Expert recommendations for four sectors: the health service, education, public administration and small and medium-sized businesses. How to effectively implement IT tools in the cloud model.
cloud computing • IT • data • e-health • resources • CC • cloud • IT • IaaS • cloud • backup • security • PaaS • e-education • e-administration • development • change • SaaS • innovation • e-economy • on-demand services • provider • cloud • growth • standard • innovation • efficiency • protection • confidentiality • online • application in cloud • data • CC • profit • server
Widespread use of cloud computing is beneficial to the economy – the cloud allows faster and less expensive introduction of innovative e-services, helps companies to adapt flexibly to the changing market situation, improves their competitiveness and lowers their operating costs. In turn, implementation of the cloud model in administration means improved functioning of government agencies and lower public spending. Therefore the state should strive to eliminate barriers to adoption of cloud computing and facilitate the use of this tool.

One of the main barriers pointed to by practitioners is legal issues. The Polish legal system does not always take into account the existence of the cloud and some regulations are ambiguous. This situation makes it difficult, and sometimes even impossible, to use many state-of-the-art solutions based on the cloud model. The problem mainly affects the public sector, but also the businesses processing sensitive data, like medical records. The competent state bodies, together with the most concerned businesses, should develop procedures and regulations allowing efficient, legally compliant and safe implementation of cloud computing.

A high level of security may be guaranteed only by a creditworthy and competent cloud provider. An enterprise that has appropriate infrastructure, uses advanced IT system security solutions, observes stringent procedures governing production of backups and internal security, and has qualified and experienced IT staff, is able to assure a higher level of security of data than a company that decides to store it on its own servers. When deciding to use the cloud computing model, particular attention should be paid to selection of the right service provider. This will reduce the possibilities of occurrence of various types of risks related to cloud processing.

Overcoming the barriers to implementation of the cloud model may be assisted by the positive experience of businesses or agencies already successfully using cloud-based solutions. Extensive communication of successful implementation case studies supported by good exchange of information on the legal and technical aspects or security of the cloud model will fuel the popularity of cloud processing.
Neither today’s economy nor the government administration are able to function without the support of IT tools.

In the quest for the optimal model of IT operation, businesses and the public sector more and more often opt for cloud computing. As shown by research, improvement of an organisation’s efficiency may be noticeable at the level of the entire economy, which is of high importance in times when inexpensive and high-performance solutions are highly valued and sought after.
Microsoft provides modern technologies to the Polish market but at the same time engages in the debate on what is important for the development of a citizen-friendly state and what is the key to the improvement of competitiveness of selected areas of public life and business. Therefore the Polish division of Microsoft supports the activities of the Polish government focused on three areas: education, support of small and medium-sized enterprises, and support for the e-justice initiative. One of the forms of these measures is the discussion on cloud computing (CC). This phenomenon is not only interesting from the point of view of technology, but also has an important influence on the Polish economy and state administration. Cloud computing influences competitiveness, effectiveness and the quality of services provided by both private business and the state sector. The cloud not only makes life easier for IT departments at organisations, but it also translates to estimable growth of GDP and employment. In this report the Gdańsk Institute for Market Economics provides an in-depth analysis of the economic influence of the cloud computing phenomenon, and in a survey it measured the extent of CC usage by Polish entrepreneurs and their knowledge of the subject. It turns out that many businesses already know and appreciate the benefits of the cloud model. However, they point to a great appetite for knowledge about CC, even among companies already using the solution. In the next part of this report, developed by THINKTANK, we invited experts – managers, entrepreneurs, scientists and representatives of public administration – for a discussion. Based on their experience in implementation and use of the cloud, as well as knowledge of the sectors they operate in, a collection of recommendations was developed for four areas: education, healthcare system, public administration and the small and medium-sized enterprise sector. We hope that this report will be able to help not only representatives of these four sectors in an informed selection of the new tool that is cloud computing.

Jacek Murawski, General Manager Microsoft Sp. z o.o.
**COMPETITIVENESS**

- Cloud computing: the new impulse for the economy. The influence of the cloud model on the Polish economy is described by KRZYSZTOF ŁAPINISKI and BOHDAN WYŻNIKIEWICZ
- Usage of cloud computing by Polish businesses – Results of a survey by IBnGR

**PRACTICE**

- New solution in practice: advantages, challenges and recommendations for cloud implementation
  - Implementing cloud-based IT tools in the healthcare sector, explained by: ALBERT JAROSZ, ADAM KOPROWSKI, KRZYSZTOF ŁAPINISKI, ANDRZEJ STRUG, DARIUSZ SPIEWAK and BOHDAN WYŻNIKIEWICZ
  - The influence of cloud computing on the teaching process and organisation of the education system, discussed by: MICHAŁ GÓLINSKI, KRZYSZTOF ŁAPINISKI, KRZYSZTOF P&WŁOWSKI, MACIEJ M. SYLO, LESLAW TOMCZAK and BOHDAN WYŻNIKIEWICZ
- Can the public sector use cloud computing, as seen by: EDWIN BENDK, JAN MACIEJ CZAJKOWSKI, KRZYSZTOF ŁAPINISKI, RAFAŁ MALUJDA, KAJETAN WOJYŚ and BOHDAN WYŻNIKIEWICZ
- The influence of the cloud on the small and medium-sized enterprise sector, analysed by: MICHAŁ GÓLINSKI, KRZYSZTOF ŁAPINISKI, HENRYK PIETRASZKIEWICZ, GRZEGORZ SKOWRON-MOSZKOWICZ and BOHDAN WYŻNIKIEWICZ
COMPETITIVENESS

THE CLOUD:
A SOURCE OF MARKET ADVANTAGE

6  ____  ANALYSIS: what is the influence of cloud use on the economy?

24  ____  SURVEY RESULTS: are Polish entrepreneurs using the cloud computing model?
Cloud computing: the new impulse for the economy
Many studies have been written about the cloud, analysing its influence on the quality and cost of management of enterprises’ IT resources. This report is an attempt to analyse the economic effects of the cloud computing concept for both businesses and the entire economy.

**Cloud computing** (CC), is currently among the most dynamically developing IT services. Demand for solutions reducing costs of doing business, while at the same time boosting processing capacities, fuels the growing popularity of this model of IT resource management. This tendency is being noted more and more in Poland too; however, the potential users of cloud computing exhibit a certain wariness towards outsourcing of their IT resources. There seems to be an analogy to the scepticism at the emergence of electronic banking, which passed in a relatively short time.

**A NEW LOOK AT IT**

**Cloud computing is a new paradigm of provision of IT services.** It totally changes the existing model of management of IT resources – businesses do not invest capital in their own IT infrastructures, but use those rented via the network. The role of computers is changing too – they are becoming dumb terminals for presentation of results of operations performed by data centres equipped with unlimited – from the perspective of the user – processing power and disk space. There are also changes in the role of employees of IT departments – they are turning into managers, one of whose main jobs is to optimise the structure of rented IT resources and provide (as needed) flexible support to business operations.

**This report reviews the economic effects that the introduction of the cloud computing model may bring to Polish businesses and the economy as a whole.** Its first articles are of a theoretical nature. They introduce the basic terms related to CC, present the microeconomic effects, i.e. benefits a business can achieve by migrating its own IT resources to the cloud, and discuss the potential barriers to widespread adoption of the cloud computing model.

The articles also demonstrate how growth of adoption of cloud computing may influence the entire economy. They show the directional influence on growth of GDP, investments and the labour market situation. They also discuss the channels of influence of effects to other sectors.

In turn the article *Cloud computing. Results of a survey of Polish businesses* presents the results of a survey on CC conducted by Gdańsk Institute for Market Economics among Polish entrepreneurs. The survey concerned general knowledge about CC, barriers, concerns related to the cloud model and information requirements. The survey results formed the basis for presentation of expectations as to the further development of CC in Poland.
OPPORTUNITIES THANKS TO CC

Cloud computing improves competitiveness of businesses: it lowers their operating costs and allows fast, flexible reactions to dynamic changes in the business environment. In certain aspects it also provides a level playing field to small and big businesses, thus stimulating growth of competition and, in turn, improvement of the quality of services offered and faster economic growth. So it is the entire national economy that benefits from the implementation of cloud computing.

It seems that every business, before deciding to change its IT resource management model from traditional to cloud computing, should analyse in detail the pros and cons of this choice. The migration of a section of the IT resources to a computing cloud means improved economic effectiveness, but also giving away control of part of the IT system to a third party. Lower control over resources typically means higher economic benefits, and vice versa. What is important is to find a proper balance between the two criteria.

Moreover, the cloud computing service is a relatively new service, and its ongoing development may be accompanied not only by new benefits but also by new threats. Therefore it will require continuous monitoring of whether the economic effects will not be achieved at too high a level of risk. It also seems that the possible concerns now accompanying migration to the cloud computing model will gradually disappear. This will be supported by growing adoption of this solution as well as ever more refined procedures and mechanisms for data protection, and thus protection of the interests of service users.

Percentage of businesses with at least nine employees using the Internet for contacts with the public administration in 2009. The highest proportion of users come from companies producing and distributing electricity, gas, steam and hot water (99 per cent), and the lowest from the hotel and restaurant sector – 81 per cent.

Source: Polish Central Statistical Office, 2011
The survey conducted by Gdańsk Institute for Market Economics (IBnGR) on a random sample of 170 businesses may lead to the conclusion that Polish entrepreneurs are approaching the new IT resource management model that is cloud computing with caution. On the one hand the lack of interest results from a lack of need to use cloud applications, and on the other it is dictated by strong attachment to the present solutions, which still work fine in many cases.

SECURITY IS THE MOST IMPORTANT ASPECT

Polish businesses value IT security and put it before purely financial and economic benefits. It seems that the propensity to use the cloud computing model will grow if organisations become convinced that their data will be provided with an appropriate level of security. Additional savings or improvement of operational effectiveness of a company – for the price of giving away control over IT resources to a third-party company or even a subjectively perceived decrease in the security level – are not yet widely accepted among Polish entrepreneurs.

The survey conducted by IBnGR also indicates the need for cloud service providers to introduce information and education campaigns on the benefits and threats related to cloud computing. The current level of knowledge on cloud computing by Polish entrepreneurs is far from sufficient.

The survey also indicates that over the next 12 months the growth in popularity of cloud computing in Poland will be rather limited. In the following years the pace of growth will to a large extent depend on the degree to which migrating to the cloud will allow companies to gain a market advantage over their competition.

Every business, before deciding to change its IT resource management model from traditional to cloud computing, should analyse in detail the pros and cons of this choice.
The term “cloud computing”, as it concerns a relatively new trend/service, so far has no single fixed definition. More official types of publications (scientific articles, government documents) tend to use the definition provided by the American National Institute of Standards and Technology: “Cloud computing is a model for enabling 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”.

A somewhat friendlier definition of cloud computing is provided by Wikipedia. According to this source, “CC is the provision of computational resources on demand via a network. Cloud computing can be compared to the supply of electricity and gas, or the provision of telephone, television and postal services…. As cloud computing is of a measurable nature (number of transmitted bytes, time of user, etc.) the customer is billed only on a pay-per-use basis, just like for water, gas, electricity, etc. The typical user of the service has no technical knowledge about the whole process of media delivery or the physical location of individual elements of the generation and transmission infrastructure. The customer is interested only in the end result. And it is just like this in the case of cloud computing. A typical resident does not know which power station produces the electricity delivered to his house, nor the route of the water line supplying his water tap. And similarly, he has no clue where on Earth are located the servers with information content he is using in his daily life.

This entire distributed, but at the same time interconnected technologically advanced IT infrastructure is simply referred to as the cloud. So the cloud is the whole set of servers, software, optical cables used for accessing the Internet. And the use of such a cloud is called cloud computing.

The end user accesses this complex IT system using a standard network connection. Thus from his point of view the use of the cloud is very simple. But in fact it is a very technically advanced process, with the end user having a very limited knowledge about it and the process taking place totally independently of the user.

**TYPES OF CLOUD COMPUTING SERVICES**

Depending on how advanced cloud computing is, three basic types or levels of this service are currently distinguished:

- **Infrastructure as a Service (IaaS)**
- **Platform as a Service (PaaS)**
- **Software as a Service (SaaS)**.

**Infrastructure as a Service (IaaS)** means using computer hardware via the Internet. This hardware may be space on a virtual web data storage disk or a leased server capacity for hosting your own operating system. IaaS also includes the use of the computing power of processors.

**Platform as a Service (PaaS)** is a more advanced level of cloud computing service than IaaS. Besides access to the infrastructure, the user also gets access to the environment (including a software development platform), where he can install and launch more or less advanced applications. The platform offers specific services allowing treatment of the infrastructure elements as one entity and using a single virtual supercomputer on which – thanks to special software components – scalable applications can be developed.
Who controls the resources

<table>
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<th>Division of control in CC models</th>
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<td>Traditional model (On-premise)</td>
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<td>Infrastructure as a Service (IaaS)</td>
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<td>Data store</td>
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Source: Microsoft.

Software as a Service (SaaS) is the most elaborate level of cloud computing. With this model the user gets access not only to the hardware infrastructure along with its operating environment, but also to defined IT applications. These may be simple programs, such as an online word processor, as well as more advanced applications, such as accounting support systems, e-mail systems, order processing systems, etc. In contrast to the PaaS model, the software used is the property of the provider, who is responsible for its updating and error-free operation.

By choosing a specific model of cloud computing the service user defines the division of control over the IT resources employed between himself and the service provider. In the traditional model the user has almost total control over the infrastructure and software he owns. However, in many cases his self-sufficiency is somewhat limited by the necessity to use Internet Service Providers.

In the IaaS model almost the entire substantial part of the IT infrastructure (server room, data stores) is outsourced. The user retains control over his data and software. In the PaaS model the service provider has more control over the resources used – the service provider also provides the service customer with the operating and runtime environments, where the user may operate the applications he installs. In the SaaS model the user remains in control of only the data. The entire infrastructure along with the software is under the control of the service provider. And it is the service provider’s responsibility to assure their quality and reliability of operation.

