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A REDEFINITION OF TELEWORK THROUGH CLOUD COMPUTING – TELEWORK 2.0

In this paper we aim to analyse two paradigms, from the perspective of the mutual recursivity between them: telework and cloud computing. The main purpose of this scientific endeavour is to determine the level of support of each paradigm for the other and the synergic effect generated by their interdependence. We will approach functional, juridical and environmental issues. As result, we aim to highlight the way Cloud computing solutions may revolutionize all that is telework and who telework may be redefined through the transition to a superior level, called telework 2.0.

Key words. telework, Cloud computing, business reengineering, Green telework, management.

Introduction. In current society (may it be information or knowledge society), economic organizations are faced with a permanent provocation to change and develop. The trends for competition globalization, technological evolution and accelerated obsolescence of products are only a few of the important traits of current market. Additionally, we are looking at new challenges targeting national economies, European economy and even global economy, generated by the migration phenomenon. Organizations (no matter of their field) work hard and continuously to survive and increase the efficiency, in order to be able to align to the current economic context,

In other words, during their lifetime, all organizations must adapt to the new realities of the internal and external environment. Most of the times, this adaptation requires an organizational or functional change, either as an improvement or as restructure. This can be summarized as one characteristic, more and more found on 21st century organizations: agility. An agile organization has a good ability to adapt to flexible market conditions, being able to speculate market opportunities never encountered before. Agility, on general level, requires agile enterprise architectures, agile procedures and instruments as well as agile human resources.

Considering the technological evolution of the last decades, the organization development may be supported by a wide range of solutions based on information and communication technology (ICT). One of these solutions is, beyond a doubt, organization redesign for telework. Table 1 presents the motivation and options for five such solutions. Also, telework is a useful instrument for the organization to increase the agility of its human resource.

Table 1. **Solutions for organization redesign**

Instrument	Reason	Options
Design and equip locations	Adaptation of work places to new tasks Flexibility Allows various locations for work Ecological work place	Work at home, at client site, satellite work centre etc. Redesign of headquarters Full/part time work program Chose the adequate site for the job (flexibility)
ICT use	Support for: data access (edit, use), information access (formal, informal), communication, collaboration	Portable equipment, GSM ISDN connections Intranet, Internet, Extranet
Rules and regulations	Support for: communication, control, coordination	Maximize the time spent at home Telework contract Who pays for what What equipment is issued for which teleworkers
Conventions (contracts)	Support for: communication, coordination, control	Insert talks about telework in meetings Connect home phone when a client calls the office
Job redesign	Efficiency and lucrativeness (some jobs are not fit for telework) Reduces stress on non-teleworkers	Divide the tasks among co-workers

Expanding technology offers new perspectives over the nature of work. New production factors like information and organization culture are no longer ignored on micro or macro level. Through the development of the telework and its adoption on an increasingly wide scale (both horizontally and vertically on the production chain) management finds new paradigms. Some of these modern paradigms of organization management are defined as the 4Data: Big Data, Social Data, Mobile Data, Linked Data [7].

The "trove" of 2005-2006 called Cloud computing comes to rattle once more the enterprise architectures (at least concerning the technological component), personnel and investment policies. Concepts like semantic web, democracy 3.0, internet of things (IoT) and older imotics and domotics are part of the same category which has a direct impact on the organization in the digital economy. In its fast development, cloud computing doesn't affect only technical aspects of a business, but also constitutes a premise for changing the way the individual works. In other words, cloud computing brings a new light on the telework.

Telework & Cloud – historic and functional landmarks. Born at the beginning of the 70s, the idea of working from a distance evolved towards the concept, phenomenon and paradigm we know today under the generic name of telework. Even more, the idea of distance management was first formulated by the recognized parent of cybernetics, Norbert Wiener, who imagined in 1950 the case of an Europe located architect supervising the construction of a skyscraper in USA via fax machine. In 1972 Jack Nilles begins researching telecommuting (USA and Canada term for telework) and a year later publishes the first theory regarding the field and the opportunities it brings to the business environment..

