 2: Fine-tuning a domain model (FinBERT). Next, we use the labeled sentences to fine-tune FinBERT, a finance-oriented language model, so that it learns to recognize DTWCM-related content in the specific context of Chinese annual reports. The goal of this step is not to develop a new algorithm but to obtain a stable classifier that can apply the labeling logic from Stage 1 to a large volume of text in a consistent way. Details on model tuning and performance diagnostics are reported in Appendix C.

Stage 3: Scoring firm-year DTWCM. In the final step, we apply the fine-tuned model (FinBERT_FT) to all firm-year annual reports. After keyword filtering, each candidate sentence is classified by FinBERT_FT, and its score is aggregated to the firm-year level to form a continuous DTWCM index. We then add one to this index and take the natural logarithm to construct DTWCMI, where higher values indicate more extensive and

substantive digital transformation in working capital management. Figure 2 illustrates the end-to-end scoring pipeline.

This design separates a conceptually rich, one-off labeling stage (using a general-purpose LLM and human oversight) from an operational scoring stage (using a fine-tuned, task-specific model). As a result, DTWCMI preserves the nuance of expert judgment while remaining transparent and replicable at scale. In robustness checks, we show that DTWCMI is highly correlated with alternative text-based and investment-based proxies of digitalization (DTWCMS and DTI) and that our main results are robust when using these alternatives, supporting both the validity and reliability of the LLM-based measure.

Proxy of Firm Resilience

Organizational resilience refers to a firm's capacity to anticipate, absorb, adapt to, and recover from adverse events such as economic downturns, supply chain disruptions, or financial distress. It captures both resistance, or the ability to withstand shocks with limited performance loss, and recovery, or the ability to restore performance after shocks (Williams and Shepherd, 2016; DesJardine et al., 2019). We operationalize resilience along four dimensions, financial, operational, strategic, and market-based, and construct a composite index that aggregates indicators within each dimension.

Financial resilience (ORI_FIN) covers profitability, earnings stability, cash buffer capacity, and leverage. Strong, stable profits and ample liquidity cushion shocks, whereas conservative leverage limits fixed obligations during downturns (Gormley and Matsa, 2016; Bauwens et al., 2021). Operational resilience (ORI_OPE) captures supply chain diversification, operational leverage, and asset turnover. Diversified supply bases reduce dependence on single nodes, lower operational leverage provides cost-adjustment flexibility, and high asset turnover reflects efficient, adaptable resource use (Barrot and Sauvagnat, 2016).

Strategic resilience (ORI_STR) is proxied by R&D intensity and internationalization. R&D supports innovation and adaptive capacity, while international footprints spread market risk and create alternative revenue channels (Coles et al., 2006; DesJardine et al., 2019). Market-based resilience (ORI_MAR) draws on stock return volatility and Beta, which reflect investor-perceived risk and exposure to aggregate shocks; lower volatility and Beta indicate more resilient business models (Cohn et al., 2015; Ortiz-de-Mandojana and Bansal, 2015).

We use the entropy method to synthesize these indicators into an overall organizational resilience index (ORI). Relative to single metrics (e.g., cash holdings), this multidimensional measure reduces idiosyncratic noise, better aligns with the dual resistance–recovery concept, and facilitates heterogeneity and mechanism analyses across ownership and institutional settings (Li et al., 2023; Lamorgese et al., 2024).

Control Variables

Consistent with prior studies, we control firm characteristics and corporate governance factors. as detailed in Appendix B. We also include year and industry fixed effects. All continuous variables are winsorized at the 1% and 99% levels.

Model

To examine the impact of digital transformation in working capital management on organizational resilience, we estimate the following regression model:

$$\mathrm{FRI}_{\mathrm{i,t+1}}=\alpha+\beta_1\mathrm{DTWCMI}_{\mathrm{i,t}}+\beta_{\mathrm{j}}\mathrm{CONTROL}_{\mathrm{i,j,t}}+\mathrm{YEAR}+\mathrm{IND}+\delta_{\mathrm{i,t}}\#\ (1)$$

In Eq. (1), CONTROL denotes a vector of control variables, YEAR represents calendar year fixed effects to control for macroeconomic shocks and time trends, and IND includes industry fixed effects to address sector-specific influences.

Results

Descriptive Statistics

Table 1 reports summary statistics for the baseline sample. The mean value of the dependent variable organizational resilience *(ORI)* is -0.701, with a relatively low standard deviation (0.033), suggesting moderate variation across firms. The key independent variable, *DTWCMI*, has a mean of 0.00240 and a wide range (0 to 0.0220), reflecting substantial heterogeneity in digital engagement. Control variables such as *SIZE*, *AGE*, and *BSIZE* display typical distributions, while *MANE* shows high variance, indicating skewed executive equity incentives.

Table 1 Descriptive statistics.

Variables	Mean	Median	Min	Max	Std. Dev
ORI	-0.701	-0.694	-0.802	-0.647	0.0330
DTWCMI	0.00240	0.000959	0	0.0220	0.00395
SIZE	22.107	21.930	20.082	25.712	1.155
AGE	2.899	2.944	1.946	3.555	0.326
BSIZE	2.093	2.197	1.609	2.565	0.190
IND	37.896	36.360	33.330	57.140	5.406
MANC	0.411	0.277	0.00807	2.389	0.430
MANE	10.607	1.481	0	63.402	15.933
MTB	1.995	1.644	0.876	7.059	1.096

Note: This table presents the descriptive statistics for the variables used in the regression analysis. The variables are defined in the Appendix B.

Table 2 presents the pairwise correlations among key variables. The correlation between *DTWCMI* and organizational resilience is positive (0.143), suggesting that greater digitalization is modestly associated with improved resilience. This supports the paper's baseline H1. Among control variables, firm size (*SIZE*) exhibits the strongest positive correlation with resilience (0.203), consistent with prior literature that larger

firms possess greater slack and adaptive capacity (e.g., Jiang et al. 2023). In contrast, managerial cash compensation (*MANC*) and market-to-book ratio (*MTB*) are negatively correlated with resilience (-0.152 and -0.117), potentially reflecting risk-taking incentives or market misvaluation. Notably, the correlation between control variables is generally low to moderate, with the highest being -0.581 between board size (*BSIZE*) and independent director ratio (*IND*), indicating no severe multicollinearity concern for the regression models. These results provide preliminary evidence of the relationship structure and support the subsequent multivariate analysis.

Table 2 Pairwise correlation.

