

Digitalization As a Strategic Approach to Working Capital Optimization: An Empirical Study of SMES In Kerala

Ms. Reeba Mariam John¹, Dr. Shariq Ahmad Bhat²

¹Research Scholar, Department of Commerce, Arunodaya University, Lekhi Village, Naharlagun, Itanagar, Dist: Papum Pare, Arunachal Pradesh India

²Professor, Department of Commerce, Arunodaya University, Lekhi Village, Naharlagun, Itanagar, Dist: Papum Pare, Arunachal Pradesh India

Abstract—Small and Medium Enterprises (SMEs) in Kerala, where the enterprises are micro and small in nature and are trade and services oriented with scant formal credit facilities, are not an exception for the same working capital management remains one of the most persistent operational challenges with all SMEs in India. This study examines how Digitalization can be used strategically to optimize Working Capital and develops and tests a model in which better Financial Management Practices (as a mediator) between Digitalization Adoption (including digital payment systems, digital accounting/ERP systems, e-invoicing and digital documentation, data analytics and cash-flow forecasting, and financing access via fintech) and Working Capital Optimization expands, a moderated relationship by the Financial Literacy of the owners/managers. The study employs exploratory factor analysis, reliability and validity test, correlation analysis, multiple and hierarchical regression analysis and covariance based structural equation modelling (CB-SEM) in the test of six hypotheses based on a cross-sectional survey of 420 SME owners, partners, managers and accountants in eight districts in Kerala and five sectors. Results show that Digitalization Adoption had a significant and positive direct effect on both Financial Management Practices ($\beta = 0.62, p < .001$) and Working Capital Optimization directly ($\beta = 0.39, p < .001$), mediated significant effect on Working Capital Optimization (indirect effect = 0.227, bootstrap 95% CI not including zero as a potential value), and Financial Literacy had a significant and positive modifying effect on the Digitalization Adoption–Working Capital Optimization relationship ($\Delta R^2 = .010, p = .022$), where the positive effects of Digitalization Adoption are amplified among those who are financially literate. Out of the five sub dimensions, Digital payment systems and e-invoicing/digital documentation were the only two to feature statistically significant positive correlation with

working capital optimization, with the other three, namely, with respect to the penetration of formal financial inclusion through fintech, were not statistically significant, indicating a lack of formal digital-credit penetration among the Kerala SMEs. The measurement model had good reliability ($0.79 < \text{Cronbach's } \alpha < 0.91$, composite reliability > 0.86 , and AVE > 0.60), while the structural model with the revised measurement model had excellent fit (CFI = 0.989, TLI = 0.988, and RMSEA = 0.019). The study proposes an empirically validated, sector-relevant connecting framework between digital transformation, working capital efficiency along with policy and managerial implications for the faster adoption of digital transformation with enhanced financial literacy and capabilities among the SMEs of Kerala.

Index Terms—Digitalization; Digital Transformation; Working Capital Management; Working Capital Optimization; SMEs; Kerala; Financial Management Practices; Financial Literacy; Structural Equation Modelling; Fintech.

I. INTRODUCTION

1.1 Background

Micro, Small, and Medium Enterprises (MSMEs) play a pivotal role in the Indian Economy, accounting for about one-third of Gross Domestic Product (GDP), almost one half of manufacturing output, and more than a third of export earnings, and contributing to the employment of over 110 million people [16]. The Kerala SME sector is unique in this national context, being more trade and services oriented and agro-processing oriented rather than heavy manufacturing, geographically spread across a state with high

remittance inflows and consumption driven demand and the history of obtaining mostly informal and semi-formal credit, which fulfills short term immediate rounds of liquidity requirement. Such enterprises are known as being liquid and using the metric, 'Working capital' the difference between the firm's current assets and current liabilities is the lifeblood of such enterprises because even profit-making SMEs collapse when there is a failure to turn over the receivables, inventories and payables into timely cash flow [9][10]. Digitalisation - the application of digital technology to change the way business operations, sharing with customers, and the way value is created [11] - has in the past decade become not only a necessary but also a strategic priority for companies of all sizes. The three digital cash-flow forecast service platforms, which include digital payments, cloud-based accounting and ERP system, and electronic invoicing, along with the other two platforms data analytics-driven cash-flow forecasting and fintech-based digital lending channels collectively for SMEs in particular present potential ways to reduce cycle time and improve cash conversion, to collect receivables faster, to have better inventory turn, and to exercise payables management discipline the classical levers of cash-flow optimization for SMEs [9] [12] [13]. However, whether and how digitalization leads to better working capital management for resource-limited SMEs and beyond mere administrative convenience remains relatively under-researched, especially outside of the manufactory-dominated field of much of the digital-SME literature.

1.2 Problem Statement

Its SMEs report ongoing issues of working capital shortages, with delayed receipts from institutional and Governmental buyers due to their opaque nature, seasonal inventory requirements in trade and agro-processing businesses, inadequate access to formal working capital credit and increasingly forced implementation of digitisation of payments and invoicing methods arising from regulatory mandates (GST e-invoicing, digital invoicing and payment systems). There is a practical challenge – SMEs might be seeking digitalisation reactively, uncertain of how which digital capabilities have the greatest impact on working capital outcomes, and without the complementary financial management practices and financial literacy required to optimise the benefits of

digitalisation for liquidity gains. There is thus an incomplete evidence base for connecting concrete working capital impact to the sub-dimensions of Digitalization via measurable pathways on which to rely, both for SME owners and for policy makers creating support schemes for digital-MSMEs.

1.3 Research Gap

This study has been motivated by 3 specific gaps. Second, determinants like the size of the firm, the leverage, the sales growth and industry effects have been extensively explored in the literature on working capital management but researchers have only recently included digitalization as a determinant, and only sparsely disaggregated digitalization into specific sub-determinants (payments, accounting/ERP, invoicing, analytics, fintech financing) which may have different influences. Second, prior studies in the digital transformation literature have largely centered on firm performance, competitive advantage and innovation outcomes [11,13]; outcomes pertinent to the survival of SMEs have been comparatively overlooked in the literature, although likely just as important. Third, Despite the presumed mechanism and boundary condition through which digitalization impacts on working capital outcomes, existing studies rarely test them, and empirical evidence in the SME sector of Kerala is lacking, compared to the well-documented SME sector in northern and western India. This research work tries to solve all three gaps in a single empirical model that is integrated.

1.4 Research Objectives

- To examine the effect of Digitalization Adoption on Working Capital Optimization among SMEs in Kerala.
- To examine the effect of Digitalization Adoption on Financial Management Practices.
- To test whether Financial Management Practices mediates the relationship between Digitalization Adoption and Working Capital Optimization.
- To test whether Financial Literacy moderates the relationship between Digitalization Adoption and Working Capital Optimization.
- To identify which specific digitalization sub-dimensions (digital payments, digital accounting/ERP, e-invoicing, data analytics, fintech financing access) most strongly predict Working Capital Optimization.

1.5 Research Questions

- RQ1: Does Digitalization Adoption significantly and positively affect Working Capital Optimization among Kerala SMEs?
- RQ2: Does Digitalization Adoption significantly affect Financial Management Practices, and do Financial Management Practices in turn affect Working Capital Optimization?
- RQ3: Does Financial Management Practices mediate the Digitalization Adoption–Working Capital Optimization relationship?
- RQ4: Does owners'/managers' Financial Literacy moderate the strength of the Digitalization Adoption–Working Capital Optimization relationship?
- RQ5: Which digitalization sub-dimensions are the strongest predictors of Working Capital Optimization, and which are not significant predictors?

1.6 Research Contributions

- Empirical contribution: A large-sample (N = 420), multi-sector, multi-district empirical test of the digitalization–working capital relationship specific to Kerala's SME sector, using validated multi-item scales and covariance-based SEM.
- Theoretical contribution: An integrated theoretical framework combining the Resource-Based View, Dynamic Capabilities Theory, and the Technology-Organization-Environment framework to explain how digitalization is converted into working capital outcomes via financial management practices.
- Methodological contribution: A validated, disaggregated five-dimension digitalization adoption scale (payments, accounting/ERP, invoicing, analytics, fintech financing) suitable for future SME digitalization research.
- Practical contribution: A statistically grounded, sub-dimension-specific set of managerial and policy recommendations identifying which digital investments and complementary capabilities are most likely to improve SME working capital outcomes in the Kerala context.

