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Artificial Intelligence in ERP

Metropolia University of Applied Sciences

Bachelor of Engineering

Information Technology

Bachelor's Thesis

6 May 2021

Abstract

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Title: Artificial Intelligence in ERP
Number of Pages: 36 pages + 1 appendix
Date: 6 May 2021

Degree: Bachelor of Engineering
Degree Programme: Information Technology
Professional Major: Software Engineering
Instructors: Matti Oosi, Senior Lecturer

Artificial Intelligence is an important field of computer science that is emerging into a different business. As it is a complex and broad concept, it is important to know what AI is and how it is integrated into various business applications.

The main goal of this thesis is to study Artificial Intelligence and how it is used in Enterprise Resource Planning (ERP). This thesis also describes a broader and more detailed study of Artificial Intelligence, machine learning, deep learning, and neural networks.

This study is based on existing literature, and it analyzes different publications and web articles about Artificial Intelligence in ERP. It also illustrates an implementation of a use case about sales forecasting from historical data with the help of the SAP Analytics Cloud application.

Based on the study, it can be concluded that with an incredible advancement in AI, machine learning, and deep learning, companies reach a new level of analytical productivity in different areas of ERP; the impact of AI is evident. Artificial Intelligence is being used a lot in various sectors of ERP, especially in customer service, predictive analysis, and sales forecasting.

Keywords: ERP, artificial intelligence, machine learning, deep learning

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List of Abbreviations

ERP:	Enterprise Resource Planning
AI:	Artificial Intelligence
BIM:	Building Information Modelling
ROI:	Return on Investment
B2B:	Business-to-business
B2C:	Business-to-customer
CX:	Customer experience
SAC:	SAP Analytics Cloud
CRM:	Customer Relationship Management
ML:	Machine Learning

1 Introduction

The growth of Artificial Intelligence has produced rapid world-changing technologies that can reshape the future, preferably for the better of humanity. Many real-world problems, such as manufacturing robots, intelligent assistants, self-driving cars, tumour detection, and intelligent ERP, are being solved with AI's help, which is beneficial for humans. Today AI applications concentrate on very narrow tasks, but these AI-driven tasks are reshaping different industries and markets. As a considerable amount of research is carried out, AI will continue to overgrow in the coming years.

This study is based on Artificial Intelligence and how it solves the problems in Enterprise Resource Planning (ERP). ERP is an application, used to manage complex business functions such as finance, manufacturing, accounting, human resources, and supply chains. ERP makes business more efficient, profitable, and manageable by integrating key business functions into one platform. The use of AI will make ERP more adaptable and intuitive and enable self-learning future predictions. Different ERP companies such as SAP and Oracle are developing more AI applications. The applications can be integrated into the ERP system easily, and they are capable of making different analytics more accurate than people. AI is very popular nowadays, and it is developing every day. It helps to develop smart applications that act and think like humans.

AI enables modern and smart solutions for large and small businesses. In business, ERP helps in different ways as it allows predictive analysis of sales and revenue and decision-making, which will both be covered in this thesis. The fundamental aim of the thesis is to describe the impact of AI and machine learning (ML) on ERP and how ERP is making business profitable.

AI is making revolutionary changes in different sectors, and it is also changing ERP, and this is why the topic is important.

2 Artificial Intelligence and Subfields of AI

2.1 Artificial Intelligence

Artificial Intelligence (AI) is a concept that comes with human intelligence. When a machine copies human intelligence and performs a task like a human, it is called Artificial Intelligence. [1.] Artificial Intelligence refers to a different complex software system that performs some tasks similar to the human brain. It can range from speech recognition and decision-making to creative work. For example, AI provides a human touch to every conversation of a chatbot with humans. The chatbot knows the user's query and triggers a precise reaction to understand another concern and respond accordingly. AI is being used widely in different areas, such as marketing, medical science, and the banking industry. It has broad subfields of study which include different theories, methods, and technology.

2.2 History of Artificial Intelligence

Artificial Intelligence is not a new term, and it has a great history from ancient times. People have always dreamt of making a machine which can perform the human tasks.

- 1921– A Czech playwright Karel Capek used the term Artificial Intelligence in his sci-fi play. In that play, there was a character called robots. It was able to think and act. Until 1950, robots were indifferent to films, plays, and literature. [2.]
- 1949 – The renowned writer Edmund Berkeley mentioned for the first time that “a machine, therefore, can think.” He wrote that in his book *Giant Brains: Or Machines That Think*. [3.]

- 1950 – Alan Turing published a paper named Computing Machinery and Intelligence and what is now known as the Turing test. The test is a method for determining the intelligence of a machine. [3.]
- 1950 – Marvin Minsky and Dane Edmond created SNARC which was the first computer with a neural network. In the same year, Claude Shannon published a paper about programming a computer for playing chess. [4]
- 1956 – John McCarthy and his team introduced the phrase ‘Artificial Intelligence’ in a Dartmouth summer research project. There was a conference held and it presented different aspects and goals of Artificial Intelligence and it marked the birth of AI. [5.]
- 1959 – Alan Newell, Herbert Simon, and J.C. Shaw developed the General Problem Solver (GPS) which is a program designed to imitate human problem-solving capabilities. In the same year, Arthur Samuel introduced the term ‘Machine Learning’ while working at IBM. This year, John McCarthy and Marvin Minsky founded the MIT Artificial Intelligence project. [6.]
- 1966 – The automatic language processing advisory committee (ALPAC) reported about the USA government’s lack of progress concerning Machine Translation research. The ALPAC reports led to the cancellation of all government funded projections. [7.]
- 1967 – The first computer, the Mark perceptron, built by Fran Rosenblatt, used the neural network model and was able to learn from trial and error. Next year, Marvin Minsky and Seymour Papert published a book named Perceptions and opened a new door to research into neural networks. [8.]
- 1997 – Deep Blue, a chess-playing computer from IBM, defeated the famous chess champion, Garry Kasparov. [8.]

