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THE ROLE AND IMPORTANCE OF PROGRAMMING LANGUAGES IN THE APPLICATION OF ERP SOLUTIONS

Uloga i značaj programskih jezika u primeni ERP rešenja

Abstract

ERP software solutions are important for every company because they significantly improve and simplify company operations through a system based on well-organized data and software modules. There are a large number of ERP solutions on the market in the form of commercial or open-source software. The paper focuses on the largest and most represented ERP software solutions, whose most significant features are presented in an overview. As these are software solutions that, by their nature, must be written in some programming language, the paper analyzes the programming languages that the presented ERP systems most use. The choice of programming language is very important when creating any new ERP solution because it often directs the system development and defines the framework of possible tasks that can be performed in it. Apart from the primary programming languages for each considered ERP system, other programming languages are also listed which they support at least in some of their segments. This approach in the paper can be useful to look at the existing situation in the field of relations between ERP software and programming languages, but also to provide a basis for the creation of some future ERP solutions viewed through the needs of the systems themselves and the capabilities of programming languages.

Keywords: *ERP systems, programming languages, business operations, software in business*

Sažetak

Softverska ERP rešenja značajna su za poslovanje svake firme jer se na taj način kroz jedan uređen sistem, zasnovan na dobro organizovanim podacima i softverskim modulima, može značajno unaprediti i pojednostaviti funkcionisanje preduzeća. Na tržištu postoji veliki broj ERP rešenja koja pripadaju komercijalnom ili otvorenom softveru. U radu je fokus na najvećim i najzastupljenijim ERP softverima koji su na pregledan način predstavljeni kroz svoje najznačajnije osobine. Kako se radi o softveru koji po prirodi stvari mora da bude napisan u nekom programskom jeziku, u radu su analizirani programski jezici koji se najviše koriste za prikazane ERP sisteme. Odabir programskog jezika je značajan pri kreiranju svakog novog ERP rešenja jer to često usmerava pravac razvoja sistema i definiše okvir mogućih zadataka koji u njemu mogu da se izvrše. Osim primarnih programskih jezika, za svaki razmatrani ERP sistem navedeni su i drugi programski jezici za koje oni bar u nekim svojim segmentima imaju podršku. Ovakav pristup u radu može biti koristan da se sa jedne strane sagleda postojeća situacija na polju odnosa između ERP softvera i programskih jezika, ali i da se da osnova za kreiranja nekih budućih ERP rešenja, imajući u vidu potrebe samih sistema i mogućnosti programskih jezika.

Ključne reči: *ERP sistemi, programski jezici, poslovanje preduzeća, softver u poslovanju*

Introduction

The accelerated digital transformation of business systems has brought major changes in the way companies operate. In order for business processes to adapt to a dynamic environment, companies need to implement some kind of application solution, such as ERP (Enterprise Resource Planning) software solutions.

ERP is a type of software that is used to manage the day-to-day business activities of a company, such as procurement, project management, risk management, accounting and business compliance of all business units. A complete ERP package includes the management of the entire company performance, as well as various modules that help plan, calculate, forecast and report on the company's financial results. ERP software connects a large number of business processes and enables fast data flow between them. Among other things, by collecting company data from different business segments, ERP systems eliminate duplication and enable data integrity.

Today, ERP software solutions play a key role in a large number of companies of all sizes in all industries. Depending on the needs of the organization, a large number of business segments, such as the overall architecture and its elements, need to be considered. These segments can include consistency, security, availability, scalability, legal segments, as well as company's organization and processes.

Regardless of the company size, ERP solutions are an indispensable part of business. Which ERP solution an organization will decide on depends on numerous factors and assessments. Different ERP solutions have their own advantages and disadvantages, which, depending on the company needs, can more or less affect its business.

ERP software consists of a large number of elements, modules, functions and layers. In order to ensure safe operation, different ERP solutions use different programming languages. The choice of programming language depends on several factors. Depending on the needs when developing an ERP software solution, it is necessary to consider various external factors, economic sector, as well as the legal issues of the country where the company is located.

