The Challenges in a Company IT Infrastructure Development and Implementation

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ABSTRACT : *Information technology (IT) infrastructure of a company intending to digitize its business processes consists of many various components and platforms. Each of the IT components or platforms constitutes the content of certain investments that must be mutually managed and coordinated to obtain a coherent, compatible and integrated infrastructure. Development and implementation of IT infrastructure needs great changes in business processes and procedures, training, software integration and many others. This paper just explains the challenges and issues in development and implementation of an IT infrastructure for a company.*

KEYWORDS: *IT infrastructure, IT platforms, IT infrastructure services, IT infrastructure development*

I. INTRODUCTION

An information system (IS) from a business perspective is an organizational and management solution based on IT to the challenges posed by the environment. The manager must understand the organizational, management and technological dimensions of IS and its ability to provide solutions to business problems.

Information systems are integral parts of organizations. The elements of the organization are: people, structure, operational procedures, politics and culture. The organization is made up of different levels, specialties and professions (Yao, Li, & Yan, 2025).

The main business functions are: sales and marketing, production, finance, accounting and human resources. Organizations require different types of knowledge and skills (human resources). In addition to managers and production workers, the organization should have professionals (engineers, architects or scientists) who design products or services and create new knowledge and administrative workers (secretaries, accountants and officers) who do administrative work. Every organization has a unique culture or a fundamental set of assumptions, attitudes, values and ways of doing business, which are accepted by the majority of its members (Han et al., 2024).

Management identifies business challenges that come from the environment; sets a business strategy as a response to challenges; allocates human and financial resources for the realization of that strategy; creates new products and services and redesigns the organizational structure of the company when necessary. Management roles and decisions vary at different levels. Each level of management has different information and IT (Information Technology) requirements (Li et al., 2022).

Information technology is a tool that managers use to manage organization and business changes. Hardware is the physical equipment used for input, processing and output activities in the IS. Software applications are detailed program instructions that control and coordinate the hardware components in the IS. IT for data storage consists of physical media and software that manages the data. Communication technology consists of physical devices and software. Computers and communication equipment can be connected to data transmission networks (Yang, & Zhang, 2025).

These information technologies are common organizational resources that make up the IT infrastructure. The IT infrastructure is the foundation or platform on which the organization builds specific information systems. Also, IT infrastructure is shared, common IT resources that provide a platform for the development and use of software applications that span multiple business functions and organizational levels.

The main aim of the paper is to analyse challenges in development and implementation of an IT infrastructure that supports business goals of a company. The challenges are great because business conditions and IT are changing dynamically and rapidly. The company management faces big issue of how to organize and coordinate different technologies and systems in order to meet the information needs of each management level, business functions and the company as a whole. If the company does not solve the challenges and issues, IT infrastructure will consists of fragmented and incompatible hardware, software, networks and systems that prevent information from flowing freely.

The paper is divided in six parts. In next part, IT infrastructure components and services are described. In the third part of paper, features of platforms for IT infrastructure are explained while the fourth part deals with the evolution of IT infrastructure. The fifth part is dedicated to challenges in managing and implementing the company's IT infrastructure and sixth part gives concluding remarks.

II. IT INFRASTRUCTURE COMPONENTS AND SERVICES

IT infrastructure composed of many components. These components are: computer hardware platforms, software platforms, computer network and communication platforms, database platforms. Within software platforms, operating system platforms are particularly distinguished. Within computer network and communication platforms, internet platforms are particularly distinguished:

Components and technologies (manufacturers) of IT infrastructure on the market are:

- **Computer system platforms** (technologies/manufacturers: Dell, IBM, Sun, HP, Apple)
- **Operating system platforms** (technologies/manufacturers: MS Windows, Linux, UNIX, Mac OS X)
- **Application software platforms** (technologies/manufacturers: SAP, Oracle, PeopleSoft, Microsoft)
- **Computer network platforms** (technologies/manufacturers: MS Windows Server, Linux, Novell, Cisco, Nortel, AT&T)
- **Data storage and management platforms**. (technologies/manufacturers: IBM DB2, Oracle, Sybase, SQL Server, MySQL,)
- **Internet platforms** (technologies/manufacturers: Apache, Unix, Cisco, Java, Microsoft IIS, .NET)