- 2008 – Google developed speech recognition technology and introduced different features. [9.]
- 2012 – Google developed a neural network that used a deep learning algorithm of 10 million YouTube videos as training datasets. The neural network identified a cat without being told that it was a cat. This was a colossal breakthrough approach for neural networks and deep learning research. [10.]
- 2015 – The Minwa computer developed by Baidu could recognize and categorize images better than humans could. A special deep neural network algorithm was used for that. [8.]

2.3 Types of Artificial Intelligence

There are different types of AI nowadays.

Reactive Machine

This type of AI is the oldest, and it does not have any memory-based functionality. A reactive machine performs simple tasks, and there is no training involved with this machine. Typically, reactive machines are specialized in only one field. For example, static learning models are reactive machines. IBM's Deep Blue is a perfect example of reactive AI. [11.]

Limited Memory AI

Limited memory AI gathers knowledge from historical data and saves the data in memory. The IA learns from the data and makes decisions. As this type of AI has limited memory, machine learning becomes more complicated. For

instance, image recognition applications are a good example of limited memory. They learn from thousands of pictures from memory and based on these references, they make perfect decisions. [11.]

Theory of Mind AI

The Theory of Mind AI machine will be available in the future. This kind of machines will understand people's behaviour and emotions and can socially interact and respect people's feelings. For example, Siri, Alexa takes people's commands and carries out them but cannot understand emotions. [12.]

Self-Aware Machines AI

Self-aware machines are the future of Artificial Intelligence and machine learning. They will be more intelligent and independent. They now exist only in stories. [12.]

2.4 Subfields of AI

Artificial Intelligence has different subfields, and all the subfields have their own characteristics. The main fields of AI are listed below, and they are developing day by day. Figure 1 describes different subfields of AI.

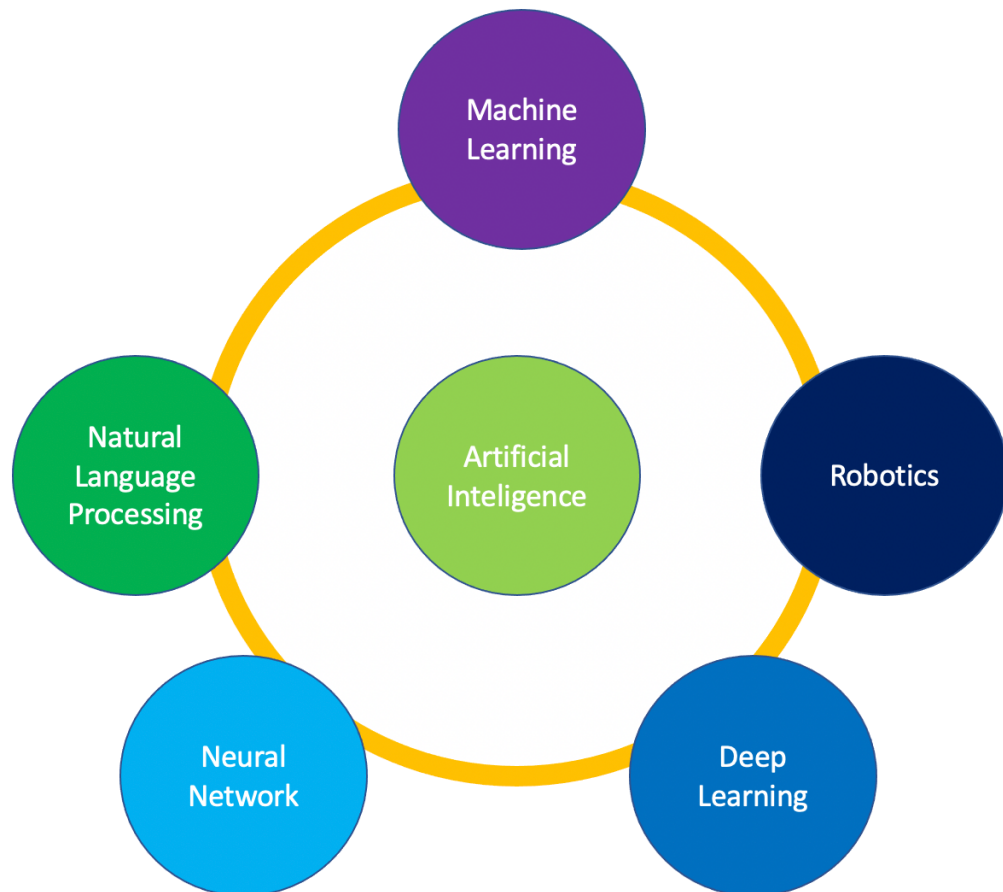


Figure 1. Subfields of Artificial Intelligence. [43.]

Machine Learning

Although machine learning and AI Machine learning are used interchangeably, machine learning is a subset of Artificial Intelligence. It is an algorithm that learns from data and upgrades automatically. Machine learning is a branch of Artificial Intelligence, and it can learn from historical data and update over time. [13.]

ML-based applications work in the same way as a human. These applications learn from data; when new data is available, they are updated and developed automatically. [14.]

There are different types of machine learning models, which are categorized depending on the nature of data. Three kinds of machine learning models are popular nowadays.

