Leveraging Enterprise Resource Planning (ERP) Systems for Productivity Enhancement in Small-Medium Pharmaceutical Enterprises

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Abstract

In the contemporary business landscape, marked by intense competition, organizations continually seek innovative strategies to elevate efficiency and achieve heightened productivity. This quantitative research investigates the influence of cross-functional information sharing facilitated by Enterprise Resource Planning (ERP) system integration on productivity within typical small-medium pharmaceutical company. Grounded in the foundational framework of DeLone and McLean (1992), the study examines the intricate relationships between ERP system integration, cross-functional information sharing, and resultant productivity improvements. Data was primarily sourced from a survey administered across various departments within DAS Pharma Plc, to help the research explore the extent of ERP system integration, cross-functional information-sharing practices, and perceived productivity enhancements. The research findings hold significant implications for DAS Pharma Plc and the broader pharmaceutical industry, emphasizing the role of ERP systems in fostering effective communication and collaboration across organizational functions. The research also contributes empirically to both theoretical and practical knowledge as it attempts to explain the nuanced relationships between ERP system integration, cross-functional information sharing, and productivity enhancement. The insights gained offer strategic guidance for optimizing operations and attaining sustainable competitive advantages in the dynamic small-medium pharmaceutical sector.

Keywords
Enterprise Resource Planning, cross-functional information sharing, system quality, Service quality, productivity.

1. Introduction
The adoption of Enterprise Resource Planning (ERP) systems has become widespread across industries, particularly in the pharmaceutical sector. ERP systems integrate core business processes by offering real-time data and analysis for informed decision-making (Yen, Chou and Chang 2002). In the pharmaceutical industry (at the global level), these systems show promise in improving supply chain management as they streamline production and enhance decision-making (Madu and Madu 2003). Despite the global surge in ERP system usage and the inherent benefits, there remains a disparity in the system's implementation between developed and developing countries due to cost, awareness, and technical expertise (Bitsini 2015). Challenges such as regulatory complexity and data security concerns, especially in developing countries like Ghana, hinder seamless ERP integration (Kanulla 2021, Al-Debei and Al-Lozi 2012).

While ERP systems offer strategic advantages, many organizations (small-medium enterprises (SMEs) in the developing world face challenges in achieving the desired seamless integration. Thus, limiting cross-functional information sharing. Limited staff access results in intermittent data input that hampers collaboration (Nguyen et al. 2018). Despite the benefits that companies stand to gain in ERP system implementation, small-medium pharmaceutical companies appear to lag in this area in developing countries. The research problem, therefore, investigates if the integration of ERP system strategy could increase productivity in small-medium pharmaceutical company. The research employed the structural equation modelling (SEM) techniques to determine whether the implementation of an integrated ERP systems can improve cross-functional information sharing and a firm's productivity in a relatively small or medium enterprise (SME) such as the DAS Pharma Plc.

This research contributes to literature addressing the challenge of effective ERP integration, to boosting productivity through shared information in SMEs in the pharmaceutical industry. DAS Pharma Plc and the likes could derive a competitive edge over compatriots in the industry when ERP is effectively implemented. The research outcomes could provide actionable insights for other pharmaceutical companies, addressing similar challenges and improving productivity as the conclusion re-echoes the convergence between business management and IT, contributing to knowledge development.

1.1 Objectives
To examine how the implementation of ERP system affects productivity in SMEs in Ghanaian pharmaceutical industries.

2. Literature Review
Pharmaceutical companies, in their pursuit of increased productivity and efficiency, are turning to Enterprise Resource Planning (ERP) systems for enhanced cross-functional information sharing. The current literature review scrutinizes existing research on the use of ERP systems to augment productivity in the pharmaceutical industry. For instance, studies by Hunton et al. (2003) and Lippincott and Reck (2003) revealed higher productivity levels in companies implementing ERP systems compared to those without. Similarly, Beheshti and Beheshti (2010) found a positive association between ERP systems and productivity, especially in small organizations. Furthermore, the implementation of ERP systems has demonstrated its efficacy in facilitating cross-functional information sharing and improving productivity in various industries. For example, Li et al. (2017) showcased how such sharing enhanced supply chain efficiency in manufacturing sector, while Modgil and Sharma (2017) found improvements in project management efficiency in the pharmaceutical industry.

