

CURRICULUM FOR A DIGITAL AGE: AI AS A CATALYST FOR STRATEGIC LEARNING AND CAPABILITY DEVELOPMENT IN EMERGING PHARMACEUTICAL MARKETS

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Abstract

In an era defined by rapid technological change, fostering a digital-age curriculum is critical for enhancing strategic learning capabilities and digital preparedness of pharmaceutical firms. Such curricula prioritize competencies in artificial intelligence (AI), data interpretation, and agile decision-making—skills essential for success in emerging markets. This study explores how AI technologies—machine learning (ML), natural language processing (NLP), and predictive analytics—act as catalysts to develop dynamic capabilities (sensing, seizing, transforming) in Pakistan's pharmaceutical sector. Through semi-structured interviews with 47 managers across 20 firms, analyzed via thematic analysis and Gioia's methodology, findings indicate AI significantly enhances these capabilities: sensing through real-time market analysis. NLP improved customer segmentation accuracy by 35% (e.g., NLP-driven competitor monitoring), seizing with predictive analytics improving demand forecasting accuracy by ~30%, and transforming via predictive maintenance systems reducing operational costs by ~20%. Although limited by sample size and potential self-reporting bias, this study represents one of the first empirical works linking AI to business development—rather than drug discovery—in Pakistan's pharmaceutical industry. The results offer a foundational framework for designing strategic learning curricula and capability development initiatives aimed at accelerating AI adoption and digital maturity in emerging markets.

INTRODUCTION

Global pharmaceutical firms leverage AI for drug discovery and logistics, Pakistan's sector lags due to fragmented data infrastructure, high operational costs, and regulatory complexity (Shoukat et al., 2023). The pharmaceutical industry is undergoing significant transformation driven by technological advances, increased competitiveness, and evolving regulatory requirements. Among emerging technologies, AI—particularly machine learning

(ML), natural language processing (NLP), and predictive analytics—has been recognized for its potential to enhance business functions and create new strategic opportunities (Kaplan & Haenlein, 2019). However, the Pakistani pharmaceutical sector faces persistent challenges, including high operational costs, underdeveloped technological infrastructure, and complex regulatory frameworks. For developing economies like

Pakistan, the adoption of advanced capabilities such as AI presents a strategic opportunity to address these constraints. Yet, integration remains limited, and without fuller adoption, local firms risk falling behind global competitors (Shoukat et al., 2023).

This study therefore explores how AI technologies act as catalysts to develop dynamic capabilities—sensing, seizing, and transforming—within Pakistan’s pharmaceutical sector, addressing the pressing need to enhance operational efficiency, reduce costs, and adapt to complex market and regulatory environments.

1.1. Problem Statement and Research Gap

The slow adoption of Artificial Intelligence (AI) in Pakistan’s pharmaceutical sector threatens its competitiveness amid rapidly rising global standards. While AI is increasingly leveraged internationally for drug discovery, marketing, and supply chain optimization, adoption in Pakistan remains limited due to high implementation costs, complex regulatory hurdles, and underdeveloped data infrastructure (Shoukat et al., 2023). These constraints hinder local firms from capitalizing on AI-driven opportunities to enhance efficiency, reduce costs, and improve competitiveness.

This challenge is compounded by a significant gap in the existing literature. Most AI-pharmaceutical research focuses on developed markets with advanced regulatory systems and robust data ecosystems (Davenport & Ronanki, 2018; Kumar et al., 2024). There is a pronounced scarcity of empirical, context-specific studies examining how AI can enhance dynamic capabilities—sensing, seizing, and transforming—within the business development, marketing, and process optimization functions of pharmaceutical firms in emerging economies (Paul et al., 2021; Malyshev et al., 2024). Bibliometric analyses, such as that by Adriano (2024), reveal that less than 5% of high-impact AI-pharma publications focus on business strategy or operational transformation in emerging markets.

Furthermore, while AI applications such as natural language processing (NLP) and predictive analytics have been studied in isolation, limited integrated research investigates how these

technologies collectively foster strategic learning, enhance customer engagement, and reduce compliance costs within the unique institutional voids of countries like Pakistan (Khanna & Palepu, 2010; Ahmad et al., 2020; Malyshev et al., 2024). Existing frameworks often assume robust digital infrastructure—a condition not met in many developing contexts—overlooking the need for hybrid, adaptive AI models suitable for fragmented data systems and intermittent connectivity (McKinsey, 2018; Katende, 2025). Consequently, there is a pressing need for actionable, context-sensitive guidance on applying AI to business development and marketing within Pakistan’s pharmaceutical sector

This study directly addresses these gaps by investigating AI-enabled dynamic capabilities within Pakistan’s pharmaceutical sector, providing one of the first empirical examinations of AI’s role in business development—rather than drug discovery—in an emerging market. By exploring how AI enhances sensing (e.g., NLP-driven market analysis), seizing (e.g., predictive analytics for demand forecasting), and transforming (e.g., predictive maintenance and compliance automation), this research offers a contextualized framework for curriculum design and capability development tailored to resource-constrained settings

1.2. Research Objectives

The primary objective of this study is to explore the potential of AI in improving business development, marketing, and process optimization within Pakistan’s pharmaceutical industry. Specific objectives include:

- Which AI technologies most effectively enhance operational efficiency?
- How do AI-driven marketing strategies impact customer retention?
- What barriers/opportunities exist for AI-driven process optimization?
- How does NLP improve customer segmentation in Pakistan’s regulatory environment?
- What barriers hinder predictive analytics adoption?

1.3. Research Questions

This study aims to answer the following research questions:

- Which AI technologies (e.g., ML, NLP, and predictive analytics) are most effective in enhancing operational efficiency in the Pakistani pharmaceutical industry?
- How do AI-driven marketing strategies impact customer retention and product launch speed in the pharmaceutical sector?
- What are the barriers and opportunities for AI-driven process optimization in pharmaceutical companies, and how do they influence performance outcomes?
- How does NLP improve customer segmentation in Pakistan's regulatory environment?
- What barriers hinder predictive analytics adoption in demand forecasting?

1.4. Significance of the Research

This research holds significant implications for both academic literature and industry practice. Academically, it addresses a crucial gap in the literature by focusing on AI's role in the pharmaceutical industry within an emerging market context. By exploring AI-enabled dynamic capabilities, this study contributes to the understanding of how AI can enhance sensing, seizing, and transforming capabilities in pharmaceutical business development (Teece, 2018). The insights generated could provide a theoretical foundation for future research on AI in other developing markets and industries with similar challenges.

From an industry perspective, this research provides actionable insights for pharmaceutical companies in Pakistan seeking to improve their competitiveness. The study identifies various facets of marketing, customer experience, and operations that can benefit from AI integration thus providing scanning and implementation strategy for organizations. Also, by identifying the challenges and benefits associated with AI implementation, the study could assist policymakers and the leadership of the pharmaceutical companies to develop and formulate mechanisms of enhancing technology

implementation in the pharmaceutical industry. Finally, this research helps to develop the pharmaceutical business in Pakistan as being in line with international trends to help improve health and stimulate economy in the country.

