COMPARISON OF CLOUD SERVICE CONSUMPTION IN THE CZECH REPUBLIC, VISEGRÁD GROUP AND EUROPEAN UNION

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Abstract: *Adoption of cloud services has an increasing trend for many years already and no indication that it should change in close future has occurred. Moreover, cloud consumption has been further enhanced due to the COVID-19 situation since a great number of employees started to work from home and therefore, they need to access resources over the internet. This article describes the performed analysis of official data provided by the European Union on the consumption of cloud services in the member countries. The analysis particularly focused on comparing the cloud consumption in the Czech Republic, Visegrád Group and European Union in total. The consumption was compared based on multiple criteria – primarily on cloud service types, organization types, consumption trends. The analysis was conducted over sets of biannual data (2014, 2016, 2018, and 2020) that are available on the Eurostat site for all the European Union countries. The comparison showed that the level of cloud consumption differs across and that the average consumption for the European Union is higher than in the Czech Republic and in Visegrád Group. Besides, the comparison revealed that consumption in the Czech Republic is slightly higher than in Visegrád Group. Such pattern in the comparison between the three subjects was present in the majority of comparisons and therefore it might be stated that the Czech Republic and Visegrád Group are behind the average cloud consumption in European Union. This article is closely related to the Information Management as one of the aims of the E&M Economics and Management journal.*

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JEL Classification: *O31, O32, O33.*

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Introduction

Usage of cloud services instead of traditional on-premise resources is a common approach that organizations widely prefer. The COVID-19 situation, even more, highlighted the importance and advantages of cloud computing. The reason is that 'home-office' has become a normal and widely adopted way of working in many worldwide organizations. The home-office results in the requirements that the data and resources need to be available everywhere over the internet.

The target of this article is to identify how the consumption of cloud services differs in the Czech Republic (referred also as 'Czechia'), Visegrád Group where the Czech Republic is a member and in the European Union in general. Since the adoption of cloud services has an increasing trend, as was described above, the comparison will indicate whether

the consumption of the Czech Republic corresponds to the consumption in the countries from Europe. The literature research of academic materials, such as reviewed papers and proceedings, indicated that the topic of cloud consumption, particularly the comparison of cloud consumption in multiple locations, is generally disregarded. Therefore, this article brings analysis that has not been performed and officially documented by anybody.

1. Theoretical Background

By the definition, cloud technology 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"* (Mell et al., 2011). The fundamental principle of cloud computing is a shared responsibility model as always certain responsibilities lay on the provider's side and some of them on the customer's side (Rao et al., 2021).

Cloud services may have many forms that are mostly named XaaS (X-as-a-Service) where you may replace 'X' with the resource type. Instead of purchasing their own hardware, organizations may use (and pay for them) resources that run at the cloud service provider's side (Sundaramoorthy et al., 2020). Organizations access the resources over the Internet and do not care about the maintenance of the hardware. Another form is providing the whole platform, e.g., database platform, where the burden of updating and securing the underlying platform is on the provider's side (Shakerkhan et al., 2019).

When disregarding cloud services in a form of 'Software-as-a-service' that is represented, e.g., by web applications, among the biggest cloud providers might be considered Microsoft with Azure platform, Amazon with AWS platform and Google with GCP platform. At all of these platforms, organizations (customers) may deploy many types of resources (virtual machines, virtual networks, databases, monitoring services, analytics services, threat protection services, etc), access them over the internet and pay for them (Zbořil, 2021).

This concept that simplifies deployment and management of resources, however, brings many security challenges that are one of the main reasons why many organizations have not adopted cloud technology so far. Examples of such issues are vendor lock-in, data confidentiality, secure data delete, availability of resources, data leakage, insufficient isolation of customer's tenant and API-level attacks (Maniah et al., 2019).

The adoption of cloud services is a global trend and only the popularity of particular cloud providers differ across the continents and countries. Multiple globally-respected organizations provide regular reports over cloud services. In general, the reports are not focused on cloud consumption and adoption though. The frequently analyzed topic is the security of cloud services. The examples of reports that target the security are Oracle and KPMG Cloud Threat Report 2020 (Oracle, 2020), 2019 Cloud Security Report (Crowd Research Partners, 2019), State of Cloud Security 2018 (Cloud Security Alliance, 2018) or The State of Cloud Security 2020 (Sophos, 2020).

The cloud adoption is, however, touched in the two following reports. The first report Cloud Adoption and Risk Report 2019 (McAfee, 2018) analysis the current cloud trends, mostly used services in multiple areas (e.g., enterprise services, data sharing services), cloud security aspects and types of data in the cloud. The percentage of how many organizations have adopted cloud services is not, however, present in the report. The most valuable finding, in relation to this article, is the identification of the percentage distribution of usage of different types of cloud services. The results show that the most used cloud service types are file-sharing and collaboration (20.9%), finance (7.5%), IT services (7.1%), cloud infrastructure (7.1%) and development (6.5%). The analysis was performed globally over McAfee's anonymized data (over 30 million McAfee MVISION Cloud users).

The second report 2021 State of the Cloud Report (Flexera, 2021) gathered answers from 750 respondents across many sections and locations who shared their insights into the adoption process of the implemented cloud infrastructure. The purpose of the survey indicates that the survey was conducted mainly among the organizations that adopted cloud services or are in the process of adoption. Therefore, the survey does not provide a correct and objective analysis of how many organizations overall use cloud services. The exemplary areas of interest are cloud strategy

(multi-cloud, hybrid cloud, etc), amount of workload in the cloud, data in the cloud, migration challenges, cloud teams, containers, etc. The most related area of the survey touched the impact of COVID-19 on cloud usage: *"90 percent said cloud usage is higher than initially planned. Some of the increase is a result of the extra capacity needed for current cloud-based applications to meet increased demand as online usage grows. Other organizations may accelerate migration from data centers to cloud in response to reduced headcount, difficulties in accessing data center facilities and delays in hardware supply chains"* (Flexera, 2021).

Multiple articles and proceedings have been published in the area of cloud adoption. Candel Haug et al. (2015) analyzed cloud adaptiveness within selected industry sectors. The authors investigated that the cloud service adaptiveness significantly differs in particular sectors and that the adaptiveness also depends on the organization's position within the supply chain. Besides, the adaptiveness also correlates to the fact that organization needs to know what exactly they plan and do with the cloud services.