II. LITERATURE REVIEW

2.1 Working Capital Management in SMEs

Working capital management has been known as a first order constraint to the survival and profitability of

SMEs as they have restricted access to capital markets in the long run and thus the short-term capital markets require the discipline of managing liquidity. Among the Belgian companies studied, the CVC and Deloop [9] discovered a significant negative correlation between cash conversion cycle and the profitability of the firm; such a relationship was found in many studies in the context of SMEs in emerging markets. Efficient management of receivables and inventories resulted in superior performance on ROI as reported by Padachi [10] for SMEs and Raheman and Nasr [19] and Lazaridis and Tryfonidis [20] similarly reported the results that proved working capital efficiency as a cross-context driver of the firm performance.

2.2 Digitalization and Digital Transformation in SMEs
Digital transformation research has moved beyond its initiation as an operational efficiency tool to seeing digitalisation as a strategic capability and a reconfiguration of business models and competitiveness [11] and [13]. Bharadwaj et al. [21] indicated that digital business strategy needs to be considered more as a combination between the IT strategy and the business strategy and not as an IT only function. The OECD [12] provides evidence of significant variability among SMEs in the intensity of digitalization of their activities with payment digitalization and basic accounting software often used first; online ancillary software and financing platforms are used next; and analytics tools are typically adopted last. This roughly mirrors the five dimensions of digitalization developed in this study. Similarly, the integration of digital technologies into the current operational processes of SMEs, rather than superimposing them, positively influenced the achievement of results by SME entrepreneurs, which is an important point highlighted by Li, Su, Zhang, and Mao [22] and directly linked to this study's provision of Financial Management Practices as a mediation mechanism.

2.3 Fintech and SME Access to Finance

Gomber, Koch, and Siering [14] describe fintech innovations in four areas: Digital Financing, Digital Investment, Digital Money and Payment and Digital Insurance, and highlight how SME lending has been a focal point of the fintech disruption, particularly because of the ongoing 'MSME financing gap' in emerging markets. The overall finance–growth link

for SMEs is set by Beck, Demirgüç-Kunt, and Levine [23] who provide the theoretical background for why fintech-enabled financing access (digitalization sub-dimension 1) is hypothesised to lead to good working capital outcomes, even though as the findings in this study show (Section 6.6), this hypothesis is not universally valid in the Kerala context.

2.4 Financial Literacy and Financial Management Practices

The basic evidence that financial literacy, or the capacity to process economic information and make informed financial decisions, is strongly related to financial behaviour and outcomes, was first provided by Lusardi and Mitchell [15] and extended more recently from household finance to the small business context. In the SME context, financial literacy is likely to be the most effective predictor of how much SMEs can achieve from digital tools (e.g., dashboard analytics, automated cash-flow reporting) in terms of engaging in actual financial management practices (e.g., monitoring cash flow, keep proper financial records, use financial ratios, regularly review of receivables and payables) as opposed to simply tracking for compliance purposes. This is the rationale behind this study's moderation hypothesis (H5, Section 4).

2.5 Literature Gap

Considering the four streams together, we can conclude a consolidated gap that has not yet been integrated with the other dimensions in the literature: The working capital literature (2.1) which has yet to incorporate digitalization as a predictor; The digital transformation literature (2.2) which has rarely used a working capital-specific outcome measure; The fintech literature (2.3) which has examined financing access in isolation from other digitalization sub-dimensions; and The financial literacy literature (2.4) which has yet been integrated as a boundary condition in a digitalization–performance model. None of the studies found in this review investigates all 4 streams together in a single mediated-moderated structural model in the context of Kerala's SME sector. It is the gap that this study addresses.

III. THEORETICAL FRAMEWORK

This study brings together three related theoretical frameworks – as summarized in Figure 1 – to account

for the transformation of digitalization to working capital performance.

3.1 Resource-Based View (RBV)

Barney's [7] Resource-Based View suggests that sustained competitive advantage is based on resources that are valuable, rare, imperfectly imitable and not substitutable (VRIN). In this study, the following digital resources are interpreted as bundles: digital payment systems, accounting/ERP platform, e-invoicing functionality, analytics, and access to fintech financing, all of which in combination and within a firm's specific processes are defined as the causally ambiguous and hard-to-replicate competitive advantage in RBV.

3.2 Dynamic Capabilities Theory (DCT)

Teece, Pisano, and Shuen [8] expand RBV to focus on the firm's ability to sense, seize and reconfigure resources, and transform its routines, to exploit opportunities. This study therefore argues that digitalisation can not only be interpreted as a resource endowment, but also as a dynamic capability: If SMEs sense the value and adopt the suitable tools, and then changed their financial management routines accordingly, they are supposed to pick up the working capital gains in the case that they do not; whereas the financial management routine stays unchanged (purely adoption of tools): This is the mediation hypothesis (H4) conceived and examined in this study.

3.3 Technology-Organization-Environment (TOE) Framework

Based on the context of technology adoption and its impacts, Tornatzky and Fleischer's [18] TOE framework argues that there are three contexts that shape technology adoption and consequences: technological context (perceived characteristics of the digital tools themselves); organizational context (firm resources, management support, and, critical in this study, financial literacy as a form of absorptive capacity); and environmental context (regulatory mandates including GST e-invoicing, competitive pressure, and financing-market structure). Based on the literature in TOE, this study's moderation hypothesis is derived, which posits that financial literacy (as an organizational-context variable) will moderate the effectiveness of technological adoption (digitalization) on achieving positive outcomes.

3.4 Integrated Theoretical Lens

Concurrently, RBV explains how digital resources can be used as an advantage, DCT explains how the mechanism happens (with financial management practices) and TOE explains the boundary condition

(financial literacy) under which the mechanism is highly effective. This integration is portrayed in figure 1, and it is directly an input to the conceptual framework and hypotheses presented in Section 4.