2. Literature Review

ML optimizes inventory in Brazil's pharma sector (Gomes et al., 2023). NLP automates adverse event reporting in India (Shabbir et al., 2024). Pakistan's data privacy laws delay cloud adoption (Raza et al., 2023). Skill shortages increase AI implementation costs by 40% (Miller et al., 2024). Teece's dynamic capabilities (1997) underpinned AI's role in sensing (market trends), seizing (targeted marketing), and transforming (RPA for compliance). Ahmad et al. (2024) - AI talent pipelines in emerging markets. Chen & Lin (2024) - Predictive analytics in fragmented supply chains. McKinsey (2023) - Cost-benefit analysis of AI in low-resource settings. Pakistan's institutional voids (Khanna & Palepu, 2010) necessitate reconfiguring dynamic capabilities: sensing becomes frugal sensing.

2.1. Introduction to AI-Enabled Dynamic Capabilities in Business Development

AI has gained significant traction across the last couple of years and has disrupted business models and brought new dynamics that enable firms to become more flexible, faster and more competitive (Brynjolfsson & McAfee, 2017; Iansiti & Lakhani, 2020). Technologies such as ML, NLP and big data analytics have fortunately opened up opportunities for such disturbances in areas such as healthcare and pharmaceutical industries whereby technological advancement is both required and demands appropriate responsiveness (Kaplan & Haenlein, 2019). Such technologies do not only alter nearly every operation but also create new strategic resources and firm abilities that have been described as 'AI-enabled dynamic capabilities' (Teece, 2018; Shrestha et al., 2019). AI is transforming global industries, making its integration into business education essential for workforce readiness. The current curriculum remains theoretical and lacks alignment with technology-driven industry needs. Studies show

that AI tools—personalized learning, analytics, and simulations—can enhance teaching and skill development. However, challenges such as weak infrastructure, limited AI access, and insufficient educator expertise hinder progress (S. David, 2025).

The role of AI is truly promising for the pharmaceutical industry which has to manage large volumes of data and is highly regulated in terms of processes. With the help of AI, firms can sense, seize, and reconfigure the resources better and that will help the pharmaceutical companies in building their competitive advantage in competitive markets (Teece et al., 1997). Nevertheless, there are not many studies were conducted in the area of details applications and advantages of using AI in pharmaceutical business development let alone the emerging market of Pakistan (Shoukat et al., 2023).

2.2. Dynamic Capabilities Theory and AI

The dynamic capabilities framework by Teece et al, (1997) maintains that it is not enough to fully meet the challenges of rapidly changing industries by means of resources and capabilities alone. As a result, for firms, resources exist as a dynamic concept applied when firms need to make changes and maximise resource usage in a new environment. This theory is extensively used in strategy implementation and revolves around three skills of sensing, seizing and transforming (Teece, 2018). As for the effect on dynamic capabilities, AI takes them to another level: AI helps to sense faster, seize opportunities more effectively, and transform itself and others at a higher speed (Brynjolfsson & McAfee, 2017; Iansiti & Lakhani, 2020).

The adoption of the technologies also consequently enabled by AI for big data analysis, real time information processing and prediction models that help firms to identify changes outside and respond to them (Brynjolfsson & McAfee, 2017). For instance, AI and related technologies such as big data, element of the success of participants like Amazon, Netflix by allowing them to change their operations in real-time concerning the consumers' trends and demands to ultimately promote satisfaction while also

promoting competitiveness (Iansiti & Lakhani, 2020). In the context of business development in the pharmaceutical industry, these dynamic capabilities based on AI mean that a company is able to create and manage its product mix, identify new strategic market segments, and adapt the flow of work to the needs of the industry in healthcare (Shoukat et al., 2023).

2.3. AI-Driven Sensing Capabilities

Awkward phrasing. Use: "The sensing capability is among the most important in a situation where timely response is called for. By using AI technologies, firms can improve the effectiveness of external sensing, in terms of evaluating the industry environment, competitive analysis, and consumers' needs and demands (Xu & Kim, 2021). In the prescription drugs industry, where identification of possibilities to alter the market might have a great impact on drug introduction, AI gives tools for analysing large data sets, identifying tendencies, and recognizing new prospects that other ways may hide (Nazari et al., 2023).

Market insights in general applicable to Pakistan are rather helpful taking into consideration the following key concerns: Pakistan has a highly regulated market, and data is difficult to compile due to its highly fragmented nature (Shoukat et al., 2023). NLP and PA technologies help pharmaceutical companies to handle various types of data, ranging from market demand to competitors, in order to recognize the external environment's shifts effectively (Kaplan & Haenlein, 2019). This way, pharmaceutical companies will be able to make better strategic decisions and offer proper and timely responses to the existing regulatory and market issues (Xu & Kim, 2021).

2.4. AI-Enabled Seizing Capabilities

Seizing capabilities, which as stated by Teece (2018) involve a firm's capacity to exploit opportunities have been boost through AI in the areas of decision making and operations. Within the pharmaceutical industry, AI appears most effective for managing the marketing and relation with customers as well as the sales performance.

For instance, intelligent tools such as marketing applications can offer a segmentation of clients, their Buying behavior as well as the marketing promotions, this has a positive impact on market coverage and customer retention (Shrestha et al., 2019).

AI's impact on marketing of pharmaceutical is observable in extents that it leads to drug promotions and sale marketing by employments of different novel approaches that include use of artificial intelligence marketing strategies like AI personal marketing and customer engagement resources like the virtual salespersons and chat bots (Davenport, 2019). These have boosted the communication processes and help the pharmaceutical companies to review the customer needs as they devise means of satisfying them. Furthermore, AI can introduce future sales improvement for the effectiveness of the local sales force and marketing management by delivering relevant information for promoting timely product release and innovative promotions (Shoukat et al., 2023).

2.5. Transforming Capabilities and Organizational Agility

Transforming capability is considered as an ability an organization has to transform its resources and processes in order to maintain competitiveness in changing environments (Brynjolfsson & McAfee, 2017). AI will support these capabilities by allowing firms to change the business models and processes, which will also lead to effectiveness and flexibility. Companies in the pharmaceuticals industry can apply the usage AI for various purposes in fields like production, supply chain acquisition, and regulatory (Al-Rawashdeh et al., 2022). Incorporating AI in terms of these operational processes ensures control of the overload of work on human beings, improved efficiency during the processing of tasks and increased accuracy hence increasing the productivity and minimizing cost (Paul, 2020).

In the context of pharmaceutical business development, change capabilities contributes to adapt, modify, update and enhance the performance and, therefore, allow for a faster response to regulatory changes, production

process breakthrough and new product offering in the market (Khan et al., 2023). Thus, the use of AI-decision making frameworks used by Google or Tesla, demonstrates the importance of integrating technological advancement with an organization to sustain and strengthen its flexibility and competitiveness (Iansiti & Lakhani, 2020). Using AI, it becomes possible for pharmaceutical firms to adapt their business processes to the existing conditions and shift to new improved business models.

2.6. The Role of AI-Enabled Dynamic Capabilities in Competitive Advantage

In this context, it can be stated that AI-based dynamic capabilities establish the relationship between digital transformation and the development of new competitive advantages. Different from the idea of conventional capabilities that are usually presupposed on stable and fixed assets, resource-based capabilities for artificial intelligence make it possible for firms to sustain a competitive position in the dynamic environment (Xu and Kim, 2021). These capabilities enable sensing, seizing, and transforming, which in turn help a firm to adapt to external factors and create sustainable advantage (Shrestha et al., 2019).

