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AI-Augmented Predictive Business Intelligence Capabilities and Sustainable Supply Chain Performance Through the Serial Mediating Roles of Data-Driven Decision-Making and Inventory and Demand Visibility in Community Pharmacies

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Abstract

This study examines how AI-augmented predictive business intelligence capabilities contribute to sustainable supply chain performance in community pharmacies. Drawing on the resource-based view, dynamic capabilities theory, and information processing theory, the study conceptualizes AI-augmented predictive BI as a formative-composite digital capability that supports data integration and predictive analytics. A quantitative cross-sectional survey was conducted using 360 complete responses from community pharmacies in Northern Jordan, and the data were analyzed using PLS-SEM. To improve construct validity, AI-augmented predictive BI capabilities were modeled as a formative-composite construct, while data-driven decision-making, inventory and demand visibility, and sustainable supply chain performance were modeled as reflective constructs. The results show that AI-augmented predictive BI capabilities strongly enhance data-driven decision-making, which in turn improves inventory and demand visibility. Inventory and demand visibility positively affects sustainable supply chain performance. However, the direct effect of AI-augmented predictive BI capabilities on sustainable performance was not significant. The serial indirect effect through data-driven decision-making and inventory and demand visibility was significant, indicating that digital capability creates sustainable value only when converted into decision routines and operational visibility. The study contributes to digital business and supply chain sustainability research by explaining a statistically significant but practically modest digital pathway in small healthcare retail settings. Findings are to be interpreted as an indication of both functional and perceptive uses of AI-augmented bi, as opposed to a confirmation that fully autonomous AI is used for predictive analytics. These findings carry implications for the Sustainable Development Goals, particularly SDG 3 (good health and well-being) and SDG 12 (responsible consumption and production), by clarifying how a digital capability can support medicine availability and reduce pharmaceutical waste in community-level healthcare supply chains.

Keywords: AI-augmented predictive business intelligence; predictive analytics; data-driven decision-making; inventory and demand visibility; sustainable supply chain performance; digital business model; community pharmacies; PLS-SEM.

1. Introduction

Community Pharmacies As Retail Businesses Using Big Data.The work of community pharmacists is becoming increasingly based on big-data healthcare-retail. Sales, inventory, expiration date, suppliers, demand, customer services and shortages are all types of data created by the day-to-day activities in community pharmacies. The data collected from the operation of community pharmacies will influence how they create value by providing customers with medicines available at the time when needed, provide customers with value through their ability to provide timely services to them, and will help them to gain value by reducing inventory loss and by enabling better purchasing decisions.

This transition of the role of the community pharmacy has placed the community pharmacy within the digital-business agenda, which includes using digital technologies to alter the ways in which

organizations create value, use digital technologies to enable the value creation process, and use digital technologies to enable organizations to capture value (Ancillai et al., 2023; Kohtamäki et al., 2024; Trischler & Li-Ying, 2023).

As stated above, Digital Business (2026) is an appropriate publication scope for this research study as its focus areas include business digitalization, digital technologies and business models, data-centric business models, digital intelligent business models, digital performance, and sustainable value propositions. Thus, this study addresses one of those scopes by viewing the community pharmacy not only as a medicine retailer, but also as a small health-care service business that can have its operations model be a data-driven one. A data-driven business model enables the capability to integrate data and perform predictive analytics using AI-augmented predictive business-intelligence capabilities. Then, data-driven decision making processes translate the results of predictive analytics into management practices. Furthermore, inventory and demand visibility turn those management practices into operational controls over stockout events, slow moving product issues, expiration risk, and demand fluctuation (Stahl et al., 2023; Wei et al., 2025; Zhang et al., 2024).

The literature continues to provide three significant limitations for digital business, predictive intelligence, and sustainable pharmacy supply chain performance. Firstly, many of the studies examining digital business and the supply chain focus primarily on large manufacturing organizations, digital platforms, and industrial ecosystems. However, small healthcare retail businesses and their respective healthcare supply chains have been relatively underrepresented in the field of digital business research. Therefore, it is essential to examine this area further as they are experiencing increasing direct operational pressures due to medicine availability issues, medicine shortages, and demand uncertainty (Samuels, 2025; Bag et al., 2023; Farghali & Borycki, 2024; Geng et al., 2024; Ibrahim et al., 2024). Secondly, most previous studies treat digital capabilities as an immediate driver of performance. This approach may be limited because technology investments themselves will not automatically produce benefits without being integrated into decision making routines, supply chain capabilities, and operational transformation processes (Latan et al., 2024; Alzghoul et al., 2022; Ancillai et al., 2023; Walter, 2023; Wu et al., 2024). Thirdly, current research does not adequately explain how predictive Business Intelligence (BI) capabilities can produce long-term sustainable value for community pharmacies. Sustainable value is defined as economic efficiency, medicine availability, waste reduction and service quality (Walter, 2023). These operational outcomes connect directly to global sustainability priorities: medicine availability and service quality bear on SDG 3 (good health and well-being), while waste reduction through improved inventory and demand visibility supports SDG 12 (responsible consumption and production). Positioning community pharmacies within this agenda also links digital-capability adoption to SDG 9 (industry, innovation and infrastructure), insofar as it represents infrastructure innovation in a resource-constrained healthcare-retail setting (Zejjari & Benhayoun, 2024).

In response to these identified gaps, this research examines a serial mediation model that describes how AI-enhanced predictive Business Intelligence capabilities impact sustainable supply chain performance in community pharmacies through data-driven decision-making and inventory/demand visibility. As such, this research presents a clear contribution with its boundaries intentionally established. The model identifies one potential digital path to achieving sustainable supply chain performance. It is not intended to represent all possible factors contributing to sustainability. Factors including regulatory compliance, supplier relationships, prices charged for medicines, pharmacy size, environmental orientation and staff capability all contribute to the overall sustainable performance of pharmacies. In doing so, the study contributes evidence relevant to SDG 3 and SDG 12 by clarifying how a digital capability may be converted into decision routines and visibility mechanisms that support medicine availability and waste reduction, without claiming to resolve the broader sustainability challenges facing the sector.

2. Theoretical foundation and hypotheses development

2.1 Theoretical foundation

the Resource Based View (RBV) serves as a foundation for explaining AI-enhanced Predictive Business Intelligence (BI) as a strategic digital capability in Community Pharmacies. According to RBV, firm performance is dependent upon resources that have value, rarity, non imitability and embeddedness in the firm (Barney, 1991), in the current study, the use of AI-augmented predictive BI is seen as a digital capability since it allows community pharmacies to gather, combine, and analyze operational data associated with sales, demand, inventory, stock-outs, expiration risk and drug availability. However, having the ability to apply such a digital capability will not guarantee enhanced performance in isolation. Dynamic Capabilities Theory illustrates how organizations need to be able to identify opportunities, decide to take advantage of those opportunities through their decisions and transform their routines so they can realize value from available resources (Teece, 2007; Pavlou & El Sawy, 2011). Additionally, Information Processing Theory demonstrates that there will be enhanced performance when an organizations' information processing capacity equals or exceeds the level of uncertainty an organization faces (Galbraith, 1974). This logic is directly applicable to Community Pharmacies due to their operationally uncertain environment surrounding changes in demand, stock outs, expiration risks and drug availability. As a result, predictive BI is only expected to enhance sustainable Supply Chain Performance when it increases data driven decision making and enhances both inventory and demand visibility.

