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Agile Project Management (APM) Implementation and Supply Chain Performance in Pharmaceutical and Food Industries in United States of America

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ABSTRACT

The study examined the effect of Agile Project Management Implementation on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America. The specific objectives are to; examine the effect of Iterative Development on Supply Chain Performance and evaluate the effect of Cross-Functional Collaboration on Supply Chain Performance in Pharmaceutical and Food Industries in the United States. A descriptive survey research design was adopted for the study. Data was collected using a structured questionnaire with closed-ended questions based on a five-point Likert scale. The collected data was analysed using the Chi-square (χ2) statistical technique, which is appropriate for assessing relationships between categorical variables. The result revealed that Iterative Development has a significant positive effect on Supply Chain Performance in the Pharmaceuticals and Food Industries with X^2 (16) = 91.489, p < 0.001. while Cross-functional collaboration also has a significant positive effect on Supply Chain Performance in Pharmaceutical and Food Industries with X^2 (16) = 38.749, p = 0.001 in U.S. The study concluded that Agile Project Management Implementation has a significant positive effect on Supply Chain Performance in the Pharmaceutical and Food Industries in U.S. The study recommended among others that organizations should fully embrace Agile Project Management (APM) principles, particularly iterative development and cross-functional collaboration.

Keywords: Agile, Chain, Management, Project, Supply.

INTRODUCTION

Agile Project Management (APM) has emerged as a transformative approach to managing projects in today's fast-paced and complex business environment. Rooted in the principles of the Agile Manifesto, APM emphasizes flexibility, collaboration, iterative progress, and a customer-centric focus (Magistretti, & Trabucchi, 2024). Unlike traditional project management methodologies that follow a linear and rigid process, Agile adopts an adaptive framework that enables teams to respond quickly to changes, uncertainties, and evolving requirements (Conforto & Amaral, 2016). Originally developed for software development, Agile Project Management has gained widespread adoption across diverse industries, including manufacturing, healthcare, finance, and supply chain management (Chia et al., 2022). Its core principles—such as delivering value incrementally, fostering open communication among stakeholders, and prioritizing customer satisfaction—make it particularly suited for projects characterized by high levels of complexity and rapid change (Casciaro et al., 2019).

At its foundation, APM relies on iterative cycles called "sprints" or "iterations," which allow teams to continuously deliver functional outcomes while seeking feedback and refining their processes. This approach improves efficiency and adaptability and enhances team collaboration and innovation (Amajuoyi et al., 2024). By focusing on delivering value early and frequently, Agile empowers organizations to better align project outcomes with strategic goals, meet customer expectations, and remain competitive in dynamic markets. As businesses face increasing demands for

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innovation and operational agility, Agile Project Management has become a cornerstone of modern project execution, enabling teams to achieve superior outcomes while navigating uncertainty with confidence, (Al-Saqqa et al., 2020).

In today's highly dynamic and competitive business environment, organizations are under increasing pressure to enhance their supply chain performance to remain agile and responsive to market demands, (Chia et al., 2022). Putri et al. (2019), hint that supply chain performance, which encompasses operational efficiency, customer satisfaction, cost-effectiveness, and resilience, plays a critical role in determining the success of organizations across industries. To address the complexities and uncertainties of modern supply chains, many organizations are turning to Agile Project Management (APM) as a strategic approach to drive efficiency, adaptability, and continuous improvement (Sanchez-Flores et al., 2020). The implementation of Agile Project Management in the pharmaceutical and food industries in the United States is not just beneficial; it is essential for maintaining a competitive edge in a fast-paced and highly regulated environment. By enabling rapid adaptation to changes, enhancing product development efficiency, and fostering a customer-centric approach, APM significantly contributes to improved supply chain performance and overall organizational success.

The pharmaceutical and food industries in the United States operate within highly complex and regulated supply chains, where efficiency, responsiveness, and compliance are critical to success. These industries face unique challenges that make adopting Agile Project Management (APM) particularly relevant, such as fluctuating demand, stringent regulatory requirements, supply chain disruptions, and the need for continuous innovation (Syahira, 2017). To address these challenges, companies are increasingly adopting Agile Project Management (APM) as a strategic approach to enhance supply chain performance. Originally developed for software development, Agile methodologies prioritize flexibility, iterative progress, and cross-functional collaboration, making them well-suited for dynamic supply chain environments (Chia et al., 2022). Consequently, implementing Agile Project Management principles, which emphasize iterative progress, cross-functional collaboration, and continuous improvement, has become a strategic tool for enhancing supply chain performance in these industries (Yin et al., 2023).