An impact of cloud computing adoption on SME's (small/medium enterprises) performance in relation to cloud-supported operations was discussed by Khayer et al. (2020). Further, the authors analyzed the key predictors for the adoption of cloud services. The research confirmed that the adoption of cloud services has generally a positive impact on the performance of SMEs. Moreover, the authors identified factors that have a significantly positive effect related to the adoption of cloud services. The identified factors are: *"relative advantage, service quality, perceived risks, top management supports, facilitating conditions, cloud providers influence, server location, computer self-efficacy, and resistance to change"* (Khayer et al., 2020).

Marešová and Hálek (2014) investigated the deployment of cloud services in SMEs in the Czech Republic. The research was conducted among 200 enterprises across all sectors. The researchers focused primarily on the perception of the enterprises in the areas such as benefits of cloud computing, risks of cloud computing, adoption barriers, return on investments, etc. The results presented in 2014 stated that only 8.7% of Czech SMEs have adopted or planned to adopt cloud services. This low number was surprising also for the authors of the survey.

Similarly focused research was conducted in the Czech environment also in 2018 and was presented in the two-part article published by Zbořil (2018), and Zbořil and Wojnar (2019). The research was conducted among 102 representatives of Czech organizations. The performed research was dedicated to the analysis of areas such as cloud security risks, benefits, adoption barriers, security threats, controls, and countermeasures, etc. The respondents were asked for current and planned usage on the Likert scale from 1 (only traditional on-premise system) to 10 (only cloud services). The average value for the current usage was 4.1 and for the planned usage was 5.63.

The consumption of cloud resources was partly touched by Ionescu and Andronie (2021) who provided a brief overview of cloud usage in European countries in 2018. Besides, the authors also indicated the average usage of seven types of cloud services in the years 2014, 2016 and 2018 in European Union (average values). The same data was also discussed by Machuga (2020) who focused on the analysis of the factors that determine cloud computing consumption in different types of enterprises. The author operated with data from 2014 to 2018.

2. Research Methodology

The analysis is based on data retrieved from Eurostat that presents official statistics across all members of the European Union (EU). The gathered data relates to many significant areas such as 'general and regional statistics', 'economy and finance', 'population and social conditions', 'transport', 'external trade', etc. One of those areas is also 'science and technology' that involves data related to information technology (European University Institute, 2021).

The 'science and technology' area includes many datasets about innovations, business activities, ICT (information and communication technologies) usage by individuals or by enterprises, and many other areas. The dataset with the code 'isoc_cicce_use' contains data related to the consumption of cloud computing services by enterprises in countries of the European Union.

This dataset has available data from the years 2014, 2015, 2016, 2017, 2018, and 2020. It is important to highlight that the dataset

completely misses data from 2019. Besides, data from 2015 and 2017 is not complete (including the fact that data for 2015 does not involve any data for the Czech Republic). For that reason, the years 2015, 2017, and 2019 will not be involved in the analysis. The result is that the analysis was performed based on biannual data (2014, 2016, 2018, 2020).

The authors compare the data for the Czech Republic, Visegrád Group and European Union (these three items are commonly called as 'subjects' within the analyses). The members of the Visegrád Group are the Slovak Republic, Poland, Hungary and the Czech Republic itself. For the analysis, only the current members of the European Union were leveraged; it means that the United Kingdom was not considered even though in the period of analyzed time (2014–2020) was a member European Union. Therefore, the total number of analyzed countries was 27. One part of the analysis involves splitting European Union into the following regions:

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- West Europe – *Austria, Belgium, Germany, France, Ireland, Luxembourg, the Netherlands;*
- North Europe – *Denmark, Estonia, Finland, Latvia, Lithuania, Sweden;*
- South Europe – *Italy, Malta, Portugal, Spain;*
- South-East Europe – *Bulgaria, Croatia, Cyprus, Greece, Romania, Slovenia;*
- Visegrád Group – *the Czech Republic, the Slovak Republic, Poland, Hungary.*

The contained data represents the percentage of enterprises (with 10 or more employees) in a country that consume computing. The leverage data that is present in this dataset and that is analyzed within this article include:

- Usage of cloud services in enterprises;
- Usage of email as a cloud service (referred to as 'Email');
- Usage of office software as a cloud service (referred to as 'Office SW');
- Usage of hosting for enterprise's database as a cloud service (referred to as 'DB');
- Usage of storage of files as a cloud service (referred to as 'Storage');
- Usage of finance or accounting software as a cloud service (referred to as 'Accounting SW');
- Usage of customer relation management software as a cloud service (referred to as 'CRM');
- Usage of computing power to run the enterprise's own software as a cloud service (referred to as 'Infrastructure');
- Usage of at least one of the above-mentioned services;
- Usage of low cloud services (email, office SW, storage);
- Usage of only medium cloud services (email, office SW, storage, DB);
- Usage of high cloud services (accounting SW, CRM, infrastructure);
- Usage of at least one of the following: DB, accounting SW, CRM.

Eurostat enables downloading the data in the Excel (.xlsx) format and therefore, the analysis was performed in Excel. The main analysis is based on a comparison of the percentage of enterprises in the Czech Republic and averages of the percentages in Visegrád Group and the European Union.

The analysis in Section 3.1 covers two calculated characteristic. The first one is the Average Annual Growth Rate (AAGR) and is calculated as:

$$Average\ Annual\ Growth\ Rate\ (AAGR) = \\ = \sqrt[2020-2014]{\frac{\%\ usage\ in\ 2020}{\%\ usage\ in\ 2014}} \quad (1)$$

The second characteristics is the Average Consumption Difference (ACD) that is defined as:

$$Average\ Consumption\ Difference\ (ACD) = \\ = \frac{\sum_{2014}^{2020}(\%\ usage\ in\ location\ 1 - \%\ usage\ in\ location\ 2)}{Count\ of\ measaurements\ [4]} \quad (2)$$

Prior to the performed comparison, the authors defined the following research question which answers they sought then:

RQ1: Was the consumption of cloud services significantly increased in 2020 due to the COVID-19 situation?