In 1980 futurologist Alvin Toffler nominated telework as one of the basic elements of the third wave in his three stage vision on the evolution of the human society [12]: first wave – agricultural society, second wave – industrial society and

third wave – informational society. The ninth decade was one of transition from industrial and post-industrial society to what we call today informational society or knowledge society. In plastic way we may call the end of the 20th century the beginning of expansion of telework in it various forms (virtual commuting, virtual office, flexible work, semi-mobile commuting etc. – see table 2).

Table 2. **Types of distance work**

Category	Definition	Design and work features
Work at home using electronic means	Work at home using electronic communications for interaction with the client	Simple tasks, external client is (usually) the employer, never from office
Virtual commuting	Work from an employer from distance, using ICT	Partially from office, partially from home, many different tasks involving reduced mobility (for example writing reports)
Flexible work	Work from anywhere (home, office, traveling) using ICT	Mobile workers (traveling salesmen, consultants)

In a generalist approach, telework involves changing the nature of work by relocation from the classic office and intense use of ICT. Due to the spectacular development of ICT (including the infrastructure of the global internet and the evolution of WWW) we know today the two major telework directions: tele-activities and tele-services. Without going too deep, in figure 1 we may see the main aspects, scientifically proven by Mokhtarian [8], of the impact telework has on environment and technology.

Fig. 1. Telework impact

It is not by chance that through the purpose of this paper 1950 is the birth year of the fundamental cloud computing concept, as the year famous mainframe computers appeared. The main idea is the sharing of computing and memory resources in the very expensive computers (at that time). The oldest reference to the term cloud, in its modern meaning, dates back from year 1996. Using the cloud as symbol for a network representing the internet started in 1994. Popularization of cloud term and paradigm starts in 2006 with the launch of Amazon.com's Elastic Compute Cloud, continued by Eucalyptus in 2008, Rackspace Hosting via OpenStack in 2010, IBM's SmartCloud in 2011, Oracle Cloud and Microsoft Azure in 2012, Sun, Google, Novell etc.

The most endorsed definition of cloud computing is the one given by national Institute of Standards and Technology (NIST) though NIST Special Publication 800-145 of 25th October 2011 (after two years of research) and describes a convenient model that allows access on request, through network (internet) to a group of configurable computation resources (for example networks, servers, storage equipment, platforms, applications and services) that can be provided to the user fast, with minimal administration effort or interaction with the provider of such resources [10].

From the perspective of marketing policies, the name "cloud computing" appears novel. Cloud computing is based on long known technologies like virtualization, web services, cluster computing (parallel, centralized and high performance computation) or grid computing (parallel and distributed computation). There are many definitions and they are no always thorough. The "cloud" is used as a metaphor suggesting that the user (consumer) of resources doesn't always know exactly their location. The clients pay for what they use, under the pay-per-use or pay-as-you-go system. The computing power of the cloud creates the impression that it is infinite, the scalability and multi-tenant administration regime of virtual resources allowing allocation or deallocation at any time, according to client requirements. From this perspective, Cloud computing is a type of Utility computing. Most of the times, cloud computing services fall into one of three categories: IaaS, PaaS and SaaS (see fig. 2).

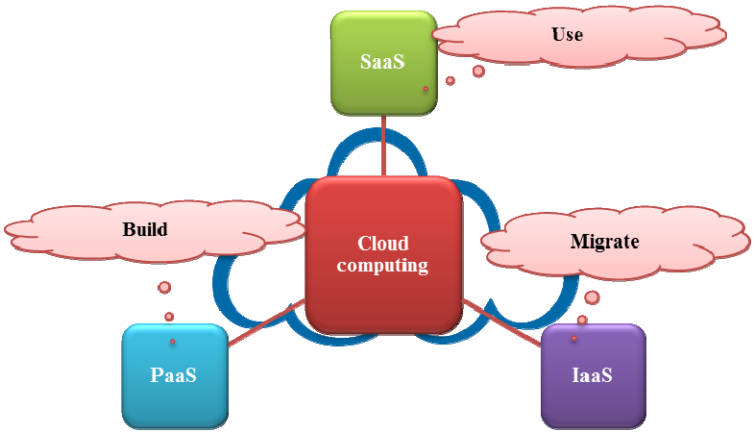

Fig. 2. Usual cloud computing services

IaaS (Infrastructure as a Service) is the lowest abstracting level. It provides the user with full computation infrastructures (processors, memory, storage, bandwidth, servers) as virtual machines.

