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sciendo

ACTA MARISIENSIS, SERIA OECONOMICA
Online:ISSN 2668-3989, ISSN L 2668-3148
Print:ISSN 2668-3148, ISSN L 2668-3148

doi: 10.2478/amso-2022-0008

ELEMENTS OF ARTIFICIAL INTELLIGENCE IN INTEGRATED INFORMATION SYSTEMS

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Abstract: *The importance of the chosen theme is given by the lack of implementation of these technologies on the Romanian market, respectively to companies in the SME category, because this niche at the moment is one in full development and expansion. In the first part, entitled 'Artificial intelligence – definitions, classifications', the theoretical aspects of artificial intelligence systems in general, the direction of development in general, are presented, the types and categories of artificial intelligence and not least the facilities and effects of the use of artificial intelligence in general and in the fields of medicine, energy, production, education, finance and the transport industry respectively. In the second part entitled "Current trends in the development of integrated ERP systems" it analyzes the procedures for the integration of artificial intelligence elements as well as market analysis through the analysis of ERP solutions equipped with existing AI, the modules of the IT solutions that have been improved with artificial intelligence and other key elements with an impact on the implementations.*

Keywords: *IA, ERP, machine learning*

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1. ARTIFICIAL INTELLIGENCE — DEFINITIONS AND CLASSIFICATIONS

The words intelligence (intelligence - understanding, knowledge) and artificial (artificialis – skill, skill, man-made) come from Latin and both are used in most of the existing modern languages. By combining these two words and applying in the digital age in which we live we find a generalized solution to the many problems we face in various fields and sectors.

Artificial intelligence or AI is an information technology-based field that studies and shapes intelligence by creating systems that can mimic human functions such as reasoning, learning, planning, decision making, creativity and more.

One definition of Andreas Kaplan and Michael Haenlein is "the ability of a system to correctly interpret external data, learn from such data, and use what it has learned to achieve specific goals and tasks through flexible adaptation" (Kaplan, 2022).

The above definitions outline and delimit concretely the systems that can be considered intelligent systems or systems with artificial intelligence capabilities; thus it is summed up that at the moment the systems can be classified into 5 groups:

- Machine learning;
- Deep learning or deep learning;
- Neural networks (Neural networks);
- Bayesian networks (Bayesian networks);
- Evolutionary algorithms.

Depending on the type or capacity, artificial intelligence is classified into 3 main categories:

- **ANI – Artificial Narrow Intelligence:** Poor artificial intelligence has the skills to autonomously perform only operations and calculations for which it was programmed and trained without exceeding the limits of the task for which it was performed. Most artificial intelligences made nowadays fall into this category.

Philosophically, this category of artificial intelligence is defined as an intelligence that has only the capabilities of action, without "mind" and "consciousness

- **AGI – Artificial General Intelligence:** General artificial intelligence is an intelligent system that hypothetically is able to understand and develop its own knowledge but also skills.

From a philosophical point of view, this category of artificial intelligence is defined as an intelligence that has "thinking" capabilities similar to that found in mankind, "mind" and "consciousness"

- **ASI – Artificial Super Intelligence:** Hypothetical artificial superintelligence is the most advanced system in the category of systems equipped with artificial intelligence with learning and permanent development skills capable of solving all problems and with intellectual capabilities far above the expert human capacity.

Philosophically, this category of artificial intelligence is defined as an intelligence that has the capacity for complex "thinking" in all areas, "mind" and "total consciousness".

1.1. Design peculiarities of modules incorporating AI

The design of modules with embedded artificial intelligence is a process that is beginning to gain ground in terms of strategy planning in many companies due to the fact that more and more companies are taking interest in the information and predictions offered by these intelligent systems.

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Making predictions by the classical method through statistical analysis cannot be made in real time or in a very short time and may include errors generated by human mistakes and CRM or ERP systems are systems are not designed for such operations especially if the data volume is the result of several years or decades.