Viewed from a broader perspective, we can see three levels of IT infrastructure (Abrosimov et al., 2020):

1. **Public infrastructure** - Internet, public telephone network and other networks (cable, cellular networks, etc.);
2. **IT infrastructure at the level of the entire organization** - E-mail, the organization's central website, the organization's intranet, software applications of the entire organization;
3. **IT infrastructure at the level of the business unit** - production systems, transaction systems, data on customers and suppliers, etc.

IT infrastructure includes investments in hardware, software and services (e.g. consulting, education, training, etc.) The company's IT infrastructure provides the basis for providing services to customers, cooperation with suppliers, but also for managing internal business processes, where the main users are the company's employees (fig. 1).

Fig. 1. IT infrastructure services

Source: Laudon, K. & Laudon, J., 2018

IT infrastructure should support the company's business and information systems strategy. New IT has a strong impact on business and IT strategies and services that companies can provide to customers, suppliers and employees (Jia, & Li, 2025). These IT services are:

1. Computing platforms that provide services to connect employees, consumers and suppliers in a coherent digital environment (mainframes, midrange computers, desktops and laptops and mobile cloud computing services);

2. Telecommunications services that provide video and voice communication, as well as data transmission between customers, employees and suppliers;

3. Data management services that relate to the storage and management of corporate data, as well as the ability to analyse such data;

4. Application software services, including online software services that provide the company with various capabilities: enterprise resource planning, supply chain management, customer relationship management and company knowledge management;

5. Physical facilities management services relating to the development and management of physical installations required for computer and telecommunications services, as well as data management services;

6. IT management services related to planning and infrastructure development, coordinating business units in relation to IT services, project management and the like;

7. IT standard setting services that provide the necessary policies to define what IT will be used, when and how;

8. IT education services related to training of employees to use the system, but also to training of managers in managing IT investments;

9. IT research and development services that will determine the potential of future IT projects on the basis of which the company can differentiate itself on the market.

III. Features Of It Platforms

Every mentioned IT platform has specific features that we must consider in process of IT development and implementation (Azarov, & Leokhin, 2020).

Features of hardware platforms. Enterprises are increasing investments in computing hardware which includes mainframes, servers, personal and laptop computers, tablets and smart phones. The majority of business computing is realized through microprocessor chips, manufactured or designed by the Intel Corporation and to a lesser extent by the AMD Corporation. Computing platforms have changed dramatically with the introduction of mobile computing devices. Smartphones and tablets are computer platform for business and personal computing.

Computers with Intel microprocessors are the first hardware computing platform that uses Complex Instruction Set Computing (CISC) with several thousand instructions built into the chip. This requires a large number of transistors per processor, large amounts of energy are consumed and a large amount of heat is emitted.

Mobile devices are able to use RISC (Reduced Instruction Set Computing), which contains fewer instructions, consumes less power and generates less heat. These processors for m-devices are produced by several different companies (Apple and Samsung).

Mainframe computers have not disappeared. It is still used for reliably and securely managing a large number of transactions, analysing large amounts of data and working in large business systems (banking and telecommunications companies). However, the number of providers of such computers has decreased and reduced to only one company, IBM. IBM has found a new purpose for mainframe systems that now function as huge servers for business networks and business websites.

Features of operating system platforms. The main corporate server operating systems are Microsoft Windows Server, Unix and Linux (a low-cost, open-source version of Unix). Microsoft Windows Server provides an enterprise-grade operating system and makes up a Windows-based IT infrastructure.

Unix and Linux are scalable, reliable and much cheaper than mainframe operating system. It can run on different types of processors. Major Unix providers are IBM, HP and Oracle-Sun. At the client level, most personal computers (PCs) use Microsoft Windows. However, there is now a much greater choice of operating systems for clients than was the case in the past, with the new operating systems for mobile digital devices (Tian, & Lu, 2023).