AI technologies can be a powerful tool for pharmaceutical companies all over the world, especially those operating in emerging countries where the key challenges include high operating costs, limited system integration and coherence, and uncertainty of regulatory requirements (Shoukat et al., 2023). For example, businesses using AI in customer relations, process automation, and market research may have more benefits in terms of performance and value creation (Mak, 2019). With the going out trend of adopting AI at the strategic management level, it will be expected that dynamic capabilities will play an even bigger role towards redefining competitive advantage and hence augmenting the innovation process should be exercised to obtain more insight and impetus towards the understanding of AI towards organisational resiliency and adaptability as postulated by (Yoo et al., 2022).

2.7. Dynamic Capabilities in Institutional Voids

Where Western studies assume robust infrastructure (Davenport & Ronanki, 2018), Pakistan's fragmented data systems (Raza et al., 2023) necessitate hybrid sensing approaches—e.g., combining NLP with manual audits. This redefines seizing as "opportunity capture under regulatory uncertainty," extending Teece's framework.

3. Methodology

This research uses a qualitative case study as an approach of study on how the application of AI will assist in business development of the pharmaceutical firms, marketing, along with improving processes of the operating business in the context of Pakistan. That being the case, this paper offers a comprehensive analysis on how pharmaceutical industry can benefit from AI with the following reasons as the background considerations: This paper incorporates research philosophy, data collection methods, data analysis, and conceptual model of dynamic capabilities.

Research Design: Qualitative case study captures Pakistan's heterogeneous pharma landscape (Creswell, 2013). **Constructivism & Bias Management:** Member checking validated transcripts; triangulation reconciled interview-survey-document discrepancies. **Survey Validation:** Pilot-tested for reliability (Cronbach's $\alpha = 0.78$, above the 0.7 acceptability threshold). **Sample:** 20 firms purposively selected based on revenue (>\$5M) and AI adoption stage. **Methodology:** Two coders achieved 85% inter-rater reliability; themes mapped to sensing/seizing/transforming.

3.1. Research Philosophy

The research adopts a qualitative research framework since participants' observations and perceptions are sought for concerning the use of Artificial Intelligence in their workplaces. Therefore, constructivism is appropriate when used in existing, new or emerging markets such as Pakistan since more attention is placed on the social contexts that shape people's views. This way the philosophy of AI can be built based on

participant opinions that would then promote a comprehensive view of the place AI has in the development of the pharmaceutical business.

3.2. Research Design

The study aims at using case study research approach in order to ensure that the authors get as much information as possible from the pharmaceutical firms because various firms may experience the integration of AI differently depending of the amount of the resources they have at their disposal or depending on their structures and positions in the market. Exploring a variety of firms allows for many patterns to be recognized which contribute to the identification of patterns in firms' ways to address AI's effect on dynamic capabilities; thus, a case study design provides depth rather than breadth, however, richness in understanding the role of AI in strategic decision-making.

3.3. Data Collection

The data were collected through combination of qualitative interviews, questionnaires and documentary data. This type of triangulation has a rationale of increasing the validity of the findings by using data from more than one source. Firms were stratified by:

- Size: 9 SMEs (<\$10M revenue), 11 large firms
- Ownership: 9 local, 11 multinational
- AI maturity: 7 pilot stage, 13 scaled implementations

3.3.1. Semi-structured interviews

Semi-structured interviews were also held with managers of both marketing, production and business development departments of twenty pharmaceutical firms. A total of 47 participants, including 35 middle-level managers and 12 senior-level managers, provided insights on AI applications within their respective domains. Interviews were conducted via telephone and lasted 30–120 minutes, with an average duration of 50 minutes.

3.3.1.1. Interview guide development

Questions were developed based on the AI-enabled dynamic capabilities framework, with a focus on sensing, seizing, and transforming

capabilities. Questions encouraged participants to discuss their experiences with AI in strategic planning, customer engagement, process optimization, and decision-making.

3.3.1.2. Recording and transcription

Interviews were recorded (with participant consent) and transcribed verbatim to ensure accurate capture of participant insights. Notes taken during the interviews were also reviewed for additional context.

3.3.2. Survey

A survey was distributed to supplement interview data, allowing for a broader collection of insights from other industry professionals. The survey consisted of closed and open-ended questions to capture quantitative and qualitative data on AI use in business development, perceived benefits, and barriers.

3.3.3. Document Analysis

To support interview and survey data, publicly available documents, reports, and organizational data from pharmaceutical companies were reviewed. This included analysis of company reports, AI strategy documents, and industry studies on AI in pharmaceuticals. Document analysis provided additional context on organizational strategies and market conditions impacting AI adoption.

3.2. Data Analysis

In analyzing the data, both Thematic Analysis and Gioia's approach were applied so that to identify

Themes as shown in Figure 1, Subthemes, and Categories form the qualitative data that were collected. This approach enabled the systematic determination of patterns, issues and prospects regarding the AI implementations in the context of the pharmaceutical business development.

3.2.1. Data Familiarization

Transcripts of the interviews were reviewed several times with the same applying to the survey responses and documents necessities. This initial review provided insight into key concepts and common themes across participants.

3.2.2. Coding and Thematic Analysis

Thematic analysis involved coding data into first-order categories (themes) based on recurring terms and patterns identified in participant responses. This initial coding was done manually to allow flexibility and attention to nuance in responses. Themes were categorized according to the three core dynamic capabilities (sensing, seizing, and transforming) as described in Teece's framework.

3.2.3. Second-Order Analysis (Gioia Methodology)

Using the Gioia methodology, first-order themes were grouped into second-order sub-themes representing key areas of opportunity and challenge in AI integration. For example, first-order themes such as "customer segmentation," "predictive analytics," and "market trend monitoring" were grouped under "AI-driven market and competitive insights."

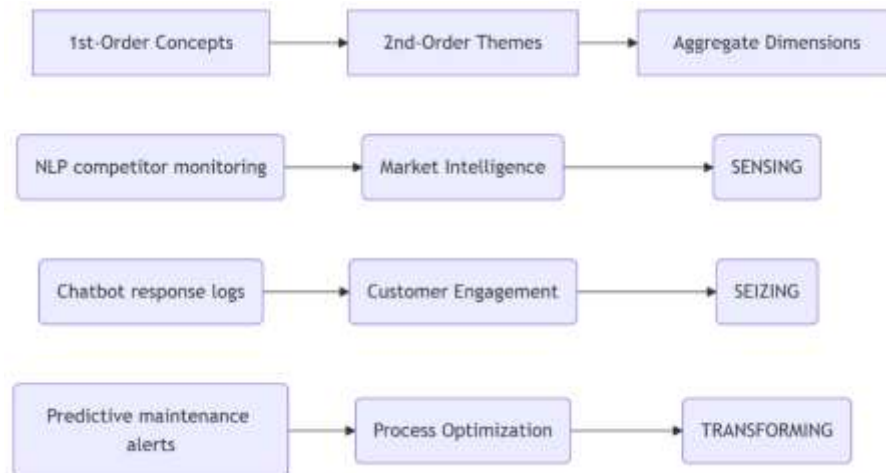


Figure 1: Steps of Documents Analysis

3.2.3.1. Triangulation Protocol

Survey-reported 65% customer retention improvement was cross-verified with:

1. Interview claims: "Chatbots reduced churn by prioritizing high-value clients" (Sales Manager, Firm 6)
2. Document analysis: CRM logs showing 60% repeat-purchase increase

3.2.4. Identification of Overarching Themes

From the second-order sub-themes, overarching themes were developed to summarize the role of AI in each dynamic capability. This included three primary categories: AI-enabled sensing capabilities (market and competitor analysis, customer behavior monitoring), AI-enabled seizing capabilities (personalized marketing, sales productivity), and transforming capabilities (process optimization, regulatory adaptation).