Regardless of the type of artificial intelligence developed, the design processes are very similar in terms of its realization and implementation (see Fig.1)

1.2. Benefits of using AI in the economy

The benefits of using artificial intelligence in the economy has aroused interests in many researchers, companies and organizations operating in fields with the potential for digitization and use of AI. Twg Chairman (part of the Dover Company Group) Jim Zoretich characterized the phenomenon of incorporation of artificial intelligence into the economy in the following way: *"The advantage of artificial intelligence guides us to rethink the fundamentals of economic relations and how to create value"* (Bloomberg, 2022).

Due to the fact that the incorporation of artificial intelligence results in an added value in the final product or service, the economic potential is high so this niche enjoys consistent funding from various government and non-governmental funds.

The total funds for research related to artificial intelligence amounted to 85.3 billion. USD and it is estimated to increase to about 204 billion. USD by 2025 – according to IDC (IDC, 2022). The funds allocated for research in this regard differ on each continent and in each country, depending on the current economic vision and situation (see Fig. 2).

According to a study by Accenture, a multinational company specializing in IT services and consulting, and Frontier Economics, a company specializing in economic consulting, the contribution of artificial intelligence would have a major impact on the global economy. The study is aimed at countries with an R&D-oriented governance based on artificial intelligence, such as the USA where the use of artificial intelligence as a factor of production would have a positive impact, increasing gross value added (GVA) by 8.305 billion. USD reaching a total relative value of 32,170 bn. USD (see Fig. 3).

China, which is the country with the economy's highest growth dynamics, annually invests billions of US dollars in AI-based technologies, solutions and startups. From 2010 to Q3 2017 China registered 704 artificial intelligence investment contracts totaling $ 6.67 billion. According to PriceWaterhouseCoopers the country's GDP will reach $38 trillion of which the contribution of artificial intelligence will reach $7 trillion (World Bank report, 2022). (see Fig. 4)

Artificial intelligence has a high potential in terms of its usefulness in the economy and can increase the efficiency and effectiveness of productivity in several industries and sectors based on information technology. The most common solutions in the current days are:

–Influencing online purchases by displaying personalized recommendations based on the analysis of searches, purchases made by users but can also be based on other related behaviors made in the online environment. Certain online stores and platforms continuously invest in the development and optimization of algorithms for product and service suggestions that are subsequently offered or recalled to users resulting in an increase in sales.

–Suggestions for information and advertising in search engines as well as on other sites, based on the actions, searches, interests of the person depending on the pages previously visited.

Search engines collect information continuously about their users so the improvement of search results can be a continuous one.

–Increasing the efficiency of information security which is the most important aspect when online transactions are constantly growing, governments are investing in e-government programs, the medical system is in the process full of digitalization and many companies have begun digitizing processes. Artificial intelligence in information and cyber security can generate significant positive effects by collecting the necessary data, analyzing them and delimiting human actions, respectively automated (robotic ones). Automated processes embedded in artificial intelligence systems can issue notifications or executing certain procedures when certain anomalies occur in the information resulting from the monitored processes.

According to a survey conducted in 2019 by the World Bank with the theme of "Artificial Intelligence: Investment trends and selected modes of use", 6 main sectors are defined that are in full evolution:

i. AI in medicine: The medical system with the help of artificial intelligence has the greatest potential in terms of increasing efficiency, effectiveness, accuracy and credibility in medical processes. Medical imaging and diagnosis benefit from an increase in processing speed and accuracy, telemedicine can be enriched with the capability to define preliminary diagnoses and provide risk analysis based on machine learning (ML) oriented towards patient information.

ii. AI in the energy industry: The energy industry with information systems equipped with artificial intelligence would have the capability to analyze complex systems in real time in terms of optimizing distributed energy resources such as photovoltane systems and related components, but they can also facilitate the distribution of electricity by monitoring the energy flow and optimizing its use. The energy industry with information systems equipped with artificial intelligence would have the capability to analyze complex systems in real time in terms of optimizing distributed energy resources such as photovoltane systems and related components, but they can also facilitate the distribution of electricity by monitoring the energy flow and optimizing its use.