Internal factors, on the other hand, include team organization, internal processes and information flow. It is also necessary to take into account the needs of the company, such as the necessary support and tools for using different modules, organization of business activities, special communication with different stakeholders, as well as communication between company's business units. There is no limit to which programming language to use to develop ERP software; however, some languages stand out. For the development itself, it is possible to use one or several integrated languages for different parts of the ERP software, depending on what is being developed in the software (front-end, back-end, business logic, security, etc.).

ERP solutions

In order to reveal the importance and use of programming languages, it is necessary to describe some ERP solutions. We use four ERP solutions as an example, three of which occupy almost half of the market share [26], and the fourth solution is an open-source solution, which by its nature is different from commercial solutions and for that reason may be more interesting to test differences in the use of programming languages in commercial ERP solutions and open-source ERP solutions.

Figure 1 shows the distribution of software platforms on the market. The most popular ERP solutions are shown, while the option "others" includes a large number of ERP solutions by smaller manufacturers. Among other things, there are open-source ERP solutions such as Odoo. The information on the market share of Odoo ERP solutions

Figure 1: Distribution of software platforms
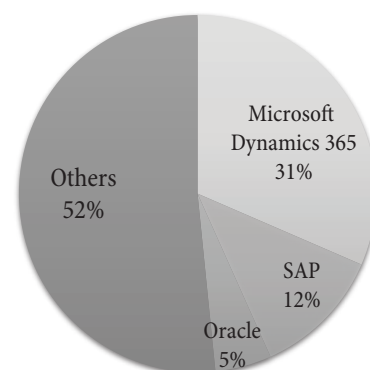
Source: Software connect [26]

is relative because this solution is not commercial, so the data on its use in companies is not relevant enough.

See more about the design of ERP systems and their development trends in [3]. The research agenda of ERP systems and expectations of how they will develop in the future is presented in more detail in [4]. See more about the analysis of the future needs of the ERP system in terms of database models in [5]. An analysis of the possible advantages and limitations of the ERP system is given in [25]. A comparative analysis of several cloud-based ERP software, such as SAP, Oracle and Microsoft solutions, is given in [7]. A more detailed description of ERP system architecture and the comparison of several systems is given in [2].

Artificial intelligence can be applied in ERP systems. A detailed bibliometric analysis of 837 publications connecting artificial intelligence and ERP systems is presented in [1]. The connection of the ERP system with blockchain technologies and accounting information systems is described in [8]. See more about the application of modern ERP systems in the era of digital transformation in [11]. The implementation of the ERP system and its challenges regarding planning, management and administration are the subject of [14].

ERP software is also studied at faculties, most often at master's studies, but there are also faculties such as the Faculty of Economics of the University of Belgrade, where this subject is covered as part of the ERP software course in undergraduate studies since 2020/21. A detailed analysis of the necessary skills for students studying ERP software is given in [6]. A detailed overview of literature on educational practices related to ERP software is given in [28].

Microsoft Dynamics 365

Dynamics 365 is an ERP software developed by Microsoft in 2016 by merging the existing ERP software Dynamics AX with the customer relationship management application Dynamics CRM. In this way, a powerful portfolio of modular SaaS (Software-as-a-Service) applications was created, designed to help companies effectively manage their main business processes. This software combines ERP and CRM software components along with artificial-intelligence-based tools. It fully encompasses internal and external business flows, fully integrating organizational data, processes and business logic. Read how students can be trained to work in the Microsoft Dynamics system in [29].

Dynamics 365 offers smart integrated tools that effectively connect processes, prioritize operations and convert prospects into customers. It consists of a large number of modules, which improve the company's operations in different ways. It mainly focuses on finance, sales, marketing, customer management, project management and talent management. Each of the modules is adapted to the specific needs of the company.

Users of Dynamics 365 services have the option of point-and-click creation of their own applications, which reduces the required programming knowledge to a minimum. The ERP software is built on the Microsoft Azure cloud platform, which provides additional security for its users. As this ERP software is managed through a web browser, all tools can be accessed from anywhere. For this reason, there is a great focus on security of access and privacy of the data itself. Microsoft does not use the data and has no access to it, as it belongs to the company.