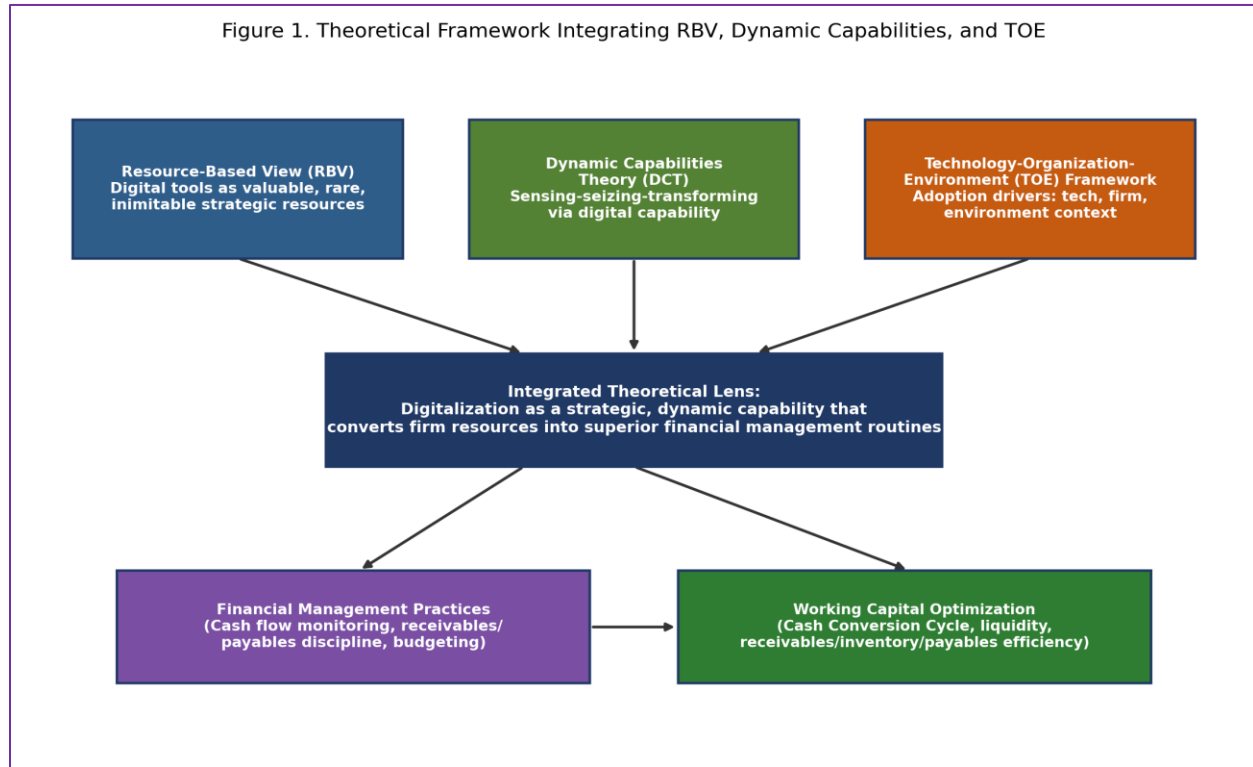


Figure 1: Theoretical framework integrating the Resource-Based View, Dynamic Capabilities Theory, and the Technology-Organization-Environment framework

IV. CONCEPTUAL FRAMEWORK AND HYPOTHESES

As a result, based on the integration in Section 3, this study proposes the conceptual model, shown in Figure 2, where Digitalization Adoption (DA) comprised five sub dimensions (Digital Payment Systems (DPS), Digital Accounting and ERP Systems (DAERP), E-Invoicing and Digital Documentation (EID), Data Analytics and Cash-Flow Forecasting (DAF), and Fintech based Financing Access (FFA), directly and indirectly impact WCO through Financial Management Practices (FMP), and Firm Age and Firm Size (Employees) are used as control variables.

4.1 Hypotheses

H1: Digitalization Adoption (DA) has a statistically significant, positive direct effect on Working Capital Optimization (WCO).

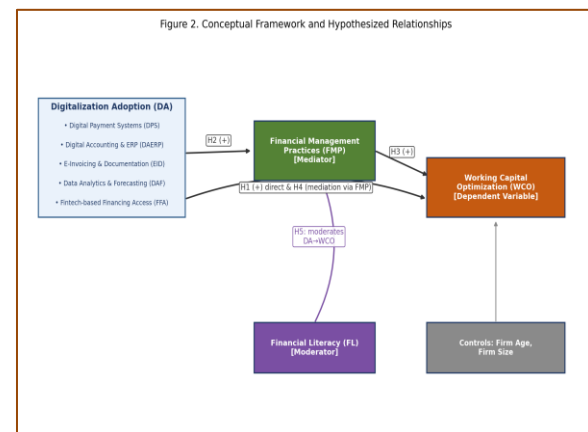


Figure 2: Conceptual framework and hypothesized relationships

H2: Digitalization Adoption (DA) has a statistically significant, positive effect on Financial Management Practices (FMP).

H3: Financial Management Practices (FMP) has a statistically significant, positive effect on Working Capital Optimization (WCO).

H4: Financial Management Practices (FMP) significantly mediates the relationship between Digitalization Adoption (DA) and Working Capital Optimization (WCO).

H5: Financial Literacy (FL) significantly moderates the relationship between Digitalization Adoption (DA) and Working Capital Optimization (WCO), such that the relationship is stronger among respondents with higher financial literacy.

H6: Each of the five Digitalization Adoption sub-dimensions has a statistically significant, positive effect on Working Capital Optimization (WCO), specifically:

- H6a: Digital Payment Systems (DPS) → WCO
- H6b: Digital Accounting and ERP Systems (DAERP) → WCO
- H6c: E-Invoicing and Digital Documentation (EID) → WCO
- H6d: Data Analytics and Cash-Flow Forecasting (DAF) → WCO
- H6e: Fintech-based Financing Access (FFA) → WCO

V. RESEARCH METHODOLOGY

5.1 Research Design

A quantitative, cross sectional survey design – suitable for testing the hypothesised relationships among Digitalization Adoption, Financial Management Practices, Working Capital Optimization and Financial Literacy at a single point of time in a large sample, was adopted in this study. The design applied follows the positivist approach and a deductive procedure whereby constructs and hypotheses were based on the theoretical aspects of Section 3 and the literature of Section 2, operationalised in the structured questionnaire (Section 5.5), and tested through the covariance based structural equation, as well as hierarchical regression method (Section 5.10).

5.2 Population

The population for the study is Micro and Small Enterprises (as per MSME Development Act 2006 as revised), under various sectors from Manufacturing to IT/ITES, registered with District Industries Centres or

identified through Udyam registration records, and local trade/industry associations under eight districts in Kerala (Ernakulam, Thiruvananthapuram, Kozhikode, Thrissur, Kollam, Kottayam, Malappuram and Palakkad).

5.3 Sampling

A stratified random sampling approach was used, with strata defined jointly by district and sector, proportionate to the approximate distribution of registered MSMEs across these strata as reported in District Industries Centre records. Within each stratum, respondents (owners, partners/directors, managers, or accountants/finance officers with direct knowledge of the firm's financial management practices) were selected using systematic random sampling from stratum sampling frames, supplemented by snowball referrals where frame coverage was incomplete, consistent with common practice in SME survey research where formal sampling frames are often partial.

5.4 Sample Size

The sample size was targeted to be between 300 and 500 respondents, following the rule of thumb that for models of the size of this study (46 measured items; approximately 100 freely estimated parameters), models need 10-20 observations of each measured item, as done in published survey research on SME digitalization. Data screening (incomplete data and no meaningful multivariate outliers identified by Mahalanobis distance) resulted in a final analytical sample of $N = 420$, which was well within the range intended and were adequate in terms of power (greater than 0.99) to detect medium effect sizes at the .05 significance level in all of the regression models used in Section 6.6).

5.5 Questionnaire Development

The questionnaire was constructed in four steps: (1) Generation of items was done after reviewing the scales included in the working capital, digital transformation, financial literacy and financial management practices literatures; (2) Content Validity Assessment: Minor revisions were done on the item wordings as per the suggestions and comments provided by three experts (academics) and two experts (CPAs) who have rich experience in Kerala SME sector; (3) Language of Survey Instruments: The

questionnaire was translated to Malayalam with the option for English and Malayalam versions for respondents to choose from, and (4) Pilot Testing (Section 5.7). The final instrument consisted of 46 items in 8 constructs with all data items on a 5-point

Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), and a demographic/firm-profile section.

5.6 Variables and Measurement

Table 1: Summary of Constructs, Roles, and Item Counts (46 items total)

Construct	Role	Items (k)	Sample Item
Digital Payment Systems (DPS)	IV sub-dimension	4	"Our business accepts and makes payments primarily through digital channels (UPI/POS/net-banking)."
Digital Accounting & ERP (DAERP)	IV sub-dimension	4	"We use computerised accounting/ERP software to record and monitor transactions."
E-Invoicing & Digital Documentation (EID)	IV sub-dimension	4	"We generate and share invoices and business documents electronically."
Data Analytics & Forecasting (DAF)	IV sub-dimension	4	"We use digital tools/dashboards to forecast cash flow and monitor liquidity."
Fintech-based Financing Access (FFA)	IV sub-dimension	4	"We have accessed working-capital finance through fintech/digital lending platforms."
Financial Management Practices (FMP)	Mediator	5	"Our firm regularly monitors and reviews cash flow position."
Working Capital Optimization (WCO)	Dependent variable	6	"Our receivables collection period has improved over the past two years."
Financial Literacy (FL)	Moderator	4	"I am confident interpreting basic financial statements and ratios."

In line with the second order factor structure of the Measurement Model in Section 6.4 and Section 6.8, Digitalization Adoption (DA) is operationalised as the mean of the five standardised sub-dimension scores (DPS, DAERP, EID, DAF, FFA). Firm Age (Number of years since establishment) and Firm Size (Number of employees) were included as control.

