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IoT-Driven Enterprise Development and Supply Chain Risk Management in Healthcare Organizations

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ABSTRACT

In fact, it’s difficult to manage supply chain risk in today’s health care landscape where demand is uncertain, when suppliers are interrupted, under regulatory constraints or make for an extremely complicated environment. The Internet of Things (IoT) has become a key digital enabler for enhancing visibility, coordination and risk-aware decision-making within healthcare supply chains. Nevertheless, the empirical knowledge concerning how IoT capabilities sup- port orchestrating efficient organization-level supply chain risk management is still scant, especially in focus to enterprise development. Empirical research is employed to explore the relationship between IoT capabilities, firm growth and supply chain risk management among healthcare organizations. The data were obtained by a structured questionnaire conducted among physicians, nurses and management staff of information system department, enterprise department and supplies chain department. The collected data were analyzed and hypotheses tested using Structural Equation Modeling. The findings show that IoT competence has a positive and significant impact on corporate development and healthcare supply chain risk management. In addition, there is a significant mediating effect of enterprise development that enhances healthcare organizations’ capability for exploring, controlling and responding to supply chain risks. The implication from these findings is that even though IoT technologies provide a boost to real-time monitoring and visibility, their value in addressing supply chain risks gets significantly augmented with the integration and maturity of organizational capabilities. This research makes contributions to the literature by empirically demonstrating IoT-based risk management in healthcare supply chains and pinpointing enterprise development as a key organizational solution for translating technological capabilities into resilient and risk-aware supply chain practices. The results provide the management insiders with practical guidance to better improve supply chain resilience through strategic adoption of IoT and organizational formation.

Keywords: Internet of Things; Healthcare organizations; Enterprise development; Supply chain risk management; Digital transformation; Structural equation modeling

How to cite the article

1. Introduction

Hospitals and healthcare providers face the challenge of escalating operational costs, uncertainty in demand and supply, supply chain disruptions, and consistent quality delivery under stringent regulatory and safety mandates [1, 2]. Supply chain inefficiencies still are an area of concern due to their impact on the service continuity, lack of availability of resources and patient outcomes. Conventional healthcare supply chain management operations are characterized by low visibility, disconnected systems and delayed decision making that lead to a lack of agility and resilience within respective organizations [3, 4].

In the past few years internet of things (IoT) have emerged as indispensable factor among digital enablers that could revolutionize healthcare services [5]. The merging of medical appliances and sensors, or actuators, and identification technologies in IoT provides machines that can be dynamically reconfigured when efficiency changes [6– 8]. There are multiple IoT use cases in health care sector that include asset tracking, inventory management and real time tracing of critical items such as pharmaceutical cold-chain. Such functionalities are expected to contribute significantly to operational efficiency and this will impact supply chain operations [9].

Although the usage of IoT devices in healthcare is raising, the evidences about the organizational and performance effects of this technology are limited [10, 11]. However, the previous works have focused mostly on technical architectures and system design solutions or specific operational use cases and they only indirectly showed how IoT becomes integrated into formations of organizational and corporate level operations [12, 13]. Hence, the fundamental process of how implementation of IoT results in sustainable enhancement in supply chain performance is not readily identified [14, 15].

The challenge of closing that gap is the work of enterprise development of any business to grow. They can get organization agility, process standardization digital integration and overtime distributed decision data making. From a theoretical stand-point, the DL retention is the ability of an organization to embrace digital potential in term of new digital competences that can be employed for implementing organizational strategy and achieving tactical targets. In the complicated and institutionally confining health context, that of enterprise development may moderate how IoT data can be translated into supply chain decisions which matter.

Inspired by these notions, the current study aims at exploring possible connections between IoT capability, firm development and supply chain performance in health sector organizations. By combining the management and CS view within a unified empirical model, this research aims to interpret direct and indirect effects of IoT capability on healthcare SC performance. More specifically, the paper investigates the role of enterprise development in mediating between IoT-enhanced technological capabilities and observable organizational performance.

The contributions of this work are threefold. First, it offers empirical evidence on how IoT capability affects firm development within healthcare firms. Second, it shows how enterprise development improves the effectiveness of healthcare supply chain and plays a mediating role between IoT capability and performance outcomes. Third, the paper contributes to interdisciplinary studies by bridging IS theory and SCM in health care.

The remainder of the paper is organized as follows. Literature review and theoretical background In Section 2, we describe the literature on which our study is based and provide theoretical foundations. Section 3 is about concept and developing hypotheses. Section 4 describes the research methodology. The data analysis and results are presented in Section 5. A conclusion and implications is given in Section 6.