Walmart, Tyson Foods, Pfizer, Kraft Heinz, and Johnson & Johnson are all facing significant supply chain challenges, including labour shortages, raw material shortages, logistical complexities, rising costs, and the need for sustainability. Walmart struggles with inventory management and aims for zero emissions by 2040, while Tyson is addressing raw material dependencies and exploring alternative proteins. Pfizer deals with cold chain logistics and regulatory compliance, partnering with logistics firms to enhance distribution. Kraft Heinz faces ingredient sourcing issues and is utilizing predictive analytics to improve forecasting, and Johnson & Johnson navigates global distribution complexities and product recalls, investing in digital technologies and setting a goal for carbon neutrality by 2030. Each company is implementing various strategies to mitigate these challenges and enhance their supply chains.

This study examines the effect of Agile Project Management implementation on supply chain performance within the U.S. pharmaceutical and food industries. It explores key performance indicators such as operational efficiency, cost reduction, supply chain agility, and customer satisfaction. By analyzing case studies and industry trends, this research aims to provide valuable insights into the benefits, challenges, and best practices for Agile adoption, offering strategic recommendations for improving supply chain efficiency and competitiveness in these vital industries.

1.1 Statement of the Problem

The pharmaceutical and food industries in the United States face increasing supply chain complexities due to stringent regulatory requirements, market volatility, rising consumer demands, and unexpected disruptions such as pandemics and supply shortages. Traditional supply chain management approaches often struggle to provide the flexibility and responsiveness needed to address these challenges, leading to inefficiencies, delays, increased operational costs, and reduced customer satisfaction.

Agile Project Management (APM), widely recognized for its adaptability and iterative approach, has gained attention as a potential solution for improving supply chain performance. By emphasizing collaboration, continuous improvement, and rapid response to changes, Agile methodologies have the potential to enhance supply chain agility, efficiency, and resilience. However, despite its growing adoption, there is limited empirical evidence on the extent to which Agile implementation impacts supply chain performance in the U.S. pharmaceutical and food industries.

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Furthermore, challenges such as regulatory constraints, integration with existing supply chain frameworks, and organizational resistance to change pose barriers to successful Agile adoption.

This study seeks to address this gap by analyzing the effect of Agile Project Management implementation on supply chain performance in the pharmaceutical and food industries within the U.S. context. It aims to evaluate key performance metrics such as lead time reduction, cost efficiency, risk mitigation, and overall supply chain adaptability. Understanding these effects will provide valuable insights for industry stakeholders, enabling them to make informed decisions about Agile adoption and optimize their supply chain strategies for improved operational performance and competitiveness.

1.2 Objective of the Study

The main objective of the study is to examine the effect of Agile Project Management Implementation on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America. The specific objectives are to;

i. Examine the effect of Iterative Development on Supply Chain Performance in Pharmaceutical and Food Industries in the United States of America.

ii. Evaluate the effect of Cross-Functional Collaboration on Supply Chain Performance in Pharmaceutical and Food Industries in the United States of America.

1.3 Hypotheses of the Study

i. Iterative Development has a significant positive effect on Supply Chain Performance in Pharmaceutical and Food Industries in the United States of America.

ii. Cross-functional collaboration has a significant positive effect on Supply Chain Performance in Pharmaceutical and Food Industries in the United States of America.

REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

Agile Project Management

Agility refers to the aptitude to create and respond quickly to changes, creating value in a turbulent business environment. It is simply a deep understanding and culture of learning and experimentation and trying things out. There are uncertainties when necessary activities are taken without understanding of the potential results and when the likelihood that they will materialize is unknown (Weid et al., 2020). There are two types of project work: defined work and high-uncertainty work. Clear processes that have been shown to be effective on related projects in the past are what define definite work projects. Project teams are working on increasingly high-uncertainty projects that call for the strategies outlined in this practice guide as more identifiable labour is automated. High levels of risk, complexity, and change are characteristics of high-uncertainty initiatives. Traditional predictive approaches that seek to ascertain the majority of the needs up front and manage modifications through a change request procedure may encounter issues as a result of these features. Alternatively, agile methods were developed to swiftly adjust according to input and evaluation, and to investigate feasibility in short cycles (Chia et al., 2022).

Iterative or agile life cycles are made up of multiple iterations or incremental steps towards the completion of a project. Agile project management is an iterative approach to delivering a project throughout its life cycle. The agile management philosophy focuses on empowered people and their interactions, as well as early and constant delivery of value into an enterprise. Agile project management is a method used to manage projects quickly with an empowered project team, striving to adapt to a constantly changing environment (Conforto and Amaral, 2016). Agile project management is thought to be more appropriate in the current project environment, tailored to the specific needs of organizations while being interactive, incremental, and collaborative (Stettina & Horz, 2015).

Agile methodologies have opened the door for more creative improvements to optimize software development processes, and iterative approaches are commonly used in software development projects to promote velocity and

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adaptability because they allow for adjustments as you go along rather than following a linear path (Chia et al., 2022). These enhancements augment traditional Agile practices, leveraging modern principles and practices to enhance project efficiency and outcomes (Magistretti & Trabucchi, 2024; Amajuoyi et al., 2024). Organizations must evaluate their team dynamics and culture before introducing improvements to Agile processes to spot any potential adoption hurdles.

