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Factors Influencing Cloud Computing Adoption by SMEs in the Czech Republic: An Empirical Analysis Using Technology-Organization-Environment Framework

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Abstract

Cloud computing technologies have come a long way and are available to virtually any company today. However, which factors will cause the company to decide to implement these services? Based on existing research abroad, we compiled a Technology-Organization-Environment (TOE) framework and proposed questions that support individual factors in our model to address this problem. Small and medium-sized enterprises (SMEs) in the Czech Republic actively participated in the research, from which we received 99 valid responses. Our results show a significant influence of four factors. The first factor is relative advantage, and the second is competitive pressure. In our case, companies are convinced that thanks to cloud computing, they will gain a more advantageous position over competitors, especially in the area of costs, increased productivity and entry into new industries. At the same time, they are convinced that competing cloud computing companies are implementing and taking advantage of it. The third factor is compatibility. This factor may be the cause of the temporary expansion of only simple implementations. The fourth factor is industry. So, companies perceive pressure to implement cloud computing in their business area. To support the further expansion of cloud computing, it is necessary to continue highlighting the cost benefits of cloud computing. At the same time, it certainly makes sense to bring new applications with a simple billing model and simple integration between the most used applications.

Keywords

Cloud computing; TOE framework; Small and medium enterprises; SaaS; PaaS; IaaS.

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1 Introduction

Tools enabling the provision of computing services via computer networks are referred to as cloud computing. There can be much more to the term cloud computing, so in this publication, we will focus on the part called public cloud computing. A public cloud, unlike a private cloud, enables businesses to acquire hardware and software resources that are concentrated in large data centres, and users of these computer services pay for the consumed computing power, for the use of storage and communication resources, or for transfer in the form of renting a certain application. These services are delivered to the customer via a public network – the Internet (Senarathna et al., 2018).

Simply put, instead of building or expanding their own information technology infrastructure, which would include both hardware and development and maintenance of software applications and databases, companies access computing resources operated by third parties on the Internet. As a result, companies can use complex services and access them using relatively inexpensive desktop computers or using various mobile devices. Examples of well-known multinational providers of these services are Amazon, Google and Microsoft.

Thanks to these principles, the implementation of cloud computing should bring many advantages to organizations, such as saving costs of acquisition and maintenance, increasing flexibility and simplifying access to data sources. The application of new technologies helps organizations increase their competitive advantage. Globalization is happening fast and the development of technology plays a significant role in the development of national economies and businesses. Cloud computing brings many positive benefits in the fields of sustainable construction, banking, healthcare, manufacturing and services (Salleh et al., 2018).

Despite the many advantages, there are negative effects associated with cloud computing. For example, it may be that the highly distributed and non-transparent nature causes some nervousness associated with trusting the service provider and its ability to reliably guarantee that the customer will not lose control of their data. It is mainly about the perceived trust in the service provider (Habib et al., 2012).

On a global scale, cloud computing is perceived positively, which proves the focus on this issue not only in the academic sphere. In the environment of the European Union, the European Commission is also very well aware of the positives, and has prepared a framework for the development and strategic financing of Europe's digital transformation, together with other programmes that aim to expand cloud computing and reduce Europe's dependence on systems and solutions originating from other regions of the world (European Commission, 2022).

The question remains why Czech SMEs, which form the backbone of the economy, do not implement cloud computing more. According to Eurostat 2021 data (Eurostat, 2021), 44% of companies in the Czech Republic with Internet access use cloud services. Even though the Czech Republic, together with Germany and other countries, is above the European average, which represents 42% of all companies with access to the Internet, this is not a high number compared to countries such as Finland and Sweden, where cloud services are used by more than 70% of companies with Internet access. If we look in more detail at the statistics for 2021 (Eurostat, 2022), then small Czech companies most often purchase services related to office applications, up to 36% of all small companies. The next most frequently purchased service is e-mail services, which represent up to 34% of all small companies. In contrast, for example, services such as customer relationship management are purchased by 6%, and computing power for own applications by 4%. In the same areas, medium-sized companies have a slightly larger presence in the use of cloud computing. Office software is purchased in the form of cloud computing by up to 41%, email services by 39%, but only 11% of organizations use customer relationship management, and only 5% of medium-sized Czech companies purchase computing power for their applications.

This paper aims to conduct a survey across Czech SMEs focused on factors that can influence decisions about the implementation of cloud computing-based information technology services. A survey of this type has not yet been carried out among Czech SMEs. Section 1.1 is devoted to the presentation of the issue and secondary data obtained through a literature survey. Based on the existing literature, the factors that often manifest themselves as significant are selected. Based on these factors, a structured questionnaire is designed. Section 2 is dedicated to the description of the data obtained from Czech companies, as well as their evaluation. The results of the statistical analysis are presented in Section 3. Finally, conclusions are presented along with a discussion, limitations of this paper and suggestions for further research.