This study's Integrated Theoretical Logic was developed around a staged Digital Capability Conversion Mechanism. An AI-augmented predictive BI capability(s) represent the digital resource which generates analytic insights from pharmacy operational data. A data-driven decision-making capability represents the managerial routine converting these analytic outputs into purchasing/procurement/replenishment/inventory/service decisions. Inventory/demand visibility represents the information-processing capability reducing uncertainty in stock flow, demand trends, expiration exposure and drug availability. Enhanced sustainable supply chain performance represents the outcome (reduced waste; improved drug availability; improved service quality; increased economic efficiency). This theoretical sequencing extends beyond a direct relationship between technology and performance. The positioning of the model within digital business research highlights that value creation comes from aligning data, decisions, operations and value propositions (Stahl et al., 2023; Bouncken et al., 2021; Mikalef et al., 2020; Kohtamäki et al., 2024).

Figure 1 summarizes how the resource-based view, dynamic capabilities theory, and information processing theory are integrated into the study construct chain.

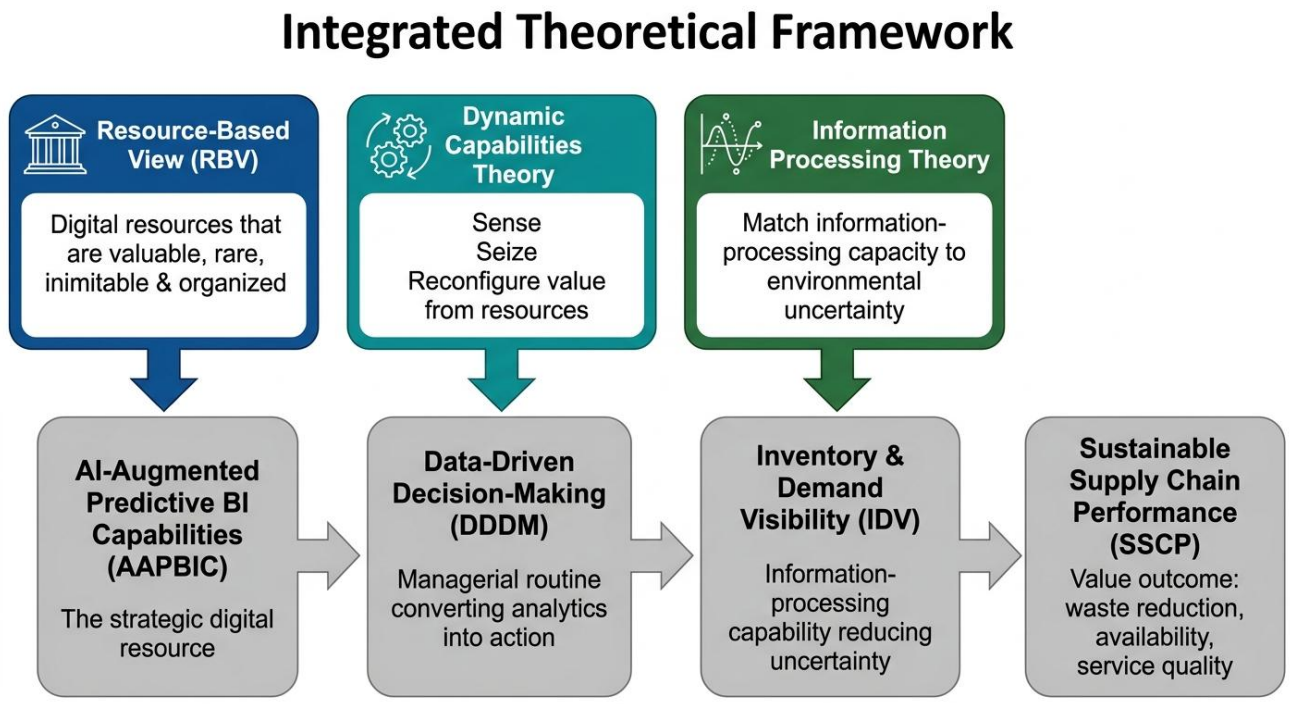


Figure 1. Integrated theoretical framework of the study.

2.2 Digital business model logic in community pharmacies

Community Pharmacy Supply Chain Performance: Implications of a Digital Business Model. The digital business model offers an important framework to explain how digital technology shapes the way community pharmacies generate value, deliver it, and capture it. In this study, generation of value occurs through using data collected from the pharmacy to anticipate demand, reduce the likelihood of stockouts, and prevent wastage due to expiration. Delivery of value occurs when customers have access to their required medicines at the right time and when they receive higher quality services by virtue of quicker and more knowledgeable decision-making. Capture of value results in lower inventory holding costs, less financial loss resulting from expired stock, improved supplier relationships, and increased consumer confidence. Framed in this manner, this research cannot be viewed solely as a traditional supply chain study. Instead, the research frames supply chain performance as a component of a data driven health care retail business model where pharmacy operations, digital intelligence, and sustainability are linked together (Ancillai et al., 2023; Kohtamäki et al., 2024; Trischler & Li-Ying, 2023).

Business implications of the business model suggest that Predictive BI creates value through its ability to convert data into information rather than through ownership alone. The creation of value depends upon a conversion process in which data generated by pharmacy operations are converted into predictions and indicators, those predictions are converted into decisions, those decisions result in improvements in both demand and inventory visibility, and that visibility leads to sustainable improvement in supply chain performance. Within community pharmacies this conversion process is realized in terms of improved management of stock levels, variations in demand for products, opportunities for reducing exposure to the risk of product expiration and availability of products. This thinking is consistent with the focus of the digital business literature on how digital technologies impact mechanisms of creating value and pathways to improving supply chain capabilities (Wei et al., 2025; Geng et al., 2024; Stahl et al., 2023; Walter, 2023; Wu et al., 2024).

2.3 AI-augmented predictive BI capabilities and data-driven decision-making

The term AI-enhanced predictive business intelligence (BI) capabilities relates to using an organization's operationally generated data for predictive analysis in support of a manager's decision making. In this model revision, the construct has been limited to only two formative dimensions: data integration and predictive analysis. As such, the choice of limiting the construct to these two dimensions will minimize overlap with data-driven decision making as well as address the prior concern of discriminant validity.
Data Integration represents an organization's ability to combine sales data and inventory levels, while Predictive Analysis represents an organization's ability to predict future demand trends based on past historical data. Identify which products are selling slowly, and send out alerts if there are signs of impending shortages or surpluses.
Data-driven decision-making refers to the consistent use of data and results from data analyses during the development of purchasing, inventory management, suppliers, and forecasting decisions regarding demand. Previous studies have shown that developing BI capabilities can lead to faster decision-making times, increased decision breadth, and improved organizational performance. More recently, studies related to the role of digitalization and AI in improving organizational performance have found that organizations utilizing analytics, AI, and digitalization technologies experience improvement in performance due to several intermediaries including decision speed, absorption capacity, agility, and visibility (Alzghoul et al., 2022; Bag et al., 2023; Jing & Fan, 2024; Latan et al., 2024; Wei et al., 2025). Therefore, AI-augmented predictive BI capabilities are expected to enhance data-driven decision-making in pharmacies.

H1: AI-augmented predictive business intelligence capabilities positively affect data-driven decision-making.

