EAI Endorsed Transactions
on Pervasive Health and Technology
Research Article EAI.EU

An Innovative approach to Improve the Quality of Pharmaceuticals approach using Cloud Computing

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Abstract

INTRODUCTION: Pharmaceuticals evolve alongside advancing technology driven by ongoing research and pharmaceutical companies' production of new medications. Ongoing research and adjustment are necessary for various aspects of the pharmaceutical sector, such as patient understanding, drug testing, manufacturing, and communication of complex concepts through technology.
OBJECTIVES: This paper discusses the intersection of cloud computing, technological advancements, and healthcare applications.
METHODS: The Azure Cloud facilitates data processing, customer and patient engagement, employee and care team empowerment, clinical and operational optimisation, and healthcare digital transformation in the pharmaceutical industry. The integration of Microsoft Azure cloud technologies inside the pharmaceutical industry is examined in this research.
RESULTS: Analysing how Internet of Things (IoT) sensors and the Industrial Internet of Things (IIoT) are used in pharmaceutical manufacturing and logistics, benefits in drug research, production monitoring and supply chain optimisation are highlighted.
CONCLUSION: Cloud computing's potential to facilitate General Data Protection Regulation compliance, improve security, and promote innovation is explored.

Keywords: Azure, Cloud, IoT, IIoT, Pharmaceutical, SAP

Received on 04 December 2023, accepted on 23 February 2024, published on 01 March 2024

doi: 10.4108/eetpht.10.5270

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1. Introduction

Using the internet, the cloud may remotely host and offer various computer services to users. It facilitates collaborative and mobile apps and services. Cloud computing offers flexibility, storage, automation, and lower prices. Cloud computing helps patient care [1]. Cloud computing is the most fundamental information technology that has become an indispensable tool for collaboration, communication, and invention across continents. Recent data show that 90% of pharmaceutical enterprises worldwide use cloud services in various ways. Despite rising private and public cloud use, the pharmaceutical and healthcare industries seldom use cloud services due to regulatory constraints. To gain pharmaceutical organisations trust, most cloud service providers meet regulatory criteria [2].

Pharmaceuticals require compliance-effective ways to use cloud services. By 2023, the market for cloud computing may be worth $623.3 billion. Startups in the pharmaceutical industry must find ways to save costs and quickly adjust to the changing healthcare industry and global economy. These businesses can handle these shifts and turn Information Technology (IT) into a business

driver using the low-cost pay-as-you-go cloud computing model. On-demand clouds provide benefits immediately, such as improved mobility and secure information access from almost any mobile device, independent of place or time. In this paper, how the pharmaceutical company can benefit from using Azure cloud technology, and relevant case studies are being analysed [3].

The pharmaceutical industry has seen tremendous development, since the epidemic began—the companies case studies and how they benefit from shifting to the Cloud. The Industrialists provide recommendations for improving the system, including care access, critical care, patient and carer safety, and more. This paper researches and identifies how Microsoft Azure lays out a plan for recovery and adaptability in an uncertain future in collaboration with the pharmaceutical sector [4]. Analyse how Cloud computing makes privacy, regulation, and security—azure help to meet data privacy and security requirements with industry-leading technologies.

2. Methodology

Accessing the Cloud is made simple by a setup adopted by the pharmaceutical sectors. For this, arrangement to make an online connection, whether a remote or wired web or a mobile broadband association, and access to a certain report kept in the Cloud. The benefit is that it can be used on any web-enabled device and access the same content from anywhere. This would also make it easier for the pharmaceutical sector to run as everyone with an internet connection and access to the Cloud can generate reports, utilise computer programs, and preserve data.

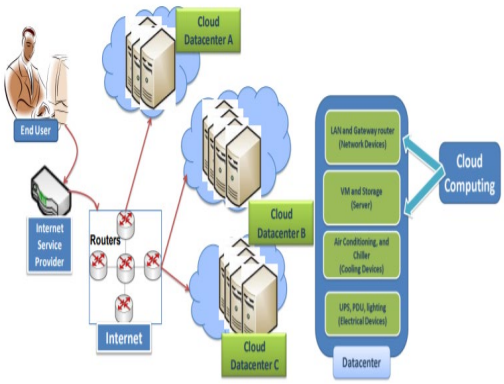

Figure 1. Architecture of Cloud Adoption

The flexibility of the Cloud will benefit the pharmaceutical sector [5]. Microsoft has internal functional restrictions around process and decision-making improvements built into its cloud solutions because it knows the necessity to retain certification. The pharmaceutical business benefits enormously from Microsoft's Azure extensive services, certification, openness, and documentation efforts because they save time, money, and effort and can put those savings where they are most needed.