1.1 Theoretical background on cloud computing adoption

There are several models of providing services through cloud computing (Jinzhou et al., 2016; Neicu et al., 2022). For the purposes of this article, we will deal with **public cloud computing** (Bello et al., 2021). Services provided through the public cloud computing model can be used by any company and bring the general benefits of outsourcing (Jones et al., 2019). Alternatively, organizations can use **virtual private cloud computing**, which provides better control over the environment using public cloud computing (Yang et al., 2018). Alternatively, organizations can combine public and private cloud computing. This creates a **hybrid cloud computing** environment (Celesti et al., 2019).

A specific service purchased through cloud computing can be delivered by different service models (IBM Cloud Education, 2021). **Infrastructure as a service (IaaS)** is a service delivery model that is most like the situation of purchasing own hardware but with much more flexibility in configuring performance parameters (Parast et al., 2022). **Platform as a service (PaaS)** provides services such as web servers, databases, IDEs and others with the ability to create custom applications using programming languages supported by the provider. The main advantage of this solution is creating and running business applications, without the need to manage and maintain hardware or software (Mohammed et al., 2020; Parast et al., 2022). **Software as a service (SaaS)** is one of the most common and currently the most widespread forms of using cloud services among ordinary users and small businesses. In this case, the cloud service provider provides the user with a ready-made application running on the cloud infrastructure (Singh et al., 2016).

If we look at articles by other authors (Oliveira et al., 2019; Phuthong, 2022; Ramchand et al., 2021), they very often agree on the conclusion that cloud computing is an ideal solution for small and medium-sized businesses. The reasons are mainly agility, which allows competition in an innovative business environment. Likewise, low costs, the availability of almost unlimited computing power and storage capacity, and the availability of solutions are often mentioned. The possibility of simply managing the entire solution with a high level of security is also mentioned. These positive features, together with others, should influence the attitude to the implementation of a cloud solution. It must be added that the technology also has some disadvantages, such as perceived data security and reduced control over the entire solution. In some cases, legislative restrictions or obstacles during implementation also result from the characteristics of individual service delivery models.

The extent to which the individual positive and negative properties of these solutions manifest themselves when deciding on the implementation of the solution is the subject of our research described in this paper. At the same time, we investigate using statistical methods whether other factors can influence the adoption of cloud computing in small and medium-sized enterprises in the Czech Republic. We also investigate how other authors approach this issue. An overview of the literature dealing with this topic is presented in the following paragraphs.

Among the theoretical frameworks used in the literature to explain the factors influencing the adoption of cloud computing, we find theoretical frameworks that have been known for a long time and are generally used in the field of information technology. The most commonly reported frameworks include:

- Technology Acceptance Model (TAM)
- Diffusion of Innovation (DOI)
- Institutional Theory (INT)
- Technology-Organization-Environment (TOE) framework

The common feature of these models is that they do not rely only on the technological properties of the given solution, but each of them has empirically demonstrated that the successful adoption of new technology is a combination of technological, social and environmental factors. There are also models that consider only one factor. These models mostly focus on the financial or technological aspect. However, they are insufficient for a broader understanding of the context. Therefore, the mentioned complex models are discussed below.

The TAM model (Ali et al., 2018) was proposed to explain the acceptance of information technology and information systems in the context of employee acceptance of new technology. The original model was introduced more than 30 years ago and has been redesigned since then. The final version of the model was presented by Song & Sohn (2022), according to whom perceived ease of use and perceived usefulness have the strongest influence on this model. Both determinants have a direct influence on the behavioural intention to use the new technology. According to the authors, the TAM model can explain between 40% and 50% of behavioural intention and actual use. The authors themselves state the need to incorporate additional theories to increase the predictive power.

The DOI model was originally proposed by Rodgers in 1983 (Oliveira et al., 2014). In various variants, the theory describes five basic processes associated with the adoption of new technology. These processes are referred to as cognition, persuasion, decision, implementation and confirmation. The processes are embedded in the context of the social environment, time and communication channels. In the original theory, relative advantage, compatibility, complexity, trialability and observability were shown to be key in explaining adoption rates. The modified version used for cloud computing does not take the factors of testability and observability into account because it is the adoption of a technology or an information system, not a process. The main disadvantage of this theory is that it does not take into account the external environment, which can have a non-negligible influence.

Different publications have come to different conclusions when using DOIs. For example, a study conducted by Charlebois et al. (2016) in Germany found that the trust factor plays a key role in adoption.