RQ2: How significantly does cloud consumption differ in the Czech Republic and Visegrád Group?

RQ3: Does the Czech Republic exceed the average consumption of cloud computing of European Union countries in some areas?

RQ4: Does consumption differ across particular regions of the European Union?

RQ5: Is the trend in cloud consumption equal in the Czech Republic, Visegrád Group and the EU?

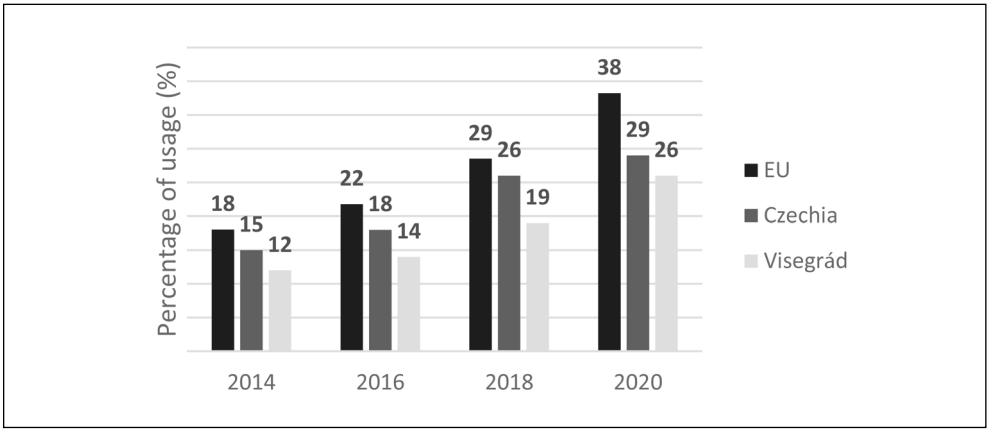
3. Research Results

This chapter provides a description of the results of the performed analysis. The chapter is divided into four sections. Section 3.1 is dedicated to the analysis of the consumption of different cloud service types. Following Section 3.2 enlarges the previous section by the comparison with different regions of the European Union. Subsequent Section 3.3 then focuses on the identification of trends in consumption. Further, Section 3.4 adds new perspectives – type and size of enterprises.

3.1 Cloud Service Types

The most fundamental indicator is the average usage across all types of cloud services in the analyzed subjects. The results are visible in Fig. 1. Czechia had a lower average percentage of enterprises using cloud services than the EU, but higher than in Visegrád in all the analyzed time periods. Besides, Czechia had the lowest AAGR (11%) between the years 2014 and 2020 while EU, as well as Visegrád, had 13%. Nevertheless, the difference is negligible. From the ACD perspective, the average difference between EU and Czechia was 4.6% and between EU and Visegrád 8.9%.

Fig. 1: Usage of cloud services (%)

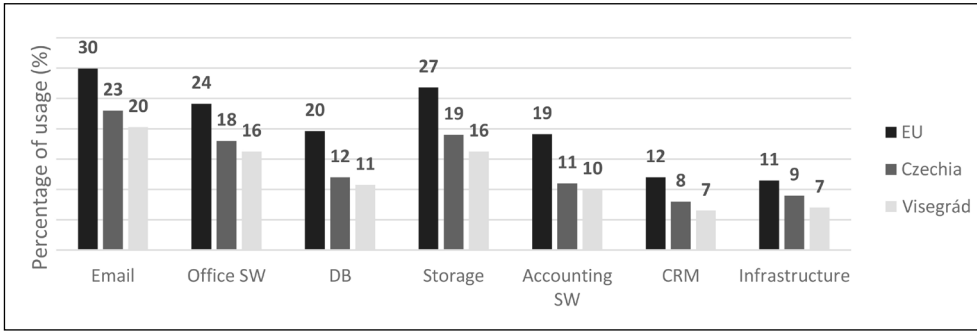


Source: own based on Eurostat

The next step of the analysis involved investigation how the consumption differed within the areas of cloud services that were defined in Chapter 2 (email, office SW, DB, etc). The comparison of their consumption in the year 2020 is shown in Fig. 2. In all the areas of cloud services, Czechia had again a lower average percentage of consumption than the enterprises in the EU, but higher than in Visegrád. The biggest difference in the usage is in the areas of storage (11% between EU and Visegrád) and email (10%). On the contrary, the smallest difference is in the area of infrastructure (4%).

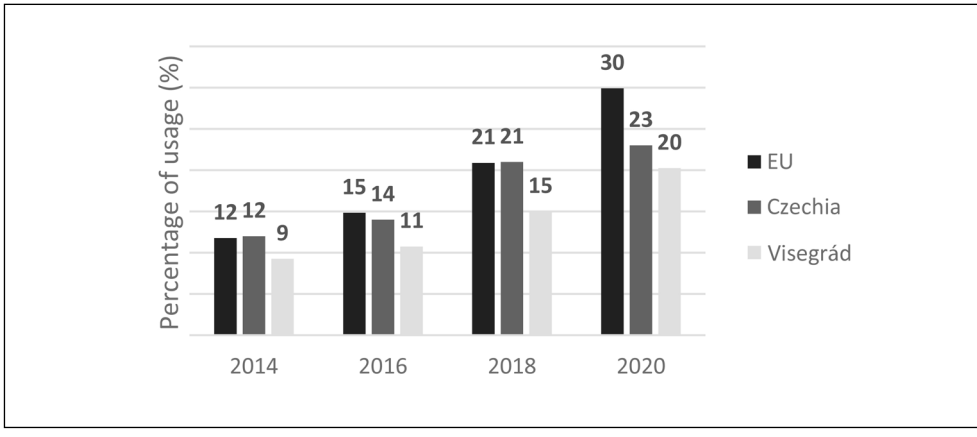
The following paragraphs analyze each type of the above-mentioned types of cloud services. The first type is 'email' and the results are visible in Fig. 3. While in the years 2014, 2016, and 2018 Czechia had approximately the same level of email usage as the EU, in the year 2020, we can notice that the growth slowed in Czechia (10%) while growth accelerated in both the EU (43%) and Visegrád (33%) when comparing the values to 2018. Consistently as at the average consumption of cloud services, Czechia had the lowest AAGR (11.5%) while EU had 16.8% and Visegrád had 13.9%. ACD