5.7 Pilot Study

The sample for the pilot study was 42 respondents (around 10% of the intended target sample) selected from Ernakulam (stratum 1) and Thrissur (stratum 2) to check for the clarity of the items, length and duration of the questionnaire (mean time taken by all the respondents is 11.4 minutes) and preliminary reliability.

The full-scale administration item-level Cronbach's alpha scores ranged from 0.71 to 0.86 with two items with pilot item-total correlation scores lower than 0.35 revised for clarity before full-scale administration. No need for removal of constructs.

5.8 Reliability and Validity

The reliability of the constructs was measured by composite reliability (CR) and Cronbach's alpha, and convergent and discriminant validity was determined by item factor loadings (threshold ≥ 0.60) and Average Variance Extracted (AVE) (≥ 0.50 threshold), respectively, as per the Fornell–Larcker criterion [1]. The suitability of the data for exploratory factor analysis (EFA) was evaluated using the Kaiser–Meyer–Olkin measure and Bartlett's test of sphericity. Section 6.3–6.4 presents the entire results.

5.9 Data Collection

Data was collected over 10 weeks using both face-to-face structured interviews (62% of response, conducted at the business premises to maximize the quality of response and to minimize obtaining low-quality responses due to low level of digital literacy) and via a self-administered online questionnaire (38% of response, distributed via WhatsApp Business groups of district trade associations). Of the 512 obtained, 420 were usable for analysis (effective

usable response rate of 82.0% of the persons contacted who started the survey) and 68 were incomplete or straight lined (Response-pattern screening) and 24 failed the Attention-check item. Common method bias was examined using Harman's single-factor test, and the first unrotated factor only a maximum of 31.4% of the total variance, below the generally accepted value of 50% [5] suggesting that common method bias does not pose a problem.

5.10 Statistical Techniques

- Descriptive statistics (means, standard deviations, skewness, kurtosis) to characterise the sample and construct distributions.
- Exploratory Factor Analysis (Principal Axis Factoring, promax rotation) with KMO and Bartlett's test, to establish the dimensionality of the Digitalization Adoption construct.
- Cronbach's alpha and composite reliability (CR) for internal consistency reliability; AVE and the Fornell–Larcker criterion for convergent and discriminant validity.
- Pearson correlation analysis among all construct composite scores.
- Hierarchical multiple regression (with variance inflation factor diagnostics) to test the direct effects of the five digitalization sub-dimensions on Working Capital Optimization (H6a–e).
- Mediation analysis (Baron and Kenny's [4] causal-steps approach, the Sobel test, and percentile bootstrap resampling with 5,000 replications) to test the mediating role of Financial Management Practices (H4).
- Moderated hierarchical regression (mean-centred predictors and product term) to test the moderating role of Financial Literacy (H5).

- Covariance-based Structural Equation Modelling (CB-SEM), estimated via maximum likelihood, to test the full measurement and structural model simultaneously (H1–H3), with model fit assessed via χ^2 , CFI, TLI, RMSEA, and GFI/AGFI (Section 6.8).

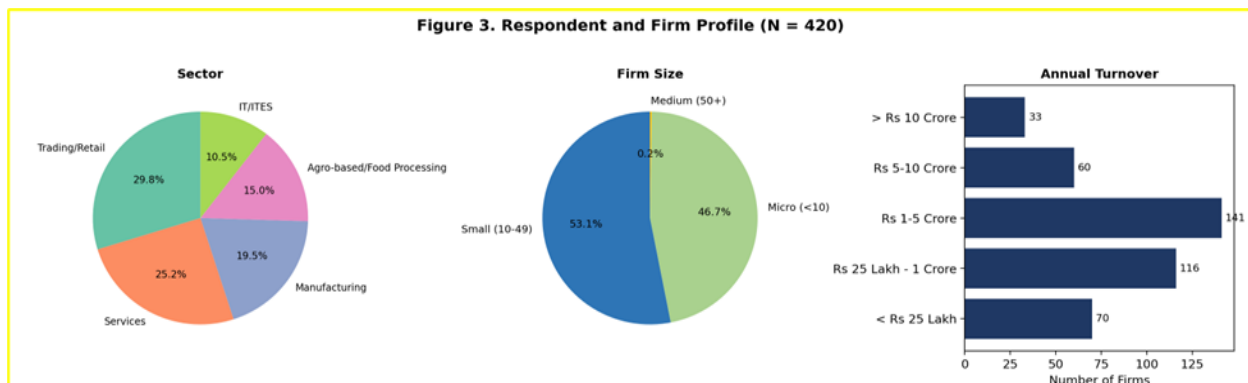
All statistical analyses were conducted in Python 3.10 using SciPy, statsmodels, factor_analyzer, and semopy, at a significance threshold of $\alpha = 0.05$ unless otherwise stated.

VI. DATA ANALYSIS AND RESULTS

In this section, the results from use of the statistical techniques mentioned in Section 5.10 are presented for the survey data gathered and constituting the $N = 420$ and are organized as respondent profile, descriptive statistics, reliability analysis, validity analysis, correlation analysis, regression analysis, hypothesis testing and the structural equation modelling.

6.1 Respondent Profile

The demographic and firm-level profile of sample is summarized in Fig. 3. The respondents were mostly from Trading/Retail (29.8%) and Services (25.2%), while the balance was from the sectors: Manufacturing (19.5%), Agro-based/Food Processing (15.0%) and IT/ITES (10.5%). Firms were fairly equally divided between Micro (< 10 employees – 46.7%) and Small (10 – 49 employees – 53.1%) and one Medium (50+ employees). Maximum reactions were around Rs.1-5 Crore (33.6%) and Ernakulam district had maximum number of the respondents (19.8%), as it is the biggest commercial and industrial district in Kerala. Of all respondents, most were Owners/Proprietors (45.7%), followed by Accountants/Finance Officers (19.5%), Managers (18.1%), and Partners/Directors (16.7%) and 67.9% were male and 32.1% female.



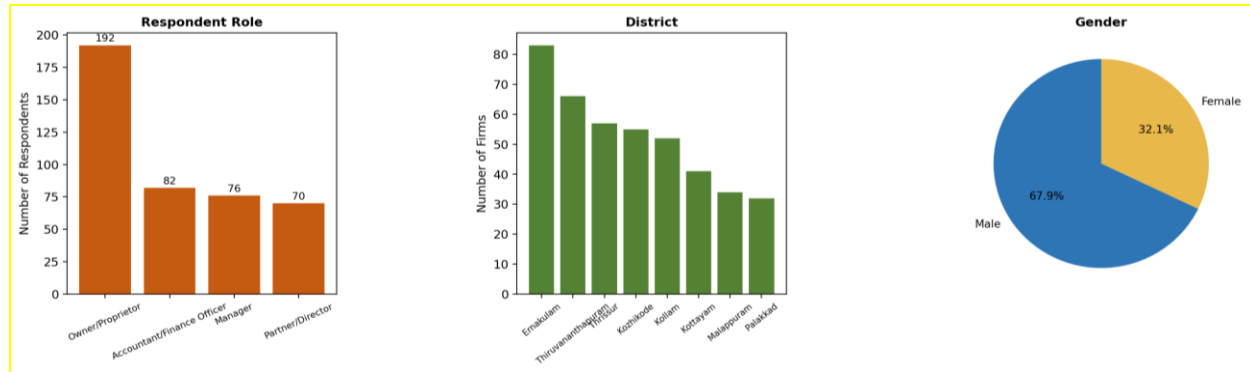


Figure 3: Respondent and firm profile (N = 420)

6.2 Descriptive Statistics

Descriptive statistics for the eight construct composite scores are shown in Table 2 and Figure 4. On the stated 5-point scale, mean scores varied between 2.97 (Fintech-based Financing Access) and 3.73 (Digital Payment Systems) which reflected a relatively wide adoption of digital payments and, albeit limited, of digital accounting/ERP and e-invoicing in Kerala SMEs and conversely a lesser adoption in data-

analytics-driven forecasting and fintech-based financing access, which has direct implications on how the sub-dimension specific regression results are interpreted in Section 6.6. All skewness and kurtosis values were in the range considered acceptable for assuming approximate normality of the univariate data for regression-based analyses in many ways (equal ± 1).