The Azure service, within the realm of information technology, plays a crucial role in facilitating pharmaceutical compliance and change management. The present study aims to investigate the efficacy of Microsoft Azure Services as the exclusive solution for expediting GxP validation processes, specifically regarding certification acceleration and assistance provided to manufacturers in testing applications to meet specific standards [6].

2.1. Azure Cloud implementation in the Pharmaceutical Industry

Microsoft's Azure Migration Programme Sponsors Data Dynamics StorageX, making cloud adoption simpler and cheaper. Pharmaceutical sectors can move huge files, unstructured data, and object storage data to Azure via the Azure File Migration Programme. IIoT might improve medicine development, production monitoring, and transportation [7]. Smart gadgets and machine-to-machine connections interrupt medicine manufacture.

- IIoT in pharmaceutical production can solve several value streams
- Patents, clinical trials, supply chain maintenance, and analytics and dashboards
- Companies can use such technologies to speed manufacturing, go-to-market, and mistake detection [8].
- IIoT gives pharmaceutical firms real-time data visibility. Industrial monitoring instruments helped the sector, but the real-time status was rare.
- IIoT's value lies in improving pharmaceutical producers' and patients' safety.

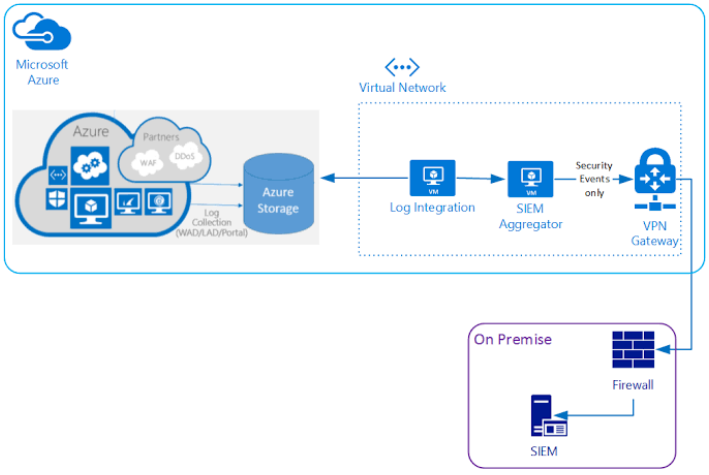

Figure 2. Azure Implementation

Businesses may easily manage their production environment using a network of sensors and devices for environmental monitoring. This ensures biomaterial and chemical quality and secure manufacturing procedures [9]. To combine data from IoT monitoring devices and notify maintenance staff of any difficulties, digital dashboards are used.

3. Innovative Approach Utilization in Cloud Computing

By employing IoT sensors, organisations can eliminate the time-consuming trial-and-error method and instead concentrate on implementing standard procedures and lessons learned into practice. Pharma IoT manufacturers require access to sensors to comprehend their activities context better [10].

The IoT enabled sensors in the pharmaceutical sector relay all facility data back into a centralised dashboard, where staff members can monitor production that isn't up to standard and make any necessary maintenance modifications.

In the pharmaceutical sector, data collection associated with air compressors, heat exchangers, and vacuum pumps can be facilitated through a singular digital dashboard [11].

The IoT has revolutionised various industries, including the pharmaceutical sector. By enabling seamless equipment connection across assembly lines, the IoT has presented new opportunities for enhanced efficiency and productivity in pharmaceutical manufacturing processes.

This study uses sensor technology embedded within pharmaceutical packaging, factory walls, and machinery to collect real-time data on environmental variables. Researchers aim to enhance the monitoring and analysis of various environmental factors by employing these sensors. This paper explores the potential benefits and implications of such technology in the context of environmental data collection [12].

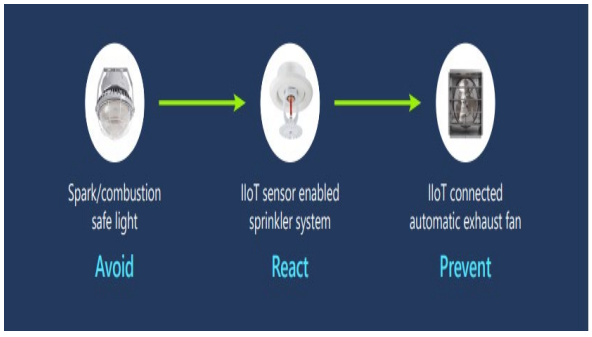

Figure 3. Implementation of Azure for Safety responses

Azure is the only Cloud platform that compares high levels of regulation, and the requirement to process vast volumes of data along the supply chain characterises with industrial and pharmaceutical sectors. The pharmaceutical sector uses Microsoft Azure since it is a full, scalable, and secure Cloud platform. In addition to facilitating suppliers' ability to plan, manufacture, transport, and comply, it also allows them to make safer and less expensive [13].

