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A Holistic View on the Adoption and Cost-Effectiveness of Technology-Driven Supply Chain Management Practices in Healthcare

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Abstract: Healthcare supply chains are complex systems facing challenges in delivering high-quality care while maintaining cost-effectiveness. Research on inventory management and control, the heart of the healthcare supply system, has demonstrated that these targets can be reached by managing inventories efficiently while aiming at desired service levels. Although this can be enabled by adopting various supply chain management practices, the healthcare sector appears to lag compared to other industries. Seeking to investigate these aspects, this study draws on operations management literature, identifies and categorizes technology-driven supply chain management practices that are applied in hospital operations, develops a holistic conceptual framework delineating the key factors influencing their adoption in healthcare facilities, and examines their aggregated impact on financial performance. The research model is tested using structural equation modeling with survey data collected from Greek public hospitals. The study results indicate that technological readiness, organizational readiness, perceived benefits, and hospital size significantly influence the adoption of these practices in hospital supply chains. Moreover, they show a statistically significant association between the supply chain management practices applied and improved hospital cost performance, suggesting greater urgency for hospitals to exploit them fully. Theoretical and practical implications of the findings are discussed.

Keywords: technology–organization–environment (TOE); structural equation modeling (SEM); hospitals; financial performance; KPI tracking; inventory optimization; data segmentation; demand forecasting; supplier evaluation; e-procurement

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1. Introduction

Healthcare organizations worldwide are pressured to reduce operating costs while meeting the growing demand for healthcare services and ensuring the quality of care. The escalating cost of healthcare delivery has led some to suggest that any discussion on healthcare improvement should be coupled with the necessity of reducing costs [1]. Considering that supply chain costs average 37.3% of the total cost of patient care [2], improving supply chain performance is key to increasing operational efficiency and reducing overall costs. One fundamental way to reduce supply chain costs is by applying selected inventory management and control practices, as inventory can be considered the "measuring stick" of an entire supply chain. This is expected to positively impact costs and provide other benefits, such as streamlined processes, increased quality of information, and overall improvement to the services offered [3].

Although many industries have reached the goal of reducing supply chain costs by applying various supply chain management practices (SCMPs), the healthcare sector is trailing behind in this respect [4]. This could be linked to the relative complexity exhibited in healthcare supply chains. For example, the healthcare sector is subject to robust national and international regulatory frameworks that can make supply chain management more challenging. Additionally, predicting demand for medical supplies can be difficult due to the high degree of patient heterogeneity, resulting in excess stock to ensure preparedness for emergencies and unpredictable demand. The long developmental cycles of pharmaceutical products can also impact supply chain strategies. Furthermore, there may be limited knowledge of SCMPs among pharmacists and physicians, who play a vital role in procuring and managing drug inventories [5]. These issues are amplified by empirical evidence in healthcare, which provides mixed results on the relationship between process improvements and various performance measures, such as financial performance and customer service performance [6]. The uncertainties over the effectiveness of SCMPs and the lack of success in their adoption indicate the need to study the challenges of their adoption within the healthcare sector. Shi and Yu [7] point out that while there is a general agreement on the benefits that SCMPs can offer to healthcare organizations, these benefits are mostly claimed rather than proven through empirical evidence. As stated by De Vries and Huijsman [8], one of the main challenges in healthcare supply chain management research is to establish performance metrics that clearly demonstrate this added value and to comprehend the circumstances that contribute to its emergence. Motivated by these issues, this study aimed to extend the understanding of the adoption of SCMPs in hospitals by identifying factors of influence and assessing their impact on hospital cost performance.

2. Research Framework and Hypotheses Development

The emergence of innovative technologies has led to a blurring of the line between technology and process-driven SCMPs. Nowadays, even process-related practices are heavily intertwined with technology applications, rendering this categorization less relevant. Previous research on SCMPs focuses on specific technologies such as ERP, EDI, RFID, and e-Business-related applications or investigates SCM concepts that are enabled by various technologies [9]. This fosters the basic view that SCMPs share a common critical enabler, namely technology, and their adoption can be studied by examining the underlying technologies. Therefore, within this paper, the term "supply chain management practices" will reference all those technology-based practices and policies identified as success facilitators for organizations' SCM.

The literature proposes multiple models and combinations of models to examine the acceptance of different technologies and innovations in a general context. The widely used theories of the technology acceptance model (TAM) and technology–organization–environment (TOE) specifically target technology acceptance and are embraced by many researchers to investigate adoption aspects at the organizational level. TAM can be improved by including social and psychological parameters that affect technology adoption, as it focuses primarily on technology-oriented determinants [10]. Consequently, other models are often used in conjunction with TAM to enhance its explanatory and predictive power. In contrast, the TOE model offers an integrative approach incorporating additional determinants, such as organizational and environmental constructs. It identifies three contextual aspects of a company that may influence its adoption of technological innovation [11]. These aspects include: (a) the technological context, which encompasses the existing technological infrastructure and the proficiency in using new technologies that are relevant to the organization; (b) the organizational context, which pertains to the characteristics of the organization, such as its culture, resources, and size; and (c) the environmental context, which relates to the framework in which a firm operates, primarily encompassing its industry, business partners, competitors, and government interactions.

Empirical evidence consistently supports the application of the TOE framework in the adoption of technology, as demonstrated by a review of relevant literature. Several researchers have validated the three aspects of technological, organizational, and environmental characteristics in various business sectors. However, the specific factors within the three contextual components may vary across studies. Among others, TOE has been used to explain the adoption and diffusion of information systems [12], electronic data interchange

(EDI) [13], e-commerce [14], radio frequency identification (RFID) [15], enterprise resource planning (ERP) systems [16], cloud computing [17], and blockchain technology [18]. Given its consistent empirical support in the study of technology adoption, the TOE framework provides a fitting foundation for examining the adoption of SCMPs.

Drawing upon the literature findings, the empirical evidence provided in related studies, and the theoretical aspects discussed above, this study synthesized a research model that combines the established theoretical perspective of the TOE framework with the concept of perceived benefits [19]. This will form a richer theoretical framework that provides a better comprehension and prediction of the extent to which hospitals adopt SCMPs and how this affects hospital cost performance. Furthermore, the application of technology-enabled SCMPs is expected to depend on organizational and technological readiness, to be impacted by environmental factors, and to be influenced by perceived benefits. Thus, the research model features six dimensions: (1) the extent of SCMP adoption, (2) technological context, (3) organizational context, (4) environmental context, (5) perceived benefits, and (6) hospital cost performance. The specifics of these model variables in a healthcare setting and the related hypotheses are outlined in the next sections.

2.1. Extent of Hospital SCMPs Adoption

Researchers and practitioners have provided evidence of the positive link between the application of SCMPs and improved operational performance in many different industries, with several studies reporting significant inventory cost reductions due to the adoption of these practices [20,21]. Demand planning and forecasting, data segmentation, inventory replenishment, and optimization are some practices that have been reported to positively impact an organization's competitive advantage [22].