A great advantage of Dynamics 365 ERP software is the ability to combine it with other Microsoft applications. In this way, users get a comprehensive overview of all transactions, records and information about relevant business activities. Companies that rely heavily on Office 365 suite applications can further improve the user experience due to full integration with ERP and CRM systems.

SAP

SAP is a widely used ERP software, developed in Germany in 1972. The original name of this software was System Analysis Program Development (German: SystemAnalyse Programmentwicklung), but over time it got its final name, Systems Applications and Products. This ERP system creates a centralized system that allows access and sharing of business data within every part of the organization, which is later used for various business analyses. In this way, the entire business is unified

and centralized, creating a better and more organized working environment for employees. In 2019, SAP was used in over 404,000 business systems worldwide, and the company itself was ranked 12th among the world's largest technology companies [19].

SAP ERP software contains over a hundred modules that cover every business aspect. The number of modules can vary significantly depending on the software version that the company owns, individual business requirements as well as industry requirements. The focus is primarily on serving large companies, but over the years, solutions have been developed for smaller companies. One of the biggest advantages of the SAP system compared to other systems is its flexibility in terms of serving companies of all sizes. SAP Business One can improve the operations of small businesses, while medium-sized enterprises can take advantage of SAP Business ByDesign.

Another advantage of the SAP solution is the shorter implementation time. Although it is among the most expensive ERP solutions, it is considered that the speed of implementation and the effect it has on business efficiency make the investment return period significantly shorter compared to the use of other systems. In addition, SAP is extremely flexible and requires relatively few business changes. In order to improve business, the development team of this ERP solution constantly makes improvements and fully adapts to all market changes. The best market practices are applied to reduce costs and increase the user's comparative advantage.

One of the most important components of the SAP ERP solution is the SAP S/4 HANA solution, which is based on the SAP HANA relational database. The HANA database enables the storage of huge amounts of data. It is possible to save files whose size reaches 16 TB per file [17]. SAP S/4 HANA is suitable for real-time data analysis and processing, with a simple and intuitive interface. All data is fully protected because the database can only be accessed with authorization, the files themselves are encrypted and it is impossible to access them from the outside. In addition, the SAP HANA database is available as a service on the cloud platform. If a company wants to avoid building and maintaining infrastructure, this can be an excellent option for storing information.

Oracle NetSuite

NetSuite is an organization that has developed a cloud-based business management assistance platform. This is one of the fastest growing ERP solutions with over 34,000 users [20] from various industries. The organization was founded in 1998 under the name NetLedger. Over the years, a large number of applications have been developed to help companies organize business, understand business results, and analyze business results as a whole.

NetSuite covers all business parts, including accounting, procurement, logistics and inventory. In addition to the basic modules, it is possible to choose applications for marketing, CRM and human resources, which includes applications for personnel records and payroll. All modules are specially adapted to the needs of each individual company and all data is stored in a single database. For this reason, information from all business flows is available in real time, which greatly facilitates business analysis and timely business decisions.

NetSuite uses a SaaS (Software-as-a-service) business model, which means that users pay a subscription fee to have access to all technologies. Companies are thus freed from the responsibility of purchasing infrastructure and worrying about software security and functionality. By eliminating the costs of software maintenance and improvement, the budget is relieved, leaving space for the development of other business components.

Although it is one of the first ERP systems, there are components that set NetSuite apart from other software solutions. First, NetSuite unifies the entire business on one platform. This means that finance, procurement, production, human resources, marketing and sales are located in one place in one database. Therefore, it is not necessary to develop separate software solutions for managing business processes. This significantly increases efficiency because workers register in one place and have access to every relevant business aspect. Second, a centralized system with a single database eliminates the need for third-party software that could be unreliable. Third, NetSuite is fully adapted to cloud operations. Many ERP systems do not have their own cloud system, which increases the risk of data loss, slows down upgrades and prevents scalability.

NetSuite Cloud enables smooth growth and meets all user requirements with a guarantee of data protection. Fourth, NetSuite provides a whole range of analytical tools that can give the company a completely new perspective of its operations. Finally, NetSuite is an extremely flexible platform. It can improve business operations regardless of the industry. The platform can be adapted to the specific needs of each company.

