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DISTANCE EDUCATION WITH THE USE OF CLOUD COMPUTING

Summary: Cloud computing creates a new opportunities for the development of virtual education. The goal of the paper is to analyze organizational, economic and legal aspects of cloud computing in the context of needs of virtual education. In addition, the article presents the identification and characteristic of these areas of virtual education, where the best way is to apply cloud computing technology, for instance teaching and distance learning, publishing, collaboration and social interaction (e.g. creation of documentation, presentation or communication). The paper presented examples of applications available in the cloud computing.

Keywords: cloud computing, education, distance education, e-learning.

Introduction

SaaS (Software as a Service) is currently the most popular model of cloud computing (CC). Comarch, a computer company based in Krakow, says that more than 131000 businesses have already been benefitting from its clouds [Comarch]. IDC report clearly show that CC popularity in Poland is growing steadily. However, in terms of CC we still rank almost on the last place in the EU [IT Polska News]. The latest reports on CC in Poland are published, among others, by such institutions as IDC or PMR. Information about CC can also be found on the Eurostat websites. On the basis of Eurostat for 2014 (Tab. 1) we find out that only 6% of all enterprises in Poland use CC, and for comparison, in Sweden it is 39%, in Norway 29% and in Germany 11%. In Poland factors with the greatest impact on the market development of CC include savings, mobility and security [PMR].

Table 1. Uses of cloud computing services in EU28 enterprises, 2014

| | Use of cloud computing | E-mail | Storage of file | Hosting the database(s) | Office software | Financial or accounting software applications | CRM software applications | Computing power for own software |
|--------|------------------------|------------------------------------|-----------------|-------------------------|-----------------|---|---------------------------|----------------------------------|
| | (% of all enterprises) | (% of enterprises using the cloud) | | | | | | |
| EU28 | 19 | 66 | 53 | 39 | 34 | 31 | 21 | 17 |
| Poland | 6 | 69 | 54 | 41 | 31 | 27 | 22 | 19 |

Source: [Eurostat].

Thanks to the cloud, we can use e-mail and social networking sites, we can store and share data and run a company using software available in the cloud and analyze data with the help of BI tools available in the cloud. CC is changing the existing model of IT management. It provides IT technology as a service over the Internet. In Poland, the benefits of CC are mostly recognized by small and medium-sized enterprises, large companies, government, corporations and government and micro-enterprises [PMR]. However, the cloud creates new opportunities for the development of education as well. Students are increasingly mobile and the cloud solves the following problems: access to data from anywhere on earth, storage and sharing of information, synchronization of data between different devices and remote collaboration. The use of CC solutions shows that education can be offered as a service in the full sense of the word [Octawave_a, Octawave_b]. With the CC we can develop the following areas of virtual education:

- 1) e-learning platforms (VLE, Virtual Learning Environment),
- 2) applications used in education,
- 3) interactive teaching aids including multimedia applications, mobile and Internet applications [Gonzalez-Martinez et al., 2015],
- 4) information exchange platforms and information and knowledge management,
- 5) university management systems (recruitment, class schedules, delegations, absences, current preview for settlement projects) and data analysis,
- 6) academic publications management systems.

The goal of this paper is to determine to which organizational, economic and legal conditions attention should be paid for CC to be more secure and more popular (especially given the growing amount of data that must be processed and due to the popularity of mobile devices). Taking the conclusions of this part of the research as a reference point, further attention will be focused on finding an-

swers to the question how these conditions affect the development of IT solutions in the cloud for the purposes of virtual education. The article also presents a case study to recognize the phenomenon studied under realistic conditions. The study was conducted by analyzing literature, diagnosing of the scale of the phenomenon and e-learning needs in this area and using the case study. The final stage of the examination procedure is to formulate conclusions.

Characteristics of the study area – organizational, economic and legal conditions of cloud computing

Cloud computing, like the supply of electricity to our homes, is provided in the service model. The user is only interested in whether the service will be provided and what benefits he or she can obtain. The research conducted by IDC in 2011 shows that the Polish market expectations in relation to the CC are associated mainly with the flexibility, speed of implementations, lower costs and transferring responsibility onto the CC supplier [IDC]. The benefits that companies notice after the introduction of CC include [McAfee, 2012 pp. 118-125]:

- increased labor productivity through easier access to documents and document exchange between people;
- facilitating of cooperation;
- easier data analysis in the cloud which allows to monitor the company's operations;
- developing and application hosting implemented on the cloud platform.

