

The use of factor analysis in the perception of benefits and disadvantages resulting from the use of cloud computing technology in the enterprise

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Abstract

The information system development is a constant process, and one of the factors driving this development is, besides the Internet, Social Media, Big Data, Internet of Things, cloud computing. Cloud computing accelerates the processes of digitalization and digital transformation, at the same time affecting the transformation of business entities in technical and social aspects as well. Thus, cloud computing becomes an inseparable element of the information systems development. Currently conducted research indicates that the use of cloud computing by enterprises is becoming more common and is perceived as an effective tool in supporting business management. These studies are being confirmed by an increasing number of Polish enterprises, which have decided to implement this solution into their basic activity. In each report or study regarding the use of cloud computing in enterprises, a long list of disadvantages and benefits is presented, of which includes cloud computing. Therefore, the purpose of the article is to try to identify the most important factors (in the layout of benefits and disadvantages) that determine the perception of cloud computing by Polish enterprises. The obtained results from the conducted factor analysis demonstrate the general image of advantages and disadvantages resulting from its use.

Keywords: cloud computing, enterprises, advantages, disadvantages, factor analysis.

1. Introduction

Cloud computing has gained significant popularity in the last 10 years and now is perceived as a paradigm shift from the traditional stationary computers into the mobile devices which use virtual sources. At present, cloud computing is no longer seen as a niche or novelty of IT technology. Now, it is more a tool used by regular users, both individual ones or organizational units. The unsurprising opportunities and savings possibilities offered by cloud computing have attracted strong market growth in services, in which providers can offer a variety of (almost any) type of service that the final user may be interested in. These models are also used in areas such as IoT – Internet of Things, Social Media, Media Streaming, Data Science, or E-commerce [7]. Global companies such as Amazon, Google, Alibaba and Microsoft are very well-known examples of cloud computing use. In Q3 of 2016, the Amazon Web Services generated \$3,2 billion in revenue (a 55% increase in comparison to the same period in 2015), driving Amazon's global market share to 31%. Meanwhile, Microsoft with its market share of 9%, predicted that by 2018 cloud products are expected to account for 30% of their total revenue. According to Waterford Technologies in 2016, "the cloud market was valued \$148 billion and growing by 25% annually". It is predicted that global spend on public cloud services should grow up to 19,4% of annual growth rate, to reach \$141 billion in 2019. 41% of enterprises are

planning to increase their investments in cloud computing technologies, 51% of big and medium sized and 35% of smaller enterprises are planning to increase their spends on cloud computing [1]. Gartner company has predicted that over the next four years the number of cloud computing users will significantly increase, thus cloud computing deployment will become the default, and it underlines the need for cloud strategy as well [4]. Research conducted by Clutch indicated that 70% of surveyed enterprises use cloud computing for storage purposes, 62% for backup and recovery, and 51% for application deployment [11]. However, RightScale indicated that 32% of companies are now considering a lack of appropriate knowledge and resources as the biggest problem, due to the fact that the need for specific skills and expertise in cloud computing area has grown recently. Additionally cloud security is no longer the main concern [20]. Also research conducted by Softchoice found that 52% of surveyed enterprises do not have a formalized cloud computing strategy [23].

According to the Eurostat data, cloud computing is being chosen by Polish enterprises more frequently, regardless of their size. Just in the case of medium-sized enterprises, a significant increase, of almost 60% in 2018 in comparison to 2014 can be noticed [6]. According to statistics, the benefits of using cloud computing in Poland are invariably appreciated by large enterprises employing over 250 people. Last year 37% of them have admitted using the cloud, 6% more than the year before. Moreover, according to experts, more and more Polish entrepreneurs recognize that adaptation of cloud solutions is no longer just a matter of savings or fashion - they are becoming an important element of shaping a competitive advantage. According to IDC analysts, the company's spending on the services provided in the cloud model currently is 15 percent of the IT budgets, and they are going to increase up to almost 35% [13]. It also causes that enterprises from SME sector are showing a significant demand for software, hardware, and IT services. As they are aware that it could strengthen its competitive position on the market.