The starting point for meeting the study's research objectives was to identify a comprehensive set of SCMPs that can be adapted to healthcare needs and are expected to improve overall SCM performance in hospitals. A panel of eight subject matter experts, comprising three healthcare managers and five SCM specialists, was tasked with narrowing down a list of SCMPs gathered from the literature and business studies and grouping them into clusters applicable to hospital supply chain processes. This procedure was facilitated using the Delphi technique, a widely used method for gathering data from respondents within their areas of expertise. Contrary to other data-gathering analysis techniques, it employs multiple iterations designed to develop a consensus among the participating experts. Two Delphi rounds were performed, resulting in the definition of eight SCMP clusters (inventory management, KPI tracking, and reporting/inventory replenishment optimization/data segmentation/demand forecasting/supplier evaluation/web-based procurement/asset tracking/supplier integration). They are enabled by various technologies ranging from mature and widely used ones, such as barcoding technology and ABC analysis, to relatively specialized applications, such as demand forecasting. Nevertheless, the common thread among all of these technologies is their primary focus on managing and regulating supply chain data and activities, as well as exchanging information both within and between organizations. The resulting SCMP clusters are reported in Table 1, including links to their underlying technologies and the selected literature sources that highlight their healthcare sector relevance.

Table 1. SCMP clusters for hospital supply chains.

	SCMP Clusters	Description	Underlying Technologies	References	Saidin Index Weighting
SCMP1	Inventory management KPI tracking and reporting	• Tracking and reporting of SCM key performance indicators (KPIs) such as inventory turnover, average stock values, and service levels • Exception management (alerts when exceeding predefined KPI thresholds)	• Business intelligence (BI) software • KPI tracking tools • ERP Systems	Cai et al. [23] Wyatt [24]	0.47
SCMP2	Inventory replenishment optimization	• Material requirements planning (deterministic, consumption-based) • Optimization of reordering parameters (reorder points (min/max), safety stocks, and order quantities calculations (such as EOQ))	• Inventory optimization software • Warehouse management systems • ERP Systems	Varghese et al. [3] Beier [25]	0.73
SCMP3	Data segmentation	• Data standardization and classification of materials (drugs, medical supplies etc.) based on ABC analysis and criticality (VED-vital, essential, desired) • Application of structured inventory management policies for each material class (segment)	• ERP Systems	Varghese et al. [3] Ramanathan [26] Danas et al. [27]	0.27
SCMP4	Demand forecasting	• Forecasting based on historical consumption data and anticipated future events or trends • Automated selection of appropriate forecasting algorithms	• Demand planning software	Van Wassenhove [28] Kalchschmidt [20] Varghese et al. [3]	0.45
SCMP5	Supplier evaluation	• Formalized systematic evaluation of suppliers based on score calculation for criteria such as price performance, delivery performance, product quality, and compliance • Integration with supplier selection process	• Vendor management software • Supplier relationship management (SRM) software • ERP Systems	Mettler and Rohner [29] Kannan and Tan [30] Tan et al. [31]	0.70
SCMP6	Web-based procurement	• Web-enabled procurement processes through the use of web-based applications and tools (such as e-procurement, e-auctions, e-catalogues, e-tender, and e-RFx)	• e-procurement software • e-auction ASPs • B2B e-commerce platforms	Puschmann and Alt [32] Smith and Flanegin [33]	0.35
SCMP7	Asset tracking	• Streamlining inventory movements (such as goods receipts, goods issues, and physical inventory counts) through automated data entry • Monitoring mobile medical equipment	• Asset tracking software • RFID • Barcodes	Yao et al. [34] Blanchard [22] Lee and Shim [35]	0.72
SCMP8	Supplier integration	• Integration of suppliers into the hospitals' inventory management business processes	• Electronic Data Interchange (EDI) • Vendor-managed inventory (VMI) Systems	Schneller and Smeltzer [5] Chau and Hui [13]	0.79

Most technology adoption studies identified as part of the literature review treat adoption as a one-shot parameter represented by a dichotomous variable (yes/no). Interestingly, the literature suggests that the mere adoption of SCMPs will only have relatively modest benefits. Morita and Flynn [21] argue that they lead to better performance levels only when they are used extensively. The application of SCMPs is an evolutionary process, where an organization initially adopts and then has to assimilate them to fully exploit their benefits. However, after initial deployment, an organization often needs more knowledge to leverage the new technology, as stressed in studies reporting differences in the relationship between SCMPs and performance based on how extensively these practices are used [36]. This suggests that an organization must have a learning culture to reap the full benefits of SCMP adoption. Additionally, although it has been widely recognized that the effects of implementing SCMPs will be amplified through the interaction between these practices, most investigations tend to deal with the influence of practices in isolation rather than collectively [37]. These learning curves and synergetic effects led to the inclusion of the extent of SCMP adoption into the proposed research framework, thus reflecting the breadth (number of SCMPs used) and depth (the degree of their usage).

After establishing the evolutionary character of SCMPs as a fundamental premise of the conceptualization of their adoption, the related construct was operationalized. The holistic approach in evaluating the aggregated impact of SCMP adoption on hospital cost performance guided the creation of a composite index. The use of composite indices is increasingly popular among academics as they meet the need for consolidation, aggregating various indicators into a sole number that encompasses and summarizes a plethora of available information [38]. Therefore, the extent of SCMP adoption was operationalized by constructing an index representing a weighted sum of the practices that a hospital would report as being implemented. Measurement items for each of the eight SCMP clusters were identified to capture its adoption's depth and intensity adequately. For the assignment of an aggregated SCMP adoption score to a hospital, the Saidin index methodology was applied, which has been suggested by Spetz and Baker [39] for evaluating hospital technology adoption. The Saidin index is calculated as the weighted sum of the eight SCMP clusters, with each cluster's weight being the percentage of hospitals that do not apply this cluster. Thus, rare SCMPs receive higher weights than common ones, leading to higher Saidin index scores for hospitals that are front runners in the path toward increased SCMP adoption.

$$s_i = \sum_{k=1}^{K} (a_k \tau_{i,k}) \qquad \text{where} \qquad a_k = 1 - \frac{1}{N} \sum_{i=1}^{N} (\tau_{i,\,k}) \tag{1}$$

where s_i is the Saidin index for hospital i, K is the number of SCMP clusters, a_k is the weight of SCMP cluster k, $\tau_{i,k} = 0$ if SCMP cluster k is not adopted in hospital i, else = 1, and N = the number of hospitals.

Table 1 reports the Saidin index weightings calculated for each SCMP cluster as part of the data analysis phase. The weighted scores of these eight clusters were added according to the Saidin index logic to form an SCMP adoption index (SCMP AI), which represents the extent of their adoption in the supply chain processes of a hospital. Similar approaches for measuring the technological breadth of companies have been followed by other scholars, albeit based on simple aggregated indices without weighting mechanisms for the technologies under consideration [36,40].