The cloud is also useful [Marciniak, 2013 p. 27]:

- for manual load peaks of IT resources;
- for rapid implementation of new applications, when organizing ad hoc marketing campaigns;
- to backup data.

Companies have noticed that there is no longer the need to own the technology (as it is in the traditional IT model) in order to compete effectively with each other. CC facilitates the implementation of systems (allows access to solutions that were previously reserved for large companies), eliminates the problems associated with their administration, allows access to resources from any location, on any device (hence the growing popularity of responsive web sites) and at any time (immediately ready for operation). It also allows for increased load capacity and speed (access to powerful data processing platforms) and scale solutions (scalability means the ability to increase or decrease the range used by the company IT resources). CC allows precise definition of the scope of access

to data (we no longer have to pay for something, which we do not need at a given moment). With an increase in the users' needs and requirements, it is possible to expand the functional scope and the information system.

Specialists from IDC company emphasize the importance of the three words in CC [IDC]: scale, speed and scope (see Fig. 1).

| CLOUD COMPUTING | | | | |
|--|--|--|---|-----------------------------------|
| ORGANIZATIONAL DETERMINANTS | | | ECONOMIC DETERMINANTS | LEGAL DETERMINANTS |
| SCALE (the scale of the phenomenon) Access to the resources anywhere and anytime | SPEED Run or implementation of informatics systems is easy and quick, administration of informatics systems is easy | SCOPE The scope of data access is precisely defined | Investment cost Time consumption of resource such as electricity Performance Reliability | Security and confidential of data |

Fig. 1. Organizational, economic and legal conditions of cloud computing

Source: Own research.

We cannot forget that the whole responsibility here lies with the provider of the solution. In addition to such organizational determinants as the implementation and administration of systems, data access, application responsiveness, reliability, performance, scalability or the speed of the Internet connection you still need to emphasize the importance of economic determinants such as the investment cost, time saving and electricity consumption. The user does not buy, they just lease access to the following resources: disc space (IaaS), platforms (PaaS) and applications (SaaS). With software available in the cloud computing model we not only save our money, but also time and even electricity (the use of CC decreases the number of computers that are being used).

Protection of personal data is a very important issue that ensures the privacy of citizens, which is why in many countries it is forbidden to store personal data on servers outside the country. Regarding the CC legal determinants, the current regulations state that service providers are obliged to obey a given country's legal provisions. The data stored in Poland is Polish legislation and Polish personal data protection. In addition to the cost of the service, the biggest concerns associated with CC include safe storage and access to data in the cloud and privacy (i.e. whether the information has been disclosed to third parties or used it in the wrong way). It is therefore recommended to use the services of reliable

suppliers who provide computing power and storage space in a secure Data Center facilities with the guarantee enshrined in the SLA at least at the level of 99.95%. A key issue related to security is also whether data transmission is encrypted. Security also means issues such as whether the CC provider owns the UPS systems, power generators, physical and logical firewalls, intrusion prevention IPS systems, VPN tunnels, or independent suppliers of Internet connections. These features ensure business continuity.

The weakest link when it comes to safety may be a human being, e.g. a system administrator. However, it might also be insufficient firewall or antivirus protection. An additional protection is a solution used by the 3S company based in Silesia. The company does not offer the possibility of purchasing access to CC in the form of online prepayment or through anonymous electronic payment channels. The profession of the future related to the development of CC in the context of security will not only be a CC Engineer (a person with the ability to increase the process efficiency, improve usability and reduce the costs associated with cloud computing and web services that use this functionality), a WebSite Acceleration Engineer (a person responsible for the constantly increasing transfer of data on web pages), a Waste Data Handler (a security specialist dealing also with the disposal/deleting of personal data on the Internet) [Tomkiewicz, 2011 p.12], but above all a Cyber Security Specialist (a digital security specialist).