In almost every paper (report, article or news) about the cloud computing, the benefits and disadvantages are listed. And based on the literature analysis, it becomes possible put the following research question (RQ): *if there is a possibility of grouping variables classified as the benefits and disadvantages resulting from the use of a cloud computing?* Having in mind the large number of perceived disadvantages and benefits, the main purpose of the article is to bring the observed correlations (covariances) between many variables regarding the perceived benefits and disadvantages of cloud computing, to a smaller number of explanatory factors. The separated factors will have a different substantive interpretation, however, they will retain much of the information contained in the primary variables.

2. Cloud computing

The function and development of modern enterprises depends on the use of appropriate information and communication technologies (ICT). In recent years the scale of applications of various IT tools and resources in enterprises have been systematically expanding, affecting the effectiveness of business processes [2]. Network infrastructure for data acquisition and processing based on the cloud is one of the main driving forces of digital technologies included in the fourth industrial revolution, referred to as Industry 4.0 [21], and the cloud itself is one of the key themes in the context of the digital transformation of business. These solutions provide opportunities for small and medium enterprises to develop technologically to the same extent as their larger counterparts, however without significant financial outlays [22].

The idea of the cloud was created in the 1960s, when J. McCarthy believed that „computation may someday be organized as a public utility”, using shared data centers. In turn the cloud computing term was used for the first time in 1987 by R. Chellapp, who used it

during the lecture „Intermediaries in cloud-Computing: A New Computing Paradigm” [5]. Concepts such as cloud computing or cloud processing, despite numerous attempts to define them, have not yet had a common definition. Currently in the literature of the subject, many definitions and attempts to interpret this concept can be found (table 1).

Table 1. Selected cloud computing definitions

| Academic dimension | |
|--|---|
| Rao, M.N. [20] | Cloud Computing is a kind of internet based computing, where distinct services are delivered to an organization through the network |
| Marston, S. et al. [15] | Cloud Computing is an IT service model where computing services are delivered on demand to customers over a network in a self-service mode, independent of device and location |
| Lewis, G. [14] | Cloud computing is a distributed computing paradigm that focuses on providing a wide range of users with distributed access to scalable, virtualized hardware and/or software infrastructure over the internet |
| McFedries, P. [16] | Cloud computing is a delivery model for technology-enabled services that provides on-demand access via a network to an elastic pool of shared computing assets (e.g. services, applications, servers, storage, and networks) that can be rapidly provisioned and released with minimal service provider interaction. The entire value can be bi-directionally scaled as needed to enable pay-per-use. |
| Furth, B. [9] | Cloud computing can be defined as a new style of computing in which dynamically scalable and often virtualized resources are provided as a services over the Internet |
| Ong, C-S., Lin, C-T. [18] | Cloud computing system is considered as a virtualized computer system that covers all software and applications required by the organizations |
| Practical dimension | |
| National Institute of Standards and Technology [17] | Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models. |
| „Open Cloud Manifesto” [23] | It is a model that provides the ability to scalability and dynamically provision of computing power in a way that reduces costs and gives customers (which are: end-user, IT department, organization) the possibility of a full use of facilities without the necessity to manage complicated technology. |
| Gartner [4] | A style of Computing where scalable and elastic IT capabilities are provided as a service to multiple customers using Internet technologies |
| IDC [13] | An emerging IT development, deployment and delivery model, enabling real-time delivery of products, services and solutions over the Internet (i.e., enabling cloud services). |

In conceptual terms, cloud computing is treated as another medium that, being available to users, allows access to virtually unlimited resources. Based on the above definitions it can be assumed that cloud computing is a model for delivering and sharing, efficient and scalable IT resources (hardware, software, and services), combined with a service provider, which is usually an external entity (possibly an internal IT department), which offers IT services to the recipients through the network. Cloud computing combines and develops solutions such as virtualization, web services, service-oriented architecture, parallel computing, ubiquitous computing, autonomic computing, grid computing and distributed computing [25][10][7]. Cloud computing architecture therefore comprises cloud services (measured services) delivered by cloud service providers (third parties, suppliers, or brokers) to cloud consumers (end users, enterprises, or IT staff) over a networked infrastructure (i.e. the Internet or a virtual private network) [3]. Services offered as part of cloud computing are available to users/recipients regardless of their device (desktop computer, laptop, tablet, smartphone) and regardless of their location (any device/any time). IT resources available by the provider in the computing cloud are paid by the recipient depending on the degree of their actual use.