For industry specific cases at various location, Li et al. (2017) emphasized the significant enhancement of knowledge sharing through ERP systems in Chinese manufacturing firms. Alattas (2016) explored the impact of ERP systems on organizational performance in Saudi Arabian companies, noting improved cross-functional information sharing, better decision-making, and increased productivity in the industries studied. In the Ghanaian context, Owusu-Mainu et al. (2019) conducted a study on ERP adoption, highlighting the positive impacts on supply chain management and overall organizational performance. The authors concluded that ERP systems can facilitate cross-functional information sharing, enhance supply chain visibility, and improve productivity.

2.1 Theoretical Background
The DeLone and McLean Information Systems Success Model (D&M IS Success Model) (2003) version 2.0 underpins the theoretical framework for this research. Widely adopted since its update in 2003, this model includes dimensions like system quality, information quality, service quality, intention to use, use, user satisfaction, and net benefits. The model provides a comprehensive understanding of IS success over time through the incorporated dynamic feedback loops (Figure 1).
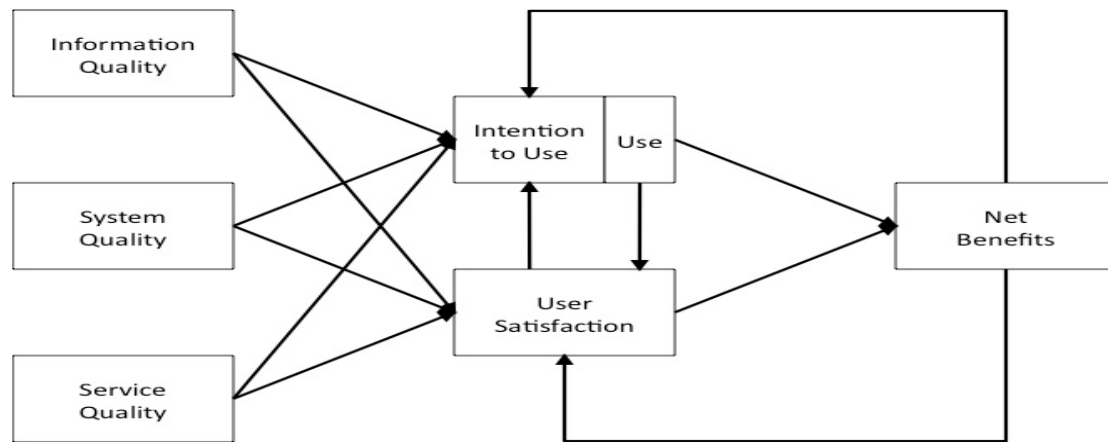
Figure 1. Delone and McLean (2003) IS Success model