iii. AI in production: Production is the most promising sector because artificial intelligence can contribute both to the production process and to the optimization of the final product in terms of functionality, cost and quality. Computer assisted design (CAD) with AI enhancements would have the ability to design a product project based on a set of well-defined parameters so accessibility to design technologies would be significantly diminished.

iv. AI in education: The use of artificial intelligence technologies can have a significant positive effect on education by increasing the efficiency of education both in classrooms and outside them by analyzing and proposing information to teachers with the subject of the performance and interests of pupils and students, facilitating a better vision of the teacher related to the deficiencies and strengths of each student.

v. AI in financial sector: The financial sector already has various mechanisms in place to assess customers, risks and opportunities, but the deployment of artificial intelligence would make a significant contribution to current processes so that financial institutions would benefit from more accurate and faster relevant information. Innovations in this direction have already begun with the IBM Watson system that predicts customer behavior based on customer history. Intelligent systems can also identify and prevent cybersecurity incidents and improve alignment with international KYC, AML, PCI standards applicable to the financial sector. Cyber crimes

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covered by the above standards can be more easily identified and prevented with machine learning, reducing fraud and high-risk investments.

vi. ***AI in transport industry***: This industry is the most promising because it already incorporates a weaker artificial intelligence used to optimize and solve certain problems such as optimizing transport routes or preventing accidents by incorporating computer vision (Cordis projects database, 2022). Increasing research in this direction and implementing solutions would contribute to vehicles, trains, ships and other driverless vehicles, with object recognition capabilities as well as traffic capabilities without human interaction. Machine learning also have contributions to optimizing routes, reducing fuel as well as reducing pollution (Kerzel, 2020).

Although the sectors listed have a very high potential to increase productivity and added value, it does not mean that all other sectors do not have potential in terms of using artificial intelligence in specific processes. Also, several studies point out the risk that automating processes or including artificial intelligence would result in the abolition of some positions, it should be noted that the process of evolution involves increasing the efficiency and effectiveness of some processes but also creating new positions due to new requirements so that the disbanded positions will be replaced by new posts, which define new tasks.

2. ERP IT SOLUTIONS WITH AI VALENCES

2.1. Microsoft D365 Business Central

The Microsoft D365 Business Central information system is an ERP system developed by Microsoft, based on the cloud and available in two operating variants: SaaS respectively on-premises (hosting and maintenance under the responsibility of the customer). The system is adapted for various regulations such as IAS/IFRS and GDPR for the EU and SOX for the US.

Microsoft D365 Business Central is the successor to Dynamics NAV and Navision programs, which appeared in April 2018, and includes modules developed especially to facilitate financial activities, sales, production, customer relationship management (CRM), supply chain management, project management and more, designed for SME companies (SMB – Small to medium businesses) (see Fig 5).

Microsoft D365 together with Microsoft Azure AI enables intelligent reports based on machine learning by connecting these two systems and configuring the report itself. The two systems together process, analyze the collected data and are returned to D365. The processing procedure can be flexibly modified because the desired properties in the data model are selected, which in turn can be processed by programs (scripts) in the R programming language.

2.2. SAP S/4HANA

The SAP S/4HANA information system is a cloud-based ERP system developed by the German company SAP SE, a company focused on specialized systems for large enterprises, cloud solutions and consulting services. The information system was developed using the ABAP programming language also developed by SAP SA, and the first launch of the product was on February 3, 2015. SAP's commercial and technical policy is based on components called "Lines of business" (Lines of business or LoB) and aims to integrate basic modules from SAP Business

Suite such as SAP ERP (Enterprise resource planning), SAP SRM (Supplier relationship management), SAP CRM (Customer relationship management), SAP SCM (Supply chain management). Due to the fact that these products come in a single package and only work with SAP HANA databases (HochleistungsANalyseAnwendung or High Performance Analysis Application), the software package is offered under the name SAP S/4HANA (v. Fig. 6).