The INT theory (Ciganek et al., 2014) explains how the firm functions as an institution. The theory offers a view of organizational structure as an important part of shaping corporate decision making. The theory is based on the fact that the company is not managed purely rationally concerning the desired results. Social and cultural factors come into play. Due to this, some decisions are made without rational reasons to justify them. To explain this behaviour, the theory identifies three kinds of external pressures. Individual pressures are coercive, normative and mimetic. Coercive pressure is exerted by external institutions that exercise some power over society. Normative pressure is caused by regulations associated with the company's business area. Mimetic pressure is induced by responses to uncertainty by imitating the decisions of surrounding societies. As stated by Martins et al. (2016), the INT theory is not comprehensive enough by itself, but it allows the TOE framework to be expanded to include an understanding of external influences on the organization.

The TOE framework (Skafi et al., 2020) was designed to explain the innovation process in the context of an organization. The model presents three groups of factors that influence the adoption of new technology. Individual groups of factors are technological, organizational and environmental. Examples of

technological factors are relative advantage, compatibility, complexity and trialability. Organizational factors represent company characteristics such as size, organizational readiness, management support and availability of resources. Environmental factors are driven by government regulations and competition. The TOE framework has been applied in many types of research on the adoption of various technologies (Oliveira et al., 2019), and is also very popular within cloud computing. Thanks to the high number of uses, it has also received considerable empirical support. Among the discussed disadvantages, the authors include the fact that the TOE framework neglects the impact of inter-organizational relationships. The corporate environment is associated with institutionalism, which can bring both opportunities and limitations. Failure to consider these factors could thus lead to inconclusive findings.

Research conducted in Indonesia by Gui et al. (2020) presents the following results. In all, 135 respondents from the SMB sector took part in the research. Among them, 30% of businesses were less than three years old, 53% of businesses had been operating for between three and ten years, and 17% of businesses had been operating for more than ten years. Among enterprises using cloud computing, 92% of implementations were SaaS-based. The model used for evaluation was based on the TOE theory and included factors of relative advantage, complexity, compatibility, privacy concern, vendor lock-in, top management support, organizational readiness, competitive pressure, government support, business partner pressure and regulatory policies. The resulting model found a significant effect only in the factors of relative advantage and top management support. The created model achieved a predictive relevance value of 0.309.

Research conducted in Portugal among businesses of all sizes by Oliveira et al. (2014) brought the following results. The research received responses from 369 respondents. In terms of size, there were 67 large enterprises, 170 medium enterprises, 100 small enterprises and 32 micro-enterprises. The model was based on the TOE theory and the factors considered were security concerns, cost savings, relative advantage, complexity, compatibility, technology readiness, top management support, firm size, competitive pressure and regulatory support. The model created was able to explain 38.1% of cloud computing adoption. The following factors were marked as significant (significance level indicated in brackets) costs savings ($p < 0.01$), relative advantage ($p < 0.05$), complexity ($p < 0.1$), technology readiness ($p < 0.01$), top management support ($p < 0.01$), firm size ($p < 0.01$) and costs savings ($p < 0.05$).

Skafi et al. (2020) conducted research into the implementation of cloud computing among SMEs in a developing economy environment in Lebanon. From the point of view of the obtained data sample, the distribution according to the number of employees was as follows: 32 companies with up to 50 employees, 27 companies with 50 to 200 employees, 61 companies with 201 to 1000 employees, and 19 companies with more than 1000 employees. The research was based on the DOI theory and the TOE framework. Factors considered in the model were the relative advantage, costs, security, privacy, compatibility, complexity, trialability, top management support, innovativeness, prior technological experience, competitive pressure, industry, market scope, supplier computing support, political issues, government initiatives and information technology infrastructure. Information technology infrastructure, government initiatives, security and privacy, complexity, top management support and technology experience were identified as significant factors.

In another study by Oliveira et al. (2019), 259 companies were involved, distributed by size as follows: 20 micro-enterprises, 54 small enterprises, 126 medium enterprises and 59 large enterprises. The model was created according to the DOI and INT theories. The factors considered were coercive pressure, normative pressure, mimetic pressure, technology competence and top management support. The resulting model explained 61.6% of the variation in SaaS adoption. All the mentioned factors were statistically significant.

In research conducted in Saudi Arabia, Alkhater et al. (2014) applied a combination of TOE and DOI and INT theories. Availability, reliability, security, privacy, trust, relative advantage, compatibility, complexity, top management support, organization size, technology readiness, compliance with

regulations, competitive pressure, trading partner pressure and physical location factors were included in the model. Only the trading partner pressure factor was not identified as significant.

Research conducted in China by Yang et al. (2015) among 173 enterprises integrated factors based on the DOI theory into an approach based on the TAM theory. The enterprises involved in this research employed up to 50 employees in 51 cases, between 51 and 250 employees in 70 cases, between 251 and 1000 employees in 22 cases, and more than 1001 employees in 30 cases. The model included the factors of information technology infrastructure, top management support, relative advantage, simplicity, compatibility, experience ability, competitor pressure and partner pressure. The research showed that technological readiness is the most important factor when determining the intention to use SaaS technology. On the contrary, at the moment of the actual adoption decision, technological readiness is the least important, and organizational readiness plays a primary role. Besides, based on a sample of data, the authors concluded that for small and medium-sized companies, the pressure of competitors is more important than the pressure of business partners. The information technology infrastructure factor was found to be insignificant.