Supervised Machine Learning

Supervised machine learning means observing or directing a particular task and making sure it is completed correctly. An example is how children learn things under the guidance of teachers in school. Similarly, in a supervised learning model, the model learns from label data, acts as input, and tells what the output must look like. In short, a supervised machine learns data from past examples and uses the data to predict future predictions. Input and output data both help to make an accurate prediction. Figure 2 outlines the whole process of supervised learning. Examples of the supervised learning algorithm are image segmentation, medical diagnosis, and fraud detection. [15.]

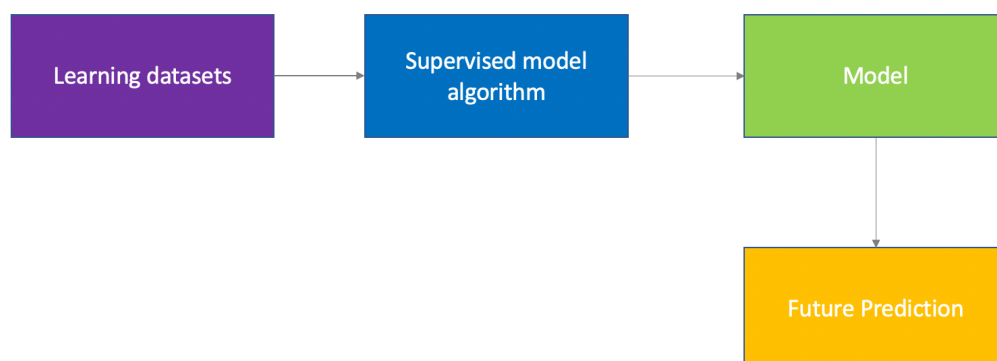


Figure 2. The process of supervised learning. [44.]

Unsupervised Machine Learning

Unsupervised machine learning means that no guidance or direction is provided. The machine reads the input data and starts to find the correct pattern from information that is neither classified nor labelled from different sources, and it is easy to get. In this kind of model, the algorithm finds out similar

patterns, equations and associations. Unsupervised learning finds some hidden patterns and similarities, which can be helpful later. Various applications are using unsupervised learning algorithms such as network analysis and search engines. [15.]

Reinforcement Machine Learning

Reinforcement machine learning differs from the other two; it learns by trial, error, and feedback of its actions. Although both the supervised and the reinforcement model have input and output mapping, correct sets of actions are provided for the supervised model. On the other hand, it decides the right actions from its errors and provides the output. A self-driving car is an example of the reinforcement machine learning model. In a self-driving car, there are many things to consider, such as zones, speed-limit, and other over-speed vehicles. There are other application using the dynamic pricing and the industrial automation of reinforcement machine learning. [15.]

Neural Networks

The concept of neural networks comes from the neural network of the human brain and its goal is to reconstruct the brain digitally. In order to construct an artificial brain, artificial neurons are essential. The brain neurons send signals to others by synapsis connections, and there are a hundred billion neurons in the human brain. They send signals from one neuron to other neurons, and they develop a vast neural network. An artificial neural network behaves in the same way as the neural networks of the brain. They get input signals from other neurons and send that input as output to another neuron. [16.]

Figure 3 shows an example of an artificial neural network with an input layer, a hidden layer and an output layer. Every connection has a weight, and significant weight connections work better than others. In a real-world scenario, robot is trained with different input weights, and we change the input to get our desired output. When this neural network is trained with inputs and weights, it can solve

real-world problems where AI can be implemented. The example neural network in this image is straightforward. Generally, there will be more inputs for the more complicated tasks, and the process will be more complex.

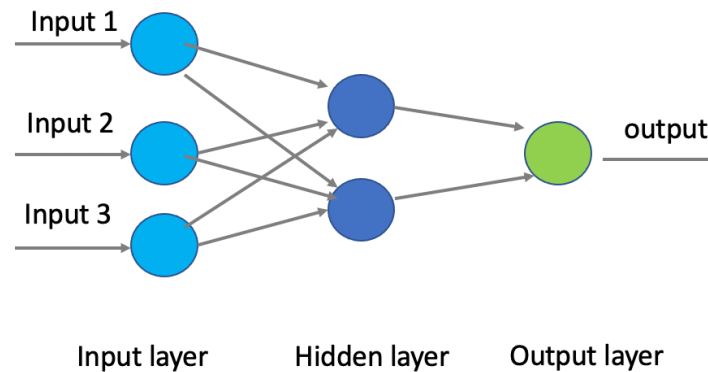


Figure 3. A simple neural network

Deep Learning

Deep learning is a subset of machine learning and machine learning algorithms that develop Artificial Intelligence. Deep learning is a compelling type of machine learning.

Deep learning is analysing input data and mapping the data by different methods until finding the correct output. It is a self-learning process of the machine. Deep learning algorithms try to make similar logical activities to a human. It always tries to analyse data with a particular logical structure. It uses neural networks to accomplish this task. The neural networks are a set of algorithms, and deep learning structures the algorithms into multiple layers to make a neural network.

A deep learning neural network has multiple layers and a complex algorithm to analyse data and find out features and patterns in the data. These layers are the input layer, the hidden layer, and the output layer. The input and output

layers are visible, but the hidden layers are invisible, and they can be large numbers depending on the input. The input layers receive the data, and then pass it to the hidden layer. The output layer is the classified, predictive data layer in a neural network. All the mathematical calculations are performed with the input data in the hidden layer, and the previous layer data is processed with a more complex algorithm. In deep learning neural networks, multiple hidden layers perform different computations from input data, which is why it is called deep learning. Deep learning is heavily used in financial services, customer service and healthcare. In financial service, it is used for predictive analysis and chatbots in customer service. [17.]