PUBLIC AND PRIVATE CLOUDS

Selecting the cloud computing model in fact means the choice between the degree of control over IT resources and the degree of economic effectiveness of the operation. A large business deciding to “move into the cloud” entirely does not incur the costs of purchasing and maintaining an extensive IT infrastructure. However, its operations become significantly dependent on the quality of the cloud services provider. To some users giving almost total control over their IT resources to external companies often becomes a condition that is difficult to accept. This is why users often opt for the “private cloud” model, or a so-called “hybrid cloud.” “Private cloud” means that the entire IT infrastructure remains physically on the premises of the service user, which he controls. Thus the user
By choosing a specific model of cloud computing the service user defines the division of control over the IT resources used between himself and the service provider.

has permanent physical access to the servers (and data storage), which contain the software making up the cloud. Users with entirely external IT resources are in fact using the public cloud. It is the user who then decides what services offered by the cloud he will be using. It is also possible to use, via the cloud provider, the services of third parties that are not direct cloud providers themselves, for example special software which is installed in the operating environment that is made available. This is a situation when the user needs access to an application which is not offered by the cloud provider himself. The division of cloud computing services, from the point of view both of advancement of the services purchased and the physical location of the cloud, is not rigid. The need to constantly adapt to user requirements results in hybrid solutions often being offered. One of them is the dedicated cloud. Typically this is used by customers wishing to use cloud functionality in a highly customised way. The service provider isolates a part of the cloud (often these are actually isolated servers), which can then be accessed only by the specific service user (e.g. a government agency). This is an intermediate solution between a private and a public cloud, also from the point of view of costs. Another available solution is the hybrid cloud mentioned earlier. There, some of the resources are used and located in the private cloud, and some in the public cloud. The private cloud is then used for processing data sensitive to the organisation or requiring protection by law (e.g. classified data). The public cloud in turn hosts these applications that are used for processing less sensitive information in this model. For clarity of further discussion on cloud processing in this report we are primarily discussing the aspects of operation of the public cloud, unless the context explicitly mentions the private cloud.

FOOTNOTES
2. “[...] the provision of computational resources on demand via a network. Cloud computing can be compared to the supply of electricity and gas, or the provision of telephone, television and postal services. All of these services are presented to the users in a simple way that is easy to understand without the users needing to know how the services are provided. This simplified view is called an abstraction. Similarly, cloud computing offers computer application developers and users an abstract view of services that simplifies and ignores much of the details and inner workings. A provider’s offering of abstracted Internet services is often called ‘the Cloud’.” – http://en.wikipedia.org/wiki/Cloud_computing (accessed: 15.03.2011).
In the traditional model, a business deciding to own its IT infrastructure has to incure the cost of purchasing the servers, network infrastructure, software, etc. The potential of this hardware (disk space, processing power) may for some time remain underutilised (e.g. at the initial phase of launching a new business service). However, throughout this time the user will incure the ongoing costs of operating the hardware (power supply, cooling, maintenance, etc.). The initial level of IT resources underutilisation is shown by the dark blue area in the chart (p. 14).

Later the continuing growth of the business (or its product or service) may force the user to invest in additional IT infrastructure. It may also turn out that business growth will exceed the forecasts and its own IT resources, even after increasing their capacity, will turn out to be insufficient to provide the company with the required IT support (the grey area). In such a case an underperforming IT infrastructure thus puts the company at risk of loss of additional sales of its products or services. The company will also achieve lower revenues, and its financial results will probably suffer.

As a result of monitoring the growing demand for IT resources the company will again spend money on necessary investments. However, its reaction will be somewhat late, and thus may hurt its image. But bearing in mind market business cycles one may safely assume that after a certain time the demand for the company’s product will drop to a level from before the boom. The potential of the installed infrastructure will then be significantly underutilised, while its operating costs related to the operation of IT resources will remain practically unchanged, at a relatively high level.

Companies able to adapt to changing business conditions in a short time will always be better off than their competitors. The inability to quickly adapt to sudden booms in demand, i.e. serve many new customers on time, typically results in the loss of such customers. They then go to those companies which can meet their needs, and the company they abandon typically loses some of its market position. Companies basing their operations on the traditional IT resource utilisation model may find themselves in the above situation as well. One of the methods of limiting the negative effects is the change of the IT resource management model to cloud computing.

A user who migrates his IT resources to the cloud will get concrete economic returns even after a short time. First of all, when beginning operations, he will not have to spend money on expanding the IT infrastructure – leading to the first tangible savings. The return on initial spending is very fast (as opposed to the traditional model, where investments take much longer to pay back their capital cost, if they pay back at all). Then, as the level of utilisation of IT resources grows, there will be no need to invest in more servers and software. The cloud provider offers the service user high scalability – the user may quickly increase his IT resources when they are actually required. This lowers the risk of a situation that may happen with the traditional model, when the user’s own IT resources are not able to meet rapid and often unforeseeable demand peaks. Implementing the cloud computing service means reduction of risk of loss of extra revenues and customers. Flexible reaction capabilities allow companies to gain a competitive advantage over companies without this flexibility at hand.

THE FEATURES OF CLOUD COMPUTING
A business that opts for cloud computing may achieve several benefits and improve the quality of its operations. These benefits directly result from seven basic features of the cloud computing model.
Migrating the IT resources to the cloud also improves the growth potential of organisations. Moving the headquarters no longer implies physical moving of the entire IT infrastructure. Moreover, cloud computing significantly simplifies the opening of new company branches. When a new field agency is connected to the Internet, it automatically becomes integrated with the whole enterprise management system.

[1] Scalability

A user deciding to use cloud computing services automatically gets access to IT resources on a practically unlimited scale. And this applies to both additional server capacity and processing power. As needs dictate, the service user may increase the capacity as required or give up part of the IT resources used. Resizing of resources may be done for any period of time. It is the user's exclusive decision as to what IT resources to use for what periods of time.

[2] Availability

Migration of a section of the IT resources improves a user's mobility. He may use the IT resources he rents regardless of his location. Therefore his employees may perform some tasks while they are away from the company. A natural limitation in accessing the services may be a low-speed Internet connection, or none at all.

Migrating the IT resources to the cloud also improves the growth potential of organisations. Moving the headquarters no longer implies physical moving of the entire IT infrastructure. Moreover, cloud computing significantly simplifies the opening of new company branches. When a new field agency is connected to the Internet, it automatically becomes integrated with the whole enterprise management system.


Cloud computing is a service that can be precisely billed for. Depending on the unit of measure employed, billing may be done per: one hour of data processing, 1 GB of data stored for defined time period, for database operation, for number of operations performed, for data volume transferred over a month, etc. Service billing principles may be diverse, and in fact will depend on the individual agreements between the service supplier and the customer. Charges may be applied for the exact usage of resources, or – as in cellular telephony – on a pre-paid basis, i.e. as an up-front purchase of access to the defined potential of services. Regardless of the billing method used, cloud computing increases the predictability of company costs and optimises them through adjustment to current needs.
 Ease of implementation

Implementation of a management support system using the cloud is much simpler than building an on-premise server room and installation of software in-house on all connected devices. A user opting for cloud computing almost automatically obtains access to ready-to-use solutions, and system configuration tasks are limited to a bare minimum. The simplicity of such solutions in combination with relatively low implementation costs make cloud computing, as opposed to on-premise solutions, affordable for any business. Small businesses with limited investment budgets can thus gain access to solutions that due to their high acquisition and implementation costs were so far reserved only for corporations – which could afford such costly projects. Therefore general access to a cloud computing service at least partly provides more equal opportunities to small businesses, thus raising the competitiveness of financially weaker companies.

 Performance

Use of the cloud computing model by businesses assures that the potential of available IT resources in no way hampers their operating and growth capabilities. Access to almost unlimited processing power, unlimited disk space and advanced development platforms allows companies to technically execute practically any complicated operation (e.g. requiring the use of very high power processors) and any number of such operations. Technically these operations are performed by high-performance data centres.

It is also worth noting that automatic performance growth of the resources at a company’s disposal not only improves its general potential, but also permits rapid reactions to changing economic conditions. This in turn improves the overall business performance of companies.

 Security

Moving the company management support system into the cloud increases its reliability and reduces the risk of data loss. The cloud provider is responsible for the stable operation of the infrastructure – the data stored in it is replicated and stored at the same time in two (or more) data processing centres. Should any one of them fail, a backup copy is launched automatically. This operation is transparent to the user, who maintains uninterrupted access to the system all the time.

The maximum number of servers that one administrator may manage in the traditional IT model; in the cloud a single person may manage thousands of servers.

Source: Microsoft, 2010
An additional factor improving the company IT resource security is geographic diversification of the location of data processing centres by the provider. Locating them in different climatic, geological or even political regions practically makes corporate IT resources immune to the consequences of accidents, acts of terrorism or natural disasters.

Cloud computing also means lower failure rates of IT resources for “hard” reasons (physical damage, fires, power outages, etc.), but also “soft” ones such as software errors. The cloud provider normally guarantees that the leased software will be regularly updated (patches), and in particular the solutions improving the overall system security will be installed whenever required. This is very important in situations when the company processes legally protected data or its proprietary information. Cloud computing thus improves the resistance of IT resources to hacker attacks and limits instances threatening with data leaks.

Implementation of the cloud computing model means savings of space, time and primarily costs. Building on-premise complex IT infrastructure requires dedicated floor space for the server room, data storage, power supply equipment, etc. Preparation and operation of such space translates to tangible costs for the business, such as real estate tax and space rental fees. In enterprises this space can be as much as 10 per cent of their total space. In a natural way this limits the operating potential of the company. Rooms occupied by servers could alternatively be used as production halls, shop outlets or office space. In the situation when corporate IT resources are located in the cloud, the above problems do not exist.

Cloud computing allows businesses to swiftly adapt to the changing market situation (time savings). Firstly, a company deciding to use cloud-based IT resources is able to commence its operations faster than a company that first has to spend money on IT infrastructure, then commission, configure, test it, etc. Secondly, in situations when expansion of IT potential is necessary, companies using the cloud model automatically have it at their fingertips. This is not the case with companies that again have to spend on extra hardware, transport it to the required location and install it. Accumulation of these tasks makes this operation rather time-consuming, and should the market situation be changing quite dynamically, the reaction by the company may turn out to be much too late and as a result totally unnecessary and without a business case. Thirdly, in the case of IT infrastructure faults, the company wastes time repairing it (replacement of damaged components, system restart, etc.). In extreme cases such a situation can influence the company’s economic results. In the cloud model, however, such situations practically do not occur, as in the case of any server outage the user is automatically switched over to another data processing centre, and the switchover is practically transparent.

Fourthly, a company with continuous and stable access to unlimited IT resources may take on more ambitious, and thus more profitable assignments, tasks and projects. In situations when new projects require extra IT potential (e.g. new servers), significant pre-project efforts go into a feasibility study of extra investments. Thus often much more attention goes to technical and infrastructural aspects, to a certain degree at the expense of cost optimization.
The cloud provider is responsible for stable operation of the infrastructure – the data stored in it is replicated and stored at the same time in at least two data processing centres.

of the subject matter of the project. At companies using the cloud computing model, managers can focus on their core business, as the problem of potential underperformance of IT resources is practically nonexistent.

Introduction of cloud computing also translates to savings in IT expenditure by the company. Firstly, cloud computing allows the cost of IT resources to be matched to their actual utilisation. There are no instances of having to pay for the upkeep of unused servers. In the cloud computing model the costs of operating the IT infrastructure (power supply, cooling, maintenance) are borne by its provider – or in other words: these costs are shared among many service users. There are also no situations when investments in extra IT hardware have to be made, as the IT resources may be sized to fit the current needs or expectations of their users. A significant IT cost item is the purchase of software licences. When there is a need to install an expensive application on dozens or hundreds of computers, such an item may pose a significant burden on the IT budget of the company. In such a situation it is much more economical to buy the appropriate number of rights to use this application (for a much lower total cost), which in the cloud computing model is owned by the cloud provider.

Cloud computing also allows much better company IT expense allocation and planning. In ceasing to make purchases of extensive IT infrastructure a company does not put an additional capital expenditure burden on its current and future budgets. This is due to the principles of accounting for such expenses. The use of cloud-based IT resources is treated as operating expenditure (OPEX). However, spending on IT infrastructure is treated as capital expenditure (CAPEX). This difference is important because fixed asset costs decrease taxable revenues only through depreciation deductions, which may – depending on the depreciation rate adopted – be deducted over several or a dozen or more tax periods. Thus they will impose an additional burden on future IT budgets. In turn, spending on outsourced IT services is treated as a current operating expense and deducted in full when determining the current taxable income. Funds saved in this way (no capital expenditures for servers, software, etc.) may be spent on other investments.

No on-premise server rooms also means important savings in energy bills. Complex IT hardware networks typically demand a lot of electricity. And it is not just the cost of power for the IT components, but also power for the cooling systems (in most cases fans), that have to dissipate significant amounts of heat generated by the servers in operation. Lack of forced ventilation may result in their overheating and breakdown. These costs of course do not concern the users of the cloud, as the technical and economic aspects of the operation of data processing centres are on the side of the provider.
3. Barriers to the implementation of cloud computing

Entrepreneurs considering switching their IT resource management model to the cloud have various concerns, obviously influencing their decisions. In particular these are:

TECHNICAL BARRIERS

Because cloud computing is used over the Internet (except in the case of private clouds), a natural barrier possibly limiting the adoption of this kind of services is insufficient access to good-quality Internet connections. A company with poor-quality Internet connectivity will not be able to make full use of all possibilities offered by migration of its IT to the cloud.

Firstly, the Internet connection must meet the specifications recommended by the cloud provider. The significant volumes of information transferred between the business and the data processing centre require appropriate transfer rates. Also no bottlenecks should occur in either transmission direction.

Secondly, the connections must have high availability – connections to the data centre cannot be lost, as this means loss of access to data by the company. If data is processed on on-premise servers this problem is virtually nonexistent, though access to data may still be lost due to other events. High failure rate may mean that the business will from time to time be cut off from its IT resources. Such situations will destabilise the operations of the company, and this will definitely be reflected in its economic results.

A way to protect oneself to a certain extent against such situations is to use at least two ISPs. Additional connections significantly improve a company’s immunity to breakdowns of connections to the data centres. They also increase the total bandwidth available to the business. The user should make sure he is using Internet connections with adequate SLA – Service Level Agreement. Good-quality circuits improve the reliability of cloud computing.

The design of the computing cloud also imposes certain requirements and limitations on the development of cloud-hosted applications. Some applications may be available only in bundles with other solutions that the user would have to use – though he would not need them. It might also turn out that these unnecessary extra functions will make the use of the cloud by some users actually more difficult. In the traditional model the user has much more freedom in selecting and configuring the software. Thus it is a good idea to keep the fundamental part of the cloud – shared by all users – limited to a minimum. The possibility to fine-tune it to individual user preferences (great freedom of selection of functionalities and software) will encourage the adoption of cloud computing. The cloud user himself should select from the market offering solutions that will provide him with an adequate level of compatibility and interoperability of the given platform, required for his future business plans.