Table 2 presents the factors that may interfere with the development of CC and the factors in favor of its development. Data was collected on the basis of literature sources [Exea; Gałężowski, 2013 pp. 14-15; www1].

Table 2. Advantages and disadvantages of cloud computing

| Disadvantages | Advantages |
|---------------------------------|-----------------------------------|
| Security (Physical and private) | Availability |
| Costs (subscription fees) | Ecology (saves electricity) |
| Legal restrictions | Ease of administration |
| Speed of Internet connection | Ease of implementation |
| --- | Measurability |
| --- | Reliability |
| --- | Frugality |
| --- | Optimization |
| --- | Privacy |
| --- | Scalability and flexibility |
| --- | Productivity |
| --- | Supervision and helpdesk 24/7/365 |

Source: On the basis [Exea; Gałężowski, 2013, pp. 14-15; www1].

To be able to benefit from CC, an internet connection should have specific parameters. Most providers have 512 kbit/s as a minimum connection speed. Among the pros and cons listed in table 2, there are a few more which must be discussed. *Availability* – means independence from space and equipment, which increases the mobility of people and make remote work possible. *Measurability* – means that the service can be precisely measured. This feature increases the predictability of costs incurred by the company and allows to optimize them in relation to the current needs of the user. *Reliability* – in other words – the absence of failure. In an emergency of a device operating in the cloud, its functions should be performed by other devices. CC platforms are designed with special regard to data security and reliability. CC service is available in the subscription model so that IT resources are no longer a capital expense but an operational one. There are no purchase costs of one's own IT infrastructure, and the payment is made only for the actual use of resources and takes place e.g. on a monthly basis (a pre-paid and post-paid options are possible). *Optimization* – means a reduction in operating costs. *Scalability and flexibility* allow you to change the parameters during the on-demand services. The service is available for any period. *Performance* – means that the load growth will not cloud her downtime, which will affect the effectiveness of the clouds. It is easier for the company if they adopt the CC model as the basis for the business development strategy from the very beginning. Amazon is still considered as the greatest expert in this field. Transfer of the IT resources already owned by the company to the cloud is much more difficult. Many companies still have concerns prior to the introduction of CC. This may be due to the lack of knowledge about CC, due to the lack of knowledge of the cloud computing market vendors (Tab. 3) and the legal requirements associated with CC. K. Kapera's survey asked the question why the company does not use the applications in the cloud model [Kapera, 2014]. As the basic reasons the respondents listed the lack of such needs, the lack of sufficient knowledge, concerns about data security, financial constraints and the lack of trust in suppliers. The answers to the question of what determines the choice of a CC supplier the included the following: mostly the price of the service, security, reliability of service and the level of customer service.

Table 3. Characteristics of the largest providers of CC in Poland

| No. | The company | Website | Realization |
|-----|---------------------|-------------------------|--------------------------------------|
| 1. | Adobe in Warsaw | www.adobe.co/pl | Adobe Creative Cloud |
| 2. | Atende in Warsaw | www.cloudia.pl | CloudiaA |
| 3. | Comarch in Krakow | www.comarch-cloud.pl/ | Comach Cloud |
| 4. | Exea in Toruń | www.exea.pl | Exea Cloud Services |
| 5. | HP in Warsaw | www8.hp.com/pl/pl | CloudSystem Enterprise Starter Suite |
| 6. | IBM in Warsaw | www-05.ibm.com/pl | IBM Smart Cloud Enterprise |
| 7. | Microsoft in Warsaw | www.microsoft.com/pl-pl | Microsoft Cloud Platform |
| 8. | Oktawave in Warsaw | www.octawave.com | OKTAWAVE |
| 9. | Oracle in Warsaw | www.oracle.com/pl | Oracle Cloud |
| 10. | SAP in Warsaw | www.sap.com/poland | SAP Cloud |
| 11. | FORPSI in Sosnowiec | www.forpsi.pl | Aruba CLOUD |

Source: Own research.

As for the benefits of the introduction of cloud computing at the university, the answer is positive, at least because of the organizational and economic conditions.