2.5 Artificial Intelligence in Different Industries

This section will examine the use of AI in some major industries and how the industries are benefiting from AI.

- **Healthcare**

AI has a significant impact on the health industry. According to the World Health Organisation (WHO), there will be a shortage of around 9.9 million healthcare experts worldwide in 2030. It is also evident that 40 million new health sector jobs will be created in the same year. [18.] AI can help in many ways with this problem. Below are some sectors in healthcare where AI is used.

Drug discovery

There are various pharmaceutical companies currently using Artificial Intelligence to help with new drug discoveries. Typically, the discovery process is very lengthy when discovering a new drug. AI can develop short timelines and good strategies balanced to finding and taking medications to the market.

Clinical Trials

Clinical trials for severe patients can be challenging. Most of these clinical trials are handled offline poorly. There are no intelligent solutions to track the actual progress, collecting data, and drug trial results. Using AI and the blockchain technology makes the process more manageable than before.

AI is helping in various healthcare services such as identifying patterns for accurate diagnosis, virtual nursing assistants, automated imaging, robotic surgeries, dosage error reduction, and new drug discovery. For example, there are some AI-based tools available which is used with critical treatment plans. It can be used to analyse a patient's records and to provide the treatment. It works like a human doctor. [19.]

- **Financial Services and Banking**

The banking and finance industry uses AI a lot, and they have plenty of cases.

Customer experience

The biggest problem of the sector is long queues. In general, customer satisfaction is important in the banking and financial sector. Banking chatbots and virtual assistants are very common nowadays, and they can solve people's normal problems, like balance checks, sending money, and paying bills. [20.]

Personalized banking

In some scenarios, robots replace human agents. They can process the loan, check the customer's historical records, and suggest good investments to the customer based on past performance and credit

records. Robots can automate different social media and email campaigns.

Insurance sector

Chatbots are used in the insurance sector to enhance customer experience and create better insurance plans analysing customer data. They can reduce the processing of claims and help customers and companies a lot.

Saving costs

Using AI in different operations can reduce costs and help make a good profit. According to Juniper research, chatbots will give \$8 billion costs saving in the banking sector by 2022. [21.] Day by day, chatbots are becoming more intelligent. Soon, they will perform the more complicated tasks and save more costs.

Smooth Information Flow

Chatbots and virtual agents can provide a smooth flow of information about different topics. They can answer specially frequently asked questions of customers without agent help. When needed, chatbots and virtual agents can transfer calls to live agents.

AI is used heavily in fraud detection and spam filtering work in detecting phishing emails. [32.]

- **Retail and E-commerce**

Artificial Intelligence is being used the most in retail and eCommerce, and the demand is increasing day by day. Figure 4 shows the growth of AI in two years, which has been 600%. [22.]

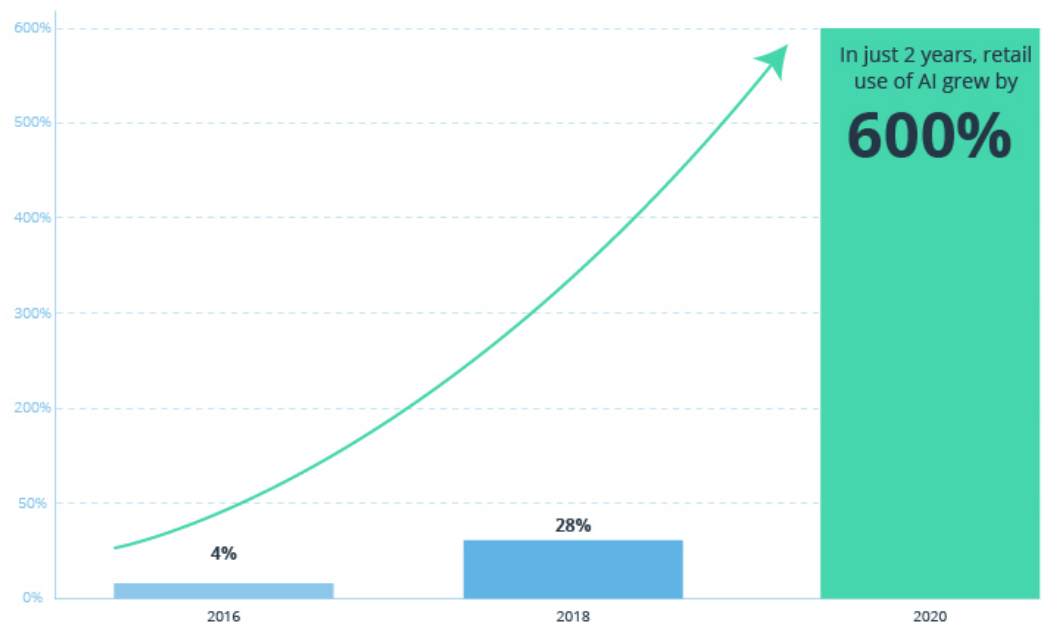


Figure 4. Growth of AI in retail. [42.]

AI is able to provide smooth user experience and sales assistance, help in product search, demand forecasting, customer segmentation and customer service optimization, analyse customer behaviour, and produce predictive analysis concerning retail and ecommerce.

3 Artificial Intelligence in ERP

3.1 Introduction to ERP

In the 1990s, a new software system called Enterprise Resource Planning (ERP) emerged. This new software system was a new development and quite different from the conventional IT systems. The ERP system was designed to integrate all the main characteristics of an enterprise regardless of the type of business. In other words, ERP system was viewed as vehicles through which companies could achieve a state where all workers and stakeholders could see what everyone was doing in the business worldwide. ERP is a systematic method of dynamically balancing and optimizing the resources of a company. When ERP systems are used correctly, they enable an organization to achieve excellent results in growth, profitability, and product and service development. ERP systems are modular in design, meaning that they are flexible and can be customizable to offer the best business practices. [23.]