Chrome operating system is the Google's operating system that goes with cloud computing and uses a computer connected to the Internet. The programs are not stored on the user's computer, but are used over the Internet and are accessed via a web browser. User data remains and resides on servers across the Internet.

Android is an open source operating system for m-devices such as smartphones or tablets. It remains the most popular smartphone platform in the world and competes with Apple's iOS operating system for its m-devices (iPhone and iPad).

The classic client operating system uses a mouse and keyboard for now, but it is becoming more natural and intuitive thanks to the use of touch screen technology.

Features of application software platforms. The largest providers of business software solutions are SAP and Oracle. Included here is middleware, offered by vendors like IBM and Oracle to integrate and connect new applications with existing systems. Microsoft is trying to achieve its market share with its software products in the market segment of small and medium enterprises (Babkin et al., 2021).

Features of database platforms. Business database management software serves to organize and manage business data, so that it can be efficiently accessed and used effectively. The largest providers of such software are IBM (DB2), Oracle (MySQL), Microsoft (SQL Server) and Sybase (Adaptive Server Enterprise).
MySQL is a Linux-based open source product for managing databases and is now owned by Oracle Corporation. Apache Hadoop is an open source software for managing large amounts of data (big data). The market for physical data storage for large systems is in the hands of EMC Corporation

Features of network and telecommunication platforms. Windows Server is the dominantly used operating system for local computer networks, followed closely by Linux and Unix. Large enterprise-level networks use some version of the Unix. Most local and global computer networks use the TCP/IP protocol as a connection standard. Cisco is one of the main companies among the providers of network hardware and communication equipment (Obukhova et al., 2020).

Telecommunication platforms are mainly provided by telecommunication companies offering voice communications, data transmission, global network services, wireless services and internet access. The world's largest sellers of telecommunications services are AT&T and Verizon. The market for these services is on the rise thanks to the providers of wireless networks, fast internet and internet-telephone services

Internet platforms include hardware, software and management services to support the company's website (e.g., web hosting services, routers, wireless equipment). Web hosting services are used in maintaining a large web server or multiple servers. Users of these services pay a subscription fee to the providers to maintain their websites. Many companies use multiple servers to conduct their Internet activities. There is constant pressure to reduce the number of servers, increasing the size and power of each individual computer (Li et al., 2022).

The internet hardware market is becoming more and more concentrated, in the hands of IBM, Dell, Oracle and HP. Prices are falling on the market. A large part of web applications and development tools are provided by the following companies:

*Microsoft (Microsoft Visual Studio and Microsoft. NET family of development tools),
*Oracle-Sun (Java is the most widely used tool for developing interactive web applications), and
*Large number of other independent software companies (Adobe - Creative Suite).

Today's IT infrastructure of enterprises and the Internet would not be possible without an agreement between the manufacturers of IT products on the acceptance of technological standards. Technological standards represent specifications that enable IT products compatibility and contribute to building communication between network nodes. Technological standards ensure the effects of economies of scale and lead to cost reductions, as manufacturers focus on production to a single standard. Without these effects, computing would be significantly more expensive than it is now (Oswald et al., 2017).

IV. The Evolution Of It Infrastructure

Historically, the evolution of IT infrastructure can be divided into five phases, each representing a different configuration of computing power and infrastructure elements (fig. 2):
1. the era of mainframes and minicomputers (1959-present),
2. the era of personal computers (1981 to present),
3. the era of client-server networks (1983 to present),
4. the era of the Internet and networking (1992 to present),
5. the era of cloud and mobile computing (2000 to present).