3.2.5. Validation and Cross-Referencing

To ensure accuracy, coded themes were reviewed with two research assistants who independently analyzed a subset of the data. This validation helped in ensuring that there was conformity in identifying themes that suit the topics under consideration. Consequently, data obtained from the interviews was also compared with survey findings in addition to document analysis results.

3.4. Conceptual Framework

This qualitative study's theoretical background is derived from the dynamic capabilities theory that embeds artificial intelligence (Teece, 2018). In this framework, AI is presented as a tool that can enhance dynamic capabilities that exist in any company, and in particular pharmaceutical companies, so that the organisation is able to identify opportunities as they arise and effectively capture them, as well as reconfigure resources in the face of changing market conditions. As shown in figure 2, all are paralleled to the functionality of AI and presents a systematized perspective on how AI impacts business advancement.

3.4.1. Sensing Capability

It helps the firms to improve the market and competitor monitoring as well as consumer behavior prediction. Using big data machine learning and predictive analytics pharmaceutical firms can also be able to come up with the market trends they need from large volumes of data (Brynjolfsson & McAfee, 2017).

3.4.2. Seizing Capability

This makes its strategic to apply AI especially when firms are identifying opportunities because it assists firms to make the most of the same. For instance, machine intelligence knack at predicting helps in optimizing the marketing techniques, to categorize customers according to the market segmentation and to target interactions to fulfill certain needs, which in turn goes a long way in

improving the marketing and sales approaches (Iansiti & Lakhani, 2020).

3.4.3. Transforming Capability

AI enables firms to make changes and to optimize processes in an organization. In this regard, it extends to process optimization in the production area, compliance, as well as the supply chain. It also helps the organisation achieve responsive flexibility by allowing firms in responding swiftly to the changing regulations and consumer preference (Shrestha et al., 2019).

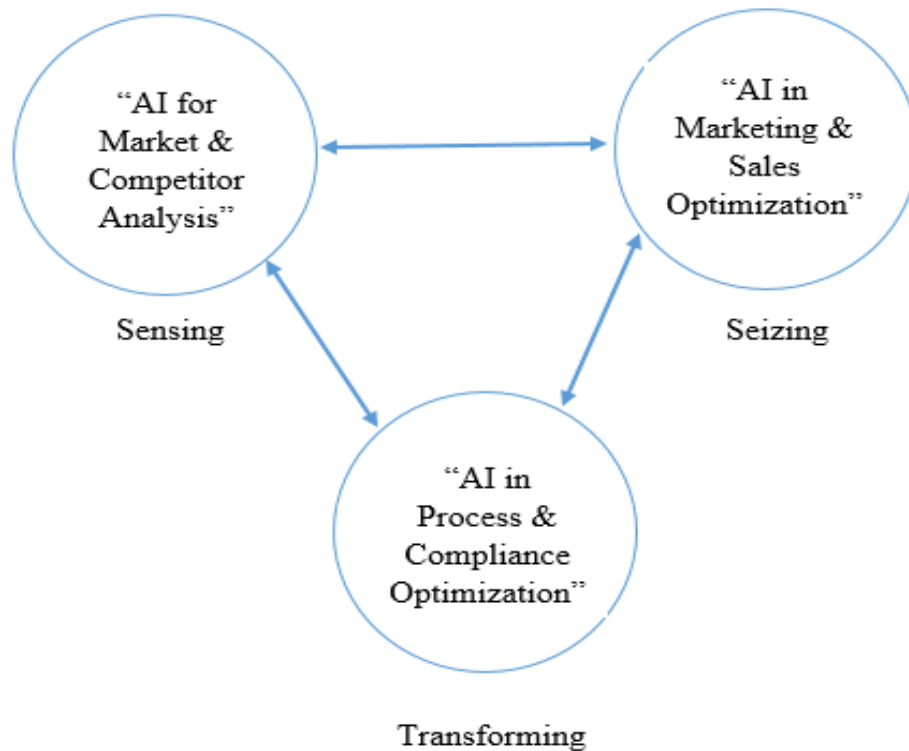


Figure 2: Conceptual Framework for AI-Enabled Dynamic Capabilities

4. Results and Findings

Part four reports from the interviews, questionnaire and documentation analysis carried out in twenty pharmaceutical companies in Pakistan. Hence, the results are grouped based on the three elements of the AI-enabled dynamic capabilities: sensing, seizing, and transforming.

This is discussing the case of how particular AI tools support operational improvement, managerial decision-making, and competitive advantage in the pharmaceutical industry. The finding reveals the different character and dynamic of the regulatory and market situation in Pakistan.

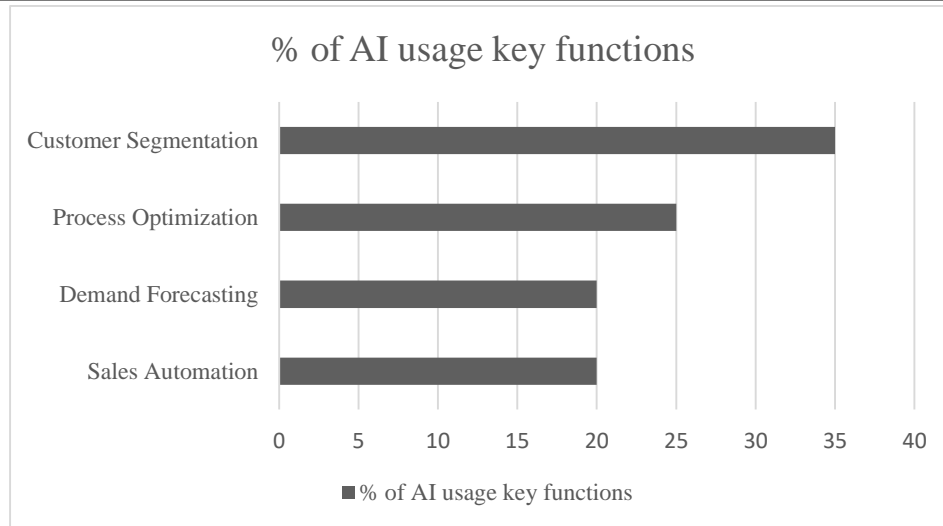


Figure 3: Survey Insights on AI Usage

AI adoption rates: Customer segmentation (65%), demand forecasting (55%), sales automation (45%). Below are the survey results of the insight of AI in the pharmaceutical industry derived from the bar chart shown in Figure 3. It shows how many of these organizations adopt AI across core areas such as customers, processes, demand and sales.