2.4 Data-driven decision-making and inventory and demand visibility

The first iteration of this research employed the terms "supply chain visibility." Through the process of refining the measurements for our variables, we found that both supplier/order visibility, as well as delivery/distribution visibility were indicators that could not be accurately applied at a pharmacy level. Therefore, we have changed the name of the construct to inventory and demand visibility. The renaming of this construct has theoretical justification in the community pharmacy environment. Community pharmacies develop operational visibility into their operations by means of quantity of products currently available, products approaching stockout status, time sensitive expiration date items, high demand products, and changing demand levels. They do so using information about product availability and movement, rather than industrial multi-tiered supply chain traceability (Al Tera et al., 2024; Bowen & Siegler, 2024; Farghali & Borycki, 2024).

Visibility is created when pharmacies make data driven decisions as it forces them to rely on reports and indicators to determine what will happen with their business rather than relying solely upon intuition. In addition to providing an improved understanding of how much they should purchase at a given time, data driven purchasing decisions provide an improved view of shortages, excesses in stock, expiry risk associated with products nearing expiration and variations in demand. As recent studies in digital supply chains illustrate, visibility, integration and responsiveness are key processes through which digitalization influences performance (Duman Altan et al., 2024; Wang et al., 2019; Yu et al., 2024; Zaid et al., 2024; Zhang et al., 2024).

H2: Data-driven decision-making positively affects inventory and demand visibility.

2.5 Inventory and demand visibility and sustainable supply chain performance

The sustainability of a pharmacy's supply chain performance encompasses three dimensions: economic, environmental/social, and social/service. The economics dimension includes lower operating costs, lower lost sales due to stockouts, and higher levels of inventory efficiency. In addition, there is an environmental aspect of sustainable performance related to reducing medicine waste and enhancing safe disposal practices for all defective/damaged/expiration date-related medicines. On the other hand, the social/service dimension involves improved availability of medicine as well as improvements in both service quality offered to patients and customer trust in the pharmacy. These three areas can be enhanced via the use of digital technologies by increasing transparency, traceability, and decision-making capabilities (Öztürk, 2025; Espahbod et al., 2024; Lee & Mangalaraj, 2022; Samuels, 2025; Zhu et al., 2019). These sustainability dimensions map onto specific global development priorities: economic efficiency and service quality align with SDG 3, while waste and disposal practices align with SDG 12, situating pharmacy-level digital capability within the broader sustainable development agenda (Zejjari & Benhayoun, 2024).

A reduction in uncertainty is anticipated from increased digital inventory and demand visibility, thus improving sustainability performance. Therefore, if a pharmacy is aware which medications are nearing their expiration date, which products are susceptible to potential stockouts and which are being demanded highly, this will allow them to minimize waste while still maintaining availability. This is supported by a growing body of research that has shown how supply chain digitalization improves performance by providing organizations greater visibility into their operations, allowing them to respond quickly to changes in the market-place (i.e. agility), enabling greater communication/information sharing among stakeholders (i.e. information exchange) and fostering greater adaptability and ability to recover from disruptions (i.e. responsiveness/resilience) (Wei et al., 2025; Yu et al., 2024; Al Tera et al., 2024; Bowen & Siegler, 2024; Zaid et al., 2024).

H3: Inventory and demand visibility positively affects sustainable supply chain performance.

2.6 Direct and indirect effects

Although a direct relationship between AI-enhanced predictive BI and sustainable performance exists, according to theoretical frameworks there is an indirect relationship as well through mediation mechanisms. The direct route of causality assumes digital intelligence automatically leads to improved sustainability. On the other hand, mediation assumes digital intelligence will lead to improved sustainability only if it results in changed decision processes and improved visibility into operations. These logical constructs are more consistent with the theories of dynamic capability (Teece, 2007), Information Processing Theory (Latan et al., 2024) and recent studies of how digital technologies have been found to influence supply chain outcomes indirectly through the development of intermediate operational capabilities (Pavlou & El Sawy, 2011). Electronic human resource management affects employee engagement through digital organizational practices, green human resource management affects performance through human capital, intelligent leadership affects excellence through organizational culture, and green organizational identity supports green innovation (Albloush et al., 2022a; Albloush et al., 2022b; Alharafsheh et al., 2022; Al-Zu'bi & Albloush, 2022). These studies provide regional support for the logic that capabilities often affect performance through internal mechanisms; they are used here as contextual support rather than as the core theoretical basis for AI or pharmacy supply chains.

H4: AI-augmented predictive BI capabilities have a positive direct effect on sustainable supply chain performance.

H5: Data-driven decision-making mediates the relationship between AI-augmented predictive BI capabilities and sustainable supply chain performance.

H6: Inventory and demand visibility mediates the relationship between data-driven decision-making and sustainable supply chain performance.

H7: Data-driven decision-making and inventory and demand visibility serially mediate the relationship between AI-augmented predictive BI capabilities and sustainable supply chain performance.

2.7 Conceptual model

Figure 2 presents the revised PLS-SEM serial mediation model. The model includes the direct AAPBIC -> SSCP path as a formal test and highlights the serial indirect pathway through DDDM and IDV.

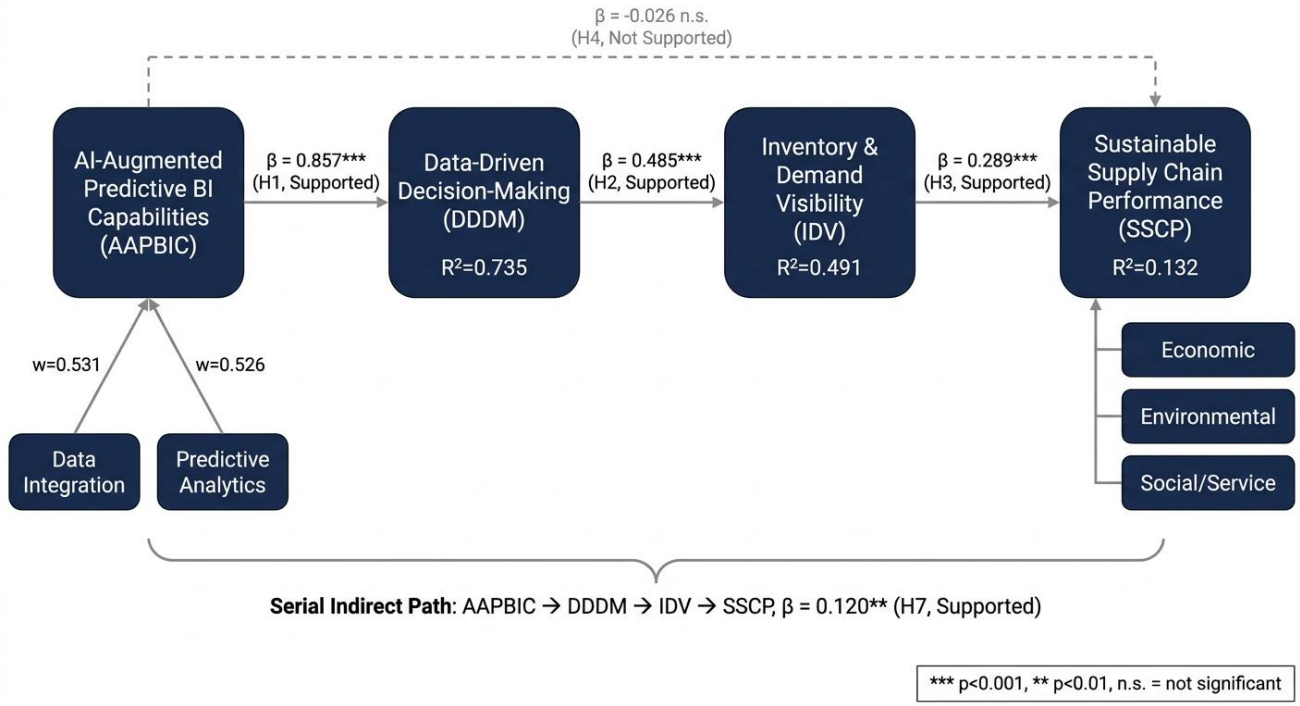


Figure 2. PLS-SEM serial mediation model with direct path coefficients, R^2 values, and significance annotations.