2.2 Conceptual Framework and Hypotheses Development

Utilizing the D&M IS Success Model, the conceptual framework for this research proposes a link in cross-functional information sharing through ERP system integration, system quality, information quality, service quality, and firm productivity (Figure 2). The adapted model in this research excluded "Intention to Use" and "Use" dimensions due to mandatory system usage in daily tasks in consistence with Ononiwu (2013) and Noor Aini et al. (2014). The omission of the 'Use' dimension is based on its compulsory nature rather than being an optional indicator of success (Seddon 1997, Sedera et al. 2004, Holsapple et al. 2005, Hsieh and Wang 2007). The primary goal of the current research is to bolster productivity at DAS Pharma Plc (which is a typical SME in the pharmaceutical industry) by promoting cross-functional information sharing via ERP system integration. Therefore Figure 2 illustrates the conceptual framework encompassing five constructs categorized into three interrelated parts. The first part examines ERP system integration for cross-functional information sharing in a SME (such as DAS Pharma Plc), the second part assesses service, information, and system quality. Finally, the last part evaluates the link of the parts to firm productivity. The framework hypothesizes that cross-functional information sharing through ERP integration will positively impact the three quality aspects, leading to increased adoption and subsequent enhancement of organizational efficiency.
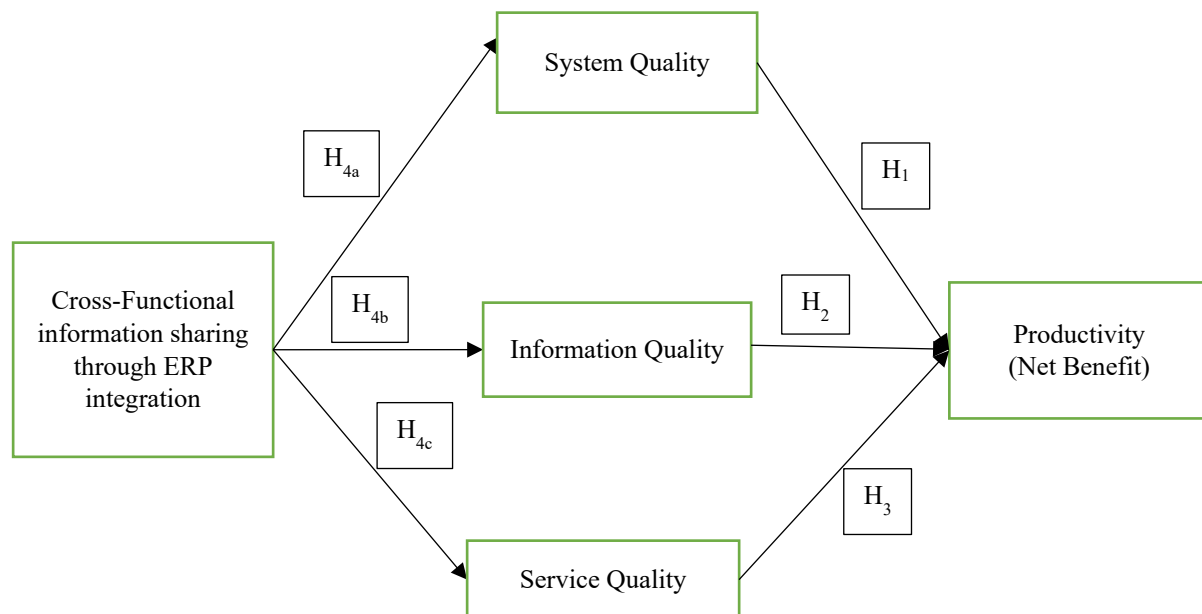

Figure 2. Conceptual model as adapted from D&M IS Success 2003 model

2.3 Hypotheses statements based on the theory and conceptual framework (figure 2)

The study revolves around DeLone and McLean's (1992) Information Systems (IS) success model, emphasizing the direct link between the quality attributes of an information system and the benefits experienced by users. Specifically, it asserts that a high-quality ERP system corresponds to increased organizational productivity. System quality, incorporating technical excellence, reliability, and user-friendliness, mirrors the efficiency of the ERP system (DeLone and McLean 2003). Organizational productivity is defined as output relative to resources expended (Pfeffer and Salancik 2015) or input. Based on the forgoing discourse and the relations in figure 2, this research posits that an enhanced ERP systems quality fosters cross-functional information sharing, providing more accurate, timely data for decision-making, thereby elevating overall productivity. Consequently, this research establishes the first hypothesis.

H_1: ERP systems quality positively influences productivity.

The research also underscores the significance of high-quality information derived from ERP systems in empowering informed decision-making among employees, leading to heightened productivity. Accurate, relevant, and timely information enables more effective task performance, contributing to overall organizational productivity. Lin's (2010) studies has demonstrated the substantial positive impact of information quality from ERP systems on organizational performance. Additionally, Ram and Wu (2013) identified information quality as a pivotal factor influencing ERP success and subsequent organizational productivity, further substantiating the critical role of quality information in enhancing overall effectiveness. Hence, this research establishes the second hypothesis:

H_2: The information quality of ERP positively influences productivity.