Fig. 2: Consumption of different types of cloud services in 2020 (%)



Source: own based on Eurostat

Fig. 3: Usage of email as a cloud service (%)

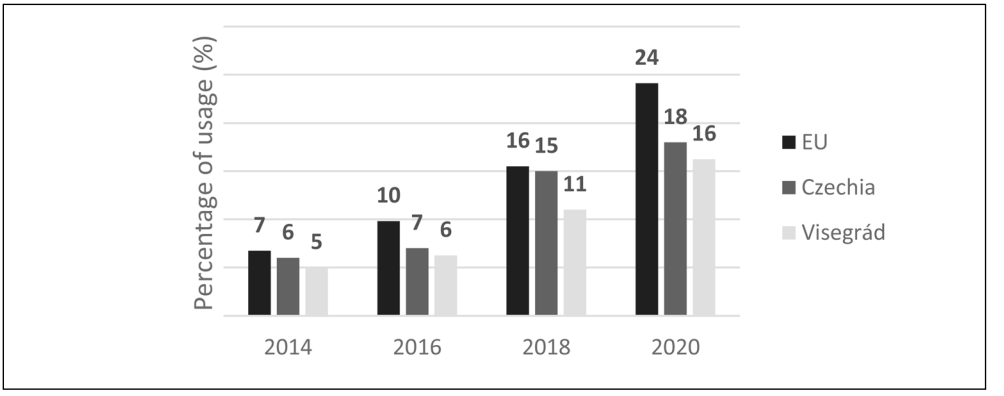


Source: own based on Eurostat

between EU and Czechia is only 1.9% and between EU and Visegrád 5.5%.

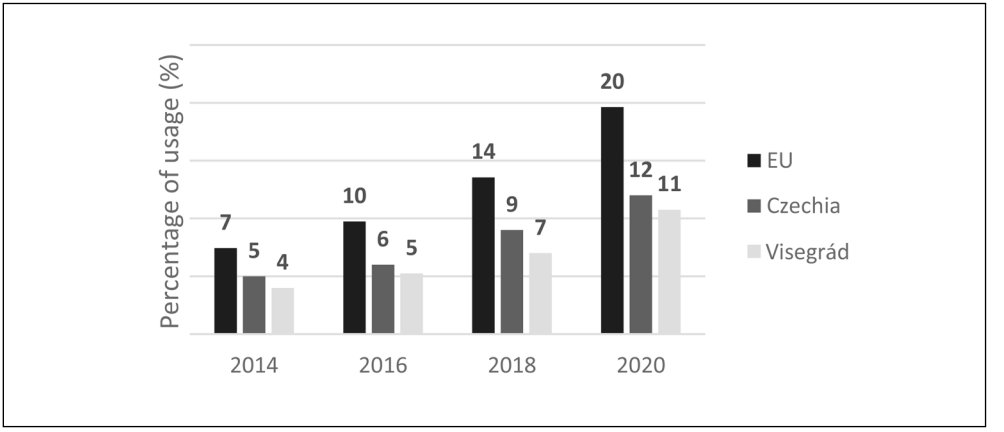
The second type of cloud service is 'Office SW' which results are presented in Fig. 4. The results in this area are very similar to the previous one (email area). In the years 2014, 2016, and 2018 Czechia had approximately the same level of office SW usage as the EU. In the year 2020, the difference between EU and Czechia deepened and was 6 percentage points. When considering ACD, the average difference between the EU and Czechia was 2.5% and between EU and Visegrád 4.4%. Besides, Czechia had the lowest AAGR (20.1%) as the EU had 23.7% and Visegrád had 21.7%. As overall, the EU had the greatest AAGR in the office sector out of all the sectors. This state is also valid for Visegrád (except of the storage sector where the AAGR is equally high). The AAGR for office SW was significantly higher than the average for all types of cloud services.

Fig. 4: Usage of office SW as a cloud service (%)



Source: own based on Eurostat

Fig. 5: Usage of DB as a cloud service (%)

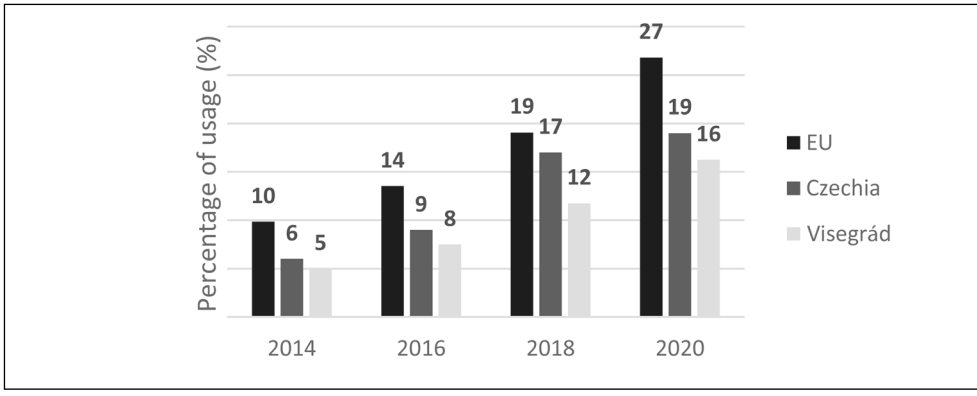


Source: own based on Eurostat

The following type of cloud service is DB and its results are shown in Fig. 5. In this area, we can see the higher difference in usage between EU and both Czechia and Visegrád (the ACD between EU and Czechia was 4.6 percentage points and the ACD between EU and Visegrád was 5.8 percentage points). Czechia had a slightly lower AAGR than the others (Czechia 15.7%, the EU 17.5%, Visegrád 17.9%).