3. Methodology

3.1 Research design

The study used a quantitative cross-sectional survey design. This design is suitable because the study tests explanatory relationships among latent constructs measured through multiple indicators. PLS-SEM was selected because the model includes serial mediation, prediction-oriented relationships, and a formative-composite digital capability construct. The analytical protocol followed current PLS-SEM recommendations for assessing formative composites, reflective measurement models, structural models, mediation, collinearity, predictive relevance, and effect sizes (Hair et al., 2022; Henseler et al., 2015; Ringle et al., 2024; Roldán & Sánchez-Franco, 2012; Sarstedt et al., 2022).

3.2 Population, sample, and unit of analysis

The study's population comprised the owners of community pharmacies that are active in Northern Jordan. The study's fieldwork followed an area-based geographic stratification approach by dividing the four north governorates – Irbid, Jerash, Ajloun and Mafraq — into a single sampling frame. The survey unit was each pharmacy; and the response unit was limited to the individual best positioned to provide information about purchasing and inventory processes as well as about digital systems within the pharmacy. This could be the pharmacy owner/manager, the chief pharmacist, the purchasing/inventory officer, or the individual who manages the digital systems/data inside the pharmacy. The analytical data set comprised 360 completed questionnaires and 52 Likert scale indicators. No missing or range-out-of-bounds values existed for any value, which ranges from 1 to 5.
Structured data for additional descriptive fields for the sample profiles — including governorate, pharmacy-type, respondent-role and level of use of digital-systems — were added to the final analytical file. As expected based upon the predetermined area-stratification framework applied during sampling, all four north-governorates have been represented appropriately in terms of their relative distributions. Level of digital-system-use was determined from the average of the 16 AAPBIC functional-indicators, where three levels were identified: low (i.e., <2.34); medium (i.e., 2.34–3.66) and high (i.e., ≥3.67). None of these supplemental profile fields will affect the PLS-SEM model-testing results derived from the original 52 Likert scale measurement indicators.

Table 1. Sample profile, response characteristics, and data-screening information

Variable	Category	Frequency (n)	Percentage (%)
Analytical profile	Complete responses	360	100.0
Analytical profile	Likert-scale indicators	52	-
Analytical profile	Scale range	1-5	-
Analytical profile	Missing or out-of-range values	0	0.0
Governorate	Irbid	176	48.9
Governorate	Jerash	60	16.7
Governorate	Ajloun	52	14.4
Governorate	Mafraq	72	20.0
Governorate	**Total**	**360**	**100.0**
Pharmacy type	Independent community pharmacy	244	67.8
Pharmacy type	Chain or branch pharmacy	76	21.1
Pharmacy type	Pharmacy within medical/clinic complex	40	11.1
Pharmacy type	**Total**	**360**	**100.0**
Respondent role	Pharmacy owner	96	26.7
Respondent role	Pharmacy manager	78	21.7
Respondent role	Responsible pharmacist	112	31.1
Respondent role	Purchasing and inventory officer	44	12.2
Respondent role	Computerized system/data management officer	30	8.3
Respondent role	**Total**	**360**	**100.0**
Digital-system use level	Low	24	6.7
Digital-system use level	Moderate	125	34.7
Digital-system use level	High	211	58.6
Digital-system use level	**Total**	**360**	**100.0**

Note. Percentages were calculated based on n = 360. Digital-system use level was computed from the mean of AIBIC-DI1 to AIBIC-IDS4. Low = <2.34; moderate = 2.34-3.66; high = ≥3.67.

3.3 Measurement instrument documentation

The measurement instrument was built through adaptation rather than direct copying. Constructs were derived from established research streams and then contextualized to pharmacy purchasing, inventory, expiry, demand, and

supplier decisions. The main methodological refinement in this version is the specification of AAPBIC as a formative-composite construct rather than a reflective construct. This change is theoretically appropriate because data integration and predictive analytics are complementary facets that jointly form a digital capability. It also resolves the earlier empirical overlap between AAPBIC and DDDM by avoiding inappropriate reflective discriminant-validity testing for a formative capability construct.

Table 2. Measurement instrument sources and adaptation logic

Construct	Measurement role	Research base	Core references	Pharmacy adaptation
AAPBIC	Formative-composite	Data integration and predictive analytics as complementary digital capability dimensions	Alghamdi & Al-Baity (2022); Alzghoul et al. (2022); Chen et al. (2012); Wamba et al. (2017)	Items retained for final construct focus on pharmacy sales, inventory integration, demand-trend analysis, slow-moving items, and shortage/surplus alerts.
DDDM	Reflective	Data-driven decision routines and BI-supported decisions	Alzghoul et al. (2022); Galbraith (1974); Wei et al. (2025)	Items adapted to purchasing quantities, reorder timing, operational problem-solving, demand forecasting, and digital decision culture.
IDV	Reflective	Operational visibility, information exchange, and pharmacy-level visibility	Al Tera et al. (2024); Bowen and Siegler (2024); Yu et al. (2024); Zaid et al. (2024)	Final construct retained inventory and demand/customer-needs visibility after empirical purification.
SSCP	Reflective	Economic, environmental, and social/service supply chain performance	Duman Altan et al. (2024); Espahbod et al. (2024); Öztürk (2025); Zhang et al. (2024)	Items adapted to cost, stockout loss, medicine waste, safe disposal, medicine availability, and service quality.

3.4 Functional evidence of AI-augmented BI use

A key concern in AI-related business studies is construct overclaiming. This study therefore does not claim verified deployment of autonomous AI or machine-learning models in all pharmacies. Rather, it examines AI-augmented BI at the functional and perceptual level, as reflected in predictive, pattern-detection, and intelligent decision-support features reported by respondents. These functions are consistent with AI-augmented analytics but may also include rule-based or analytics-enabled features embedded in pharmacy information systems. This distinction is explicitly disclosed to strengthen validity and avoid overstating the technical sophistication of the systems.

Table 3. Functional evidence supporting the AI-augmented BI interpretation

Indicator	Function measured	Mean	Agree/strongly agree
AIBIC-IPA1	Systems analyze medicine demand trends.	3.969	76.944
AIBIC-IPA2	Systems help predict medicines whose demand may increase.	3.694	64.722
AIBIC-IPA3	Digital analytics identify slow-moving medicines.	3.711	62.778
AIBIC-IPA4	Systems detect shortage or surplus signals before a problem occurs.	3.558	52.778
AIBIC-IDS1	Systems provide indicators supporting inventory decisions.	3.017	41.111
AIBIC-IDS2	Smart reports identify items requiring reorder.	3.167	45.556
AIBIC-IDS3	Digital systems help select the most appropriate supplier.	3.697	64.167
AIBIC-IDS4	Digital systems support faster and more accurate decisions.	3.786	70.556

3.5 Analytical procedure and data-quality controls

The analysis proceeded in five stages. First, the dataset was screened for missing values, out-of-range values, and response completeness. Second, AAPBIC was evaluated as a formative-composite construct through dimension

weights and dimension collinearity. Third, the reflective constructs were evaluated using outer loadings, Cronbach's alpha, composite reliability, AVE, Fornell-Larcker, and HTMT. Fourth, the structural model was evaluated using VIF, path coefficients, R^2, f^2, and Q^2. Fifth, indirect effects were assessed using 5,000-sample bootstrapping logic. Common method bias was addressed procedurally through anonymity and non-identification and statistically through Harman's single-factor screening and full collinearity VIF. The first factor explained 39.86% of variance, below the common 50% screening threshold. Full collinearity VIF values for AAPBIC and DDDM exceeded the conservative 3.3 threshold but remained below the broader 5.0 threshold. Therefore, common method bias and conceptual proximity cannot be fully dismissed, and the results are interpreted with caution (Kock, 2015; Kock & Lynn, 2012).

