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Study on Connection between ERP and Artificial Intelligence through the Application of ML Techniques in ERP Industrial Processes

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ABSTRACT

Keeping up with the latest trends is critical in the ever-evolving world of technology and business operations. This article explores the effects of recent advances on ERP optimization by assessing the state of machine learning (ML) integration with ERP systems. We have seen tremendous progress in integrating ML technology into ERP setups in the past few years. To enhance the precision of their forecasts and data-driven choices, ERP systems are beginning to incorporate ML algorithms. These algorithms have the ability to reveal intricate patterns within massive datasets. This is how ML makes ERP systems more adaptable and efficient: they can alter on the fly based on real-time discoveries. Many businesses are also looking to AI solutions to help stakeholders better comprehend the machine learning (ML) models used by ERP systems. Businesses are able to efficiently adapt to changing situations because ERP systems can process and act on data as it floods in, thanks to these solutions that use ML models. Several industries have been profoundly affected by the trend's quick insights and practical knowledge. Ongoing integration of ML with ERP and the Internet of Things (IoT) is becoming increasingly important. Several advantages can be gained by optimizing ERP systems with the use of these algorithms, which enable the development of flexible strategies backed by continuous learning and data-driven optimization. This study also investigated the IIoT to provide the present status quo as well as potential issues brought on by ML integration in the future. Research pertaining to decision-making covers topics like academic planning, resource allocation, financial management, and student support services. Findings from this research on educational institutions in India shed light on the practical applications of artificial intelligence and machine learning. It sheds light on the difficulties of implementing ERP, the usefulness of AI and ML for decision-making, operational efficiency, resource utilization, and fresh ideas. Educational institutions, lawmakers, and technology suppliers can all benefit from a better grasp of the possibilities presented by AI and ML in ERP deployment, which is why this study is being performed.

Keywords: Artificial intelligence, ERP, Industrial processes, Machine learning.

INTRODUCTION

The incorporation of machine learning (ML) into enterprise resource planning (ERP) systems is a crucial area of technical advancement in today's data-driven corporate environment. Examining the intricate realm of ML-driven ERP development is the main focus of this comprehensive study. In order to provide clarity for future development, this review has been separated into various sections, each of which tackles significant areas of this integration. Enterprise resource planning (ERP) systems are comprehensive software packages that include a wide range of applications and modules designed to facilitate different company processes. Recent evaluations have shown that some of the most popular modules are accounting, HR, sales, manufacturing, supply chain management, and CRM. A number of critical components work together in these systems to facilitate efficient and data-driven management. In addition, enterprise resource planning (ERP) systems have reporting and analytics features that enable users to generate customized reports, access data, and learn about the performance of their companies.

Despite the critical role that traditional enterprise resource planning (ERP) systems have played in modernizing corporate operations, these systems are far from flawless and are actually getting worse as a result of changes in the business climate. However, studies have shown time and time again that these limitations can be explained by:
The procedure necessitates an expensive software license, hardware infrastructure, personalization, training, and ongoing maintenance.
ERP systems could necessitate extensive customisation to align with an organization's unique operational processes. Because of this complexity, the implementation time and cost can increase.
ERP, on the other hand, impacts strategy and tactics simultaneously [2]. The strategic decisions and future operations of the organization are susceptible to strategic repercussions. The way the organization runs its internal operations will be affected by tactical impacts on both a managerial and operational level. But nowadays, ERP systems can't function without connecting to other systems, such as those of vendors, consumers, and other apps. Accessibility and data exchange are both enhanced by this partnership.
Enterprise resource planning (ERP) technologies have evolved and impacted modern business procedures from their inception [3]. It is possible that the material requirements planning (MRP) systems that first appeared in the 1960s were the inspiration for the first enterprise resource planning (ERP) systems. Meeting the production and inventory needs of manufacturing enterprises was the primary focus of these early systems. Manufacturers were able to better plan and manage their production operations with the use of MRP systems, which maximized material needs.