The research explores service quality in the context of Enterprise Resource Planning (ERP) systems, with a specific focus on user satisfaction, particularly among employees. Key dimensions of service quality, including reliability, responsiveness, assurance, empathy, and tangibles, collectively shape the overall quality of the ERP system's service delivery. Various studies, such as Ullah et al. (2017), affirm a positive correlation between service quality and user satisfaction with ERP systems. Furthermore, Al-Mashari and Zairi (2001) underscore the pivotal role of service quality in successful ERP implementation. Enhancing service quality emerges as a critical factor in improving ERP system performance, effectiveness, and, consequently, elevating overall productivity and organizational success. By this, the research establishes its third hypothesis.

H_3: The service quality of ERP positively influences productivity.

The research further highlights the efficacy of integrated ERP systems in fostering information sharing across diverse organizational functions, ultimately enhancing system quality. Studies conducted by Oliva and Watson (2011), Shehab et al. (2004), and O'Brien (2011) respectively affirm the positive impact of cross-functional integration, particularly within information systems ERP systems, on system quality. These studies emphasize that integrating ERP systems with other information systems contributes to improved system quality by providing a more comprehensive and accurate representation of organizational processes. Furthermore, cross-functional integration results in more efficient resource utilization, thereby reinforcing and elevating the overall quality of the system. Therefore, this research establishes the fourth hypothesis.

H_{4a}: Cross-functional information sharing through ERP system integration positively influences system quality.

Research conducted by Berente et al. (2009) underscores that the cross-functional integration of ERP systems plays a crucial role in improving accuracy, completeness, and timeliness of information, thereby enhancing information quality. Similarly, Eckartz et al. (2009) emphasize that this integration contributes to a more comprehensive and integrated perspective on information, positively impacting its overall quality. Furthermore, findings from Marciniak et al. (2014) suggest that cross-functional information sharing facilitated by ERP system integration fosters collaboration and communication among diverse organizational functions. This collaborative environment enhances the understanding of information needs, ultimately elevating information quality. Thus, this establishes the fifth research hypothesis:

H_{4b}: Cross-functional information sharing through ERP system integration positively influences information quality.

In Huang and Palvia's (2001) study, they co-authors observed a positive impact of cross-functional integration of ERP systems on communication and coordination among various organizational functions, leading to enhanced efficiency in service delivery. Similarly, Almahamid and Hourani (2015) highlighted that cross-functional information sharing facilitated by ERP system integration fosters collaboration among different functional areas, ultimately improving service quality. Furthermore, Wongchotewiriyakit (2019) noted that cross-functional integration of ERP systems

facilitates more accurate and timely information exchange, ultimately enhancing the overall quality of services provided by the organization. Consequently, this research establishes the final hypothesis:

H_{4c}: Cross-functional information sharing through ERP system integration positively influences service quality.

These hypotheses form the foundation for the empirical investigation into the relationships between ERP system integration, cross-functional information sharing, and various quality dimensions influencing productivity at DAS Pharma Plc. The proposed model aims to contribute to a nuanced understanding of the dynamics in the pharmaceutical industry's pursuit of enhanced productivity through ERP systems.

3. Methods

This section outlines the research design, data collection methods, and analysis techniques employed in the study. DAS Pharma Plc (Ghana) was used as the case studies because of accessibility and convenience. The research adopted a quantitative approach with a deductive research design mindset. An online questionnaire survey was employed to

collect data from selected departments within DAS Pharma Plc. The target population consisted of 1000 staff members, and a sample size of 210 employees was selected through stratified random sampling. All ethical considerations included confidentiality, informed consent, and data storage security were observed.

The respondents' profile revealed the diversity of the workforce at DAS Pharma Plc, with 59.18% male and 40.82% female respondents. At the departmental levels, 29.59% worked in sales and marketing, with others distributed across various departments that use the ERP systems. The majority (35.20%) had worked with DAS Pharma Plc for 4-6 and 7-10 years. Refer to Table 1 below for summary of the statistics.

