BENEFITS AND BARRIERS TO THE USE OF CLOUD COMPUTING AND THEIR IMPORTANCE IN THE ASSESSMENT OF INDIVIDUAL USERS - STUDENTS OF THE WARSAW UNIVERSITY

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Abstract

The main goal of the article is to present the benefits and barriers associated with the use of Cloud Computing in the context of their importance to the organization. As an introduction, cloud computing was presented, its basic features, service offering models and implementation models were discussed. Selected statistical data on the CC market and its services in Poland and in the world were also presented. The main part of this study is the presentation of benefits and barriers from the point of view of their importance from the perspective of individual users. This study is a presentation of the next stage of research. The earlier edition of research related to the identification of manifestations of benefits and barriers was described in the author's previous works. The presented results were obtained on the basis of author's own research carried out among students of the Warsaw University in 2018. The research was performed using the Computer-Assisted Web Interviewing (CAWI) method in the form of a survey. The form and questions prepared for the needs of this research was compiled on the basis of research from previous years. Both the benefits and barriers are presented in groups. The benefits were divided into 4 groups, while the barriers into two groups. The results obtained in the article were discussed and summarized in the form of synthetic conclusions.

Keywords: Cloud computing, barriers, benefits, IT services, importance.

1 INTRODUCTION

Cloud computing is a relatively new concept associated with providing IT services. The ever-increasing computing power of modern computers, new technologies of hard drives and the ability to build virtually unlimited memory storage spaces determined by them result in the fact that the perspectives of the development of IT services no longer encounter such limitations as a few years ago. Currently, the limits of applying IT technology and its tools are no longer conditioned by technology or its capacity, but only by imagination, needs and naturally financial resources. Cloud Computing is presented and described as an opportunity to improve the functioning of a business, increasing its competitiveness as well as a tool which helps to reach new markets and new clients. It is a concept of providing IT services addressed to companies (both large and small) as well as individual users. The application of Cloud Computing, as any other concept, technology or IT tool, means benefits resulting from its application and specific barriers pertaining to its implementation and subsequent use in the organisation. These factors and their importance from the point of view of the organisation (user) have been analysed by the author based on the author’s own research presented in this paper.

The term “Cloud Computing” is relatively new. Therefore, there is no one generally applied definition of the concept. It is translated into Polish in a number of ways. The most frequently used equivalents are “przetwarzanie w chmurze” and “chmura obliczeniowa” [14]. For the first time the term "Cloud Computing" was officially used in 1997 by Ramnath Chellappa, Professor from the University of Texas. That year he gave a lecture during “INFORMS meeting” in Dallas entitled “Intermediaries in Cloud-Computing: A New Computing Paradigm” [9]. The researcher presented the definition of a new paradigm concerning the provision of IT services. He pointed out that “the limitations of computing services will be determined by economic justification, not by technological limitations” [6]. The event is perceived as the first scientific use of the term [14]. Due to the extensive presentation of the Cloud Computing model in the literature of the subject [2, 3, 6, 8, 11, 12, 13 and 15] in this work the author does not include specific definitions of the concept, its features, models of services or implementation mechanisms, and he only presents the selected characteristics of the discussed phenomenon.

The CC services model is present in the contemporary application of information technology in various forms. The services such as electronic mail (e.g. free e-mail accounts - google Gmail), portals for publishing media (e.g. YouTube, Picassa), virtual workstations (e.g. IBM Smart Business Desktop), file
sharing and exchange services (e.g. Google drive, Userscloud, 1Fichier, Chomikuj), virtual development environments (e.g. Vagrant, Docker) operate in this model [7]. Virtually any currently available service provided by the Internet may be based on the CC model, very often without the user being aware of the fact. Cloud Computing is the result of the evolution of various information technologies as well as philosophy, the economics of data, services and company infrastructure management. The solutions which are offered and available in the cloud, even though they are not a novelty, they still create new opportunities of creating and using the services, earning money together with a reduction of costs, and they impact the physical size of the premises and hardware in the company.

Cloud Computing may be considered from two major points of view, i.e. IT and business perspective. In the first case, it can be defined as “a model of IT services which concerns IT resources which are available outside the physical location. From the business (management-related) point of view, however, CC can be perceived as a new form of outsourcing of IT [11]. From the point of view of a client, computing cloud is simply access and the possibility of using the hardware and software which is not physically available but is located somewhere on the Internet. Thus, it may be stated that a cloud is a model of storing and processing data based on the use of external services [5].