***Fig 1**: Erp and their resources*

The majority of businesses nowadays use some kind of enterprise resource planning (ERP) technology. They are so commonplace that we tend to overlook their significance. Indeed, it is the foundation upon which all applications rest, bridging the gap between an organization's many different departments. Massive volumes of real-time data are also stored there.
In the 1980s, a new generation of MRP II systems was created, offering enhanced capabilities like capacity planning, production scheduling, and financial management. A more holistic approach to planning and decision-making was to be achieved by integrating various organizational domains with MRP II systems. Beyond these watershed moments, the "enterprise resource planning" (ERP) concept really took off in the 90s, when ERP systems began to cover all bases and integrate vital corporate operations like accounting, HR, purchasing, and more. In an effort to streamline internal processes and consolidate data, enterprise resource planning (ERP) solutions aimed to provide a unified platform.
In order to facilitate e-business and e-commerce operations, ERP II systems [4] were created in the 2000s. Connectivity with suppliers and consumers, collaboration, and real-time data exchange were key components of these systems. Online transactions, supply chain visibility, and customer relationship management were all made possible for businesses by implementing enterprise resource planning (ERP) II systems, which allowed them to fully embrace digital transformation.
Enhancing real-time decision-making, mobile accessibility offers clients access to ERP data and functionalities via smartphones and tablets. Prior to the advent of cloud-based ERP [5] and mobile accessibility (2010s-2020s), which provided scalability, flexibility, and reduced IT infrastructure costs, this was a popular feature.
Looking at the efficiency measurement data in [6], we can see that the decision-making unit became more efficient when ERP was implemented. Nonetheless, ML's incorporation into ERP systems is a reaction to current trends, such as the need for educated decision support, big data, and the Internet of Things (IoT). In order to maximize

efficiency and cut down on waste, modern businesses use enterprise resource planning (ERP) systems [7]. The technological integration of these systems has not only made them more successful, but it has also opened up many new options. One such innovation that is changing the way ERP systems are seen and used is machine learning (ML). By capitalizing on data-driven insights and predictive analytics, ML techniques may transform ERPs into smart, flexible, and decision-supportive platforms. As an example, paper [8] discusses the benefits and drawbacks of using ERP for auditing and how ERP supports auditing procedures in greater detail. Additionally, the overall impact of the audit process on expanding technological developments would be the subject of future studies.

LITERATURE REVIEW

A cloud-based ERP framework leverages the advantages of cloud infrastructure to enhance the adaptability of host ERP systems [9]. One major benefit of cloud computing is the ability to guarantee availability, cost, and scalability through Service Level Agreements (SLAs). Cloud ERP combines many ERP framework principles with cloud services to increase the efficiency and effectiveness of data storage and administration for enterprises. In today's era of rapid technological development and massive data sets, including those containing confidential and sensitive information, cloud computing has emerged as a crucial component. Cloud computing has been associated with dependable data processing of massive amounts and the prevention of data failure through the provision of a storage network.

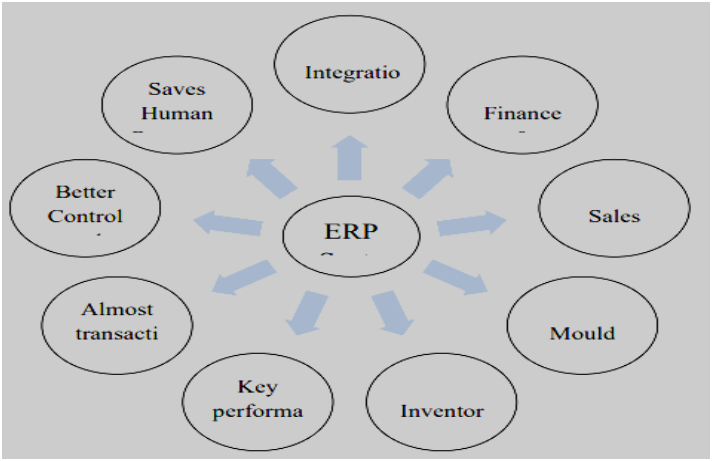

Fig. 2: *ERP System*

Cloud ERP and hosted ERP are two types of traditional enterprise resource planning systems. The corporation is responsible for managing the device licensing ERP framework, as well as paying for maintenance, repairs, disaster recovery, system loading, and operation across all of its networks, devices, computers, and servers in cloud ERP [10-15]

Resource planning is inefficient at the beginning. The materials, personnel, and inventory must be managed, tracked, and controlled in an innovative and efficient manner by the corporate executives. Currently, software such as Material Requirements Planning is used for management [16-18]

These are quite helpful for inventory planning and monitoring, as well as for making preliminary purchases, producing, and arranging for delivery. These systems, which evolved to meet changing needs, were widely used by businesses in the 1970s. Over time, more production steps were incorporated, resulting in enhanced capabilities and superior versions compared to earlier iterations. Due to its evolution from its 1970s roots, the requirements planning system needed a new moniker as it reflected the system's increasing sophistication. When Gartner Group initially introduced the word "Enterprise Resource Planning" in the 1990s, it referred to a system that had grown beyond simple inventory management to encompass other parts of the business [19-20]. Prior to ERP, where enhancements have been made on an ongoing basis, several systems were used.