Odoo ERP

Apart from commercial ERP software, there are also ERP software solutions that are more or less free and open source. Their common feature is that they can be adapted, supplemented and developed according to the company's needs. There are a large number of open-source ERP systems, but they occupy a relatively small market share. Sixteen most frequently selected open-source ERP systems can be seen in [18]. Odoo is among them.

The Odoo ERP system is enterprise resource planning software used to manage business processes. Odoo ensures the entire integration of business activities on a single platform using Odoo applications. The Odoo ERP solution is an open-source software, which sets it apart from other popular and commercial ERP solutions. The Odoo system covers almost the entire business and is mostly applied in accounting, subscriptions, planning, business consolidation, invoicing, inventory management, human resources management, marketing, CRM, as well as a system for dynamic site content management (Content Management System). On their website [21] they claim to have 7 million users.

It used to be called OpenERP, so it appears in literature under this name as well. The presentation of this system is given in [9]. A comparative study of this ERP system and its technologies in relation to others is given in [12]. A thorough comparison between ERP software Odoo and Microsoft Dynamics NAV is given in [10].

Odoo is available in 2 versions: the *Enterprise edition*, which works on a subscription basis, as well as the *Community version*, which is completely free. Both versions are mainly aimed at small and medium-sized companies, because this ERP software still cannot compete with expensive ERP systems such as SAP and Oracle. Odoo stands out among small companies dealing with distribution, production, marketing and accounting. The price of the Odoo ERP system depends on the number of users and the number of required Odoo applications.

The main advantage of this system is the price. Odoo implies a large number of applications that can cover the entire business, at significantly lower prices for system installation and maintenance. Small businesses are often unable to afford even the cheapest versions of well-known ERP systems. For this reason, Odoo offers a free version, which can be found on the official website, or on GitHub. In addition, the whole system is very flexible, offering easy integration with many third-party software solutions and applications. Also, the official website offers extensive training on the standard functions of the ERP system, while training on the use of other ERP software is significantly more expensive. Odoo can function on a cloud platform or locally, depending on the company's needs. Finally, Odoo has a wide user base, which means that almost any problem can be solved easily.

It is important to mention the shortcomings of Odoo software. First, the setup of the system itself is very complex. It is possible to encounter a whole range of problems when trying to integrate independently. Second, the Enterprise version has a number of hidden costs. If the company opts for only one additional application, it has to allocate a significantly higher amount than the standard annual subscription. This means that businesses in the growth phase may encounter additional unplanned expenses, which can create further budgeting problems. Third, due to the limited number of servers, it is often not possible to reach the necessary support, and users are left with insufficiently broadly defined documentation.

However, it is important to note that most open-source ERP systems represent a much more affordable and better solution for small businesses that do not have enough resources to implement an expensive system. Odoo adapts and automates a large number of processes, which can significantly improve business. This system can represent a unique solution to a large number of problems small and medium-sized enterprises face.

Application of programming languages in ERP solutions

ERP software solutions are very complex systems that increase the effectiveness of the entire business. Many organizations have recognized the potential of implementing an ERP solution and it is believed that over 70% of large businesses use some type of ERP software. Additionally, the global market for these systems is estimated to be worth $74.2 billion in 2023 [13]. For this reason, the provision of ERP system services is one of the most profitable sectors of application software.

ERP software solutions are very complex computer systems that automate the most important business processes of a company. They are made up of a large number of modules that are adapted to the specific needs of each business unit. These systems are fully centralized, so information needed for various business aspects can be downloaded from a common database. Therefore, building and using these systems require detailed planning and the use of one or more programming languages.