A culture that values collaboration, experimentation, and continuous improvement is conducive to Agile practices. However, organizations with hierarchical structures or resistance to change may face challenges in embracing Agile principles. It is essential to foster a culture of openness and transparency to support the successful adoption of enhanced Agile methodologies. Additionally, understanding project-specific requirements, such as regulatory constraints or customer preferences, ensures that enhancements are tailored to meet the unique needs of each project (Adeniyi et al., 2024; Amajuoyi et al., 2024). Implementing enhancements to Agile methodologies may encounter challenges such as resistance to change, lack of buy-in from stakeholders, and difficulties in scaling practices across teams or departments. To mitigate these challenges, organizations can engage in proactive communication and stakeholder engagement to build support for the proposed enhancements. Training and coaching team members ensure they have the necessary skills and knowledge to adopt new practices effectively. Fostering a culture of experimentation and learning allows teams to adapt and refine their approach based on feedback and experience (Amajuoyi et al., 2024).

Iterative Development

Despite the difficulties of uncertainty, iterative development is a software development methodology that divides the final result into smaller subsets and continuously improves them over several cycles and the need for disciplined project management. Iterative development is a fundamental approach in software engineering and project management that emphasizes the continuous refinement and enhancement of products through repeated cycles, or iterations. This methodology is particularly valuable in dynamic environments where requirements may evolve or are not fully known at the outset. By allowing for regular feedback and adjustments, iterative development enhances the adaptability and quality of the final product (Isyaku et al., 2020).

Iterative development has found widespread application across various domains, particularly in software engineering. Methodologies such as Agile and Scrum exemplify iterative principles, emphasizing short development cycles (sprints) and regular stakeholder engagement. These frameworks have gained popularity due to their ability to deliver high-quality software in a fast-paced environment. Sectors such as healthcare and education have begun to adopt iterative development approaches. In healthcare, for example, iterative methods can enhance the design and implementation of patient care solutions, leading to better outcomes through continuous feedback and adjustment, (IJzerman et al., 2023). Similarly, educational institutions are using iterative development to refine curricula and teaching methods based on student feedback and performance metrics.

At its core, iterative development is built upon several key principles. First, it promotes the idea that software development is an incremental process. Rather than attempting to deliver a complete product in one go, the project is divided into smaller, manageable components or iterations. Each iteration typically involves planning, design, development, and testing, followed by a review phase where stakeholders can provide feedback, (Ljubović, 2009). Second, iterative development emphasizes continuous improvement. With each iteration, teams assess what worked well and what did not, fostering an environment of learning and adaptation. This reflection is crucial for identifying areas for improvement and ensuring that the final product aligns more closely with user needs. Third, user involvement is a vital element. Stakeholders, including end-users, are encouraged to participate throughout the development process. Their feedback is invaluable for refining features and functionalities, ultimately leading to a product that better meets their expectations, (Al-Saqqa et al., 2020).

The iterative development model offers numerous advantages that make it appealing to software developers and project managers alike. One of the most significant benefits is increased flexibility. Since iterations allow for adjustments based on user feedback and changing requirements, teams can pivot more easily when new information arises or when market conditions shift (Larman & Basili, 2003). Additionally, the iterative approach enhances risk management. By breaking projects into smaller segments, potential issues can be identified and addressed early in

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the development cycle, reducing the risk of major failures at later stages. This early detection can save time and resources, ultimately leading to a more successful project outcome. Furthermore, iterative development facilitates better quality assurance. Continuous testing and feedback loops ensure that defects are caught early, leading to a more polished final product. This focus on quality is especially important in today's fast-paced digital landscape, where user expectations are high and competition is fierce. Despite its many advantages, iterative development is not without its challenges. One major issue is the potential for scope creep. As stakeholders provide feedback and suggest new features, there may be a tendency to continuously add functionalities, which can lead to projects extending beyond their original scope and timelines. Effective project management and clear communication about project boundaries are essential to mitigate this risk (IJzerman et al., 2023).

Cross-Functional Collaboration

Project teams are essential to complete projects successfully. The team's governance and clear goals are essential for guiding the group toward success (Pavez et al., 2022). Inadequate governance and poorly defined goals are the main causes of subpar team performance. Collaboration is a governing mechanism that supports the organization in handling uncertainty. There is no need to cooperate and oversee the process in regular meetings when there is no ambiguity (Pesamaa et al., 2018). According to Beck (2017), cross-functional cooperation occurs when members of various teams or functions collaborate on a project, goal, or duty. With varying emphasis, similar definitions have been proposed. Instead of focusing on people, Udoagwu (2020) highlighted functional expertise. Holland et al. (2000) emphasized that the interdependence of the work is crucial, and Prokopets (2021) thought that cross-functional collaboration should involve a range of seniority levels. Additionally, cross-functional cooperation is sometimes used interchangeably with inter-functional collaboration, inter-departmental collaboration, cross-group collaboration, and cross-disciplinary collaboration (Leopold et al., 2020; Lee, 2020).