2.2. Technological Context of a Hospital's Adoption of SCMPs

In the conceptual framework, the technological aspect is defined by the hospital's readiness, which includes the IT infrastructure, IT expertise, and IT system integration [41]. The IT infrastructure provides a foundation for implementing SCMPs, while IT expertise involves the knowledge and skills to execute these practices. Additionally, IT system integration facilitates SCMPs by connecting different systems and applications to work as a cohesive whole [42]. Studies have shown that organizations with advanced IT infrastructure and skilled IT resources are more likely to successfully implement technology innovations [43]. Furthermore, research suggests that IT system integration can improve organizational performance by streamlining operations, enhancing customer service, and generating cost savings [44], and it can also increase compatibility with other technologies [45]. Consequently, technological readiness is a significant determinant of IT adoption, as noted in several empirical studies [36,46]. Thus, it is proposed that a hospital's technological readiness, influenced by IT infrastructure, IT expertise, and technology integration, positively impacts the extent of SCMP adoption in its supply chain.

Hypothesis 1 (H1). *Technological readiness positively impacts the extent of SCMP adoption in hospitals.*

2.3. Organizational Context of a Hospital's Adoption of SCMPs

Several organizational factors have been proposed to affect the adoption of innovation and technology. Among them, organizational readiness is a commonly researched factor that indicates an organization's internal capacity to embrace new technologies [47]. The organization's culture impacts organizational readiness as well as the organization's disposition toward change. Organizational readiness can also be affected by the presence of proficient, informed, and adequately trained personnel with regard to new technologies [48]. Resources with better information systems knowledge are likely to use these systems more extensively, thus increasing the chances of adopting new technologies. Consequently, adoption may depend not only on the skill level of an organization's IT professionals, which reflects the organization's IT expertise but also on the ability and confidence of other employees tasked with operating the new technologies. Finally, in many studies examining the adoption of IT, top management support and commitment are viewed as another vital aspect of organizational readiness. Such support is critical in securing sufficient resources and overcoming any internal barriers or resistance to change within the organization [49].

Therefore, it was assumed that the extent of SCMP adoption is impacted by a hospital's organizational readiness, which comprises (1) pro-innovation organizational culture, (2) resources that are skilled and educated on new technologies, and (3) top management support.

Hypothesis 2 (H2). *Organizational readiness positively impacts the extent of SCMP adoption in hospitals.*

In the context of technology adoption, organizational size is often studied as a variable that can impact the adoption of new technologies [50]. Despite numerous studies, a definitive agreement has not been reached regarding the correlation between organization size and innovation. According to some studies such as Zhu and Kraemer [42] and Oliveira and Martins [41], smaller organizations are believed to have more agility and fewer bureaucratic hindrances, leading to increased innovation. Conversely, other studies, such as Hung et al. [51] and Pan and Jang [46], argue that larger organizations have more financial resources at their disposal, which they can invest in new technologies and take on associated risks. However, they may face more significant challenges due to their size and complexity. For instance, employees may resist change, and decision making may be more centralized and bureaucratic, making it harder to implement SCMPs quickly. Moreover, larger organizations may require more significant investments due to the costs of implementing SCMPs across multiple locations and departments. Additionally, the impact of SCMP adoption on larger organizations may have a more significant ripple effect. Their implementation may require changes to existing processes, which can be more complex in a larger organization with more interconnected systems and processes. Considering the conditions under which Greek public hospitals operate, it is anticipated that the extent of SCMP adoption is positively impacted by a hospital's size, which is often determined by the number of beds [52].

Hypothesis 3 (H3). *Hospital size positively impacts the extent of SCMP adoption.*

2.4. Environmental Context of a Hospital's Adoption of SCMPs

The environmental context pertains to external parameters that impact the business operations of an organization. In various studies on innovation, environmental factors have been identified as crucial in understanding the decision-making process in the adoption of new technologies [53]. The proposed research concentrates on two critical external variables for implementing SCMPs in healthcare institutions: influence from business partners and government policies. Although TOE-based studies often consider competitive pressure as an environmental factor, it was not incorporated into the model for this study's specific context, as public hospitals operate in a nonmarket environment [54].

Environmental factors, such as the influence of external stakeholders, can impact an organization's technology adoption decisions. For instance, a partner in a business relationship may recommend or even exert pressure on their counterparts to adopt certain technologies. A characteristic example is the impact of suppliers on EDI technology adoption, as organizations adopting EDI attempt to influence their business partners to do the same to increase their own benefits of adoption [55]. The literature has also provided evidence regarding business partner influence on the adoption of e-procurement technologies [43]. Even in the case where an organization is the initiator of new technology adoption, this process might be impacted by the level of its business partner readiness, as compatibility between systems along the supply chain is crucial for integration beyond the walls of an individual organization [56]. Conversely, a lack of business partner readiness may present a significant barrier to technology adoption.

Viewing these aspects from a healthcare sector-specific angle, it is noteworthy that suppliers have been traditionally viewed as adversaries rather than business partners. Many healthcare providers confine their supply chain improvement efforts to pressuring their suppliers for price reductions [57]. However, as more studies on healthcare supply chains are published, healthcare providers are becoming more aware of the fact that the old rules of business are changing and that more supply chain collaboration with combined efforts between hospitals and their suppliers leads to mutual benefits [58]. Therefore, it is reasonable to assume that business partner readiness positively impacts the extent of SCMP adoption in a hospital's supply chain processes.

Hypothesis 4 (H4). *Business partner readiness positively impacts the extent of SCMP adoption in hospitals.*

Government influence constitutes another important environmental aspect that can encourage the adoption of technologies [59], as governments can provide incentives or, in the case of public entities, even mandate technology adoption. The regulatory environment and governmental institutions can, in some cases, have more influence than the markets and can impact the adoption of innovations via the government's ability to promote specific technologies. The literature provides empirical evidence regarding government influence on adopting new technologies across business sectors [36,49]. Lee and Jung [60] argue that government-driven policies impact the adoption of new technologies such as EDI, especially in European countries where the size of the policy effect is much bigger compared to developing countries. They imply that governmental policy can play a critical role even in developed countries such as the UK, where the government has strongly pushed firms into adopting new technologies such as RFID [61]. Especially for the healthcare sector, it is imperative to study whether governmental policies encourage or even dictate the adoption of new technologies, as it is considered one of the most regulated sectors. Given that governments try to contain rising healthcare costs and supply chains are known to account for a large portion of these costs, it is anticipated that government policies can play a significant role in adopting SCMPs in healthcare settings.

Hypothesis 5 (H5). *Government policies positively impact the extent of SCMP adoption in hospitals.*

2.5. Perceived Benefits as an Influencing Factor for the Extent of SCMP Adoption in Hospitals

In conventional innovation literature, perceived benefits, which are often referred to as "relative advantage," pertain to the expected benefits that can be gained from the adoption of technologies within an organization [62]. Empirical studies, as cited by Oliveira and Martins [41], confirm that a favorable perception of the benefits of technology can serve as an incentive for its implementation. Furthermore, perceived benefits are expected to play a key role in overcoming SCMP adoption barriers since implementing their underlying technologies requires technical and organizational competencies [63]. Perceived benefits are associated with both direct and indirect benefits of SCMP adoption. Direct benefits encompass the operational savings that can be achieved, such as inventory cost reductions which are easier to identify and have an immediate effect. Indirect benefits may need more time to be visible as they represent opportunities derived from the impact of SCMP adoption in a hospital's business processes, such as the improvement of patient safety and quality of care.