Variables	ORI	DTWCMI	SIZE	AGE	BSIZE	IND	MANC	MANE	MTB
ORI	1								
DTWCMI	0.143	1							
SIZE	0.203	0.129	1						
AGE	-0.0809	0.123	0.212	1					
BSIZE	0.0786	-0.0175	0.226	0.0397	1				
IND	-0.0027	0.0353	0.0075	0.0111	-0.581	1			
MANC	-0.152	-0.0090	-0.546	-0.126	-0.0925	-0.0169	1		
MANE	-0.0398	-0.0025	-0.310	0.149	-0.149	0.0629	0.221	1	
MTB	-0.117	-0.0452	-0.231	-0.0519	-0.0639	0.0091	0.200	0.0276	1

Note: This table reports the pairwise correlation for the variables used in the regression analysis. The variables are defined in the Appendix B.

Baseline Regression Results

Table 3 reports the baseline estimates of the effect of DTWCMI on organizational resilience. Across both pooled OLS and two-way fixed effects specifications, the coefficient on DTWCMI is positive and highly significant, lending robust support to H1. This result indicates that firms with greater digitalization of working capital routines are systematically more resilient to disruption. Theoretically, these findings align with the Dynamic Capabilities perspective, which emphasizes that resilience stems from firms' ability to sense, seize, and transform in volatile contexts (Teece, 2007). Digitalized WCM tools, such as AI-driven forecasting or blockchain-enabled invoicing, enhance sensing by improving visibility into liquidity risks, enable seizing by facilitating rapid reallocation of financial resources, and foster transformation by embedding adaptive financial processes that persist across crises. At the same time, the Resource-Based View highlights that digital WCM systems constitute valuable and difficult-to-imitate resources that strengthen financial flexibility and ensure continuity of operations (Barney, 1991; Bharadwaj et al., 2013).

From an information-processing lens, DTWCM enhances organizational capacity to gather, interpret, and act upon real-time financial data, reducing uncertainty and enabling more effective responses to shocks (Galbraith, 1973; Zhu and Yu, 2024). Finally, the results are consistent with institutional theory, which suggests that in China's policy-driven environment, firms that integrate digital tools substantively, rather than symbolically, are better positioned to convert external pressures into adaptive capability (DiMaggio and Powell, 1983; Bothello et al., 2023; Jung et al., 2024). Taken together, these results confirm that digital transformation in financial operations is not merely supportive infrastructure but a resilience-enhancing capability, extending organization research on micro-foundations of resilience by demonstrating how digitalized working capital routines function as a core operational buffer in turbulent environments.

Control variables align with prior research. Firm SIZE and AGE are positively related to resilience, consistent with larger, more established firms possessing greater slack and structural maturity (Levine et al., 2018). BSIZE also loads positively, supporting the view that board diversity facilitates crisis deliberation (Schmid and Urban, 2023; Pan et al., 2025). By contrast, MANC and MTB are negatively associated with resilience, while MANE becomes marginally positive in fixed-effects models. Overall, these patterns reinforce H1 and validate DTWCMI as a meaningful proxy for digitalized financial operations.

Table 3 Baseline regression results.

	Dependent variable: *ORI*			
	Pooled OLS		Two-Way Fixed-Effect Model	
	Column A	Column B	Column C	Column D
DTWCMI	1.203*** (11.04)	1.008*** (9.25)	1.474*** (12.28)	1.267*** (10.92)
SIZE		0.00362*** (5.31)		0.00473*** (6.84)
AGE		0.00301** (1.67)		0.00644*** (3.14)
BSIZE		0.0103*** (2.80)		0.00557 (1.51)
IND		0.000146 (1.24)		0.0000813 (0.71)
MANC		-0.00510*** (-3.47)		-0.00223 (-1.48)
MANE		0.0000572 (1.51)		0.0000734* (1.94)
MTB		-0.00197*** (-4.07)		-0.00192*** (-3.72)
INDUSTRY	No	No	Yes	Yes
YEAR	No	No	Yes	Yes
Observations	15,902	15,902	15,902	15,902
Adj-R^2	0.0204	0.0660	0.060	0.108

Note: This table presents the regression results of Equation (1) to test H1. T-statistics clustered at the firm level are reported in parentheses. The variables are defined in the Appendix B. *p < 0.10; **p < 0.05; ***p < 0.01.

Endogeneity Concern

A key empirical concern is that the estimated relation between digital transformation in working-capital management and organizational resilience may reflect endogeneity rather than a substantive effect. More resilient firms may have stronger financial capacity, better managerial systems, or superior organizational routines that allow them to invest earlier in digital working-capital technologies. In addition, omitted local

institutional conditions or managerial quality may jointly affect both digital transformation and resilience. To address these concerns, we employ two complementary approaches: an instrumental-variable two-stage least squares estimator and propensity score matching.

We first use the intensity of local digital policy support, denoted DTCITY, as an instrument for firm-level digital transformation in working-capital management. DTCITY is constructed from annual government work reports of 289 Chinese prefecture-level cities, using text-based measures of local policy emphasis on digital development. The logic is that local governments with stronger digital-policy commitments are more likely to improve digital infrastructure, data platforms, e-government systems, and related policy support, thereby facilitating firms' adoption of digital tools in cash-to-cash routines. At the same time, local digital-policy intensity is unlikely to affect an individual listed firm's organizational resilience directly after controlling for firm characteristics, industry effects, and year effects, except through its influence on firms' digital transformation.

Table 4 presents the findings. The first-stage result supports the relevance of the instrument. The coefficient on DTCITY is positive and significant, indicating that firms located in cities with stronger digital-policy support exhibit higher levels of digital transformation in working-capital management. The Kleibergen–Paap rk LM statistic is 12.191, rejecting the null of under-identification, and the Cragg–Donald Wald F statistic is 29.183, well above the conventional threshold of 10. These diagnostics indicate that the instrument has sufficient explanatory power and that weak-instrument concerns are unlikely to drive the results. The second-stage estimate further reinforces our baseline conclusion. After instrumenting DTWCMI with DTCITY, the coefficient on DTWCMI remains positive and statistically significant at the 1% level. Economically, the estimated coefficient is larger than in the baseline specification, suggesting that measurement error, reverse causality, or omitted heterogeneity may have attenuated the ordinary least squares estimate. More importantly, the result indicates that exogenous variation in digital working-capital transformation induced by local digital-policy support is associated with higher subsequent organizational resilience. This evidence strengthens the interpretation that digitally embedded cash-to-cash routines contribute to firms' capacity to withstand and adapt to disruption, rather than merely reflecting pre-existing resilience advantages.