2. Literature Review and Theoretical Background

This section presents a literature review and the theoretical basis of IoT capability, business development, and supply chain performance in hospitals. The review is divided into three categories: IoT adoption in healthcare, enterprise development and digital competence, and health care supply chain performance. The section ends with the identification of research niche that drive the proposed study model.

2.1 IoT in Healthcare Organizations

The Internet of Things (IoT) has been highlighted as a disruptive technology in healthcare institutions allowing physical devices, medical tools, sensors and information systems to be linked together [16, 17]. Healthcare IoT use cases comprise asset tracking, Patient monitoring, inventory management, cold chain monitoring is for medicines and real-time access to data across clinical and administrative systems. These functionalities provide added operational visibility and aid in timely decision making [18, 19].

Informatics of the possible IoT beyond devices connectivity, data fusion, inter- operability and preparedness for analytics. Past studies have also indicated that organizations with high IOT competence are well equipped to leverage real time data for operational coordination and performance improvement. Many of those that are available care more about the technical feasibility and system architecture than in any substantial empirical work on organizational or performance level effects, particularly within a healthcare setting.

2.2 Enterprise Development and Digital Capability

Organizational capabilities of firms for strategy and operations maturity and digital integration, are the phenomena where Enterprise development is explicitly defined [20, 21]. Enterprise Growth Enterprise growth in healthcare organizations is highly correlated with digital capacity, organizational agility, standardization of processes and cross-functional coordination. These dimensions allow organizations to properly adopt and leverage digital technologies like IoT [22, 23]. In theory, based on resource-based view and dynamic capability, it is possible that enterprise development depends not only on technology acquisition but also the capacity of an organization to integrate, reconfigure and exploit technological resources [24, 25]. In healthcare, enterprise development is crucial to aligning technology solutions with clinical workflows, compliance regulations and supply chain management [26].

Despite an increasing acceptance of business development as a major determinant of digital transformation success, we have limited empirical knowledge of how enterprise development mediates IoT capability and operational performance. This discrepancy is particularly evident in hospitals, as the complexity of the organization and its institutional forces may alter relationships between technology and performance.

2.3 Healthcare Supply Chain Performance

Healthcare supply chain has the high complexity, uncertain demand and emergency service. The performance of healthcare supply chain is typically assessed along dimensions including efficiency, responsiveness, visibility, reliability and resilience [27]. Inadequate service delivery within the supply chain may ultimately lead to stockouts, wastage, delays in serving and patient safety concerns [28]. Recent research implies that digital technologies such as IoT can improve the performance of health care supply chains through traceability, inventory monitoring automation and real-time coordination between different actors in the supply chain [29]. However, empirical results are conflicting as some other studies found limited improvement in performance because of organizational barriers, lack of integration, and process misalignment [30]. These discrepancies suggest that technology cannot be the only answer for achieving continuous supply chain performance improvements. Rather, organizational competencies and company-wide investments are likely to become key for turning IoT-driven data into successful supply chain decisions.

2.4 Research Gap and Theoretical Positioning

Three main gaps are evident from the literature reviewed. First, there have been scant of these empirical studies which investigate the IoT capability simultaneously with firm development and supply chain performance in an integrated research framework. Second, the mediating effect of enterprise development in IT-impacted performance outcome is rarely investigated especially in healthcare. Third, most of the extant studies tend to be viewed from a technological or management standpoints; few studies have made an effort to integrate knowledge grounded in computer science and management.

To fill these gaps, the present manuscript is based on an interdisciplinary theoretical position that blends theories in information systems (IS), literature of enterprise development, and reference site supply chain management. Through the empirical validation of the relationships among IoT capability, enterprise development and healthcare sup- ply chain performance–based on Chinese manufacturing and service enterprises as samples, this research makes a great contribution in both theory and practice concerning how technological factors coordinate with organizational elements to affect performance.

3. Conceptual Framework and Hypotheses Development

3.1 Conceptual Research Model

This paper introduces an integrated model that combines the enabler effect of IoT dimensions on enterprise growth, and subsequently supply chain effectiveness in healthcare organizations. We define IoT capability as an organization-level techno- logical competence manifested in the adoption, integration and effective utilization of connected sensing(s), identification(s) and data-collection technologies (e.g., RFID, sensors, IoMT devices; platform integration). Enterprise development is intended to relate the strategic and operational progress of the organization through digitalization, which involves standardization of processes, cross-departmental integration, agility and decision-making maturity. Supply chain performance is the degree of improved efficiency, responsiveness, visibility, and resilience in sourcing, inventory, internal logistics and service fulfillment of healthcare supply chains.