Table 1 was created based on the literature review, and it contains significant factors identified by other authors of research papers.

Table 1. *Studied relevant factors. Source: Based on Zhang et al. (2021), van de Weerd et al. (2016), and Oliveira et al. (2019).*

Technological factors		**Organizational factors**		**Environmental factors**	
Compatibility	15	Top management support	13	Competitive pressure	5
Relative advantage	14	Organization size	10	Trading partner pressure	5
Complexity	7	Organizational readiness	5	Government support	5
Data security	7	Innovativeness	1	Industry	4
Trialability	4	Technology-sensing capability	1	Supplier computing support	2
Technology readiness	4	Cloud knowledge	1	Competition intensity	1
Cost savings	4	Resistance to new technologies	1	Market scope	1
Observability	3			Service level agreement	1
Availability	2			Suppliers competences	1
Accessibility	2			Share best practices	1
Uncertainty	1			Advice from friends and families	1
Perceived benefits	1			Advice of business network	1
Reliability	1			Advice from information technology specialists and consultants	1
Ease of use	1			Choice of skilled cloud vendors	1

2 Research methods

2.1 Formulation of hypotheses

Technological factors are often referred to as factors influencing cloud computing adoption decisions. An overview of the factors mentioned in the literature is available in Table 1. We also adopted the first four most frequently mentioned factors as significant in our model. *Compatibility* should be an important factor

in the decision, as companies plan to augment an existing solution rather than completely replace it (Alkhater et al., 2014; Yang et al., 2015). *Relative advantage* is often associated with general properties of cloud computing, such as a reduction of the total costs of ownership (Skafi et al., 2020) and an increase in scalability, durability and interoperability. Along with this, a transformation towards performance-based management is expected, thus increasing efficiency (Gui et al., 2020). *Relative advantage* is also associated with the DOI model. Businesses should adopt new technologies if they perceive significant benefits such as increased productivity and assistance in completing tasks faster (Alkhater et al., 2018). We define the *selected characteristics* factor by the features of cloud computing that we consider to be outstanding, based on the known benefits (Stieninger & Nedbal, 2014). Basic characteristics include on-demand self-service. Thus, applications can be provided automatically and no active interaction is required. Further characteristics include wide network access, making resources available from virtually anywhere with Internet access. Fast elasticity is also one of the basic characteristics, thanks to which the customer's resources are allocated dynamically, according to his needs. *Privacy* represents a company's concern about the possibility of its data being misused. An organization in a cloud computing environment cannot have complete control over stored information (Alkhater et al., 2014; Alkhater et al., 2018).

From the organizational factors, we selected the three most frequently identified as significant for decisions about cloud computing implementation. *Top management support* is very often referred to as the most important factor. Without the support of top management, the implementation project cannot be started, let alone successfully completed (Gui et al., 2020; Yang et al., 2015; van de Weerd et al., 2016). According to empirical studies, it has been proven that *the size of the organization* should have a positive effect on the implementation of information technology innovations. The same behaviour is expected for cloud computing (van de Weerd et al., 2016). Small companies should have been flexible enough to implement innovations (Skafi et al., 2020). *Organization readiness* represents readiness for the implementation of a new environment, in terms of both company resources and long-term strategy (Gui et al., 2020; Yang et al., 2015).

Environmental factors involve the influence of the surroundings. Some of the environmental factors are compatible with the INT theory. *Competitive pressure* refers to the pressure exerted on the organization by competing organizations that can overtake the organization and thus gain a competitive advantage (Alkhater et al., 2014; Yang et al., 2015). *Trading partner pressure* refers to mutual cooperation with customers. If business partners need to share important data, it requires the implementation of tools to enable this sharing (Oliveira et al., 2019; Yang et al., 2015). The factor *Industry* represents pressure with regard to the field of business and thus the use of the latest technologies, i.e., the pressure of companies in the field to implement this technology (Oliveira et al., 2019). We included this factor with regard to the structure of the Czech industry.

This article focuses on the analysis of data obtained from Czech SMEs, independent of other characteristics of these enterprises. The authors focus in particular on answering the following research hypotheses:

H1 – The decision to adopt cloud computing is not influenced by relative advantage.

H2 – The decision to adopt cloud computing is not influenced by selected characteristics.

H3 – The decision to adopt cloud computing is not influenced by privacy.

H4 – The decision to adopt cloud computing is not influenced by compatibility.

H5 – The decision to adopt cloud computing is not influenced by the support of TOP management.

H6 – The decision to adopt cloud computing is not influenced by the size of the organization.