The complex approach to cloud computing is based on the concept of creating of distributed computing systems, often located in various data centres, scattered around the world and accessible via the internet network, in which the distributed data reside in unknown locations, which usually are not relevant to us. An important element is that access to this information guarantees the continuity of actions of any organisation, automatically or in cooperation with others. Thus, the concept of computing cloud can be identified as any kind of services available from the level of a large internet network [10].

In addition, cloud computing is not a simple consolidation of computer cluster and grid processing systems. This is a new generation of data centre and data management, which puts emphasis on virtualised resources in the systems. Cloud Computing provides both software and hardware tools which enable the virtualisation of resources and free access to them [3].

It should be borne in mind that the idea of sharing programmes and services in the Cloud Computing model is not new – it dates back to the beginning of the era of digitalisation when all calculations were made in central units. Workstations (terminals) were only used to enter and read data [13]. Decades later, in the era of the popularity of personal computers, it was mainly considerations related to economics and organisation of work that induced the users and service providers to return to the old model [14]. Cloud Computing is not the use of ICT technology, understood as hardware and software resources, but rather a new model of sharing and using them as services supporting broadly understood business activity.

The total value of the global market of cloud computing in 2018 was estimated at USD 305.8 billion. In 2019 it is to reach 355.6 billion, and in 2020 it is to amount to the value of USD 411 billion [1]. According to the Goldman Sachs report, companies’ global expenditure on Cloud Computing technologies until 2021 is to double in relation to last year. In three years, they will already constitute 15 per cent of their IT budgets. At present, the major players are Google, Amazon, Alibaba and Microsoft. In 2017, they held 54 percent of the market, and in 2019 this share would increase to the level of 84%. This means that the remaining players would own only 16 per cent of the market [4].

According to IDC, the Cloud Computing market in Poland in 2019 is to reach the value of around 300 million dollars, i.e. approximately 11 per cent of the entire national market of IT services. In the next three years, the cloud computing market in Poland will double its value. It is estimated that in 2022 it will be worth around 593.5 million dollars [16].

2 METHODOLOGY

The research into the benefits and barriers of the application of Cloud Computing was based on the author’s approach consisting of the following steps:

- analysis of a selected group of Cloud Computing users on the basis of the quantitative and qualitative survey, specifying the types of services and the tools and devices used, the frequency of their use, benefits and barriers of CC application;
- on the basis of survey responses, identification of specific manifestations of the benefits and barriers of the application of the Cloud Computing model,

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identification of the importance of particular benefits and barriers for the organisation from the perspective of an individual user.

The research procedure was as follows:

- selection and justification of the research sample,
- construction of a survey concerning the benefits and barriers, and carrying it out (pilot study),
- preparation and discussion of the results – the verification of the previously compiled list of benefits and barriers,
- preparation and carrying out of the survey which, apart from the benefits and barriers, also examines the importance of their particular manifestations from the point of view of individual clients,
- analysis and discussion of the findings – summarising the research stage.

The author's approach and procedure presented above were successfully applied by the author during a number of previously conducted studies. This work presents the findings of the last stage.

The author's own research was carried out in the winter term (the turn of November and December) of the academic year of 2018/2019 with the application of the CAWI (Computer Associated Web Interview) method. The selection of the research sample was not accidental; it belongs to the group of convenient sampling. The respondents were students of the Faculty of Management at the University of Warsaw, all types of BA and MA studies; full-time, evening and part-time courses with the specialisations: Management and Accounting, Finance and Insurance. A specific limitation of the selection is, among others, an expected high share of individuals with access to smartphones, tablets, laptops and desktop computers, who have wide experience in using such devices and using the services offered as part of Cloud Computing.

656 individuals took part in the survey, including – 487 people in its full and correct form, which constitutes a 74.24% responsiveness rate. Among the survey participants, there were 71.9 % of women and 28.1 % of men. The vast majority of 94.66% respondents were aged 18-25. It is a typical age for students of BA and BSc courses. 4.31% of the respondents were aged 26-35, which was a typical age for students of MA full-time studies and BA part-time studies. The remaining 1.03% belonged to other age groups.

In terms of education, 93.63% of the respondents declared having secondary level education, 4.11% of them held the title of BA and BSc, while the remaining share (2.26%) indicated having higher education. The research sample included a 43.33% share of non-working students, 55.85% of the sample claimed they are working students, and the remaining 0.82% share were professional workers. Among the respondents, 31.21 % declared coming from a city with more than 500,000 residents, 12.11 % from cities between 100,000 - 500 000 inhabitants, 11.91 % from towns with 50,000 - 100,000 residents, 28.13% from cities of up to 50,000 inhabitants, and 16.63% came from villages.