4. Analysis and results

4.1 Descriptive statistics

Table 4. Descriptive statistics of final constructs

Construct	Mean	SD	Min	Max
AAPBIC	3.718	0.787	1.000	5.000
DDDM	3.400	0.870	1.000	4.833
IDV	3.668	0.856	1.200	5.000
SSCP	3.990	0.466	2.333	4.889

4.2 Measurement-model revision and problem resolution

The earlier reflective specification of AIBIC and DDDM produced high empirical overlap. Rather than relying on theoretical justification alone, the present revision changes the modeling logic. AAPBIC is now specified as a formative-composite digital capability formed by data integration and predictive analytics. DDDM remains a reflective decision-routine construct. This distinction is theoretically consistent with the difference between digital resources and managerial routines and avoids applying reflective discriminant-validity criteria to a formative capability construct.

The earlier broad supply chain visibility construct also showed weak supplier/order and delivery/distribution indicators. The purification narrowed the empirical domain of visibility to inventory and demand visibility. Therefore, the construct was renamed inventory and demand visibility and interpreted within the community pharmacy context rather than as broad multi-tier supply chain visibility. This is a more accurate and defensible representation of the retained measurement domain.

Table 5. Key measurement-model corrections implemented in the revised manuscript

Issue in earlier version	Correction implemented	Rationale
High AIBIC-DDDM overlap in Fornell-Larcker and HTMT	AAPBIC specified as formative-composite; DDDM retained as reflective	Digital capability is formed by complementary facets, while DDDM is a decision routine.
AI-enabled claim was too strong	Term changed to AI-augmented predictive BI; technical audit limitation disclosed	Avoids claiming verified autonomous AI deployment.
SCV indicators for supplier/order/delivery visibility were weak	Construct renamed inventory and demand visibility	Retained indicators capture pharmacy-level visibility in inventory and demand.
Weak SSCP indicators reduced measurement quality	SSCP-EP3, SSCP-EP4, and SSCP-ENP1 removed from final reflective model	Improves convergent validity while preserving economic, environmental, and service coverage.
Full collinearity VIF was overstated as fully safe	Text revised to disclose values above 3.3 but below 5.0	Improves methodological transparency.

4.3 Formative-composite assessment of AAPBIC

AAPBIC was assessed as a formative-composite construct. The two retained dimensions, data integration and predictive analytics, represent complementary capability facets. Dimension VIF values were below 3.3, indicating

no serious collinearity problem at the formative dimension level. The standardized weights were balanced, supporting the use of both facets in the composite.

Table 6. Formative-composite assessment of AAPBIC

Formative dimension	Mean	SD	Outer weight	VIF
Data integration	3.702	0.836	0.531	2.646
Predictive analytics	3.733	0.828	0.526	2.646

Because AAPBIC was specified as a formative-composite capability, internal consistency metrics such as Cronbach's alpha and AVE were not used to assess this construct. Instead, the evaluation focused on conceptual relevance, dimension weights, and formative collinearity. The two dimensions were retained because they represent complementary facets of predictive BI capability rather than interchangeable manifestations of a single reflective construct. Therefore, low or moderate correlations between formative dimensions would not be interpreted as a reliability problem; what matters is whether each dimension contributes conceptually and empirically to the composite capability.

4.4 Reflective measurement model

DDDM, IDV, and SSCP were assessed as reflective constructs. Cronbach's alpha and composite reliability exceeded 0.70. AVE exceeded 0.50 for all reflective constructs. The minimum retained loading in SSCP increased to 0.667 after removing weak indicators, which resolves the most visible weakness in the earlier model.

Table 7. Reflective construct reliability and convergent validity

Construct	Items	Cronbach alpha	Composite reliability	AVE	Loading min	Loading max
DDDM	12	0.949	0.956	0.643	0.761	0.858
IDV	5	0.880	0.912	0.676	0.746	0.885
SSCP	9	0.890	0.913	0.538	0.667	0.780

4.5 Discriminant validity of reflective constructs

Discriminant validity was assessed only for reflective constructs. This is the appropriate procedure because AAPBIC is modeled as a formative-composite capability. The Fornell-Larcker criterion (Fornell & Larcker, 1981) and HTMT values support discriminant validity among DDDM, IDV, and SSCP. This resolves the earlier discriminant-validity problem that resulted from treating the digital capability and decision routine as two reflective constructs.

Table 8. Fornell-Larcker criterion for reflective constructs

Construct	DDDM	IDV	SSCP
DDDM	0.802	0.690	0.298
IDV	0.690	0.822	0.355
SSCP	0.298	0.355	0.734

Table 9. HTMT criterion for reflective constructs

Construct	DDDM	IDV	SSCP
DDDM	1.000	0.748	0.363
IDV	0.748	1.000	0.453
SSCP	0.363	0.453	1.000

4.6 Collinearity and common method bias

Inner VIF values for all variables are less than 5.0 indicating structural coefficient values can be interpreted.
The full collinearity VIF values (AAPBIC = 7.59; DDDM=6.36) are greater than 3.3 and less than 5.0. As a result, it appears that due to common method bias and conceptual closeness we may not have been able to completely rule them out as issues; however, they are not indicative of extreme collinearity.

Table 10. Inner VIF values

Endogenous construct	Predictor	VIF
DDDM	AAPBIC	1.000
IDV	AAPBIC	3.769
IDV	DDDM	3.769
SSCP	AAPBIC	3.881
SSCP	DDDM	4.230
SSCP	IDV	1.964

Table 11. Full collinearity VIF values

Construct	Full collinearity VIF
AAPBIC	3.882
DDDM	4.247
IDV	2.060
SSCP	1.152

4.7 Structural model and hypothesis testing

The Structural Model was also modeled with standardized coefficients and Bootstrapped. H1, H2, & H3 were supported; however, H4 was not. This indicates that although AAPBIC may have a positive impact on Sustainable Performance, this is mediated by decision making and visibility. Thusly, there is no significant Direct Effect of AAPBIC on Sustainable Performance after accounting for decision-making and visibility.

Table 12. Direct path coefficients

Path	Beta	SE	t value	p value	CI 2.5%	CI 97.5%	Decision
AAPBIC -> DDDM	0.857	0.024	36.380	0.000	0.814	0.905	Supported
AAPBIC -> IDV	0.239	0.138	1.737	0.082	-0.055	0.487	Not supported
DDDM -> IDV	0.485	0.125	3.870	<0.001	0.258	0.741	Supported
AAPBIC -> SSCP	-0.026	0.097	-0.270	0.787	-0.219	0.162	Not supported
DDDM -> SSCP	0.121	0.092	1.314	0.189	-0.057	0.306	Not supported
IDV -> SSCP	0.289	0.064	4.488	<0.001	0.163	0.413	Supported

4.8 Explanatory power, predictive relevance, and effect sizes

The model accounted for a total of 73.5 percent of the variation in DDDM, 49.1 percent in IDV and, 13.2 percent in SSCP. A moderate theoretical explanation exists for SSCP's R^2 due to the model explaining only one pathway of digital conversions versus all potential drivers of sustainable performance. The support from positive Q^2 values indicates the predictive relevance of the model; however, effect size analyses conducted post-H1 showed that the mechanism had very small effects (i.e., an indication that although the relationship was statistically significant it would not be sufficient on its own to account for sustainable supply chain performance).