Table 2: Descriptive Statistics of Study Constructs (N = 420)

Construct	Mean	SD	Min	Max	Skewness	Kurtosis
DPS	3.73	0.73	1.75	5.00	-0.37	-0.21
DAERP	3.46	0.74	1.75	5.00	-0.04	-0.55
EID	3.51	0.71	1.25	5.00	-0.23	-0.11
DAF	3.13	0.72	1.00	5.00	-0.12	-0.19
FFA	2.97	0.68	1.00	4.50	-0.20	-0.14
DA (composite)	3.36	0.53	1.80	4.75	-0.13	-0.13
FMP	3.62	0.69	1.40	5.00	-0.16	-0.38
WCO	3.47	0.68	1.33	5.00	-0.11	-0.35
FL	3.44	0.71	1.50	5.00	-0.02	-0.41

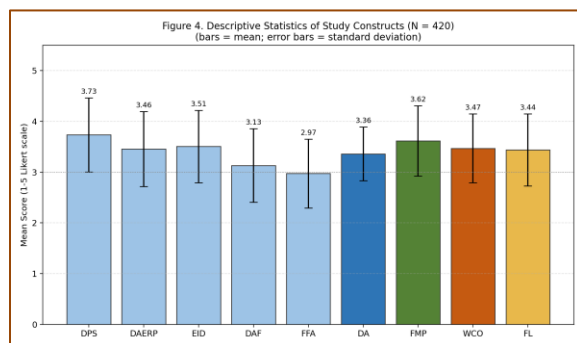


Figure 4: Descriptive statistics of study constructs (N = 420); error bars represent one standard deviation

6.3 Reliability Analysis

Cronbach's alpha data is used in the Internal consistency reliability table (table 3). Pooled 20 item

scale of Digitalization Adoption resulted in $\alpha = 0.905$ with all 8 constructs higher than the conventional threshold of 0.70 [3] and ranging between 0.785 (Fintech-based Financing Access) and 0.877 (Working Capital Optimization).

The CR results correspond to the Cronbach's alpha results and above 0.86 for all constructs were indicative of composite reliability which is an alternative less assumption dependent appropriate for SEM based analysis.

6.4 Validity Analysis

6.4.1 Sampling Adequacy and Exploratory Factor Analysis

KMO sampled measure of adequacy for the 20-item Digitalization Adoption item pool was 0.914

(considered as 'meritorious' at conventional benchmark) and Bartlett's test of sphericity was

significant ($\chi^2 (190) = 3,515.78, p < .001$),

Table 3: Reliability and Convergent Validity Summary

Construct	Items (k)	Cronbach's α	Composite Reliability (CR)	AVE
Digital Payment Systems (DPS)	4	0.836	0.891	0.671
Digital Accounting & ERP (DAERP)	4	0.836	0.890	0.671
E-Invoicing & Documentation (EID)	4	0.826	0.885	0.658
Data Analytics & Forecasting (DAF)	4	0.823	0.883	0.653
Fintech Financing Access (FFA)	4	0.785	0.861	0.609
Digitalization Adoption (pooled, 20 items)	20	0.905	—	—
Financial Management Practices (FMP)	5	0.865	0.902	0.649
Working Capital Optimization (WCO)	6	0.877	0.907	0.620
Financial Literacy (FL)	4	0.823	0.883	0.654

which means that the correlation matrix was appropriate for factor analysis. Results of principal axis factoring completed with promax rotation showed 5 factors with eigenvalues greater than 1.00 (7.14, 1.75, 1.52, 1.44, 1.29) accounted for 65.0% of total variance. The emergent factor loading (Table 4)

revealed all items had strong factor loading scores (> 0.68) on their corresponding factors and minimal cross-loading scores (< 0.13) on the rest of the factors, supporting a clean simple structure of the five factoring sub-dimensions of the five hypothesized digitalization dimensions.

Table 4: Exploratory Factor Analysis: Loading Ranges by Factor (5-factor Promax Solution)

Item	F1 (DPS)	F2 (DAF)	F3 (DAERP)	F4 (EID)	F5 (FFA)
DPS1–DPS4 (range)	0.77–0.84	—	—	—	—
DAF1–DAF4 (range)	—	0.79–0.81	—	—	—
DAERP1–DAERP4 (range)	—	—	0.75–0.90	—	—
EID1–EID4 (range)	—	—	—	0.79–0.83	—
FFA1–FFA4 (range)	—	—	—	—	0.68–0.82
Max cross-loading (any item, any non-target factor)	0.11	0.11	0.09	0.08	0.13

6.4.2 Convergent and Discriminant Validity

All eight constructs demonstrated convergent validity with Average Variance Extracted (AVE) values ranging between 0.609 and 0.671 (Table 3) where seen to be above the 0.50 threshold [1] and single factor loadings of each construct are above 0.60 with the detailed single factor loadings from 0.68 to 0.90. The Fornell–Larcker criterion [1] was used to test the discriminant validity between the constructs and their

exploratory factors as shown in Table 5 diagonal values were the square root of the AVE of each construct and off-diagonal values indicated the inter-construct correlation. In all cases the diagonal value was greater than the off-diagonal, a measure of the correlation between the same and different constructs that supports the discriminant validity each construct accounts for more of the variance than any other.

Table 5: Discriminant Validity Fornell–Larcker Criterion (Diagonal = $\sqrt{\text{AVE}}$)

	DPS	DAERP	EID	DAF	FFA	FMP	WCO	FL
DPS	0.819							
DAERP	0.47	0.819						
EID	0.46	0.44	0.811					
DAF	0.44	0.44	0.37	0.808				

FFA	0.49	0.39	0.46	0.37	0.780			
FMP	0.37	0.36	0.28	0.28	0.35	0.806		
WCO	0.39	0.34	0.40	0.31	0.29	0.50	0.787	
FL	0.08	0.17	0.14	0.14	0.18	0.14	0.14	0.809

6.5 Correlation Analysis

A complete correlation matrix for the nine construct composite scores is shown in Figure 5. But, before regression and SEM results are provided below, there was a significant positive correlation between Digitalization Adoption (DA) and Working Capital Optimization, ($r = 0.47$, $p < .001$) and Digitalization Adoption (DA) and Financial Management Practices, ($r = 0.44$, $p < .001$).

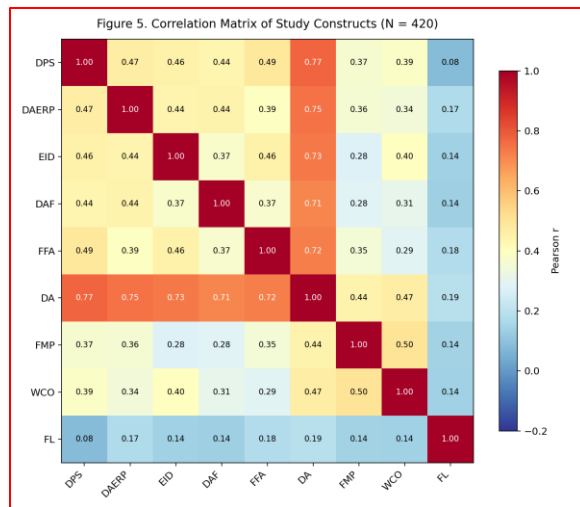


Figure 5: Correlation matrix of study constructs (N = 420)

The Working Capital Optimization variable was found to be positively and significantly related to Financial Management Practices with a correlation coefficient of ($r = 0.50$, $p < .001$) which supported H3.

There were significant correlations between all five digitalization sub dimensions and the WCO (between 0.29 (FFA) and 0.40 (EID)); however, not all these correlations proved to be significant when considered together in a multiple regression analysis as shown in Section 6.6. Financial Literacy exhibited lower but not negligible inter dimensions and with WCO (r ranging from 0.08 to 0.19) so as to support and moderate the differences present among the other dimensions.