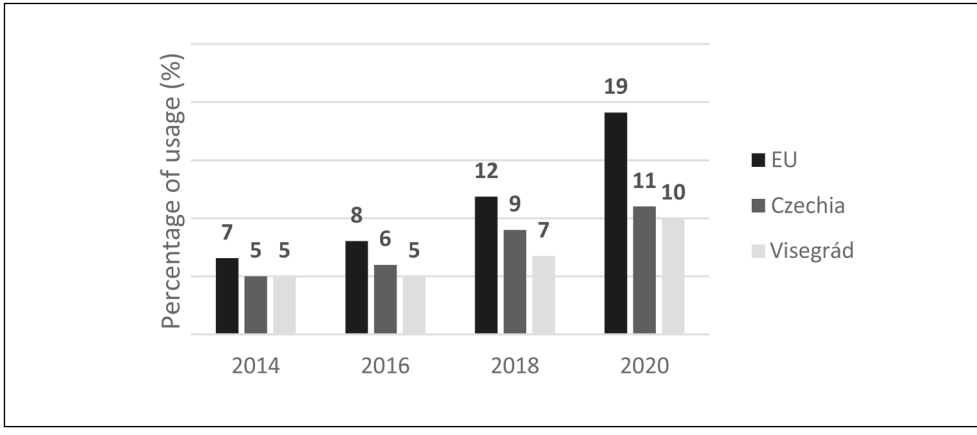
Another type of examined cloud service is storage with the results shown in Fig. 6. The area of cloud storage usage is aligned with the common patterns presented in the previous charts. The only exclusion is that in this area, the AAGR was slightly higher in Czechia and mainly in Visegrád than in the EU (the EU 18.2%, Czechia 21.2% and Visegrád 21.7%). This sector is the one where Czechia had the greates AAGR when considering Czech AAGR for all the analyzed sectors. Furthermore, the ACD between EU and Czechia was 4.6% and between EU and Visegrád 7.2%.

Fig. 6: Usage of storage as a cloud service (%)



Source: own based on Eurostat

Fig. 7: Usage of accounting SW as a cloud service (%)



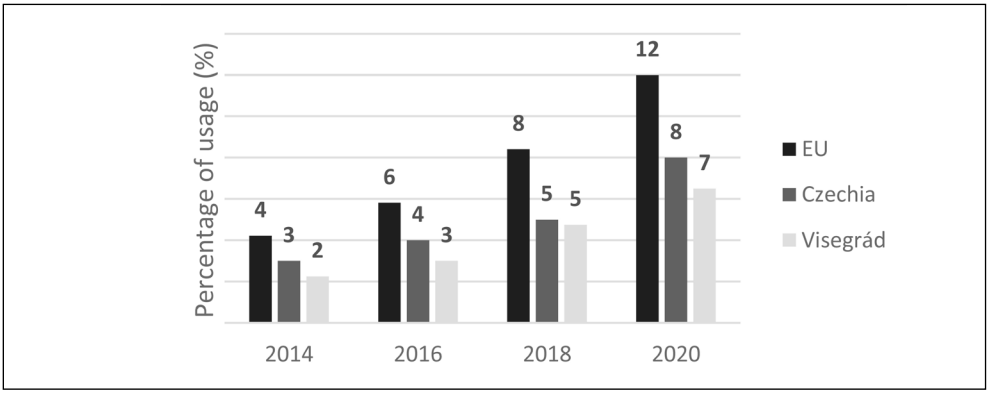
Source: own based on Eurostat

The analysis further involved accounting SW as a cloud service. The relevant results are gathered in Fig. 7. The area of accounting software is similar to the results of DB usage. The difference between EU and Czechia is greater than in other areas (the ACD between EU and Czechia is 3.6%). For completing, the ACD between EU and Visegrád is 4.7%. The AAGR in EU (19.5%) is again significantly higher than in Czechia (14.0%) and Visegrád (12.2%).

The following cloud service type is CRM. The identified results are presented in Fig. 8. When considering ACD in this area, the difference between EU and Czechia is 2.6% and between EU and Visegrád 3.5%. Further, the results showed that the AAGR is the highest in Visegrád (19.3%) followed by EU (19.0%) and Czechia (17.8%).

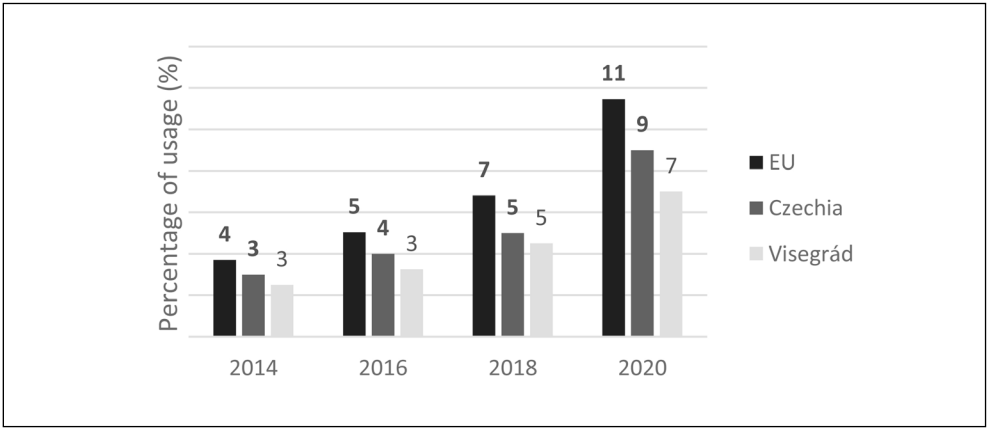
The last analyzed type of cloud service is infrastructure (computing power to run the enterprise's own software) and its results are

Fig. 8: Usage of CRM as a cloud service (%)



Source: own based on Eurostat

Fig. 9: Usage of infrastructure as a cloud service (%)