Table 13. R^2, adjusted R^2, and Q^2

Endogenous construct	R2	Adjusted R2	Q2 predict
DDDM	0.735	0.734	0.730
IDV	0.491	0.488	0.455
SSCP	0.132	0.125	0.117

Table 14. Effect size f^2

Path	f2	Effect size
AAPBIC -> DDDM	2.769	Large
AAPBIC -> IDV	0.030	Small
DDDM -> IDV	0.123	Small
AAPBIC -> SSCP	<0.001	No effect
DDDM -> SSCP	0.004	No effect
IDV -> SSCP	0.049	Small

4.9 Mediation analysis

The mediation results were the most compelling support of the research's theoretical model. The specified indirect path (AAPBIC -> DDDM -> SSCP) was not significant, which indicates that decisions based on data may be insufficient to produce sustainable outcomes. The path (DDD M -> IDV -> SSCP) was significant; thus, decisions must first become operational visibility in order to have an impact upon sustainability. The serial indirect path (AAPBIC -> DDDM -> IDV -> SSCP) was significant. The total indirect effect was significant as well as the direct effect was insignificant. This is indicative of nearly complete indirect pathways.

Table 15. Bootstrapped indirect effects

Indirect effect	Beta	SE	t value	p value	CI 2.5%	CI 97.5%	Decision
AAPBIC -> DDDM -> IDV	0.416	0.112	3.706	<0.001	0.217	0.652	Supported
DDDM -> IDV -> SSCP	0.140	0.048	2.902	0.004	0.061	0.245	Supported
AAPBIC -> IDV -> SSCP	0.069	0.043	1.599	0.110	-0.015	0.158	Not supported
AAPBIC -> DDDM -> SSCP	0.104	0.080	1.302	0.193	-0.049	0.266	Not supported
AAPBIC -> DDDM -> IDV -> SSCP	0.120	0.042	2.846	0.004	0.051	0.212	Supported
Total indirect AAPBIC -> SSCP	0.293	0.085	3.459	<0.001	0.120	0.466	Supported
Total effect AAPBIC -> SSCP	0.267	0.055	4.878	<0.001	0.159	0.379	Supported

Table 16. Summary of hypothesis testing

Hypothesis	Relationship	Type	Beta	p value	Decision
H1	AAPBIC -> DDDM	Positive direct effect	0.857	<0.001	Supported
H2	DDDM -> IDV	Positive direct effect	0.485	<0.001	Supported
H3	IDV -> SSCP	Positive direct effect	0.289	<0.001	Supported
H4	AAPBIC -> SSCP	Positive direct effect	-0.026	0.787	Not supported
H5	AAPBIC -> DDDM -> SSCP	Specific indirect effect	0.104	0.193	Not supported
H6	DDDM -> IDV -> SSCP	Specific indirect effect	0.140	0.004	Supported
H7	AAPBIC -> DDDM -> IDV -> SSCP	Serial indirect effect	0.120	0.004	Supported

5. Discussion

5.1 Digital Capability and Decision Routines

The findings confirm that augmented AI predictive BI capabilities provide a strong predictor for data-driven decision making within Community Pharmacies. These findings support the Resource-Based View as the digital capability functioned as an available resource and supported Information Processing Theory as pharmacies with higher analytical capabilities can process demand and inventory data better when dealing with uncertain demand conditions. The findings support previous BI research that have found that BI capabilities improved decision processes and more recent digital supply chain studies that have shown that digitalization impacts performance through intermediary mechanisms (Alzghoul et al., 2022; Jing & Fan, 2024; Wei et al., 2025).

5.2 Why Decisions Alone Were Insufficient

A very important finding of this study was the non-supportive AAPBIC -> DDDM -> SSCP path. While using data to inform managerial decisions will likely result in improved managerial choice-making, using such decisions to achieve improvements in sustainability outcomes are dependent upon those decisions providing inventory and demand visibility. Practically speaking, a pharmacy could utilize data to make decisions yet if these decisions do not create transparency regarding stock levels, stock-out risk, expiration risk, etc. related to high-demand medications then the impact on waste, availability, and quality of service will remain minimal.

5.3 Why Direct Effect Was Not Significant

The lack of significance of the direct effect from AAPBIC to SSCP has theoretical implications. It addresses the concept of the digital value paradox where an organization can invest in digital technologies but fail to realize a benefit unless the technology is embedded in routines, capabilities or other control mechanisms related to operations (Ancillai et al., 2023; Kohtamäki et al., 2024; Trischler & Li-Ying, 2023). Thus, the findings further strengthen the argument that the realization of the digital business benefits of predictive BI in pharmacies occurs through a phased conversion pathway and not solely due to owning technology.

5.4 Practical Meaning of Modest Effects

While the serial indirect effect of AAPBIC on SSCP is significant, the relatively small magnitude of the effect suggests that the mechanism identified in this study is meaningful, however not sufficient to fully account for variance in sustainable supply chain performance. Variance in sustainable pharmacy performance includes many factors including supplier integration, regulatory requirements, pricing practices, government policies affecting access to medication, employee training, the pharmacy's environmental focus, pharmacy size and quality of data used for analysis. As such, the study should be viewed as evidence of one of several potential pathways for realizing sustainable supply chain performance rather than a comprehensive explanation of all factors influencing sustainable pharmacy performance. Accordingly, these findings should be interpreted as a modest but meaningful contribution to the SDG 3 and SDG 12 agendas rather than a comprehensive account of pharmacy sustainability.

6. Contributions

6.2 Theoretical contribution

The study has contributed to the field of Digital Business with the development of a model for converting digital capabilities into sustainable competitive advantage via a process that starts with an organization's use of augmented predictive BI capabilities, which enables data driven decisions, thereby enabling organizations to have better insight into their demand and inventory levels and ultimately leading to higher sustainable SC performance.

Figure 3 visualizes this conversion mechanism and clarifies why technology ownership alone is insufficient without decision translation, operational embedding, and value realization.