The modules work in real-time and can either work as stand-alone units or combine several modules to form an integrated ERP system. ERP systems aim to integrate systems not only across the departments of an enterprise but also across the whole enterprise. Thus, when implemented in an organization, ERP systems possess both advantages and disadvantages. First, ERP systems can function as a reliable source of information and provide better information management, better control of information, and increased productivity and efficiency, and enable better decision-making. On the other hand, implementing ERP systems could be incredibly time-consuming and expensive for companies, especially start-ups. [24.]

Companies also need to consider that ERP systems have features and modules which may be challenging to understand and work with; in this regard, there are problems that ERP systems face, such as the compatibility with the development of hardware and software, the integration as well as the development of the data between the modules.

One of the most significant challenges that ERP systems face is the drastically changing business environment. The constant challenge posed due to the expanding market consists of increasing competition, business requirements, and rising customer expectations, putting more pressure on companies to reduce total costs and perform specific tasks in less time. It means that ERP vendors are continually improving and evolving the ERP system to meet the demands of business changes to adapt faster to changes in the business environment. While ERP systems used to be a practical tool for the production environment due to the reporting capabilities, decision-makers and C-level executives need more Business Intelligence (BI) capable tools. They can help them to analyse a massive amount of data that ERP systems are capable of collecting in order to assist them in making better decisions. [25.]

At that point, AI was missing the tool that decision-makers were looking for. AI is the intelligence shown by machines or software. Research in AI's purpose is to make an intelligent agent that can understand the environment, enabling people to make decisions. Artificial Intelligence aims to make software work like the human brain to perform in-depth analysis, perceive its environment, and make decisions based on the analysis and perception.

3.2 AI in Different areas of ERP

AI is helping businesses to boost productivity and efficiency. Figure 3 describes how AI is used in different sectors of ERP.

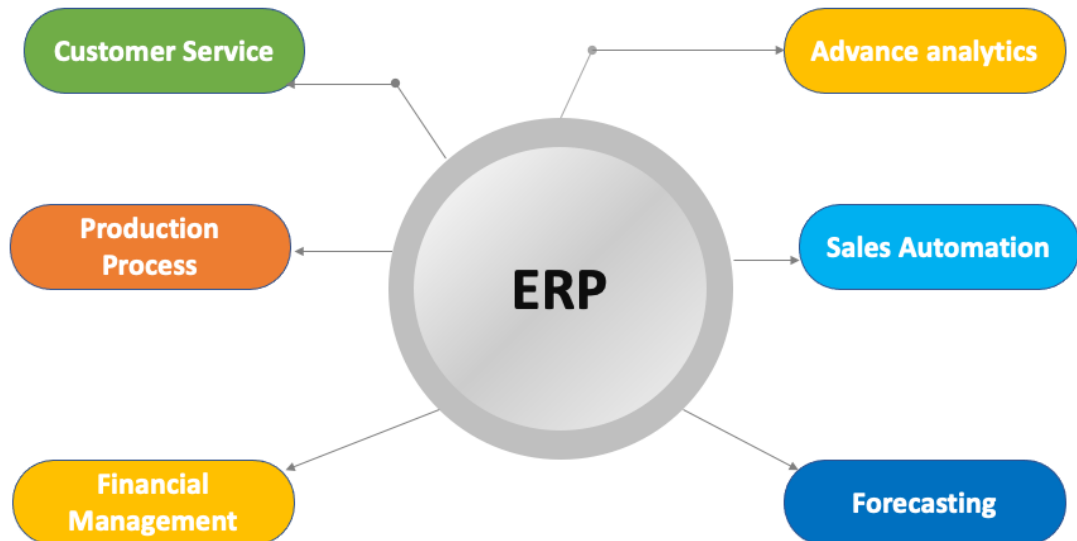


Figure 5. AI in ERP

Customer Service

Artificial Intelligence aims to make software work like the human brain and perform a deep analysis of the human brain functionalities. For example, a chatbot is one of the many digital assistance applications widely used for different purposes such as commercial purposes, entertainment systems, and business purposes. AI is getting attention because it clearly saves time in customer service. It works by using natural languages and is characterised as interaction between human users and software. On the other hand, an ERP system is a system that an organization can use to see the integrated business at the same time. ERP systems can collect a wide range of data about organizations. However, it could not analyse the data in its early editions and generate more useful support and insight for the decision-making process. Therefore, the need of AI integration into ERP systems increases as this can enhance the functionality of the ERP system and make it better at analysing and generating decisions/actions/suggestions. The value can add to the overall offering of ERP systems. Nevertheless, overviewing the technology's limitations and areas of improvement and future research recommendations is crucial and will give better performance. [26.]

Findings show that integrating AI and chatbots into ERP systems will help managers deliver more effective and efficient outcomes. [27.] Besides, one result is to automate the routine administrative and coordination tasks for better time utilization. AI saves managers time because they can have time for other administrative work.