4. Results and Discussion

With the help of the Analysis of Moment Structures (AMOS) software, a Structural Equation Model (SEM) was developed to help analyse the relationships between the key research constructs. SEM is a statistical technique for assessing complex relationships between variables, incorporating measurement and structural models. AMOS is a user-friendly software for model estimation and evaluation which provides graphical representations and output tables. The SEM in this research followed the conceptual framework (figure 2), and in line with the study's variables as derived from the field data procured from DAS Pharma Plc. AMOS 26 facilitated the visualization and analysis as represented in the Figure 3 and Table 2, 3 and 4 respectively below.

Table 1. Basic descriptive statistics of the responses.

| Variables		Frequency (196)	Percentage (100)
Gender	Female	80	40.82
	Male	116	59.18
Age	18 - 25	2	1.02
	26 - 35	56	28.57
	36 - 45	119	60.71
	46 - 55	17	8.67
	56 and above	2	1.02
Department	Quality Assurance	9	4.59
	Sales and Marketing	58	29.59
	Finance	45	22.96
	Human Resource	3	1.53
	Production (Manufacturing)	11	5.61
	Logistics and Procurements	43	21.94
	Audit	27	13.78
Years of Experience	Less than 1 year	3	1.53
	1 – 3 years	27	13.78
	4 – 6 years	69	35.20
	7 – 10 years	69	35.20
	More than 10 years	28	14.29

4.1 Graphical Results
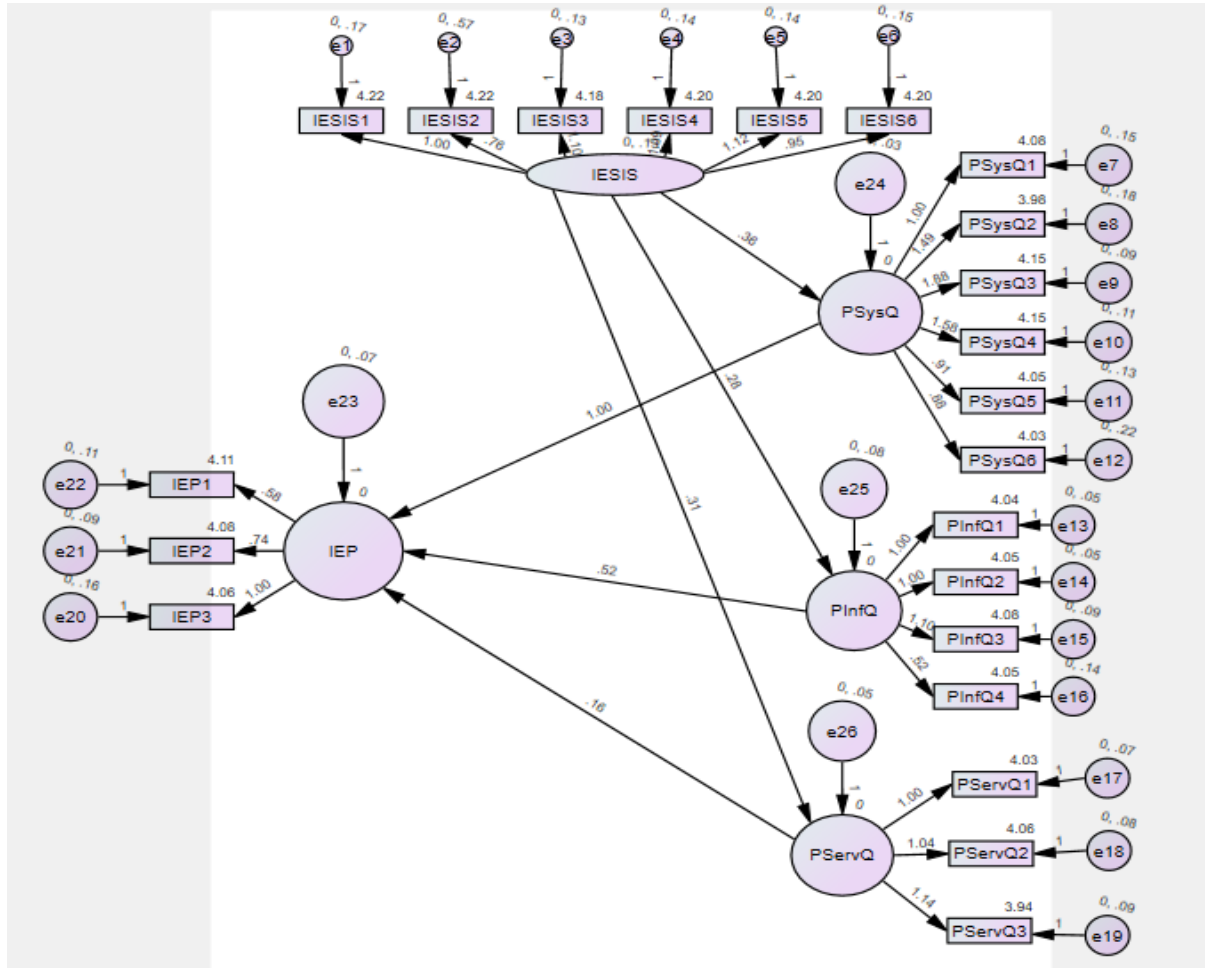
Figure 3. The SEM-AMOS model for Analysis as developed from the conceptual framework in figure 2