Some of the well-known programming languages that are often found in the structure of an ERP system are Java, PHP, SQL, Python, Ruby, JavaScript, C++, C#, etc. In addition, a number of programming languages have been developed to support the development and maintenance of such systems, such as ABAP, X++, SuiteScript and AL. ERP systems must be carefully adapted to all company needs, so a combination of several programming languages is often used to achieve the desired results. There are several reasons for this:

- Building a multi-layered system: Many ERP systems are multi-layered, so different languages are used to build the user interface, database, business logic, program logic and for various analyses and reports. For example, JavaScript combined with HTML can often be used in building interface, Python and Java are used to implement business logic, while SQL and PHP are used to communicate with the database.
- User interface development of mobile and web applications: If the target is accessed via the Android operating system using various applications, then the Kotlin programming language can be used to develop applications on the Android operating system, which is compatible with a wide range of existing Java libraries and tools. Kotlin is a modern programming language originally used for Android application development but is increasingly used in general software development as well. Also, ERP platforms that are developed in Java can be extended or updated using Kotlin without having to replace the entire code.
- Special analytical tools: ERP systems give very powerful analytical options to their users. In order to make the best business decisions, programming languages R and MATLAB are often used for statistical and numerical calculations within various modules.
- Integration with other systems: It is often necessary to integrate ERP modules with various third-party services such as banking, trade, transport and special systems. It may happen that the ERP system is written in one programming language, and the external systems in a completely different one, so in that case it is necessary to use an additional programming language for successful integration.
- Integration with old systems: In cases where a new ERP solution is developed over existing systems, it is necessary to use a greater number of programming languages in order to maintain full compatibility and functionality of the entire system.

This practice requires a high level of planning, the ability to manage projects, as well as a great knowledge of the entire system. If these conditions are met, the use of multiple layers of programming languages can improve business efficiency, system application flexibility, as well as the implementation of additional tools that can subsequently bring a competitive advantage to the company.

In the case of the 16 open-source ERP systems shown in [18], the most represented programming languages are Java (used by 6 systems), Python (4) and PHP (4).

Programming languages in the MS Dynamics 365 environment

Dynamics 365 supports several programming languages depending on the development and integration needs

of different modules and applications, including C, C#, HTML, JavaScript, X++, SQL, FetchXML, and ASP.NET. One of the key features of the Dynamics 365 ERP system is adaptability to different business needs, and the choice of programming language itself depends on different application needs and modules within the system. By combining different programming languages and technologies, it allows for continuous development of existing solutions and successful integration with other systems.

The most commonly used programming language for developing applications in the field of finance and business within the Dynamics 365 software is X++. X++ is used to write business logic, create custom solutions, and integrate third-party solutions. It is an object-oriented programming language for building applications and working with data, which is used in enterprise resource planning programming and database applications. It provides the ability to use the system class for a wide range of areas of system programming, such as classes, tables, user interface, file import and export, form and report manipulation, etc. This programming language runs all the elements in this Microsoft environment, such as classes, forms, queries, data types, and the like. X++ is an object-oriented language that is very similar to C# or Java programming language. Some of the main features of the X++ language are the ability to work with relational tables in Microsoft Dynamics 365. This is so because this language uses keywords that mostly match the common keywords in the standard SQL language. Also, this language is extremely efficient in terms of saving memory space. X++ has mechanisms for discarding objects that are no longer referenced, so that their memory space can be reused.

When developing CRM applications, the most commonly used programming languages are C#, JavaScript and SQL. C# is a widespread object-oriented language that is used in many services provided by Microsoft. When building CRM applications within the Dynamics 365 ERP system, C# has several roles. First, it is important to note the development of plugins, i.e. special code components that react to special events or orders within the CRM system. Second, C# can support the X++ language for writing business logic, enabling the implementation of complex operations and integrations. Finally, it is used when automating business processes and

specialized actions. JavaScript plays an important role in customizing the behavior and functionality of various forms in Dynamics 365. In addition, this language is used to set various events that are triggered during interaction with the system itself, such as pressing a certain button, loading and saving processes, changing field values and the like. JavaScript provides developers with a range of system and user experience customization options, which can be significant for attracting new users. SQL (Structured Query Language) plays a key role in the development of the Dynamics 365 CRM system. It is used to store and manage various business data, as well as to create various analyses and reports. The Microsoft Dynamics 365 CRM system supports all types of queries as a standard SQL language because it uses the Microsoft SQL server to store and manage data.