3. Research Methodology

3.1. Study Sample and Data collection

Based on in-depth literature studies and own research¹, a quantitative study was prepared

¹ Bajdor, P., Lis, T.: Cloud Computing in Polish SME Enterprises. In: Central European Conference on Information and Intelligent Systems. 25th International Conference. September 17th - 19th, 2014, Varazdin, Croatia, 40-47; Bajdor, P.: The Environmental Benefits of Cloud computing. In: 5th IEEE International Conference on Advanced Logistics and Transport (IEEE ICALT'2016),

which took the form of a questionnaire, consisting of 28 questions, 21 of a substantive nature and 7 constituting a metric. The main purpose of the study was to find an answer on research question formulated in the Introduction section. The first stage of the research was to carry out pilot studies among 10 small and medium-sized enterprises operating in the Silesia Voivodeship. The aim of this pilot study was to identify any inaccuracies and possible ambiguities that could make it difficult for the respondents to understand the question. Then the main survey was conducted, in which a representative sample of 243 enterprises took part, with the assumed confidence level of $1-2 = 0.90$ and the maximum error of estimated $d = 5\%$.

The main survey was conducted in the form of a telephone interview using the CATI method, which is a computer-assisted interview. The interview was conducted over the phone, and the answers received were noted in a special computer script which made it possible to fully automate the questionnaire. In order to collect and analyze data, SPSS Statistics 20 software and Excel spreadsheet were used.

The respondents were representatives of enterprises in managerial positions (or owners) as well as persons designated by them as persons responsible for IT departments, as an IT specialist with in-depth knowledge of IT systems used in the surveyed enterprise.

3.2. Convergent Validity

Before starting the analysis of the obtained survey results an analysis of the reliability of the measurement scale was carried out, using the Cronbach's Alpha statistic for this purpose, which is the most often used method to measure internal consistency or psychometric reliability of the tool. Cronbach's Alpha statistics are based on correlation coefficients of all questions from the questionnaire with the overall result of this scale [11]. Cronbach's Alpha statistics, calculated for all questions, amounted to 0.944, which means high coherence or reliability of the scale.

3.3. Factor Analysis

Factor analysis is a set of statistical methods and procedures that allow to study the relationship between a large number of variables and the detection of hidden conditions that explain their occurrence. It allows to bring a large number of studied variables to a much smaller number of mutually independent (uncorrelated) factors. Factor analysis is an interdependence technique whose primary purpose is to define the underlying structure among the variables in the analysis [11]. Due to the fact that in questions about perceived disadvantages and benefits Likert's numerical scale was used, and the aim of the analysis was to classify variables into relatively homogeneous groups, a factor analysis seemed to be a proper tool to use. Certain groups of random variables represent the variability of the same factors, which means that random variables in a given group are somewhat dependent on each other. It can identify the structure of a set of variables as well as provide a process for data reduction. In this case it can reduce the 16 variables (benefits) and 17 variables (disadvantages) to a smaller number.

4. Data Analysis

4.1. Descriptive analysis

Based on in-depth literature studies, a quantitative study was prepared. The quantitative

survey adopted the form of a survey, whose questionnaire consists of 28 questions - 21 of a substantive nature and 7 constituting a metric. The questionnaire included questions with a single answer choice, a 5-fold answer choice and 5-step Likert's scale was adopted, which is a bipolar interval scale. The scale used in the study consists of 5 categories of answers ("strongly agree", "agree", "hard to say", "disagree", "strongly disagree"), which were ordered in the correct order. The first stage of the research was to carry out pilot studies among 10 small and medium-sized enterprises operating in the Silesia Voivodeship. The main purpose of this study was to identify any inaccuracies and possible ambiguities that could make it difficult for the respondents to understand the survey questions. Then in the period between September and December 2018, the main study was carried out, in which a representative sample of 240 micro, small, medium and large enterprises took part. For the purpose of this article, we accepted the SME definition, provided OECD: „*Small and medium-sized enterprises (SMEs) are non-subsidiary, independent firms which employ fewer than a given number of employees. This number varies across countries (OECD)*. In the EU the upper limit designating an SME is 250 employees, while in US SME can hire up to 500, but in other countries this limit has been cut to 200 employees only. According to Commission Recommendation (Commission Recommendation):

1. The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.
2. A small enterprise is defined as an enterprise which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.
3. Microenterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.