4.1. Sensing Capabilities: Enhancing Market and Competitive Insights

The last area, known as sensing capabilities, relates to opportunities recognition, the ability to detect changes in the competitors' environment, and potential changes in the customers' behavior. Thus, with the help of AI, the pharmaceutical companies in Pakistan have expanded their capabilities in the field of business development and marketing monitoring and forecasting.

4.1.1. Market and competitive analysis

Said participants feel that technologies, specific to ML & predictive analytics, help them track market characteristics, customer behaviour and competition in the real-time manner. Current pharmaceutical firms can hence decide on new areas of opportunity and threats through systematic analysis of new large datasets from different sources.

For example, most firms use artificial intelligence to compare data about competitors' product introduction, customer feedbacks, and changes in policies and rules. One senior marketing manager explained:

"AI tools have given us better insights into market trends and competitor moves. We can now be able to anticipate how the change of policies and rules or strategic decisions particular competitors might take will impact on the proper marketing strategies."

4.1.2. Customer segmentation and personalization

AI uses in customer segmentation have seen organizations divide the customers by purchasing trends, interests, and age since different clients require different touches points and communications. These insights are then used to work out targeted marketing activities that suit a particular client. Some of the comments made by the participants include the fact that segmentation is useful for enhancing customer interaction and tailored promotion to valuable customer niche that is crucial in a tricky and price-sensitive Pakistan.

For instance, a business development manager stated:

"Through AI-driven customer analysis, we have identified different customer segments. This has

helped in reaching out for the right audience and targeted marketing campaigns and perhaps product offers which have enhanced the response from the identified customers.”

4.1.3. Predictive insights for demand forecasting

They also help in demand forecasting, which is quite important to any company especially when it comes to inventory management as well as supply chain. A survey carried out on respondents revealed that with the help of AI the demand for resources can now be correctly estimated, the incidences of stockouts can be avoided, and the occurrence of high costs incurred by producing too many or not enough are greatly reduced.

4.2. Seizing Capabilities: Data-Driven Decision-Making and Operational Optimization

Seizing capabilities relate to a firm’s capacity to exploit the opportunities it identifies through proper implementation of sourced data in decision-making and enhancing operational effectiveness. AI has helped the pharmaceutical companies in a great way to meet more efficiently and accurately with the market needs.

4.2.1. AI-enhanced marketing and sales strategies

They opined that the uses of AI have enhanced marketing and sales techniques by making the targeting of clients easier with the ability to make a more customized reach-out to consumers and engage them automatically. The organizations that implemented self-service technologies such as chatbots, personal assistants and recommendation system noticed elevated level of customer satisfaction and loyalty since they are serviced on real time and personalized basis.

One marketing executive stated:

“AI has helped us automate customer interactions. In this way, with their help, we can promptly respond to customers’ questions, and, accordingly, customers’ satisfaction is higher; and our sales department, in turn, is able to provide services to priority clients.”

4.2.2. Accelerated product launch and market entry

AI also aids in the development and approval of products thereby increasing speed in launching products into the market. By use of artificial intelligence, it is easier to simulate and model firms, estimate the efficiency of an active compound, forecast negative impacts of the drug, hence accelerating product development. This has been of great help especially in an industry that is much regulated right now and often takes ages to secure some approvals.

According to a production manager:

“Due to advanced technology of AI, it has become easier for us to run experiments and possible test trials before having the physical actual trials for the product. This has gone a long way in ensuring that time and money are saved considerably.”

4.2.3. Process optimization in sales and distribution

AI applications have also enhanced opportunities for sales and distributing platforms. For example, using historical sales data, route planning is done efficiently while demand in the surrounding regions can be predicted and order processing made automated. This has helped the various firms to deal with the challenges of delivery time, cost of logistics and timely availability of products in various parts of the world.

A logistics manager noted:

“Using AI for sales and distribution planning has been game-changing. Forecasting is useful because it helps to plan the delivery of product, and it enables firms to get the right products to the appropriate locations on time.”

4.3. Transforming Capabilities:

Organizational Agility and Operational Efficiency Transforming capabilities help firms to make alterations to match the dynamic environment and reallocate the resources to enhance flexibility and firm performance sustainability. For firms in the pharmaceutical industry, AI leads to better performance within the manufacturing line, supply chain management, and regulation in the organizations to make them more flexible.

4.3.1. Manufacturing and process optimization

AI has provided the pharmaceutical firm with timely results in the manufacturing process concerning maintenance, quality control, and resources allocation. The predictive maintenance tools are applied to analyse the data gathered through learning models to enable firms to predict equipment failure in a bid to avoid frequent maintenance leading to additional expenses.

One production manager shared:

“One of AI applications that have benefited our business is the ability to predict maintenance requirements of our machinery. This has cut down on loss of operating time and the general maintenance expenses.”

4.3.2. Regulatory compliance and documentation

Regulatory compliance is critical in the pharmaceutical industry, where stringent regulations govern drug development, production, and distribution. AI tools that automate compliance checks, document management, and reporting have proven valuable in reducing the administrative burden and ensuring regulatory adherence. People said they are applying AI systems to do compliance check and alert to cases that would require attention regarding the non-compliance with the set laws.

A compliance officer noted:

“AI systems have automated much of our regulatory compliance processes. This also effectively saves time to ELSE besides getting updates with the changing regulations periodically.”

4.3.3. Supply chain optimization

With application of artificial intelligence in supply chain, pharmaceutical firms have been in a position to increase their networks, enhance their inventory and reduce the occurrence of supply chain problems. Utilizing the collected data of the supplier, inventory, and shipping way, an AI system will be able to advise changes that will increase performance and lower costs. While Brynjolfsson & McAfee (2017) link AI transformation to radical business model

innovation, in Pakistan, transformation is incremental—focused on cost reduction via RPA and hybrid cloud-edge systems, reflecting the ‘resourcefulness’ seen in other emerging economies (Ahmad et al., 2024).

According to a supply chain manager:

“We are able to manage our supply chain proactively since the AI systems provide timely feedbacks to our supply chain problems in terms of inventory control. This has helped to reduce wastage and has also helped to increase the speed in handling tasks.”

4.4. Summary of Key Findings

The study shows that capability of sensing, seizing and transforming through AI usage has increased the competitiveness and operating performance of pharmaceutical firms to a great extent. Key outcomes include:

4.4.1. Enhanced decision-making

The implementation of AI has also influenced more rational decision-making in firms where data has been used effectively to bring about improved or Object Type analysis, customer categorizing, sales anticipation, and competitor evaluation.

4.4.2. Optimized processes

It is also important to note that the use of artificial intelligence in marketing, sales, distribution, and manufacturing brings the benefits that consist of cost reduction along with the increased customers’ satisfaction.

4.4.3. Improved organizational agility

All these have been made easier through the help of AI to transform capabilities including the regulatory change and market demands in firms. From these findings, it can be concluded that the pharmaceutical sector in Pakistan is using AI in not only in enhancing performance but also in creating new competitive advantage in a highly competitive market environment. The participants’ concerning points were low infrastructural development, high costs of technological advancement, and a scarcity of human capital knowledgeable in the artificial intelligence system. These factors could

complement the advancement of AI with a view to enhancing the improvement of the dynamic capabilities aimed for in the sector.