The assessment of enterprise resource planning (ERP) and electronic commerce (e-commerce) was covered in depth by Lee and Wang (2019), who also addressed SaaS and e-ERP. Unfortunately, this model fails to account for creative technique or maturity models when it comes to architecture verification. Therefore, it is essential to thoroughly examine and validate the model with maturity levels of cloud-based SOA for it to be effective. [21-25]

These massive market forms are managed and streamlined by ERP programming. The ERP structure makes use of the executive framework, and Blockchain uses a constantly evolving archive to enable checking of concepts, measures, and implementations; similarly, it is a database core that aids collaboration in working easily and continuously with integrated applications [26-28] Accounting for vendors, customers, and company partners becomes much easier when cryptocurrencies are used. Cryptocurrency offers numerous advantages to companies.

You may buy and sell digitally paid products fast. Using the Blockchain, not only can the ledgers and journals be stored, but the balance can also be easily kept. To ensure that the online financial records for that ERP blockchain module are kept current and maintained, bitcoin is a priceless asset for ERP and blockchain management, as shown in Figure 5 [29-32]

METHODOLOGY

Research on educational institutions served as the empirical basis for this paper. This study's data came from a 6-point Likert scale questionnaire that was distributed to key personnel at the company's headquarters and utilized to gather information about the ERP deployment. A basic regression analysis model was used to examine the data, which were validated by ANOVA and F ratio. A total of 238 out of 400 questionnaires, or 63%, were returned.

Design of the Study:

A random selection method is employed to pick a subset of the given pool of educational institutions that are considered representative based on the study goals. Based on practical considerations and available resources, a sample size of 400 was determined to be appropriate for this study, and a representative sample of educational institutions in the state of Chhattisgarh that have implemented an ERP system was selected from this pool using a random sampling technique. Applying AI and ML techniques to an ERP system has various benefits, including the potential to greatly increase the system's functionality.

Pilot Test:

It is usual practice for businesses to use ERP systems to consolidate and oversee many processes. Manual analysis and human judgement are often used to make decisions in these systems, although they can be laborious and prone to mistakes. Automation and optimization of ERP decision-making processes are within reach with the help of AI and ML, allowing for greater efficiency and precision.

It is the goal of this project to construct and implement ML and AI algorithms in a simulated ERP system. One method will make use of conventional decision-making processes, while the other will make use of artificial intelligence and machine learning. Important decision-making indicators including speed, accuracy, and resource usage will be used to measure and compare the performance of different strategies. Due to the magnitude of the undertaking, the pilot study will assess the efficacy and user satisfaction of integrating AI and ML into ERP systems. We will conduct surveys and interviews to gather user input regarding the benefits and drawbacks of utilizing AI and ML for decision-making.

Sampling:

Random Sampling:

This strategy guarantees that each and every member of the target demographic has an equal opportunity to be chosen. It guarantees that the sample is truly representative of the population and reduces the likelihood of bias. For instance, a random sample method can be employed to select participants from each organization if the target market comprises ERP users from multiple companies.

Sampling Size:

There are enough data points to back up this research and produce useful insights from the 400-person population.

Research Method:

By combining qualitative and quantitative techniques, the study can shed light on the topic from multiple angles. By integrating quantitative and qualitative methods, it permits a more comprehensive examination of the research topic. While the quantitative part can measure the effect size and generalizability, the qualitative part can throw light on nuances and contextual factors that play a role in decision-making. For this reason, gathering quantitative and qualitative information is essential for a complete understanding of the problem. Qualitative data can shed light on the experiences, viewpoints, and challenges of users and decision-makers, on the one hand, quantitative data can assess the influence of ML and AI on decision-making and provide statistical proof.

RESULTS AND DISCUSSION

Table 1: The effect on decision-making of implementing ERP with ML and AI

Model	Sum Of Squares	Df	Mean Square (Ms)	F-Ratio	Sig.	R2	Adjusted R2 Square
Regression	272.379	1	272.379	120.797	0.000	0.341	0.338
Residual	530.208	234	2.237				
TOTAL	803.587	235					

Table 2: Evaluation Criteria for the Determined Variable's Impact on Decision-Making (ERP Implementation using AI and ML)

Model	Unstandardized Co-Efficients		Standardized Co-Efficients	t	Sig.
	B	Standard Error (SE)	Beta		
Constant	4.351	0.938		4.372	0.000
Implementation of ERP through AI & ML	0.165	0.17	0.584	11.143	0.000

Table 1 shows that the use of AI and ML in ERP implementation has a considerable impact on decision making, with an F-Ratio value of 120.797 and a p-value of 0.000. Both the raw and corrected R-values are 0.341. Since the p-value is smaller than 0.05, we can conclude that the null hypothesis is not true. A substantial portion of the variance in management decision-making is explained by the use of ERP systems that utilize AI and ML by organizations, as indicated by an R2 value of 0.341. Using AI and ML during ERP deployment affects 34% or more of management decisions, according to the data.

