

Leveraging Artificial Intelligence for Developing Future Intelligent ERP Systems

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Abstract: Artificial Intelligence is one of the fields in Information Technology space which has seen unprecedented growth. ERP on the other hand has been very mature space which has evolved very slowly. This article puts forward various possibilities of using AI for creating future ERP solutions which are capable to addressing the needs of modern organisations. This article discusses how AI can be leveraged for solving many business and technical problems faced by the organisations using ERP. Most of the topics discussed in this paper are not yet productively used in ERP solutions. Some might be in ideations stage or development stage. This paper is expected to provide a bridge for AI developer and ERP developers on various functionalities that can brought in the ERP product for enhanced ERP experience.

Keywords: Artificial Intelligence in ERP, Intelligent ERP, AI in ERP, Enterprise Resource Planning, Next Generation ERP, ERP III, Machine Learning, Deep Learning, Image processing, AI, AI controlled Robots, Central AI.

1. Introduction

Enterprise resource planning(ERP) systems are the backbone IT systems for most of the large and medium enterprises across the globe. However, compared to the customer facing IT systems like social media platforms, search engines or discussion forums, ERPs have been sluggish in accepting the changes in technology, be it the cloud adoption or visual appeal or even the end user interface. This can be attributed to the very nature of ERP system of being enormously complex and the focus on stability over any other attribute. The organizations cannot afford the backbone systems to fail. Even then, one area where ERP vendors have been investing over the years have been their reporting capabilities(Adjie Eryadi & Nizar Hidayanto, 2020). In fact some of the front runners in reporting have been the ERP vendors. The hype in big data analytics space resulted in spawning of agile and aggressive start-ups. This upped the ante in the reporting and visualizing area and ERP vendors could not compete with these startups and were forced to play a catchup game.

The history of artificial intelligence can be dated back to 1950s and 1960s. Even though in 1960s the concept and possibilities of AI raised a lot of interest among the industrialists, academics and governmental agencies, it could not sustain the momentum because of the complexity of the systems and the computing power needed for it(Haenlein & Kaplan, 2019).The journey of AI was in fact a roller coaster ride with occasional spikes of interest again

in 1980s. Starting early 2010s excitement in AI gained momentum with the bigshots in industry launching AI products targeting consumer segment in general market like Apple's Siri, IBM's Watson and the self-driven cars from Google.

The year 2022 and 2023 seems to be the turning point in AI life cycle. The launch of ChatGPT from OpenAI a venture backed by Microsoft in November 2022, saw a unprecedented surge of interest on AI among the common public. It broke the records till date on user acquisition. The number of users crossed 1 million in 5 days which was multiple time faster than any product heard of previously, and even unimaginable. In 2 months', time ChatGPT raked up 100 million users. This unprecedented growth resulted spurge of investments in the area of AI by other major corporates in technology sector(Ruby, 2023).

This euphoria resonated not only to the niche players in technology sector, but every industry has now started to explore the possibilities of using AI to increase the operation efficiencies and productivity, and look at potential of AI in informed, efficient, and quick decision making(Jordan, 2019). It is at this point; ERP vendors are also examining the various options of embedding AI in the ERP systems.

This paper would be discussing the various possibilities of using AI in the field of ERP.

2. Use Cases of AI in ERP Space

Data Entry

With the initial onslaught of ERPs in 1990s and 2000s, even though ERP solutions were able to replace notepads, paper files, and spread sheets, there was always a need to humans

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keying in information to the ERP systems. This change resulted in more structured, consistent, integrated, and reliable information getting available to all departments, shop floor and management. This evolution took years to materialize due to the cultural shock, resistance from employees and the lack of qualified personals to handle a complex system like ERP. This inputting of data in ERP systems are still a pain point to organizations as it is cumbersome, resource intensive and prone to errors. As the initial ERP implementation got matured organizations started to look at opportunities to reduce the human efforts and errors in inputting the data. Over the last decade, with different technological advancement, like advent of robotics or more precisely robotic process automation, organizations invested heavily on the data entry automation. In the initial stages, robotics process automation (RPA) delivered some benefits to organizations using ERP. This prompted ERP vendors to dive in into the RPA world with many of them developing integrated RPA tools for their ERP. After the initial successes, soon they started realizing the limitations of robotic process automation. Robotic process automation, even though as a technology was lean and could reduce human efforts in the beginning, the lack of flexibility and adaptability started to play spoil sport (Herm et al., 2021). Every upgrade, or even the minutest process changes in system due to business streamlining or adaptations or technical changes resulted in huge efforts in the robotic process automation side to reconfigure and redo the automation which was previously done. Another major limitation of RPA was the need of human interference for every run where there is a deviation from process or input that RPA system was configured for. This was due to fact that RPA systems could only repeat tasks it was configured and was not intelligent to know what it was doing. It ended up many a time that for majority of processes needed a human to validate and verify the activities done by the robot.

