

COMPARATIVE ANALYSIS OF THE EFFICIENCY OF IT TECHNOLOGY VIRTUALIZATION IN ORGANIZATIONS

#virtualization #VirtualMachine #CloudComputing #GreenComputing #CSR #ESG #roicocalculator #roi #returnoninvestment #tco #totalcostofownership #DSR #DesignScienceResearch

The idea of virtualization, although known for several decades, until recently was omitted in most projects of digital transformation of enterprises, especially in the area of optimizing the use of computer hardware, memory resources and IT equipment. Hence, IT virtualization has become an important technology on the ICT services market.

Virtualization is a technology that dramatically changes the way of creating and using the IT environment. It is a method of running many virtual computers or servers on one hardware platform, without the fear that the failure of one virtual component will automatically fail the others. The described technology is easy to understand on the example of a virtual machine (VM). It is implemented when operating systems and applications are combined in different configurations to create virtual machines that are hosted on a physical server that runs independently of the VM. Thus, virtualization of IT resources is a permanent separation of two layers of each computer system: the hardware layer and the operating system layer on which applications are installed - residing embedded and working within one digital machine. In addition to the old existing components, an addition is a software layer called a hypervisor, hypervisor or virtual machine monitor VMM (Virtual Machine Manager), which implements the functionality of the hardware - a computer in a computer. The main premise behind the idea of virtualization is that typically an application workload uses only a fraction of the hardware capabilities of a computer or server. By combining complementary computing and storage workloads, you can reduce the number of physical machines needed to support your business operations, thereby reducing the space, hardware, and electrical power requirements for powering and cooling your server clusters. The described technology brings a whole range of advantages (such as cost reduction, increased service level, or high flexibility and scalability of the infrastructure), but it is not without some disadvantages (potential failure of the host server). Therefore, the main research problem in this doctoral thesis was formulated as follows: "What are the benefits and limitations of the effects of implementing virtualization technology in the enterprise's IT environment?".

The main purpose of the doctoral thesis is to develop a prototype of the ROI/TCO calculator to assess the effectiveness of the use of virtualization technology, as well as its subsequent practical verification (during a simulation workshop), evaluation and validation in selected, surveyed organizations.

To achieve the research goal, the DSR (Design Science Research) methodology was used. DSR is an approach to scientific research proposed by A. Hevner, which assumes that on the basis of scientific knowledge, knowledge of the economic environment determining the subject of research, new, original knowledge is generated, supplementing the resources of previous knowledge, but at the same time being significant and useful for representatives of economic practice. As a consequence of adopting the DSR approach, an original scientific solution and a tool useful for practitioners (the so-called artifact) should be expected. Thus, DSR takes up practical challenges while contributing to both practice and theory, thus gaining increasing recognition among information systems researchers. The DSR methodology is also successfully used to create projects that ensure the highest usability in the context of business process management.

In order to achieve the goals indicated in the work, the following main hypothesis was also verified: "The implementation of virtualization technology ensures more effective use of the company's IT resources." The main hypothesis has been detailed in the following auxiliary hypotheses:

- H1. ROI/TCO calculators allow you to evaluate the effectiveness of virtualization technologies.
- H2. Virtualization technology works in accordance with the idea of Green Computing and is part of the CSR policy and the ESG concept.
- H3. Virtualization is an efficient method of delivering services in the Cloud Computing model.

The doctoral dissertation consists of four chapters. The first chapter identifies and introduces the importance of modern information technologies. In this part of the work, the concept of virtualization technology has been approximated along with its definition and main premises. In addition, issues related to the Green Computing and Cloud Computing models were discussed. In the case of "green IT", the main assumptions of this idea, examples of ecological solutions and an indication of why virtualization technology is part of this trend were presented. The part concerning CC is primarily a description of the cloud computing model, an overview of definitions available in the literature, types of clouds and a catalog of services with their description and examples. An important part is the technological aspect of CC, i.e. the description of virtualization in the context of cloud computing.

An introduction to the virtualization of the IT environment is the subject of the second chapter. In this part, through the historical dimension and a review of issues related to the subject of the work, virtualization in a dynamic IT infrastructure is presented. In addition, the classification of architecture types was reviewed, along with an indication of its own division, and the available virtualization solutions were cataloged. The applications of virtualization - server, desktop, application, presentation (interface), memory and network - along with their description were also indicated, as well as the theories of implementing virtualization solutions available in the literature. The chapter ends with a market forecast for the development of virtualization technology.

The third chapter is a presentation of technology in economic terms. Economic This dimension of virtualization was indicated by discussing the ROI/TCO analysis, as well as technology in the context of CSR policy and the concept of ESG. This chapter details ROI and TCO, as well as classifications of implementation costs. In addition, this part defines a calculator with an indication of specific tools that will be analyzed and compared in the further part of the work.

A description of the DSR research method, a comparative analysis of ROI/TCO calculators and a study of five cases are included in the fourth, empirical chapter. This part first describes the line of research, and then, in accordance with the adopted line, the ROI/TCO calculators are discussed in detail. The following subchapters describe the organization of empirical research, the research sample, as well as a brief description of the surveyed enterprises. The conclusions from the interviews were divided into 4 areas: assessment of knowledge of the concept of virtualization and its degree of application, assessment of knowledge of the concept of Green Computing, CSR and ESG and their application, assessment of knowledge of the concept of Cloud Computing and its application, and assessment of the effects of implementing virtualization solutions. Based on the conclusions of the research, an artifact was created and described, i.e. a prototype of the ROI/TCO calculator, which was later evaluated and validated. Therefore, a comparative analysis of the effectiveness of the use of virtualization technology in selected organizations was carried out twice: on the prototype of the ROI/TCO calculator, and then on its improved version. The entire line of research, in line with DSR, will culminate in developing theoretical and practical implications for the effectiveness of virtualization technologies.

The dissertation ended with a summary containing conclusions that were based on the research carried out as part of this work in accordance with the DRS and the line of research adopted by the author, literature review and the results of study and empirical research conducted in the planned doctoral dissertation. The final part of the work also includes a bibliography, netography and a list of figures, tables and an interview form.