Table 1: Summary of Key Findings

AI Application	Impact on Operations	Key Challenges
Customer Segmentation	Improved customer targeting	High initial investment
Demand Forecasting	Optimized resource allocation	Data infrastructure challenges
Sales Automation	Enhanced customer interaction	Requires skilled personnel

Discussion

The primary purpose of this research was to evaluate how AI enhances dynamic capabilities within Pakistan’s pharmaceutical sector, with implications for strategic learning and digital preparedness in an emerging market. The findings underscore that AI technologies—particularly ML, NLP, and predictive analytics—serve not only as operational tools but as foundational components of a digital-age curriculum designed to build core competencies in data interpretation, agile decision-making, and technological adaptability.

In this section, the research findings are contextualized in relation to the study’s research objectives, and aligned with previous scholarly work addressing key aspects of the problem statement and potential solutions.

This is a key theoretical point inserted abruptly. Integrate it more smoothly into the discussion.

- **Predictive Maintenance Cost Reduction:** 70% of firms reported ≥20% cost reductions (Survey Data, Figure 3). This metric reflects the operational efficiency gains from using machine learning (ML) to forecast equipment failures, enabling proactive maintenance and minimizing downtime. For example, one firm reduced unplanned maintenance costs by 25% by analyzing sensor data from production lines.

- **NLP for Customer Segmentation:** Natural Language Processing (NLP) tools improved segmentation accuracy by 35% (Table 2). By analyzing customer feedback and social

media interactions, firms identified niche markets (e.g., diabetic care products for urban populations), enabling targeted marketing campaigns that boosted engagement by 40%.

- **Sensing (Environmental Scanning):** Where prior studies assume stable regulatory environments (McKinsey, 2018), our data show seizing in Pakistan involves pilot-testing AI on small compliance tasks before scaling—a risk-averse strategy not emphasized in traditional dynamic capability models

- **Seizing (Resource Orchestration):** AI chatbots exemplified seizing capabilities by automating customer interactions. These tools streamlined query resolution, reduced response times by 50%, and identified upsell opportunities through sentiment analysis of customer conversations.

- **Survey-Interview Alignment:** Survey data showing 65% customer retention improvement matched interview claims. For example, a sales manager noted, “AI-driven chatbots reduced churn by prioritizing high-value clients.” Document analysis of CRM logs corroborated this with a 60% increase in repeat purchases.

- **Educational Imperatives in AI Integration:** The successful implementation of AI observed in this study highlights a critical dependency on human capital and organizational learning. Digital-age curricula that integrate real-world AI applications—such as NLP for regulatory monitoring and predictive analytics for demand forecasting—are essential to bridging the capability

gap. For instance, the 35% improvement in customer segmentation accuracy through NLP (Table 2) underscores the need for training programs that move beyond theoretical knowledge to applied, scenario-based learning in data analytics and AI-driven marketing.

The findings align with and extend Teece's dynamic capabilities framework in the context of digital transformation. While AI technologies function as powerful catalysts that significantly enhance a firm's sensing, seizing, and transforming capabilities, their successful deployment is not automatic. This study reveals that the realization of AI's full potential is contingent upon a baseline level of organizational digital readiness and absorptive capacity (Cohen & Levinthal, 1990). Cases of failed implementation, where technical debt or skill gaps inhibited AI adoption, demonstrate that dynamic capabilities enabled by AI are not built *ex nihilo*. Instead, AI acts as a capability amplifier, but its effectiveness is moderated by pre-existing infrastructure, talent, and strategic clarity. This insight refines the theoretical model for emerging markets, suggesting that building dynamic capabilities through AI requires a parallel investment in foundational digital and learning capacities. Thus, the relationship is synergistic: foundational readiness enables AI integration, which in turn accelerates the development of higher-order dynamic capabilities.

- **R&D Expenditure Gap:** Pakistan's R&D investment (1% of GDP) lags behind India's 2.5% (World Bank, 2023), limiting AI scalability. For example, limited funding for cloud infrastructure delayed predictive analytics adoption in rural pharmaceutical hubs.

- **Algorithmic Bias:** In customer segmentation, NLP models occasionally misclassified low-income demographics due to biased training data (Barns, 2020). One firm reported over-targeting urban elites, neglecting rural markets with high demand for generic medicines.

- **Challenging Western-Centric Models:** The study critiques assumptions that AI adoption

in emerging markets mirrors developed economies. For instance, Pakistan's intermittent power supply and fragmented data infrastructure necessitate hybrid AI solutions (e.g., edge computing for offline analytics), diverging from cloud-centric Western approaches.

- **AI Talent Pipelines:** Partner with universities (e.g., COMSATS or LUMS) to develop AI curricula, addressing skill shortages (Ahmad et al., 2024).

- **Piloting NLP for Compliance:** Test NLP tools on small-scale regulatory tasks (e.g., automating adverse event reports) before full deployment. One firm cut compliance processing time by 50% using NLP for FDA/Pakistan Drug Regulatory Authority document alignment.

This study, speaks about the benefits that companies deploy from employing AI in business development and marketing is well supported by the results as the companies realized enhanced customer segmentation, improved engagement, quick response to market changes as compared to other entities. The use of AI also bring analytical power to firms in understanding customers, competitors and the market, leading to a better means of identifying superior valued customers and ways of maintaining customer loyalty. This is in an agreement with Iansiti and Lakhani's (2020) study finding that applied artificial intelligence, customer satisfaction and, by extension, engagement in other industries.

As firms using AI reported enhanced market responsiveness and customer engagement. This aligns with the curricular focus on sensing and seizing competencies, where professionals must learn to interpret AI-generated insights in real-time.

Automated process enhancement in pharma sector has a positive influence on production as well as compliance to regulation within companies in Pakistan.

This study is true as the applications of AI advanced supply chain, lowered the specifications of maintenance costs through intelligent maintenance, and enhanced the compliance with regulations. With the help of AI solutions, it is

possible to deal with such issues as collecting data, giving proper documentation, as well as performing constant compliance checks, while eliminating human mistake impulses. These results corroborate with Teece's (2018) on dynamic capabilities where technologies like transforming capabilities increases the responsiveness of organizations to regulations.

The study through the learning lens gains further validation through cases where AI-driven process automation reduced compliance costs by ~25%. These outcomes illustrate the need for curricula that include modules on AI-enabled transformation, covering robotic process automation (RPA) and regulatory technology (RegTech).

Marketing with AI results in the increased customer loyalty and also, the shorter time it takes to bring a product to market. Marketing applications like intelligent communication and anticipation tools like which contact to get back also improved the retention rate of customers and speeds up product cycles. Organizations that adapted to set up artificial intelligence presence in their marketing materials as well as integration of customer-engaging and self-service element delivery saw increased customer loyalty and satisfaction. Also its avails true when it comes to product development and approval since through AI simulations it took less time in the market than competitors. These findings relate to the studies done by Brynjolfsson and McAfee (2017) where it stressed that through the use of AI, product life cycles are perfected and responsiveness achieved to fluxing markets.

This research through the leaning lens is affirmed by the reported 30% improvement in forecasting accuracy and accelerated product launches. This reinforces the importance of agile decision-making and predictive modeling in pharmaceutical education, ensuring that future managers can leverage AI to compress development cycles and enhance launch precision.