We also implement propensity score matching to reduce observable differences between firms with high and low levels of digital transformation in working-capital management. Firms are matched on the full set of control variables used in the baseline model, thereby comparing treated firms with observationally similar control firms. The PSM estimate remains positive and significant. Specifically, the coefficient on DTWCMI is 1.114 and significant at the 1% level, closely aligned with the baseline results. This finding indicates that the positive association between digital working-capital transformation and resilience is not driven solely by systematic differences in firm size, age, governance structure, managerial incentives, or market valuation.

Taken together, the IV and PSM results provide consistent evidence that endogeneity concerns do not explain the main findings. The instrumental-variable estimates address reverse causality and unobserved heterogeneity through plausibly exogenous local digital-policy variation, while the matching analysis

alleviates selection bias based on observable firm characteristics. Across both approaches, digital transformation in working-capital management remains positively and significantly associated with organizational resilience. These results lend further support to our central argument that the digital redesign and operational embedding of inventory, receivables, and payables routines constitute a resilience-enhancing capability rather than a mere reflection of firms' prior strength.

Table 4 The regression results of 2SLS and PSM.

	IV-1st	IV-2nd	PSM
	$DTWCMI_t$ as DV	ORI_{t+1} as DV	ORI_{t+1} as DV
$DTCITY_t$	0.128***		
	(3.52)		
$DTWCMI_t$		7.298***	1.114***
		(2.87)	(9.28)
CONTROL	YES	YES	YES
Kleibergen-Paap rk LM statistic	12.191		
Cragg-Donald Wald F statistic	29.183		
INDUSTRY	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
Observations	15,740	15,740	8601
Adj-R^2	0.139	0.0892	0.100

Note: The variables are defined in the Appendix B. *p < 0.10; **p < 0.05; ***p < 0.01.

Double Machine Learning Estimates

To further address potential endogeneity and functional-form misspecification, we employ a double machine learning (DML) approach. The DML estimator is useful in this setting for two reasons. First, the relation between digital transformation in working-capital management, firm characteristics, governance attributes, and resilience may be highly nonlinear. Conventional regression models impose relatively restrictive functional forms and may therefore leave residual confounding unaddressed. Second, DML uses sample splitting and orthogonalization to partial out the predictive effects of high-dimensional controls from both the treatment variable and the outcome variable. This procedure reduces overfitting bias and allows the coefficient on DTWCMI to be interpreted after flexibly controlling for complex relations among observed covariates. In this sense, DML provides a stringent robustness test that complements the baseline regressions, IV estimates, and PSM analysis.

Table 5 reports the DML estimates using five alternative machine-learning algorithms: random forest, LASSO, ridge regression, support vector machine, and gradient boosting. Across all specifications, the coefficient on DTWCMI remains positive and statistically significant at the 1% level. The estimated coefficients range from 0.0072 to 0.0096, with very similar standard errors across models. This consistency is important because the five algorithms rely on different assumptions about the structure of the data. LASSO and ridge regression emphasize penalized linear prediction, random forest and gradient boosting capture nonlinearities and interactions, and support vector machine allows flexible margin-based prediction. The fact that DTWCMI remains significant across these alternative learners indicates that the main result is not driven by a particular modeling choice.

Economically, the DML evidence reinforces the central conclusion of the paper. Even after allowing the control variables to affect both digital transformation and organizational resilience in flexible and potentially nonlinear ways, firms with deeper digital transformation in working-capital routines exhibit higher subsequent resilience. This suggests that the documented effect is not merely a by-product of firm size, governance structure, managerial incentives, industry conditions, or other observable characteristics. Rather, the results are consistent with the view that digitally embedded cash-to-cash routines enhance firms' capacity to process information, coordinate liquidity decisions, and reconfigure operational buffers under disruption.

Overall, the DML results provide additional support for the robustness of our findings. Together with the IV and PSM analyses, they indicate that the positive relation between DTWCMI and organizational resilience is unlikely to be explained by observable selection, nonlinear confounding, or model dependence. These findings strengthen our interpretation that digital transformation in working-capital management operates as a resilience-enhancing capability.

Table 5 Double Machine Learning estimates.

ORI_{t+1} as DV (K=7)	RF	LASSO	Ridge	SVM	Gradboost
$DTWCMI_t$	0.0072***	0.0096***	0.0095***	0.0092***	0.0092***
	(12.00)	(16.00)	(15.83)	(15.33)	(15.33)
Linear term of CONTROL	Yes	Yes	Yes	Yes	Yes
Quadratic term of CONTROL	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
Observations	14,204	14,204	14,204	14,204	14,204

Note: T-statistics clustered at the firm level are reported in parentheses. The variables are defined in the Appendix B. *p < 0.10; **p < 0.05; ***p < 0.01.

Robustness tests

To economize on space, we report additional robustness analyses in the Supporting Information Appendix. First, we assess whether our text-based DTWCMI measure is sensitive to the choice of large language model. Specifically, we replace Tongyi Qianwen with DeepSeek, an independently developed LLM with a distinct architecture and training paradigm. This exercise provides a useful check on whether the classification of digital working-capital content reflects the underlying construct rather than model-specific labeling behavior. As reported in Appendix C, the main results remain robust when DTWCMI is reconstructed using DeepSeek, indicating that our proxy is not driven by a particular LLM implementation.

Second, we construct a dictionary-based alternative measure of digital transformation in working-capital management, denoted DTWCMS. This measure captures the frequency with which firms disclose the use of digital technologies in working-capital activities. We develop a domain-specific dictionary of digital WCM terms, reported in Column A of Appendix D, and adapt the Jieba segmentation procedure by incorporating these terms into a customized lexicon suitable for Chinese annual reports. After tokenization and stop-word removal, we calculate the term frequency of digital WCM keywords for each firm-year and define DTWCMS as the natural logarithm of one plus the total keyword frequency[1]. The results, reported in Appendix D, are consistent with the baseline findings.

Third, we use digital transformation investment (DTI) as a further alternative proxy. Unlike disclosure-based measures, DTI captures firms' financial commitment to digital infrastructure, systems, and tools that can support digitalized working-capital practices, such as real-time inventory tracking, automated receivables management, electronic payment systems, and predictive cash-flow analytics. The results based on DTI, also reported in Column A of Appendix D, continue to show a positive association between digital transformation in working-capital management and organizational resilience.