LEGAL BARRIERS

The most important legal aspect of cloud computing is the requirement to assure privacy and security of the processed data, in particular the protection of personal data.

A business deciding to move even some of its resources to a cloud other than a private one must be sure that the exported data is adequately protected by the provider. First of all the provider must clarify where the processed information will be physically located. This issue is important, as moving the data of citizens outside of their country is subject to strict regulations. In the event the data is processed on the territory of Poland or the European Union, the service provider should observe the security regulations in force in the EU.

If the cloud is located outside the EU, the cloud provider must observe all security procedures to a degree adequate to
Community principles. Moreover, in many cases these procedures have to be approved by the Polish General Inspectorate for Personal Data, which decides if data protected in this way may be processed outside the EU.

Such regulations on the one hand protect the interests of citizens, while on the other they favour those cloud providers who have their data centres located within the European Union. The requirement to meet high standards applicable to personal data processing eliminates some of the non-European companies and in a way limits the availability of the cloud computing service.

MINDSET BARRIERS

Despite the growing popularity of cloud computing, the majority of businesses still apply the traditional IT resource management models based on acquisition and installation of hardware and software and then their management. Some businesses, though, see the benefits that migration to the cloud computing model can bring and are in the process of developing an optimal scenario for such migration. However, some companies remain quite sceptical about the idea to outsource a section of their business management support systems to external operators. On the one hand this reluctance is dictated by limited trust in new IT solutions and attachment to legacy models. On the other, it is the result of incomplete knowledge, or – just the opposite – informed choice (after in-depth analysis of the pros and cons) of the model based on their on-premise IT infrastructure.

Therefore one of the methods for increasing the willingness of businesses to move their IT resources to the cloud is to popularise the general knowledge about cloud computing. A frank presentation of what this service is all about, what the most often used solutions are and what benefits and risks this model entails will definitely favour the growth in the popularity of cloud computing. It is also important that, particularly at the development phase of the service, it should be offered to businesses free of charge on an evaluation basis. This will allow prospective users to try the service, check out its functionality and make a decision optimal for the organisation. Not all companies, even the ones with full knowledge about cloud computing, will wish to use the service. The reason may be the limitations and risks related to cloud migration. And surely so may be the technical or legal barriers discussed before. It seems, however, that the biggest barrier may be concerns about IT security.

The cloud computing model assures higher security than the traditional one (lower failure rate of the system, data back-ups). At the same time it results in the company to a certain extent giving up its control over its IT resources. This very aspect of cloud computing leads to the biggest concerns among potential cloud users.

First of all, a sceptical company may be convinced that it is able to assure better control over access to premises housing servers with data. When the servers are outside the area controlled by the company, in a different country or on a different continent, the service user has no overview of who enters such a data centre. So companies are concerned with situations where unauthorised persons could illegally obtain access to data located on servers in the data processing centres. They are also concerned that they might not even be aware of such situations, as the cloud provider may not be willing to disclose the fact that data centre security rules have been breached, although the agreement may provide for mandatory notification of such circumstances.
Another important aspect of data security is the procedures of erasing or destruction of functional or faulty elements/disks. At data centres typically the whole server modules are replaced when their failure rate reaches a defined threshold. So businesses are concerned about a situation of data not being permanently erased or disks destroyed beyond the possibility of recovery of any information they contained. Such concerns have resulted in some cloud providers introducing appropriate certification systems requiring physical destruction of disks inside the data centre.

Businesses may also be uneasy about sharing of IT resources between many users. On the one hand, sharing lowers the costs of maintaining the IT infrastructure. On the other, a potential bug in the software could result in users theoretically being able to unintentionally (or indeed intentionally) get hold of similar data belonging to other businesses. To prevent such situations and related concerns, some of the cloud providers can assure an adequate level of data isolation through the use of appropriate physical mechanisms and cryptographic solutions.

The above data security breach examples are of course extreme in nature, but raise the concern of many companies, for which a situation where they are not in direct control of their IT resources may not be acceptable.

The three irregularities mentioned above (illegal copying of data, improper decommissioning of disks, software breaches) may also happen in the case of the traditional IT resource management model. Any company is at risk of having a dishonest employee who might copy strategic data and pass it on to the competition, or good disks with data may make it to the rubbish dump. However it seems that companies give more consideration to such threats only when they begin to contemplate implementing the cloud computing model. The very same threats are normally ignored when IT resources are physically located on company premises. They do not always take into consideration the fact that cloud providers typically have the latest, and thus the best, security mechanisms and technologies, unlike non-IT companies.

It is also worth noting that the very process of cloud computing is appropriately described in the agreement between the service user and service provider, defining among others the aspects relating to assurance of an appropriate access control level to resources and the security level. The level of this protection may even be more stringent than that imposed by the internal regulations of the customer company.

Therefore it is important that the entire cloud computing process be as transparent as possible and that agreements on provision of such services contain applicable clauses at the same time increasing the liability of the cloud provider and protecting the interest of the service user. Then the concerns of businesses will gradually fade away and the cloud computing model will more and more be perceived as one that can provide better IT security than the traditional model.

A mindset barrier to the growth of cloud computing may also be the conviction that the cloud providers could in future use an unfair advantage over companies that are in fact locked in with them. The simplest example here would be unjustified increase of prices. The company would then have to look for a different supplier, implement the entire software again from scratch (probably coming from a different vendor), retrain its employees, etc., or completely withdraw from cloud computing. In such a case the business case may indicate that the cheapest way is still to continue using the services of the current provider. Therefore before moving to the cloud it is sensible to select a renowned vendor with a solid market position – to minimise the risk of possible misbehaviour.
Effects for the Polish national economy

The financial results of using cloud computing may be calculated quite precisely at the level of a business. A simple and efficient method is comparison ex ante (analysis of needs before implementation) and ex post (comparison of previous forecasts with the results obtained) of IT expenditures without and with the use of the cloud. When estimating the effects on a macroeconomic scale, that is for the economy as a whole, it is necessary to make assumptions concerning matters such as the percentage of businesses using cloud computing or the extent of commitment to the cloud. Also mechanisms should be developed for translating the results of the use of outsourcing in IT and creation of positive feedback and synergies. The matter is further complicated by the different cloud computing models available. When focusing on growth of production (GDP) one must remember that it is not possible to isolate the pure effect of cloud computing.

Assessments of the macroeconomic benefits of cloud computing, due to the effects mentioned above, will show approximate values. It is also important to indicate the trends and mechanisms, which cannot always be predicted. Some effects are difficult or simply impossible to quantify, as they may be of a qualitative nature. At the current state of development of the cloud computing service there are too many unknowns and uncertainties to allow formulation of projections of economic growth or labour market development to be made with high precision.

There are several studies and reports containing forecasts of benefits in GDP and employment growth in different time scales. However, the possibilities of scenarios outlined in such reports coming true should be approached with caution resulting from awareness of the existence of barriers and various types of risks related to the development of cloud computing.

EFFECTS IN THE IT SECTOR

An increasing numbers of users migrating to cloud computing influences the situation of IT sector companies. Thus a need arises for a change of operating model in domains related to hardware as well as software. On the one hand there will be a drop in demand for certain types of hardware and some IT services, and on the other, the demand for hardware and services will increase from the cloud providers as their needs will be growing. These changes will also force changes in the type of work performed by developers and IT specialists, with a general trend of growing employment. The IT sector is sufficiently dynamic and flexible to make retraining in this area relatively easy.

According to conservative estimates by IDC in October 2009, between 2010 and 2013 the cloud computing revenues of the IT sector in Poland will be growing dynamically. It is expected that they will double on a year-to-year basis in the initial period of uptake of cloud solutions, resulting in revenues growing from around 1.2 billion PLN in 2010 to around 8.3 billion PLN in 2013.

Wider adoption of CC by small, dynamic companies from the IT sector may lead to a change in the nature of competition in this sector: lowering of CAPEX entry barriers will result in smaller companies more effectively competing with big ones. In this industry progress comes mainly from innovation, and lower financial entry barriers will allow creativity by larger numbers of businesses.

To make the macroeconomic balance complete it also has to include the losses incurred by businesses providing traditional IT services, hardware and software vendors and distributors. These losses will only be partially offset by new employment possibilities offered by growing adoption of cloud computing. In other words, cloud computing service providers will take over part of the revenues so far achieved by the abovementioned group of IT...
services and hardware providers. The traditional IT sector businesses will be forced to change their business profiles, a quite typical situation in this sector anyway.

**Effects in Other Sectors**

The most significant and obvious effect for businesses and organisations deciding to use CC is the lowering of IT-related expenditures. Lower costs combined with higher processing powers have numerous consequences, such as freeing of resources that can be allocated to other ends, improved operating effectiveness as well as productivity.

Studies based on face-to-face interviews with Polish entrepreneurs disclosed another benefit that had so far not been sufficiently noticed and appreciated. The possibility of cloud computing – due to low IT costs – leads to significant changes in business development strategies. The new possibilities generated by cloud computing drive company management to take on more daring, ambitious, experimental and thus innovative projects requiring IT support. Cloud computing allows such an approach due to lower and foreseeable IT costs. At the same time this means greatly reduced financial risk of venturing into innovation and thus results in businesses innovating more readily. This is very important in view of the relatively low general degree of innovation of the Polish economy.

Wider use of CC in central and local government administration and public services (health and education sectors) leads to improved citizen services. In Poland this opens up opportunities for an improvement in the public image of administration, and thus may lower the dissatisfaction with the level of public services. By positively influencing the effectiveness of public administration operations, the cloud also creates a better environment for development of entrepreneurship which has to go through the red tape.

There are promising prospects for the use of CC in education, commencing with primary schools, right up to universities. This concerns transmission of information by central and regional governments to schools, pupils, students and educators, as well as processing information for schools. Virtual dean’s offices, contacts between students and lecturers or transmission of the contents of the curriculum over the network are becoming standard in the Polish education sector, and cloud computing can provide the new stimulus allowing improvement of the quality of education.

The possibilities for application of cloud computing in the health service sector are also numerous and wide, assuming its full computerisation. They can lead to improvement of treatment thanks to easy access by doctors to patient medical files or extending the remote specialist diagnosing capabilities of, for example, X-rays. Integrated IT systems will also allow rational use of resources, e.g. effective supervision over prescriptions issued by doctors.

**Effects for Labour Market and Investments**

Lower IT spending by businesses and organisations due to migration to the cloud computing model means savings in IT spending, thus more money left in the tills. This opens up possibilities for creation of new jobs and investing the savings both directly in companies using cloud computing, and indirectly in other sectors of the economy.

A systemic effect of migration to the cloud computing model will be a more rational allocation of resources by businesses than with the traditional IT usage model. There is a reduction and – in a longer timeframe – elimination of effectively using only the small part of in-house IT potential, so common today. Migration to cloud computing means lower IT upkeep costs, as well as significant reduction of capital expenditures on IT infrastructure.

In the case of human resources, the cloud leads to growth in employment in the IT sector and sectors using this service. The effects will be diverse and related to sector specifics.
In the case of human resources, the cloud leads to growth in employment not only in the IT sector, but also in the sectors using cloud computing. The effects on employment will be diverse and related to sector specifics.

One has to remember that IT is an industry requiring frequent hardware and software replacements due to continuing development and progress, as opposed to other sectors of industry. Such savings – minus the costs of outsourcing, in this case cloud computing – may be spent on investments outside the IT area, but also in the IT area, however of a different nature than has previously been the case. Only a small part of these savings is spent on other objectives, such as increase in salaries or dividends for owners. Such behaviours are forced by ever growing competition both in the global and in the Polish economy in many sectors.

**EFFECTS FOR THE SME SECTOR**

Small and medium-sized enterprises, through the opportunity to significantly reduce the financial and organisational entry barriers concerning the use of IT resources, are gaining an extremely effective tool allowing very fast growth and high revenues. The potential scale of growth of SMEs in Poland when using cloud computing would not be achievable with the traditional IT model. Probably initially only a few representatives of the sector will succeed, despite attempts being made by many. The popularity of CC among small and medium enterprises will increase, however, as the number of successful companies in the sector grows. The spectacular successes achieved by small businesses thanks to the cloud are and will be a stimulating example to follow for others. The sectors with the best outlook for success through the use of cloud computing models in Poland are IT, commerce, media, and the hospitality industry.

The biggest benefits of cloud computing will go to SMEs – they will improve their innovation level and gain financial benefits (also through the ability to compete as equals with large corporations with a higher financial potential). The SME should see all the possible effects generated by CC, i.e. business growth possibilities, creation of new business projects and cost savings.

**ESTIMATED EFFECTS FOR GROWTH OF PRODUCTION**

The benefits of using the tools provided by the IT sector in business are obvious. IDC reports that every 1 PLN of revenues of Microsoft in Poland generated 11.45 PLN of revenues in Polish companies from the “Microsoft ecosystem”, i.e. those using the services and hardware offered on the Polish market by Microsoft.
A report published in February 2011 by the British Centre for Economic and Business Research (CEBR) contains a list of the sectors of the five largest countries of the European Union (Germany, Great Britain, France, Italy and Spain) most predisposed to benefit from cloud computing. These are: public services (education, healthcare service), the financial sector, retail trade, hospitality sector and processing industry. According to this report macro scale benefits in these countries between 2010 and 2015 will reach over 763 billion euros, and the number of new jobs will grow by 2.4 million. In our opinion the drawback of the CEBR projection is the use of only one scenario, and quite an optimistic one.

Another report by the International Thinktank on Innovation and Competition presents two variants of migration to cloud computing for the European Union's labour market. In the short term the EU labour market would gain 270,000 new jobs per year using the conservative scenario (gradual migration to the cloud) and 1.36 million jobs in the scenario of a boom in adoption of cloud computing. The numbers for Poland are 21,600 and 108,800 new jobs per year respectively.

According to estimates by Gdańsk Institute for Market Economics (IBnGR) the growth in GDP in 2011–2013 will in total gain between 0.5 and 0.9 percentage points as a result of development of the cloud computing model, depending on the scenario used.

In the case of employment numbers the forecasted growth would be from 75 to 150 thousand new jobs, where initially one third would be in the IT sector and the rest in the remaining sectors of the economy. In the following years the employment numbers in the IT sector would grow slower than in the rest of the economy.

The cautious (conservative) scenario assumes gradual and relatively slow decisions by businesses and public administration on the use of cloud computing; however, through positive experience in subsequent years more and more businesses will be using CC. In addition, businesses using CC will be expanding the scope of services in this model. The optimistic scenario assumes faster and more common decisions on outsourcing IT services, among others as a result of dynamic, frank and convincing information and marketing campaigns by providers of such services.