IT that characterizes one phase of evolution may be in use at another time or for a different purpose. For example, some companies still operate on classic mainframe systems or use mainframe computers as servers to support large websites or business applications (Klymchuk et al. 2020).
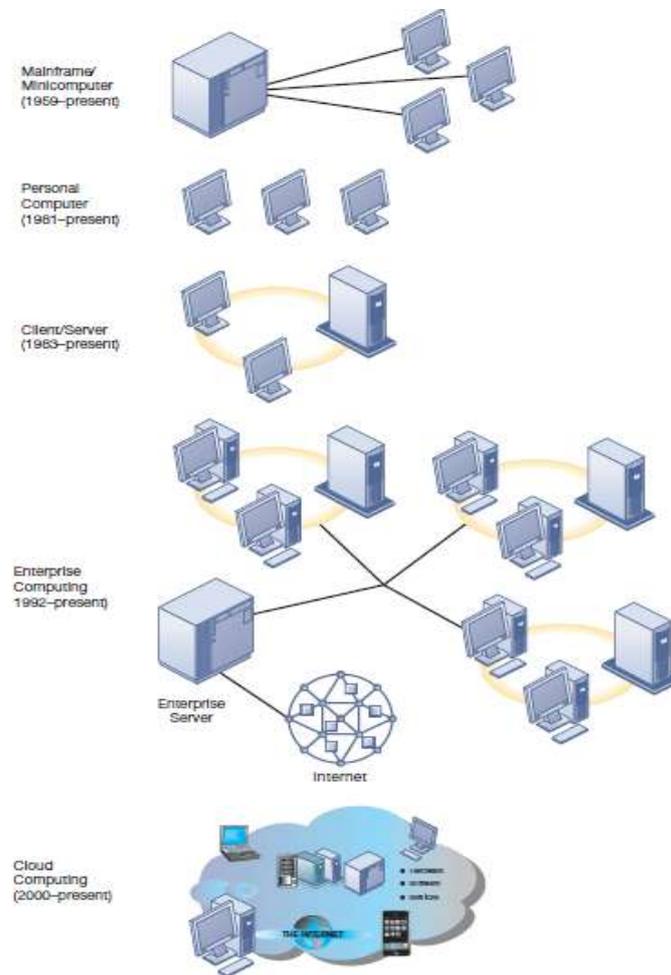

Fig. 2. Stages in IT infrastructure evolution
Source: Laudon, K. & Laudon, J., 2018)

The era of mainframes and minicomputers. The introduction of IBM's computer systems in 1959 marked the beginning of the mass commercial use of mainframe computers. Mainframe computers became particularly popular in 1965 with the introduction of the IBM 360 series. This is the first computer to enable processor time sharing, multitasking, and virtual memory.

IBM dominated mainframe computing from this point on. The mainframe era was a period of highly centralized computing under the control of professional programmers and system operators, where most elements were provided by a single vendor, namely the hardware and software manufacturer.

Changes occurred in 1965 with the introduction of minicomputers manufactured by DEC (Digital Equipment Corporation). Minicomputers were powerful and cheaper than IBM mainframes, which allowed for the emergence of decentralized computing that was focused on the specific needs of individual departments within a company. More recently, minicomputers have evolved into mid-sized computers or servers that are part of a network (Mandava, 2023).

The era of personal computers. The appearance of the IBM PC in 1981 is considered the beginning of the PC era, as this computer was widely adopted in American companies. The Wintel PC (Windows OS and Intel microprocessor) becomes the standard desktop that initially used DOS (a text-based command language), and later Windows.

The spread of PCs in the 1980s and early 1990s, triggered the use of many tools to improve user productivity: software for text processing, spreadsheet creation, e-presentations creation and data management.

Extremely useful for personal and business use, PCs were standalone, until operating systems developed in the 1990s enabled networking.

Sales of PCs have decreased due to the popularity of m-devices, but PCs are still popular in enterprises. Wintel's dominance as a computing platform is slowly declining with the growth of Android and iPhone m-device sales.