Source: own based on Eurostat

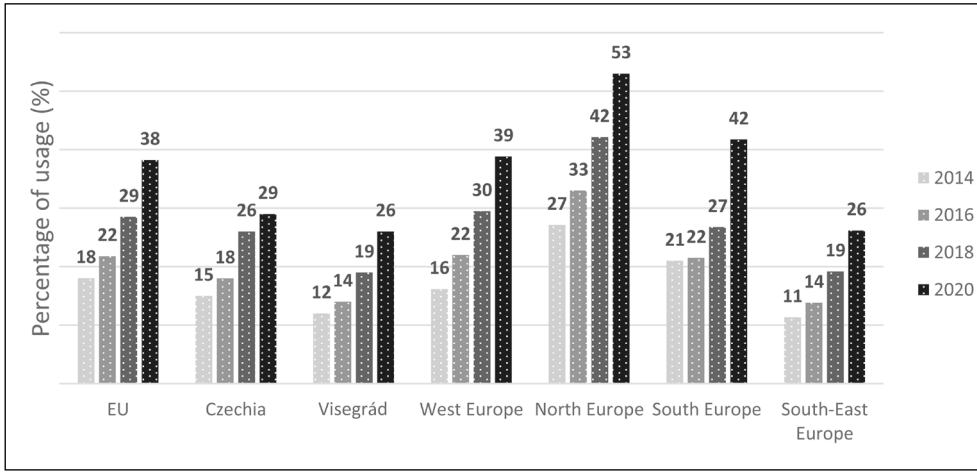
shown in Fig. 9. The AAGR in the EU (20.7%) was higher than in Czechia (20.1%) and Visegrád (18.7%). The infrastructure sector is linked with the lowest ACD of all sectors. The ACD for EU and Czechia was only 1.5% and for EU and Visegrád only 2.4%.

3.2 Cloud Service Usage across European Union Regions

This section brings an analysis of the usage of cloud services across different regions of European Union. The considered regions are Visegrád Group, West Europe, North Europe, South Europe and South-East Europe. The definition of what countries belong to what region is present in Chapter 2. The results are shown in Fig. 10 where the applicable data for the EU (average) and Czechia is also present for better comparison.

The results show that the cloud consumption in Czechia, as well as the entire Visegrád Group, is far behind the consumption in West, North

Fig. 10: Usage of cloud services in European Union regions (%)



Source: own based on Eurostat

Tab. 1: Descriptive statistics related to cloud consumption in 2020 in European regions

Region	Mean	Variance	Min.	Max.	St. dev.	Skew.	Kurtosis	1st Quar.	Median	3rd Quar.
EU	38.2	292.1	11	75	17.4	0.6	−0.6	26.0	33.0	53.0
Visegrád	26.0	3.5	24	29	2.2	1.2	1.5	24.8	25.5	26.8
West E.	38.8	112.1	27	53	11.6	0.6	−2.0	30.0	35.5	49.3
North E.	53.0	355.7	21	75	20.4	−0.7	−1.0	41.0	56.0	68.5
South E.	41.8	208.7	26	59	16.7	0.1	−5.2	28.3	41.0	54.5
South-East E.	26.2	137.5	11	39	12.8	−0.1	−2.9	16.3	26.0	38.0

Source: own based on Eurostat

and South Europe. When comparing the current consumption in Czechia with the previous years of the above-mentioned regions, the data shows that the consumption in Czechia in 2020 is similar to the consumption in West and South Europe in 2018 and approximately equals the consumption in North Europe in 2015.

Czechia has, however, higher usage than the average in South-East Europe. The chart also indicates that the consumption in the Visegrád group completely equals the consumption in this South-East Europe region in the years 2016, 2018, and 2020.

The important characteristics of descriptive statistics that facilitate the data interpretation are presented in Tab. 1. The extreme values (minimums, maximums) are highlighted with light-grey and dark-grey filling. The analyzed data is related to cloud consumption in 2020. The data in the table above shows that the cloud consumption in members of Visegrád Group is very much consistent in comparison to other countries (as is declared by the variance/standard deviation).

3.3 Trends in Cloud Service Consumption

The authors further focused on analyzing the trend in the consumption of cloud services. The trends were already touched in Section 3.1, however, this section dives deeper into the analysis of the trends. The biannual percentage increase is calculated as:

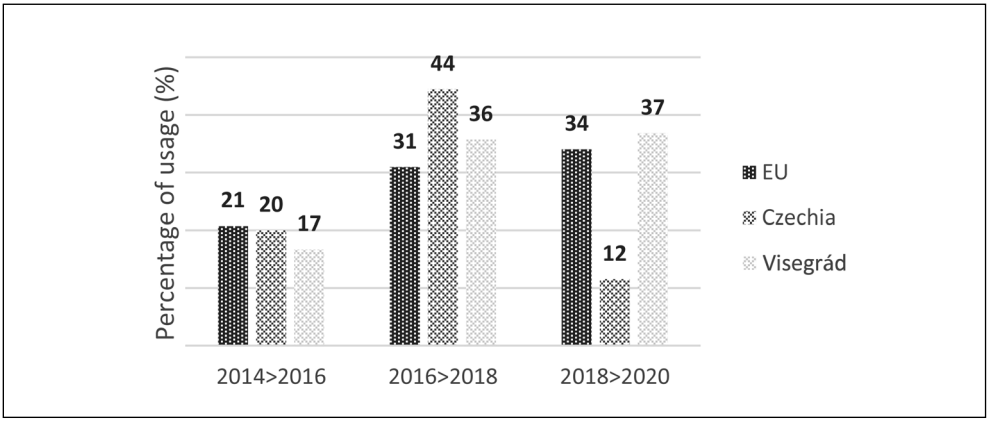
$$Percentage\ increase\ (\%) = \\ = \frac{\%\ usage\ in\ a\ new\ year}{\%\ usage\ in\ a\ previous\ year} - 100\ \% \quad (3)$$

To properly distribute the two types of values presented in this article, the charts that show the percentage increases are differently colored than charts that show absolute numbers for each year.

The initial chart located in Fig. 11 presents the percentage increase in the cloud service consumption between every two subsequent years of the analyzed ones. The data indicates that the consumption trends continually raised in the EU and Visegrád. In Czechia, the highest increase was between 2016 and 2018 though. Between the following 2018 and 2020, the increase was significantly lower. The data indicates that COVID-19 did not significantly influence cloud computing consumption in the analyzed countries since the increase corresponds mostly to the existing trends from the years when COVID-19 did not exist.