Among the most notable macroeconomic effects of the development of cloud computing the main consideration should be given to the growth of investments in the economy that will be possible with the savings generated in the business sector. An important effect that will also be indirectly visible in the macroeconomic scale will be the increase in competitiveness of businesses through more effective allocation of resources and growing innovativeness. Increased competitiveness of companies in fact translates to an increase in the competitiveness of the economy as a whole. This will be positively reflected in, for example, the balances of foreign trade mainly through increased improved capabilities to compete with quality, among others resulting from improved innovativeness.

The macroeconomic effects of the development of CC can more easily be assessed in terms of direction than precisely quantified. One has to remember that cloud processing is an important element of IT progress, but not the only one, so it gets in a feedback loop with other new uses and IT tools.

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FOOTNOTES


The award of the title and signing of the partnership agreement took place in January 2011.

Representatives of Microsoft and the Ministry of Foreign Affairs have signed a partnership agreement and declaration on collaboration, on the power of which the company will provide Poland for the term of presidency with licences for Office and Windows software and collaborate in communication and promotional activities supporting the presidency and events organised during its term.

This is not the first time that Microsoft has provided support and engaged in collaboration during the presidency of the Council of the European Union. Before the Polish presidency Microsoft supported among others the Spanish, Czech, Slovenian, Portuguese and Hungarian presidencies.
Cloud computing
results of a survey
of Polish businesses
The Gdańsk Institute for Market Economics (IBnGR) has conducted a survey indicating that Polish businesses more and more often use information technologies in their operations. Many businesses know the concept of cloud computing, but very many are still afraid of using this solution.

**BY > Krzysztof Łapiński, Bohdan Wyżnikiewicz**

It is more and more difficult to find a well-established company in Poland that is able to run its business without using the Internet. The web has become one of the fundamental sources of information, means of communication and sales and business contact establishment channels. Economic progress has resulted in use of the Internet becoming practically indispensable in the day-to-day operations of most entrepreneurs. Sure, there will always be businesses (particularly very small ones) and types of business where the Internet may be of absolutely no use. Nevertheless businesses striving to be innovative and interested in dynamic growth will not be able to achieve these goals without the use of new technologies, or will achieve them much later than their competitors.

Cloud computing seems to be similar – for many businesses it will become a necessity, as one of the basic factors enabling competitive advantage. In turn for some companies – due to the specifics of their business or their location – migrating to the cloud will not result in any economic benefits. Therefore in some cases lack of use of cloud computing services by entrepreneurs will be fully justified.

**KNOWLEDGE OF CC**

The survey conducted by IBnGR indicates that cloud computing as the new paradigm of delivery of IT services is still in a state of emergence and is not appreciated by Polish businesses. This to a large extent results from a great shortage of in-depth knowledge about this type of services outside the IT community. The very term “cloud computing” is not too familiar to Polish entrepreneurs. However, after hearing an explanation of this definition, that it is simply the rental and usage of IT resources or services over the Internet, the respondents said that they were familiar with this kind of service usage.

Only every fourth respondent declared a lack of knowledge of what cloud computing is all about. However, it seems that the result obtained may not fully reflect reality, as it is too optimistic (more on this further on in the report).

The results of the survey allow division of cloud computing services users into two groups – aware users and unaware users1. Aware users are those who at least to a general extent know of the cloud computing topic: they know exactly what CC is about, can distinguish between public and private clouds, recognise levels of CC services (IaaS, PaaS, SaaS) etc. Unaware users actually use cloud computing services, but are not fully aware of this fact.

When asked directly: “Are you planning to (within 12 months) use cloud computing?” only 8 per cent replied that they were using cloud computing already (figure 6, page 33). In turn ca. 67 per cent of respondents declare that they rent space on external servers hosting their company websites, and 49 per cent use external e-mail servers. After adding these two sets it turns out that around 69 per cent of entrepreneurs actually use cloud computing services, although only 8 per cent directly declare that they are using the cloud (figure 4, page 29). Thus we may conclude that a significant majority of Polish entrepreneurs are – according to the definition above – unaware users of services in the cloud model.

Thus, cloud computing is a service widely used by Polish businesses. However, it is not...
being concerned about if the external provider will meet customer expectations and provide uninterrupted access to rented resources, or whether it will not take any actions that may indirectly interfere with normal business operations.

Half of the entrepreneurs surveyed are concerned with a situation where data gets outside the internal channels of the company. Loss of one’s own control over data flows strengthens the concerns that information critical to the business may be put at risk. A physical elongation of information flow routes in a natural way increases the number of places where privacy may be compromised, faults may occur, data may be leaked or stolen, access to data may be blocked or data may be completely lost. Such situations may occur totally independently – the cloud provider itself may have no influence on their occurrence.

Other concerns were raised by entrepreneurs to a lesser extent. However, what is interesting is the relatively high percentage of businesses pointing to a lack of financial feasibility of the cloud computing model (18 per cent). So nearly every sixth entrepreneur points to exactly the opposite characteristic of the model than the one it should have. This may result from a lack of knowledge of cloud solutions or conviction or past experience that in fact traditional IT resource management models may be cheaper to upkeep.

Good protection of the cloud against viruses is not questioned by the respondents. The 2 per cent pointing to the risk of weaker antivirus protection shows that businesses do not consider outsourcing of IT resources as a factor that may increase the vulnerability of their systems and data to infection by viruses, Trojans, etc. In turn nearly every fourth respondent thinks that using the cloud may weaken corporate IT immunity to hacking and other malicious attacks.

It seems that, along with improvement of knowledge about the CC model, the knowledge of various types of associated risks is also increasing. After comparing the concerns expressed by people who declared they knew what cloud computing is about with the concerns of those not fully knowledgeable on the subject a conclusion may be made that the above statement seems sound (figure 2, page 29). The key concerns mainly raised by entrepreneurs in general were much more often indicated by those declaring knowledge on subjects related to CC (differences in the responses were between 15 and 21 per centage points). In turn the remaining risks, which in the general list did not play a significant role, were generally ranked
Concerns versus use
Biggest concerns of entrepreneurs related to CC and use of the cloud

Concerns versus knowledge
Biggest risk related to cloud computing and knowledge of CC

Biggest risks related to CC
Opinions of Polish entrepreneurs

Own or outsourced
How do you use the resources or services listed below?

Results of survey conducted by Gdańsk Institute for Market Economics on a sample of 170 businesses. Questions on the use of cloud computing were answered by representatives of micro-, small, medium-sized and big businesses.
higher by people with no knowledge about the cloud. This may mean that the biggest concerns of Polish entrepreneurs are justified, as they grow along with increasing knowledge of cloud computing.

What seem interesting is the large percentage of mentions of “loss of data” as one of the types of risks associated with CC by people without knowledge of cloud computing. This risk was indicated by 37 per cent of such respondents, which means it concerns them more than “lack of own control over data flows”, third from the top. In turn only 16 per cent of those with knowledge on cloud computing pointed to data loss as one of the biggest possible threats. It therefore seems that when using cloud-based solutions it is much more probable that data owned by the company will be illegally copied than irrecoverably lost. It turns out that better knowledge of the principles of operation of cloud computing may result in higher trust in certain aspects of the operation of this model. Lower concern with loss of data is a good example here. However, the link already mentioned – that better knowledge of cloud computing also means higher awareness of associated threats – cannot be ignored.

The perception of types of risks associated with cloud computing is to a certain extent influenced by the practical experiences of entrepreneurs. For reporting purposes the entrepreneurs designated as using the cloud are those who have outsourced their website hosting or e-mail system (ca. 68 per cent of those surveyed). The remainder are companies hosting their websites on their own servers as well as with their own e-mail servers (figure 1, page 29).

It turns out there are no big differences in indications by both groups, concerning the three key concerns of Polish
entrepreneurs (the maximum difference was 8 percentage points in the case of “lack of own control over data flows”). Double-digit percentage differences appeared in the cases of “High failure rates/frequent lack of access to resources” (13 percentage points) and “Loss of data” (14 points). Disconnection of access to a company’s own resources (in this case its own websites or e-mail accounts) was indicated more often by companies using external hosting. In turn this type of risk is indicated to a clearly lesser extent by companies with their own e-mail system and web servers. Thus, based on the experience of companies using services over the Internet it may be suspected that the transfer of some resources to an external company increases the risk of a more frequent lack of access.

Businesses using hosting less frequently indicate the possibility of loss of data than companies with their own servers. This to a certain extent confirms the prior statement that better knowledge of cloud computing techniques (practical, in this case) eliminates certain concerns, which in the case of less informed persons may be exaggerated. The order of key concerns is also confirmed by the distribution of replies in the case of the 8 per cent of respondents mentioned previously who declared that they used cloud computing. 79 per cent of them indicated the risk of a data leak as their key concern with cloud use. The next concerns were giving away control over IT resources to an external provider (64 per cent) and lack of control over the flow of data (43 per cent). Thus the two top categories were pointed to much more often than in the case of the whole surveyed group of entrepreneurs.

BARRIERS TO THE DEVELOPMENT OF CC

Polish entrepreneurs are of the opinion that the key factor hampering development of cloud computing services is mindset barriers – this factor was mentioned by 69 per cent of businesses surveyed (figure 7, page 33).

The main types of barriers include concerns with various types of risks associated with cloud computing and limited trust in new IT solutions coupled with an attachment to traditional models. According to ca. 48 per cent of those surveyed, widespread use of the model is limited by purely technical barriers. The biggest problem is the number and quality of Internet connections. Most businesses have a single Internet line, discouraging them from using the cloud, as such a solution does not practically assure uninterrupted access to resources. Migration to the cloud would mean the need to connect another circuit from another operator. Also low bandwidth of circuits would not appropriately protect the interest of entrepreneurs, as high transmission speeds are the necessary condition to comfortably enjoy the benefits of cloud computing. Entrepreneurs stressed that migration to the cloud creates dependence not only on its provider, but also on the ISP. The capabilities of the cloud will not be utilised if the ISP does not provide a high quality of services.
Lack of knowledge and legal barriers in the opinion of entrepreneurs are not the factors that significantly limit adoption of the cloud computing model. Such barriers were pointed to by only a dozen or so per cent of respondents. The lower importance attached to legal aspects related to cloud computing may result from a lack of practical knowledge about CC.

INFORMATION NEEDS
Nearly half of the Polish entrepreneurs surveyed do not need information on CC. On the one hand this results from some of them having the information about CC they need, and on the other hand they are not considering migration to the cloud, thus for them additional information may turn out to be of no use.

The entrepreneurs primarily need information on IT security and the potential types of risks associated with the cloud computing model. It turns out such information is much more often in demand than knowledge of the benefits available through cloud migration. This may mean that companies would be more willing to use CC if they had deeper knowledge about the security mechanisms that will be used in this model. Entrepreneurs value the IT security of the cloud in the first place; the potential benefits (financial and economic) seem to be slightly more in the background. Also the technical aspects of cloud processing do not seem to be the information most sought by businesses.

CURRENT SITUATION AND OUTLOOK
Nearly 80 per cent of businesses think that within the coming 12 months they will not be using CC. Three quarters think there simply will be no such need (figure 6, page 33). Such opinions in the context of knowledge of use by entrepreneurs of external services (website hosting and e-mail systems) lead to the conclusion that to a large extent companies do not consider such services as cloud computing.

Around 9 per cent of entrepreneurs do not intend to use cloud solutions mainly due to insufficient information about them. It may seem surprising that these respondents mainly indicated the cost of implementation (63 per cent) as the information they would need most importantly. Information on IT security and types of risks associated with CC took only second place – indicated by nearly half of this group of entrepreneurs (figure 5, page 33).

Every eleventh business does not intend to use the CC model due to possible related threats. The risks most often mentioned by these companies in general match the overall results. The top choices were: data leaks or unauthorised access to data, lack of their own control over flow of data and giving away control over IT resources to an external company.

Use of the benefits offered by the cloud was declared directly by around 8 per cent of entrepreneurs, and the next 2 per cent are currently at the CC implementation stage. A move to this model of IT resource management is being considered by every ninth company. The main reason for this rather reserved approach to cloud computing seems to be a strong attachment to the IT solutions currently in place.

More than half of the companies which felt that their IT resource potential was ceasing to be adequate for their needs expand it by buying hardware or software.
Results of survey conducted by Gdańsk Institute for Market Economics on a sample of 170 businesses. Questions on the use of cloud computing were answered by representatives of micro-, small, medium-sized and big businesses.
The benefits of CC in the case of urgent needs are used by only 2 per cent of entrepreneurs. These companies may thus more flexibly respond to new market conditions and therefore achieve a competitive advantage.

The survey was conducted by Gdańsk Institute for Market Economics on a sample of 170 businesses. The sample was selected randomly and was diversified in terms of size (micro-, small, medium-sized and large businesses), as well as by sector (industry, construction, banks, commerce etc.).

This kind of approach seems the most logical to entrepreneurs, despite the various imperfections of the approach, like for example the time and cost intensity of such projects.

A significant proportion of businesses do not also need flexibility in IT resource usage, as their current IT infrastructure has sufficient reserves of potential, and situations where a quick boost would be required typically do not occur. The issue of extra costs of maintaining surplus IT potential for longer periods of time is not considered by businesses at all (figure 8, page 33).

BIBLIOGRAPHY

FOOTNOTE
1. This is a completely different division from the one that may be found in many articles on CC, where aware users are typically deemed to be persons/companies aware of the benefits they may achieve from migrating their IT resources to the cloud.
RECOMMENDATIONS: HOW CAN THE CLOUD MODEL BE USED?

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58  THE CLOUD as a growth opportunity for small and medium-sized businesses
Cloud computing in practice
Four looks at cloud technologies
As the study by Gdańsk Institute for Market Economics shows, the use of cloud computing solutions has significant economic effects: thanks to lower costs the effectiveness of companies using this solution increases, while they also adapt faster to changing market conditions. Thanks to cloud computing new jobs are created throughout the economy, and GDP is growing too. THINKTANK invited experts and practitioners from four areas: the healthcare service, education, public administration and small and medium-sized businesses, for a discussion on cloud computing. This resulted in the development of a map of concerns, practices and recommendations.

In all four areas the recurring topic was the concern about the security of data stored in the cloud. However, after a closer look at the issue it turned out that these concerns were overblown. Data security in this IT model depends on the professionalism of the service provider, and with companies observing the most stringent standards, data in the cloud should be at least as safe as that stored in the classical model. The situation is similar in the case of the legal barriers most often pointed to by representatives of public administration (also in areas related to health and education). A detailed analysis of regulations indicates that in general there are no prohibitions to the use of cloud computing, although some of the regulations, particularly those concerning personal data, require further elaboration.