H7 – The decision to adopt cloud computing is not influenced by organizational readiness.

H8 – The decision to adopt cloud computing is not influenced by pressure from competitors.

H9 – The decision to adopt cloud computing is not influenced by pressure from business partners.

H10 – The decision to adopt cloud computing is not influenced by industry pressure.

2.2 Conceptual framework

Based on the analysis of other scientific works and contributions from conferences available in the Web of Science and Scopus databases focusing on the explanation of the factors influencing the decision whether to implement cloud computing, we prepared a theoretical basis and an overview of the factors identified as relevant (see Section 1.1). To find these articles, various keywords were searched for: cloud computing, infrastructure as a service, platform as a service, software as a service, technology acceptance model, diffusion of innovation, technology acceptance model, intention to adopt, TOE, etc.

Based on the factors often referred to as significant, we suggest using the model shown in Figure 1 below. This model is based on the TOE framework. We will use the same division of individual factors. Since some factors have the same or a similar definition as factors from other theories, overlaps occur. When defining the influence of the environment, we were also inspired by the INT theory. Here, we believe that some companies could feel significant pressure to implement cloud computing to compete with the competition.

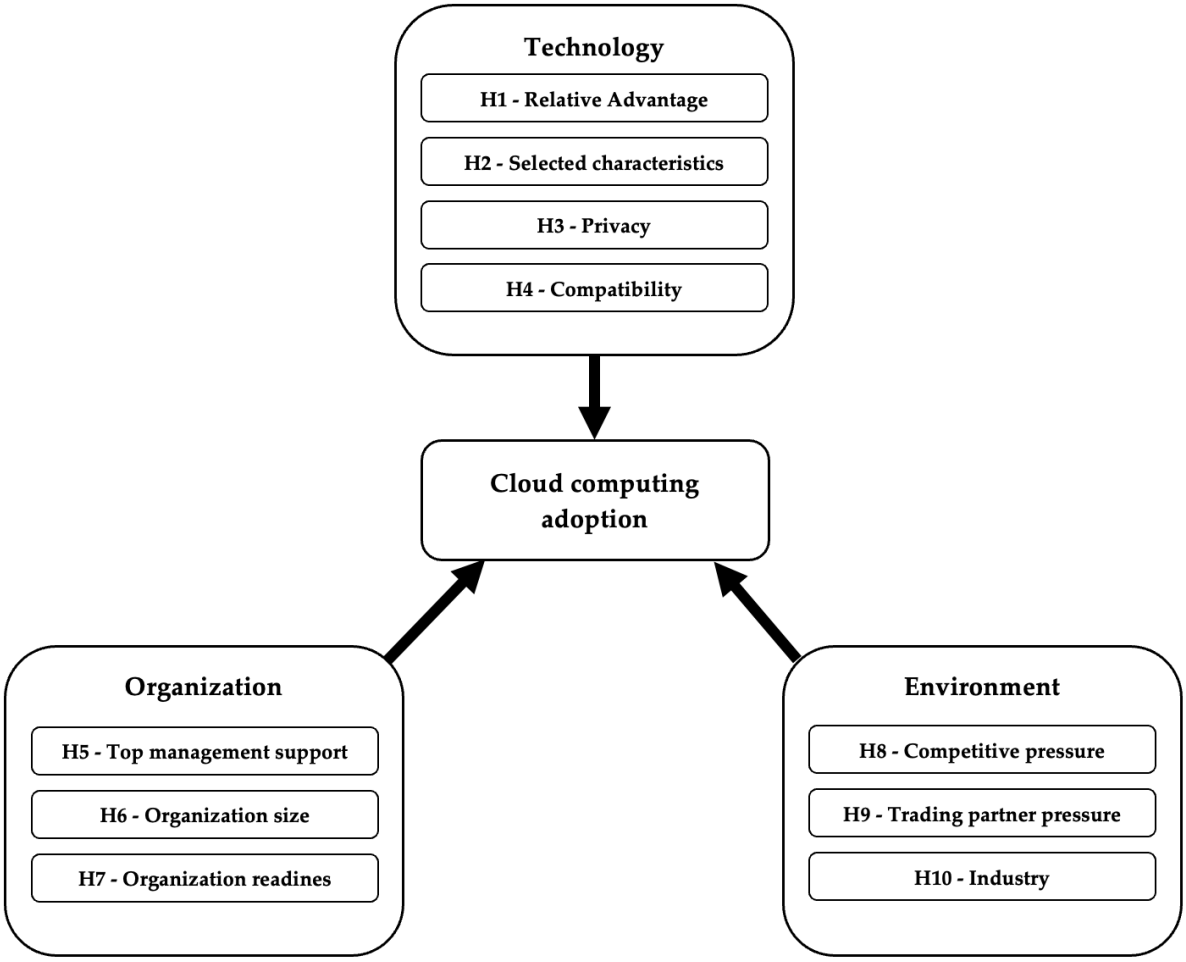

Figure 1. *Suggested modification of TOE framework. Based on chosen factors from Table 1.*

According to our model, a structured questionnaire was then compiled, which was built on the Microsoft Forms platform. A Likert scale from 1 to 5 (Sullivan & Artino Jr, 2013) was chosen for the questions determining the degree of presence of a certain phenomenon. For categorical questions, a list of possible answers was displayed. There was no open question in the questionnaire. For companies implementing

cloud computing, a question was inserted on the category of the product used. A complete overview of all factors, questions supporting individual factors and possible answers is available in Appendix A.