Business Central is one of the solutions of Microsoft Dynamics 365 and is used in business management in small and medium-sized enterprises, to automate and simplify business processes. Within this solution, the AL (Application Language) programming language is used to manipulate data (input, download, change) in the database, and it is also used to control the execution of application objects (application segments, reports, etc.). Using the AL language, business rules can be created to ensure the process of storing meaningful data in the database in line with the way clients do business. Code written in the AL language can be part of triggers on database objects such as tables, fields, reports, records, queries, and the like. Unlike other languages, AL is tailored to the development of Dynamics 365 Business Central only.

Microsoft has developed the Dynamics 365 for Phones Android application that provides access to system data and functionality. This Android app provides sellers, agents and supervisors with tools to manage their data and update records and status when online or offline. The Kotlin programming language is used to develop Android applications.

Programming languages in the SAP environment

SAP makes it possible to use different programming languages, offering great flexibility when developing and adapting

the system to the business. SAP has multiple development environments that implement programming languages in different ways to enable building, customizing, extending, and integrating SAP applications. It is fully compatible with programming languages such as Java, C, C++, SQL, Python, JavaScript. However, in order to provide a secure environment for developing and modifying applications, the ABAP programming language was developed.

ABAP (Advanced Business Application Programming) is a programming language specifically designed for the development of business applications and tools within SAP solutions and represents the development base of the entire range of SAP products. This programming language can be used in many SAP services, such as SAP ERP, SAP Business Suite and SAP S/4 HANA. ABAP enables the construction and customization of specialized modules for materials management, financial accounting, asset management, sales and other modules available. The SAP NetWeaver development environment allows users to upgrade existing applications using the ABAP programming language. Application Server ABAP (AS ABAP) is also in this development environment. It is a variant of the application server that serves as a development environment for SAP applications and consists of three layers: presentation layer, application layer and database layer. This ensures independence of ABAP applications from hardware, operating system and database. Authors' experiences in training IT students in the ABAP programming language at Victoria University in Australia is given in [15].

SQL (Structured Query Language) is a standardized language for communicating with relational databases. The SAP HANA database supports a large number of SQL items for data entry, system administration and manipulation of existing data. As SAP has a fully centralized system, SQL is a key tool for almost all modules and applications and is essential for the creation of various business reports and the analysis of specific financial results of the company. In addition, the SQL programming language is a key tool for customizing and possibly expanding the SAP system. SQL is easily combined with ABAP items and thus facilitates the development of business applications. During system integration, it is often necessary to communicate between the old system and the new one, and the SQL language

is used for data synchronization. Due to its relational structure, but also its simplicity, the SAP HANA database is primarily focused on the use of the SQL language, i.e. its improved version of SAP HANA SQL.

Although ABAP is the primary programming language for developing and building an SAP software solution, other programming languages are also of great importance. Java plays an important role in designing specific business applications. The SAP Application Server (AS) Java system, like the ABAP programming language, is located in the SAP NetWeaver development environment. This environment consists of three layers: Java Enterprise Runtime, AS Java System Components and Applications. Java provides platform independence, object-oriented programming capabilities, and a wide range of libraries, which can help when building very complex applications. Java plays a role in the development of programs on the Java Enterprise Editon 5 platform, which is used especially for the development of large-scale applications in the SAP ERP system. In addition, Java is often used when building web-based user interfaces and enables data exchange between SAP and other solutions. Finally, SAP GUI for Java is client software that allows users to access the SAP system from a Java environment.

In addition to the mentioned programming languages, which play a primary role in the development of various modules, SAP provides a platform for the implementation of other programming languages. Python is widely applied and is used to connect to the SAP database, apply artificial intelligence to extract different entities from textual data using the Business Entity Recognition service. It is also used to automate repetitive tasks, which can significantly reduce user errors and save time. C and C++ can be used to integrate applications written in those languages with ABAP codes. Various functions written in C/C++ are also available, which can enhance existing applications. Finally, HTML and JavaScript can be used to create SAP GUI applications that use JavaScript libraries. However, the application of all these programming languages must be done with care and caution because they can affect the stability and security of the system.

SAP also developed an Android application that provides access to business data, reports and system

functionalities, for which the Kotlin programming language was used.