4.2 Proposed Improvements

The Structural Equation Modelling analysis in AMOS 26 indicates a positive influence of each indicator on the endogenous variables. This raise concerns that warrant further investigation. The model's mutual acceptability is apparent, as supported by residual assessment and the allowance for prediction errors.

Table 2. Regression Weights (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
PSysQ	<---	IESIS	0.362	0.073	4.972	***	par_18
PInfQ	<---	IESIS	0.276	0.073	3.783	***	par_19
PServQ	<---	IESIS	0.314	0.07	4.499	***	par_20
IEP	<---	PSysQ	1.004	0.205	4.902	***	par_21
IEP	<---	PInfQ	0.52	0.113	4.616	***	par_22
IEP	<---	PServQ	0.157	0.135	1.16	0.024	par_23
IESIS1	<---	IESIS	1				
IESIS2	<---	IESIS	0.756	0.173	4.368	***	par_1
IESIS3	<---	IESIS	1.099	0.126	8.687	***	par_2
IESIS4	<---	IESIS	1.095	0.128	8.557	***	par_3
IESIS5	<---	IESIS	1.121	0.13	8.605	***	par_4
IESIS6	<---	IESIS	0.951	0.12	7.933	***	par_5
PSysQ1	<---	PSysQ	1				
PSysQ2	<---	PSysQ	1.489	0.249	5.985	***	par_6
PSysQ3	<---	PSysQ	1.885	0.278	6.772	***	par_7
PSysQ4	<---	PSysQ	1.578	0.242	6.51	***	par_8
PSysQ5	<---	PSysQ	0.912	0.175	5.219	***	par_9
PSysQ6	<---	PSysQ	0.878	0.198	4.425	***	par_10
PInfQ1	<---	PInfQ	1				
PInfQ2	<---	PInfQ	0.998	0.094	10.632	***	par_11
PInfQ3	<---	PInfQ	1.098	0.109	10.105	***	par_12
PInfQ4	<---	PInfQ	0.517	0.103	5.037	***	par_13
PServQ1	<---	PServQ	1				
PServQ2	<---	PServQ	1.037	0.151	6.881	***	par_14
PServQ3	<---	PServQ	1.138	0.165	6.876	***	par_15
IEP3	<---	IEP	1				
IEP2	<---	IEP	0.743	0.093	8.007	***	par_16
IEP1	<---	IEP	0.585	0.085	6.922	***	par_17

The regression weights reveal significant positive impacts, which implies that the model can be confidently deemed acceptable.