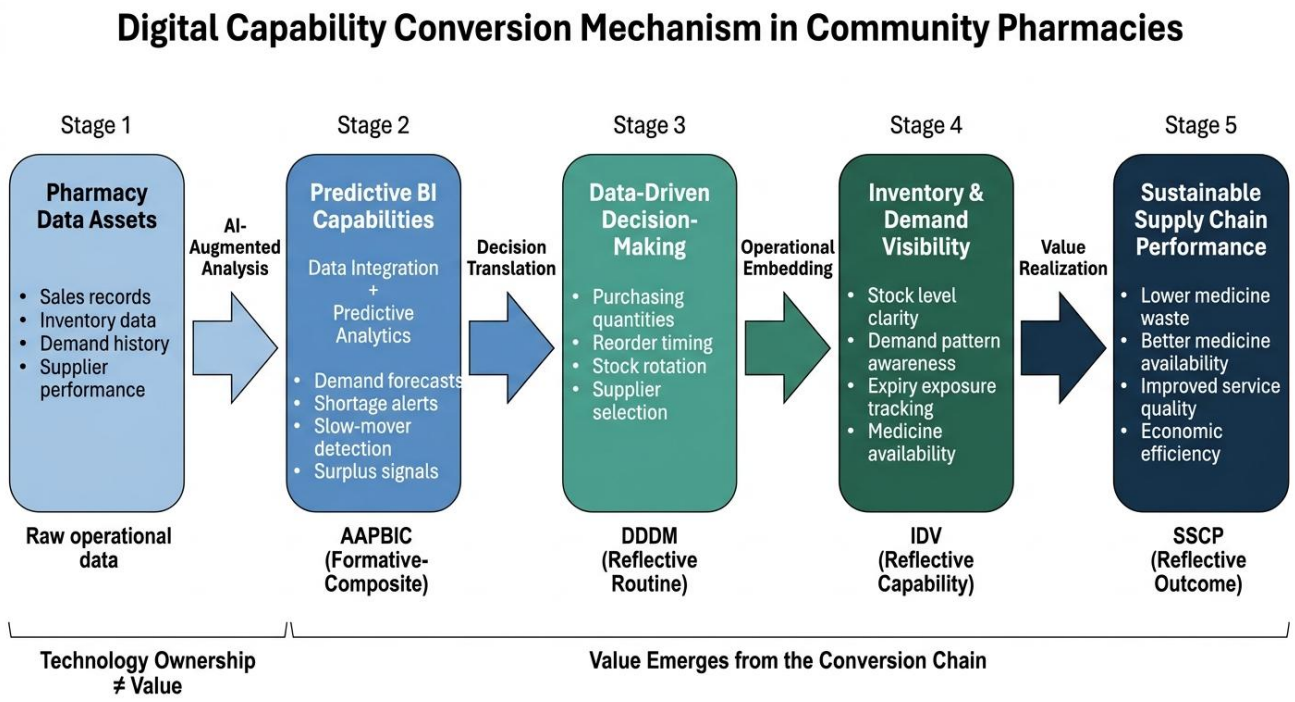


Figure 3. Digital capability conversion mechanism in community pharmacies.

Secondly, the study supports and develops the theoretical connection to be made between digital business models and sustainable supply chains. The study has demonstrated that a pharmacy's digital business model is not limited to whether or not they have control over technology; it also includes the manner in which data affect (1) how value is created, (2) how value is delivered, and (3) how value is captured through data analysis. As such, medicine availability, waste reduction, and service quality are the outputs of a data-based operational approach. By linking digital-capability conversion to reduced waste and improved availability, this contribution has implications for the SDG 3 and SDG 12 objectives within small healthcare retail settings (Zejjari & Benhayoun, 2024).

Thirdly, the study has developed the "visibility" concept within the context of community pharmacies. Visibility within this context was found to primarily include inventory visibility and demand visibility. While general industrial visibility scales may be appropriate in many contexts, these scales may not provide as complete a picture when applied to small healthcare retailing.

Lastly, the study provides additional evidence regarding the application of Predictive Business Intelligence (BI) in small healthcare retailers in an emerging economy. The digital transformation of small healthcare retailers in emerging economies has been relatively unexplored. In addition to resource constraints, varying levels of digital maturity among suppliers can limit how effectively the capabilities provided by predictive BI can be translated into performance improvements.

6.2 Methodological contributions

Methodologically, the study demonstrates why digital capability constructs should not automatically be specified as reflective constructs. The revised model treats AAPBIC as a formative-composite capability and DDDM as a reflective routine. This distinction resolves the earlier discriminant-validity issue and provides a more defensible PLS-SEM specification.

6.3 Practical contributions

The primary managerial implications are that pharmacies cannot approach (the) purchase of AI-based BI (as an) application or software; rather they should view it through the lens of decision architecture. Therefore, digital systems should be designed with features that include: reorder alerting; trend-dashboards for sales volume and trends; risk-reporting on expiration-date products; reporting and tracking on performance by suppliers; and metrics regarding product availability. Pharmacy owners, Responsible Pharmacists, Software Vendors, Professional Associations, and Regulatory Bodies can use these results to convert their pharmacy's digital systems into routine measurement processes toward sustainability.

Table 17. Stakeholder-specific practical implications

Stakeholder	Actionable implication	Possible performance indicator
Pharmacy owners	Use weekly dashboards for reorder points, high-demand medicines, and expiry risk.	Lower stockout frequency; lower expired-stock value
Responsible pharmacists	Use BI reports before purchasing and stock rotation decisions.	Higher decision accuracy; shorter decision cycle time
System vendors	Embed predictive alerts, slow-moving item detection, and supplier-score functions.	Dashboard adoption; alert-response rate
Professional associations	Offer short training modules on pharmacy analytics and digital inventory decisions.	Training completion; dashboard use frequency
Regulators and public health bodies	Encourage anonymized digital reporting on medicine availability and waste.	Essential medicine availability; safe disposal reporting

7. Managerial recommendations

Table 18. Practical implementation matrix

Area	Recommended action	Practical indicator
Inventory decisions	Create weekly reorder dashboards for high-demand and essential medicines.	Stockout frequency; reorder accuracy
Expiry control	Generate alerts for medicines approaching expiry within 90-120 days.	Expired stock value; disposal rate
Supplier management	Rank suppliers by delivery reliability, shortage frequency, and price stability.	Delivery delay rate; supplier score
Demand forecasting	Use historical sales and seasonal patterns to forecast demand.	Forecast error; emergency orders
Digital training	Train pharmacists and managers to interpret BI dashboards.	Dashboard usage rate; decision cycle time
Sustainability practice	Link waste reduction and medicine availability to digital performance reports.	Waste reduction; essential medicine availability

8. Conclusion

There are no direct linkages between the predictive capabilities offered by AI enhanced Business Intelligence in community pharmacies and sustainable Supply Chain Performance. However, there is an indirect relationship when those capabilities contribute to better-informed data driven decision making, and provide greater insight into inventory levels and demand. The results of our study confirm one statistically significant, although practically small digital business pathway through which the collective contribution of data, analytics, decisions and visibility contribute to sustainable value creation. For community pharmacies, the focus needs to be on converting digital systems into decision routines and operational dashboards that can reduce stockouts, minimize wasted expired medicines, enhance purchasing decisions and increase available medicines.

9. Limitations and future research

There are limitations to the study's ability to generalize findings to other areas of Jordan such as hospital pharmacies and distributors. In addition, due to its cross sectional nature, this study cannot establish cause and effect relationships among variables at different points in time. To address these limitations in future studies, researchers could use longitudinal survey designs to examine how the digital maturity of community pharmacies changes over time and how predictive business intelligence becomes an integral part of their operations.

The sampling structure was based on the four governorates in northern Jordan where all participating pharmacies were selected through an eligibility criteria that required individuals who had first hand experience with purchasing, inventory management, and use of digital systems. However, despite using a stratified sampling approach to select eligible participants for the study, there is no independent verification of the number of responses received from each of the four strata. Although the subgroup profile helps increase transparency in the sample, it can only be considered descriptive of the characteristics of those included in the sample. It cannot be used to make inferences about the sample as representative of the population.

Additionally, the measurement model showed that the supplier and delivery visibility indicators did not appear to fit particularly well within the community pharmacy setting. As such, in future studies, a separate pharmacy specific visibility measure would need to be developed that would include measures of inventory visibility, demand visibility, supplier visibility, and delivery visibility.