Table 2. SME enterprises definition

| Category | Employees | Turnover |
|----------|-----------|--------------|
| Micro | ≤ 10 | < 2 mln EUR |
| Small | 10-49 | < 10 mln EUR |
| Medium | 50-249 | < 50 mln EUR |

Due to the use of the representative method in the study, attempts were made in order to minimize the sample size while maintaining the required accuracy and certainty of inference.

The minimum sample size for estimating the probability of p success in a general population, was calculated on the basis of the formula for sample size with a very large population:

$$n = \frac{u_{\alpha}^2 p(1-p)N}{u_{\alpha}^2 p(1-p) + (N-1)d^2} = \frac{(1,64)^2 * 0,6 * 0,6 * 1900000}{(1,64)^2 * 0,6 * 0,6 + 1900000 * (0,5)^2} = 236 \quad (1)$$

where:

α = level of significance (0,1-0,01),

u_{α}^2 = the value acquired from the table of normal distribution for the adopted level of significance,

p – the structure index,

d – accepted level of the highest error

As is evident from the calculations, the minimum sample size, with the adopted confidence level $1-2 = 0.90$, and the accepted level of highest error $d = 6\%$, should be 236 questionnaires. Due to the fact that the study involved 243 questionnaires, it can be assumed that this condition has been met. In total, 243 survey questionnaires have been

returned and all of them have been classified for further analysis. Descriptive statistical results (table 2) showed that in the structure of the surveyed entities (243 enterprises; $M=1$; $SD=0,868$), micro-enterprises had the biggest share - 51,4%, and then small enterprises - 28,4%. The largest percentage (30.5%) were enterprises ($M = 4$, $SD = 4.383$) operating on a national scale, and 26.3% of them operate on a European scale. 72% of the surveyed enterprises ($M = 2$, $SD = 1.618$) are limited liability companies, and over 60% of them started their activity in 1990-2009, in terms of a market economy.

Table 3. Descriptive Statistical Results

| | Classification | Frequency | % | Avg | Median | Standard Deviation |
|--|----------------------------|-----------|------|---------|----------------|--------------------|
| Company's size | Micro (up to 9 people) | 125 | 51.4 | 1.72 | 1 | 0.868 |
| | Small (10-49 people) | 69 | 28.4 | | | |
| | Medium (50-24 people) | 40 | 16.5 | | | |
| | Big (more than 249 people) | 9 | 3.7 | | | |
| Duration of CC use | Up to 3 years | 112 | 46.1 | 5.09 | 4 | 4.383 |
| | 3-6 years | 79 | 32.5 | | | |
| | 6-10 years | 32 | 13.1 | | | |
| | more than 10 years | 20 | 8.3 | | | |
| The position held by respondent | Top management | 133 | 54.7 | 1.92 | 1 | 1.156 |
| | Manager | 35 | 14.4 | | | |
| | Specialist | 36 | 14.8 | | | |
| | IT | 39 | 16 | | | |
| Company's range | Local | 19 | 7.8 | 3.27 | 3 | 1.175 |
| | Regional | 44 | 18.1 | | | |
| | National | 74 | 30.5 | | | |
| | European | 64 | 26.3 | | | |
| | Worldwide | 42 | 17.3 | | | |
| Company's income from the last year | up to 25.000 Euro | 30 | 12.3 | 4.27 | 4 | 2.141 |
| | 25.000-50.000 Euro | 37 | 15.2 | | | |
| | 50.000-250.000 Euro | 66 | 26.1 | | | |
| | 250.000-1 mln Euro | 28 | 11.5 | | | |
| | more than 1 mln Euro | 82 | 33.7 | | | |
| CC costs for the last year | up to 1250 Euro | 34 | 38.3 | 27324.4 | I do not know* | 194259.2 |
| | 1250-2500 Euro | 110 | 16.8 | | | |
| | more than 2500 Euro | 30 | 16.5 | | | |
| | I do not know | 69 | 28.4 | | | |

*means the year

** the most often chosen answer

Over half of respondents (54.7%) occupy the highest positions in the company, and almost equally, 14.4% and 14.8% were managers and specialists ($M = 1$, $SD = 1.156$). Over 30% of them recorded last year's revenue of more than 1 million Euro and 26.1% achieved revenues in the range of 50,000. Euro to 250,000 Euro ($M = 4$, $SD = 2.14$). Almost half of the surveyed enterprises (46.1%) have used cloud computing for less than 3 years, and 32.5% used them for longer than 3 years but less than 6 years ($M = 4$, $SD = 4.383$). It

therefore follows that almost all companies used cloud computing solutions quite briefly. Almost 40% of them incurred costs for using it at a level not exceeding 1250 Euro/year in 2017 ($M = I$ do not know, $SD = 194259, 18$).