The questionnaire was set up for anonymous access without the collection of identification data. A link to this questionnaire was sent via e-mail to 335 companies in the SME sector. The email was accompanied by a cover letter explaining the focus of the questionnaire on public cloud computing services and a request for completion by a person responsible for information technology decision making. Contacts were obtained from public sources and through Chamber of Commerce databases. The questionnaire was sent to the following spectrum of companies according to Table 2.

Table 2. *Distribution by company size.*

Organization size	Count	Percentage
Up to 10 employees	154	45.97%
11 to 50 employees	73	18.18%
51 to 250 employees	108	36.36%

The questionnaire was distributed in the first two weeks of May 2022. The questionnaire was closed for responses at the end of August 2022. We received a total of 114 responses, which were further analysed in MS Excel and STATISTICA software.

2.3 Exploratory analysis

First, an exploratory analysis was performed to detect missing values. Missing values were detected for sample questions (services used/just implemented, business area). Cases without these answers were discarded. Furthermore, the size of individual companies according to the number of employees was checked in case the values in the database or public sources were out of date. Cases with more than 250 employees were discarded.

An analysis of outliers was performed with the help of a box diagram. Thanks to this, irrelevant cases were found, which were characterized by a high number of responses with the same cutoff value. These cases were removed. We kept the cases that showed an outlier but looked trustworthy in the questionnaire. A total of 15 cases were excluded, while 99 cases were marked as valid.

Subsequently, the normal distribution was verified using a histogram and the Lilliefors test. After checking the normal distribution, further statistical tests were chosen to verify the mutual correlation. The correlation was verified by Pearson's correlation coefficient or, alternatively, by the non-parametric alternative, Spearman's correlation coefficient, and the data were visualized using dot charts. We did this to verify the correctness of the suggested groups of questions in relation to the factors. For some combinations, we did not manage to demonstrate a statistically high level of correlation, but when visualizing the data, we concluded that the selected groups were suitable for continuation. Therefore, we created average values for individual groups based on the responses from the questionnaire.

2.4 Descriptive characteristics

The overall descriptive characteristics for individual continuous input variables are shown in Table 3. Out of the total of 99 valid answers received, 45 were positive in terms of the use of cloud computing and 54 were negative in this sense. In percentage terms, 45% use cloud computing (according to Eurostat data for 2021, it was 44% of companies). Regarding representation by company size, the distribution is shown in Table 4. In this case, the smallest companies predominated in our questionnaire. For comparison, we supplemented the division of enterprises according to the number of employees based on statistics obtained from the Czech Statistical Office. The data obtained are valid as of 30 September 2022. The last column contains the P-values of the one-sample test of proportions. If the P-value is lower than 0.05, the

hypothesis that the observed proportion is equal to the pre-specified proportion value is rejected, and the alternative hypothesis that there is a significant difference between the two proportions can be accepted.

Table 3. *Basic characteristics of factors.*

Name	Minimum	Maximum	Average
Relative advantage	1	4.6	3.73
Selected characteristics	1.2	4.8	3.8
Privacy	1	5	3.85
Compatibility	2	4.5	3.65
Top management support	1	5	4.28
Organizational readiness	1.25	4.5	3.43
Competitive pressure	1.2	5	4.36
Trading partner pressure	1.25	4.75	3.37
Industry	1	5	3.09

Table 4. *Organization size distribution. Source: Authors based on Czech Statistical Office (2022).*

Organization size	Count	Percentage	CSO percentage	P-value
Up to 10 employees	45	45.45%	81.38%	< 0.0001
11 to 50 employees	18	18.18%	14.71%	0.3297
51 to 250 employees	36	36.36%	3.91%	< 0.0001

Table 5. *Business area distribution. Source: Authors based on Czech Statistical Office (2022).*

Areas of business	Count	Percentage	CSO percentage	P-value
Information and communication activities	14	14.14%	2.84%	< 0.0001
Information and communication activities; Administrative and support activities	13	13.13%	2.84%; 2.5%	< 0.0001; < 0.0001
Information and communication activities; Professional, scientific, and technical activities	2	2.02%	2.84%; 13.06%	0.6233; 0.0011
Wholesale and retail; Repair and maintenance of motor vehicles	9	9.09%	19.02%	0.0118
Education	13	13.13%	1.91%	< 0.0001
Health and social care	2	2.02%	1.2%	0.4537
Agriculture, forestry, fishing	2	2.02%	4.82%	0.1934
Manufacturing industry	44	44.44%	11.28%	< 0.0001