3 RESULTS

The survey questionnaire contained substantive questions and the section related to demographics. It was divided into three parts:

- information concerning infrastructure (among others, the frequency of internet connections and the devices used for the purpose),
- benefits and barriers, their manifestations together with the frequency of their occurrence,
- benefits and barriers along with their manifestations in terms of their importance.

This article presents and discusses the findings of the two parts, i.e. the first and the third part of the study. The results of the survey related to the second part, i.e. benefits and barriers and their manifestations together with the evaluation of the frequency of their occurrence were published in the author's previous work [13].

The survey questionnaire presented to the respondents contained mainly closed questions focusing on the above mentioned ranges. The survey included two open questions, where the respondents had an opportunity to refer to the list of presented benefits and barriers as well as to indicate the manifestations which were not included in the form and add comments. Nearly half of the respondents
used this opportunity (223 individuals, which constitutes a 45.91% share of the survey participants). They entered many comments and suggestions on modifying/supplementing the list of benefits and barriers, which after a thorough analysis will be taken into consideration in the subsequent series of the study.

The first part of the survey concerned the characteristics of the devices, the frequency of their use, the services they used, and the purchases made via the Internet. The device which was used most frequently by the respondents to communicate was a smartphone (61.19%) as well as a smartphone together with the laptop (26.08%). A much smaller number of respondents used only a laptop (6.16%) or only a desktop computer (2.26%). The devices which were used most rarely for the purpose were only tablets (0.21%). The remaining 6.13% of the responses concerned other configurations of the use of equipment, e.g. a laptop and a tablet, a desktop computer together with a tablet.

As far as the frequency of using the Internet is concerned, 96.51% of the respondents replied that they use it at least a couple of times a day, and 1.64% use it virtually non-stop (non-stop, without interruption, etc.). The responses: at least once a day, at least once a week, or a few times a month (1.85% in total). The last question contained in the first part of the survey concerned the services used via mobile devices. The users could point to a few services which they use. The three most frequently indicated were: social media (93.84%), browsing websites (92.19%) and communication with the family, colleagues and friends (97.33%). The items which were pointed out the least frequently were: databases (e.g. legal acts) (37.58%), internet blogs (42.92%) and official, administrative matters (e.g. e-PUAP) – only 18.07%.

Analysing the above results one can conclude that the research sample was made up of experienced Internet users, who are familiar with the specificity of the Internet as well as services offered via the Internet.

### 3.1 Benefits and their manifestations

In terms of benefits, the survey was divided into four groups. In each group, which in the survey questionnaire constituted a separate question, the author has presented the approved questions concerning manifestations to the respondents and asked them to assess their importance. The responses of the survey participants are displayed in the charts shown below. The percentage data shown in the figures have been rounded to full values (without fractional values), except the values of less than 2%, in the case of which the rounding would make the illustrations difficult to interpret.

The first group of benefits were those directly related to the data. The results obtained in this respect in the form of percentage distribution of the responses are illustrated in the chart below.

![Figure 1. The percentage distribution of the responses connected with the importance of manifestations of data-related benefits. Source: own work](image-url)

According to the findings presented above, the respondents attach great importance to the benefits related directly to data. Each of the benefits indicated in this group has been evaluated as very significant ("very important" and "the most important"). It can also be noticed that the users
accustomed to the mobility offered by smartphones appreciate the possibility of free access to data from any location offered by CC.

The second group of benefits included those which were associated with costs. They are presented below.

![Figure 2. The percentage distribution of the responses connected with the importance of manifestations of costs-related benefits. Source: own work](image)

All the manifestations included in this group were perceived by the respondents as significant (most responses included comments such as “important” and “very important”). It should be indicated that the total of the indications was lower than in other groups. However, the percentage of the indications of “the most important” in each case did not exceed 10%. The indication of the manifestation of “a smaller IT department”, which turned out to be the least important element in this study (it received the highest number of “not very important” and “unimportant” indications (36%)) also belonged to this group.

The subsequent group of benefits considered in the research were those related to IT technology. The findings were presented in the figure below.