Analysis of barriers to the use of cloud computing in the four areas which were discussed by practitioners, experts, managers, representatives of public administration and academics indicates that the real challenge is psychological resistance: fear of the new and not fully known. Thus the challenge turns out to be mainly taming the new solutions and management of change.

Dispelling the concerns related to cloud computing will primarily require honest education that will change conventional wisdom. An important role here has to be played by the providers, who should explain in detail to the interested parties in what way services in the cloud are offered and what are their specifics. It may be expected that as awareness of cloud computing increases, so will the number of its implementations.

Let's take a look at the detailed results of the expert discussions.
The decision-makers responsible for computerisation of the healthcare system are facing a difficult task. Organisation of this system has a bearing on the health and lives of citizens. Most developed countries spend large amounts of money on this sector; according to the Organisation for Economic Co-operation and Development, in 2007 spending on public health in Poland was 4.6 per cent of the GDP, while at the same time in Germany it was 7.8 per cent. The health service market players are private businesses (single-doctor practices, small clinics, businesses offering a full range of medical care), as well as state-owned (large hospitals) and those of local governments (county or district hospitals). Such diversity of players results in difficulties in implementation of an IT systems – different owners may have different visions of computerisation. The system stores highly sensitive data – patient medical records – so the question and at the same time concern about their security and the patient’s right to decide about their disclosure keep coming up over and over again.

EASE OF IMPLEMENTATION

Can cloud computing overcome the barriers to computerisation of the healthcare service? One of the key advantages of the cloud – regardless of the sector it is being implemented in – is low service entry costs. Analyses of the possibilities of development of a centralised system for healthcare management revolve around hundreds of millions of zlotys and a project that will take years to complete. Practice shows that implementing large host systems, due to their scale, encounters many problems related to, among others, reaching a compromise as to their structure and finding funding on such a large scale, and their commissioning suffers long delays. It might turn out to be much more efficient to perform much smaller implementations, e.g. on the scale of a region.

Implementation of ICT tools at an even lower level – in a single hospital, especially a small one – may be most effective using the cloud model. Construction of a server room, purchase of hardware and employment of staff for its maintenance and operation, are moves that do not find economic justification. Particularly so, as initially the latest tools will not be used by all doctors, but only by the group of early adopters. In the cloud...
model the hospital manager may purchase accounts only for the most innovative doctors to allow them to offer their patients additional e-services. Implementing a project on this scale means monthly spending of several hundred zlotys instead of tens or hundreds of thousands in the case of a hospital keeping its own server room. The cloud allows system scaling, that is opening accounts for other medics who decide to use the technology.

PATIENT DATA DISCLOSURE

In IT, cloud computing means the creation of a “computing cloud” consisting of servers and IT specialists who operate them, but this technology also allows the creation of “clouds” consisting of doctors of various specialisations. An IT system allowing instantaneous retrieval of data on patients (results of examinations, treatment history, prescriptions issued, etc.) facilitates diagnosis of difficult cases by renowned doctors. They will not have to receive information about the patient’s health; it will already be in the system – the cloud. All it will take will be for the hospital to contract a consultation service, and specialists will analyse the test results and issue recommendations on further treatment.

A cloud may also be used to provide access to other medical services, like X-ray examinations or various diagnostic tests. The image or result of the examination will be sent to a centre analysing all results and the doctor in charge will receive the analysed test or examination from there. Such a scenario is achievable without the cloud; however, assuring as fast communications as possible between centres will be more difficult, as sending files by, for instance, electronic mail, will unnecessarily complicate the entire procedure.

The important aspect of cloud-type solutions is that they allow creation of secure systems, with security mechanisms exceeding the standard solutions and allowing access only to authorised persons.

ANALYSES AND FORECASTS

A healthcare system using modern IT tools in the cloud gains advanced reporting and analytical abilities as well capability of forecasting based on the data collected. An example here could be the analysis of historical data of flu incidents and forecasting demand for vaccines or numbers of hospital beds required in the following year. On the scale of a national healthcare system, when decisions concern the safety of millions of citizens and spending large amounts of money, every possibility of optimisation of decision-making is valuable.

It is possible to analyse data both of a medical (e.g. incidence), and financial nature (cost of treatment of specific diseases), as well to detect fraud by trapping exceptional data (e.g. a sudden boost of sales of specific medication refunded by the state due to prescriptions issued by a single doctor). Such systems may be implemented both using the classic IT model and in the cloud. As the operations they perform require instantaneous processing power boosts, the cloud service would allow processing power peaks to be ordered for specific needs without the requirement to build one’s own data centres.
SHARING OF MEDICAL DATA

There is a growing need to share medical data between service providers and the payer. This process is complicated, as not only in Poland the healthcare system is becoming more and more diversified. It includes many players with different owners: from small single-doctor practices (e.g. GPs or dentists), through private clinics and hospitals, local government facilities, up to state-owned big hospitals and others.

Thus the structure of a healthcare system is complicated, and the patient has to move between the independent parts of it, resulting in problems with transferring his medical records. The necessity to have examination and test results only in paper form is quite burdensome, as in the case of chronic diseases it forces the patient to move from specialist to specialist with a paper file and in the case of therapy lasting many years examination results may get destroyed or lost. Using the results in digital form becomes a necessity. But IT systems developed by different players may turn out to be incompatible. There will also be a problem with porting the data between various medical establishments. Use of various data media for this purpose, such as DVDs or USB sticks, causes additional threats. A need then arises to assure antivirus protection, lack of backup copies and problems with device compatibility, lack of compatible readers (not all netbooks and laptops have DVD drives) or formats.

These problems may be overcome simply by service providers locating patients’ medical records in an IT system that can be placed in the cloud. In the case of smaller players launching such a system in the cloud model will be easier to achieve because of the much lower initial investment requirements.

Another matter is the interconnection of such systems owned by individual establishments (hospitals, university hospitals and clinics), allowing both a doctor in his private practice and a specialist at a university hospital to access a patient’s data using a computer. If the system is not a standard imposed by the regulatory authorities, the patient himself should require that his information be entered into it (e.g. the latest examination results or X-ray scans). This will facilitate access to up-to-date information by the doctors the patient discloses his digital medical records to.

Another solution could consist of creation of a central system which would not retain patient data, but data on where such information is stored (which healthcare establishment examined the patient and has the results in its system). Due to the diversity and number of players in the healthcare system, cloud computing is a good way to connect independent entities to the IT system. The Polish Ministry of Health is working on implementation of this kind of IT system. Thought should be given to whether implementing it in the cloud model would not be a better solution.

The role of systems containing the complete medical records of patients, working together thanks to standardisation of interoperability, accessible with access control to all
medical services, is crucial in urgent situations. For emergency rescue paramedics the knowledge of, for example, allergies to medication of accident victims is very important and practically invaluable for the patient. Diagnosing an unconscious victim taken by ambulance to a hospital will be very much faster if it only takes a few clicks to check which chronic illnesses the patient may suffer from.

Access to a patient’s complete medical records in a single place may save his life in emergencies and in the scale of an entire country generates huge savings. Having all the test results in a single place, the doctor does not have to request their repetition. Patient recovery may also be faster – instead of waiting for another result of the same repeated test, the doctor will be able to progress with therapy faster. There will also be better control over undisciplined patients who generate large costs to the system by not informing doctors of the results of procedures conducted so far, having them performed once again “just in case”. If complete information about a person is in the cloud, the patient will not be able to withhold information that he has recently been examined. Hospitals will also not order tests they are not able to justify with medical reasons, as the payer will be able to audit the patient’s treatment and question unjustified expenses.

Control over doctors’ work will also be better – the hospital manager will be able to check how many tests of each type are ordered by individual doctors. Should any of them exceed his authorisation and order certain procedures twice as often as other doctors at the establishment, the supervisor might ask him to explain his decisions. Limiting unnecessary medical procedures and lab tests will improve the financial situation of individual medical establishments and on a system scale will yield savings in the millions.

THE CHALLENGE

The development of cloud computing systems in the healthcare sector currently encounters barriers delaying the pace of migration to this model of IT resource management.

The absolute priority is to assure data security – medical records which are helpful to doctors during treatment are the most sensitive personal data. A situation where patient health status information is disclosed to that patient’s insurer, employer or other unauthorised persons is inadmissible. Preventing such a situation requires precise and unambiguous regulations. Lack of or ambiguity of regulations results in concerns with cloud implementation and also lowers the security of the entire system.

The Polish act on personal data protection allows medical data to be processed on condition of “assurance of full guarantees of (its) security”. Unfortunately this term is not precisely defined, resulting in a lack of certainty for those responsible for the process of data collection and processing if their methods of operation are compliant with the act. The basic problem is legal regulations – their lack or imprecise provisions result in fear of using the cloud. Private healthcare establishments, which are significantly more advanced in the use of IT than the public sector, currently process patient data in a private cloud – a data centre provides services to hospitals or clinics owned by the same business. Until recently there was a prohibition on storing patient information outside the entity that produced it. This meant it could not be transferred to, for example, an external cloud services provider; all that was possible was to create a private cloud where a hospital network gathered all its data in a single place. Currently the regulation does not directly prohibit using the public cloud, but its wording does not unambiguously define if it is admissible. Although hospital managers would gladly move this part of the business to CC to focus on development of medical services, at present they have to build their own server rooms and manage them.

The percentage of Polish hospitals where most of the medical personnel have access to the Internet. Source: Healthcare Information Systems Centre, 2010
The existing legal restrictions are related to concerns about security of data that in the case of health is highly sensitive. Information Security Administrators (ISAs), responsible for data security in organisations, as they are walking on uncertain ground, to be on the safe side recommend solutions that are not controversial from the point of view of the law, yet not always the most secure.

Besides making the regulations more precise, it would be helpful to have legally defined standards on the security of services offered by cloud providers. They should define the conditions of storage of patient data and data protection mechanisms, but without defining specific guidelines on technologies and solutions. Setting such security standards will make them independent in a time of a dynamically changing technology environment and will introduce competition between entities on the protection used. A good step in this direction is the draft ordinance on the National Interoperability Framework, the minimum requirements on public registers and interchange of information in electronic format as well as minimum requirements for ICT systems. This ordinance proposes clear and transparent principles concerning both the interoperability of systems and the minimum requirements they must meet – among others concerning their security.

Having vast volumes of data, it is necessary to specify which data should be made available to other entities. These could be both state agencies (e.g. data for the Polish Central Statistical Office), and private establishments (e.g. pharmaceutical companies). Anonymous data provided to e.g. the Central Statistical Office would allow significant reduction of costs of development of statistics for the healthcare sector, primarily those concerning the health of Polish citizens – the Office would not have to research or estimate many areas, receiving ready and very precise data instead.

Such information may also be useful to the private sector – pharmaceutical companies or hospitals. They could better allocate funds to research and adapt the network of hospitals and numbers of hospital beds to the real needs of the patients if they had information about incidence, length of treatment, complications, etc. The practice of providing data is quite popular in the old EU countries and is not surrounded by a climate of suspicion – the better adjustment of the private sector benefits patients themselves and data is made available on the same principles to all entities.

Better Use of Data

An important question is the appropriate location of the IT system, accepting responsibility for its upkeep, development and generation of reports and forecasts for the healthcare system on its basis. Bottom-up initiatives appear at the level of hospitals or regions, but creation of a central IT system requires that it be developed so that the Ministry of Health can use it to organise the functioning of a national healthcare system in the best possible way for the benefit of patients. The place where all data would flow to could be the National Health Fund, which, as a payer, has to record all events; it could also be the Healthcare Information Systems Centre, with observance of applicable organisational and competence procedures for this institution. What is important is to have the competences and scope of data processing by individual agencies defined, and that the decisions made by authorised persons be based on trustworthy analyses.

Progress Bonus

For the private sector using IT tools in healthcare is something natural – IT solutions are used by shops, wholesalers, petrol stations, banks and other businesses. The healthcare sector is not an exception, and in their quest for maximising the effectiveness of their operations organisations reach for all

Currently the regulation does not directly prohibit using the public cloud, but its wording does not unambiguously define if it is admissible.
available IT tools. In the case of state-owned establishments the matter of implementing optimal solutions is not as simple. First of all, the current model of billing the payer (that is the National Health Fund) does not promote the use of more advanced tools or improvement of efficiency. A hospital or clinic is paid per event, i.e. the service rendered, regardless of its standard. The same amount will be paid for a cardiology consultation of a patient to an establishment allowing the visit to be booked remotely via an electronic system, and to one where the patient had to come in person in advance and spend several hours in a queue to the reception desk to arrange for the date of the test.

Though private establishments will implement all possible solutions to lower costs and improve their efficiency, state-owned establishments approach the topic of implementing new technologies and optimisation of its operations at arm’s length – in their case it is more an issue of the good will or personal commitment of the management. As long as the payer (the state) does not introduce bonuses for improvement of quality of services, we will have more of a crawling computerisation than a revolution.

Computerisation of the healthcare sector is a process that is already taking place and is irreversible. Such a complicated system cannot be managed effectively without appropriate IT tools. It is mainly the patients who exert pressure on speeding up this process – today’s 20- and 30-year-olds use computers every day, share information on community portals, and contact their banks only through the Internet, so for them dealing with health-related matters in the same way is only natural. In the public sector the leader will probably be the local governments keen to raise the attractiveness of their regions to citizens. Cloud computing may speed up implementation of modern technologies in the healthcare sector.

This article was written based on a roundtable discussion attended by: Albert Jarosz (IT systems development manager at Medicover), Adam Koprowski (European Commission expert on computerisation of the healthcare system), Krzysztof Łapiński (expert of Gdańsk Institute for Market Economics), Andrzej Strug (IT department director at the National Health Fund), Dariusz Śpiewak (vice-president of Social Security in charge of IT) and Dr Bohdan Wyżnikiewicz (vice-president of Gdańsk Institute for Market Economics).

THINKTANK RECOMMENDATIONS:

1. PROCEDURES AND APPROPRIATE REGULATIONS SHOULD BE DEVELOPED to allow those responsible for IT in the healthcare sector to move to CC in a legally sanctioned way. Creation of such procedures may be aided by active dialogue between the regulator, technology providers and healthcare system stakeholders, as well as exchange of experience.

2. IMPLEMENTATION OF MODERN IT TOOLS should be associated with simultaneous reorganisation of management processes in healthcare establishments, creatively using the possibilities offered by these tools.