Now with the advancement in AI and especially in machine learning, AI based tools are expected to replace RPA tools which are much more powerful and capable for certain use cases (Shi, 2021). Accounts payable process is one area which is fast emerging as a very exciting use case. With no standard format for the invoice received from supplier, this was an area where RPA failed miserably. But now with AI powered document/image scanning and OCR extraction engines, with ability to self-learn, new accounts payable process is soon expected to heavily benefit out the recent innovations. With AI powered accounted payable process, it is possible to scan the invoice document and also extract the relevant information even though the formatting of invoice from each supplier would be different. This extracted information can be used for automated creation of invoice with no or limited manual intervention.

Integration

When ERP system hit the market in 1990s and during its early stages in 2000s the concept was that ERP system would replace all existing IT systems of the organization with one system having one single database. ERPs were quite successful during those times in reducing the number of legacy systems and even removing all legacy system in certain organizations (Hufgard & Gerhardt, 2011). But a lot have changed from those periods with the evolution information technology and its impact on people and how business is carried out. Soon organizations started to realize the ideal world portrayed by ERP vendors one single monolithic ERP system catering all their needs is more a myth than reality. The world was too complex and multifaceted for this consolidation to happen. The modern IT landscape of organizations are often a convoluted mesh with many heterogenous systems based on multiple technology stacks and platforms catering many distinct but interrelated functional needs. ERPs many a time are still the central systems which have data and information flows with these connected systems and acts as a system of records. A modern ERP system has to integrate with most of other IT systems within the organization and other stakeholder systems outside the organization like that of supplier, customer, governmental and other compliance systems (Amini & Abukari, 2020). This makes integration in ERPs very complex as it must integrated with multiple technology stacks and platforms which have their own open or proprietary standards for communication. Building integrations to ERPs for many organizations have become extremely costly and time consuming because of this complexity and lack of expertise of personals having knowledge of all system in the integration.

Artificial intelligence can be a game changer in reducing this complexity with its ability to consume, grasp, and process specificities of each technology and platform. Once such intelligent platforms developed and plugged or embedded to ERPs, the complexities in integrations will be a story of the past. Such integration system will act as a middleware or central integration system knowing the specifics of connected system. Such a central integration system will have an ever growing knowledge of connected systems and can not only get better based on knowledge of systems within the organization but based on the datasets from other organizations. The ERP vendors will be able to capture the best solutions for each integration scenario from across the organizations, just like how they captured the best practices for each business scenario in their early days. Such AI powered integration tools will result is more integrated network of connected systems.

Materials Requirements Planning and Supply Chain optimizations

ERPs are described as the successor of the material

requirement planning (MRP) systems of 1970s and 1980s. Manufacturing companies first identified need for systems which can predict the need of materials for production and procurement of materials based on the demand resulting MRP systems. Later ERP system were born to catered end to end flow across functional areas(Beheshti, 2006).

With AI, ERP systems can gain muscle taking into factors which were not easily possible before. The traditional MRP used the demand based on the sales order generated; replenishments and supply where purely based on the production capacity and the delivery times as per the procurement terms. With AI, both the demand side and the supply and replenishment side data can be augmented to make use additional information which was not previously available. For example, on the demand side, rather than only considering the active sales orders more sale opportunities could be predicted and better planned using AI utilizing the current market volatility, seasonal variations, and other environmental factors. On the supply side as well, the AI can provide huge benefit by taking into consideration more factors like historic vendors adherence to commitments, historic speed of delivery, external factors that impact vendor speed, variations based on order date, market conditions, demand cycles etc.(Yang et al., 2021). On the supply side AI can provide better supply chain integration and end to end monitoring with its ability to predict better utilizing the information and insights of the supplier side network collaboration with sub vendors.