4.3 Validation

Table 3. Test results of the hypotheses tested

Model of fit indices	Accepted fit	Model result	Information Result	
CMINDF	≤ 2.00	2.823	ok	Kline (1998)
NFI	≥ 0.95<1	0.921	ok	
RFI	≥ 0.95<1	0.944	ok	
IFI	approaching 1	0.938	ok	
TLI	≥ 0.95<1	0.934	ok	
CFI	≥ 0.95<1	0.918	ok	West et al. (2012)
PNFI	≥ 0.05<1	0.478	ok	James, Mulaik & Brett, (1982)
PCFI	≥ 0.05<1	0.562	ok	
NCP	2- Chi square	370.056	ok	
RMSEA	between 0.03-0.08	0.097	ok	MacCallum (1996)
AIC, BCC, BIC, CAIC,ECVI, MECVI	≤ model independent =28.578	4.49	ok	
Hoelter Critical N (1% and 5%	≥ 200	64	Deficient	

Table 4.0: Displays various measures used to assess the quality of fit in the proposed study.

			Estimate	**S.E.**	**C.R.**	**P**	**Result**
PSysQ	<---	IESIS	0.362	0.073	4.972	***	Supported
PInfQ	<---	IESIS	0.276	0.073	3.783	***	Supported
PServQ	<---	IESIS	0.314	0.07	4.499	***	Supported
IEP	<---	PSysQ	1.004	0.205	4.902	***	Supported
IEP	<---	PInfQ	0.52	0.113	4.616	***	Supported
IEP	<---	PServQ	0.157	0.135	1.16	0.024	Supported

The hypotheses testing (table 3) confirms the support for the relationships between the key variables. This further validates the model.

The fit indices (table 4) indicate that the model is generally acceptable, with only one category falling slightly out of the desirable level. For example, the impact of Cross-functional information sharing through ERP system integration (IESIS) on system quality (PSysQ) (the AMOS analysis (table 2 and 3)) reveals a noteworthy positive impact of integrating ERP systems, particularly in fostering cross-functional information sharing (IESIS), and system quality (PSysQ). The substantial coefficient of 0.362, supported by a Critical Ratio (C.R.) value of 4.972, underscores a significant influence. More importantly, the statistical significance is robust, with a p-value of 0.000, well below the 0.05 threshold. This result is consistent with a study by Li et al. (2017), highlighting the improvement of supply chain efficiency in manufacturing companies through ERP-enabled cross-functional information sharing which supports H_1 of this research.

Also, the Cross-functional information sharing through ERP system integration (IESIS) and Information quality (PInfQ) revealed a significant and positive impact of ERP systems integration, specifically in fostering the impact of cross-functional information sharing (IESIS) and Information Quality (PInfQ). The relation is supported by a positively signed coefficient of 0.276 and a Critical Ratio (C.R.) value of 3.783. These results indicate a substantial

influence and supports H_2. Moreover, the statistical significance is robust, with a p-value of 0.000, well below the 0.05 threshold. This finding aligns with the research of Modgil and Sharma (2017), who posit that leveraging ERP systems

for cross-functional information exchange enhanced project management efficiency in the pharmaceutical industry, ultimately boosting productivity.

The calculations (table 2 and 3) further reveal a significant and positive impact of integrating ERP systems, specifically in facilitating impact of cross-functional information sharing (IESIS), on Service Quality (PServQ). Supported by a positively signed coefficient of 0.314 and a Critical Ratio (C.R.) value of 4.499, these findings indicate a substantial influence. The statistical significance is robust, with a p-value of 0.000, well below the specified significance threshold of 0.05. This supports H_3 of this research.

Additionally, the numbers on Table 2 and 3 reveal a significant and positive impact of integrating ERP systems, particularly in enhancing system quality (PSysQ), on Productivity. Supported by a positively signed coefficient of 1.004 and a Critical Ratio (C.R.) value of 4.902, these findings highlight a substantial influence. The statistical significance is robust, with a p-value of 0.000, well below the specified significance threshold of 0.05. This is consistent with Beheshti and Beheshti's (2010) discovery of a positive correlation between ERP systems and increased organizational productivity.