It might happen naturally, such when one function contacts another, or consciously, like when management requests that two functions collaborate with or without a project team. Cross-functional cooperation is now a recognized structure for decision-making (Anibaba & Akaighe, 2018; Safapour et al., 2022), information and knowledge integration (Ganotakis et al., 2013), and business development. Dismantling boundaries between various departments or functional areas is the primary goal of cross-functional collaboration. When a corporation does so, it develops links beyond functional silos and compartmentalization inside traditional organizations (Mohamed et al., 2004).

The following traits are present in cross-functional cooperation: It makes it easier to integrate and coordinate various functions and provides a chance to bring in more diverse and substantial amounts of information for reference from different expertise, it provides access to a larger scale of knowledge and a wider range of different perspectives (Edmondson & Nembhard, 2009), it enhances the level of creativity, it improves a team's ability to handle complexity, it decentralizes decision-making, thereby accelerating the process and it advances the potential of generating higher quality decisions. According to research, cross-functional collaboration also improves project planning and delivery efficiency, organizational innovation, managerial process, and organizational performance and project performance and success (Frishammar & Åke Horte, 2005).

According to De Clercq et al. (2011), cross-functional cooperation does not always result in better performance (Somech, 2006). Such collaboration can be difficult to implement in a variety of ways, and both internal and external factors may have an impact on the implementation (Daspit et al., 2013). First, because of the organizational structure, management professionals have difficulties with departmental or functional silos (Casciaro et al., 2019). Hence, if no team is officially constituted, cross-functional tasks or work functions need to be in place to bring collaborators together (Yun, 2013). Second, people involved in the collaboration could have shared goals or objectives established, they may also have diverse functional aims, priorities, and agendas in their various departments (Jassawalla & Sashittal, 1999). According to Luo et al. (2006), the cross-functional connection might therefore be both cooperative and competitive. Third, such collaboration may necessitate a new method of working (Erdogan et al., 2014) and requires the development of trust (Tsai & Chi, 2015). The collaborators are also subjected to a great deal of strain if the partnership is only transitory (Holland et al., 2000).

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Supply Chain Performance

The definition of a supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to customer; in other words, supply chain activities include the conversion of natural resources, raw materials, and components into a finished product that is delivered to an end user. A supply chain is a dynamic and complex network of partners. However, currently, production systems are globalized, and, commonly, natural resources are extracted in one country, components are manufactured in others, and finally, a final product is assembled in another, so supply chains are also globalized (Sanchez-Flores, 2020). Performance is concerned with what happened in the past or what is happening in the present instance, and therefore, it is observable and measurable (Hon, 2005). 'Performance' may include inputs, outputs, intermediate outcomes, end outcomes, net impacts, and unintended outcomes.

Performance may relate to economy, efficiency, effectiveness, cost-effectiveness, or equity (Folan et al., 2007). Supply chain performance" refers to the overall ability of a network of companies involved in producing and delivering a product to meet customer needs effectively, encompassing factors like on-time delivery, product availability, cost efficiency, and responsiveness throughout the entire supply chain, from raw materials to the final customer; essentially measuring how well the chain functions in delivering the right product at the right time and the right cost., (Putri et al., 2019). Cost-containment and performance reliability constructs are two well-known indicators that measure supply chain performance. Jie et al. (2007) define supply chain performance in two dimensions: effectiveness, which is "doing the right thing," and efficiency, which is "doing things right." Cost-containment indicators include activities like cost in and outbound activities, warehousing costs, inventory-holding costs, and increasing asset turnover, while reliability indicators address areas like order fulfillment rate, inventory turns, safety stocks, inventory obsolesces, and number of product warranty claims.

Although there are numerous studies on integration and performance, there are no coherent studies to measure the performance of supply chain operations based on the degree of integration among and between their stakeholders (suppliers, internal customers, and external customers) (Syahira, 2017). With an understanding of the factors that influence supply chain performance, companies are expected to be able to prepare their technical and practical supply chain management practices. Currently, companies that have better supply chain performance are more likely to win the competition

2.2 Theoretical Review

Agile Manifesto

The Agile Manifesto, introduced in 2001 by a group of 17 software development experts, represents a paradigm shift in software engineering by emphasizing iterative development, collaboration, and adaptability (Beck et al., 2001), and revolutionized software development by emphasizing flexibility, collaboration, and customer-centric approaches. It emerged as a response to the limitations of traditional, plan-driven methodologies like the Waterfall model, which often failed to meet changing customer needs or deliver timely value (Highsmith, 2002). The manifesto comprises four core values and 12 guiding principles, all aimed at fostering a more flexible and customer-focused approach to software development (Beck et al., 2001). These values emphasize the human-centric and adaptive nature of Agile development. By prioritizing working software and ongoing communication with stakeholders, Agile teams can deliver functional increments more efficiently. Iterative development supports Agile's emphasis on customer collaboration by enabling stakeholders to review and provide feedback after each cycle (Highsmith, 2002). This iterative feedback loop ensures that the software aligns with evolving user requirements.