AI not only benefits on the operational side of transactions but can contribute heavily on the strategic and tactical side of planning. Off late, those industries especially the ones which benefitted heavily in previous decades from offshored manufacturing are facing problems at the supply chain side. Most of these companies which were convinced about the benefits about lowered manufacturing cost at large manufacturing locations at far offshore were not equipped to handle the supply chain uncertainties. Majority of them could not foresee the problem coming, till they were hit with the delays and supply chain crisis. Apart from the offshored supply chain issues, the uncertainties in last year's due to conflicts in different parts of the world like the one in Europe has increased the volatilities including the availability of raw materials, shipping route issues and the overall transportation and transaction issues. AI models which can take into consideration these factors will definitely help organization in the strategic and tactical planning.

Transactions based on voice or chat

Any transaction that needs to be recorded in traditional ERP systems must be entered manually by people. With capabilities of AI, it is possible to develop ERP systems which can extract information from chat messages and from audio track. This makes it possible to have and purchase

order, proposal sales order or even an invoice created with chats or even with a voice message or a call to a dedicated number. This can increase the speed processing heavily in most industries and could be greatly beneficial to industries where the end users' skill level is not the best. Ability of AI models to work with varied languages will also be hugely beneficial where in operator can communicate in his local language and AI can take care of converting and preparing a structured purchase order, sales order, or invoice in the formal communication language of the organization.

Chatbots and voicebots is an area which has seen lot interest even today. The AI can make the CRM modules in ERP systems to be more efficient and easily accessed and thereby more customer focused. It would be possible to provide information to the customer about the deliverables via easily accessible chatbots and voicebots, without having to login to portal or waiting for a human to provide information or phone or email. Some ERP vendors have already started exploring this use case.

Self-healing Systems

ERP systems typically have data coming from multiple sources which would result in a transaction in ERP. The source system can be anything from a web portal, another enterprise system, 3rd party stakeholder system, and email extraction or even an IoT system. As the level of automation increases in the organization the number of interfaces and its complexity normally goes higher. On the other side, this high level of complexity due interfaces and automation results in increased efforts of interface monitoring and issue identification(Singh & Best, 2015). Issue monitoring and issue fixing are normally a manual process with the help of tools. There would be specialized support handling such issues. It is quite a common site in organizations, that there is quite a big team of IT support team who would be handling only monitoring and corresponding data error fixing based on their experience or any knowledge base created.

With the AI, it would be now possible to have these issues corrected automatically based on the kind of error. The machine learning capabilities allows systems to correct data and reprocess it based on knowledge available at the AI model. This can help to reduce the number of support resources and a very highly capable and matured model can even reduce the support staff monitoring to a near ZERO level.

Advanced analytics and tailored intelligent insights

The ERP vendors from early days itself understood the power of data that was stored in their system. Most of the ERP software therefore contained embedded analytics and reporting module or a dedicated module for reporting and analytics(Chiu et al., 2014). The AI and its capabilities allow ERP vendors to augment the reporting, analytical and

planning capabilities. Reporting, visualization, and analytical capabilities in some of the ERP vendors are now top notch and now comparable to the best class reporting, visualization and data lake or data warehouse systems. Now a days ERP vendors are pitching in for alternative models for reporting and visualization directly with embedded analytics without need for specialized data warehouse and data lakes. This is now advocated by some major ERP players using their enhanced in memory databases and column store databases which are now possible with technological advancements and reduced costs at hardware side(Sarferaz, 2022).AI on its part would be a big leap in providing intelligent insights with data available.

With AI, it may no longer be needed for a developer or a consultant to create and develop reports, visualizations and dashboards based on requirements of the user(Ågerfalk, 2020).The user would be able to chat and talk to the tool to create dashboards, reporting and visualizations. This would bring the IT systems much more closer to business, and avoid many complexities that are associated when translating the business requirement to end reporting.AI can take it further ahead to build reports automatically based on the nature of data available and preselect best possible way of visualizing it and even suggesting the be KPIs(Bag et al., 2021). The possibility to augment the organizational data with the data available in public marketplace or paid marketplace will make it exceptional use case.