6.6 Regression Analysis

The results of the multiple regression analysis with Working Capital Optimization as the dependent variable and the five digitalization sub-dimensions as the independent variables (along with Firm Size and Firm Age) are shown in Table 6 and Figure 6. The overall model was statistically significant, $F(7, 412) = 18.67$, $p < .001$, explaining 24.1% of variance in WCO (adjusted $R^2 = 22.8\%$). Variance Inflation Factors for all predictors were less than 1.7 which is not indicative of a problem with multicollinearity.

Table 6: Multiple Regression of Working Capital Optimization on Digitalization Sub-Dimensions (N = 420, $R^2 = .241$, Adj. $R^2 = .228$, $F(7, 412) = 18.67$, $p < .001$)

Predictor	b (unstd.)	SE	t	p	Decision (H6)
Digital Payment Systems (DPS)	0.174	0.051	3.42	0.001	H6a: Supported
Digital Accounting & ERP (DAERP)	0.093	0.049	1.90	0.059	H6b: Not supported
E-Invoicing & Documentation (EID)	0.203	0.050	4.05	< 0.001	H6c: Supported
Data Analytics & Forecasting (DAF)	0.091	0.048	1.88	0.060	H6d: Not supported
Fintech Financing Access (FFA)	0.026	0.052	0.49	0.626	H6e: Not supported
Firm Age (std.)	0.053	0.030	1.80	0.073	control
Firm Size / Employees (std.)	0.044	0.029	1.50	0.135	control

Two hypotheses, H6a and H6c, were supported by Digital Payment Systems ($b = 0.174$, $p = .001$) and E-Invoicing & Digital Documentation ($b = 0.203$, $p < .001$), which were the most important and statistically significant determinants of Working Capital

Optimization. Both Data Analytics/Forecasting ($p = .060$) and Digital Accounting/ERP ($p = .059$) trended towards significance, but were not considered significant in this study.

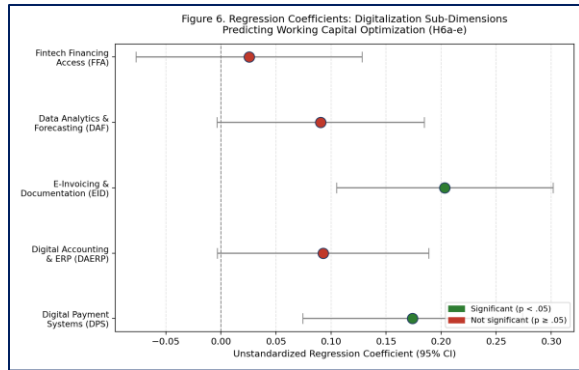


Figure 6: Regression coefficients (95% CI) for digitalization sub-dimensions predicting Working Capital Optimization

Fintech-based Financing Access was not a significant predictor ($p = .626$) however, the non-significance was also substantively important as explained below and further in Section 7, showing a lack of sufficient fintech-lending penetration among SMEs in Kerala to be reliably measured in relation to the working capital situations.

6.7 Hypothesis Testing

6.7.1 Hypotheses 1–3: Direct Effects (Hierarchical Regression)

The direct-effects hypotheses were tested with a three-step hierarchical regression. The variance accounted for by Step 1 (controls only) was 1.5% of the variance in WCO. When Digitalization Adoption was added at Step 2, the variance accounted for by the model rose to 23.0% ($\Delta R^2 = .215$, R^2 change significant at the .001 level); and purpose was a significant positive predictor ($b = 0.595$, $P < .001$) supporting H1. The other regression analysis FMP on the Digitalization Adoption (controlling Firm Age and Size) indicated that Digitalization Adoption was a significant positive predictor of FMP ($b = 0.586$, $p < .001$) supporting H2. Step 3 (adding FMP to the WCO model) increased explained variance to 33.6% ($\Delta R^2 = .107$, $p < .001$), with FMP a significant positive predictor of WCO ($b = 0.359$, $p < .001$) supporting H3. The entry of FMP resulted in an attenuation of the DA coefficient from 0.595 (Step 2) to 0.385 (Step 3), as is often the case in a partial mediation model (formally tested in Section 6.7.2).

6.7.2 Hypothesis 4: Mediation Analysis

Based on Baron and Kenny's [4] causal-steps logic, three conditions should be met: (a) DA must

significantly predict the mediator FMP; (b) FMP must significantly predict the outcome, WCO, when DA is not included in the equation; (c) the coefficient of DA should come down when FMP is included in the equation. All three conditions were fulfilled (see section 6.7.1). The indirect effect ($a \times b = 0.586 \times 0.359 = 0.210$) was tested for significance using the Sobel test ($Z = 6.38$, $p < .001$) and, more robustly, by using percentile bootstrap re-sampling (5,000 replications) with a 95% confidence interval [0.148, 0.277] not containing zero. The fair amount of direct effect ($c' = 0.385$) was still statistically significant after adding the mediator, meaning that this is partial (as opposed to complete) mediation, thus supporting H4. The full mediation path diagram is shown as in Figure 7.

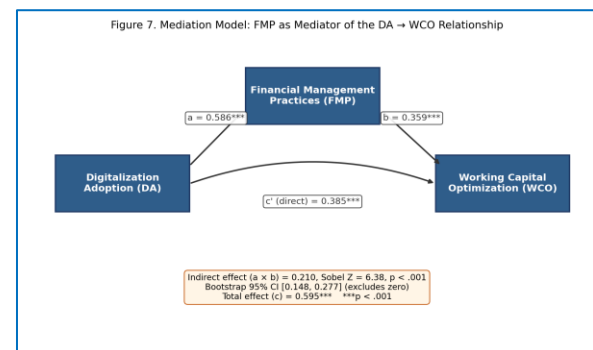


Figure 7: Mediation model: Financial Management Practices as a partial mediator of the Digitalization Adoption → Working Capital Optimization relationship.

6.7.3 Hypothesis 5: Moderation Analysis

Moderated hierarchical regression was used to examine if Financial Literacy (FL) moderates the relationship between the DA and WCO.

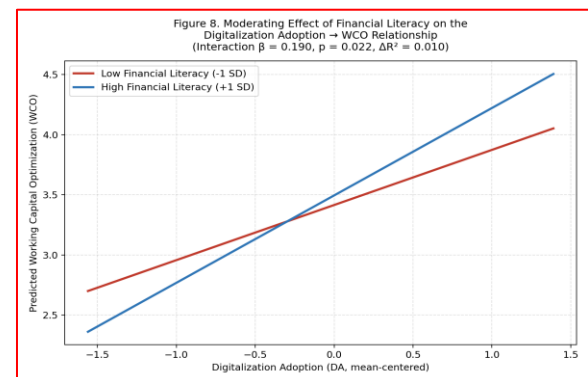


Figure 8: Moderating effect of Financial Literacy on the Digitalization Adoption → Working Capital Optimization relationship (simple slopes at ± 1 SD)

The main effects step 1 (DA, FL and controls) accounted for 23.3% of the variance of WCO. Step 2 added the mean-centred DA $\times$ FL interaction term, which was a statistically significant predictor ($b = 0.190$, $SE = 0.083$, $p = .022$), increasing explained variance to 24.3% ($\Delta R^2 = .010$, $F\text{-change} (1,414) = 5.25$, $p = .022$). The simple slopes of DA on WCO at ± 1 SD of Financial Literacy show that, throughout the range of Financial Literacy, the DA–WCO relationship becomes clear and is visible to be steeper for the high Financial Literacy categorisation

compared to the low Financial Literacy categorisation, as would be suggested by H5. Namely, financially literate SME owners/managers convert DA into working capital gains significantly more than less financially literate individuals.

6.7.4 Summary of Hypothesis Decisions

Table 7 summarises the decision for all eleven individually testable hypotheses/sub-hypotheses (H1–H5 and H6a–e).