The hypotheses regarding the impact of iterative development and cross-functional collaboration on supply chain performance in the pharmaceutical and food industries can be informed by various established theories, notably the Agile Manifesto and Agency Theory. Here's how each theory directly informs these hypotheses:

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1. **Hypothesis: Iterative Development has a significant positive effect on Supply Chain Performance in Pharmaceutical and Food Industries in the United States.**

Agile Manifesto

i. The Agile Manifesto emphasizes customer collaboration, responsiveness to change, and delivering working products iteratively. In the context of supply chain performance, iterative development allows organizations to adjust to market feedback and regulatory changes more rapidly, which is critical in the fast-paced pharmaceutical and food sectors.

ii. By implementing iterative cycles, organizations can continuously refine their processes and products, thus ensuring higher quality and compliance with safety standards. This focus on continuous improvement contributes directly to improved supply chain performance metrics, such as reduced lead times and increased reliability.

iii. Iterative development enables teams to identify potential issues early in the product life cycle and address them immediately, minimizing risks associated with supply chain disruptions or product recalls. This proactive approach enhances overall supply chain resilience and efficiency.

Agency Theory

Agency theory, first propounded by Jensen and Meckling (1976), explores the relationship between principals, such as shareholders, and agents, such as company executives. The theory emphasizes how the separation of ownership and control in organizations creates the potential for conflicts of interest. These conflicts arise when agents prioritize their interests over those of the principals, potentially leading to inefficiencies and value loss (Eisenhardt, 1989). Agency theory is a management and economic doctrine that strives to elucidate relationships and self-interest in organizational settings. According to Daily et al. (2003), "Agency theory originates from the problems of risk sharing between principal and agents." The background provides an overview of the cross-functional Collaboration on mission alignment by appraising its strengths and weaknesses (SWOT analysis). It uses case study evidence to validate how the theory is applied in diverse businesses and contexts. Agency theory can impact cross-functional collaboration by highlighting potential issues that may arise when individuals from different. departments with diverse goals need to work together towards a shared objective, creating challenges in aligning incentives and ensuring everyone is working towards the overall company benefit.

2. **Hypothesis: Cross-functional collaboration has a significant positive effect on Supply Chain Performance in Pharmaceutical and Food Industries in the United States.**

Agency Theory

i. Agency Theory posits that aligning the interests of various stakeholders (principals and agents) is essential for improving organizational performance. In the context of supply chains, cross-functional collaboration enables different departments—such as R&D, manufacturing, and marketing—to work together towards common goals, thus reducing information asymmetry and enhancing decision-making.

ii. Cross-functional teams enhance communication among departments, which is crucial in industries that require compliance with strict regulatory standards. Improved communication facilitates quicker identification of bottlenecks and inefficiencies, leading to streamlined processes that positively impact supply chain performance.

iii. Cross-functional collaboration fosters a culture of shared responsibility and collective problem-solving. By harnessing diverse expertise from various functions, organizations can develop more innovative solutions to challenges faced within the supply chain, ultimately improving overall performance and meeting customer demands more effectively.

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2.3 Empirical Reviews

Elikwu (2019) conducted a study to explore the impact of cross-functional collaboration on organizational mission alignment in the US. The study aims to examine empirical research on the collaborative decision-making methods used by mission-aligned organizations through cross-functional cooperation, based on agency theory and a strategic management framework. Using electronic databases, the study is a systematic review of the literature (ABI/Inform, Business Source Complete, Google Scholar). The findings demonstrated the importance of systemically integrating cross-functional collaboration to sustain mission alignment and growth strategy.

Isyaku et al. (2020) conducted a study on the Iterative and Incremental Development (IID) model and justified its role in the analysis and design of software systems in selected firms in some secondary schools, Kaduna Polytechnic, and Apprentices in Kaduna, Nigeria. The study aims to examine the relationship between iterative and incremental development with an in-depth study referencing vocational career information systems (VCIS). The paper adopted the qualitative research approach. The results revealed some system specifications, functional specifications of the system, and design specifications that can be used in implementing the VCIS using the IID model.

IJzerman et al. (2023) conducted a study on the iterative development, evaluation, and improvement of the implementation strategy for the BENEFIT program, a complex eHealth intervention within routine cardiac care in the Netherlands. The study aims to outline the iterative process used to create, test, and improve a multifaceted implementation strategy for a complicated eHealth solution in clinical practice. The case study technique of research technique was used in this study. The findings showed that the program's pilot helped identify important practical issues (phase 4), which were then linked to more general theory (phase 5) through the use of the Consolidated Framework of Implementation Research (CFIR).