Fourth, we examine whether our findings are robust to alternative definitions of the dependent variable. Instead of using the composite organizational resilience index, we separately use its four disaggregated components: financial resilience (ORI_FIN), operational resilience (ORI_OPE), strategic resilience (ORI_STR), and market-based resilience (ORI_MAR). This test helps determine whether the baseline result is concentrated in a single dimension or reflects a broader resilience effect. Appendix E shows that the positive relation between DTWCMI and resilience is not confined to one component, supporting the multidimensional interpretation of our main measure.

Finally, we implement a difference-in-differences design that exploits the COVID-19 shock as an external disruption to firms' operating, supply-chain, and financing conditions. This test examines whether firms with stronger pre-shock digital transformation in working-capital management were better able to withstand a severe and unexpected disruption. As reported in Appendix F, the findings remain consistent with our main conclusion. Overall, these additional analyses reinforce the robustness of the DTWCMI–resilience relationship and suggest that the results are not driven by a specific language model, measurement approach, resilience proxy, or empirical specification.

Further Analyses

Mediating Effect of Working Capital Management Efficiency

The mediation evidence in Table 6 indicates that digital transformation in working capital management strengthens organizational resilience not by mechanically compressing the cash conversion cycle, but by enabling firms to reconfigure inventories, receivables, and payables in ways that balance transactional efficiency with shock-absorbing buffers. This pattern is consistent with H2, which proposes that the effect of DTWCM on resilience operates in part through a firm's working-capital posture and aligns with a dynamic-capabilities and information-processing logic in which digitalized routines enhance sensing, seizing, and reconfiguration under uncertainty (Galbraith, 1973; Teece et al., 1997; Teece, 2007).

DTWCM is positively associated with DIO, and higher DIO is in turn positively related to resilience. Rather than implying wasteful accumulation, this pattern is consistent with digitally transformed firms being better able to position targeted inventory buffers. Inventory research shows that information distortion and coordination failures can amplify oscillations and risk propagation along supply chains (Lee et al., 1997). By improving forecasting, real-time visibility, and exception-based control, digital tools can mitigate these distortions and support deliberate safety-stock placement at critical nodes (Raj et al., 2025). The results therefore align with resilience arguments that continuity under disruption depends on analytically governed slack that reduces stockouts and production interruptions (Ortiz-de-Mandojana and Bansal, 2015; DesJardine et al., 2019).

DTWCM is also associated with longer DSO, and DSO positively predicts resilience. Although extended collections are typically viewed as inefficiency, resilience perspectives emphasize the strategic value of slack and stakeholder support when shocks threaten demand and liquidity (Sonenshein and Nault, 2024). Digital credit management systems that integrate transaction histories with external signals can enable selective trade credit—supporting financially constrained but strategically important customers while tightening terms for riskier accounts (Mithas et al., 2012; Kieschnick et al., 2013). Such targeted credit provision can function as a demand-side buffer that stabilizes relationships and future cash flows, consistent with evidence that resilient organizations actively sustain key stakeholders during adversity (Williams and Shepherd, 2016; Sonenshein and Nault, 2024).

Table 6 Tests of H2.

	Column A	Column B	Column C	Column D	Column E	Column F
	DIO as DV	*ORI* as DV	*DSO* as DV	*ORI* as DV	*DPO* as DV	*ORI* as DV
DTWCMI	6.821**	1.185***	11.495***	1.168***	14.596***	1.030***
	(2.42)	(10.04)	(3.11)	(9.90)	(6.25)	(9.04)
DIO		0.006***				
		(6.00)				
DSO				0.005***		
				(5.00)		
DPO						0.014***
						(14.00)
CONTROL	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,204	14,204	14,204	14,204	14,204	14,204
Adj-R^2	0.15	0.12	0.21	0.12	0.14	0.17

Note: This table presents the regression results of testing mediating effect of working capital management efficiency. T-statistics clustered at the firm level are reported in parentheses. The variables are defined in the Appendix B. *p < 0.10; **p < 0.05; ***p < 0.01.

Finally, DTWCM is strongly positively associated with DPO, and DPO mediates the DTWCM–resilience relationship. This suggests that digitalization can convert payables into a flexible liquidity instrument, consistent with research on trade credit as a mechanism for smoothing liquidity when financing tightens (Levine et al., 2018). Digital procurement platforms and supply-chain-finance solutions can facilitate longer terms while enabling suppliers to monetize receivables via intermediaries (Bharadwaj et al., 2013; Xia et al., 2022). Overall, the positive links between DTWCM, DIO/DSO/DPO, and resilience indicate a shift from minimizing the cash conversion cycle to configuring a resilience-oriented working-capital posture through digitally enabled routine reconfiguration (Woodard et al., 2013; Salvato and Rerup, 2018).

Effect of Competitive Strategies

Prior research commonly operationalizes generic strategies using multi-indicator composites that capture activity-system emphasis rather than relying on single accounting ratios (Dess and Davis, 1984; White, 1986; Campbell-Hunt, 2000). This approach is consistent with evidence that strategy dimensions can be inferred from persistent patterns of functional choices and resource allocation (Miller, 1988; Hill, 1988).

Following this tradition, we construct strategy indices using industry–year relative positioning, standardization, and principal component analysis (PCA).

Focus strategy (FOC). Focus reflects concentration in scope and can be proxied by business-structure concentration measures. We use four complementary indicators, including a single-business dummy, number of segments, revenue entropy, and the Herfindahl–Hirschman index (HHI). We align indicator directionality, standardize, and extract the first principal component to form the focus index.

Differentiation strategy (DIF). Differentiation is typically grounded in innovation and knowledge inputs as well as market-facing investments and value-creating outputs (Hill, 1988; Miller, 1988). We build the DIF index from R&D intensity, R&D personnel share, invention patents, advertising intensity, selling-expense intensity, intangible assets (including goodwill) intensity, and gross margin. We de-mean by industry–year to capture relative positioning, standardize, and apply PCA to obtain a composite differentiation score.

Cost leadership strategy (CLI). Cost leadership emphasizes efficiency-oriented activity systems characterized by low cost intensity and high operating productivity (Dess and Davis, 1984; White, 1986; Hill, 1988). We operationalize CLI using cost of sales ratio and SG&A intensity (reverse coded so higher indicates stronger cost leadership), together with total asset turnover, inventory turnover, and receivables turnover. All components are standardized within industry–year and combined using PCA.