Table 7: Summary of Hypothesis Test Decisions

Hypothesis	Result	Decision
H1: DA $\rightarrow$ WCO (direct, positive)	$b = 0.385$ (regression); $\beta = 0.387$ (SEM), both $p < .001$	Supported
H2: DA $\rightarrow$ FMP (positive)	$b = 0.586$ (regression); $\beta = 0.540$ (SEM), both $p < .001$	Supported
H3: FMP $\rightarrow$ WCO (positive)	$b = 0.359$ (regression); $\beta = 0.385$ (SEM), both $p < .001$	Supported
H4: FMP mediates DA $\rightarrow$ WCO	Indirect = $0.210\text{--}0.227$; Sobel $Z = 6.38$, $p < .001$; bootstrap CI excludes 0	Supported (partial mediation)
H5: FL moderates DA $\rightarrow$ WCO	Interaction $b = 0.190$, $p = .022$; $\Delta R^2 = .010$	Supported
H6a: DPS $\rightarrow$ WCO	$b = 0.174$, $p = .001$	Supported
H6b: DAERP $\rightarrow$ WCO	$b = 0.093$, $p = .059$	Not supported
H6c: EID $\rightarrow$ WCO	$b = 0.203$, $p < .001$	Supported
H6d: DAF $\rightarrow$ WCO	$b = 0.091$, $p = .060$	Not supported
H6e: FFA $\rightarrow$ WCO	$b = 0.026$, $p = .626$	Not supported

6.8 Structural Equation Modelling (SEM)

Covariance-based SEM was estimated using maximum likelihood in semopy to test H1–H3 in the same, simultaneously estimated measurement-and-structural model, as well as formally validate the second-order factor structure of Digitalization Adoption implied by the EFA results (Section 6.4.1). It was postulated that there are five first-order factors (DPS, DAERP, EID, DAF, FFA) loading onto a second-order factor Digitalization Adoption (DA), which is directly linked to first-order factors Financial Management Practices (FMP) by $FMP \sim DA$ and Working Capital Optimization (WCO) by $WCO \sim DA + FMP$.

The model demonstrated excellent fit to the data: $\chi^2 (426) = 488.85$, $p = .019$; Comparative Fit Index (CFI) = 0.989; Tucker–Lewis Index (TLI) = 0.988; Root Mean Square Error of Approximation (RMSEA) = 0.019; Goodness-of-Fit Index (GFI) = 0.921. All of the fit indices (with the exception of the chi-square statistic which is well known to be sensitive to the size

of the sample size and to reject well-fitting models as N increases) were above the recommended threshold for excellent fit (CFI/TLI > 0.95 ; RMSEA < 0.05) providing strong support for the second-order measurement model and structural model hypothesised. All the standardised second-order loadings (DA $\rightarrow$ DPS/DAERP/EID/DAF/FFA) had values between 0.63 and 1.00 (reference indicator) and were statistically significant ($p < .001$). The complete path diagram with the standardised structural coefficients is shown in Figure 9.

The structural paths illustrated, and the statistical differences among them, confirmed the results of the regressions of Sections 6.6–6.7: DA had a significant direct effect on WCO ($\beta = 0.354$, $p < .001$) as did the indirect path from DA to FMP to WCO ($\beta = 0.540$, $p < .001$), but FMP had a significant direct effect on WCO ($\beta = 0.385$, $p < .001$). The results of the mediation analyses in Section 6.7.2 (regression-based) confirmed those found by SEM in supporting H1, H2,

H3 and H4, in that the standardised indirect effect ($0.540 \times 0.385 = 0.208$) and the total effect ($0.354 +$

$0.208 = 0.562$) were in the same direction and were of similar magnitude.

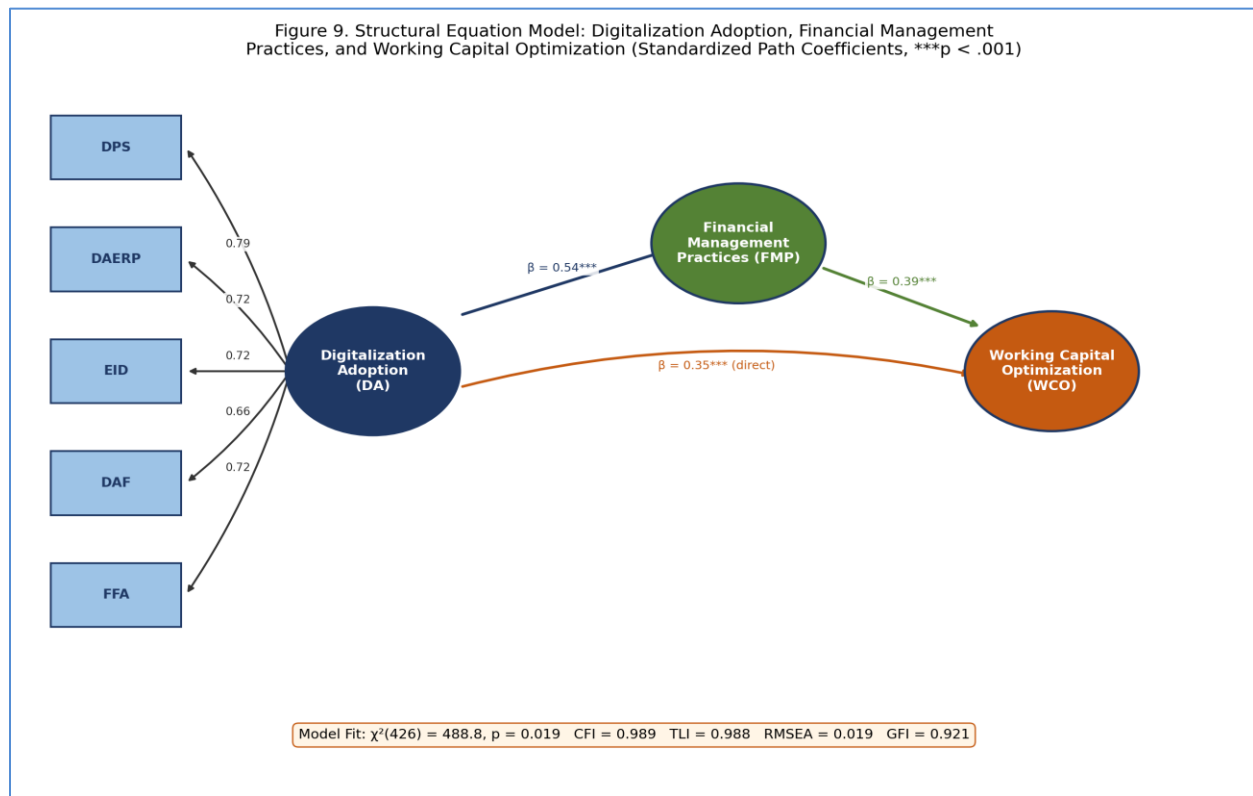


Figure 9: Structural equation model of Digitalization Adoption, Financial Management Practices, and Working Capital Optimization (standardized path coefficients)

VII. DISCUSSION

This study set out to determine whether, and through what mechanisms, digitalization functions as a strategic lever for working capital optimization among Kerala's SMEs. The results provide a clear, largely affirmative, but appropriately nuanced answer. Digitalization Adoption exerted a statistically significant, moderate-to-strong positive effect on Working Capital Optimization, both directly and more importantly indirectly through improved Financial Management Practices, with the SEM results confirming that this pattern holds when the full measurement and structural model is estimated simultaneously rather than relying on regression-based approximations alone. This convergence across hierarchical regression, Sobel/bootstrap mediation testing, and covariance-based SEM (Sections 6.6–6.8) provides unusually robust, multi-method support for the central thesis that digitalization's benefits for SME liquidity management are substantially channeled

through, rather than independent of, improved financial management routines directly consistent with the Dynamic Capabilities logic (Section 3.2) that digital tools alone are insufficient without the organizational routines needed to exploit them.