4.2. Factor Analysis Results

Due to the fact that in the literature the benefits and disadvantages resulting from the use of cloud computing are presented in very different configurations, causing the occurrence of a large number of variables, a factor analysis was carried out in order to reduce a large number of variables thus narrowing the area of consideration. As mentioned earlier, the separated factors have a different substantive interpretation, while retaining a significant part of the information contained in the primary variables. Performing a factor analysis requires data measured on an interval scale or Likert scale, which means that the condition is met in the case of the presented research. The factor analysis carried out considered the following issues: advantages and disadvantages resulting from the use of cloud computing in the company (table). The following list has been developed based on the analysis peer reviewed articles² and reports³ on the use of cloud computing in enterprises.

Table 4. Perceived benefits and disadvantages of cloud computing use

| Benefits of cloud computing use | Disadvantages of cloud computing use |
|---|--|
| Financial | Problems with the data security and its processing |
| Reduced demand for IT specialists | Legal problems (different regulations in different countries, unfavorable or ambiguous clauses in contracts, lack of behavior patterns, etc.). |
| High availability | Dependency on the quality of the Internet connection (Internet network failures that prevent the use of resources) |
| Flexibility of solutions | Partial or total dependence on the supplier |
| Ease of use | Lack or limited control over the supplier's activities |
| Better support for mobile work | Difficulties in adapting IT resources to customer's needs |
| Increased effectiveness | Problems related to data migration |
| High level of security offered by the IT supplier | High costs of broadband Internet connections |
| Better cooperation between employees and partners | Limited possibilities to integrate local and external IT resources |
| Better meeting the needs of customers | Solutions' technological immaturity |
| Scalability | Market immaturity that generates the risk of cooperation with a non-professional supplier |
| Better accountability and control | Lack of local technical support |
| Ease of resource sharing | Lack of appropriate language version |
| Unlimited storage space | Lack of qualified employees |
| Accelerated implementation of innovation, including the introduction of new services/products | Lack of tax incentives or EU funds |
| Development of new ventures and business projects | Risk of losing knowledge in the IT area |
| | Possibility to incur additional/unpaid costs (due to adjustment activities, integration, higher level of services) |

² Vasiljeva, T., Shaikhulina, S., Kreslins, K.: Cloud Computing: Business Perspectives, Benefits and Challenges for Small and Medium Enterprises (Case of Latvia). In: Procedia Engineering. 178, 443-451 (2017); Nasarul Ismal, K.V.: Review on Benefits and Security Challenges of Cloud Computing. In: International Journal of Computer Science and Information Technologies. 8 (2), 224-228 (2017); Parlinska, M., Petrovska, I.: Cloud Computing and its Benefits. In: Information Systems in Management. 6 (4), 309-317 (2017); Xue, C.T.S., Xin, F.T.W.: Benefits and Challenges of the Adoption of Cloud Computing in Business. In: International Journal on Cloud Computing: Services and Architecture. 6 (6), 1-15 (2016); Rocha, L., Vazquez, A.: Benefits of Adoption of Cloud Computing in Mexico. In: ECORFAN Journal. 5(12), 2043-2056 (2014); Widyastuti, D., Irwansyah, I.: Benefits and Challenges of Cloud Computing Technology Adoption in Small and Medium Enterprises (SMEs). In: Advances in Economics, Business and Management Research, 41, 241-246 (2017); Chen, T., Chuang, T., Nakatani, K.: The Perceived Business Benefit of Cloud Computing: An Exploratory Study. In: Journal of International Technology and Information Management, 25 (4), 101-122 (2016); Bajdor, P., Lis, T.: Cloud Computing in Polish SME Enterprises. In: Central European Conference on Information and Intelligent Systems. 25th International Conference. September 17th - 19th, 2014, Varazdin, Croatia, 40-47; Bajdor, P.: The Environmental Benefits of Cloud computing. In: 5th IEEE International Conference on Advanced Logistics and Transport (IEEE ICALT'2016), Kraków, Polska, 273-278 and own research.