SAP S/4HANA is a component-based information system (LoB) so it is configurable and can be customized for different lines of business / activity such as finance-banking activities, activities with consumer products, finance, insurance, production, project and portfolio management, retail, sales and marketing and last but not least telecommunications.

The SAP S/4HANA solution offers possibilities for integration with artificial intelligence, more precisely with machine learning (ML) through 3 main methods: built-in ML (embedded ML), ML side by side (side by side) and explorative ML. The difference between the listed ways of integration is the volume and computational capacity required. SAP blog, 2022, accessed 2022; SAP blog, 2018, accessed 2022).

2.3. Oracle Cloud ERP

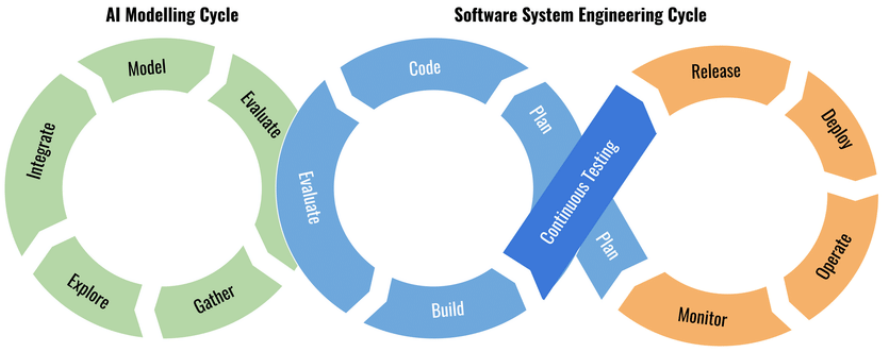
Oracle Cloud ERP is a SaaS information system developed by Oracle Corp. run in Oracle data centers, based on modules as follows: financial, accounting, sourcing, project management, risk management, performance management (EPM), AI applications, supply chain management (SCM), and NetSuite.

Oracle AI Apps is a set of tools found in the cloud version of the application and is based on artificial intelligence, specifically machine learning. These tools are aimed at improving the following modules: financial, human resources, sales, service and procurement / supply.

Oracle Cloud ERP stands out for implementing a wide variety of existing functionalities in the market such as feeling analysis, image data extraction, intelligent chatbots, anomaly detections, and more.

The IT solution facilitates the user's work because the database can recognize up to 17 types of entities (company names, countries, localities, streets, name, surname, etc.) and together with the OCR (optical character recognition) function, it can classify and process a wide range of documents such as invoices, receipts, receipts, bank statements and other documents (see Fig. 7).

Figure 1 The life cycle of AI design in line with the life cycle of the development of information system



Source: https://www.researchgate.net/publication/348142248_AI_System_Engineering-Key_Challenges_and_Lessons_Learned, 30.11.2022