Tailored intelligent insights can also make the ERP of future, provide customized answers just like the generative AI systems like ChatGPT is doing now. This can infuse ERPs much more to the organization and make it more enticing to the end users. This can bring a similar impact what generative AI systems have done in last few months to search industry. The complexity of decoding information and provide intelligent answer, forecast planning and decisions can be aided by such tailored intelligent systems.

Self-learning master data

With the complexity IT landscape in modern organizations, maintaining master data is not as straight forward as it used to be years back. This is very true when it comes to master data like customer, supplier, material, asset etc. The process of creation to deletion of these master data is now a days complex, tricky and a burden on its own(Ibrahim et al., 2021). Since ERP is normally the backbone system is most organizations, the master data is most cases are handled in ERP and its lifecycle is mostly managed in ERP. Some organizations also implement specialized master data tools to maintain the source of truth concept. Whichever be the case, ERP will be a very key contributor when it comes to master data if not the most prominent and only one. AI can aid organization to disentangle the complex mesh or master data within the organization. There are multiple ways in which AI can ease the intricacy, based on the nature of

master data and the problem associated with it

Supplier master data for instance is something, which is very fluid with the address getting changed, contacts getting changed and even the communication method getting changed. There are public and paid databases available like Duns & Bradstreet database which keeps track of the latest information. There are numerous other supplier information sources like ERP vendor networks and governmental and other open portals as well. AI can get information from these sources on the suppliers of an organization and update the ERP system automatically or a semi-automatic way with manual intervention.

In case of material or assets, in many organizational ERP systems, the completeness and correctness and validity of data is an issue. For example, of a software IT asset, many a time version and key features of the data might be missing. But this information might be crucial for identifying the need for such a software. An AI system can augment the data in ERP system with the data in public domain, say based on manufacturer part number of supplier part number. This way the correctness and authenticity of data can be assured.

Validation of input

In case of transactions, where the fully automated mode of data entry may not be possible as discussed earlier, due to the nature of transaction and data flow, AI would still be able to assist the user with assisted data entry wherein the user is prompted with few probable options for data entry or at the least warning him about a probable error in data entered for the transaction. This would help in early detection of errors in the system and thereby reduce the errors in the system.

This can be extremely helpful invoices wherein is system can notice different payment term than what is normally used for a customer or a missing/errored tax amount or even a missing delivery cost etc. In sales order if the organization is committing on a delivery which is improbable based on AI rules can be really helpful to the end user.

Risk Reduction and better Compliance

Most organizations now a days use the ERP system as a system of records, capturing most important information of an organization is a structured way. However, these ERP systems may not be used for generating documents like proposals, master service agreement, large contracts etc. Since these kinds of documents are very complex and non-standardized and heavily dependent and customized based on the stake holders the organization is dealing with, these are mostly done in manual way or may be semi-automatic way with the help other specialized software tools. The end result would be an unstructured document mostly in PDF. This is same irrespective of whether the organization is at

the buyer side or seller side.

One difficulty that organizations face is the data discrepancy between the documents in PDF and data entered in ERP system. This discrepancy can cost huge risk and also compliance issues to the organization. AI can compare the data in structured and unstructured data easily and identify the discrepancies there by resulting risk reduction and better compliance. Another area where AI tools can contribute is identifying risky or not so common clauses in the unstructured PDF documents and warning the organization of the repercussions.

Personalised UI

The most prominent and commonly used ERPs are never known for their intuitive UI designs. It was always been a catchup for ERP vendors to modern UI trends in market throughout their history. For long many ERP vendors even took a stand that ERPs need not have most appealing UIs as the speed and flexibility are more important for ERPs than aesthetics (Scholtz et al., 2010). They backed their stand with the fact that ERP users are very frequent users of the system and system UI will lose appeal after frequent use. They also claimed that their UI are best suited for speed and flexibility which was more important to them.