³ Reports including the following: Cloud Security 2017 Spotlight Report; Computerworld; Gartner; Control Engineering Poland; IDC; Report on the Public Consultation on Cloud Computing Research and Innovation Challenges: Horizon 2020 Work Programme 2018-2020; The State of Cloud Readiness Fall 2018; A Technical Seminar Report on Cloud Computing; The Cloud Computing Report Business Insider; Cloud the Report, How Businesses Use Cloud Computing: 2017 survey and our own research.

In the conducted factor analysis, the exploratory factor analysis approach was used in which the factors are initially unknown and are separated by the analysis of the values of random variables. In order to determine the number of factors the criterion of the scree plot was used, which allows identification of the so-called "Break point", which in turn determines the number of factors eligible for further analysis (fig. 1 and fig. 2).

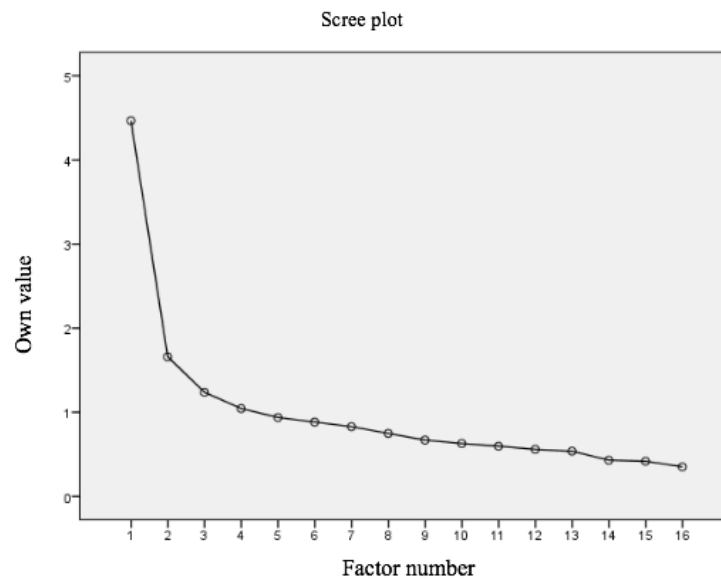


Fig. 1. Scree plot of benefits factors.

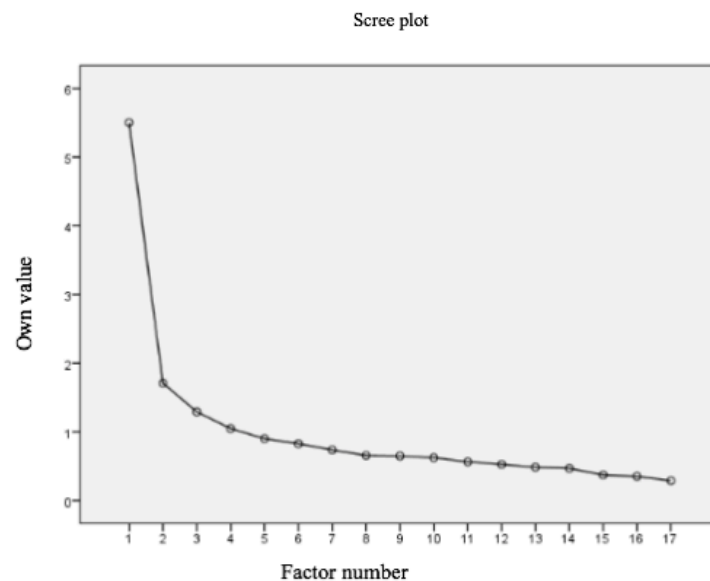


Fig. 2. Scree plot of disadvantages factors.

The scree plots presented above made it possible to pick up a point where further increase of factors will cause only small increments in the sense of explained variance. In this study, the presented scree plots show that four factors are eligible for further analysis, both in the case of disadvantages and benefits. This assumption is confirmed by the result of the factor analysis carried out using the main components method in IBM SPSS Statistics 20 program, as it was established that four factors should be distinguished for both groups (performed using Varimax analysis of orthogonal factors). In the first group (benefits), the separated factors explain a total of 52.5% of the variance of the obtained results (table) and 56% of variance in the case of disadvantages.