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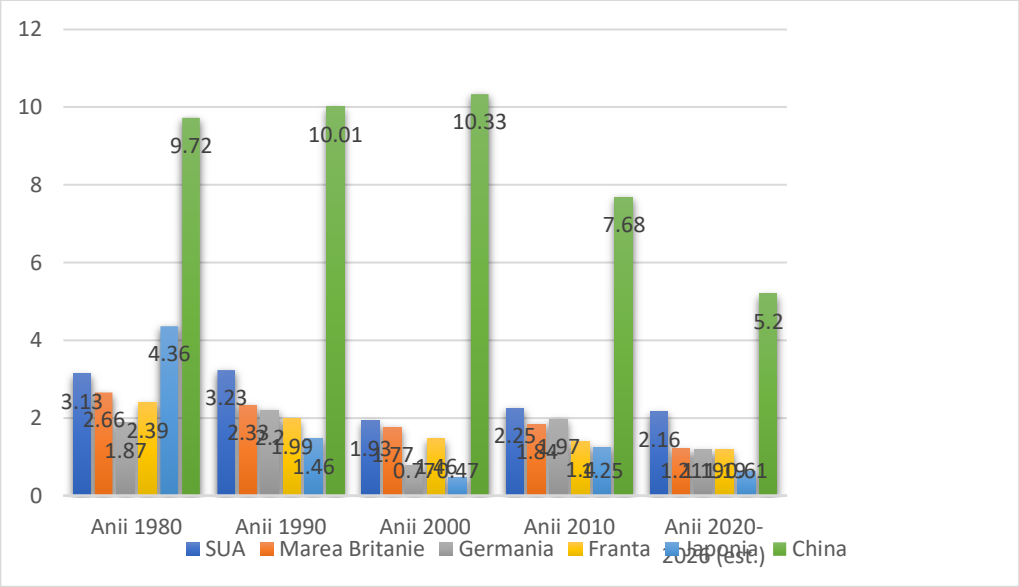
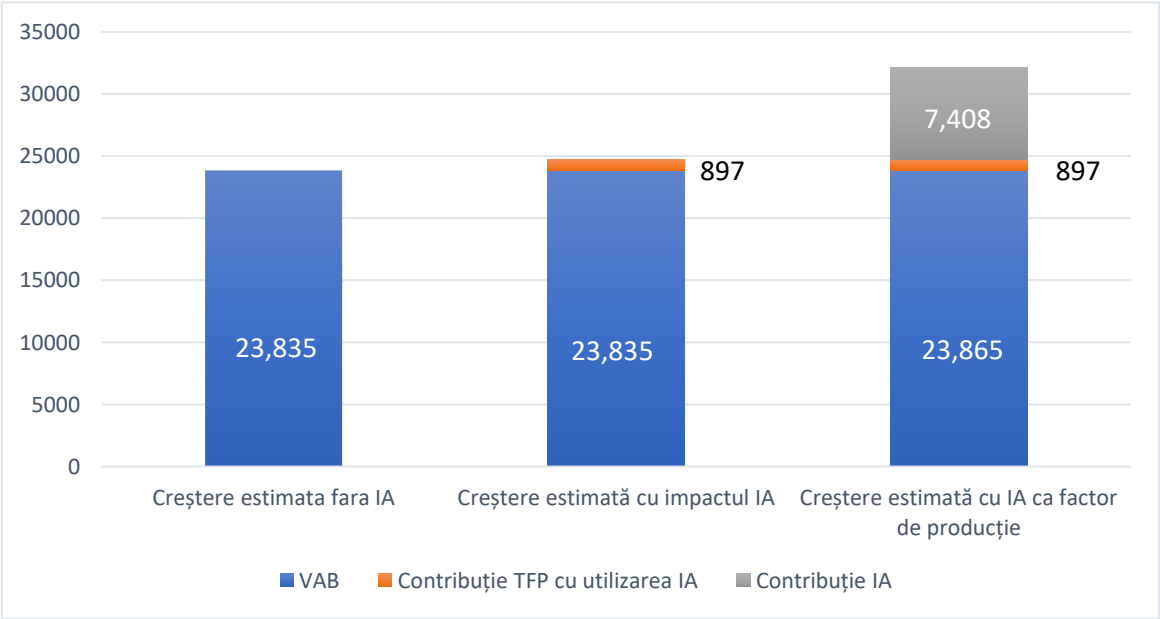
Figure 2 Evolution of the GDP average in absolute values, related to countries with high interest in AI