From the point of view of business areas, the activities and possible combinations are shown in Table 5. At the same time, Table 5 shows the percentage representation by the predominant activity according to CZ-NACE. However, we were unable to find the given statistics for companies from the SME sector, but only for the overall distribution in the Czech Republic. The data obtained are valid as of 30 September 2022. The last column contains the P-values of the one-sample test of proportions. If the P-value is lower than 0.05, the hypothesis that the observed proportion is equal to the pre-specified proportion value is rejected, and the alternative hypothesis that there is a significant difference between the two proportions can be accepted.

If we look at the percentage representation of individual services that companies use via cloud computing, we will find them displayed in Table 6. Our values differ from those presented by Eurostat in the case of

e-mail services, which are used by all the respondents, and also in customer relationship management services, which are used less by the entities surveyed than the data presented by Eurostat. The data presented by Eurostat are again added to Table 6. In this case, the data are valid for 2021, as this statistic is not yet available for 2022. The last column contains the P-values of the one-sample test of proportions. If the P-value is lower than 0.05, the hypothesis that the observed proportion is equal to the pre-specified proportion value is rejected, and the alternative hypothesis that there is a significant difference between the two proportions can be accepted.

Table 6. *Distribution of cloud services used. Source: Authors based on Eurostat (2021).*

Application	Count	Percentage	Eurostat percentage	P-value
E-mail	45	45%	35%	0.0370
Office software	30	30%	37%	0.1491
Hosting	23	23%		
Storage of files	20	20%	26%	0.1735
Enterprise resource planning	20	20%		
Reporting services	20	20%		
Customer relationship management	3	3%	7%	0.1188
Project solution	3	3%		

The obtained sample matches the data obtained from Eurostat in the cases of applications used and the ratio of companies using cloud computing. In the case of the company size and the distribution of the business area, it was not possible to obtain a sample that would copy the distribution obtained from the Czech Statistical Office. Based on this information, we estimate that the sample is partially representative.

2.5 Model creation

Logit regression was chosen to create the model. Before creating the model, statistical tests were performed to rule out the presence of phenomena that could negatively affect the model. Tests performed:

- It was verified whether the individual factors came from a normal distribution. The verification was done with the help of histogram visualization and the Lilliefors test. None of the discrete factors follow a normal distribution.
- For discrete factors, an intergroup comparison of independent variables with respect to explanatory variables was performed using the Mann-Whitney U test.
- A chi-square test was used for categorical factors, in order to test independence in contingency tables. The relationship between company size and cloud computing adoption is stochastically independent.
- For factors that do not come from a normal distribution, multicollinearity was tested using Spearman's correlation. No intercorrelation was identified for these factors. The highest identified value was 0.22.

Subsequently, the creation of the model started. In order to evaluate all the factors, a model was created with all the factors.

3 Results

The results of the model are shown in Table 7. Four factors emerged as significant. The results are discussed in the following chapter.

Table 7. *Results.*

Factor	Hypothesis	P-value	Result
Relative advantage	H1	0.0198	significant
Selected characteristics	H2	0.6873	insignificant
Privacy	H3	0.1435	insignificant
Compatibility	H4	0.0386	significant
Top management	H5	0.4097	insignificant
Organization size	H6	0.1367	insignificant
Readiness	H7	0.6294	insignificant
Competitors	H8	0.0088	significant
Business partners	H9	0.7130	insignificant
Industry pressure	H10	0.0359	significant

4 Discussion and Future Research

Before evaluating the results, we first evaluate the limitations given by the inputs. If we look at the input data, unfortunately, the answers obtained do not accurately reflect the distribution of Czech companies in terms of size. In this case, in our data sample, there was mainly a greater representation of medium-sized companies to the detriment of micro-enterprises. The second limitation is the division in terms of the business area. Unfortunately, getting the ideal layout is not a trivial matter. From the point of view of the model, a certain limitation is the model reliability. In the statistical evaluation of our model, we achieved an AUC value of 0.76 for the ROC curve. In the verbal assessment, it can be expressed as good discrimination. However, we reach a certain contradiction when evaluating the test hypothesis H_0 = Predicted and observed values do not differ. When evaluating this hypothesis based on the Hosmer-Lemeshow test, the null hypothesis cannot be rejected based on p = 0.3307. Based on Pearson's chi-square assessment, the null hypothesis cannot be rejected either. However, based on the evaluation of deviance, we reject the null hypothesis.