Table 5. Total variance explained for a group of factors determining the benefits of using cloud computing in an enterprise

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|--------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 4.466 | 27.912 | 27.912 | 4.466 | 27.912 | 27.912 |
| 2 | 1.660 | 10.373 | 38.285 | 1.660 | 10.373 | 38.285 |
| 3 | 1.238 | 7.738 | 46.023 | 1.238 | 7.738 | 46.023 |
| 4 | 1.044 | 6.526 | 52.549 | 1.044 | 6.526 | 52.549 |
| 5 | .939 | 5.866 | 58.415 | | | |
| 6 | .884 | 5.523 | 63.938 | | | |
| 7 | .829 | 5.182 | 69.120 | | | |
| 8 | .749 | 4.679 | 73.799 | | | |
| 9 | .670 | 4.186 | 77.984 | | | |
| 10 | .629 | 3.930 | 81.914 | | | |
| 11 | .597 | 3.732 | 85.646 | | | |
| 12 | .559 | 3.494 | 89.140 | | | |
| 13 | .537 | 3.357 | 92.497 | | | |
| 14 | .431 | 2.693 | 95.190 | | | |
| 15 | .418 | 2.611 | 97.802 | | | |
| 16 | .352 | 2.198 | 100.000 | | | |

As the table above shows, in the case of variables defining the benefits of using CC, four main factors were identified. In turn, the variable in the form of "High level of security offered by the IT supplier" should be removed from the scale because it is not saturated with any of the distinguished factors. The table below presents a summary of the separated factors together with the variables assigned to them.

Table 6. Extracted factors with the variables assigned

| The benefits of cloud computing | |
|---|--|
| Technology | Improvement |
| <ul style="list-style-type: none"> - Development of new ventures and business projects - Accelerated implementation of innovation, including the introduction of new services/products - Scalability - Better meeting the needs of customers - Reduced demand for IT specialists | <ul style="list-style-type: none"> - Ease of use - Flexibility of solutions - High availability - Better support for mobile work |
| Organization | Economy |
| <ul style="list-style-type: none"> - Ease of resource sharing - Unlimited storage space - Better accountability and control - Increased effectiveness | <ul style="list-style-type: none"> - Financial |

The next step was to conduct a factor analysis for the variables defining the disadvantages of cloud computing. The table below also shows that four factors were extracted.

Table 7. Total variance explained for a group of factors determining the disadvantages of using cloud computing in an enterprise.

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|--------|---------------------|---------------|--------|-------------------------------------|--------|---------------|
| | Total | % of Variance | Total | % of Variance | Total | % of Variance |
| 1 | 5.502 | 32.365 | 32.365 | 5.502 | 32.365 | 32.365 |
| 2 | 1.709 | 10.054 | 42.419 | 1.709 | 10.054 | 42.419 |
| 3 | 1.291 | 7.597 | 50.016 | 1.291 | 7.597 | 50.016 |
| 4 | 1.048 | 6.166 | 56.182 | 1.048 | 6.166 | 56.182 |
| 5 | .901 | 5.299 | 61.481 | | | |
| 6 | .828 | 4.869 | 66.350 | | | |
| 7 | .737 | 4.333 | 70.683 | | | |
| 8 | .656 | 3.857 | 74.540 | | | |
| 9 | .648 | 3.813 | 78.353 | | | |
| 10 | .624 | 3.672 | 82.025 | | | |
| 11 | .563 | 3.312 | 85.337 | | | |

| | | | | | | |
|----|------|-------|---------|--|--|--|
| 12 | .526 | 3.097 | 88.434 | | | |
| 13 | .484 | 2.850 | 91.284 | | | |
| 14 | .469 | 2.759 | 94.043 | | | |
| 15 | .373 | 2.191 | 96.234 | | | |
| 16 | .352 | 2.071 | 98.306 | | | |
| 17 | .288 | 1.694 | 100.000 | | | |

The variable in the form of "Solutions' technological immaturity" should also be removed because it is not saturated with any of the distinguished factors. The table below presents a summary of the separated factors together with the variables assigned to them.