By integrating AI and Chatbots into ERP systems, managers can spend more time on other things like solving problems, collaborating, making strategies, creating innovations, developing people, and engaging with stakeholders, which no machine alone can do. When AI and Chatbots are integrated into ERP systems, managers have a lot of time to be more productive in administrative work and focus more on decision making. Another outcome of integration is that AI and Chatbots will improve the ERP system and make the design and usability easier to manage. ERP systems have too many features and modules that make them difficult for the user to work and use. In many scenarios, lacking the skills of using an ERP system prevents access to the right information. The ERP market has different major suppliers and lacks standardization. In other words, when a manager that is familiar with the SAP ERP system moves to another company that uses the Oracle ERP system, some training is required before the manager is able to utilize the system fully. The learning curve varies from one ERP system to another. However, in the end, it is a necessary procedure to use the ERP system fully. However, integrating chatbots and AI into ERP systems will make the interaction with the ERP system more natural and reduce the learning curve's negative effects. One of the main features of AI is the ability to learn throughout time and suggest decisions and actions based on accumulated knowledge throughout time. By interpreting their understanding through Natural Language Programming (NLP) fine-tuned interaction, managers will act more naturally while interacting with the chatbot during the analysis and decision process. Therefore, they will be more focused on analysing the data rather than being distracted by how to get the data from the ERP system. [28.]

Sales Automation

Nowadays, AI is being used widely in sales and marketing, especially in ERP. AI enabled ERP can analyse market and customer behaviour and make the market strategy automatically.

There are two types of ERP systems: general AI and narrow AI. General AI is a concept of a machine that can mimic the human brain and perform complicated tasks, which means it has a learning ability. In turn, narrow AI is used to do simple and singular operations. Sales automation uses narrow AI.

Sales management is a big part of any business, and AI can perform well in this field. There are many time-consuming and complex tasks in sales which is challenging for a sales employee. For example, predictive analytics is essential for sales. AI can be implemented in the ERP system to make the analytics fast and smooth. It will find the selling opportunities, give pricing analysis automatically, and ensure the highest ROI.

Some big companies like Zalando are implementing Artificial Intelligence in their system. Not only B2C (business-to-consumer) companies are doing that; b2b (business-to-business) companies have actually already adopted AI in their ERP. [29.]

Inventory Management

Inventory is the stock of goods like raw material. It is not only raw materials, but it can also be software. Inventory management means planning, organizing, handling and storing an adequate inventory level with optimized cost to meet a consumer's demand. An inventory occupies 50-80% of the total current assets of the business organization. It is an essential part of working in capital management and production management. [30.]

Inventory management is an essential part of the business, and it needs a lot of work force. AI can be used here to make the process faster, and more accurate. AI can be implemented in different tasks, as described below.

Inventory Monitoring Automation

Manual tracking of inventory is hard for employees and also time-consuming. Automation can perform well in this field. AI-based inventory management can carry out this job in real-time quickly and with fewer errors, which means employees can concentrate on other tasks.

Robot Automation

AI-driven implementation in inventory management can help in managing inventories, checking inventories, and stocking. Its underlying algorithm commands the machine to perform specific tasks. It is already very popular and widely used in inventory management. [6.]

Data Mining

Data mining and utilization of data are very important for a successful business. A company needs to appoint a good amount of data analysts to analyse data. However, in AI-driven implementation, every record of a consumer is tracked and analysed automatically. Overall, it is easier for an organization to plan its sales and production plans. They can also improve their business model based on the analysis. [31.]

Less Error in Forecasting

Forecasting is very important in business, and it has a big impact on supply chain management. A company needs to know the amounts of products they have enough stock and what quality the products are to improve customer satisfaction and profit margin. AI can make error-free forecasting analysing sales and inventory data. [6.]

Financial Management

Financial management is important in ERP, and AI is being used heavily in this department. AI can perform this job faster and more error-free. It can create invoices atomically and even send and pay them, as ERP is a centralized system. It is also able to close different financial operations of a company automatically monthly and yearly. Using machine learning more and more in this field, AI can adopt human behaviour patterns and develop better judgements than human. [32.]

Manual accounting processes can have typical human errors. However, with AI, accounting can be faster and include fewer errors in comparison to human-led processes. AI-based ERP can process bills, pay the bills, and perform predictable data entries with better accuracy than the manual process. When AI helps with data entries, paying an invoice, or creating invoices, finance employees can involve themselves in other financial work, which is profitable for a company. It is also beneficial for business leaders in different ways. They can concentrate on sales and marketing decisions based on predictive analysis using AI. [33.]

Advance Analytics

ERP is becoming more and more intelligent day by day, and it is empowering different sectors. In supply chain management and production, ERP analysis and prediction are essential. Accurate analysis and forecasts can be beneficial in many ways, and AI can improve data analysis and prediction substantially.

4 Artificial Intelligence in Sales

B2B (business to business) sales are tricky because of a lowest conversion rate and a more comprehensive business cycle system. People do not buy a product without thinking about it, and day by day, it is getting harder. There are many things involved in the sales process which need a lot of effort, analysis, and

customer reaction. However, this is a tough job for humans and not cost-effective. Nevertheless, Artificial Intelligence can improve the sales process and make it easy for companies to increase their sales. According to a Harvard business review study, the use of AI in sales increased the lead by more than 50% and reduced costs by 40%-60%, and call time by 60%-70%. [34.] Interest in AI is increasing because of its effective solutions. AI can improve sales differently, described below.

- Helping sales teams with simple tasks

AI in ERP is not yet smart enough to call a customer and build a relationship with the client. Nevertheless, it can help salespeople with repetitive jobs such as data entries and scheduling meetings. They can also prioritize work for salespeople by analysing the needs. It can also make some automatic sales where the relationship with the customer is not necessary.