![Figure 3. The percentage distribution of responses connected with the importance of manifestations of IT technology-related benefits. Source: own work](image)

All manifestations of benefits included in this group were perceived by the respondents as important. The total of the indications of “important” and “very important” in each case was not smaller than 80%.
A small share of individuals saw the manifestations from this group as the most important assessing their role as “the most important” (not more than 15%).

The next group of benefits analysed in the study was the group concerning the functioning of an enterprise and the services provided by the organisation. The percentage share of the responses was presented in Figure 4.

![Figure 4](8696)

This group included the manifestations of the benefits which respondents perceived as very important for the functioning of an enterprise. They were as follows: high quality of customer service, the possibility of remote work and greater flexibility of provided services. The percentage share according to accumulated values (“very important” and “the most important”) amounted to 69%, 65% and 63% respectively. The smallest share of the responses was obtained in the case of the response associated with no difficulty related to maintaining the infrastructure – 39%.

### 3.2 Barriers and their manifestations

The survey also presented the barriers to CC application divided into two groups. In each group, which similarly to benefits in the survey questionnaire constituted a separate question, the respondents were presented with the manifestations of the barriers and they were asked to evaluate them in terms of their importance. The responses given are presented in figures below. The percentage data included in the figures are rounded to the full values according to the same criteria as in the case of benefits.

The first group of barriers was related to data. The obtained findings in the form of percentage distribution of the responses are illustrated in the chart below.

![Figure 5](8696)
Among the barriers associated with data, there were the manifestations which were perceived by the respondents as the most important aspects in the entire study. They included: the possibility of losing data (87%), potential possibility of competitors taking over data (78%) and lack of data privacy (75%). This clearly indicates that the questions connected with data security are a key issue for users.

The second and the last barrier in the group of manifestations were barriers related to the services provided as part of Cloud Computing. The results are illustrated in Figure 6.

![Figure 6. The percentage distribution of the responses in terms of the importance of manifestations related to services provided as part of Cloud Computing. Source: own work](image)

Referring to the results obtained in this group, three barriers, namely, too low service efficiency, difficult access due to poor connection and difficulty in integrating CC with the company infrastructure may be included in the group of technical barriers, while lack of trust in the service provider may be regarded as a mental barrier. In the respondents’ opinion, the latter was the most important factor (39% indications of “very important” and 25% “the most important”). This coincides with the findings received in another part of this study (the results of which are published in the previous work of the author), where the respondents claimed that the mental barrier occurs in the 59% cases and technical barrier in 23%. In the remaining 18%, the legal barrier is also seen as significant [13].

4 CONCLUSIONS

The respondents claimed that the presented manifestations of the benefits and barriers are, in their view, important for the organisation. The responses of “important” and “very important” dominated the vast majority of the groups. It is important to notice that the percentage of the “unimportant” responses in the case of nearly all (apart from two cases) manifestations of both barriers and benefits amounted to approximately 1%.

According to the accumulated value of “very important” and “the most important” indications, the responses are as follows:

- In the group of benefits, the manifestations which were most important for the respondents included:
  - free access to data from any location – 82% (400 individuals)
  - ensured security of critical data – 79% (387 individuals)
  - faster and more efficient data processing – 72 % (349 individuals).

- According to the users, the most important manifestations of barriers were:
  - the possibility of losing data – 87% (425 individuals)
  - potential possibility of data being taken over by competition – 77% (375 individuals)
  - no data privacy – 75% (363 individuals).
In the group of benefits, according to respondents, their least important manifestations included:
- a smaller IT department – 36% (174 individuals)
- no difficulty connected with maintaining infrastructure – 14% (69 individuals)
- smaller losses connected with equipment breakdowns – 13% (62 individuals).

According to the users, the least important barrier manifestations were:
- lack of knowledge concerning the physical location of data – 21% (102 individuals)
- difficulty in integrating CC with the company’s infrastructure - 18% (88 individuals)
- free data transfer – 15% (74 individuals).

For users of the services provided in the Cloud Computing model, the most important issue is data and data security. Both in the group of benefits and barriers, the percentage share of the respondents pointing to the data-related manifestations as the most important factors each time exceeded 70%. The least important aspect was a matter of reducing costs in connection with a smaller IT department in the company.

Summing up, it can be concluded that the conducted research has shown that the issue related to benefits and barriers to the application of Cloud Computing is important and relevant, and the obtained findings have indicated that the users attach considerable importance to its particular manifestations. The respondents submitted many proposals for supplementing/modifying the lists of both benefits and barriers, which after careful consideration will be included in the subsequent editions of the study.

REFERENCES