PaaS (Platform as a Service) is an intermediary level. Platforms are built on the IaaS foundations and provided to programmer clients with open source or proprietary frameworks, instruments and development and execution environments.

SaaS (Software as a Service) is the upper level, the application level, the closest to the usual user. Application are web-based and usually accessed via web-browsers. They may be e-mail, collaborative, office, file storage or even CRM or ERP applications.

From this point, the challenge is to estimate how much telework has influenced the emergence and development of cloud computing (also the other way around, concerning only the development aspect or prove the amount of interdependence/mutual recursivity between the two paradigms. Once proven, we will have all premises to claim that telework through cloud computing is a solution for business development, anytime, anywhere.

Telework – juridical and statistical aspects. From a geographical point of view, the first forms of distance working appeared in USA, Australia and Canada, spreading later to south-east Asia, japan and northern Europe. The first sociological researches in teleworking highlight and justify the expansion of telework in those areas as a reaction to a dangerous phenomenon: social and professional isolation [9]. One of the plausible explanations at that time (the end of 90s) is the relative long distance between populated areas in those countries, between populated areas and work areas etc. Later, the scientific explanations and argumentations became a lot more complex and nuanced.

The only telework component that did not develop as spectacular as the rest is the juridical side. While outside Europe this didn't last too long, in Europe, the first agreement on teleworking was signed by social partners in July 2002 in Bruxelles, and is known today as *European framework for telework S/2002/206.01.02* EUR-lex [3]. This European agreement defines telework as a form of organization and/or working using ICT in a contract or work relation, where work (equally performable at employer site) is performed regularly outside the employer site. The party performing the work is such a contract is called tele-employee. Out of the 28 EU states only 6 have not yet implemented this agreement, sadly one of them being Romania, along Bulgaria, Cyprus, Estonia, Lithuania and Malta. Still, telework is present in Romania, being used by local branches of multinational companies based in EU countries that implemented the framework.

In Romania, although there is no specific regulation regarding teleworking, it may happen, as long as legislation does not forbid it. Additionally, the Work Code (through Law 53/2003 with later changes) regulates in chapter IX the work from home in Romania (articles 105, 106, 107). This, together with chapter II, article 3, second paragraph ("*every person is free to choose the work place and profession, job or activity*" and third paragraph ("*nobody may be coerced in working or not working in a certain place or profession, no matter what it is*") constitute the premises to align Romanian legislation to the European one regarding teleworking.

Meanwhile, there is a citizen's initiative from the National Syndicate Block (BNS) regarding teleworking on the agenda of the Chamber of Deputies (which decides in this case) requiring a modification of the Work Code by introduction of the notion of telework and the obligations of teleworkers and employers. This initiative was silently adopted on September 2nd, 2015 by the Senate, as the first chamber notified. One way or another, Romania must align its legislation and juridical policies regarding telework with the European legislation. The first signal dates from October 2001, when our country, along with Hungary, Latvia, Lithuania and Poland became associated states to the European Union (E3WORK program – eWork in Eastern Europe 2001-2003) [5].

According to Global Telework Survey Report, a study by PGi published on June 23rd 2015, globally 60% of the workers would give up their current job if they would find a new job, with the same salary, that allows them to work from home (telework) [11]. Additionally, 79% of those interviewed declared they already work from home at least one day per week, and the main reasons named are, in order of importance: no more commute time, better balance between professional and personal/family life and increased productivity. Adding reduced administrative expenses (office rent, utilities, consumables), increased trust between employer and employee and implicitly increased employee loyalty, reduced absences, we realise that teleworking brings real benefits to both sides.