While a few studies have included perceived benefits within their technological or organizational constructs, this research adopted the approach of other researchers such as Oliveira and Martins [41] and Gibbs and Kraemer [14], who have used separate constructs to represent perceived benefits. This seems plausible considering they are distinct from other factors as they stem from the personal beliefs of decision makers rather than being based on the organization's characteristics. Furthermore, although the construct of perceived benefits has been operationalized in various ways across different studies, it has consistently been found to be a determinant of technology adoption [48,64]. As a result, the following hypothesis is proposed.

Hypothesis 6 (H6). *Perceived benefits positively impact the extent of SCMP adoption in hospitals.*

2.6. Effect of the Extent of SCMP Adoption on the Cost Performance of Hospitals

Apart from studying the determinants and mechanics of SCMP adoption in hospitals, their impact on hospital performance is also investigated. The challenge of establishing a connection between technological innovations and an organization's performance is a long-standing issue. Concerning the healthcare sector, in particular, many researchers have emphasized the need for empirical proof regarding the correlation between technology implementation and hospital performance [65]. Existing studies, however, yielded mixed results, ranging from positive impact [66] to minimal or even negative effect [67]. According to Sharma et al. [68], these conflicting findings can result from the focus on single technologies and the integration of hospital performance metrics, such as readmission and mortality rates, which can be influenced by various patient characteristics.

A holistic view of SCMP adoption is followed to overcome these limitations and to create a composite index to investigate their aggregated impact, as previously outlined. A firm-level performance measure was used that is not associated with patient characteristics. Given the worldwide shift toward decreasing healthcare costs and fiscal policies that seek to cut public healthcare spending, the proposed research concentrated on hospital cost performance. The hospital cost-function literature contains various empirical models and different methodological approaches for evaluating cost performance. Some scholars use the operating costs incurred by a hospital divided by its number of beds as a metric [68], while others choose to base their cost assessment on a per-admission or per-capita basis [69]. To operationalize the cost performance of Greek public hospitals, the average cost per patient day was calculated. For this purpose, a database containing data from Greek public hospitals was accessed through the Greek Ministry of Health business intelligence health portal [70]. As the adoption of SCMPs is expected to improve hospital cost performance, a greater extent of SCMP adoption should be linked to a lower average cost per patient day. Therefore, the final hypothesis was postulated:

Hypothesis 7 (H7). *Hospital cost performance is positively impacted by the extent of SCMP adoption in hospital supply chains.*

The theoretical model and the corresponding hypotheses are illustrated in Figure 1. The related literature was thoroughly studied, considering methodological aspects and addressing issues such as endogeneity and common method bias. Attempting to lessen possible endogeneity concerns beforehand, the model was built by adapting well-known theoretical frameworks, as many prestigious research studies have validated their contextual soundness. The application of established frameworks, even more so, a synthesis thereof, lessens the possibility of omitting important model variables, perhaps the most common source of endogeneity problems [71]. The second methodological aspect of common method bias was addressed as part of the data collection process described in the following section.

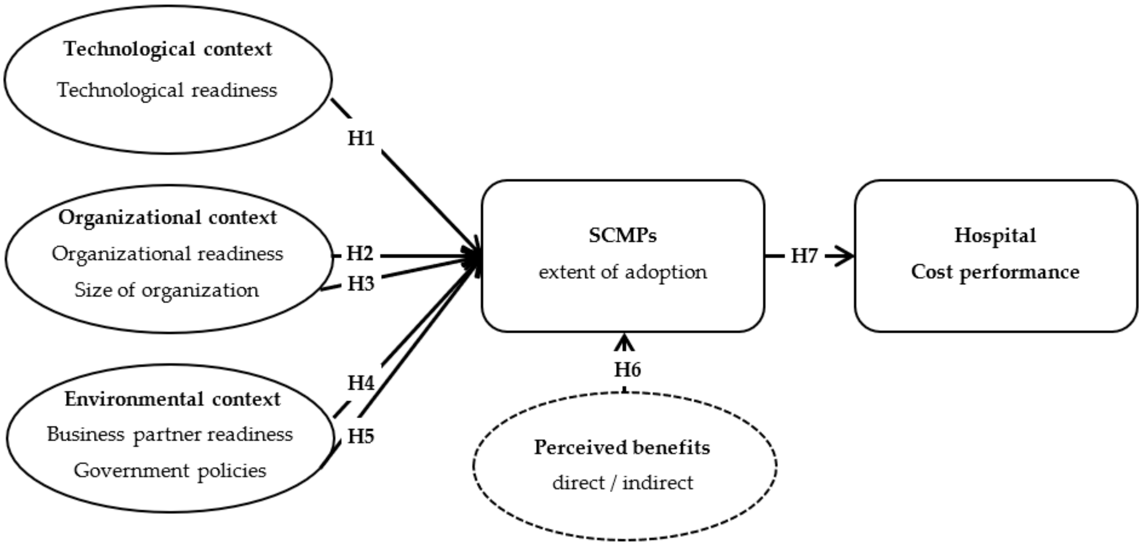

Figure 1. Theoretical research framework.

3. Research Methodology

To test the hypotheses, the commonly used survey research approach was employed to gather the necessary primary data. A questionnaire consisting of four parts was developed. The first part relates to demographic information, such as the role of the participant in the organization, the type of the organization (public/private), and the hospital's size. The latter was determined based on the number of beds by applying a classification used in reports of the Greek Ministry of Health (small: ≤100 beds, medium: 101 to 400 beds, and large: >400 beds). The second part includes the previously defined list of the eight SCMP clusters (Table 1) to evaluate the extent of their utilization on a 5-point Likert scale (from 1, "Not at all", to 5, "To a full extent"). To increase the survey's construct validity and reliability, the third part comprises several measurement items aimed at assessing the independent variables of the model. The survey items, as depicted in Table 2, represent manifestations of the related constructs, share a common theme, and dropping a measurement item does not alter the conceptual domain of its related construct. They were adapted from the literature in accordance with other technology adoption studies and were verified as part of a pilot test. Additionally, they were validated through confirmatory factor analysis (CFA) during the data analysis phase. The fourth part has a section to capture additional comments and remarks from the survey participants.

To ensure the questionnaire's face validity, it was tested and examined in four hospitals before the final data collection. Personal interviews were conducted with inventory and purchasing managers, who were asked to comment on the instrument's content, clarity, and scaling. Based on their feedback, some questions were rephrased to improve their clarity, and minor revisions were applied to the questionnaire. After sending out the questionnaire, the key informants of each hospital were contacted (in person or via phone) to guide them through the survey and provide further clarifications when needed.

Table 2. Measurement items, associated constructs, and their adapted sources.