Client-server era. In client-server computing, desktop or laptop computers, which we call clients, are connected to powerful servers that provide various services to clients. The work of processing data is divided between these two types of machines. The term server refers to the software application and the computer itself through which the network software functions. A server can be a mainframe computer, but today the role of the server is played by extremely powerful variants of PCs that use cheap chips, and often have several processors.
The simplest client-server network consists of a client computer connected to a server, where data processing is divided between these computers. We call such an architecture a two-tier client-server architecture. Such networks are usually found in smaller companies, while most other companies have more complex, multi-tier client/server architectures, where the work of the entire network is divided and balanced between several different levels of servers, depending on the type of service required. In a multi-tier client-server network, a client request for a specific service is processed on multiple different server tiers simultaneously.
Client-server computing allows an enterprise to divide computing tasks across multiple smaller devices that cost much less than a centralized mainframe system. Today, Microsoft is the market leader with its Windows OS (Windows Server) which is the leading client-server networking technology.

The era of the Internet and enterprise computing. In the early 1990s, companies began to turn to network standards and software tools that could integrate different networks and applications into a single infrastructure. With the development of the Internet, it is becoming a secure environment for communication (Asmaganbetova et al. 2022).

After 1995, companies began to seriously use TCP/IP network standards to connect their disparate networks. The newly created IT infrastructure connects different parts of computer hardware and smaller networks into a single network. Information moves freely through the company and between the company and other external networks. It can connect different types of computer hardware such as mainframe systems, servers, PCs, m-devices etc. It also includes public infrastructure such as telephone system, internet and others public networks. This IT infrastructure requires software that serves to connect different applications (business applications and web services) and enables the flow of information between different business segments.

The era of cloud and mobile computing. Cloud computing is a computing model that provides access to shared IT resources (computers, applications, memory and services) over the Internet or other networks. Cloud resources can be accessed as needed from any device and from any location. With cloud computing, you pay only for that level of service that is actually used, without owning IT resources. Cloud computing is now the fastest growing form of computing. A huge number of computers are located in cloud systems and data centres, where it can be accessed via desktops and laptops, tablets, smartphones and others devices connected to the Internet.

Amazon, Google, IBM and Microsoft operate large scalable cloud centres that provide computing power, data storage and fast internet connectivity to companies that maintain its IT infrastructure remotely. Google, Microsoft, SAP, Oracle and Salesforce sell software applications as services delivered over the Internet.

V. Challenges In Managing And Implementing The Company's It Infrastructure
One of the most important questions is who will control and manage the company's IT infrastructure. In addition, The implementation and management of IT infrastructure poses various challenges to the company: 1) integration and coordination of different IT components and platforms, 2) monitoring changes in information technology, 3) rational and smart investment in IT infrastructure, taking into account the total costs of ownership of IT resources (Chevereva et al., 2019).
1) Integration and coordination of different IT components and platforms. Organization, integration and coordination of different technologies and systems of business applications in order to satisfy the information requirements of each management level and the organization as a whole is big challenge. There are problems with fragmented and incompatible hardware, software, networks and systems that prevent information from flowing freely. Internet standards solve some of those connectivity problems.

Each of the IT components or platforms constitutes the content of certain investments that must be mutually coordinated to ensure a coherent infrastructure. In the past, the IT vendors would offer organizations a

mix of incompatible, piecemeal solutions that could not work with other vendors' products. Vendors of IT products were forced to cooperate through strategic partnerships in order to retain their customer-users.

Another big change is that companies are moving its IT infrastructure to the cloud or to external services, which means that own and manage fewer and fewer systems in-house. The company's IT infrastructure will increasingly be a mixture of components and services that are partly owned by the company, partly rented or licensed, partly located on the site, and partly provided by external vendors or via cloud infrastructure (Fostolovych, 2020).

Today, even a large company does not have the staff, competence, budget or experience necessary to develop and maintain the entire IT infrastructure. Implementing IT infrastructure requires major changes in business processes and procedures, training and education, software integration and many others. The largest consulting firms that offer their experience in IT infrastructure development are: Accenture, IBM Global Business Services, Infosys and Wipro Technologies

Software integration implies that the new infrastructure works perfectly in combination with the old, so-called legacy systems. Legacy systems are generally older transaction processing systems, created for mainframe computers that continue to be used to avoid the high costs of replacing or redesigning them. Replacing these systems is impossible due to high costs and usually not even necessary, if these systems can be integrated into the existing infrastructure.