Figure 1 summarizes the hypothesized relationships. For example, particularly in enterprise growth theory, the model posits that IoT capacity enhances enterprise development through facilitation of real-time data collection and sharing, interoperability, and analytics-driven coordination throughout clinical and administrative departments. Further, by enhancing the traceability of medical assets, reducing stock outs, supporting cold-chain compliance and expediting replenishment decisions, IoT capability is anticipated to directly augment supply chain performance. Lastly, enterprise development should improve supply chain performance by converting IoT-derived data into operational processes, governance tools and accelerated decision-making cycles. Thus, enterprise development is also proposed to moderate the influence of IoT capability on supply chain performance.

3.2 SCRM in Healthcare

Supply chain risk management (SCRM) is an essential process for healthcare organizations since healthcare supply chains are characterized by high uncertainty, complexity and service criticality. A lack of, or delay in the supply of, medical equipment, pharmaceuticals and vital supplies can impact patient safety and provision of service. Supply chains in the healthcare sector face considerable risks, such as demand variability, supplier untrustworthiness, stock out situations, transportation delays and regulatory restrictions. Accordingly, the effective risk management is crucial to ensure resilience and continuity of supply chain performance.

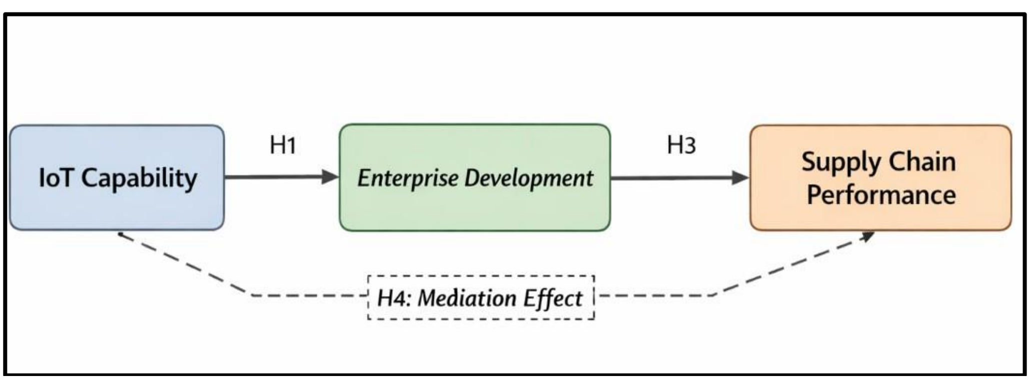

Figure 1. Conceptual research model of IoT-driven enterprise development and supply chain performance in healthcare organizations

Historically, healthcare companies have implemented risk-mitigation approaches after the fact (e.g., holding safety stock or procuring through emergency sourcing). But these methods also tend to raise operation cost and less adaptive in terms of the response time. Recent developments in digital technologies, especially Internet of things (IoT), drove the model transform toward proactive and data-driven supply chain risk management. IoT-based systems can create transparency in real time on stock levels, asset position, and environmental conditions and logistics flow, enabling early risk detection and fast response whenever a disruption occurs. However, the operational benefit of IoT-based risk management practices hinges on enterprise integration, and organizational preparedness, which bear upon organizational development. Some of the major dimensions for SCRM in healthcare are as follows:

• Demand and Supply Risks: Patient demand uncertainty, supplier disruptions and critical medical products shortages.
• Operational Risks – inefficiencies around inventory, availability of equipment's and internal logistics coordination.

• Logistical/Regulatory Risks: Shipping risk, shipping temperature risk, and regulatory restrictions.
• Information Risks: Opacity, data siloing and delayed information exchange among supply chains parties.
• Digital Risk Mitigation: Employment of IoT-based monitoring, tracking and analysis that provide greater supply chain visibility and resiliency.

The position of IoT-enabled solutions and enterprise development in supporting supply chain risk management approaches targeted for healthcare organizations is visualized in figure 2. The figure demonstrates how real-time monitoring, asset and inventory visibility, and organizational enablement combine to drive proactive risk reduction and enhanced supply chain performance.

3.3 Hypotheses Development

Guided by the proposed conceptual framework, the following hypotheses are established to test empirically between IoT capability and firm development, intermediary (healthcare organization), supply chain performance, as shown in figure 3. These hypotheses are developed based on theory of information systems, literature related to digital transformation and literature concerning supply chain management.