Table 7 reports tests of the competitive strategy hypotheses. Column A estimates the focus moderation model with ORI as the dependent variable. DTWCMI is positively associated with resilience ($\beta = 1.245$, $p < 0.01$). Focus has a small negative main effect ($\beta = -0.001$, $p < 0.05$), consistent with the idea that greater scope concentration can increase exposure to segment-specific shocks. Importantly, the interaction term DTWCMI × FOC is positive and marginally significant ($\beta = 0.093$, $p < 0.10$). This pattern supports H3a and indicates that the resilience benefits of DTWCMI are stronger for more focused firms.

Table 7 Tests of H3 and H4.

	Column A	Column B	Column C	Column D	Column E	Column F	Column G
	ORI as DV	DIF as DV	*ORI* as DV	CLI as DV	*ORI* as DV	OSI as DV	*ORI* as DV
	H3a	H3b	H3b	H3c	H3c	H4	H4
DTWCMI	1.245***	32.516***	1.108***	-19.566***	1.141***	-3.826***	1.225***
	(10.38)	(4.86)	(7.91)	(-3.48)	(9.51)	(-3.01)	(9.70)
FOC	-0.001**						
	(-2.10)						
DTWCMI*FOC	0.093*						
	(1.69)						
DIF			0.001**				
			(2.27)				
CLI					-0.004***		
					(-9.30)		
OSI							0.002**
							(2.30)
CONTROL	YES	YES	YES	YES	YES	YES	YES
INDUSTRY	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES
Observations	13505	10434	10434	14164	14164	10811	10811
Adj. R^2	0.10	0.16	0.11	0.23	0.13	0.05	0.10

Note: This table presents the regression results of testing effects of different strategies. T-statistics clustered at the firm level are reported in parentheses. The variables are defined in the Appendix B.

*p < 0.10; **p < 0.05; ***p < 0.01.

From an operations perspective, focused firms have fewer options to smooth disruption across diversified segments, so resilience depends more heavily on rapid reprioritization of cash-to-cash flows toward the most critical products and customer relationships. Digitally embedded working-capital routines increase visibility and exception handling in receivables, payables, and inventory decisions, which helps focused firms stabilize continuity under stress.

Columns B and C evaluate the differentiation pathway. Column B shows DTWCMI is strongly positively associated with differentiation orientation ($\beta = 32.516$, $p < 0.01$). Column C then shows differentiation is positively associated with resilience ($\beta = 0.001$, $p < 0.05$) while DTWCMI remains positive and significant ($\beta = 1.108$, $p < 0.01$). Together, these results are consistent with partial mediation, supporting H3b. Substantively, DTWCMI appears to complement differentiation by enabling service reliability and relationship protection through cash-to-cash execution. Under disruption, digitally embedded working-capital routines support targeted credit and inventory decisions that protect important customers and stabilize fulfillment, which aligns with differentiation-based value creation and strengthens resilience.

Columns D and E examine the cost leadership pathway. Column D shows DTWCMI is negatively associated with cost leadership orientation ($\beta = -19.566$, $p < 0.01$). Column E shows cost leadership orientation is negatively associated with resilience ($\beta = -0.004$, $p < 0.01$), while DTWCMI remains positive and significant ($\beta = 1.141$, $p < 0.01$). This pattern supports H3c and implies a positive indirect association through reduced cost-leadership reliance, because both links are negative. Operationally, cost leadership is often paired with leaner buffers and tighter slack, which can constrain resilience-oriented buffer reconfiguration when shocks occur. DTWCMI, in contrast, supports selective buffering and rapid liquidity redeployment. The negative DTWCMI–CLI relationship suggests that firms embedding digital working-capital routines tend to rely less on a pure cost-leadership orientation. Because CLI is negatively related to resilience, this shift away from cost leadership is associated with additional resilience benefits.

Overall, Table 7 provides consistent support for the strategy-related mechanisms and boundary conditions proposed in H3. Focus strengthens the DTWCMI–resilience relationship (H3a). Differentiation serves as a partial mediating pathway (H3b). Cost leadership operates as a constraining orientation that is reduced under DTWCMI and is negatively related to resilience (H3c). These results reinforce the interpretation that DTWCMI contributes to resilience through operations-relevant execution and buffering capabilities, and that its value depends on how firms compete.

Effect of Business Development Strategy

To test H4, we capture firms' business development posture using a composite development strategy index (DSI) that reflects an offensive (aggressive) versus conservative orientation in search and expansion (Hambrick, 1983; DeSarbo et al., 2005; March, 1991). DSI is constructed from ten indicators commonly associated with aggressive growth, risk taking, and scope expansion, including R&D intensity, capital expenditure intensity, invention patents, foreign sales ratio, leverage, sales growth, fixed-asset growth, profit volatility, an M&A indicator, and a diversification indicator (Ferrier, 2001; Connelly et al., 2020; Feichter et al., 2022). All components are oriented such that higher values indicate greater offensiveness. The first eight measures are adjusted relative to the industry–year median and standardized, and PCA is used to extract a single index. Firms in the top quartile of DSI are classified as having an offensive posture (OSI = 1).

Columns F and G of Table 7 evaluate the development posture pathway. Column F shows that DTWCMI is negatively associated with OSI ($\beta = -3.826$, $p < 0.05$), indicating that firms with greater digital transformation in working-capital routines are less likely to exhibit an offensive development posture as

captured by DSI. Column G shows that OSI is positively associated with organizational resilience ($\beta = 0.002$, $p < 0.05$), while DTWCMI remains positive and statistically significant ($\beta = 1.225$, $p < 0.01$). Taken together, these results imply a negative indirect pathway through OSI (DTWCMI $\rightarrow$ OSI < 0; OSI $\rightarrow$ ORI > 0). This pattern is consistent with a countervailing (offsetting) mediation channel, rather than the predicted positive mediation.

Substantively, the findings suggest that DTWCMI contributes to resilience primarily through improvements in cash-to-cash visibility, exception handling, and routine reconfiguration, rather than through enabling a more offensive development posture. One interpretation is that embedding digital control and monitoring into liquidity routines increases discipline and makes cash-to-cash exposure more transparent, which may reduce the propensity to pursue aggressive expansion, even though aggressiveness can contribute to resilience by building options and recovery capacity. Importantly, the positive main association between DTWCMI and resilience remains robust, indicating that the countervailing OSI pathway does not explain the core effect.