4. Innovative Approaches to employing Azure Cloud in Pharma Sectors

Cloud features allow real-time data collection and businesses to sample, recreate, test, and modify tests in various settings. Pharmaceutical organisations could only conduct automated and structured tests during active production with the process optimisation tools provided by the Azure cloud. Azure Cloud's process optimisation features allow pharmaceutical businesses to perform automated and structured tests throughout continuous manufacturing. Manufacture Edge technologies like Azure Stack, IoT Edge, and real time operating system allow manufacturers to build connected, agile factories without depending only on sensor networks [14].

With the help of these cloud services, companies can more easily adapt the shop-floor infrastructures that support IIoT in the Cloud. With the aid of these services, manufacturers improved operational reliability and speed up reaction times to local changes, allowing cloud workloads to run on IoT edge devices. Additionally, by utilising this cloud technology, manufacturers can choose which data is aggregated into the Cloud using Azure and which is kept on-premises.

As a result, manufacturers can utilise incremental validation while still employing existing cloud infrastructure. The pharmaceutical sector can utilise Azure services to solve a major issue limiting development for years: the inability to retain data and maintain constant communication across production lines. The pharmaceutical industry is experiencing a revitalisation of its digital infrastructure, operational effectiveness, and return on investment through integrating cloud-based insights that are compatible with industry needs [15].

4.1. Employing IoT Sensors in Transporting Pharmaceutical Products

The IIoT may solve transit chain custody issues. Pharmaceutical companies use IoT-connected devices to monitor drug shipments. Smart labelling and Radio Frequency Identification technologies might improve logistics batch monitoring. These modern monitoring technologies and Global Positioning System enabled vehicles increase cargo visibility [16]. Connected devices improve inventory control, quality assurance, and

production speed, helping pharma companies track costs and meet strict quality standards. Tracing supply sources is essential to supporting production speed and quality.

Keeping pharmaceutical firms organised is another benefit of IIoT. Implementation of IoT sensors informs firms to refill when client stockpiles are low. As a result, businesses reduce the need for additional supplies to avoid a shortage. By detecting expired batches, data guides stocking decisions. IoT location devices let pharma businesses quickly and thoroughly recall batches by locating containers in a supply chain. In addition, data analytics from IoT-connected devices may help pharmaceutical businesses identify cost overruns and inefficient parts of their processes. Pharma firms need IoT and IIoT to achieve quality standards, record procedures digitally, and eliminate mistakes to maintain regulatory compliance while delivering medications and medical equipment.

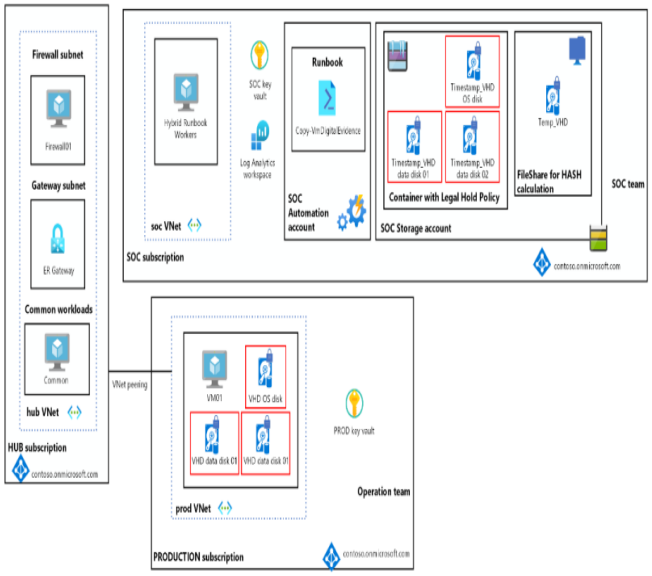

Figure 4. Azure's Chain of Custody

4.2. Challenges in Cloud-based Medical Development

The pharmaceutical industry undoubtedly encounters challenges, the following are some main problems and difficulties with cloud-based medical development.

- Need to improve in the theoretical analysis of client demands. Comprehensive planning must be included for business application development, incorporating cloud-based medical construction. There needs to be more financial investment and technical skills.
- A severe shortage of money, technology, talent, and other resources is quite worrying. Because cloud computing offers greater data protection, documents may be preserved safer and longer lasting.