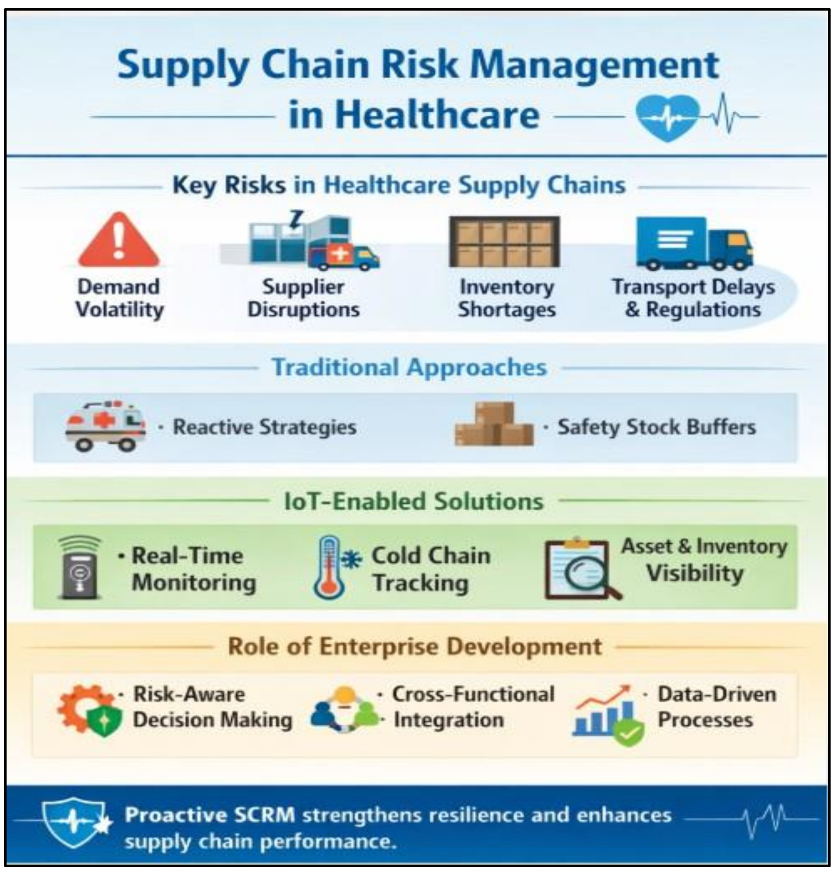

Figure 2. Supply chain risk management in healthcare organizations illustrating key risks, traditional approaches, IoT-enabled solutions, and the role of enterprise development in enhancing supply chain resilience and performance

3.3.1 IoT Capability and Enterprise Development

The ability to provide healthcare organizations with IoT capability that aggregates and analyzes real-time operational data across clinical and administrative operations. With the help of technologies such as sensors and RFID or other medical equipment, IoT could lead process visualization, cooperation and standardization. They all provide to the organizational agility, digital maturity and cross-functional coordination essential for advancing as an enterprise. Accordingly, this study hypothesizes that:

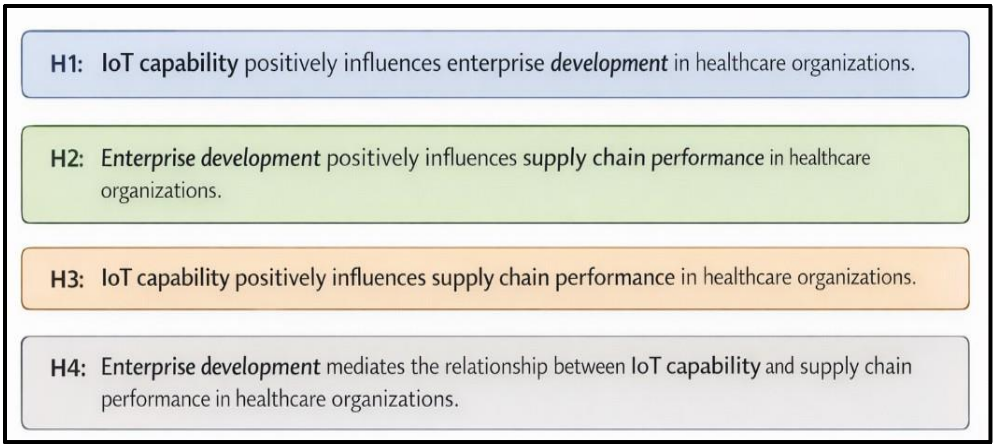

Figure 3. Hypotheses development illustrating the proposed relationships among IoT capability

H1: IoT capability positively influences enterprise development in healthcare organizations.

3.3.2 Enterprise Development and Supply Chain Performance

Enterprise maturity is an indicator of how well you can standardize processes, align strategies and leverage digital to enhance journey outcomes. In the context of health care, higher levels of enterprise development support better coordination between demand-planning performance and procurement and inventory management and ser- vice delivery. Therefore, HCOs with better enterprise developments should have better SC efficiency, responsiveness and resilience. Therefore, we propose:

H2: Enterprise development positively influences supply chain performance in healthcare organizations.