Yin et al. (2023) conducted a study on the obstacles to productive cross-functional cooperation and related contributing elements in capital project early stages in the USA. The study aims to identify the most important obstacles to successful interdisciplinary cooperation in the early stages of downstream and chemical capital projects. A systematic review method, a series of interviews, and the Delphi method with a panel of 12 subject matter experts (SMEs) were employed in this research. The results revealed unclear business objectives, lack of alignment between functions or teams, and unrealistic targets and expectations as the most important cross-functional barriers to effective cross-functional collaboration.

METHODOLOGY

This study adopts a descriptive survey research design to examine the effect of Agile Project Management Implementation on Supply Chain Performance in Pharmaceutical and Food Industries in the United States of America. Descriptive surveys are particularly effective when the primary objective is to gather detailed information about a population's characteristics, attitudes, or behaviours. If the research aims to quantify perceptions or experiences within a particular group (such as professionals in the pharmaceutical or food industries regarding Agile Project Management), a descriptive survey design provides a structured approach to obtain measurable data. The descriptive survey design was chosen over case studies or mixed methods due to its ability to efficiently gather measurable data from a broad population, standardize responses, and facilitate quantitative analysis.

This approach is particularly justified since the study aimed to understand general trends and patterns in perceptions and practices related to Agile Project Management in the highly regulated contexts of the pharmaceutical and food industries. The questionnaire was decided based on the types of questions to be used, such as closed-ended (multiple choice, Likert scale) or open-ended questions. Closed-ended questions are suitable for quantitative analysis, while open-ended questions can provide qualitative insights. The closed-ended questions were considered more appropriate; however, the questionnaire was structured to ensure that questions were phrased neutrally to avoid leading respondents toward a particular answer. Pilot testing was carried out with a small sample from the target population. Necessary adjustments were made on the gathered feedback regarding clarity, relevance, and the overall length of the questionnaire. This includes rephrasing the questions, adding or removing items, and ensuring that the questionnaire flows logically. The essence was to avoid emotionally charged language or overly complex terms that might confuse participants.

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The target population consists of 7846 employees, including managerial, supervisory, and operational staff. A sample size of 380 respondents is determined using Taro Yamane's formula;

$$n = \frac{N}{1 + N(e)^2}$$

where N=7846 and e=0.05, leading to n=380. A stratified random sampling technique is employed to ensure representation across different Pharmaceutical and Food Industries, with respondents selected randomly from each stratum. Data is collected using a structured questionnaire with closed-ended questions based on a five-point Likert scale ranging from Strongly Agree to Strongly Disagree. The questionnaire is pre-tested for validity and reliability before full distribution. The collected data were analysed using the Chi-square (χ2) statistical technique, which is appropriate for assessing relationships between categorical variables. The formula is stated below;

$$X^2 = \frac{\sum(O_{ij} - E_{ij})^2}{E_{ij}}$$

Were,

O_{ij} Represent the observed frequency.

E_{ij} Represent the expected frequency.

$\sum$ Represent the summation across all categories.

α Represent the 5% level of significance.

Degree of freedom =(n-1)

The analysis is conducted using SPSS 29.0 software to ensure accuracy and efficiency in result interpretation.

Table 1: Demographic Characteristics

Demographic Variable	Category	Frequency (n=380)	Percentage (%)
Gender	Male	211	55.5
	Female	169	44.5
Age Group (Years)	18-25	52	13.7
	26-35	138	36.3
	36-45	121	31.8
	>46yrs	69	18.2
Industry type	Pharmaceutical	73	19.2
	Food	307	80.8
Job Role	Supply Chain Manager	85	22.4
	Procurement Officer	92	24.2
	Logistic Officer	98	25.8
	Warehouse Manager	105	27.6
Years of Experience	Less than 1yrs	29	7.6
	1-5yrs	111	29.2
	6-10yrs	153	40.3

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Demographic Variable	Category	Frequency (n=380)	Percentage (%)
	>10yrs	87	22.9
Educational Qualification	Secondary Education	36	9.5
	OND/NCE	72	18.9
	Bachelor's Degree	178	46.8
	Postgraduate Degree	94	24.7
Awareness Agile Project Management	Yes	253	66.6
	No	127	33.4
Level of Agile Implementation in Organization	Low	120	31.6
	Moderate	167	43.9
	High	93	24.5

Table 1 is the demographic profile of the respondents. The results revealed a slight male dominance in the study, with 55.5% male respondents compared to 44.5% females. This suggests a relatively balanced gender representation, indicating that both men and women play significant roles in the supply chain management of the pharmaceutical and food industries in U.S. The age distribution shows that the majority of respondents (36.3%) fall within the 26–35 years age group, followed by 31.8% in the 36–45 years category. This suggests that most employees are in their early to mid-career stages, bringing a mix of youthful innovation and experience to the industry. Regarding industry type, the food industry dominates with 80.8% of the respondents, while only 19.2% work in the pharmaceutical sector. This indicates that agile project management is more prevalent or applicable in food supply chains than in pharmaceuticals. The job role distribution shows that warehouse managers (27.6%) and logistics officers (25.8%) form the largest groups, followed by procurement officers (24.2%) and supply chain managers (22.4%). This suggests that employees directly handling inventory, distribution, and procurement are most engaged in agile project management implementation.