	Construct	Adapted Sources for Constructs	Items	Item Descriptions
Technological context	Technological readiness	Lian et al. [72]	TR1	Sufficient IT infrastructure (HW/SW)
		Lumsden and Anabel [73]	TR2	IT resources with adequate expertise
			TR3	Level of integration of internal IT applications
		Hsu et al. [74]	TR4	IT system adaptability to new requirements
		Teo and Ranganathan [75]	TR5	Adequate use of ERP system
		Chau and Hui [13]	TR6	Level of spending on new technologies
			TR7	Integration capability with external systems
Organizational context	Organizational readiness	Oliveira et al. [76]	OR1	Organization's favorable attitude toward change
		Lian et al. [72]	OR2	Personnel competent with new technologies
		Teo and Ranganathan [75] Premkumar and Ramamurthy [77] Rogers [78]	OR3 OR4 OR5	Top management support Cross-departmental cooperation Regularity of personnel training
	Organization size (single item)	Hung et al. [51] Kimberly and Evanisko [79]	SIZE	Classification of hospitals based on the number of beds
Environmental context	Business partner readiness	Wang et al. [80]	BPI1	Business partners' capabilities
		Chau and Hui [13]	BPI2	Recommended by business partners
		Hsu et al. [74]	BPI3 BPI4	Requested by business partners Cooperation level with business partners
	Government policies	Oliveira et al. (2014)	GPI1	Supported by government policies
		Lian et al. [76]	GPI2	Mandated by government policies
		Chau and Hui [13] Low et al. [81] Crow [82]	GPI3 GPI4	Sufficient regulatory environment Government incentives
Perceived Benefits	Perceived benefits	Low et al. [81]	PB1	Reduced supply chain costs
	(direct & indirect)	Wang et al. [80]	PB2	Improved supply chain process efficiency
		Arunachalam [83]	PB3	Improved quality of care
		Iacovou et al. [64]	PB4	Other resulting indirect benefits

Note: All items except SIZE were measured using a 5-point Likert scale.

Out of 179 questionnaires sent (125 to public and 54 to private hospitals), 115 were returned (107 from public and 8 from private hospitals), including 4 incomplete questionnaires, which were discarded. Thus, 111 useful questionnaires were obtained, exceeding initial expectations. Due to the low response rate of private hospitals, it was decided not to include them in the current study. Additionally, after calculating the average cost per inpatient day, three hospitals were excluded from further analysis due to the strikingly low values they yielded, which were attributed to their distinctive character (mental health clinics).

Although using single respondents for organization-level studies is widespread among empirical studies, there are known common method bias issues associated with this approach, as already indicated [84]. To lessen possible concerns, Harman's single-factor technique was applied as it is a widely used statistical remedy designed to control for common method variance. The analysis revealed five factors that accounted for 72.52% of the variance, with the initial factor accounting for 32.19%. As no single factor occurred and none of the factors accounted for most of the variance, the use of a single data collection method appeared to be an acceptable risk based on this method [85]. Bearing in mind that there are some serious problems inherent in the use of this technique [71], it was additionally attempted to address these issues ex ante by (1) providing written instructions for the respondents, directing them to confine their responses to the context of the study and to respond as key informants for the hospital except when they were explicitly asked for their personal views, (2) assuring respondents of the study's anonymity and confidentiality, that there are no correct or incorrect answers, and that they should provide their responses as truthfully as possible, (3) ensuring that individual items are formulated as concisely as possible and avoiding ambiguous, vague, and unfamiliar terms, (4) mixing the order of questions relating to different constructs, and (5) using a different source of information for the dependent variable of cost performance.

Once data were collected, the mean of all measured variables between early and late respondents was compared to investigate the possibility of nonresponse bias. This analysis was conducted under the premise that late respondents are more similar to non-respondents than to early respondents [86]. However, no statistically significant differences were found, implying that nonresponse bias was not a concern for this study.

4. Data Analysis and Results

To ensure the content validity of the survey instrument, a literature review, interviews with subject matter experts, and pilot tests were conducted before data collection. Following data collection, structural equation modeling (SEM) was utilized to analyze the data, using the AMOS 22.0 software [87]. The measurement and structural components were evaluated through a two-step approach recommended by Anderson and Gerbing [88]. Because the constructs of interest cannot be perfectly observed, employing SEM allowed us to address the common problem of measurement errors [89]. This could be achieved through an observed and latent variable structure, simultaneous calculation of model parameters, and a test of the model's overall fit to the data while paying attention to the chi-square statistic [90]. To confirm the conceptual validity of the latent variables employed in the structural model, the multiple measurement items for each latent variable underwent a confirmatory factor analysis (CFA) [91].

Establishing the reliability of the underlying constructs was essential for the validity of the final data analysis results. Therefore, CFA was employed to assess the variables and the hypothesized path relationships of the model and to test reliability and unidimensionality, as suggested by Hair et al. [92]. For this purpose, the individual measurement items were mapped to the latent variables representing the constructs of the proposed model. CFA is considered a rigorous method for assessing validity, requires fewer assumptions than traditional methods [93], and helps establish unidimensionality of the indicators [88], meaning that a set of measurement items measures only a single construct. Maximum likelihood was used as the estimation method, as several studies have shown that it outperforms other estimation methods, such as the generalized least squares or asymptotically distribution-free methods, even in the case of non-normality of data [94].

4.1. Measurement Model Results

The analysis led to the removal of several items from individual constructs, and the final measurement model consists of five latent variables, each measured by multiple indicators (Table 2). The χ^2 of the model was calculated as 83,758, with 80 degrees of freedom. The resulting model fit statistics for the measurement model are reported in Table 3. As recommended by Hair et al. [92], both absolute indices and incremental indices were calculated to assess the goodness of fit of the hypothesized model to the covariance matrix obtained from the sample data, as well as the benefits it provides over the worst-case model. While one of the incremental fit indices, the NFI, falls slightly below the conventional levels, all other incremental indices exceed the recommended thresholds, as shown in Table 3. Therefore, the results of the measurement model indicate satisfactory absolute and incremental measurement model fit, according to Hair et al. [92]. Moreover, the calculated model fit indices are comparable to those of other SCM studies [6,95,96], further indicating unidimensionality, reliability, and model acceptability.

Table 3. Goodness-of-fit measures for the measurement model.