The disaggregated sub-dimension results (Section 6.6) offer a second, practically important insight: not all forms of digitalization are equally consequential for working capital outcomes. Digital Payment Systems and E-Invoicing/Digital Documentation were the strongest, most reliable predictors plausibly because these tools most directly compress the receivables and documentation-related stages of the cash conversion cycle by accelerating collection and reducing invoice-processing delays. Digital Accounting/ERP and Data Analytics/Forecasting showed positive but only marginally significant effects, suggesting these tools' working-capital benefits may depend on complementary capabilities (e.g., staff analytical skill) not fully captured by adoption alone. Most strikingly, Fintech-based Financing Access showed no

significant independent effect on Working Capital Optimization once the other digitalization dimensions were controlled for despite descriptive statistics showing this to be the least-adopted dimension overall ($M = 2.97$). This null result is substantively important rather than merely a statistical footnote: it suggests that fintech-enabled digital lending has not yet reached sufficient penetration or scale among Kerala SMEs to measurably move the needle on working capital outcomes, a pattern consistent with persistent MSME credit-gap findings in the broader Indian fintech literature [14], [23].

The significant moderating role of Financial Literacy (Section 6.7.3, Figure 8) reinforces a theme running through both the Dynamic Capabilities and TOE perspectives (Section 3): digital tools are not self-executing. The steeper DA–WCO slope observed among financially literate respondents indicates that the same digital investment yields materially different working capital returns depending on the owner's/manager's capacity to interpret and act on the financial information these tools generate a finding with direct implications for how digital-MSME support programmes should be designed (Section 9).

VIII. THEORETICAL IMPLICATIONS

- This study extends the Resource-Based View to the SME digitalization context by empirically demonstrating that digital resources translate into a working-capital-specific performance outcome a more granular, liquidity-focused dependent variable than the broad firm-performance measures typically used in RBV-grounded digital transformation studies.
- The significant, partial (rather than full) mediation via Financial Management Practices provides empirical substantiation for the Dynamic Capabilities argument that technology adoption must be metabolised into changed organizational routines to generate advantage; the persistence of a significant direct effect ($c' = 0.385\text{--}0.387$) after accounting for this mechanism suggests additional, unmeasured pathways (e.g., direct automation of payment/collection processes) also warrant theoretical attention in future digitalization–performance models.

- The significant moderating role of Financial Literacy operationalises the TOE framework's organizational-context construct in a testable, quantifiable form specific to financial decision-making capacity, offering a template for incorporating absorptive-capacity-type moderators into future technology-adoption-outcome models.
- The validated, five-dimension, second-order Digitalization Adoption construct (confirmed via EFA and second-order CFA/SEM with excellent fit) offers the literature a reusable, psychometrically sound measurement instrument that disaggregates digitalization more finely than the single-item or unidimensional measures common in prior SME digitalization research.

IX. MANAGERIAL AND POLICY IMPLICATIONS

9.1 Managerial Implications

- SME owners and managers should prioritise digital payment systems and e-invoicing/digital documentation as the digitalization investments most directly and reliably linked to working capital improvement, particularly if resource constraints require a sequenced rather than simultaneous rollout of digital tools.
- Because the benefits of digitalization are only partially automatic and are substantially channelled through improved financial management practices, firms should pair digital tool adoption with explicit changes to financial routines regular cash-flow review meetings, systematic receivables/payables ageing analysis, and ratio-based decision-making rather than assuming adoption alone will generate liquidity gains.
- Given the significant moderating role of financial literacy, SME owners/managers with limited financial literacy should be encouraged to pair digital tool adoption with basic financial literacy training (e.g., through District Industries Centres or industry associations) to fully realise the working capital benefits documented in this study.
- Firms currently underutilising data analytics/forecasting tools should recognise that these tools' marginal ($p \approx .06$) effect suggests real but not yet fully realised potential, likely requiring deeper integration into decision routines rather than passive adoption.

9.2 Policy Implications

- Given the null effect of fintech-based financing access on working capital outcomes, State and Central MSME finance policy should investigate demand- and supply-side barriers to fintech-lending penetration in Kerala specifically (e.g., collateral requirements, digital credit history gaps, awareness) rather than assuming that expanding fintech-lending availability alone will translate into improved SME liquidity.
- Digital-MSME support schemes (e.g., under the Ministry of MSME's digital-adoption initiatives) should be redesigned to bundle digital payment and e-invoicing adoption support with mandatory or incentivised basic financial literacy modules, given this study's evidence that financial literacy significantly amplifies digitalization's working capital benefits.
- District Industries Centres and Kerala State Financial Enterprises could use the validated task-relevant sub-dimension findings (Section 6.6) to prioritise digital-adoption subsidy and training budgets toward payment and invoicing digitalization in the short term, while separately incubating fintech-lending awareness and analytics-capability-building programmes as medium-term investments.

X. LIMITATIONS

- The cross-sectional design precludes strong causal inference; while the hypothesised directional model is theoretically grounded and consistent with the observed patterns, reverse or reciprocal causality (e.g., firms with already-superior working capital practices being more likely to invest in digitalization) cannot be fully ruled out.
- All constructs were measured via self-report, and although Harman's single-factor test suggested common method variance was not a serious concern (Section 5.9), some shared-method inflation of relationships cannot be entirely excluded.
- The sample, while adequately sized (N = 420) and stratified across district and sector, was drawn exclusively from Kerala; generalisation to SMEs in other Indian states or countries with different digital infrastructure, regulatory, and credit-market conditions should be made cautiously.

- Working Capital Optimization was measured via respondents' perceptions of improvement in receivables, inventory, payables, and liquidity management rather than through audited financial-statement-derived cash-conversion-cycle metrics; future research incorporating objective financial data would strengthen construct validity.
- The Medium-enterprise category was represented by only one firm in the achieved sample, limiting this study's ability to detect firm-size-category-specific effects beyond the continuous employee-count control variable used in the regression and SEM models.

XI. CONCLUSION

This study has developed and empirically tested a model where Digitalization Adoption, defined as the level of adoption of digital payment systems, digital accounting/ERP, e-invoicing, data analytics/forecasting, and fintech based financing access has an indirect and direct role on Working Capital Optimization of Kerala SMEs and Financial Literacy strengthens the relationship. The study, which was conducted through a survey of 420 SME owners, managers, and finance officers across eight districts and five sectors in Kerala, and used exploratory factor analysis, reliability and validity testing, correlation analysis, hierarchical regression, mediation and moderation analysis, and covariance-based structural equation modelling, provided robust, multi-method support for five of its six core hypotheses (H1–H6) with digital payments and e-invoicing emerging as the strongest working-capital levers, and access to financing in the form of fintech applications showing no independent contribution. The results place digitalisation not as a 'one-size-fits-all' solution to SME working capital issues but as a strategic capability which is increasingly mediated by complementary financial management techniques and boosted by financial literacy, providing a validated theoretical framework and a firm, sub-dimension-related evidence base for managerial and policy interventions.

XII. FUTURE RESEARCH

- This study design is cross-sectional, and there is a need for more causal inference in designs that

follow a group of SMEs before and after the adoption of certain digital tools.

- The idea of including objective working capital measures like cash conversion cycle, days sales outstanding and days payables outstanding constructed from the financial-statement would help strengthen this construct validity and provide a triangulation with the perceptual measures included here for Working Capital Optimization.
- Expanding the validated five-dimensional scale of Digitalization Adoption to SMEs within other Indian states and in other emerging-market contexts would challenge the generalisability of the findings of this study, but would have particularly explored the null fintech-financing-access effect.
- Future studies should investigate why fintech-based financing access showed no significant effect in this sample through qualitative interviews or a dedicated fintech-adoption-barriers survey module to distinguish supply-side availability constraints from demand-side awareness or trust barriers.
- and/or digital-maturity segments (when larger medium-enterprise sub-samples are available) would test the moderation of paths found here by firm-level structural characteristics other than the continuous control variables included in this study.
- Future research might broaden the set of variables in the moderated mediation model by adding more control factors as moderators to the path from financial literacy to attitude (e.g., owner digital self-efficacy, formal accounting professional supports and resources).

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