3. WHEN MAKING ANY DECISIONS, THE HIGHEST PRIORITY SHOULD GO TO THE GOOD OF THE PATIENT, understood among others as improvement of efficiency of treatment through access to more complete information, or assuring better accessibility to services through better management of healthcare spending thanks to the support of IT tools. When implementing these objectives, patient data security must be borne in mind.
A modern innovation-based economy needs employees educated in a modern way. At the same time, today’s pupils, just like their parents and grandparents, go to schools with schoolbags full of textbooks and exercise books, and their contact with modern technology at school is limited to one or two IT classes a week. School has not changed very much for over a hundred years, while the education process today may be supported with the latest technologies.

Pupils should get computers allowing them to benefit from modern methods of teaching. And the textbooks themselves should end up in the cloud, that is on a server that can be accessed by any student.

In fact the very word “textbook” no longer makes sense, as well-developed educational content is not a scanned-in book, but an e-learning platform allowing interaction, enriched with exercises, tests, puzzles and audio and video content. It seems that an ideal education system would be one where pupils using advanced devices get access to the interactive multimedia content located in the cloud, which is continuously enriched and updated by specialists from the applicable domains.

AWARENESS OF BARRIERS

One of the most often encountered barriers is legal limitations. Public administration (and the education sector is in general a part of it) is quite conservative, and a lack of appropriate regulations results in its reluctance to implement new solutions that could be questioned by higher-level authorities. This was the case with electronic school registers: initially headteachers did not know whether they could use them as a replacement for printed registers. Thanks to an ordinance by the ministry, the installation of e-registers commenced on school servers. Concerns with moving this service into the cloud arose from a prohibition on removing registers from school premises, and transferring them to external servers meant exactly that. Currently the regulations allow use of school registers in the cloud model, which is much more convenient – in the case of ready-to-use applications all it takes is to set up an account.

Various regulatory gaps or missing legal interpretations of processing data in the cloud may be eliminated by the legislator and competent authorities through creation of educational laws.
taking technology progress into account to a greater extent, as well as by issuing precise interpretations of existing laws.

In Poland a barrier to the development of cloud computing (CC) in education is also the availability and bandwidth of circuits. The fastest lines in the world are in South Korea: according to a measurement performed by Akamai the average line speed in 2009 there was over 14 Mb/s, while in Poland it was 3.6 Mb/s, though outside of big cities this is more a dream than reality. One of the problems is insufficient access to the web by both schools and schoolchildren. According to the European Commission’s report on the progress of the Digital Agenda, by the end of 2010 only 56.8 per cent of households in Poland had broadband Internet connections. Over 50 per cent had a bandwidth below 2 Mb/s, significantly limiting the possibilities of multimedia content distribution, for example video streams.

The situation with access lines will improve with time, but Poland has a long way to go to have such widespread Internet access as, for example, Finland. In this country since 2010 access to a 1 Mb/s circuit is legally guaranteed by the state. Polish schools are short of modern computer hardware for pupils, while at the same time many cost items – direct and indirect – come from the administration of school servers.

There is also a problem in the age of hardware in Polish schools. When implementing education reforms in 1999, the then Ministry of National Education released funds for purchase of hardware, adaptation of classrooms and training of teachers. In total over 300 million PLN was spent. Then, thanks to the accession to the European Union, Poland obtained funding from the European Social Fund and hardware for over a billion zlotys was purchased. Unfortunately, many years have already elapsed since these two waves of purchasing. Moore’s law states that the processing power of computers doubles every two years. And therefore, after so many years since purchase, many computers in Polish schools will not run advanced interactive and multimedia applications.

We can expect that a reduction in the number of paper books or their total elimination in favour of the interactive applications available in the cloud will cause a reduction in costs of accessing knowledge. Probably this will not happen immediately, but after a certain time, when the number of pupils and students using CC grows and the cost of access to content per pupil drops. Initially no rapid decrease in prices should be expected, as the publishers will have to recreate the contents enriching e-textbooks with interactive elements, buy the copyright to movies or audio records, produce animations, etc. With time the cost of these elements will depreciate and a publisher who develops good content will be able to focus only on its ongoing updating, which will be much less expensive.

Teachers, who are at very different levels of competences in using new technologies, are concerned with coping with modern equipment. Particular discomfort may come from situations when pupils, who do not know a world without computers, Internet or cellular phones, may turn out to be more proficient in using modern tools. It is a natural fear...
of loss of authority. Therefore teachers who for many years have worked in traditional ways may approach cloud computing with caution.

This may be overcome only by appropriate training and assistance in understanding modern technology solutions. When planning the implementation it must be assumed that one training session will not be enough – preferably the need for perpetual training should be considered, at different levels, presenting novelties and benefits from new technologies, that will remove concerns with time. This was the case in Portugal, where under the Magellan education project 30 thousand teachers were trained.

NEW QUALITY WITH THE CLOUD

The use of cloud computing in education primarily has an influence on the content that pupils are studying: its quality, pace of updating, customisation to individual pupil needs; the education process itself, and in particular on streamlining communications.

Cloud computing may have an influence on raising the quality of content. This requires a total change in the way of thinking by existing publishers of schoolbooks. As much as so far they dealt with printing books, where the text, tables, graphs and photos were important, in the cloud model they will have to additionally produce attractive but also substantially well-prepared multimedia content. Besides the text, pupils will be able to study video clips or animations or listen to archive audio recordings. Therefore, when thinking about the 21st-century school one must remember that the appliances used by pupils should be versatile, with extensive capabilities and assuring maximum interactivity. For children from the least affluent families these can be the only devices of this kind they have, so equipping them with simple text readers will only widen the digital exclusion and differences among young Poles. If we want real 21st-century education, we may not base it only on transposing paper content to digital format, we need completely new solutions.

The most important change that transition to an e-learning platform offers is establishment of interaction between pupils and the educational content. With paper schoolbooks a pupil or student could only read the materials, and possible tests had to be checked and explained by the teacher. The cloud allows for interaction with an e-textbook. Pupils may not only solve multiple answer tests, put certain elements in the right order, etc., but in the case of certain materials not constituting a knowledge validation test also see the right answers, learn the reasoning, and study additional materials. Technology allows a lot, and a completely new approach by schoolbook publishers and authors is required – they have to go through a revolution currently affecting press publishers already testing new content presentation methods on the Internet and more and more often reaching for multimedia.

A cloud-based educational platform may be used to create a new form of interaction, known from community portals – gamification. By completing exercises, as a reward for tasks completed, they will get access to attractive educational materials, like an interesting movie related to the current topic. This mechanism is known from computer games: a player's avatar, after completing tasks, develops and receives new capabilities, passes to the next round, etc. Also competition between pupils is possible, for instance a scoreboard showing who took the shortest time to complete an exercise or got the most points. Besides competition, cloud computing may open up new possibilities of collaboration between pupils: tools such as wikis, forums or file-sharing may facilitate working together on projects. This is very important for development of a modern education system – a 21st-century economy needs creative employees who can collaborate with others, because this is how they will be solving problems at work. A school where most importance is attached to writing essays and tests is not a modern one.
What is also very important is fast content updating. In a traditional schoolbook, in the case of latest discoveries or research results, in the best case they reached pupils or students in the next school or academic year; in practice this process takes a few years. Until that time students may supplement their knowledge with secondary sources (newspapers, blogs, portals, Wikipedia), but their credibility and quality is sometimes problematic. Frequent updating will allow assurance of diversification of content or presentation of various approaches.

Although philosophy or maths textbooks do not require too frequent updates, in the case of economics, management or IT it is important. The cloud allows digital textbooks for these subjects to be updated on the go with case studies and reviews of recent events, such as the fall of Lehman Brothers or Greece’s financial problems. The best form and currency of content would be taken care of by publishers and teachers. The education platform – or rather platforms – should provide applications (e-textbooks) written by different authors and published by different publishing houses, as in the case of today’s traditional textbooks. Selection of the platform and content provider should be the choice of the teacher, allowing him to use the materials he finds most appropriate. This will assure adaptation to pupil needs and also appropriate diversification – there will be no situation where all the pupils learn exactly the same schematic problem resolutions. The state’s duties should include appropriate stimulation of competition between publishers, so that subsequent editions, or rather releases, of e-textbooks would be even better and the authors would not be concerned with piracy. It would be an error in fact to call for tenders for a single educational application with free-of-charge access. Although at a first glance this model looks very attractive, in a short time the quality of the e-textbook would start to decline, and the publisher would just focus on meeting the terms of reference of the tender.

The cloud can host practically any amount of data, providing the possibility to create content better adjusted to the needs of various pupils. A standard hardcopy textbook contains a few extra exercises for the most talented pupils; in the cloud model exercises may be available on many difficulty levels which will be made available by the teacher on the basis of the progress of individual pupils. Where this is reasonable, the same content may be prepared in various formats: visual learners will prefer reading the text, while auditory learners may choose the audio version of the same material. In this way everyone will be able to learn in a way they are most predisposed to.

The possibility to adapt the educational content to pupil needs is particularly important in the case of pupils who do not match the standards in the education system: both very talented pupils (exercises and materials extending beyond the curriculum), as well as less talented or with disabilities (the possibility to magnify sections of text, having the material read aloud, etc.).

Decreasing the costs of access to educational content and its better adaptation to individual pupil needs will help in providing equal opportunities to pupils and students threatened.
with exclusion. The education system, particularly at the primary and secondary level, should cater to the needs of the less capable. Well applied education tools hosted in the cloud open up the possibility of providing equal opportunities to the excluded individuals and at the same time offering support to the development of the most talented through a better match for the needs and capabilities of pupils.

The benefit of implementing the educational platform in the cloud model is improved organisation of the teaching process. The progress of pupils and the work of the teachers in the traditional teaching model is checked quite randomly: the whole class gets the homework, but only one person has to present the solution on the blackboard. If pupils or students are obliged to put their homework results on the educational platform in the cloud, the teacher will have to check everyone’s homework. The teaching process conducted in the cloud is more transparent – the progress by the pupil is visible, as is the work by the teacher, who posts additional educational materials on the platform.

Currently computer science teachers at schools often have to wear two hats – besides teaching the subject they have to be administrators: manage the server, take care of its security, apply timely software upgrades (security-related as well as education-related), and make sure applications work correctly, which means maintaining individual computers. In some schools, to relieve them, additional school computer network administrator positions are established.

**Transition to CC solves two issues at the same time – security and focusing on the teaching process alone.** Security is assured by the cloud provider with a professional data processing centre, backup copy procedures and the latest and probably most threat-resistant version of software. Locating the platform and its related data, like the work by pupils, in the cloud means
that even a most severe failure of computer hardware in the computer room will not threaten the data – the cloud will always keep it up to date; the computers just have to be repaired and all work progress will be there. Also the school e-register, mentioned earlier, will be much safer on the server of a professional provider, and pupils who might be tempted to tamper with it will have no physical access to it. If we assume that the amount of computer hardware in schools will be increasing, the problem of assuring security will gain in importance and become more costly (the need to employ a larger number of administrators), and it therefore makes sense to leave as many functions as possible in the cloud.

Cloud computing also means reduction of hardware management at school to a minimum – there is no need to maintain a school server, as all that is needed is a router assuring connection to the Internet, and application management comes down to making sure that the computers of pupils and teachers are running the latest version of the Internet browser. The computer science teacher may focus on teaching instead of server administration, and there is no more need to employ additional people to support the school’s IT.

It also streamlines the communication between pupils and instructors. Instead of sending term papers by e-mail, a common practice today, they are posted to a defined place in the educational platform. This makes file management easier: lecturers work at different places and check the papers using devices at home and at the university. Collecting files of students from the same university on the platform facilitates order and work.

Also the relations between the school and parents change: a child’s progress or absences can be monitored on the go by custodians online. The cloud-based application also sends them information about parent meetings, class excursions, etc. Since at parent meetings the teachers do not have to inform parents about their children’s grades, as they know them already, more time is left for individual discussions on the progress and conduct of children.

CHALLENGES TO BE CONSIDERED

Moving education to the cloud model also causes certain challenges to be taken into account. A bad decision by the regulator of the education system about implementing a central cloud and locating in it the only binding e-schoolbook would result in excessive unification throughout the whole system. Great Britain has coped with this problem by not implementing a nationwide education platform, but 16 regional platforms instead. The platforms should also host the educational applications of many publishers and authors. Teachers will be able to select from among them, as well as host their own materials or tests. This solution will provide for diversity.

If we have gained certain education at some stage of our life, we must be able to officially prove it, for example to the employer or when wishing to pursue higher education levels (like postgraduate studies). A complete transition to digital forms of documents certifying education and stored in the cloud may cause their loss (e.g. due to closure of the school or university) or a data format mismatch. A solution could be to place in the educational system an IT platform that would be a place of certification of the education credentials of citizens. Such an information database, organisationally located at the ministry responsible for education, will assure its continuity of existence and compatibility of data formats, allowing all those concerned to confirm the education of a given person.

Finally, when considering e-education solutions, one has to remember about the social functions of schools. A project of a school where the teachers contact pupils exclusively using new technologies has not yet been implemented. An educational platform located in the cloud is an excellent tool to support the teachers. But one must not forget the great value of direct encounters between pupils and instructors and other pupils, their interactions and the opportunity to hold discussions or conduct experiments – this too is a task of a school, one which cannot be achieved completely in the virtual space.
HOW TO CORRECTLY IMPLEMENT THE CLOUD IN EDUCATION

Use of cloud computing in the education process requires the same approach as any other IT implementation – just putting up the servers with software installed is not sufficient alone. To make the transition of the education system into cloud computing an important step to society, it must be part of a bigger project covering various initiatives and all stages of education, so that contacts with modern education are not severed when progressing to further stages of studies.

An example could be the Portuguese Magellan project, where pupils have bought half a million laptops subsidised by the state. The programme also included teacher training among others. Portugal has noted the biggest improvement in the PISA educational test conducted in the OECD countries. A project in Romania consisted only of distributing laptops to children, resulting in a worsening of the results of science tests.

In an innovation-oriented economy education is a capital we provide to the next generations. Today’s wrong decisions, using old ways of thinking, may condemn pupils and students to a loss in the global competitive race.

This article was written based on a discussion attended by: Dr Michał Goliński (Head of the Centre for Information Economy and Information Society at Warsaw School of Economics), Krzysztof Łapiński (expert of Gdańsk Institute for Market Economics), Dr Krzysztof Pawlowski (Rector of National-Louis University School of Business), Professor Maciej M. Sysło (Faculty of Mathematics and Computer Science of Wrocław University and Mikolaj Kopernik University of Torun), Leslaw Tomczak (director of Regional Centre for Computer Science and Technical Sciences Qualifications Improvement Centre in Opole) and Dr Bohdan Wyznikiewicz (vice-president of Gdańsk Institute for Market Economics).