- Accurate lead scoring and prioritization

AI can investigate a large amount of data and help find the best lead and prioritize it, allowing lead scoring. It can also give insights into customer emails, phone calls, and messages. Victor Antonio, a sales expert, wrote in the Harvard Business Review about humans performing lead scoring in an incorrect way [35.]:

Often, this decision-making process is based on gut instinct and incomplete information. With AI, the algorithm can compile historical information about a client, along with social media postings and the salesperson's customer interaction history (e.g., emails sent, voicemails left, text messages sent, etc.) and rank the opportunities or leads in the pipeline according to their chances of closing successfully. [35.]

AI can improve the process of lead scoring more accurately than humans.

- smart sales recommendation

Some AI systems can recommend the best sales technique according to the needs and insights from historical data. They can also help fix good price deals, target the next customer, and help in upsells and cross-sells. These recommendations work as a guide for a salesperson. They can work proceed based on those recommendations. [37.]

- Better Sales Management

The use of AI helps a lot in sales management and structuring the sales teams and adds new insight. It is creating a more accurate and aggressive sales quota. AI can be used in optimizing different sales areas. It can suggest where more resources and sales expertise are needed. Releasing new products and changing products has a good impact on sales. AI can test that impact before releasing, which will reduce the cost. AI can be used to study the product demand for the coming year. It can help to estimate how many people a company should hire. [37.]

- Predictive analysis

Data is essential to any business, and it can help businesses to predict consumer action and research the market. The company has data from different sources such as CRM, ERP systems, market research data, and other sources. However, utilizing large amounts of data and turning the data into intelligence is a challenging task for the company. Artificial Intelligence comes with a solution for that complex job. Its underlying sophisticated machine learning algorithm can analyse customer and prospect data. The prediction is mostly close to reality. [31.]

Predictive analysis means making analysis based on historical data from a different source. Based on that analysis, it recommends the most critical sales operations to perceive and forecast results, adjust pricing,

and perform many other sales tasks. It is not only sales and marketing; it can also help gather more information about a customer, enhance business capabilities, and find out more about competitors. This system learns from data and improves results over time. It is good that large amounts of data are available now to analyse different sources. Figure 5 shows the predictive analysis method process in ERP. [38.]

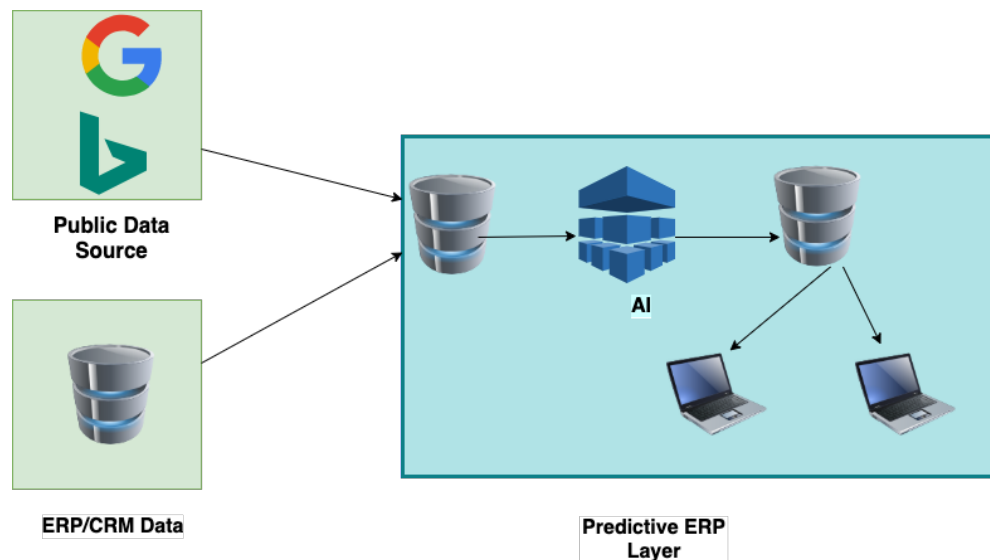


Figure 6. The predictive analysis processes.

Predictive analysis in ERP based on historical data to make decisions for the future or to analyze data is not complicated. In the beginning, it is important to find use cases and relevant data from the company's own ERP/CRM system. If the information is not available, different data sources are available on the internet. Next, it is essential to aggregate the data and save them in a database. Then the data are analyzed and made ready for final advanced reporting. Finally, based on that report, final and technical decisions are made for different use cases.

Predictive analysis is used heavily in different areas of ERP. It helps in correct sales forecasts and also in supply chain management. Some AI-powered tools are available to provide deep insights about target audiences, such as customers' interests, demography, and psychographics.

- Predictive analysis in sales forecasting:

Predicting sales is the key and an essential tool for any business. Predictive analysis can help the business owner improve their budget plan and the estimate for different products. Overall, it helps the company develop its inventory management strategy, and it also helps in the company's growth a lot. The predictive analysis makes predictions with the help of the previous year's sales data and advanced ERP-based AI. [39.]

- Robots in store and retail

Robots are already famous in heavy industrial work and waste management work. Now they are working even as store associates in large shops. They will work as customer assistants in the shop, answering customer queries about products and checking the products' availability. However, there are also some challenges. The customer might not be comfortable with interacting with robots as helpers. According to research, new robots named Z will be seen in retail very soon with new technology. In the meantime, people will be more open to new technology. [40.]

5 Predictive Analysis with Sap Analytics Cloud

There are various types of applications for predictive analysis and forecasting from different vendors. Sap Analytics Cloud (SAC) is one of them which is owned by SAP.

SAP Analytics Cloud that helps you generate predictions about future events, values, and trends by leveraging historical data. [41.]

Forecasting sales for different products is challenging and time-consuming work. SAP Analytics Cloud, which is owned by SAP, has a feature that can help make intelligent predictions for a particular product. It is a data scientist's job, but Sap Analytics Cloud makes the job easier.