The years of experience data indicate that 40.3% of respondents have 6–10 years of experience, followed by 29.2% with 1–5 years' experience. This suggests that the majority of employees have gained significant industry expertise but are still actively engaged in learning and adapting to new supply chain strategies like agile project management. In terms of education, most respondents hold at least a Bachelor's degree (46.8%), while 24.7% have postgraduate qualifications, showing that the workforce is highly educated. Furthermore, 66.6% of respondents are aware of agile project management, but only 24.5% reported a high level of implementation in their organizations, indicating that while awareness is relatively high, full adoption remains moderate to low (75.5%). These findings suggest the need for further training, investment, and strategic implementation of agile project management within the sector.

RESULTS

Descriptive Statistics

Descriptive statistics were used to summarize the responses to each variance which include Iterative Development, Cross-Functional Collaboration, and Supply Chain Performance.

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Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation
Iterative Development	3.7605	1.93188
Cross-Functional Collaboration	3.2026	0.77514
Supply Chain Performance	3.4327	1.49415

Table 2 above results of descriptive statistics show that Iterative Development had a mean score of 3.76 with a standard deviation of 1.93, indicating a relatively high level of agreement with the statements related to iterative development, though there was some variability in the responses. Cross-functional collaboration recorded a slightly higher mean of 3.20 with a standard deviation of 0.78, suggesting stronger agreement among respondents regarding the importance of collaboration between different functions in the supply chain, with less variation compared to Iterative Development. For Supply Chain Performance, the mean was 3.43 with a standard deviation of 1.49, reflecting a moderate level of perceived supply chain performance, and with moderate variation in responses among the three variables. These descriptive statistics indicate a consensus on the significance of iterative development and cross-functional collaboration, while supply chain performance was rated more moderately.

Reliability Test

To ensure the internal consistency of the questionnaire items, a reliability test using Cronbach's alpha was conducted.

Table 3: Reliability Test Results

Construct	No. of Items	Cronbach's Alpha
Iterative Development	5	0.707
Cross-Functional Collaboration	5	0.734
Supply Chain Performance	4	0.720

Results of the reliability test using Cronbach's alpha (table 3) show that all constructs demonstrated acceptable internal consistency, with values above the recommended threshold of 0.70. Iterative Development recorded an alpha of 0.707, Cross-Functional Collaboration achieved 0.734, and Supply Chain Performance scored 0.720. These findings indicate that the questionnaire items used to measure these constructs are reliable and suitable for further analysis.

Test of Hypotheses

Chi-Square test of independence with 5% level of significance was employed in testing the hypotheses. This decision rule was that if the calculated Chi-Square value exceeds the critical Chi-Square value or if the p-value is less than or equal to 0.05, the null hypothesis will be rejected. Otherwise, the null hypothesis will be accepted.

Hypothesis One

H_0: Iterative Development has no significant effect on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America.

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Table 4: Does Iterative Development have significant effect on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America?

S/N	Likert Scale	Frequency (N) of Responses	Percentage (%) of Responses
5	Strongly Agree	212	55.8%
4	Agree	71	18.7%
3	Neutral	44	11.6%
2	Disagree	24	6.3%
1	Strongly Disagree	29	7.6%

Source: Field Work, 2025

Table 5: Chi-Square Analysis

Statistics	Value	Df	Asymp. Sig.
Chi-Square	91.489[a]	16	0.000
Likelihood Ratio	89.547	16	0.000
Linear-by-Linear Association	38.246	1	0.000

Decision:

Table 5 above Chi-Square test of independence was conducted to assess the relationship between Iterative Development and supply chain performance in the pharmaceutical and food industries in United States of America. The result was statistically significant, X^2 (16) = 91.489, p < 0.001, indicating that iterative development has a significant effect on supply chain performance in the U.S.

Hypothesis Two

H_0: Cross-functional collaboration has no significant effect on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America.

Table 6: Does Cross-functional collaboration have significant effect on Supply Chain Performance in Pharmaceutical and Food Industries in United States of America?

S/N	Likert Scale	Frequency (N) of Responses	Percentage (%) of Responses
5	Strongly Agree	242	63.7%
4	Agree	56	14.7%
3	Neutral	43	11.3%
2	Disagree	37	9.7%
1	Strongly Disagree	2	0.5%

Source: Field Work, 2025

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Table 7: Chi-Square Analysis

Statistics	Value	Df	Asymp. Sig.
Chi-Square	38.749[a]	16	0.001
Likelihood Ratio	38.696	16	0.001
Linear-by-Linear Association	11.786	1	0.001

Decision:

A Chi-Square test was conducted to assess the relationship between cross-functional collaboration and supply chain performance in the pharmaceutical and food industries in United States of America. The results revealed a significant association, X^2 (16) = 38.749, p = 0.001. This suggests that cross-collaboration influences supply chain performance in the selected pharmaceutical and food industries.