THINKTANK RECOMMENDATIONS:

1. EDUCATION SHOULD BE A PROCESS THAT SUPPORTS DIVERSITY: the state administration should stimulate competition for quality, and multiple Internet platforms should contain materials with diverse contents. This will allow teachers and academic lecturers to make the right selection of support materials. Low price should not be the most important criterion in selection of e-textbooks.

2. WHEN IMPLEMENTING THE EDUCATION PLATFORM it is important to transform the teaching process and the processes of communication on the pupils–teacher–parent axis and adapt them to the possibilities provided by new technology.

3. BEFORE NEW EDUCATION TOOLS ARE USED IN EDUCATION teachers must be trained in their use. The new working methods will not work without preparing academic and teaching staff to use them in advance.
Why now?
Computer industry innovations create new possibilities for societies, beginning with “a computer in every home”, up to cloud computing. The latter means the possibility of using processing power we do not own, but located somewhere in the “cloud” of remote networks.

What’s new about this? This concept is surely known to everyone using network services to manage and store their data “on the web”, such as Hotmail for e-mail and Flickr for photos. At the same time businesses and public administration prefer to keep their data in their own IT systems to keep full control over it. However, as costs are decreasing, interest in alternative approaches increases. Cloud services are currently more reliable and provide such users with wider possibilities. Huge data processing centres provide economies of scale, decreasing the costs of using the processing power on a pay-per-use basis. It is just like with electricity, where we do not have to have our own power generators – we plug devices “into the wall” and pay for the energy they consume.

New possibilities for Europe
Thanks to reductions of costs and entry barriers to the software developer market, cloud computing may be the “medicine needed for our [European] credit-squeezed economy” – said EU commissioner Viviane Reding. To put it more simply, both users and developers will be able to do more with less, having access to greater processing power without the need to put large amounts of money up front for hardware investments.

These new possibilities stimulate innovation. Under the framework of the BizSpark programme, which helps start-up companies by providing them with software and technical assistance, many among the 8 thousand participating European companies are already providing services in the cloud model. Cloud-based resources help companies such as Lokad from France to offer powerful tools forecasting, for example, the sales figures in big retail chains.

As time goes by, all organisations, particularly enterprising small and medium-sized businesses, will be interested in using computer resources they could previously not afford, which will allow them to increase productivity and grow their markets.

New obligations
Before the promise of cloud computing becomes a reality, we must all gain more trust in the security, confidentiality, portability and availability of our data. We must have a cloud that is secure, open and interoperable – protected against thieves and hackers and at the same time providing an open platform for exchange and storage of information for all citizens of the world. We need reliable communications. Rational questions point to the obligations imposed by cloud-model-based services.

Are we sure that our data is secure and safe and available whenever we need it? If you live in one country and your data is stored in another, which legislation is it subject to and are the rules consistent?

Both the industry and state administrations have extensive experience allowing them to deal with these dilemmas. Current IT trends have the potential of huge savings, flexibility and growth. However, when implementing emerging cloud services we must also meet the basic requirements for management of data of users. Microsoft is collaborating with customers, partners and national governments to allow Europe to benefit from its cloud potential.

For additional information visit:
www.microsoft.eu
There are not many sectors operating on as large a scale as the public administration – its customer base includes all citizens. In Poland this means providing services to over 38 million clients.

Due to an increasing number of regulations and growing range of obligations of the state towards its citizens (including healthcare, retirement pensions, disability pensions, allowances, education, road and rail infrastructure, zoning plans, tax collection, various registers and many others) the number of tasks to be performed increases too. At the same time due to limited public funding the pressure is increasing from public opinion for more rational spending of public funds. Public administration has been using IT tools for several decades already (the first implementations mainly supported the creation of data registers). Today, however, it needs more advanced tools to meet new challenges.

Without them, analysing the collected data and providing it to citizens or forecasting is quite time-consuming and overcomplicated. More and more central or local and regional government agencies are implementing IT systems. However, due to the scale of such projects, it is often a long-lasting and costly process. A good example here may be the Polish Ministry of Finances – due to the number of entities it serves (all taxpayers, both private and incorporated) and very large financial database, it is continually expanding its IT systems. At a certain point in time the ministry employed over 1300 IT staff! On the one hand this demonstrates the immense IT needs of the state, and on the other the scale of problems and costs related to the development of IT systems in central government agencies.

Implementing huge elaborate systems in public administration translates to: time-consuming tenders for procurement of hardware and software, employing teams of people, organisation of work to assure hardware and software maintenance, security-related updates, production of backup copies, development of procedures, implementation of supervision tools to enforce compliance with them, etc. All these activities are expensive, commissioning takes plenty of time, and when

Cloud computing and administration

To operate effectively, the public sector more and more often needs information technology tools. Most IT solutions are implemented using the traditional IT resource management model, i.e. utilising in-house infrastructure and IT staff. However, cloud computing solutions are much more effective – the state may use them while assuring the required level of security and without breaching the regulations in force.

By Edwin Bendyk, Jan Maciej Czajkowski, Krzysztof Łapiński, Rafał Malujda, Kajetan Wojsyk, Bohdan Wyżnikiewicz
Percentage of GDP spent by the public sector in Poland on modern technologies.

By way of contrast – in North European countries this percentage is twice as high.

Source: Boston Consulting Group, 2011
hosting their data or techniques used by the provider. In the case of large projects the cloud provider of course gives detailed information on the terms and conditions of its provision; a conscious user should also be interested in acquiring this information.

**HOW TO COMMENCE A PROJECT**

A big challenge – both in legal and technical terms – lies in proper planning and execution of the call for tenders for the delivery of cloud computing services. The main difficulty is correct preparation of the terms of reference, e.g. defining the processing power requirements, disk space or connection bandwidth. In the case of building a new system from scratch, these have to be estimates of varying degrees of accuracy.

Underestimating demand will result in the need to amend the contract soon to increase the order, causing public auditors to question the fairness of the contract award procedure, if the lowest cost bid was selected and the contract with supplier was soon amended to extend the scope of services and fees. Overestimating the needs will result in the opposite situation – the agency will be paying for resources it is using to a small extent, possibly resulting in questions as to the efficiency of the decisions made.

Agencies that manage to pass this most difficult initial implementation phase will in subsequent phases have quite predictable requirements for processing power. If in a given year tax returns were filed by 25.1 million taxpayers, the next year this number will be comparable, not double. It is also known that the biggest processing workload will occur around April, when the returns arrive, and in subsequent months, when they are processed. In business the amplitude of processing power demand fluctuations is much bigger and much less predictable.

A solution to the above issue may be to conduct pilot implementations on a smaller scale. Well described and disseminated case study reviews will facilitate preparation of the terms of reference (the assessment of needs) and in case of any legal doubts they can be referred to.

This is why, among others, the Association of Polish Cities and the Association of Polish Counties decided on a pilot implementation of the office suite in the Office 365 cloud and the Sharepoint software to facilitate office work and document flow. Implementation of this suite in, among others, the offices of the management of both organisations is intended to test the cloud and establish a reference plane for other institutions interested in implementing CC. Other institutions will always be able to refer to permits already granted and to the approved forms of implementation, and it will also be easier to determine the technical requirements. All pilot implementations should consider all issues related to CC solutions described in this report so as to make CC implementation fully compliant with the laws and meet the interoperability requirements.

**SECURITY**

A frequently raised argument against migration to cloud computing by the public administration is the issue of security – the state is processing sensitive data it may not transfer to a private business. However, not all data collected and processed by administration is sensitive. The vast majority may be non-classified and may be – or actually should be – available to citizens and other institutions. Use of the cloud facilitates offering the data using API or XML, which in the model approach should be of an open nature (open source). This will allow third parties or other agencies to process data and, for example, offer other services based on them. An example could be cartographic data and services built on top of it, like online maps.

Thanks to open source, the administration will have an easier job changing service providers, should the need arise, and will meet the aforementioned provision of article 44 of the Act on Public Finances. Catering to make the service provider switch technically easy at the very beginning of implementation in practice meets the “easy come, easy go” principle to the benefit of administration and citizens, at the same time meeting the requirement to provide interoperability resulting from the
Computerisation Act. Lack of knowledge of the law (or its unambiguous interpretation) and fear of liability result in agencies being afraid to disclose even public data. Such an approach also makes it difficult to implement the CC model.

The administration also collects sensitive data about citizens: in Poland PESEL population register numbers, data on income or medical records. These are the most sensitive data which without question should be protected. Effective protection against leaks does not always have to mean that such data must physically be located on the premises of an agency or on a server belonging to the agency. **Data security should be assured by an appropriately designed contract, very precisely defining the technical conditions of service provision, scope of responsibility of the provider and severe penalties for data leak or loss.** The state has competences and tools (including special services, personal data protection laws), which would allow in-depth validation of the credibility of the cloud service provided for sensitive data.

The weakest link in IT security is often the human factor: errors, negligence or intentional actions (like data theft). It is difficult to clearly establish whether the bigger threat comes from an organisation’s own employees or those of the service provider. The risk here will probably be similar.

In the case of sensitive data the state sector may protect itself in yet another way – it may remove the personal identification elements from data records. The cloud provider may store and process for instance annual tax returns, but without such data items as the PESEL number, name, surname and address of residence. Each return would have an internal IT system ID key, and only the agency could combine a specific tax return with the data of a specific person. Such depersonalised data would not pose a big threat in case of a leak – the potential thief would just learn that an unidentified person had earned a certain amount of money. This could also be used to protect medical records and many other sensitive data sets. This quite simple method is very effective and allows the administration to use a public cloud instead of building its private cloud at a prohibitive cost, which is the solution most often suggested in the case of particularly sensitive data.

When analysing the security level of any IT system it makes sense to ask the question whether the highest level is always required. A good example of this is the Polish PIT tax return. For many years it was not allowed to be submitted via the Internet. Since a few years ago this has changed: the taxpayer has to provide several identification data (PESEL and NIP tax ID number) and information about his income, which the tax office then compares with the data submitted by the employer – comparing this information coming from two sources allows verification of whether anyone was impersonating the taxpayer. Additional protection mechanisms turned out to be unnecessary. In 2010 nearly a million taxpayers used this channel to file their tax returns.

Concerns about the security of official data in the cloud may result from an awareness of the imperfections of modern IT solutions, but also from the old way of approaching security. Case files, personal files, binders and other documents kept at the agency were safe – a citizen could not take them home, and locking them in armoured cupboards and protecting room doors with seals for the night guaranteed that no one could interfere with them or destroy them. Today data is stored on servers. Locating it on the premises of an agency and sealing the doors provides no guarantee against destruction or tampering – a hacker can act remotely without a physical presence at the agency.

Locating data at a CC provider’s data centre may turn out to be a safer solution, as assuring the required level of security will be the job of a team of people dedicated only to this task. In the case of data in digital format the location of the server is of less importance than the quality of IT security mechanisms; however, a good contract should describe the technical details of such security mechanisms, location of the infrastructure and the possibilities of CC providers to use the services of their subcontractors. Also the legal regulations in force should not be forgotten.
A NEW WAY OF THINKING ABOUT DATA

One of the main barriers to implementation of CC in public administration is psychological resistance. Firstly, many officials tend to think that data is their property, and citizens are often required during standard administrative procedures to provide many pieces of information, which are not necessarily directly related to the case, but are used only for statistical purposes or for record keeping, that is for internal use by the agencies. In fact, the administration is not the owner of the data, and is to disclose it to citizens on their request. Although the regulations are clear about this, many agencies still do not want to disclose their assets or expenses.

Data is treated as a resource providing some kind of power. The new way of thinking about data assumes that primarily it should be used to make the functioning of agencies more effective and to provide citizens with new services. For example if a citizen wishes to obtain access to a public document, which has been addressed to several agencies, any of them will typically direct the citizen to address the sender of the document. In fact the law says otherwise – every agency, also an addressee, is obliged to disclose a public document to a citizen.

Public access to data also means higher transparency of operation of authorities. Using the cloud platform in, for example, a recruitment process for jobs at an agency, means not only convenience in the technical dimension, but also a more transparent procedure. If the job candidate has to publish his documents in the cloud (e.g. fill in forms, upload scans of his education credentials), this will immediately validate his computer proficiency. But the transparency of the process is more important: the platform will display the number of people who have filled in documents – all logins to the system will leave their digital trail. In the case of submission of hardcopy documents manipulating them may be a lot easier. Using appropriate IT technologies may limit such behaviour.

INTEGRATION: FOR AND AGAINST

Data collected by administration is currently located in many IT systems of government administration: sometimes agencies do not know they are duplicating information collection, and sometimes they are not aware of the benefits of aggregating such data, e.g. cross-control of invoices between companies or comparison of data on bank transfers by employers with the tax returns of their employees. Such integration would increase the knowledge of officials and allow detection of many types of fraud, like tax evasion or misuse of the healthcare system.

At the same time the progress of integration brings with it certain threats. Firstly, gathering by the public sector of immense knowledge about citizens may go beyond common sense and lead to control associated with totalitarian systems. Data should be integrated to a certain extent, but the question that comes up is where to set the line guaranteeing citizens freedom and liberty. Secondly, a database integrating more data would be particularly interesting to criminals. Thirdly, certain distribution of data improves security in a different dimension – potential breakdown of one system will not disable the operation of others.

Cloud computing allows integration of another kind: instead of moving different data to one system, it can be kept in existing systems with an intermediate platform in the cloud playing the role of table of contents – indicating where other data is stored.

Cloud computing facilitates integration of data: instead of moving data to one system, it can be combined with a cloud-based platform playing the role of a table of contents – indicating where other data is stored.
a central database a system is being constructed that will retrieve information from nationwide or regional systems.

WHERE WILL THE CHANGE COME FROM?
The stimulus for speeding up computerisation and more daring use of cloud computing will probably come from two areas of public administration. Firstly, central government agencies will start using CC more often. Their scale of operation requires processing of vast volumes of data (this is why they need to expand their IT systems). Some projects are also related to interchange of data within the European Union. Central administration authorities also have the biggest experience in computerisation, so in a natural way they are traversing its subsequent stages. A reason also lies in unification of the law and tasks, i.e. tax offices have the same tasks and obligations towards the Ministry of Finances regardless of their location. With this kind of structure the cloud may be a good solution making work easier for all the offices.