But with the onset and growing acceptance of social media and modern websites, the disconnect and lag of ERP user interface was getting more and more evident. Over the last decade major ERP vendors have heavily invested in UI to make it as up to date as possible. SAP the largest ERP vendor for instance came up with SAP persona and SAP Fiori and more intuitive UI options. However, one major issue faced by ERP vendors was that nature of ERP itself, where there are huge number of input fields in every screen as these are needed due to the varied nature of business who use ERP. It was not possible or difficult to limit the fields in screens for an organization. Even within an organization, different people would be using different fields for the same transaction. For example, the fields of interest for a data entry clerk would be different from an approver.

This is where AI can come very handy. With the power of AI, screen can be personalized based on the usage pattern of a user (Ameen et al., 2021). Based on how a user uses the screen, it would be possible to determine which fields are most important to that person and which would be least priority for him. AI can contribute not only from a field hiding perspective, but as well from aesthetics point of view based on the user pattern. For example, the most important factor for a finance and controlling approver for a purchase order might be a cost center and the amount. He may not be that interested in the item purchased. However, for a purchasing department approver the person might be most interested in material purchased and supplier. So, AI based on user pattern and roles can place the fields of UI in such a way

that it is aesthetically well suited for the user.

Connected IoT systems controlled with Artificial Intelligence

Traditionally the decision making was solely done by humans. With disconnected machines, humans always gave instructions to machines going near to the machines. As technology advanced, and the connected systems evolved which allowed humans to control systems without physically going near to machine but from farther locations like a central control point. Even then the power of decision making solely rested with human.

But now with advancement of IoT systems powered with AI, there can be a major change in the way operational decisions are made (Zhang & Lu, 2021). ERP systems with its very extensive integration to other enterprise-wide systems and availability of data within, can be the focal point in controlling IoT devices. If the data from IoT devices is made available in real time, building an intelligent control system in ERP would be an opportunity that ERP vendors could be interested in. This would mean that many operational decisions that are currently taken and operationalized by humans can be automated with such a control system. With IoT systems and machine-to-machine communication gaining prominence, communication aspect will not be a roadblock (Zhao et al., 2021). Even there are many conversion modules available in market which can convert traditional machines to digitally controlled machines.

Recruitment in organisations

Hiring of personnel be it internal employees or external employees has primarily been very much human-centric. With the arrival of ERPs, they defined processes on how recruitment must be done in organization starting with intent hire to the final onboarding of the personnel. Many supporting tools came up which assisted in this hiring processes, but the core process of hiring continued same and stayed within the ERP.

Now introducing AI into ERP recruitment module can be a game changer. Mostly job description would be written by the departments and handed over to HR departments who would work on it to make it publishable. Many a time, issues start at this stage with departments not having the expertise to write a job description that can target the right candidates and generate interest in them. HR departments may have the right knowledge on how to write a job description but may not have the in-depth understanding of the needs of the department. AI can be an option which can bridge this gap. Utilising the knowledge and data of job description available in the open market or public internet as well as the previous job descriptions within the organizations stored in ERP and understanding the specificities needed by department using conversational intelligent chatbots, a much more relevant job descriptions can be generated. This

conversational chat bot can also help to unearth some information which otherwise would have missed by the department if job description was handed over to HR just over a document. Not only in the creation of more precise and effective job description, ERP with AI can also contribute in enhancing the initial screening and shortlisting of resumes based on the requirements (Haefner et al., 2021). In case of lot of applicants for the open job position, rather than HR department or the hiring manager shortlisting the resumes AI can perform initial screening so that only relevant resumes reach the HR and hiring manager. This can reduce the overall efforts and time spent by the organization and increase focus of hiring managers and HR departments.

3. Conclusion

In IT industry, ERP systems have been very stable over the years compared to other IT systems where ground breaking innovations are rampant. This has, to some extent taken away the sheen from ERP industry over the years. But, now the emergence of AI is an opportunity to ERP vendors to reinvent themselves to the modern world. If ERP vendors manage to successfully utilize the potential of AI by incorporating it within ERP products, this would be the next big thing in the enterprise information technology business. In the first wave, ERPs transformed the businesses from the ones which stored their data in notepads to storing data in a structure format accessible to all. If successfully embedded with AI, ERP can drive the second wave of transformation which could enable the organization to reap unprecedented benefits in terms of efficiency, productivity, cost saving, data quality and better integrated IT environment. This could in turn result in cost saving, increased compliancy, business transparency, agility, trustful insights, and better decision making.

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