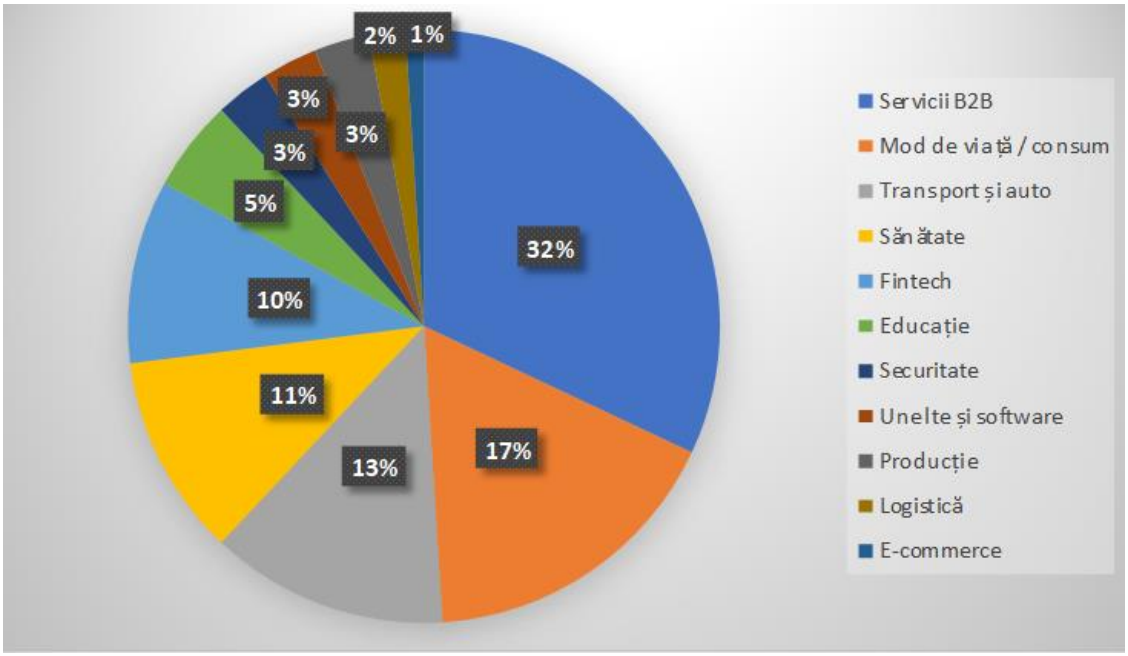
Source: https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/USA/GBR/DEU/FRA/JPN/CHN

Figure 3 Estimated increase in GVA with/without AI contribution to the USA



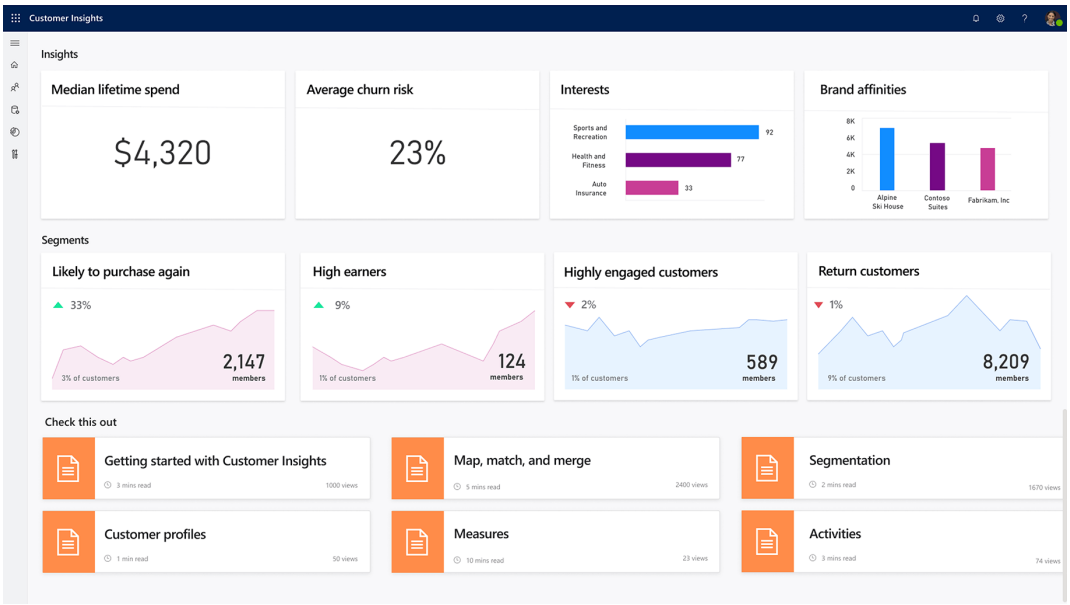
Source: https://www.crcom.gov.co/uploads/images/files/4-MarkPurdy%20-%20Artificial%20intelligence%20and%20growth.pdf, 18.11.2022