Goodness-of-Fit Indices	Recommended Value (Source)	Measurement Model Result
Absolute fit		
χ^2/df Chi-square/Degrees of freedom	<3.00 (Jöreskog and Sörbom) [97]	1.047
GFI Goodness-of-Fit Index	>0.90 (Jöreskog and Sörbom) [97]	0.901
AGFI Adjusted Goodness-of-Fit Index	>0.85 (Jöreskog and Sörbom) [97]	0.851
RMSEA Root Mean Square Error of Approximation	<0.05 (Steiger) [98]	0.022
Incremental fit		
IFI Incremental Fit Index	>0.95 (Hu and Bentler) [99]	0.993
NFI Normed Fit Index	>0.90 (Byrne,) [100]	0.864
TLI (NNFI) Tucker Lewis Index	>0.95 (Hu and Bentler) [99]	0.990
CFI Comparative Fit Index	>0.95 (Hu and Bentler) [99]	0.993

After evaluating the measurement model's fit, an assessment of construct validity and reliability, particularly regarding convergent and discriminant validity, was conducted. The results (Table 4) confirmed the reliability and convergent validity of each factor, with construct reliabilities surpassing the generally recommended threshold of 0.70 [88], and average variances extracted (AVE) exceeding the suggested threshold of 0.50 [101], thus reflecting that more than half of a factor's variance is attributable to its measurement items. All of the measurement items that were retained in the study displayed significant factor loadings well above 0.7, with only two items falling slightly below, at 0.678 and 0.679. This result further confirms the convergent validity of the study, as even the items with lower factor loadings exceeded the threshold of 0.5 for reliable measurement recommended by Hair et al. [92]. The presence of discriminant validity was also confirmed by applying Fornell and Larcker's [101] suggestion, which involved ensuring that the inter-factor correlations were smaller than the square root of the average variance extracted for each factor. These findings suggested that the analysis utilized a clearly defined factor structure and that the established constructs were suitable for assessing the conceptual model and the corresponding hypotheses.

Table 4. Construct reliabilities (CR), average variances extracted (AVE), and inter-factor correlations.

	CR	AVE	TR	OR	BR	PB	GP
TR	0.829	0.618	**0.786**				
OR	0.749	0.508	0.589	**0.713**			
BR	0.754	0.511	0.127	0.369	**0.715**		
PB	0.768	0.529	0.059	0.104	0.411	**0.727**	
GP	0.849	0.654	0.602	0.554	0.410	0.368	**0.809**

Note 1: Diagonal elements (in bold) are the square root of the average variance extracted (AVE). Off-diagonal elements are the inter-construct correlations. Note 2: **TR** = technological readiness; **OR** = organizational readiness; **BR** = business partner readiness; **PB** = perceived benefits; **GP** = government policies.

4.2. Structural Model Results

Upon obtaining a positive evaluation of the measurement model, the seven hypotheses were tested by examining the structural model and by computing its absolute and incremental indices. The results demonstrated that all of the fit indices for the structural model fell within the acceptable ranges (Table 5), indicating that the proposed model is a good fit for the data. Given these findings, no post hoc modifications were made to the model.

Table 5. Goodness-of-fit measures for the structural model.

Goodness-of-Fit Indices	Recommended Value (Source)	Structural Model Result
Absolute fit		
χ^2/df Chi-square/Degrees of freedom	<3.00 (Jöreskog and Sörbom) [97]	1.108
GFI Goodness-of-Fit Index	>0.90 (Jöreskog and Sörbom) [97]	0.984
AGFI Adjusted Goodness-of-Fit Index	>0.85 (Jöreskog and Sörbom) [97]	0.904
RMSEA Root Mean Square Error of Approximation	<0.05 (Steiger) [98]	0.033
Incremental fit		
IFI Incremental Fit Index	>0.95 (Hu and Bentler) [99]	0.997
NFI Normed Fit Index	>0.90 (Byrne) [100]	0.966
TLI (NNFI) Tucker Lewis Index	>0.95 (Hu and Bentler) [99]	0.982
CFI Comparative Fit Index	>0.95 (Hu and Bentler) [99]	0.996

The hypotheses test results are presented in Table 6 and visualized in Figure 2. They confirm the first hypothesis (γ = 0.22, t = 2.069, and p < 0.05), providing evidence that technological readiness positively affects the extent of SCMP adoption in hospitals. Similarly, they confirm the second hypothesis (γ = 0.27, t = 2.721, and p < 0.01), demonstrating that organizational readiness positively affects the extent of SCMP adoption in hospitals. They also confirm the third hypothesis (γ = 0.16, t = 2.052, and p < 0.05), suggesting that organizational size positively affects the extent of SCMP adoption in hospitals. The fourth hypothesis, however, was not confirmed (γ = 0.09, t = 1.076, and p = 0.282), indicating that business partners do not have a significant effect on the extent of SCMP adoption in hospitals. Similarly, the fifth hypothesis was not confirmed (γ = 0.06, t = 0.640, and p = 0.522), indicating that government policies do not have a significant effect on the extent of SCMP adoption in hospitals. The sixth hypothesis was confirmed (γ = 0.17, t = 2.040, and p < 0.05), indicating the positive effect that perceived benefits have on the extent of SCMP adoption in hospitals. Support was also found for the seventh and final hypothesis (γ = 0.44, t = 4.931, and p < 0.001), demonstrating that the extent of SCMPs adoption in hospitals significantly affects hospital cost performance in a positive way (negative signs for γ and *t*-values were reversed due to the inverse relationship between cost performance and cost per patient day).

Table 6. Results of hypotheses.

Hypotheses	Path from	Path to	r^2	*t*-Value	Path Coeff.	*p*-Value	Supported
H1	Technological readiness	The extent of SCMP adoption	0.396	2.069	0.22 *	0.039	Yes
H2	Organizational readiness			2.721	0.27 **	0.007	Yes
H3	Organization size			2.052	0.16 *	0.040	Yes
H4	Business partner readiness			1.076	0.09	0.282	No
H5	Government policies			0.640	0.06	0.522	No
H6	Perceived benefits			2.040	0.17 *	0.041	Yes
H7	SCMP extent of adoption	Hospital cost performance	0.197	4.931	0.44 ***	<0.001	Yes

Note: * p < 0.05, ** p < 0.01, and *** p < 0.001.

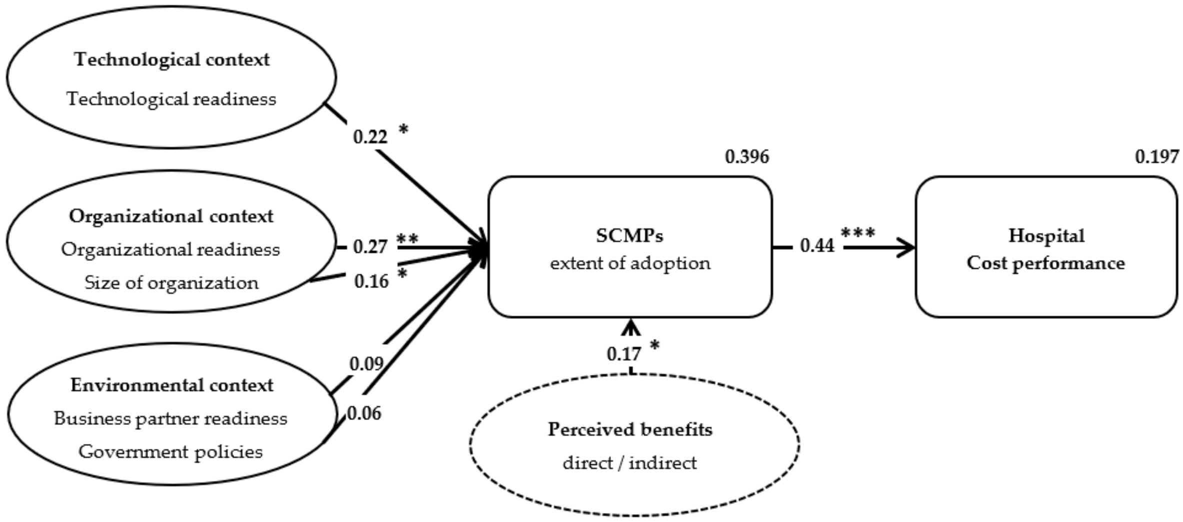

Figure 2. Structural model results with path coefficients. Notes: The exogenous variables were freed to correlate with one another. Values are standardized. * $p < 0.05$; ** $p < 0.01$; and *** $p < 0.001$.