The development of education and the possibilities of cloud computing

The university opting for cloud computing arising from a desire to improve the quality of its services should pay attention at least to the following CC benefits [McAfee, 2012 p. 125]:

- the availability and development of systems, programs and applications,
- productivity,
- collaboration
- and analytics.

Universities should primarily care for:

- increasing the pace of the introduction of the ‘product’ (i.e. facilitated incorporation of modern software into the curriculum, provision of up-to-date information about various events at the university) and the development of services (software updates without downtime, shorter time of the implementation of IT solutions),
- accelerating the implementation of activities (e.g. control of affairs and document circulation on a regular basis),
- changes in the model of cooperation (e.g. improving communication between lecturers and students in the field of continuing assessment),
- increasing labor productivity through obtaining information from the university itself and from its surroundings in a faster manner.

Economic aspects are also of great significance, namely reduction of the cost of consumables, energy consumption, maintenance of IT infrastructure and the processes. When it comes to teaching, CC creates the possibility to access the latest version of the system and software (Google Apps, Microsoft Office 365). Different items require access to different programs. It is difficult to install them all locally, administer them and still ensure that the academic teachers and students have access to these systems 24/7/365 in the traditional IT model. Classes are much more interesting if the lecturer/tutor can provide students with access to different programs and uses them during lectures and classes. An example of this at the University of Economics in Katowice can be an Internet access to the integrated business management system MRPII/ERP called ImpulsEvo in the educational version provided by BPSC, thanks to which lecturers/teachers and students have access to the system 24/7/365. Google also offers to universities and schools an integrated solution for communication and collaboration called Google Apps (Classroom, Gmail, Drive, Calendar, Docs, Sheets, Slides, Sites). As for the university management what CC can offer is: the possibility of secure access to the tools related to the management of the university, media monitoring, analytics, and the execution of standard data communication services (videoconferencing). Academics and students of the University of Economics in Katowice can currently have online access (via the Internet) to programs such as Virtual Dean's Office, Graphic halls, Schedules and Moodle. However, they are web hosted. The university is also developing a mobile application myUE which provides access to current information and events that take place at the university [myUE]. The application is designed to maintain regular contact between the university, the students, candidates, academics and alumni. An online recruitment system has also been launched. These solutions may become the first step towards a wider use of CC solutions at the university. For the university to be able to analyze the data easier and faster, they can make use of Google Analytics, included in the CC model. As for the staff and students, CC offers the possibility of access programs that allow for the collaboration and improve work effectiveness. Resource sharing and collaboration using CC is referred to as Cloud Collaboration. The cloud becomes a tool that facilitates team work aimed at the documents or files management. iBrand24 is an IT solution proposed by Comarch. The CC model offers programs with the help of which one can make to-do lists and set reminders such as: Remember The Milk [Remember], Wunderlist [Wunderlist] and record one's ideas, e.g. by using Evernote [Evernote].

Case study – classes conducted with the use of Bizlook Cloud

Classes during which the Bizlook Cloud program was used were carried out as part of the subject *IT management* for full-time second-cycle students at the Faculty of Informatics, University of Economics in Katowice. The aim of this course is to provide knowledge about the necessity of planning, organizing and controlling the resources in an economic organization. The course is to prepare for administering and monitoring IT systems. Its aim is also to indicate potential threats to IT resources. Once students were given a task to perform with the use of the cloud Bizlook program. Bizlook is an optimal solution for the companies and institutions that want to know what their employees' performance is and which do not have their own IT infrastructure. The use of Bizlook Cloud is subject to a monthly subscription. The program analyzes the performance of employees working with computers during their working hours. It monitors, among others, how the employees use the Internet, which computer programs they use and what is the actual length of breaks. The company's management can accurately and quickly identify the source of the waste of time [www2]. The purpose of the lecturer/tutor was to describe to the students the functionality of the system. The students' task was to perform the tasks set by the lecturer/teacher and prepare a report and send it to the Moodle platform at the end of the classes. The use of Bizlook during the classes was aimed at drawing the students' attention to the problem of the control how the employees use computers during their working hours. The program not only allows to evaluate its users' activity, but it also measures the actual demand for software and hardware in the company. The case study is presented in Tab. 4. Stimulating the involvement is one method of activating the students in the classroom. Activating methods promote learning by doing. They are aimed at enhancing the effectiveness of teaching, they also affect the quality of education.