Table 8. Extracted factors with the variables assigned

| The disadvantages of cloud computing | |
|--|---|
| Limitations | Dependance |
| <ul style="list-style-type: none"> - Lack of qualified employees - Lack of tax incentives or EU funds - Lack of appropriate language version - Market immaturity that generates the risk of cooperation with a non-professional supplier - Lack of local technical support - Risk of losing knowledge in the IT area - Possibility to incur additional/unpaid costs (due to adjustment activities, integration, higher level of services) - High costs of broadband Internet connections | <ul style="list-style-type: none"> - Dependency on the quality of the Internet connection (Internet network failures that prevent the use of resources) - Lack or limited control over the supplier's activities - Partial or total dependence on the supplier |
| Difficulties | Threats |
| <ul style="list-style-type: none"> - Difficulties in adapting IT resources to customer's needs - Limited possibilities to integrate local and external IT resources - Problems related to data migration | <ul style="list-style-type: none"> - Problems with the data security and its processing - Legal problems (different regulations in different countries, unfavorable or ambiguous clauses in contracts, lack of behavior patterns, etc.) |

The effect of the conducted factor analysis in relation to the perceived benefits and disadvantages by the respondents resulting from the use of cloud computing in the enterprise was the isolation of eight factors in total, each of which is somewhat charged to individual variables.

5. Discussion

The performed statistical analysis allows to find an answer on the research question, formulated as follows: *If there is a possibility of grouping of variables classified as the benefits and disadvantages resulting from the use of a cloud computing?* The results of factor analysis provide several key pieces of information on the benefits and disadvantages of using cloud computing, and also enabled data reduction. The results of the analysis are two sets, each consisting of four factors, covering a wide range of variables. In the case of the benefits of using cloud computing, having distinguished factors such as technology, improvement, organization and economy, and includes elements ranging from the development of new business projects, through ease of use, increased efficiency to visible financial benefits. However, in the case of disadvantages of cloud computing, factors such as limitations, dependence, difficulties, and threats were identified, including the following elements: lack of qualified employees, partial or total dependence on the supplier, difficulties in adapting IT resources to customer's needs or problems with the data security and its processing.

The obtained results not only increase knowledge about perceived benefits and disadvantages resulting from the use of cloud computing, but in addition the obtained set of factors covering particular variables may be the starting point for further research and may be a helpful tool in developing a strategy for implementing cloud computing in the enterprise. As they can be used in order to develop plans related to the implementation of cloud computing in an enterprise, they are covering only factors within a given set instead of focusing on each single variable (benefit or disadvantage). The presented results can also be used in the process of creating a strategy regarding the use of cloud computing in

an enterprise. The necessity to develop such a strategy results from the several reasons: an increasing amount of data possessed by enterprises and the need to protect them against loss or unauthorized access; widespread use of information and communication technologies using cloud computing solutions; ensuring continuity of undisturbed operation of the enterprise and the development of a security policy related to the huge growth of data and information in the digital form and progressive digitization. In addition, the enterprises participating in the survey almost unanimously (90%) agreed with the statement that "modern enterprises while creating their business strategy should take into account the use of modern information technologies such as Cloud Computing". Thus, the obtained results may be helpful in its creation, because when developing strategies, enterprises should focus on separate factors in order to maximize benefits and minimize the disadvantages resulting from the use of cloud computing.

6. Conclusions

Currently, cloud computing is a significant matter for the modern economy and it is the heart of almost all IT systems and services. Services and possibilities offered by cloud computing are becoming ubiquitous, and are present in almost every enterprise as well as in almost every device. Together, with Big Data, Digital Intelligence, Internet of Things, and more, it is responsible for constant development in the ICT area. Thus, it plays a major role in national economy development as well.

However, there are number of limitations to the study. The conducted study was restricted to SME's companies from Poland only, thus limiting generalizability. Also, despite striving to identify as many variables as possible regarding the disadvantages and benefits of using cloud computing, the factor analysis shows a quite low proportion of explained variance – 52,5% for benefits and 56% for disadvantages. It indicates that there are more advantages and disadvantages omitted in this study, such as cultural factors or supplier's management style, that could be useful extensions. Due to this, future research should further concentrate on investigation of individual factors related to benefits and disadvantages in order to group them into new factor groups. Thus, future research will focus on factor groups with a higher proportion of explained variance.

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