These findings suggest that the research model has a substantial capacity to explain the phenomenon under investigation. Specifically, the r^2 values illustrate that technological readiness, organizational readiness, organizational size, and perceived benefits collectively account for 40% of SCMP adoption in hospitals. Moreover, the results indicate that 20% of hospital cost performance can be attributed to the adoption of SCMPs. These findings bear significant implications, which will be addressed in the conclusions section.

4.3. Endogeneity and Robustness

Recent literature on statistical modeling stresses the importance of addressing the endogeneity dilemma, as it can pose serious threats to the credibility of research findings [71]. As noted by Antonakis et al. [90], the two-stage least squares (2SLS) estimation stands out as a robust and versatile methodology for addressing endogeneity concerns in research. Its effectiveness extends to mitigating issues stemming from omitted variables, measurement error, simultaneity, and common method bias. Consequently, a two-stage least squares (2SLS) estimation procedure was conducted with a focus on the relationship between the extent of SCMP adoption and cost performance. This relationship goes beyond the boundaries of TOE-based frameworks, which have been validated by many previous research studies. The results of the 2SLS regression revealed that the predicted variable of SCMPs adoption has a statistically significant relationship with cost performance ($p < 0.01$), thus verifying the stability of evidence regarding potential endogeneity bias stemming from reverse causality and omitted variables [90]. Considering that it is infeasible to rule out endogeneity completely, the efforts in addressing this topic increase the confidence that the variables in question can be regarded as plausibly exogenous, as suggested by Conley et al. [102].

To further increase confidence in the validity of research findings, possible sources of bias were examined. Due to using a survey for data collection purposes, common method bias is a cause of concern. It could threaten the empirical findings, particularly in cases where information on independent and dependent variables is gathered using the same source [90]. This issue was addressed by acquiring secondary data from an alternative source to evaluate hospital cost performance rather than solely relying on subjective estimates from the hospital's key informants. Besides providing more detailed analysis, this also reduces the risks of potential informant bias and random errors, as the measures of the hospital's cost performance construct are objective [103].

Finally, to further increase the findings' robustness, the model was evaluated based on two variations. Firstly, following other scholars' approaches [104], the model was re-tested using one-year lagged values for the endogenous variable of hospital cost performance. The nature of the determinants of SCMP adoption, which decreases the chances of drastic changes and the associated procurement cost and implementation time of their underlying technologies, allow us to hypothesize that lagged values of cost performance are correlated with a hospital's SCMP adoption. Secondly, the SCMP AI was calculated by adding the scores of the individual SCMP clusters without using a weighting mechanism such as the previously outlined Saidin index logic. A non-weighted score ranging from 8 (no adoption of any SCMPs cluster) to 40 (full depth of adoption of all SCMPs clusters) was formed for each hospital, representing the extent of its SCMP adoption. In both cases, the data analysis yielded results consistent with the primary analysis. The model goodness-of-fit statistics continued to exceed the acceptable thresholds, and the supported hypotheses stayed robust regarding direction and significance. Hence, further support was provided for the overall robustness of the empirical findings.

5. Conclusions

The results of this study signify the importance of SCMPs in driving hospital cost performance, which is highly relevant for theory and practice. The data analysis also confirms the core TOE technological and organizational relationships and the hypothesized impact of perceived benefits on the aggregated adoption of SCMPs, creating an in-depth understanding of the phenomenon and tools for managerial action.

5.1. Scholarly Implications

From a theoretical standpoint, this study aimed at developing a holistic framework to enhance understanding of the contextual drivers of SCMPs within the downstream element of the healthcare supply chain, ultimately driving improvements in operational cost performance. In this context, it offered several meaningful insights and theoretical contributions. Firstly, it is one of the few studies empirically examining hospital SCMPs using a business performance lens. Despite increasing regulatory pressures for healthcare providers to improve the efficiency and effectiveness of their operational practices, especially their supply chains, there has been a dearth of empirical work within this domain [105]. To contribute toward filling this gap, this study aimed at advancing the current understanding of the contextual factors driving the adoption of SCMPs and their performance outcomes in hospitals.

Secondly, although SCMPs are considered key factors driving supply chain and overall organizational performance, there needs to be more research that has employed appropriate theoretical lenses to test such relationships empirically. Therefore, this study examines SCMPs and their impact by developing and applying a conceptual framework that approaches SCMP adoption and the resulting cost performance via the established theoretical perspective of the TOE model along with the concept of perceived benefits. The proposed synthesized model attempts to address some weaknesses of technology adoption models. It differs from other frameworks as it (a) expands existing models by adding new constructs, (b) includes organizational traits as well as personal beliefs aspects, (c) incorporates elements of organizational performance, and d) is adapted to the healthcare context. The results of the data analysis lend support for this synthesized TOE-based framework in explaining the determinants of SCMP adoption in hospital supply chains and their impact on cost performance.

Additionally, the present study significantly contributes to the body of SCM and technology adoption research by expanding the current knowledge frontier and introducing an integrated approach that goes beyond the traditional orientation on single technologies. Previous studies examine determinants of adoption by concentrating primarily on specific technologies and vary their research goals by focusing on different business sectors and countries. To facilitate richer analysis, we take an integrated view (1) by investigating the full spectrum of technologies used to enable and support SCMPs and (2) by evaluating their aggregated impact on performance. Adopting specific technologies, although essential and linked to performance improvements, as demonstrated in many cross-country and cross-industry studies, they cannot lead to reaping the full benefits if it remains isolated. Using EDI technology as an example, adopting it in business transactions with partners can offer obvious benefits. However, to fully exploit its potential in achieving an organization's business goals, it needs to be complemented by optimal replenishment strategies, improved accuracy in demand forecasting, data segmentation, and supplier evaluation. Thus, the answer to realizing the full benefits of SCMPs may lie in following an integrative approach in their implementation. Embracing this point of view, a focus was placed on a comprehensive set of SCMPs in conjunction with their underlying technologies. Hence, the present study advocates a shift in this research domain to embrace a more holistic view of technology adoption to understand better how performance can be improved, thereby enriching the literature on the business value of SCM.