Additional analyses provide limited support for business development posture as a boundary condition. The conservative posture pathway is not statistically significant (results available upon request), and interaction terms between DTWCMI and either offensive or conservative posture are not significant (results available upon request). Overall, the evidence indicates that DTWCMI's resilience benefits do not vary systematically by development posture, and that development posture plays, at most, a small offsetting mediating role.

Supplemental tests

To economize on space, additional supplemental tests are reported in the Supporting Information Appendix. These include heterogeneity analyses by ownership structure (Appendix G), institutional environment (Appendix G), and external pressures and governance attributes (Appendix H), including policy support (government subsidies), analyst coverage, chairman education, and chairman reputation. Across these checks, DTWCMI remains positively and significantly associated with organizational resilience. The DTWCMI–resilience association is stronger for SOEs than for POEs, while interactions with institutional development (LEGAL and MARKET) are negative but statistically insignificant. By contrast, external pressures and elite governance signals attenuate the DTWCMI effect, consistent with more symbolic or compliance-oriented digitalization.

Conclusion and Policy Implications

Conclusion

This study examines whether digital transformation in working-capital management strengthens organisational resilience by changing how firms govern the cash-to-cash processes linking inventories, receivables, payables, and liquidity. Using Chinese listed firms from 2012 to 2024, we develop a large-language-model-based measure designed to identify substantive digital transformation in working-capital routines rather than generic references to digital technologies. The evidence shows that firms with more

deeply digitalised cash-to-cash routines exhibit greater organisational resilience. This relationship remains robust across alternative measures and a range of empirical approaches designed to address endogeneity, selection, and model dependence.

The central finding is not simply that digitalisation matters, but that where digitalisation is embedded matters. Digital technologies appear to generate resilience value when they become part of the recurring routines through which firms monitor inventory positions, manage customer credit and collections, coordinate supplier payments, and allocate short-term liquidity. In this respect, the results support a process-based interpretation of digital transformation. The acquisition of digital technologies alone is unlikely to change organisational outcomes unless those technologies alter the information flows, decision processes, and coordination mechanisms through which firms respond to changing conditions. This interpretation is consistent with research that views digital transformation as an organisational process rather than a stand-alone technological investment (Bharadwaj et al., 2013; Nambisan et al., 2019; Piccoli et al., 2022).

The mechanism evidence further refines this argument. Conventional working-capital management often emphasises efficiency through tighter control and shorter cash conversion cycles (Kieschnick et al., 2013). Our findings point to a different logic when firms face disruption. Digital working-capital transformation is associated with higher inventory, receivables, and payables postures, and each of these positions is positively related to organisational resilience. Rather than suggesting indiscriminate accumulation of working capital, the evidence is consistent with a buffer-configuration mechanism: digital technologies improve firms' capacity to identify where short-term resources are most valuable and to position or redeploy those resources as conditions change. In this setting, inventories can protect production continuity, receivables can support strategically important customers, and payables can provide liquidity flexibility. Working capital therefore functions not only as an efficiency variable, but also as an adaptive financial-operational resource.

The strategic analyses show that these resilience benefits are not uniform across firms. The positive association between digital working-capital transformation and resilience is stronger among more focused firms, suggesting that granular information and targeted liquidity allocation become particularly valuable when resources and managerial attention are concentrated in narrower product-market domains. Differentiation also provides a meaningful pathway: digitally embedded cash-to-cash routines appear particularly compatible with strategies that depend on service reliability, fulfilment stability, customer support, and relationship-specific investments. By contrast, cost-leadership orientation is negatively associated with resilience and is inversely related to digital working-capital transformation. This result is consistent with the possibility that a strong emphasis on standardisation, efficiency, and low slack becomes less advantageous when disruption requires flexibility and selective buffering.

The evidence concerning business-development posture is more limited. Although the theoretical framework allows for the possibility that greater cash-flow visibility may discipline aggressive expansion, business-development posture does not provide a strong explanatory channel in the empirical results. This finding is informative because it narrows the interpretation of the main relationship. The resilience value of

digital working-capital transformation appears to arise primarily from better information processing, cross-functional coordination, and the reconfiguration of existing cash-to-cash resources, rather than from a systematic shift towards more aggressive or more conservative growth strategies.

Taken together, these findings extend research on organisational resilience in three related ways. First, they identify working-capital routines as an important micro-level setting in which digital capabilities become operationally consequential. Resilience is not generated only by broad resource endowments or general digital maturity; it is also shaped by the recurring routines through which firms translate information into liquidity and operating decisions. Second, the findings qualify the conventional efficiency interpretation of working capital by showing that resilience may require selective rather than uniform reduction of short-term resource commitments. Third, they show that the value of digitally enabled routines depends on strategic alignment. Digital transformation does not create equivalent benefits in every organisational setting; its consequences depend on how digital capabilities complement firms' operating priorities and competitive positioning.

Policy implications

The findings have several implications for policymakers, regulators, financial institutions, and corporate managers. First, policies supporting corporate digital transformation should place greater emphasis on process integration rather than technology adoption alone. Many digitalisation programmes are evaluated using measures such as software expenditure, platform adoption, cloud deployment, or the number of digital projects introduced by firms. These indicators are useful but incomplete. Our findings suggest that resilience benefits are more likely to emerge when digital technologies become embedded in core financial-operational routines. Government programmes designed to support enterprise digitalisation could therefore place greater weight on projects that integrate information across procurement, inventory management, sales, receivables, payments, treasury, and supply-chain management.

This distinction is particularly important for small and medium-sized firms, which may have limited resources to implement comprehensive digital systems. Policy support need not encourage expensive digital adoption for its own sake. Instead, subsidies, tax incentives, digital-service vouchers, or public technology platforms could prioritise applications that address specific coordination problems—for example, real-time inventory visibility, electronic invoicing, receivables monitoring, cash-flow forecasting, supplier-payment coordination, and supply-chain finance. The objective should be to increase the quality of information and decision making within operating routines rather than simply increase the number of digital technologies reported by firms.

Second, digital-transformation policies should be coordinated with working-capital and supply-chain finance policies. Our results indicate that resilience does not arise primarily from mechanically reducing working capital. Under disruption, inventory, receivables, and payables can serve useful buffering functions. Policies that evaluate firms solely according to lean inventories or rapid working-capital compression may therefore create unintended vulnerability. Financial institutions and supply-chain platforms could instead use digital information to distinguish productive working-capital buffers from persistent inefficiency.