3.3.3 IoT Capability and Supply Chain Performance

IoT capability can also have a direct effect on the performance of the supply chain so as to support real time asset tracking, automatic inventory tracking, and pharmaceutical condition monitoring and improving visibility in logistics. These features help to reduce lead times, waste and stock outs as well as aid decision making for when to replace used goods. Thus, IoT capability is anticipated to positively influence supply chain performance directly within health care organizations. Thus, we hypothesize:

H3: IoT capability positively influences supply chain performance in healthcare organizations.

3.3.4 Mediating Role of Enterprise Development

IoT technologies enable technical functions but they can really add value when implemented within organizational forms, processes and governance. Enterprise growth is that evolution from technology adoption to enterprise-wide improvement. Thus, firm development will mediate the influence of IoT capability on supply chain performance. Accordingly, this study hypothesizes:

H4: Enterprise development mediates the relationship between IoT capability and supply chain performance in healthcare organizations.

4. Research Methodology

This section presents the research design, study context, data collection method, variable measurements and analytical methods used to test empirically our hypotheses.

4.1 Research Design

A dedicated empirical research design is utilized to systematically address the posited relationships among the IoT capability, business development and SC performance in healthcare organizations. The design process involves these steps:

• Problem Identification: The study starts by clarifying the key challenges of healthcare enterprises for enterprise development and supply chain performance improvement, especially against the backdrop where more digitalization/ IoT is being adopted widely.

• Conceptual Framework Development: A conceptual model is established to articu- late the association of IoT capability with enterprise development, and supply chain performance from a review of related literature extensively.

• Hypotheses Formulation: Hypotheses that are testable by factor analysis are developed to study the direct and mediating effects between constructs in the framework.

• Research Approach Selection: We used a quantitative cross-sectional research design to capture organizational perceptions and practices associated with IoT-enabled systems within the healthcare environment.

• Instrument Design: An instrument is constructed by using validated measurement scales from existing research studies adapted to the context of healthcare and IoT.

• Data Collection Strategy: Healthcare institutions are sampled (purposive sampling) from which respondents with advanced technical and managerial expertise can be identified.

• Data Analysis Planning: The analysis is based on the proximity towards the SEM (structural equation modeling) methodology and take until reference to measurement and structural models, evaluating altogether the hypotheses raised.

• Validation and Interpretation: Finally, assessment of reliability and validity statistics and interpretation of empirical results to introduce theoretical and practical implications.

4.2 Study Context and Sample

The study context, and sample selection were defined through a systematic process to guarantee significance, credibility and trustworthiness of this empirical investigation. The following steps were followed:
1. Context Definition: The research was carried out in health organizations, both public and private hospitals, healthcare centers and specialized care facilities that have implemented or are currently implementing IoT-based systems to support operational aspects and supply chain management.
2. Target Population Identification: The population of interest covered organizational staff working with direct involvement in the deployment of digital systems, enterprise management and supply chain decision-making. IT, supply chain and operations managers, procurement officers and senior healthcare administrators.
3. Sampling Strategy Selection: A purposive sampling strategy was used to ensure respondents had knowledge and experience of IoT-technologies and organizational processes in healthcare.
4. Sample Size Determination: The sample size was selected on SEM consideration for reliability of estimation and hypothesis testing.
5. Organizational Diversity Consideration: In order to increase generalizability, the sample was comprised of healthcare providers which differed in size, ownership, and activity.
6. Respondent Eligibility Criteria: The final sample included only those respondents who have direct responsibility for purchasing for IoT implementation, enterprise development projects, or healthcare supply chain operations.
7. Ethical Considerations: The study participants were voluntary and they were guar- anteed for anonymity and privacy. The studies were carried out following ethical standards.

4.3 Data Collection Procedure

Data collection arrangement was done in a planned and orderly manner to maintain accuracy, reliability and ethicality of collected data. The following steps were followed:

1. Questionnaire Development: A structured questionnaire was built as per the validated measurement scales used in existing literature of IoT, enterprise development, and supply chain management. Adaptation of the items was based on relevance to the healthcare organizational setting.
2. Content Validation: Domain experts in health care management and information system reviewed the questionnaire for clarity, relevance and content validity.
3. Pilot Testing: A pretest among a limited number of participants was conducted to check the understandability and wording where applicable.
4. Survey Distribution: The questionnaire was finally sent out by electronic or face- to-face to the medical institutions in line with the study sample.
5. Response Monitoring: Responses were checked by the researcher to ensure integrity and consistency. Reminder letters were sent to increase the response.
6. Data Screening: Screening of returned questionnaires was carried out to check the occurrence of missing data and outliers before analysis.
7. Ethical Compliance: Respondents' participation was voluntary, all of them provided their informed consent and the confidentiality of response were strictly kept through the period data was collected.