Figure 4. Number of AI investment contracts per domain (China)



Source: https://openknowledge.worldbank.org/bitstream/handle/10986/32652/Artificial-Intelligence-Investment-Trends-and-Selected-Industry-Uses.pdf, 18.11.2022

Figure 5. Microsoft D365 AI application dashboard



Source: https://www.avelon.be/news-blog/sap-cloud-platform-central-launchpad, 06.05.2022

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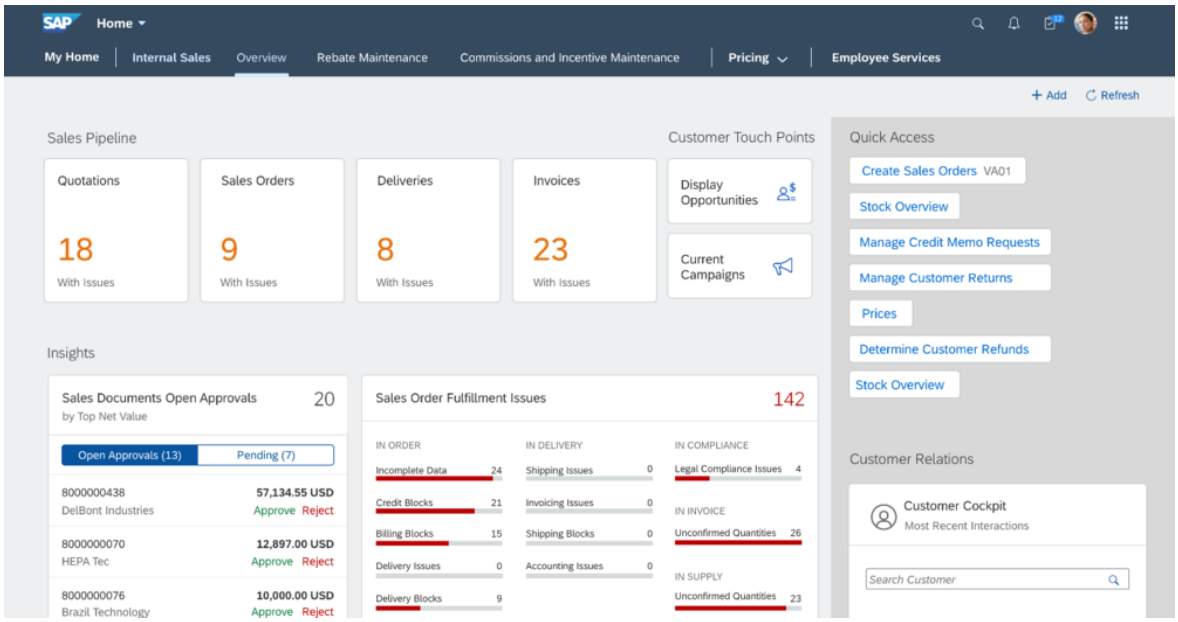
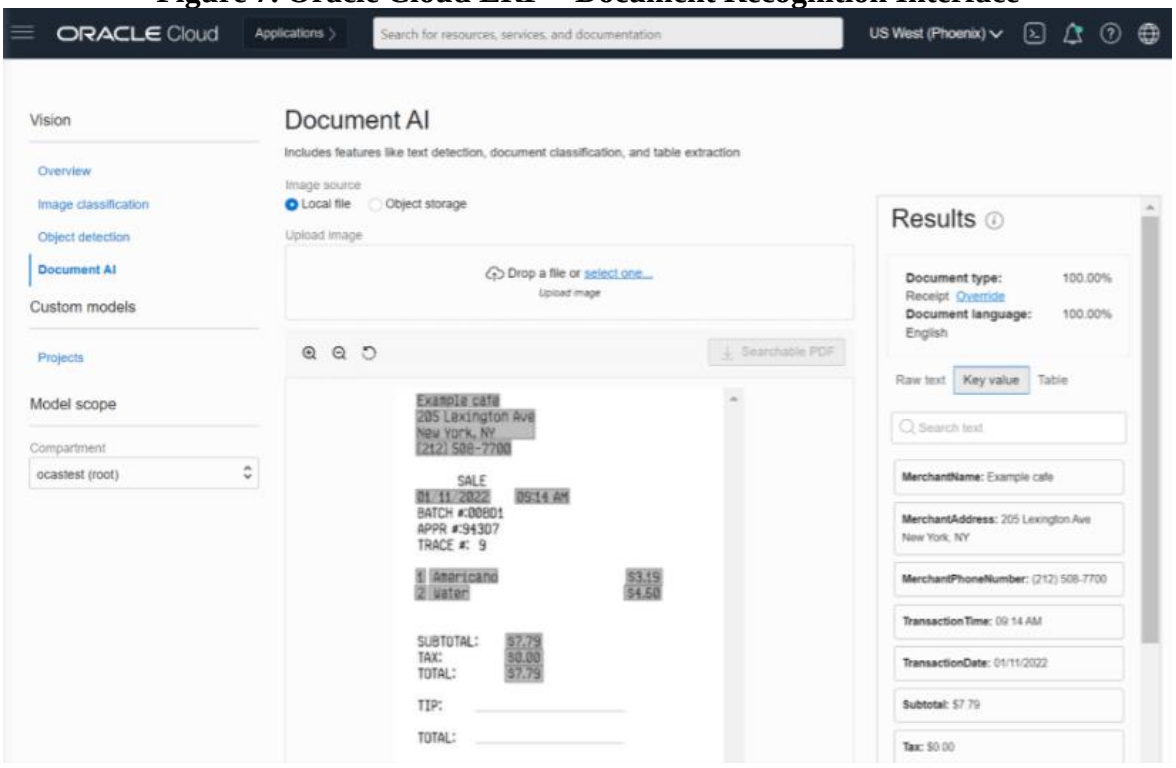
Figure 6. SAP S/4HANA Cloud Application Dashboard



Source: https://www.avelon.be/news-blog/sap-cloud-platform-central-launchpad, 06.05.2022

Figure 7. Oracle Cloud ERP—Document Recognition Interface



Source: https://www.oracle.com/artificial-intelligence/vision/, data 11.05.2022

3. CONCLUSIONS

As can be seen in everyday life, this branch of ICT is still in full development, and there is still no computer system equipped with real artificial intelligence that really thinks with the reasoning that a person has. However, taking into account the possibilities and visions of using AI, it can be considered a new chapter in the digitization process that is beginning to gain ground due to the economic advantages offered.

In conclusion, existing systems based on artificial intelligence are based on mathematical and statistical techniques and formulas that are applied to existing structured and unstructured data.

Artificial intelligence offers unlimited possibilities in terms of exploitation because it can facilitate various processes such as providing statistical data that substantiate decisions, can improve various processes found within many companies, facilitate the bidding process but also the supply process and last but not least can increase the productivity, competitiveness and security of some systems.

The ERP systems with AI valences analyzed have a similar implementation in terms of business logic because all the analyzed systems are aimed at improving the most common processes by incorporating artificial intelligence.

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