Third, regulators should encourage greater interoperability and standardisation of business data. The effectiveness of digital working-capital routines depends on information moving across organisational boundaries and functional units. Fragmented systems reduce the capacity of firms to observe simultaneous changes in inventory, customer payments, supplier obligations, and cash requirements. Wider adoption of interoperable e-invoicing systems, standardised electronic payment records, digital supply-chain documentation, and secure data-sharing protocols can lower the cost of integrating these information flows.

Such infrastructure also has implications beyond individual firms. During periods of widespread disruption, better digital visibility across supply chains can help financial institutions and public authorities identify liquidity stress, payment bottlenecks, and concentrated supply risks earlier. Policy support for interoperable digital infrastructure should therefore be viewed not merely as a productivity initiative but also as part of the institutional architecture supporting business continuity and economic resilience.

Fourth, the results suggest that corporate digitalisation policies should avoid a one-size-fits-all model. The stronger effect among focused firms and the positive role of differentiation indicate that the economic value of digital working-capital routines depends on strategic context. Firms whose competitive advantage depends heavily on customer relationships, specialised products, service quality, or reliable fulfilment may benefit particularly from digital capabilities that improve granular working-capital monitoring and targeted buffer allocation. Policy programmes could therefore allow greater flexibility in the objectives and design of digital-transformation projects rather than evaluating every firm against the same efficiency indicators.

Limitations and future research

Several limitations should be acknowledged. They also point to promising directions for future research. First, the analysis focuses on Chinese listed firms. China provides a useful setting because rapid digital development, substantial variation in institutional environments, and strong policy encouragement of technological upgrading generate meaningful variation in digital transformation. Nevertheless, listed firms tend to be larger, more formalised, and better resourced than privately held firms and small and medium-sized enterprises. Their access to finance, technological capabilities, and supply-chain relationships may also differ from those of firms in other countries. The results should therefore not be assumed to generalise automatically beyond this setting. Future research could examine whether digital cash-to-cash transformation has similar resilience effects in smaller firms, privately owned firms, and economies with different banking systems, digital infrastructures, and trade-credit institutions.

Second, although the study employs several approaches to address endogeneity and the results remain consistent across alternative specifications, causal interpretation should remain appropriately cautious. Digital transformation is an organisational choice, and firms adopting deeper digital working-capital systems may differ in unobserved managerial quality, organisational discipline, or prior technological capabilities. Future research could exploit sharper quasi-exogenous changes, such as staggered digital-infrastructure rollouts, reforms in electronic invoicing, changes in digital-payment regulation, or policy shocks affecting access to supply-chain finance. Such settings would allow researchers to observe more directly how externally induced changes in digital working-capital capabilities affect resilience.

Third, our textual measure improves on broad digitalisation proxies but inevitably remains an indirect measure of process implementation. Annual reports describe organisational practices but cannot reveal precisely how intensively individual systems are used, whether managers act on the information generated, or how deeply digital tools are integrated across functions. Disclosure may also differ across firms because of reporting incentives. Future studies could combine textual indicators with system-use records, transaction-level payment and invoicing data, inventory-management logs, supply-chain platform participation, or process-mining information. Such data could provide a more direct view of how digital technologies alter decision timing, exception management, and cross-functional coordination.

This measurement issue is particularly important for LLM-based research. Large language models improve the ability to identify context and distinguish substantive descriptions from generic terminology, but they do not remove the need for construct validation. Future work could compare LLM-generated classifications with manually coded samples, operational data, management surveys, or external technology-adoption records. Research could also examine the stability of LLM-based measures across alternative models, prompts, training samples, and reporting environments. Such validation would help clarify both the possibilities and the limits of language-model-based measurement in organisational research.

Finally, organisational resilience itself is multidimensional and evolves over time. The present study captures financial, operational, strategic, and market dimensions, but future research could examine resilience around identifiable shocks and distinguish more explicitly between resistance, adaptation, and recovery. Digital working-capital transformation may matter differently at each stage. Inventory buffers may be particularly valuable in absorbing an initial supply shock, customer-credit flexibility may matter during the adaptation phase, and liquidity coordination may become especially important during recovery. Identifying these temporal differences would provide a richer understanding of how digitally embedded routines contribute to resilience.

Declarations

Endnotes

[1]The keywords used for *DTWCMS* include artificial intelligence, intelligent manufacturing, smart manufacturing, smart cities, smart transportation, intelligent data analysis, intelligent robotics, machine learning, deep learning, cloud computing, cloud migration, cloud platforms, cloud services, big data, data security, data services, data governance, data sharing, industrial internet, internet of things (IoT), blockchain, 5G, digital technology, digitalization, and the digital economy.

Author contributions

Gang Wei: Conceptualization, investigation, formal analysis, writing-original draft, and revision of the manuscript.

Yu Cao: Methodology, supervision, project administration, and writing-review & editing.

Peng Liu: Conceptualization, methodology, validation, supervision, and writing-review & editing.

All authors read and approved the final manuscript and agreed to be accountable for the work.

Competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Ethical approval

Ethical approval was not required as no human participants were involved in this research.

Informed consent

Informed consent was not required as no human participants were involved in this research.