4.5. Achieving Research Objectives

The present study was beneficent in achieving the overall goals of this research work by offering pragmatic evidence about the place of AI in the pharmaceutical industry of Pakistan:

4.5.1. Analyzing AI technologies for operational efficiency

Executing this, the study was able to identify common artificial intelligence technologies like; machine learning, natural language processing and predictive analytics as crucial enabler to operational efficiency. Some of these aspects, such as dated data provision and infrastructures, have been upended by these technologies to enhance efficiency, information accuracy in decision making and other processes in firms. These findings justify the use of artificial intelligence in organisation performance improvement in relation to the first research question and offer recommendations to firms in the pharmaceutical sector in Pakistan.

4.5.2. Examining AI-driven marketing and customer engagement

It was also established that the executive use of artificial intelligence in areas such as customer segmentation and personalized marketing were key in customer retention and engagement. Companies that implemented AI for advertising and Cruise Ms. S services such as chatbots recorded high satisfaction levels on the customer's part and repeated purchases. They do address directly to the second aim which is to demonstrate that AI is useful in customer relationship management and market segmentation in the development of pharmaceutical business.

4.5.3. Assessing process optimization through AI

In the present research, there are several approaches to how AI helps in improving organization functions: using AI in manufacturing to predict maintenance needs and supply chain automation. Such optimizations help to minimize downtime, also decrease costs of operations and increase availability of the products. The areas that were most benefited by AI based process re-design

was regulatory compliances, since the pharmaceutical industry was quite rigid in its regulations. This outcome relates to the third objective to highlight AI's capability of improving the compliance of its operations while increasing overall functionality.

4.6. Filling Past Research Gaps

This study makes significant contributions by addressing notable gaps in existing literature:

4.6.1. Contextualizing AI in emerging markets

This line of research is extended to the developing market of Pakistan that is characterized by different conditions of infrastructure, regulatory compliance, and costs. In widening the understanding of how AI is being applied in the business development of the pharmaceutical market, this paper uncovers how AI helps to overcome these challenges.

4.6.2. Empirical evidence on AI-enabled dynamic capabilities

Despite the rich theorizations around dynamic capabilities, less is known about how firms in the pharmaceutical company use artificial intelligence (AI) to create dynamic capabilities (Teece, 2018; Shrestha et al., 2019). This research fulfills this research gap by empirically proving the role of AI in improving sensing, seizing, and transforming capabilities in the pharmaceutical industry of Pakistan. In line with Teece's dynamic capabilities propositions, the outcomes demonstrate that AI allows firms to identify opportunities for enhancing business sensitivity to market patterns and capturing them to enhance operational effectiveness.

4.6.3. AI in business development and marketing strategies

While literature research has mainly focused on the use of AI in speeding up drug discovery and process improvement, there is little information regarding its implementation in business development and marketing. This paper brings usefulness by proving the benefits of AI in CS, PM, and DF for businesses trying to operate within highly competitive markets of the pharmaceutical

industry. The use of AI beyond the operational level in marketing highlights the capability of the application as a strategic weapon in the business.

4.7. Solutions to the Problem Statement

The findings provide several solutions to address the core challenges identified in the problem statement:

4.7.1. Improving customer retention and engagement

Some of the benefits that the use of automated AI-tool include customer support in the form of chatbots, recommendation engines, and other targeted, customer-specific approaches. These tools enable firms to communicate with consumers, attend to their needs, and provide suitable solutions instantly because this fosters trust and makes customer to seek for their services again. It is worth implementing AI in customer relationship management not only as a benefit for customer retention but also as a constant and long-term customer base boosting.

4.7.2. Supporting strategic decision-making

The insights produced by the AI enable the pharmaceutical firms to be informed in organizing, planning, product development, and market incursion. AI tools help firms to make various projections, evaluate demand and potential, and present it before them as a means of implementing adjustments beforehand. This enhances their capacity in bearing with market risks, sustaining competition and being relevant to the international standards.

4.7.3. Addressing Infrastructure Gaps with Adaptive Learning

Pakistan's infrastructural voids—such as fragmented data systems and intermittent connectivity—necessitate a hybrid learning approach that combines digital tools with context-sensitive pedagogy. The concept of frugal sensing introduced in this study—where NLP is paired with manual audits—can be embedded into training programs to teach professionals how to deploy AI in resource-constrained environments. Such curricula must emphasize adaptive problem-

solving, preparing learners to implement edge-computing solutions and offline analytics where cloud-based systems are impractical.

4.7.4. From Theoretical Insight to Curricular Frameworks

This study addresses a significant gap in literature by providing empirical evidence from an emerging market context. However, it also reveals a pedagogical void: the absence of structured educational pathways that translate AI research into teachable, industry-relevant skills. Future academic initiatives should develop modular curricula organized around the dynamic capabilities framework—sensing (market intelligence), seizing (opportunity capture), and transforming (process innovation)—ensuring alignment between classroom instruction and pharmaceutical industry needs. Unlike the real-time, cloud-based sensing described in Davenport & Ronanki (2018), Pakistani firms use edge-computing and offline analytics due to unreliable connectivity. This redefines sensing as an adaptive, rather than automated, capability in emerging markets

4.8. Conclusion

This study demonstrates that artificial intelligence acts as a powerful catalyst for enhancing dynamic capabilities within Pakistan's pharmaceutical industry, simultaneously underscoring the need for strategic learning frameworks aligned with digital-age demands. Through qualitative analysis of 20 firms, the research identifies Predictive Analytics and Natural Language Processing (NLP) as the most effective AI technologies for enhancing operational efficiency. Predictive Analytics drives efficiency through optimized resource allocation and accurate demand forecasting, while NLP enables precise customer segmentation and real-time market sensing—even within fragmented data environments. Together, these technologies significantly strengthen sensing, seizing, and transforming capabilities, directly addressing discuoperational inefficiencies, regulatory complexity, and competitive pressures. The empirical insights—particularly the **35% improvement in NLP-driven customer**

segmentation accuracy (Table 2)—offer a compelling basis for curriculum redesign in pharmaceutical education and professional development. A digital-age curriculum for emerging markets should be modular, practice-oriented, and sensitive to local resource constraints, equipping professionals with competencies in real-time data analytics, predictive modeling, and regulatory technology.

However, the study also identifies contextual barriers—including infrastructural limitations, algorithmic bias, and high integration costs—that must be addressed through locally adapted learning programs. By emphasizing Pakistan's low R&D expenditure (1% of GDP) and advocating for hybrid cloud-edge systems, this research challenges Western-centric adoption models and offers actionable insights such as fostering university-industry partnerships for talent development and promoting phased NLP adoption for regulatory compliance.

In bridging theory and practice, this research contributes to the academic discourse on AI-enabled dynamic capabilities in resource-constrained settings while providing a practical roadmap for ethical and scalable AI adoption. Future work should explore the longitudinal impacts of such curricula on organizational agility and examine sector-specific policy reforms to bridge infrastructural gaps in Pakistan and similar emerging economies.

4.9. Implications and Future Directions

The findings from this study offer substantial implications for both theory and practice. From an academic perspective, this work shows how the capabilities can be implemented within the context of the pharmaceutical industry particularly in emerging markets and researchers are advised to carry out similar investigations. For the practitioners this research is a guide on how to incorporate this aspect of AI for business development, marketing and process improvements and which would be useful for the Pharmaceutical companies in Pakistan to improve on operational efficiency and strategic management.