Soon the leader of change may turn out to be the local governments of big cities. These are organisations of sufficient calibre to feel the need for computerisation and streamlining their processes related to citizen services, and at the same time are looking for financial efficiencies and opportunities for competing against other cities. Quality of services is one of the elements intended to attract new residents and investors.

Polish public administration may draw on the examples of others, more advanced in the cloud migration process. The leading countries in this aspect are the USA, the Netherlands and Denmark. Interesting examples are also the Jaén province in Andalusia, Spain, or the Japanese cloud developed jointly with Fujitsu as a business incubator. It is also sensible to use the guidelines by the European Network and Information Security Agency which have in recent times approached the topic of CC very attentively. When looking at how others are doing it we should collect knowledge on our implementations and share it as widely as possible.

This article was written based on a discussion attended by: Edwin Bendyk (columnist at Polityka magazine), Dr Jan Maciej Czajkowski (co-chairman of the Joint Central and Local Government Committee Group for Information Society), Krzysztof Łapiński (expert of Gdańsk Institute for Market Economics), Rafał Malujda (legal counsel), Dr Kajetan Wojsyk (deputy director in charge of IT of the Healthcare Information Systems Centre) and Dr Bohdan Wyżnikiewicz (vice-president of Gdańsk Institute for Market Economics).

THINKTANK RECOMMENDATIONS:

1. BEFORE COMMENCING WITH IMPLEMENTATION OF AN IT PROJECT in public administration, it makes sense to analyse which implementation model would be the best: the traditional one (using one's own infrastructure) or cloud computing (based on rented infrastructure). It is also reasonable to consider an intermediate solution, such as the hybrid model, where sensitive data is processed on agency premises, and the remainder in the public cloud. Selection of the solution should be based on business case and legal compliance.

2. AN AGENCY INTERESTED IN CLOUD-BASED IT IMPLEMENTATION should conduct an appropriate legal study to find out exactly what the legal possibilities are for using the cloud in its specific case.

3. THE USE OF THE CLOUD MODEL IN PUBLIC ADMINISTRATION WORKS FINE, as shown by examples of other countries, such as the United States, the Netherlands and Denmark. When implementing CC in Poland it also makes sense to consider the experience of those using the cloud already.
In Poland there are around 1.9 million businesses. The majority, over 1.8 million, are the smallest enterprises – micro-businesses with less than 10 employees. The number of small businesses (employing between 10 and 49 staff) is 55,000, while that of medium-sized ones, with more than 49 and fewer than 250 – is just 15,000. Big companies are even less numerous, around 3,200. The scale of operation of the latter is so great that managing them in modern ways without advanced IT tools seems practically impossible. At the same time due to their immense budgets these companies may order any IT solution, which is not practically affordable to smaller, particularly micro, enterprises.

Cloud computing allows small businesses to use the solutions so far affordable only to the biggest companies, paying only for actually used resources, without the need for capital upfront spending. There are more and more cloud-based applications on the market supporting business management, starting with office suites, through financial and accounting applications up to CRM systems. An important value to businesses lies in the speed of software upgrading and lack of need to be concerned with the process. In a classic IT model, where financial and accounting applications are installed on in-house computers, every amendment of the applicable laws, quite frequent in Poland (like changes in VAT rates), typically means the need to download a new release of the product or update to the application. In the case of cloud-based applications the responsibility for updating remains with the application provider. They adapt it to changes as they take place, so the service user does not have to do any updating – when logging in to the system he will be using the latest available version of the software. Of course how up-to-date it is and its quality will depend on the degree of responsibility of the service provider, but one may expect that the market will quickly eliminate unreliable providers.

Flexible, innovative and effective – these are the traits of SME sector entrepreneurs in Poland. This is why they are more and more daringly adopting new solutions such as cloud computing. Many are already using simple cloud solutions like electronic mail or website hosting. Now new more advanced tools are emerging on the market, which may facilitate running businesses by Polish entrepreneurs even more.

Michał Goliński, Krzysztof Łapiński, Henryk Pietraszkiewicz, Grzegorz Skowron-Moszkowicz, Bohdan Wyżnikiewicz
Use of CC by a business totally changes its approach to IT solutions – investment costs decrease and are replaced with ongoing service costs. IT infrastructure moves into the background, like in the telecommunications services – a pre-paid model comes into play where, just like in the case of telecommunications services, the entrepreneur signs an agreement with the operator, receives access to equipment (a phone for a penny) and pays monthly usage bills. For the business assuring efficient communications is not a capital investment, but a service billed on a pay-per-use basis. This also results in tax benefits. In a typical IT resource management model, the purchased hardware is depreciated in the accounting system and after its full amortisation in time provided for by the regulations the company must decide on new investments or discontinuation. The question is whether to renew the hardware to begin depreciating a new investment, even if the performance of the existing hardware is sufficient, or keep the existing solution but pay higher taxes. The cloud eliminates this dilemma: the costs of using IT resources each and every time are deducted from taxable revenues. Using CC also positively influences the financial results. Lower capital expenditures result in improvement of, among others, return on investment (ROI) and return on net assets (RONA). In the case of valuation of a company for sale or IPO this may be of paramount importance.

Another characteristic of small business is the amplitude of changes in their environment – for example an increase in the number of customers by several hundred per cent per month is not a rarity. If they are supported using a cloud-based CRM system, for example, or a dedicated website, increasing the IT resources in most cases will boil down to informing the service provider of the new requirements and purchasing a bigger data transfer bundle, processing power or disk space. Thus the cloud allows rapid adaptation to changing business needs.

The cloud model provides SMEs with access to IT solutions that due to their cost so far were reserved only for big businesses.

Despite widespread concerns a professional cloud provider can assure data security better than most entrepreneurs.

Small and medium-sized businesses will more and more often be using cloud computing services. Many are currently at the phase of searching for the best scenario for cloud entry.
INNOVATION THANKS TO THE CLOUD

Cloud computing supports growth of innovation – it supports high-tech businesses, particularly those providing advanced online services. When an idea for a new service or a portal comes up, its creators do not have to build infrastructure – they can just focus on development of their product. In the cloud model they buy the service from the providers as Platform-as-a-Service and use it to develop software they can subsequently offer to users in a Software-as-a-Service model.

This is of particular importance in the case of projects with a global reach – development of infrastructure allowing fast access to the service on every continent means: an investment of at least tens of thousands of euros, the monthly costs of its operation at a level of over a dozen thousand euro and a big technological challenge. A global cloud provider who has data centres on different continents is able to offer such a service starting at several dozen euros per month.

Besides low costs, what counts is the speed of launching cloud-based services – all it takes is to buy the service and remotely configure the device or devices that are ready to go at the service provider’s data centre. When the configuration process is complete, the software hosted on the server is ready for use and a new service can be offered to the market. In the case of putting up IT resources on-premises the process of adapting the room, hardware selection, vendor selection, delivery, installation, etc., may take weeks or months.

The cloud causes almost complete elimination of entry barriers to the market of online services. This is very well illustrated by one of the simplest cloud services offered: webhosting. Because the cheapest account costs just a few zlotys per month, young entrepreneurs, university or college students, are able to launch their first e-businesses (portals, Internet shops, blogs). If they succeed, all they have to do is order a more advanced hosting account with the provider. In turn, the potential losses if the business does not catch on are minimal.

Cloud computing is also a big market for small, often local IT businesses, which may provide implementation of tools designed for the SME sector.

A SECURE BUSINESS WITH THE CLOUD

Although the biggest concern is raised by the security of CC services, in the case of SMEs, particularly micro-businesses, storage and processing of data in the cloud instead of on-premises may turn out to be much more secure. According to research by Symantec, 80 per cent of people responsible for IT in the SME sector perform backups more than once a month, but at the same time a backup policy for portable computers is implemented in only 42 per cent of businesses. Probably the survey results are more optimistic than the reality: in practice probably fewer companies ensure regular backups.

Small organisations, such as SMEs, lack IT security procedures: backup creation, rules for destruction of obsolete hardware and the data it contains, physical access to hardware, emergency power supplies or backup communication links, etc. Often the reason is lack of knowledge and awareness of how important the data is, until the first incident of data loss. Iomega estimates that over 250 thousand small businesses in Germany, Great Britain and France would face bankruptcy if they lost their computer data.
The choice of services offered by an experienced cloud computing solutions provider means not only using its infrastructure, but also its knowledge and experience in data security. Professional, experienced providers have their internal regulations on producing backups, their location, and emergency backup restore procedures, allowing swift recovery of access to data. Data is protected by transmission to another data centre in a different location, so even physical destruction of a centre, for example by natural disaster, will not result in loss of data. In most instances the user of services will not even notice the switchover to the backup copy. The advantage of the cloud may be seen in the case of worst scenarios coming true, such as terrorist attacks or fires burning not only the computers storing all information, but also DVDs or other media with backup copies stored onsite. Their recovery may not be possible at all – in the case of the cloud all it takes is logging in to the cloud, where all data will still be available.

The best cloud computing providers give top priority to data safety; therefore it is assured by full time specialists making sure, for example, that the installed software does not contain bugs allowing hacker attacks. Data is protected against not only a digital attack, but also attempts of physical theft or destruction. The buildings housing the servers are typically equipped with redundant power supply lines, have emergency generators, structurally are more like bunkers than office buildings, can be accessed only by authorised personnel and are guarded by security agencies, with agents often equipped with firearms. A renowned cloud provider has such resources devoted to security and knowledge that SMEs cannot have. Particularly non-IT sector companies, which neither feel the need for this nor are able to develop competences in this area.

CLOUD COMPUTING: BEGINNING OF THE ROAD

The SME sector is dynamic and open to innovation, and gladly adopts modern solutions, so already many businesses are using more or less advanced cloud services. Despite this, both the service providers and their customers are facing numerous challenges.

The problem raised by entrepreneurs operating in the cloud, especially those from the IT sector, is the need for even greater scalability, and its automation in particular. Currently scalability, which is one of the cloud’s biggest advantages, requires service user intervention. A business purchasing a certain service bundle from the provider tries to adjust it quantitatively to its needs, taking into account periodic service demand peaks.

An example might be an Internet shop with a server capacity allowing 1 thousand customer site visits per hour to be processed. In most cases the purchased service bundle will also cope with a larger number of customers, say 2 thousand visits per hour (e.g. on rainy days,
when more people surf Internet shops). A business expecting significantly higher traffic before Christmas time may order for a limited time extra processing power or an additional server allowing them to support for instance 10 thousand site visits per hour. Such a boost in the number of customers without increasing the service parameters may cause a much slower response time of the shop, some customers may not get access at all, or the service provider may block site access if the purchased transfer volume is exhausted. The e-shop administrator must be able to foresee such situations.

If the situation is predictable, the service user may increase its service parameters with just a few clicks of the mouse, e.g. on the day it is launching an advertising campaign on a popular portal. But today’s business, particularly on the Internet, is full of surprises. If the e-shop gets a positive review by a popular blogger, is praised by a celebrity on Facebook or attracts interest

96%

The percentage of enterprises in Poland in 2010 with any kind of Internet access. In the hospitality and restaurant sector only 91% of businesses had web access. 

Source: Central Statistical Office, 2011
The problem raised by entrepreneurs operating in the cloud, especially those from the IT sector, is the need for even greater scalability and its automation in particular. Currently scalability, which is one of cloud’s biggest advantages, requires service user intervention.

on social news portals (like Wykop, Kciuk, Digg) – then it may turn out that there are 100 thousand prospective customers trying to access the shop in an hour. If the service administrator is not aware of this and does not boost the parameters (the blogger may be in a different time zone and the avalanche of customers comes after local business hours), within a few minutes the service will go down, and instead of thousands of orders from new customers it will get millions of critical comments for not being available at all. Of course it is possible to keep permanent overhead service parameters, but then the operating costs will significantly increase and may become comparable with the operation of an on-premise server room.

A solution particularly sought by CC customers is the possibility to scale server operation: in the case of a sudden boost in demand other processors or machines could be activated without the administrator's intervention. An obvious threat here will come from attacks by competitors, who might try to artificially boost the traffic on another business's servers using a DDoS (Distributed Denial of Service) attack, by sending an avalanche of requests to the server. In the case of scalability of services this would not result in a server crash, but activation of subsequent services and a significant rise of costs to the service user. There are, however, methods of mitigation of such risks: one of them is blocking the IP addresses trying to access the server too frequently.

Cloud computing is a challenge to small implementation companies, which so far made their living installing applications on the computers of hundreds of small businesses and subsequently on their configuration and upgrading. They may keep their implementation business lines as application of the cloud also requires implementation and configuration, but they will be able to perform much more work remotely by changing the settings on the servers.

However, the sales model requires a different approach – today it is focused on implementing software on on-premise computers and the costs of this job. The new sales model will have to focus on providing the business with IT support. For small businesses providing their services to local retailers, baker shops or wholesale outlets, and themselves belonging to the micro or small business category, transition from selling applications to selling...
cloud-based services will be a huge change, a challenge, but also a business opportunity. There is also a big role to play for CC providers, who will have to face the challenge of educating smaller partners.

The SME sector is at the moment most advanced in implementing cloud-based services, although as the results of the survey conducted by Gdańsk Institute for Market Economics demonstrate, the businesses are not always aware of this. They need more knowledge on the cloud computing model and more advanced tools that will make their day-to-day business easier.

This article was written based on a discussion attended by: Dr Michał Goliński (Head of the Centre for Information Economy and Information Society at the Warsaw School of Economics), Krzysztof Łapiński (expert of Gdańsk Institute for Market Economics), Henryk Pietraszkiewicz (president of the management board of FM Bank), Grzegorz Skowron-Moszkowicz (co-founder of nioovo.com) and Dr Bohdan Wyżnikiewicz (vice-president of Gdańsk Institute for Market Economics).

THINKTANK RECOMMENDATIONS:

1. **ENTREPRENEURS SHOULD SELECT TRUSTWORTHY SERVICE PROVIDERS**, those who are able to assure an appropriate level of security of the data processed.

2. **CLOUD COMPUTING IS A VERY GOOD TOOL FOR TESTING AND IMPLEMENTING NEW IT APPLICATIONS**, at the same time with a lower business risk. Thus the cloud environment should in particular be used by innovative businesses valuing low costs, as they will benefit the most from CC.

3. **CLOUD ADOPTION RATES MAY BE IMPROVED THROUGH CLOUD PROVIDERS OFFERING** a free-of-charge test period. This will allow companies to learn more about the principles of operation of such a solution and in future will simplify their choice of the best IT resource combination from the business point of view.