Programming languages in the Oracle NetSuite environment

NetSuite is one of the most well-known cloud-based ERP solutions that provides support to organizations in conducting business, increasing efficiency, directing business decisions and analyzing results. A large number of tools have been developed that specialize in different aspects of business such as accounting, finance, e-commerce and the like. However, as the needs of organizations become more complex, NetSuite enables the application of different programming languages in order to fully adapt the services to the different business logics of individual companies. The primary programming language for the development of this ERP solution is SuiteScript.

SuiteScript is a NetSuite platform built with the help of the JavaScript programming language whose primary role is the automation and customization of business processes. However, the possibilities are much wider than that. This script programming language allows users to manipulate business and user information with the help of user events such as web requests, value changes within various fields, form submit and pre-scheduled events. SuiteScript consists of several key components that provide a high degree of flexibility to users. *Suitelet* is an upgrade to the standard SuiteScript that allows you to create a customized user experience using the HTML language. *Portlet* allows upgrading the existing dashboard to display relevant information to users. Integration of RSS, HTML, as well as maps, blogs and applications for sending messages is possible. *Scheduled SuiteScript* enables the automation of business processes with the help of scheduled actions that can be triggered at a predetermined time using JavaScript extensions. *User Event SuiteScript* component is used to validate required data and implement business logic with the help of user events. A defined set of rules is triggered when users interact with the system such as opening, modifying and saving records. *Client SuiteScript* is an upgrade that supports custom calculations and various alerts based on user inputs or interactions. If the full potential of these components is used, it is possible to create completely customized software for any business.

NetSuite provides a wide range of capabilities to build reliable and scalable integrations that extend core capabilities. This means that in addition to using SuiteScript, there is a platform that supports programming in several well-known programming languages. Users have the ability to integrate existing or new applications written in Java, PHP, C# and Ruby. SuiteTalk API is an integrated web service that enables communication with external systems and integration of applications written in different programming languages. A set of SOAP (Simple Object Access Protocol) protocols is provided that serve to exchange structured data with more complex applications written in JavaScript, Java and Python using XML (eXtensible Markup Language) of the protocol. In addition, it is possible to work with the REST (Representational State Transfer) API, which is based on principles that support the scalability and simplicity of applications. The REST API enables the exchange of data between different systems using HTTP methods (GET, POST, PUT, DELETE). This ensures smooth integration of external systems within the NetSuite ERP system, thereby removing potential limitations during migration or implementation of this ERP software solution.

Access to the NetSuite solution is also enabled through the Android application. This route allows access to key business functions such as finance, sales, inventory management and human resources. In order to enable this approach, the Kotlin programming language was used to create the Android application.

Programming languages in the Odoo solution

Odoo ERP is an open-source software used by a large number of companies for business automation, management and analysis. Most of this software is written in the Python programming language and therefore uses the versatility and simplicity of this language to automate and customize business processes. The programming language Python is a general-purpose language which according to the TIOBE Programming Community Index [27] is the most popular programming language, so many open-source

ERP software solutions use Python as a development environment.

Python provides tools for improving existing as well as developing new components within the system. This programming language allows for input and extensive analysis of business processes, which also includes a visual overview of data, which can significantly facilitate the understanding of statistical information and the monitoring of generated invoices, reports and project results. Odoo Python also helps employees within the organization. Almost the entire HR module is written in this programming language, and with it, employees receive tasks, receive salary calculations and determine the remaining number of days off. Effective monitoring of projects is also enabled with a number of tools and modules that take care of accounting items, accounts, inventory and marketing. Users have the ability to develop their own automated actions with just a few lines of code. Odoo Python uses various packages to develop ERP systems. The Python-docutils package is used to load business documentation in more useful formats such as XML and HTML. On the other hand, the Python-simplejson package is tasked with encoding and decoding JSON files. Also, the Python-dateutil package provides a powerful extension for more complex date operations.