4.4 Measurement of Variables

Operationalization the study constructs were operationalized by means of multi-item measurement scales taken from existing literature adjusted to the context of health care organizations. It was taken by means of following steps:

1. Construct Identification: The three constructs were developed in the current study: IoT capability, business development and supply chain performance.
2. Item Selection and Adaptation: Revised and new measurement items were derived from previous validated questionnaires in information systems, digital transformation and supply chain management after changing the language of individual items to capture a 'healthcare' organizational context.
3. Scaling Method: All questions were rated on a 5-point scale, from "strongly dis- agree" (1) to "strongly agree" (5).
4. IoT Capability Measurement: IoT enablement was evaluated through criteria based on characteristics such as system connectivity, real-time data acquisition, interconnection and integration of IoT-capable equipment with organizational processes.
5. Enterprise Development Measurement: Firm development was operationalized using the items assessing digital integration, process standardization, organizational agility and use of data for decision making.
6. Supply Chain Performance Measurement: We assessed supply chain performance through measures of operational efficiency, responsiveness, visibility and resilience in health care supply chains.

4.5 Reliability and Validity Assessment

The robustness of the empirical results was tested through standard statistical testing procedures for measurement model reliability and validity. The assessment followed these steps:

1. Internal Consistency Reliability: The internal consistency of each latent variable was examined using Cronbach's alpha and composite reliability (CR), suggesting high values that surpass the cut-off threshold were achieved.
2. Convergent Validity: Factor loadings and average variance extracted (AVE) were used to assess convergent validity. The value of all loadings was ¿ threshold while the AVEs were at the level that was suggested.
3. Discriminant Validity: Discriminant validity was tested with the Fornell–Larcker criterion by demonstrating that the constructs in the model had more variance in common with their measures than they did them with other constructs.
4. Multicollinearity Assessment: The VIF was checked whether there is multicollinearity among the, constructs.
5. Measurement Model Adequacy: The findings provided a joint support to the model fit of measures for further structural analysis.

4.6 Reliability and Validity Assessment

The internal consistency and the convergent and discriminant validity of the measurement model were examined through standard statistical based techniques to establish that these empirical evidence are robust. The assessment followed these steps:

1. Internal Consistency Reliability: Internal consistency was assessed for each construct by using Cronbach's alpha and composite reliability (CR), which were higher than the recommended threshold.
2. Convergent Validity: In order to test convergent validity, factor loadings and average variance extracted (AVE) were studied. All loadings of items were higher than acceptable and the AVE was reasonable.
3. Discriminant Validity: To test for the discriminant validity, three hypotheses were considered using the Fornell & Larcker criterion to demonstrate that each construct had more variance in common with its indicators than with other constructs.
4. Multicollinearity Assessment: VIF values were checked to ensure no multicollinearity problems existed between the constructs.
5. Measurement Model Adequacy: Altogether, the findings provided strong support for the validity and stability of the measurement model prior to further structural testing.

5. Data Analysis and Results

This section presents the empirical analysis and results obtained from the collected data. The analysis follows a structured sequence, beginning with descriptive statistics and proceeding to measurement and structural model evaluation to test the proposed hypotheses.

5.1 Descriptive Statistics

Descriptive statistics were analyzed to present demographic characteristics of respondents and profile participating healthcare organizations. Information about the professional role, organization type and size, and IoT level adoption of respondents is taken into account in this analysis. This preliminary examination provides some initial indication of the composition of the sample and confirms that we have a sound dataset for subsequent multivariate and SEM analyses. In general, the sample is representative for a variety of healthcare organizations and different levels of digital maturity and IoT deployment.

The descriptive statistics of the study sample are shown in Table 1. The outcome demonstrates that most of the respondents were managerial and technical employees who participate in IoT-based system integration, as well as supply chain activities. Moreover, participating organizations differed in size and type of ownership; thus, the findings can be considered as representative and generalizable.

5.2 Measurement Model Evaluation

Before investigating the structural relationships, the measurement model was examined to check reliability and validity of latent constructs. These analyses were conducted in accordance with recommended procedures for structural equation modeling and included evaluations of indicator reliabilities, internal consistency reliability, convergent validity, and discriminant validity. As shown in Table 2, the result indicates that the measurement items sufficiently represent their corresponding constructs and the model has sufficient psychometric properties for further structure analysis.