Table 4. The characteristics of the described case study

| | |
|-------------------------|---|
| The name of the project | IT management – analysis of the performance of employees using Bizlook Cloud. |
| Nature of the project | Qualitative testing (measured by the assessment of student engagement). |
| Target | Familiarizing students with the possibilities of the program and drawing their attention to the problem of the time wasted by the employees in given company. |
| Methodology | Students were asked 7 open questions. The students' task was to answer them. To make this possible, students had to carry out an analysis and assessment of the situation in different contexts (organization, department, employee). |
| Restricts, challenge | Time limit. Individual work. |
| Feedback | For academics – reports stored on the Moodle platform. For students – credits for being active. |
| Expectations | Assessment of students' involvement. |

Source: Own research.

To sum up, we can conclude that all persons present in the classroom eagerly participated in the survey, i.e. 10 people (two people were absent on the day of the experiment). Student involvement was therefore at the level of 100%. The study leads to the following conclusions:

- 1) the time of a new program introduction for teaching/educational purposes was shortened,
- 2) professional, technical service was no longer needed,
- 3) every student had access to a unified workplace,
- 4) the quality of classes was raised,
- 5) students productivity was enhanced,
- 6) the process of information exchange and collection of students' assignments was streamlined,
- 7) the classes during which the new program was used could be carried out on any day, because the proposed solution would guarantee flexibility of the demand for resources.

CC can facilitate the inclusion of activating methods into teaching. The presented case shows how the cloud allows the user to quickly allocate specific resources. It is much easier to teach and run educational classes if the software indispensable in the teaching process is available immediately, and we do not have to wait for its installation, let alone for the purchase of any equipment necessary for this installation.

Conclusion

In conclusion, cloud computing is what has been done in informatics so far, but in a different way, which makes it possible to develop new concepts, applications and processes. The former, stationary model of data storage and processing was not immune to theft, unauthorized data access or acts of God such as fire or flood. The CC model avoids these risks.

It is believed that the best definition of the cloud is given by Gartner analysts. According to them, CC is a mode of calculation, in which dynamically scalable (usually virtualized) resources are delivered as a service via the Internet. The user does not need any knowledge of how this service is implemented, they do not have to deal with any technical aspects necessary for its operation.

The article widely presents one of the eight areas of CC application proposed by Marciniak [2013]. It has been shown, however, that the use of the latest cloud technology makes it easier to achieve their objectives. Additionally, companies have already been recognizing its benefits. SAP has launched the SAP Business One system in the Cloud model, Adobe – in their Creative Cloud pro-

vides pupils, students and academics with access to the application for creating web pages, graphics, photographs and videos, with a view to developing the creative potential of the pupils and students. The development of CC creates new opportunities for education. It is certainly a trend benefiting the academic teachers who will no longer have to carry heavy laptops, but only the devices that will allow them to access the data. This will benefit the students who are becoming more and more mobile and also want to have access to data stored in remote locations from anywhere and at any time. In a word, both groups want to have the *data on them*. Especially since the next upcoming trend in the society will be called *the Internet of Things*.

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KSZTAŁCENIE NA ODLEGŁOŚĆ Z WYKORZYSTANIEM CLOUD COMPUTING

Streszczenie: Cloud computing stwarza nowe możliwości dla rozwoju wirtualnej edukacji. Celem artykułu jest analiza aspektów organizacyjnych, ekonomicznych i prawnych cloud computing w kontekście potrzeb edukacji wirtualnej. Ponadto artykuł przedstawia identyfikację i charakterystykę tych obszarów edukacji, gdzie najlepiej jest zastosować technologię cloud computing, na przykład nauczania i uczenia się na odległość, działalności wydawniczej, współpracy i interakcji społecznych (np. tworzenia dokumentacji, prezentacji lub komunikacji). W artykule przedstawiono także przykłady aplikacji dostępnych w chmurze.

Słowa kluczowe: cloud computing, edukacja, wirtualna edukacja, e-learning.