Furthermore, the analysis (table 2 and 3) reveals a significant and positive impact of integrating ERP systems, particularly in enhancing Information Quality of ERP (PInfQ), on the Productivity (IEP). Evidenced by a positively signed coefficient of 0.520 and a Critical Ratio (CR) value of 4.616, these findings indicate a substantial influence. Additionally, the statistical significance is robust, with a p-value of 0.000, well below the specified significance threshold of 0.05. This aligns with the study by Hunton et al. (2003) and Lippincott and Reck (2003), which found that companies implementing ERP systems exhibited higher levels of productivity compared to those that did not utilize such systems.

Finally, the Tables (2 and 3) demonstrate a significant and positive impact of integrating ERP systems, especially in enhancing Service Quality of ERP (PServQ), on the Productivity. Indicated by a positively signed coefficient of 0.157 and a Critical Ratio (CR) value of 1.16, these results suggest a notable influence. The statistical significance is also strong, with a p-value of 0.024, which is lower than the specified significance threshold of 0.05.

5. Conclusion
The case study investigated the impact of integrating Enterprise Resource Planning (ERP) systems on productivity at DAS Pharma Plc (a typical SME pharmaceutical company in Ghana). The study examines three key factors: the influence of ERP on system quality (PSysQ), information quality of ERP (PInfQ), and service quality of ERP (PServQ) in relation to the productivity of DAS Pharma (IEP).

The findings consistently demonstrate a significant and positive impact of ERP integration on various aspects of the organisation. Notably, ERP's contribution to system quality, information quality, and service quality is supported by robust statistical significance, as indicated by positive signed coefficients, Critical Ratio (CR) values, and p-values. These results align with existing research, including studies by Li et al. (2017), Modgil and Sharma (2017), and Beheshti and Beheshti (2010), confirming a positive correlation between ERP systems and enhanced organizational productivity.

In conclusion, the case study affirms the effectiveness of leveraging ERP systems for productivity enhancement at SMEs such as DAS Pharma Plc. The significant and positive impacts on system quality, information quality, and service quality underscore the strategic importance of ERP integration in pharmaceutical operations. The findings do not only contribute to the growing body of knowledge on ERP systems integration but also provide empirical and practical insights for organizations aiming to improve productivity through technology adoption. As businesses continue to navigate competitive landscapes, the study reinforces the value of ERP as a key enabler for sustainable productivity gains in the pharmaceutical sector.

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Acknowledgements

Biographies

John Kwesi Buor is a Lecturer in the field of Logistics Supply Chain and Operations Management at the department of Operations and Management Information Systems (OMIS) in the University of Ghana Business School (UGBS). Prior to his joining the UGBS, he taught courses in Logistics, Supply chain, Procurement, and Operations Management in the GIMPA Business School (2015 - 2021). He was at the Hull University Business School's Logistics Institute (HUBSLI) both as a research fellow and an associate lecturer (2010 - 2015). He researched into logistics/supply chain risk, security, emergency, and disaster management leading to findings that could reduce disruptions in global logistics flows. He employs hybrid methodological approach (System Dynamics modelling and Simulation techniques) to gain and provide insight into the potential consequences of policy interventions on the structural behaviour of complex logistics systems, resilience, and sustainability. His research interest is mainly in humanitarian crisis and disaster management (e.g., food security, poverty, inequality, migration, extreme conditions, and conflict reduction); green/sustainable supply chain and systemic resilience; policy design and public procurement management; logistics/supply chain data analytics, complex systems modelling, managerial decision making, and climate change.

Enock Selasi Darteh is a dedicated professional with a diverse educational background. He obtained his BSc degree in Chemistry from the University of Cape Coast, where he developed a strong foundation in the sciences. Building upon this knowledge, he pursued his studies and earned MBA in Management Information Systems from the University of Ghana, to shape his knowledge as well as obtain valuable skills in business administration and technology. Currently, he serves as a Quality Assurance Supervisor at DAS Pharma PLC, where he ensures that pharmaceutical products of the company meet rigorous standards of safety and efficacy. His research interest is in integration of technology in the small-medium pharmaceutical sector to enhancing productivity.