Full collinearity values for two of the constructs were less than the more broad threshold value of 5.0 but both were greater than the conservative guideline value of 3.3. Thus, to further mitigate common-method biases (i.e., differences in how questions are answered by respondents), future studies may want to consider using either one of several approaches including separating perceptions of digital capabilities from actual decision making processes in terms of time, using multiple respondents per pharmacy, collecting objective data regarding actual system usage patterns by each respondent or conducting technical audits of each pharmacy's information systems.

10. Declarations

10.1 Ethical Approval and Accordance

This study was reviewed and approved by the Research Ethics Committee / Institutional Review Board (IRB) of Amman Arab University (Reference No. 06/11/2025-2026; approval date: 20 June 2026). The research was conducted in accordance with the ethical standards of the institutional review board and with the ethical principles of the 1964 Declaration of Helsinki and its later amendments.

10.2 Consent to Participate

Participation was voluntary. Respondents were informed about the purpose of the study, confidentiality procedures, anonymity protections, and their right to withdraw before completing the questionnaire. No personally identifiable information, pharmacy names, or patient-level clinical data were collected. Informed consent was obtained from all respondents prior to participation.

10.3 Consent to Publish

Not applicable. This manuscript does not contain any individual person's identifiable images, videos, or personal data requiring publication consent.

10.4 Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

10.5 Competing interests
The author(s) declare no competing interests.

10.6 Data availability
The dataset used in this study may be made available by the corresponding author upon reasonable request, subject to privacy and ethical restrictions. The dataset has not been deposited in a public repository.

10.7 CRediT author statement
The author was responsible for conceptualization, methodology, formal analysis, investigation, data curation, writing - original draft, writing - review and editing, validation, visualization, and project administration, and approved the final manuscript for submission.

10.8 Declaration of generative AI and AI-assisted technologies
AI-assisted tools were used only for language refinement, formatting support, and proofreading. The author reviewed, edited, and verified the manuscript and takes full responsibility for its content.

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Appendix A. Final retained indicators

Table A1. Retained reflective outer loadings

Construct	Indicator	Outer loading
DDDM	DDDM-DPP1	0.832
DDDM	DDDM-DPP2	0.825
DDDM	DDDM-DPP3	0.828
DDDM	DDDM-OPS1	0.858
DDDM	DDDM-OPS2	0.806
DDDM	DDDM-OPS3	0.780
DDDM	DDDM-DFF1	0.767
DDDM	DDDM-DFF2	0.801
DDDM	DDDM-DFF3	0.774
DDDM	DDDM-DDC1	0.792
DDDM	DDDM-DDC2	0.761
DDDM	DDDM-DDC3	0.796
IDV	SCV-IV2	0.880
IDV	SCV-IV3	0.817
IDV	SCV-DCV1	0.885
IDV	SCV-DCV2	0.773
IDV	SCV-DCV3	0.746
SSCP	SSCP-EP1	0.701
SSCP	SSCP-EP2	0.736
SSCP	SSCP-ENP2	0.709
SSCP	SSCP-ENP3	0.667
SSCP	SSCP-ENP4	0.713
SSCP	SSCP-SSP1	0.763
SSCP	SSCP-SSP2	0.780
SSCP	SSCP-SSP3	0.759
SSCP	SSCP-SSP4	0.768

Appendix B. Measurement instrument audit trail

Table B1. Measurement instrument audit trail

Code	Final construct/status	Dimension	Item text or content basis	Final treatment
AIBIC-DI1	AAPBIC	Data integration / Predictive analytics	The pharmacy has a digital system that regularly collects sales and inventory data.	Retained in formative-composite construct
AIBIC-DI2	AAPBIC	Data integration / Predictive analytics	The pharmacy can integrate purchasing, sales, and inventory data in one system or connected reports.	Retained in formative-composite construct
AIBIC-DI3	AAPBIC	Data integration / Predictive analytics	Medicine and available quantity data are continuously updated in the pharmacy system.	Retained in formative-composite construct
AIBIC-DI4	AAPBIC	Data integration / Predictive analytics	The pharmacy can access accurate data on pharmaceutical items when needed.	Retained in formative-composite construct
AIBIC-IPA1	AAPBIC	Data integration / Predictive analytics	Systems used in the pharmacy help analyze demand trends for medicines.	Retained in formative-composite construct
AIBIC-IPA2	AAPBIC	Data integration / Predictive analytics	The pharmacy can predict medicines whose demand may increase during certain periods.	Retained in formative-composite construct
AIBIC-IPA3	AAPBIC	Data integration / Predictive analytics	Digital analytics help identify slow-moving medicines.	Retained in formative-composite construct
AIBIC-IPA4	AAPBIC	Data integration / Predictive analytics	Digital systems help detect shortage or surplus signals before a problem occurs.	Retained in formative-composite construct
AIBIC-DIQ1	AAPBIC evidence only	Information quality / Intelligent support	Digital systems provide accurate information about inventory.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-DIQ2	AAPBIC evidence only	Information quality / Intelligent support	Digital systems provide updated information to monitor daily sales.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-DIQ3	AAPBIC evidence only	Information quality / Intelligent support	Information extracted from the system is clear and easy to understand.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-DIQ4	AAPBIC evidence only	Information quality / Intelligent support	Digital information can be relied on when making supplier and inventory decisions.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM

AIBIC-IDS1	AAPBIC evidence only	Information quality / Intelligent support	Digital systems provide indicators that support inventory management decisions.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-IDS2	AAPBIC evidence only	Information quality / Intelligent support	Smart reports identify items that need reordering.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-IDS3	AAPBIC evidence only	Information quality / Intelligent support	Digital systems provide information that helps select the most appropriate supplier.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
AIBIC-IDS4	AAPBIC evidence only	Information quality / Intelligent support	Digital systems help make faster and more accurate decisions.	Not retained in AAPBIC final construct; used as functional evidence and/or excluded to reduce overlap with DDDM
DDDM-DPP1	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DPP2	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DPP3	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-OPS1	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-OPS2	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-OPS3	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DFF1	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DFF2	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DFF3	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DDC1	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DDC2	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
DDDM-DDC3	DDDM	Data-driven decision-making	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SCV-SOV1	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-SOV2	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-SOV3	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-IV1	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-IV2	IDV	Inventory and demand visibility	Item retained from the original	Retained in reflective construct

			questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	
SCV-IV3	IDV	Inventory and demand visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SCV-DCV1	IDV	Inventory and demand visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SCV-DCV2	IDV	Inventory and demand visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SCV-DCV3	IDV	Inventory and demand visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SCV-DDV1	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-DDV2	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SCV-DDV3	IDV audit trail	Supplier/order/delivery visibility	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification; outside final retained empirical visibility domain
SSCP-EP1	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-EP2	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-EP3	SSCP audit trail	Sustainable performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification due weak loading or measurement noise
SSCP-EP4	SSCP audit trail	Sustainable performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification due weak loading or measurement noise
SSCP-ENP1	SSCP audit trail	Sustainable performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Excluded after purification due weak loading or measurement noise
SSCP-ENP2	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-ENP3	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-ENP4	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-SSP1	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-SSP2	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-SSP3	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory, visibility, or sustainable performance context.	Retained in reflective construct
SSCP-SSP4	SSCP	Economic/environmental/social-service performance	Item retained from the original questionnaire and adapted to pharmacy purchasing, inventory,	Retained in reflective construct

			visibility, or sustainable performance context.	

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Data.xlsx