5.1 Sales Price Prediction Use Case

This section will illustrate forecasting the sales of a plastic manufacturing company using some historical data. This use case will use two variables, total sales in one month and months of the year. The objective is to examine the data and understand whether the company needs to reduce or increase production to avoid exceeding their budget. The free plan of SAC (Sap Analytics Cloud) is used to analyse the data.

Figure 6 shows the plastic sales price from 2016 to 2018 and here the sales price is the target variable.

The screenshot displays the SAP Analytics Cloud interface. On the left, a table titled 'Create Transform' shows a dataset with columns 'Month' and 'Sales'. The data spans from 30-1-2016 to 30-5-2017. On the right, the 'Dataset Overview' panel for 'PlasticSales' is visible, showing 64 rows and 2 columns. The panel includes a search bar, 'Output' and 'Columns' tabs, and sections for 'Measures (1)' (Sales, SUM) and 'Dimensions (1)' (Month).

	Month	z2 Sales
1	30-1-2016	742
2	28-2-2016	697
3	30-3-2016	776
4	30-4-2016	898
5	30-5-2016	1030
6	30-6-2016	1107
7	30-7-2016	1165
8	30-8-2016	1216
9	30-9-2016	1208
10	30-10-2016	1131
11	30-11-2016	971
12	30-12-2016	783
13	30-1-2017	741
14	28-2-2017	700
15	30-3-2017	774
16	30-4-2017	932
17	30-5-2017	1099

Figure 7. Datasets for plastic sales use case

Modelling process of SAP Analytics Cloud

During the analysis process, SAC splits the datasets into different variables and segments. Figure 7 describes the whole data modelling process. In the figure, the source of the data is plasticsales.csv. In the predictive goal section, the signal is sales and based on the signal, it will make the integer values forecast. The date variable is also important here because of its time series prediction. Both variables are mandatory in time series prediction modelling. In time series prediction, the future is predicted using historical data, which is time. That is why it is called time series modelling. When the two variables are available, the train button is clicked to train the model. After that, it trains the model and creates a forecast. In this use case, Horizon-Wide MAPE is 1.94% which means only 1.94 percent of the forecasts were wrong during predictive analysis. The

graph shows actual and forecast values and there an uptrend is visible, which indicates that sales are increasing over time.



Figure 8. Predictive scenario of plastic sales data

Figure 8 outlines the actual sales and forecast values in numbers, which indicates how accurate the forecasting is.

The resulting predictive model can make advanced future forecasting, providing cutting-edge insights to plan future business strategies. In this example use case, SAC also predicted monthly forecasts, which is visible in appendix 1. Based on those nearly accurate predictions, and it is easy to plan the future business strategy.

6 Conclusion and Implications for Future Research

Artificial Intelligence has existed for a long time already, but it has only been discussed more broadly in the last decade. Technology has taken notable leaps during the last decade, so AI is an exciting topic nowadays.

The main idea of the thesis is to study, how Artificial Intelligence is implemented in ERP and what impact of AI has on ERP business. The goal of this study is to increase the reader's understanding of AI and its different subfields. The study has also discussed how ERP is being used in different operations and how it improves the ERP industry day by day.

Artificial Intelligence is heavily used in different sectors of ERP, and it has a good impact on making the business profitable. It allows vendors to improve their ERP system using natural language processing (NLP) and machine learning. It is undoubtedly true that Artificial Intelligence has big impact on human life these days. In everyday life, people are using AI without even knowing it when using different applications. ERP is not only using AI in their application, but various business industries are also using it flawlessly. AI is being used to measure customer behaviour, different customer interactions in online purchasing platforms, and creating automatic feedback.

In conclusion, the growth of AI is revolutionary, and it has a significant impact on the ERP business. Nevertheless, the range of AI-based ERP applications is limited. However, nowadays, there is a considerable amount of new research being carried out in this field. This study has mainly concentrated on predictive analysis, sales forecasting and knowing more about AI and its components. The author will concentrate on other areas such as natural language processing and business intelligence in future research.

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 Create Transform					
	Month	2022 Sales	1 ²³ Forecast	1 ²³ Error Min	1 ²³ Error Max
1	2016-01-30	742	<i>null</i>	<i>null</i>	<i>null</i>
2	2016-02-28	697	701	<i>null</i>	<i>null</i>
3	2016-03-30	776	773.5	<i>null</i>	<i>null</i>
4	2016-04-30	898	916	<i>null</i>	<i>null</i>
5	2016-05-30	1030	1047.5	<i>null</i>	<i>null</i>
6	2016-06-30	1107	1130.5	<i>null</i>	<i>null</i>
7	2016-07-30	1165	1169.5	<i>null</i>	<i>null</i>
8	2016-08-30	1216	1220	<i>null</i>	<i>null</i>
9	2016-09-30	1208	1208	<i>null</i>	<i>null</i>
10	2016-10-30	1131	1147	<i>null</i>	<i>null</i>
11	2016-11-30	971	936	<i>null</i>	<i>null</i>
12	2016-12-30	783	794.5	<i>null</i>	<i>null</i>
13	2017-01-30	741	759.5	<i>null</i>	<i>null</i>
14	2017-02-28	700	700	<i>null</i>	<i>null</i>
15	2017-03-30	774	776.5	<i>null</i>	<i>null</i>
16	2017-04-30	932	914	<i>null</i>	<i>null</i>
17	2017-05-30	1099	1081.5	<i>null</i>	<i>null</i>
18	2017-06-30	1222	1199.5	<i>null</i>	<i>null</i>