In the regression model indicated earlier, the independent variable, ERP implementation with AI and ML, has a value of 0.165 and a p-value of 0.000, as shown in Table 2. The use of ERP with AI and ML has a substantial impact on management choices, as seen here. So, to rephrase the regression model, we can substitute the following values for the "a" and "b" variables;

Y = 4.351 + 0.165 (Implementation of ERP through AI & ML)

According to prior studies, a well-developed ERP system can have a substantial effect on management's internal decisions as well as investors' outward evaluations. It follows that an organization's success or failure in making sound decisions may hinge on how well it implements ERP through AI and ML. After all, a company can't make good use of its physical assets if its people aren't competent to run it and make good decisions. In order to help investors make smart choices, it is desirable to create an ERP system that uses AI and ML for decision-making.

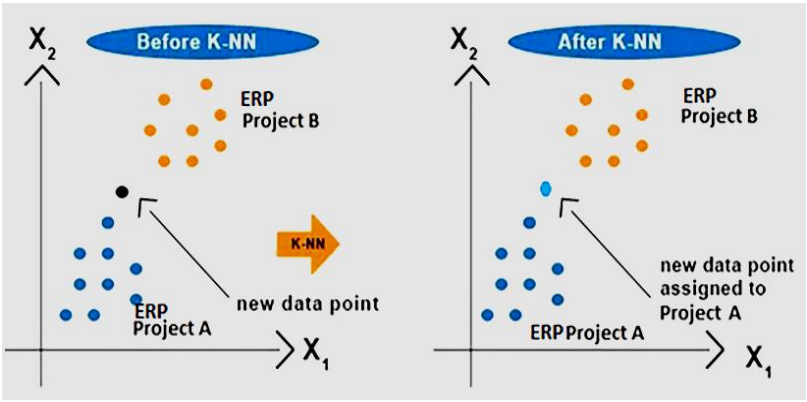

Figure 3. *Using the KNN-ERP algorithm to forecast the level of ERP customization*

Based on its resemblance with previously customized ERP projects, Figure 3 displays the expected degree of customisation for ARs, PRs, and DRs separately. It also illustrates the minimum and maximum degrees of customization needed for the new ERP project.

Traditional enterprise resource planning software is inadequate for today's complex corporate processes. ML models and conversational AI systems are just a few examples of how AI-enabled ERP solutions may simplify ERP operations for enterprises. That is why more and more ERP software with AI capabilities are being invested in by company executives (see Figure 4)

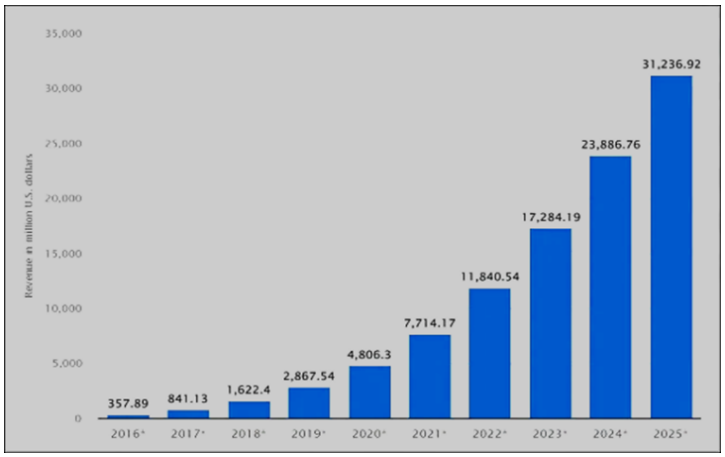

Figure 4. *Global AI for enterprise applications market from 2016 to 2025*

In order to help company executives get ready to invest in AI in the future, this study looks at the top use cases and case studies of AI in ERP.

CONCLUSION

Decision-makers benefit from enterprise resource planning (ERP) systems because these systems streamline operations, increase collaboration, provide accurate and timely information, and provide insights through analytics and reporting. By utilizing these abilities, organizations can enhance operational efficiency, achieve their strategic objectives, and make better judgments. There is a lot of work, data integration, compatibility, training of algorithms, and easy implementation that goes into integrating AI and ML into ERP systems. The potential for AI and ML decision-making to uphold prejudice and discrimination raises ethical questions. Businesses should make sure their models are open, honest, and responsible. By shedding light on decision-making processes and variables, explainability tactics improve ERP decisionmaking. This, in turn, helps businesses find development possibilities and tweak decision models. Information about customers, products, finances, and market trends are just a few examples of the kinds of data that can be useful for making decisions when collected. Machine learning and statistical methods are used to build models that can provide predictions, categorizations, or suggestions. Methods for improving explainability, such feature importance, shed light on the decision-making process for companies. Enhancing precision is possible through the prioritization of data collection tasks and the evaluation of input importance.

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