Discussion of Results

The demographic analysis of respondents revealed a relatively balanced gender representation, with a slight male dominance (55.5% male, 44.5% female), indicating that both men and women play crucial roles in supply chain management within the pharmaceutical and food industries in Enugu State. The age distribution suggests that the majority of employees (36.3%) are in the 26–35 years age group, followed by 31.8% in the 36–45 years category, highlighting a workforce that combines both youthful innovation and experience. The food industry had the highest representation (80.8%), suggesting that agile project management is more widely applied in food supply chains than in pharmaceuticals. The job role distribution indicated that warehouse managers (27.6%) and logistics officers (25.8%) are the most involved in supply chain activities, followed by procurement officers (24.2%) and supply chain managers (22.4%). Additionally, 40.3% of respondents have between 6–10 years of experience, showing that a significant portion of the workforce possesses substantial industry expertise while continuing to adapt to modern supply chain strategies like agile project management. Despite 66.6% awareness of agile project management, only 24.5% of respondents reported a high level of implementation, highlighting the need for greater adoption and training in the sector.

The descriptive statistics of the variables show that Iterative Development had a mean score of 3.76 with a standard deviation of 1.93, suggesting high agreement among respondents but with some variability in responses. The cross-functional collaboration had a mean of 3.20 with a standard deviation of 0.78, indicating strong agreement with relatively low response variation, signifying a shared understanding of the importance of collaboration in supply chain management. Supply Chain Performance was rated moderately, with a mean of 3.43 and a standard deviation of 1.49, suggesting a fair perception of performance but with the least variation among responses. The reliability analysis using Cronbach's alpha confirmed that the questionnaire constructs were statistically reliable, with all values exceeding 0.70, supporting the robustness of the study instruments for further analysis.

The hypotheses tested using Chi-Square analysis revealed significant relationships between key agile project management principles and supply chain performance. Hypothesis One examined the relationship between Iterative Development and supply chain performance, yielding a statistically significant result (X^2 (16) = 91.489, p < 0.001), confirming that Iterative Development significantly enhances supply chain performance. Similarly, Hypothesis Two tested the relationship between Cross-Functional Collaboration and supply chain performance, producing a significant association (X^2 (16) = 38.749, p = 0.001), and therefore suggesting that effective collaboration across supply chain functions improves overall performance of pharmaceutical and food industries in the area.

CONCLUSION

The implementation of Agile Project Management (APM) has demonstrated a significant positive effect on supply chain performance in the pharmaceutical and food industries in United States of America. Specifically, iterative development has played a crucial role in enhancing supply chain efficiency by allowing continuous improvements,

rapid adjustments to market demands, and the early identification of potential disruptions. This adaptive approach has led to increased responsiveness, reduced lead times, and improved overall operational efficiency.

Furthermore, cross-functional collaboration has significantly influenced supply chain performance by fostering better communication, knowledge sharing, and coordinated decision-making among stakeholders. The integration of diverse expertise across departments has enhanced problem-solving capabilities, minimized bottlenecks, and improved supply chain agility. This collaborative approach has not only strengthened internal operations but also enhanced relationships with suppliers and distributors, ensuring a more resilient and responsive supply chain.

Overall, the adoption of Agile Project Management principles has proven to be a strategic enabler for improving supply chain performance in the pharmaceutical and food industries in Enugu State. By leveraging iterative development and cross-functional collaboration, organizations in these sectors can achieve greater adaptability, efficiency, and competitiveness in an increasingly dynamic business environment. The study concluded that Agile Project Management Implementation has a significant positive effect on Supply Chain Performance in the Pharmaceutical and Food Industries in United States of America.

Recommendations:

To further enhance supply chain performance in the pharmaceutical and food industries in United States of America, organizations should fully embrace Agile Project Management (APM) principles, particularly iterative development and cross-functional collaboration.

i. Pharmaceutical and food industries in the area should implement iterative processes in their supply chain operations to allow continuous improvements and adaptability. This approach will enable them to respond swiftly to market fluctuations, regulatory changes, and supply chain disruptions. Regular feedback loops and incremental improvements should be integrated into supply chain strategies to enhance efficiency and reduce delays.

ii. Organizations should foster a culture of teamwork across various departments, including procurement, logistics, production, and distribution. By encouraging cross-functional collaboration, these companies can improve communication, enhance decision-making, and reduce inefficiencies. Training programs and workshops should be organized to equip employees with Agile methodologies, ensuring seamless coordination across the supply chain.

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