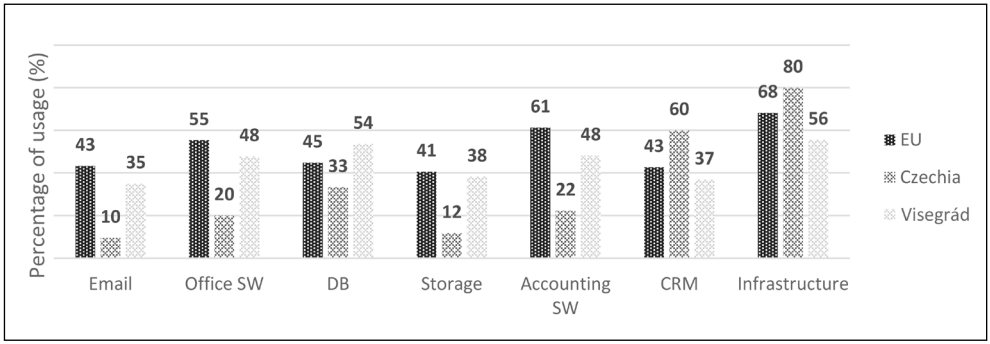
The analysis further examined how the increase differed for particular types of cloud services between the years 2018 and 2020. The results shown in Fig. 12 describe that the highest increase was in the infrastructure components in all Czechia, Visegrád and the EU. Then, the following cloud services types across all three regions have no common pattern. In Czechia, the next and second significant cloud service

Fig. 11: Percentage increase in cloud consumption between the defined years



Source: own based on Eurostat

Fig. 12: **Percentage increase in cloud consumption between 2018 and 2020 in the defined areas**



Source: own based on Eurostat

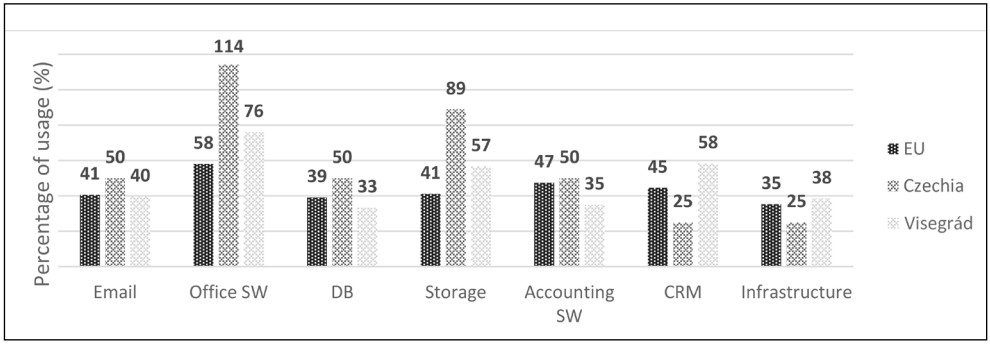
type is CRM. In Visegrád, the infrastructure is followed by DB, office SW and accounting SW. In the EU, the second and third significant cloud service types are accounting SW and office SW.

The chart above might be compared with the following chart that focuses on the same topic, however, for the different time periods – the years 2016 and 2018. When comparing both charts, multiple cloud service types highly differ. A common type for all three regions with the greatest increase is the infrastructure. The comparison for Czechia is influenced by the fact that the increase between 2016 and 2018 was much higher than between 2018 and 2020 as is shown in Fig. 11. The most significant differences except for the infrastructure are in office SW and storage. The results might be also interpreted that Czechia has the adoption peek for infrastructure between 2018 and 2020 and for office SW and storage between 2016 and 2020. For the EU and Visegrád, the comparison shows that the increase in the two analyzed periods was stable (the only exception is the infrastructure for both regions and office SW for Visegrád).

3.4 Enterprise Types

Eurostat offers detailed statistics over the cloud service consumption for different sizes of enterprises and different sectors where the enterprises operate. This section describes the results of the analysis that was performed from the two above-mentioned perspectives.

Fig. 13: **Percentage increase in cloud consumption between 2016 and 2018 in the defined areas**

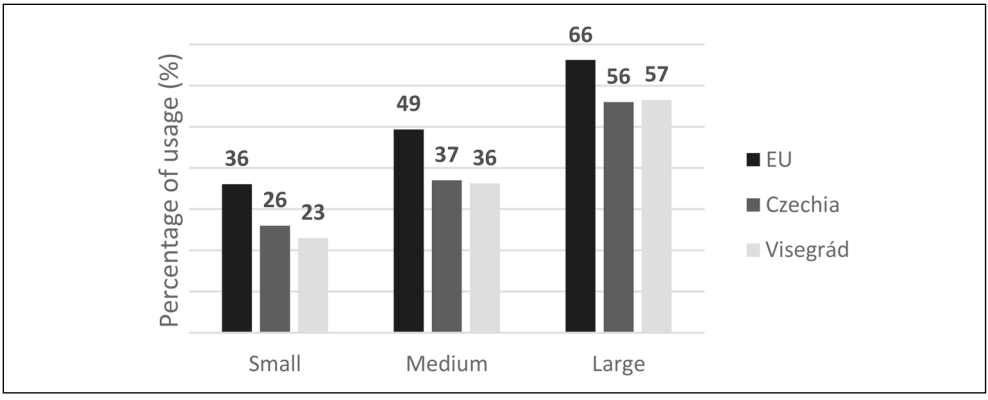


Source: own based on Eurostat

The perspective of enterprise size considers the distribution of enterprises among small (10–49 employees), medium (50–249 employees) and large (250+ employees). The detailed data is shown in Fig. 14 where is visible that amount of consumed cloud computing in all EU, Czechia and Visegrád Group strictly correspond to the size of enterprises. The analysis showed that large enterprises consume significantly more cloud computing than medium and small enterprises.