Odoo ERP system is closely related to the PostgreSQL database system and uses it as a standard DBMS system. PostgreSQL is an extremely powerful open-source database management system. It was developed in 1986 as part of the POSTGRES project at the University of California. PostgreSQL is a relational database and provides a number of tools and options to help developers build applications, manage data, and protect data. The Odoo ERP system uses the Python library psycopg2, which is specifically designed to communicate with data storage programs. As these systems are separate, users can expect a high level of service in both aspects. Companies get a very efficient solution for managing various business processes, as well as for storing the necessary data. The PostgreSQL database allows for a large number of upgrades that can take data analysis to a whole new level. This can help businesses make later business decisions. Among the 16 displayed open-source ERP solutions, [20] most often used PostgreSQL (10 systems) and MySQL (7) as database management systems.
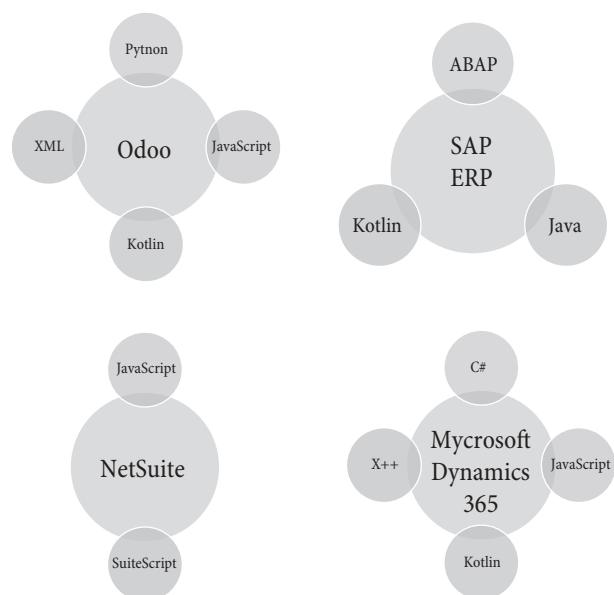
In addition to the Python programming language, the Odoo system takes advantage of other languages to develop various modules and to communicate with external systems. JavaScript plays an important role when building user interfaces in combination with HTML and CSS. A special Javascript platform has been built which has three main roles:

- The web client: Javascript is used when building single-page private web applications that are used to view and modify business data

- The website: Odoo provides the possibility of building websites that should provide the necessary information to all stakeholders such as customers and potential collaborators. This is the public part of the Odoo ERP system.

- The point of sale: Odoo supports the development of a one-page web sales point that supports efficient electronic commerce.

Odoo supports the integration of other programming languages such as XML for defining data structures, QWeb for creating formatted and styled reports, HTML and CSS for the front-end part of the application. Integration with applications written in the most well-known object-

Figure 2: Display of the relations between ERP solutions and the programming languages they use

Source: Authors

oriented languages is enabled, but the primary focus is still on developing solutions in the Python environment.

Since Odoo has an app available for Android systems, it uses the Kotlin programming language. Every application in the Odoo database is available from one source applications, which allows for maintenance and monitoring, record keeping, sales, etc.

Since the ERP solutions selected in this paper use several different programming languages for different purposes, Figure 2 gives a clearer overview. The lines on the graph define which ERP solution uses which programming language, where, due to the large number of languages, the bold line represents the connection between the ERP solution and its primary language.

Conclusion

ERP software solutions are increasingly used and have become an indispensable part of every company's business. The paper presents some of the most popular ERP solutions on the global market. Microsoft Dynamics 365, SAP ERP, Oracle NetSuite and Odoo, as an open-source software solution, are presented. The specifics of each of these systems are highlighted from the point of view of their application in business operations, as well as from the point of view of differences in platforms, database management systems, modules, and the most commonly used applications. Special attention is paid to the programming languages used in these ERP solutions. Each of them has a primary programming language, but due to the need to work with large amounts of diverse data and software, at least in some parts they support other programming languages, which is shown in more detail in Figure 2. The importance of programming languages in ERP systems is large because the speed of further development and the possibility of applying new software solutions is mostly based on the strength and ability of the programming language to realize it.

Development teams tasked with building enterprise resource planning software opt for different programming languages depending on the needs of the business systems. Depending on the choice of ERP solution, organizations have complex tools for analysis and efficient management

of business processes, thus the choice of programming language can make a big difference when implementing and developing the system. It is important to note that most ERP solutions are not limited to only selected languages. Platforms for the implementation of other programming languages have been developed, which enables easier integration of ERP solutions with various business processes, as well as the application of specific tools and applications written in lesser-known programming languages.

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