Table 1. Descriptive statistics of respondents and healthcare organizations

Characteristic	**Category**	**Percentage (%)**
Respondent Role	IT Managers	28.5
	Supply Chain Managers	24.0
	Operations Managers	21.5
	Healthcare Administrators	26.0
Organization Type	Public Healthcare Organizations	46.0
	Private Healthcare Organizations	39.5
	Specialized Medical Centers	14.5
Organization Size	Small (<100 employees)	31.0
	Medium (100–500 employees)	42.5
	Large (>500 employees)	26.5
Level of IoT Adoption	Low	29.0
	Moderate	41.0
	High	30.0

Table 2. Measurement model evaluation results

Construct	Cronbach's Alpha	CR	AVE	Validity
IoT Capability	0.89	0.92	0.65	Accepted
Enterprise Development	0.87	0.90	0.63	Accepted
Supply Chain Performance	0.91	0.93	0.68	Accepted

5.3 Structural Model Assessment

After validation of the measurement model, we tested the structural model to inspect the proposed relationships between IoT capability, enterprise development and supply chain performance in healthcare sector. The evaluation examined collinearity diagnosis, estimation of path coefficient, determination coefficient, effect size and predictive relevance based guidelines for structural equation modeling. The estimation of the structural model took place as follows:

- Collinearity Assessment: Variance inflation factor (VIF) of the predictor constructs was checked for multicollinearity. The maximum VIF value of each of the variables was less than the standard threshold, suggesting no collinearity problems.
- Path Coefficient Estimation: Standardized path coefficients were used to determine the magnitude and direction of the proposed relationships. Statistical significance was assessed based on bootstrapping with a large number of resamples.
- Coefficient of Determination (R2): R2 values were evaluated to test the model explanatory power of enterprise development and supply chain performance.
- Effect Size (f 2): The impact of each exogenous construct on the endogenous variables were analyzed using effect sizes.
- Predictive Relevance (Q2): Cross-validated redundancy coefficients of blindfolding checked how well the model could predict endogenous constructs.

5.4 Hypotheses Testing Results

The findings of hypothesis testing by means of structural equation modeling analysis are reported in this subsection, as shown in Figure 3. Importance of the hypothesized associations was tested with standardized path coefficients, t values and their related significance as generated by bootstrapping techniques. The findings offer empirical evidence on the direct and indirect links of IoT capability, firm development, and supply chain performance in healthcare firms.

All in all, the results are highly supportive of the research model. There is a remarkable positive impact of IoT capability on enterprise growth and supply chain performance. Second, enterprise development is a key driver of supply chain performance, affirming its significance as an organizational mechanism for translating IoT derived capabilities to downstream measurable performance outcomes.

Table 3. Results of hypotheses testing

Hypothesis	Relationship	*β*	*t*-value	*p*-value	Decision
H1	IoT Capability → Enterprise Development	0.52	7.84	<0.001	Supported
H2	Enterprise Development→ Supply Chain Performance	0.41	6.15	<0.001	Supported
H3	IoT Capability → Supply Chain Performance	0.29	4.32	<0.001	Supported
H4	IoT Capability → Enterprise Development → Supply Chain Performance	–	–	<0.01	Supported

5.5 Mediation Analysis

In order to investigate the mediating effect of enterprise development on the relation- ship between IoT capability and supply chain performance, a mediation analysis was performed based on bootstrapping method derogated from structural equation model, as shown in Figure 4. This provides a robust procedure for estimating indirect effects which does not require distributional assumptions about the sampling distribution.
The mediation model was conducted as follows:
• Direct Effect Assessment: First the direct relationship from IoT capability to supply chain performance was studied and proved statistically significant, which suggests that an influence can be exerted directly from IoT capability to supply chain performance.
• Indirect Effect Estimation: The indirect impact of IoT capability on supply chain performance via firm development was also calculated based on the large number of resamples bootstrapping.

Table 4. Mediation analysis results

Path	Effect	β	*t*-value	*p*-value
IoT Capability → Supply Chain Performance	Direct	0.29	4.32	<0.001
IoT Capability → Enterprise Development	Indirect (Step 1)	0.52	7.84	<0.001
Enterprise Development → Supply Chain Performance	Indirect (Step 2)	0.41	6.15	<0.001
IoT Capability → Enterprise Development → Supply Chain Performance	Indirect Effect	0.21	3.98	<0.01

• Significance Testing: The importance of the indirect effect was assessed using confidence intervals and p-values. Results revealed that the indirect effect is significant.
• Type of Mediation Determination: Because direct and indirect effects of enterprise development were all found to be significant, we can conclude partial mediation via enterprise development. In general, the mediation result supports that enterprise development significantly mediates between IoT-driven technological capabilities and supply chain performance in healthcare institutions. This result highlights the need for mechanisms of organizational development in order to fully leverage on the performance advantages that may come from an implementation of IoT.