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Figures

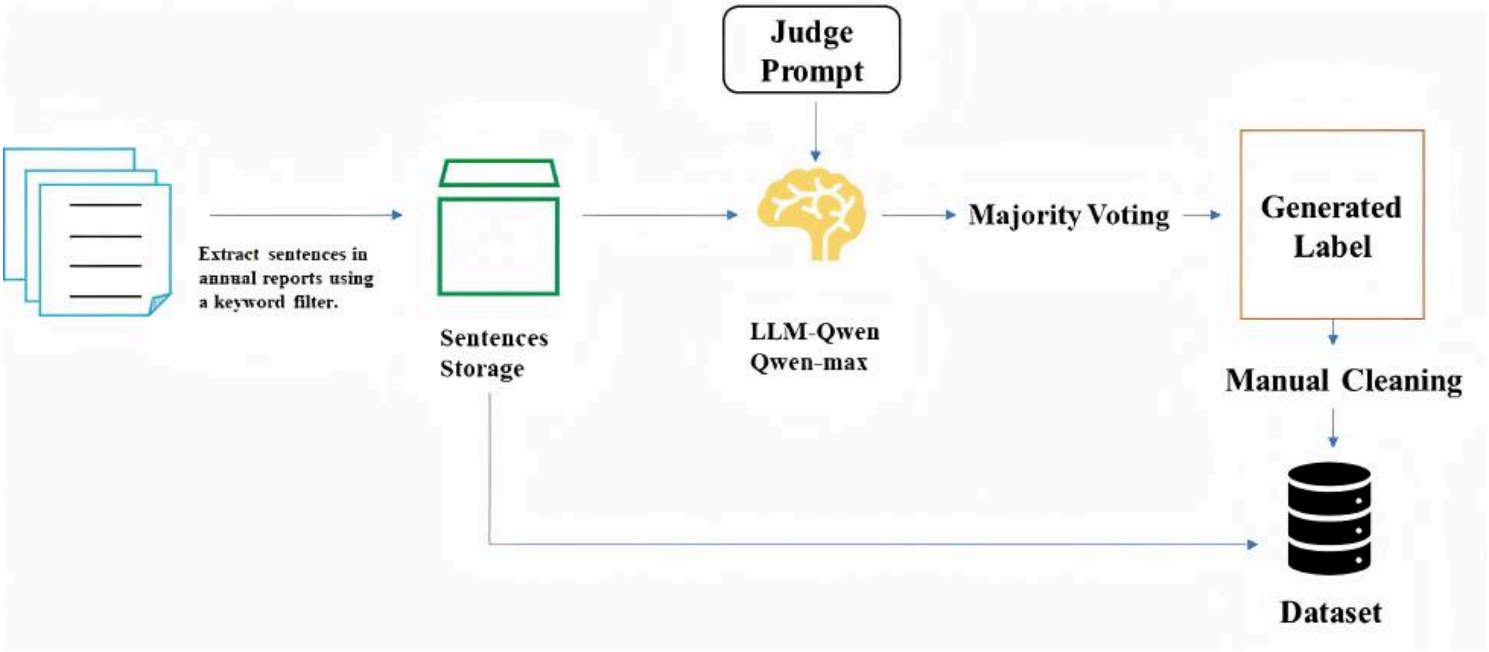


Figure 1

Workflow for constructing the labeled dataset using LLM-based sentence annotation. This figure depicts the LLM-assisted labeling process for DT in WCM. Sentences from annual reports are filtered by keywords, evaluated by Qwen models via judge prompts, majority-voted, manually cleaned, and compiled into D_{train}. This hybrid approach combines AI efficiency with human oversight to enhance label quality and reliability.

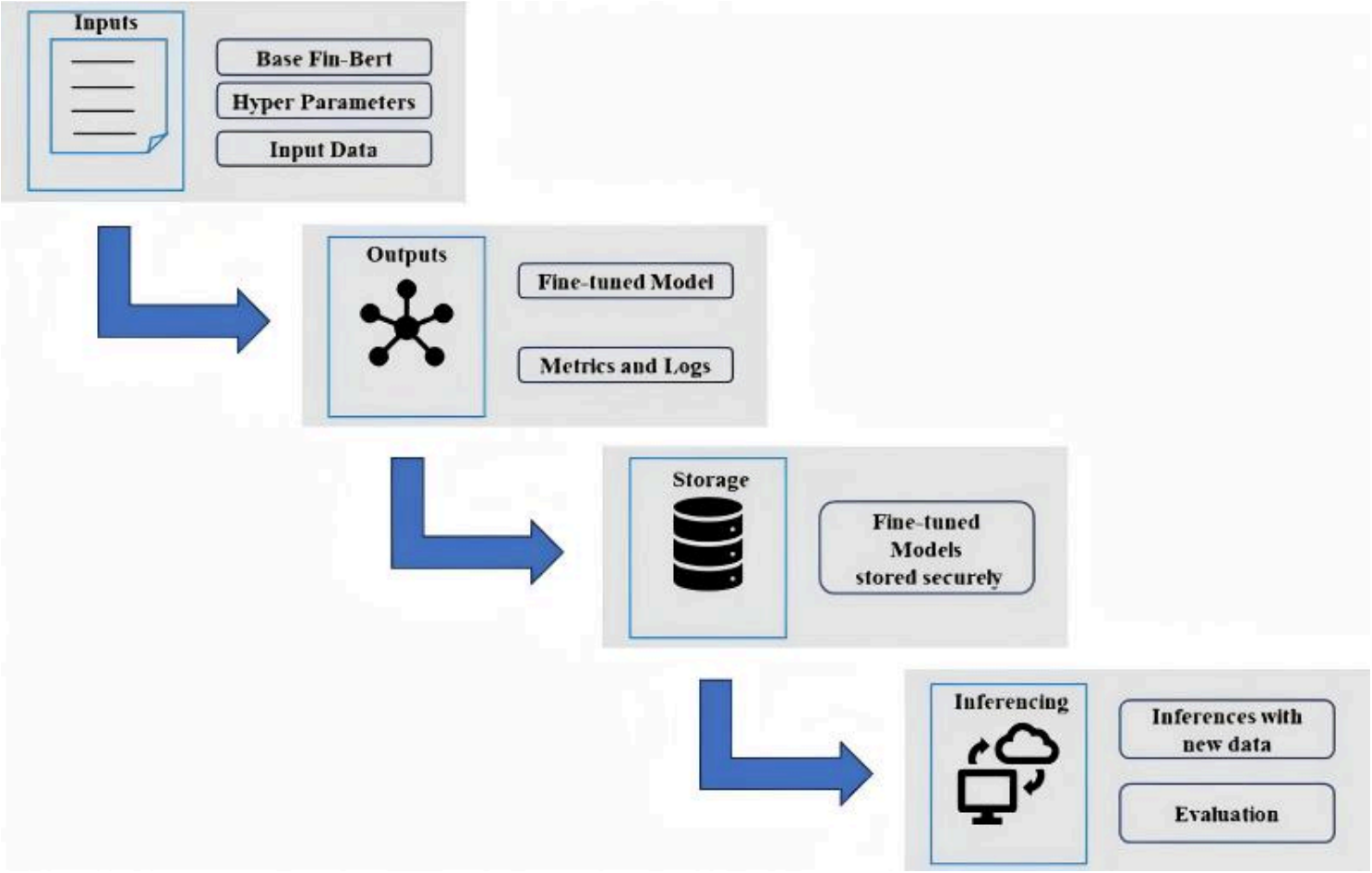


Figure 2

Workflow for fine-tuning and deployment of FinBERT for DTWCMI classification. This figure illustrates the end-to-end pipeline used to fine-tune the FinBERT model for identifying DT in working capital management. It begins with input preparation, including base FinBERT, hyperparameters, and labeled data, followed by model training and performance logging. The fine-tuned model is then securely stored and later used for inference on new data, enabling evaluation and downstream empirical analysis.