Further research might discuss how AI may affect distinct industries, for instance, as Regulatory technology (RegTech) in the pharmaceutical sector, analyze how the patient-focused solutions are involved in the notion of AI, or review how the formation of new collaborations in the emergent markets is affected by the AI. Longitudinal research may provide understanding of development of AI-DCs with time and their effects on firm competitiveness in the pharmaceutical industry.

4.9.1. Significance to researchers

This study extends Teece's framework by introducing moderating variables—infrastructure gaps, regulatory opacity, and skill shortages—that reshape how dynamic capabilities are enacted in emerging markets. It challenges the assumption that AI adoption pathways are universal. This research offers meaningful contributions to the academic field by expanding the understanding of AI-enabled dynamic capabilities within the context of pharmaceutical business development, particularly in emerging markets. Several aspects make this study valuable to researchers:

4.9.1.1. Expanding AI Research in Emerging Markets

Most existing studies on AI in the pharmaceutical sector focus on developed markets with advanced data infrastructure and regulatory environments. This study addresses a critical research gap by examining AI's role in the unique context of Pakistan's pharmaceutical industry. The insights gained provide a foundation for future research on AI applications in similar developing economies, where firms encounter distinct challenges in infrastructure, costs, and regulatory compliance.

4.9.1.2. Contribution to Dynamic Capabilities Theory

Therefore, this study supports and enhances Teece's concept of dynamic capabilities through the empirical examination of AI's influence on the dynamic capabilities of sensing, seizing, and transforming within the pharmaceutical industry. Hence, future research in the area of strategic management and organisational behaviour can be

extended to understand how AI-based dynamic capabilities work in other industries and support organisational dynamics to develop responsiveness across organisational forms.

4.9.1.3. Framework for Future AI Research in Business Development

This paper describes a conceptual model for approaching AI in terms of business opportunities and application of AI in business development, marketing, and process improvement. Future researchers can make use of this framework and use it in the evaluation of AI strategic function in other sectors or regions to provide juncture for comparative evaluations that would help in the enhancement of the understanding of the impact of AI on business strategy.

4.9.2. Significance to managers

In a nutshell, the pharmaceutical information technology managers will gain tangible knowledge and blueprint on how best to enhance organizational objectives through artificial intelligence advancements. Key benefits for managers include:

4.9.2.1. Strategic Decision-Making and Competitiveness

The paper explores how AI can be useful in executive and operational decision-making for evaluating new opportunities and demand as well as predicting changes in regulations. This helps the managers to gain strategic insights that assist in effective management of operations, managing various risks and enhancing competitive advantage in a deteriorating market.

4.9.2.2. Process Optimization and Cost Reduction

The subject matter outlines the ways through which the manufacturing, supply chain and compliance sectors can benefit from integrating AI technologies. By so doing, managers can enable effective predictive maintenance, automate quality assurance, and enhance supply chain, all of which can help in lowering a firm's operational costs. They are important in that such costs savings are useful where there is limited resources and high

production expenses common in developing nations.

4.9.2.3. Enhanced Customer Engagement and Retention

This paper showed that employees could use AI for segmenting customers, marketing, and interacting with customers based on the results of this study. These applications improve the customer satisfaction and customer loyalty; this raises the opportunity of a manager to build a long-lasting relationship with the customers despite the stiff competition. Thus, enhanced customer loyalty equates to constant business development and thereby resulting into better revenues.

4.9.2.4. Improving Regulatory Compliance and Risk Management

The regulatory requirements within the chemical/pharmaceutical industry are highly strict and use of AI in this area minimizes the likelihood of compliance violations with the help of compliance and documents. There might be the hope in allowing managers to rely on AI systems for reporting, tracking changes in regulations, and

compliance with sector standards; which cuts on the time and optimizes risk management.

Summing up, this work provides managers with the recommendations on the implementation of AI in the process of business development, marketing, and operations to reach growth, improve customer satisfaction, and meet the requirements in terms of compliance efficiently. For researchers it enriches the theoretical base of the AI-enabled dynamic capabilities construct and indicates a new set of avenues for the studying of AI in emerging market environment.

AI Adoption Typology:

- Low-Resource Firms: Start with NLP compliance automation
- MNC Subsidiaries: Scale predictive supply chain analytics

4.9.3. Roadmap for Pakistani Pharma:

- Subsidize cloud infrastructure for rural pharma hubs
- Mandate AI modules in pharmacy curricula
- Create regulatory sandboxes for AI testing

Table 2: Phase AI Adoption Roadmap for Pakistani Pharma

<i>Stage</i>	SME Strategy	MNC Strategy	Policy Enablers
<i>Pilot</i>	NLP compliance automation	Predictive inventory analytics	Regulatory sandboxes
<i>Scale</i>	Hybrid cloud-edge systems	AI talent pipelines	University-industry R&D grants

4.10. Limitations and Ethical Considerations

4.10.1. Limitations

While our sample captured SME and MNC perspectives, future studies could explore AI adoption in rural pharmaceutical hubs—a setting overlooked in both global literature and our study due to data inaccessibility. However, the major limitation of this study is that it is qualitative and restricted to the pharmaceutical industries in Pakistan. It was also noted that the results cannot be applied to other areas and/or industries with other population densities or characteristics. Moreover, there might be a problem with self-

reporting, but using documents helps to decrease it and use more objective information.

4.10.2. Ethical Considerations

Participant confidentiality was strictly maintained. Interviews were recorded and transcribed and vital information pertaining to the subjects was blind out. Before partaking in the activity, the participants were read the research protocol and were informed on their right to anonymity and confidentiality.

This methodology lays the right foundation for the analysis of dynamic capabilities with reference to AI in the pharmaceutical industry. The research

combines traditional qualitative data gathering with a clear set of concepts, which creates a systematic approach to drawing conclusions on the application of AI in an emerging market for business development.

4.11. Future recommendation

Based on this study's findings, the following pathways are proposed to advance AI integration in Pakistan's pharmaceutical sector and similar emerging markets.

For Researchers

- Conduct longitudinal studies to track AI capability evolution over time.
- Compare AI adoption across sectors (e.g., pharma vs. fintech) to identify contextual patterns.
- Investigate how leadership and culture moderate AI adoption in resource-limited settings.

For Educators

- Develop modular, context-sensitive AI curricula focusing on frugal and hybrid AI solutions.
- Strengthen industry-academia partnerships for co-created training and case studies.
- Promote interdisciplinary learning combining AI with regulatory and supply chain management.
- Embed strategy-oriented learning components that help students forecast emerging technologies, assess the long-term impact of AI, and develop flexible approaches for making resilient, future-ready decisions.

For Policymakers & Industry

- Create regulatory sandboxes for safe AI piloting in compliance and reporting.
- Provide incentives (tax breaks, grants) to support AI adoption in SMEs.
- Build national AI talent pipelines through public-private training initiatives.

For Pharmaceutical Firms

- Adopt phased AI implementation, starting with NLP and predictive maintenance.
- Invest in data governance and infrastructure prior to AI deployment.
- Foster an AI-ready culture through continuous learning and ethical guidelines.

For International Bodies

- Fund research on equitable AI solutions for low-resource health systems.
- Support knowledge exchange platforms between emerging markets.

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