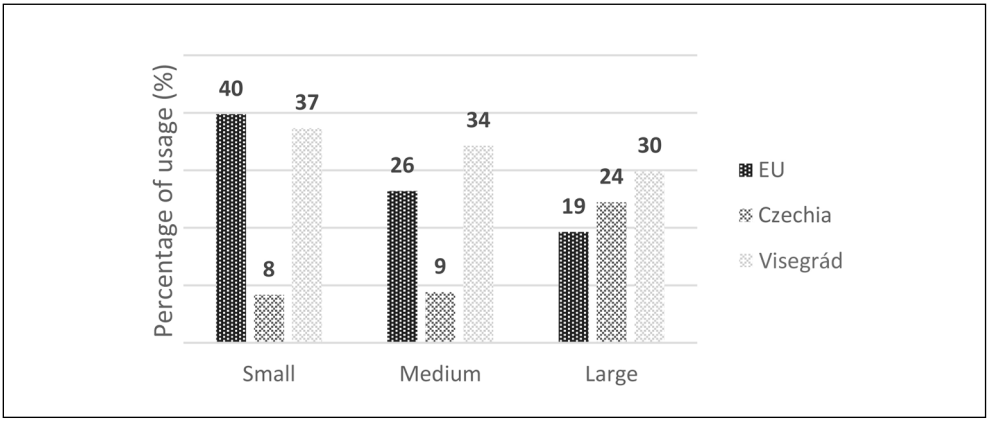
Fig. 15 shows the percentage increase in cloud consumption between the years 2018 and 2020 for the defined sizes of enterprises. The data indicates that the most significant increase in Czechia was recorded in large enterprises and the lowest in small enterprises; nevertheless, the difference between small and medium enterprises is negligible. The situation for the EU and Visegrád is, however, completely reversed. The most significant increase is detected in small enterprises and the lowest increase in large ones.

Fig. 14: Consumption of cloud services in 2020 based on the size of enterprises



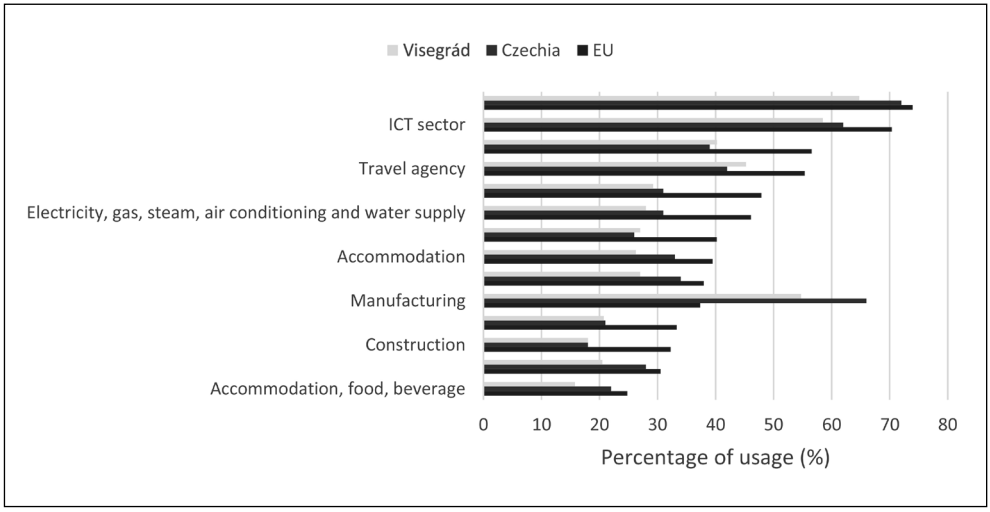
Source: own based on Eurostat

Fig. 15: Percentage increase in cloud consumption between 2018 and 2020 for small, medium and large enterprises



Source: own based on Eurostat

Fig. 16: Consumption of cloud services in 2020 based on the sector of enterprises



Source: own based on Eurostat

The last chart shown in Fig. 16 presents the distribution of cloud service consumption among particular sectors of enterprises. Cloud services are naturally consumed the most in services associated with information technology (computer programming, information service, ICT). The only exception is that in Czechia, cloud computing is consumed more in manufacturing (two out of three enterprises) than in the ICT sector. The manufacturing sector is associated with the most significant differences between Czechia (66%), Visegrád (55%) and EU (37%) of all analyzed sectors. Manufacturing is also the only sector where the EU is not leading in comparison to Czechia and Visegrád.

Conclusions

The performed analysis showed that all the Czechia, Visegrád Group and the EU continually consume more and more cloud resources. The data from 2014 till 2020 recorded no decrease in cloud consumption. The only decreases were identified in the growth rates.

One significant topic and also the first research question touched the COVID-19. The authors of this article assumed that COVID-19 would play a remarkable role in consumption and thus the increase of cloud computing consumption would be greatest between the years 2018 and 2020. However, the results showed no affection for COVID-19 since the growth between the years 2018 and 2020 corresponded to the growth from the previous years. This finding might have multiple explanations. The authors see as the most significant explanation the fact that COVID-19 affected European organizations in spring 2020 and that onboarding of new services into organizations is not an easy task. The onboarding (adoption) requires proper risk analysis, selection of cloud vendor, adoption process, testing, etc. Therefore, the consumption rate might be significantly increased in the following year, in 2021. Nevertheless, the finding does not mean that the cloud was not consumed more due to COVID-19 since the analyses focused only on the percentage of enterprises. The cloud services might have been, however, significantly more consumed at the enterprises where the cloud services were already deployed.

During the analysis, the authors discovered that the common pattern is that the consumption of cloud services in Czechia is lower than in the European Union but is higher than Visegrád Group. This pattern was projected in the majority of cloud service types. This implies that Czechia and other countries from Visegrád

Group (as well as countries from the south-east of Europe) are behind with cloud consumption and still rather operate in the traditional on-premise environment in comparison to other parts of Europe. The authors consider as positive that at least the cloud consumption growth rate is not significantly higher in the EU than in Czechia. The analysis showed that the growth rates do not have any common pattern and the average across the EU, Czechia and Visegrád Group and across all the analyzed years might be considered as approximately equal.

When considering cloud consumption in Czechia, the data indicated that the consumption was highly accelerated between the years 2016 and 2018. The acceleration occurred especially in the office SW and storage areas. Then, however, the slowdown in the growth of cloud consumption occurred. Despite the slowing, the growth of cloud consumption in areas of infrastructure and CRM was higher in Czechia than in the EU and Visegrád Group between the years 2018 and 2020.

This research might be enlarged by analysis of different types of enterprises in combination with different sizes of enterprises. Besides, also a deeper investigation might be performed over other mentioned regions of the European Union. Nevertheless, the analysis should continue as soon as new data is available to identify whether COVID-19 influenced cloud computing consumption in 2021 and 2022.

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