2) Rapid changes in technologies and platforms. As companies grow, it happens very often that outgrow its IT infrastructure. On the other hand, as the company shrinks, it may happen that its IT infrastructure remains too large, because it was bought in better times, when it suited it in terms of size. A serious and complex question arises: how successfully can the size of the IT infrastructure be changed and adjusted?

Scalability refers to the ability of computers, software products to expand to serve an increased number of users, but without negative side effects in the form of system crashes. Changes in business volume must be taken into account when planning hardware capacity. Companies using mobile computing and cloud platforms will need new policies and procedures to manage these platforms. It will need to inventory all mobile devices used for business purposes and then develop policies and tools to monitor, update, secure and control data and applications (Han et al., 2024).

Companies using the cloud platform and SaaS services will have to create new contracts and agreements with providers, so that the hardware and software of critical applications are always available when they are needed, and so that they always meet information security standards. It is up to management to determine what computer response time is acceptable, as well as what level of IT resource availability is required to maintain a certain level of business performance.

3) Investing in the company's IT infrastructure. The investing is one of biggest the company expenses. If too much money is spent on IT infrastructure, it will remain unused and will be a burden on the company's financial performance. If, on the other hand, too little is spent, essential business services cannot be delivered and competitors of the firm will gain an advantage. It is very difficult to determine how much a company should spend on IT infrastructure.

The question arises whether the company should buy and maintain its IT infrastructure. or to rent IT infrastructure components from external vendors (e.g., cloud services). This decision is usually treated as a "buy or rent" dilemma. Cloud computing is an inexpensive way to increase the scalability and flexibility of the company, while respecting security requirements and impact on business procedures and workflows in the company. In some cases, the cost of renting software is higher than buying and maintaining it yourself. However, there are many benefits of using cloud services: significant reductions in hardware, software and human resources and maintenance costs. With the cloud, a company can focus on the essence of its business, instead of technological problems (Tsvetkov et al., 2020).

The total cost of owning IT includes the initial cost of acquiring and installing hardware and software, as well as ongoing costs for their improvement, maintenance, technical support, employee training, utility costs and housing costs related to technology protection and storage. The total cost of ownership (TCO) model can be used to analyse direct and indirect costs that will allow a firm to determine the total real cost of implementing a particular technology. The cost of ownership for a PC can be 3 times the original purchase price.

Benefits in the context of increased productivity and efficiency that come from equipping employees with m-devices must be balanced with the growing costs of integrating these devices into the company's IT infrastructure and with maintenance costs. Other costs are: wireless network costs, employee training and technical support. Hardware and software purchases account for only 20% of the total cost of ownership, so managers must account for administrative costs. It is possible to reduce some of these costs through better management.

In addition to reorienting to cloud services, companies can reduce total cost of ownership through better centralization and standardization of hardware and software resources. Companies can reduce the number of employees in the IT department needed to maintain its IT infrastructure, if the number of computer models and versions of software that employees can use is reduced. In a centralized infrastructure, systems can be administered from a centralized location, which reduces costs.

VI. CONCLUSION

Information technologies such as hardware, software databases, computer networks are common organizational resources that make up the IT infrastructure. The IT infrastructure is the foundation or platform on which the company develops and builds specific information systems and business applications. Also, IT infrastructure is shared IT asset that provides a platform for the development and implementation of software applications that span multiple business functions and management levels.

One of the most important questions is who will control and manage the company's IT infrastructure and how to develop and implement the infrastructure in order to achieve business aims of the company. Company management must govern IT infrastructure development process in such way that provides integration and coordination of different IT components and platforms, monitoring changes in information technology, rational investment in IT infrastructure taking into account the total costs of ownership of IT components.

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