5. Case Studies

5.1. ADAMED

One of Europe's leading pharmaceutical firms, Adamed Group, sells over 500 items in 65 countries. Adamed teamed with Microsoft Partner Network full-stack consulting business Predica to simplify its data and base its decisions on relevant historical and real-time data. Predica specialises in Microsoft Cloud application development, Machine Learning (ML), data analytics, and security. Predica helped Adamed combine their data sources into one data factory for Power BI business analytics. Predica utilised Azure Data Factory to combine Adamed's data to construct an accurate forecasting model. Azure SQL Database processed and transformed data securely. This pattern is used for predicting ML and reporting using IoT data. Adamed reduced forecasting mistakes to less than 5% across all product lines by automating and centralising their forecasting process.

5.2. DARNITSA

Ukraine's biggest pharmaceutical company Darnitsa has used market-leading technology throughout the digital transformation. Darnitsa wants to move its Systems Applications and Products in Data Processing (SAP) system. SAP platform performance and demanding operations needed to improve their infrastructure management, dynamic computation, and data storage resource allocation.

5.3. ALVOGEN

Alvogen is a rapidly expanding pharmaceutical corporation aiming to achieve worldwide industry dominance. Operational diversions, such as the management of data centers, hinder the ability to reach its intended destination. When Alvogen decided to merge its two worldwide instances of SAP into a single location, it became imperative to establish measures to protect this site from potential calamities.The proposed resolution Alvogen collaborated with its partner, S&T Croatia, to establish a disaster recovery site for the SAP system on the Microsoft Azure platform. Alvogen is strategically reallocating its IT assets to the Azure platform to enhance company growth while reducing IT expenditures.

5.4. PHLEXGLOBAL

Phlexglobal stands itself as an unparalleled supplier of technology and services. The transfer of Phlexglobal to the Microsoft Azure platform has facilitated the use of Microsoft Azure Machine Learning and Artificial Intelligence capabilities. According to Daniel Koppers, Microsoft Azure Machine Learning technologies provide rapid resource provisioning and efficient processing of large data sets. This technology enables the deployment of cutting-edge solutions in a cost-effective manner. Phlexglobal uses advanced Artificial Intelligence technology to enhance its customers operational enhancements. One of the solutions offered by PhlexTMF is to improve the efficiency of indexing and monitoring trial master files.

5.5. Outcomes and Benefits Achieved

IT Sectors, specifically Azure services, has proven highly advantageous in facilitating change management and ensuring pharmaceutical compliance. By leveraging the capabilities offered by Azure services, organisations can enhance their processes and operations in these critical areas. This research paper explores how Azure services contribute to the effectiveness of change management and pharmaceutical compliance, highlighting the key benefits and outcomes that can be achieved through their implementation. Integrating Artificial Intelligence into automation systems can significantly improve various tools and processes. Automation can effectively track and analyse data in real-time by leveraging Artificial Intelligence capabilities, enhancing performance and responsiveness.

The comparison between human-operated equipment and alternative techniques poses numerous challenges for manufacturers. One notable advantage observed in this study was the implementation of quicker time-to-market techniques, which proved instrumental in addressing new requirements more expedited. To effectively respond to clients evolving expectations, it is essential to speed up the process of launching products or services. According to existing research, organisations implementing SAP automation systems can allocate more time and resources toward critical tasks.

Implementing high levels of SAP automation has been found to reduce errors and enhance data quality significantly. This, in turn, leads to a higher level of dependability and accuracy in the data. The study provides empirical evidence regarding the scalability of SAP systems, highlighting their ability to adapt the varying workloads by scaling.

6. Conclusion

Microsoft's Azure will help pharmaceutical companies understand customer buying habits and communicate with them via multiple channels, eliminating the need for customer-targeted marketing. Pharma businesses may also adopt customer-centricity and boost corporate efficiency. They will be better able to produce and provide customer-focused services. As regulations and security concerns are resolved, the cloud computing business will likely develop rapidly. Data will continue to grow in a globalised industry. Pharmaceutical firms must guarantee their technical infrastructure can meet current and future needs. Cloud-based technologies benefit the pharmaceutical business. These technology breakthroughs eliminate stagnating productivity and develop new pharmaceutical organisations that change their economic structures. Today, cloud-based technologies help organisations explore the future. Cloud-enabled pharmaceutical technology will also grow. Empowering medical research with the Cloud's massive computing capabilities might enhance our lives.

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