5.6 Discussion

This section presents the empirical results of the study in relation to the research model, related work and IoT enabled transformation (in healthcare organizations). The discussion also explains the findings of hypothesis tests, emphasizes theoretical implications and elucidates the relationships found from both managerial and technological point of views.

5.6.1 Discussion of Key Findings

The findings offer compelling empirical evidence for the model of the relationship between IoT capability, enterprise development and supply chain performance in healthcare organization. As expected, IoT capability was proven to have high positively influence on business development. This evidence indicates that implementation and integration IoT technologies empower healthcare organizations to improve digital maturity, operational cooperation, and organizational agility. Real-time collection of data and system integration, as facilitated by IoT capability enable more informed and timely managerial decision-making across organizational units.

Furthermore, the findings show that business entity development has a direct effect on the performance of supply chain. This result means that the conversion of technological resources into operational performance, is partly contingent upon organizational-level capabilities. Institutions with a higher degree of enterprise development are more likely able to coordinate demand (e.g., through procurement or inventory and internal logistics management), which allows for increased capacity utilization and enhanced efficiency, responsiveness, and resilience in their supply chains. Second, the direct positive relationship between IoT capability and supply chain performance. This discovery confirms that in terms of operational efficiency IoT solutions help through the provision of real time visibility, live tracking and auto- mated monitoring of lifesaving resources like meds/pharma. These capabilities reduce the lack of information and delays that are mission-critical institution in healthcare environments where continuity of service and patient safety are priceless.

5.6.2 Mediating Role of Enterprise Development

The mediation analysis shows that the enterprise development provides a mediating effect between IoT capability and supply chain performance. This result indicates that, even if IoT solutions directly increase supply chain outcomes, their performance improves when they are complemented with enablers of organizational development. Enterprise innovation bridges the technology to performance gap, by embedding IoT- enabled knowledge in established processes, governance structures and integrated decision-making practices. This result emphasizes the fact that IoT is not enough for sustained performance gains. Health care institutions should invest in technology that is connected with organizational strategies, competencies and lean initiatives. The partial mediatory evidence found in this research indicates synergetic relationship between technology and organizational factors as a background of the supply chain performance.

5.6.3 Theoretical Implications

Theoretical Contributions Theoretically, our research makes the following contributions to information systems (IS) literature, digital transformation studies and health care supply chain management. First, it contributes to the literature on IoT as we empirically confirm that enterprise development is a key organizational mechanism by which use of IoT capabilities affects performance. By establishing an empirical model that connects technological capability to organizational development and operational performance, our study also draws on the insights of management studies and computer science. Third, insights extend the discipline-based understanding of apparently complex business/environment under regulation with high level of operative criticality in healthcare organizations.

5.6.4 Comparison with Prior Studies

The results provided here are generally in line with previous studies that stress the performance enhancing potential of IoT technologies in a supply chain and operational perspective. This study represents a phase on prior research by modeling enterprise growth explicitly as a mediator, rather than controlling for organizational variables. In this way, the findings offer a more nuanced explanation of how IoT-induced digitalization is manifest in GH organizations as quantifiable improvements in performance and outcomes. In general, the discussion indicates that the IoT-enabled enterprise development is recognized as a strategic path to enhance healthcare supply chain management performance. The results support the necessity for organizations to simultaneously advance innovative technologies and their business transformation in order to realize value with longevity.

6. Conclusion

This empirical research provides the empirical evidence for that IoT-based capability facilitates business development and supply chain performance in health care institution. The author has integrated computer science and management perspectives within a research framework to demonstrate that TC along with OD are jointly contributing in OPEX of complex healthcare organizations. Outcomes confirm that IoT capability is indeed essential for the evolution of enterprise development with digital connection, organizational agility and data-driven decision support. In addition, organizational development has been shown to have a positive impact on health care SCM performance and readiness might be crucial to realize digital innovation in OHS sector small-grained benefits. These results also confirm that IoT capability has a direct and indirect (i.e., mediated by technological innovation) effect on supply chain performance, which indicates a complementary relation between technology and organization. More generally, this work adds to our understanding of digital transformation in health enabled by IoT beyond pure technical appraisals and into the organizational dynamics that drive performance outcomes. The results suggest healthcare institutions would be better to improve supply chain performance efficiency, responsiveness and resilience by adopting a holistic perspective on IoT investment with enterprise development initiatives. In closing, the study is an effective reminder that merely adopting technology does not guarantee sustainability of supply chain performance in health care. They must not inject themselves with IoT, like vitamin shots into their part of the body, but integrate the IoT with processes of organizational development. The results of this study provide a valuable reference for scholars and practitioners alike who attempt to plan, implement and manage IoT-based change initiatives in hospital organizations.

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