Another distinct aspect differentiating this study from most technology adoption studies is that it focuses on the extent of adoption rather than approaching adoption as a dichotomous (yes/no) variable. Simply investigating whether an SCMP has been implemented decreases the informative value of studying its effects, as there can be significant variations on how extensively it is used. Hence, this study contributes to the literature by exploring the factors linked with both the adoption of SCMPs as well as the extent of their usage. This motivates other scholars to explore beyond simply adopting technology by delving deeper into its evolutionary process.

5.2. Managerial Implications

Concerning practitioners and hospital supply chain stakeholders in particular, a major contribution is that the proposed research provides empirical evidence of the cost benefits resulting from SCMP adoption. The evidenced impact on organizational-level performance is important because hospital managers, such as managers of other organizations, have to demonstrate the value obtained from the application of SCMPs and the underlying technology investments. It implies that the rising hospital supply chain costs, which constitute a considerable proportion of the overall cost of care, can be mitigated by implementing a full array of SCMPs in their supply chains. Thus, hospital management can better justify the investment in SCMPs and their enabling technologies, which are often neglected as they compete with investment in clinical technologies.

From a practical perspective, research findings have several other implications for supply chain executives, hospital top management, inventory managers, procurement managers, financial managers, pharmacists, and healthcare practitioners. While certain organizations recognize the significance of implementing SCMPs, they often do not know what to implement due to a lack of understanding of what constitutes a comprehensive set of these practices [106]. It is essential to identify the applicable SCMPs in healthcare settings, as they operate in a highly unique and complex environment, requiring business practices to be carefully tailored to fit with targeted outcomes and within given organizational contexts. Drawing on this necessity, the study identifies SCMPs applicable to hospital supply chain operations and classifies them into suitable clusters. Findings suggest that healthcare managers should develop congruent operations strategies rather than concentrate on single decision areas and technologies as a key to improving a hospital's efficiency and performance. They should approach their supply chain with an integrated view, encouraging collaboration between the organization's functional areas and external partners. This ensures that these entities do not act as silos, as this causes data and information necessary for efficient business operations to be fragmented. Hence, a key contribution of the study is that it shifts the focus of SCMPs from functional to integrative, which encourages hospital executives to view them as a strategic asset that can be leveraged to meet operational and financial performance imperatives.

To fully exploit the abovementioned opportunities, valuable insights into technological and organizational aspects are highlighted. One central area of focus for managers charged with achieving superior results is the hospital's technological readiness. Investments in IT infrastructure need to be sought for the hospitals to be equipped with adequate hardware and powerful software applications, which act as critical enablers for the implementation of SCMPs. The integration of systems and applications should be a priority, as it allows for reaping the full benefits of this infrastructure. Equally important is the access to robust IT expertise, as this goes hand in hand with the increasingly complex customization requirements of state-of-the-art technological infrastructure. This can be achieved by enhancing the existing IT personnel's knowledge, hiring new IT professionals with the required skill set, or even outsourcing some of these functions to external specialists. These prerequisites for establishing technological readiness command a thorough understanding of the indispensable role of technology in SCMP adoption.

Another key finding is the elevated role of a hospital's organizational readiness, which has an even more significant impact on SCMP adoption than technological readiness. Efforts to enhance technological readiness will yield the anticipated results only if integrated within a culture of continuous learning and improvement. Therefore, hospital executives should promote a pro-innovation culture by encouraging suggestions for improvement, supporting learning processes, promoting current employee training programs, cultivating a solution-seeking mentality and practicing fast decision making, fostering trust and respect in employees. They might convene frequent sessions for solving problems and sharing information (formal and ad hoc) to reinforce transparency and collaboration between functional areas of the organization.

Top management support has been found to play a critical direct role in adopting SCMPs, implying managers must ensure the availability of sufficient financial and organizational resources, initiate related projects, provide active implementation support, and eliminate obstacles. Furthermore, personnel's attitude toward change is another aspect of organizational readiness. Hospital executives must emphasize the beneficial effect of SCMPs on the processes and tasks performed by the hospital's personnel, and incentivize employees that are directly involved in their implementation. Hospital size constitutes an additional factor within the organizational pillar that affects SCMP adoption, implying there is no universal approach that can be applied to all hospitals. The aforementioned efforts are more likely to be fruitful if adapted to the different organizational contexts, and the specific conditions met in small and large hospitals.

Furthermore, the findings of the present study indicate that hospital managers should rely on something other than external factors to impact SCMP adoption. Business partners and governmental policies might influence the adoption of a specific subset of SCMPs. However, no significant impact on the extent of their overall adoption could be confirmed. This should motivate hospital managers and suppliers to fill this gap by fostering relationships of collaboration and trust, which are positively linked with supply chain performance and can be enabled through knowledge exchange [105].

Additionally, the significant influence of perceived direct and indirect benefits implies that technology vendors should engage in more focused and substantial marketing efforts to enable hospitals to comprehend the advantages of adopting SCMPs. Moreover, given their position as key stakeholders in public health, the government, top management of healthcare institutions, and the research community should collaborate on targeted actions aimed at promoting awareness of SCMPs. A better comprehension of their potential benefits on hospital performance, and better knowledge of the technologies involved may lead to faster, broader, and deeper SCMP adoption.

In conclusion, the time has come for hospital executives to view SCM as a strategic asset and make the supply chain an integral part of their organization.

6. Limitations and Future Research

Difficulty in collecting data from hospitals in Greece is the reason for some of the study's limitations. Although the largest fraction of public expenditure in the Greek healthcare sector is directed toward hospital care, no centralized systematic data collection on important qualitative and quantitative KPIs is taking place. Many hospitals were reluctant to provide data that could be used for benchmarking as they are part of the Greek public sector which is known for its inherent inefficiencies. Data collection was often slowed down by bureaucratic procedures or was impossible due to the unavailability of data of interest, such as hospital case mix indices and data related to the quality of care. The case mix index (CMI), a relative value assigned to a diagnosis-related group (DRG), reflects the diversity and clinical complexity of cases treated in a hospital and would enable a more detailed level of cost performance evaluation by including case mix adjusted costs in the calculations. Moreover, the availability of data related to hospital quality performance would facilitate investigating their relationship to SCMPs. This would allow us to examine whether SCMP adoption positively impacts the quality of care.

Another limitation of the study was that the environmental construct was not found to play a significant role in SCMP adoption. This finding contrasts the theoretical expectations of the TOE framework, which suggests that the environmental context can influence the adoption of SCMPs. One possible explanation could be that our sample consisted of organizations that were similar in terms of their industry and geographical location, which may have limited the variability in the environmental context. Therefore, future research could benefit from applying the same methodology across various industries and geographical locations to determine whether the environmental context can be validated as a significant factor in adopting SCMPs.

Finally, as with any research study examining relationships among variables, it is impossible to eliminate endogeneity and common method bias limitations completely. One limitation of the study was the use of Harman's single-factor technique to control for common method variance, which has been criticized for its lack of precision [71]. To lessen these concerns, a different source of information was used for the dependent cost performance variable. Moreover, potential impacts were tested as part of a post hoc analysis of the data. Consequently, a study of compelling robustness was presented, which is expected to stimulate further interest in exploring the business value of SCMP adoption.

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