The *relative advantage* factor proved to be significant in our model. This factor was also marked as significant in other papers (Gui et al., 2020; Oliveira et al., 2014). In the case of trying to gain a competitive advantage, this is, in our opinion, a completely rational solution. When analysing specific answers, one can see the effort to obtain mainly financial benefits. Entry into a new industry has a correlated relationship with the others, but from the point of view of the scale, the perceived value is about 20% lower. According to other authors (Gui et al., 2020; Skafi et al., 2020), the main advantages of cloud computing are associated with financial benefits (reduction of costs) and thus an increase in the profitability of the organization as a whole. Some papers associate this factor with an increase in efficiency (Alkhater et al., 2018). We tried to include this in our model and the increase in productivity was correlated with other properties in this factor. We perceive the financial benefits as completely rational. If we look at the context of frequently implemented applications, we cannot think of many scenarios where there could be a real increase in productivity compared to an on-premise solution.

The *competitive pressure* factor proved to be significant. According to other papers, this factor is marked as significant (Gutierrez et al., 2015; Yang et al., 2015). This factor can be connected to both the TOE framework and the INT theory (Alkhater et al., 2014). If we look again at the existing implementations, we explain this situation more by the effort to gain cost-based benefits. Another question is whether it is an irrational perception of the environment explained by the INT theory (Ciganek et al., 2014).

In the case of the *selected characteristics* factor, we expected cloud computing characteristics to enable native support for the home office in the current situation. Further enabling rapid deployment and high availability of services will be among the significant factors for decision making (Stieninger & Nedbal, 2014). A similar factor is not found among the factors often referred to as significant.

The factor labelled *privacy* in our model represents companies' concerns about their data being misused. In some papers, this factor is referred to as significant (Alkhater et al., 2014; Alkhater et al., 2018) and in some cases, it is the main subject of research (Habib et al., 2012). In other papers (Gui et al., 2020) as well as in our study, it does not appear to be significant. Despite this, the average shows a relatively high value.

We understood the *compatibility* factor as something that has a fundamental influence on decision making, as did the authors of other papers (Alkhater et al., 2014; Oliveira et al., 2014). In our case, the factor proved to be valid for decision making. We understand that companies implement such new applications that can be integrated into their current environment. Some papers (Oliveira et al., 2019; Yang et al., 2015) did not show a positive link between this factor and decision making. Other papers (e.g., Gutierrez et al., 2015) suggest that this factor has a strong link, especially for adopters.

The *top management support* factor is also referred to as significant (Oliveira et al., 2019). In some papers, this factor does not appear or even shows a negative link against the adoption of cloud computing (Alkhater et al., 2018). In our case, we do not see a negative link, on the contrary, we would look for the reason for the non-appearance of this factor in the questionnaire. The values of this factor are high for both adopters and non-adopters. The reason may therefore be a misunderstanding with the respondents and the respondents labelling this factor as significant due to the general belief that without the support of top management, changes cannot be effectively implemented.

The theory associated with the factor *organization size* is contradictory according to individual authors. Some authors point to the fact that there is a relationship between intention to adopt and organization size (Gutierrez et al., 2015), while others do not identify this relationship (van de Weerd et al., 2016). Van de Weerd et al. (2016) presented specific thought processes for small companies implementing cloud computing, as well as for large companies. The result is the same, one is the motivation to reduce costs, and the other is the motivation to adopt the system set by the parent company.

According to theory, the *organizational readiness* factor should influence the intention to adopt cloud computing technology. If the organization was not sufficiently prepared due to a deficiency in any area, it should have a negative impact on the intention to adopt (Alkhater et al., 2014). Van de Weerd et al. (2016) quoted specific cases where a deficiency in one area caused the implementation to be postponed and, in another company, the same situation accelerated the implementation. If several similar cases were to occur, this may cause the factor to be marked as non-significant in the data sample.

The factor *trading partner pressure* failed to prove to be significant as in other papers (Alkhater et al., 2014; Gui et al., 2020). The *industry* factor proved to be significant. In this case, the result is implied to some extent by the *competitive pressure* factor. We assume that this pressure arises based on current trends.

In further research, we would like to focus more on the link between a specific type of cloud service and the decision-making process that takes place in the company. From the current results, we can conclude that services that are easy to implement and integrate and clearly priced are interesting for Czech SMEs. We think that due to the simplicity of charging for prevailing services, companies can easily find out the total costs of ownership and then decide about the service. This is supported by our results. For other services, it can be an obstacle for companies to determine the total costs of ownership and then make them stay in the current regime, rather than choosing uncertainty.

The second possible explanation we have for the current situation is the strong position of Microsoft on the European, and therefore the Czech market, and thanks to this, a significant expansion of the services that are associated with typical products of this company. We will verify these assumptions in further research aimed at understanding cloud computing in Czech conditions.

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Data Availability: The data that support the findings of this study are available from the corresponding author.

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