These trends are highlighted by numerous other studies and market researches. Thus, Forbes magazine noticed in 2013 that one in five USA employees (representing a total of about 30 million people) work from home at least once a week and there is a tend to increase to over 63% [6]. A survey conducted between August 5-9, 2015 by Gallup reveals that 37% of USA employees say they performed telework (as virtual telecommute), a bit higher than the 30% of the previous decade, but 4 times higher than the 9% of 1995 (see fig. 3).

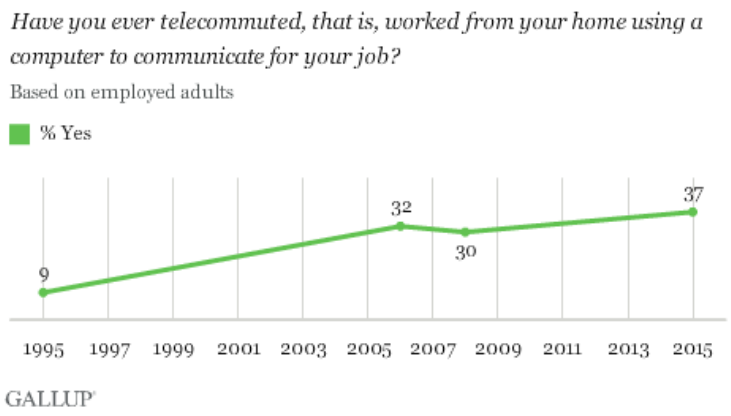

Fig. 3. The evolution of telecommuting in the USA, according Gallup

Source: http://www.gallup.com/poll/184649/telecommuting-work-climbs.aspx

In spite of lack of dedicated regulations, in Romania many telework conventions/contracts are (and will be) signed. The lack of legislation maybe a reason for the relatively rare endeavours to statistically measure the real spread of telework. Still, in Ciutacu [1] we find a series of estimations of the telework phenomenon in Romania, which are (approximatively) confirmed in a report by European Foundation for the Improvement of Living and Working Conditions, called *Telework in the European Union* [2]. Thus, estimations indicate an average of 36.000 teleworkers in 2000, 61.500 in 2005 and 100.500 in 2010. The above mentioned European report estimates 0.7% of total occupied population in Romania are using telework exclusively (see figure 4). Considering about 9 million persons as occupied population in Romania in 2005, it amounts to about 63.000 teleworkers in 2005.

Applying the above mentioned (figure 4) 2.5% on the 9 million occupied population, the result is 225.000 employees were performing telework for at least a quarter of their total work time. There are no more recent estimations for Romania, but extrapolating the evolution of the telework "phenomenon", we consider the current spread to be significantly higher than 10% of the occupied population.

Mutual recursion between Cloud computing and Telework. Attempting to determine whether there is or isn't a mutual recursivity between the two paradigms, telework and cloud computing, we consider that the following question must be asked: *is cloud computing a consequence of telework expansion?* At this time, no person, institution or business entity can provide with a correct answer. In order to find an answer, we propose two approaches: first one starts from the endorsed definitions of the two paradigms and the second statistically follows the evolution of the two paradigms (we used publically available statistical data concerning telework and cloud computing in USA, since they are easier to access).

Thus, in the first approach, International Telework Association and Council formulates in September 2009, under the scientific guiding of prof. Ellen Ernst Kossek (Ph.D., Yale) from Michigan State University the following definition of telework: telework is a work arrangement where an employee works form a distance (full or part time) and the communication with the employer, clients or collaborators is performed *exclusively through information and communication technology*. [15]. We notice a significant emphasis on the use of technology during work processes. The communication and data processing infrastructure is usually provided by the employer, which requires a certain level of financial investment. In this context the expenses of the employer for one teleworking employee may be synthesized as follows: **TE = WC + TC + NC**, where TE are Total Expenses, WC are the Wage/salary Costs, TC are the Technology Costs and NC are the Network Costs (telecommunications).

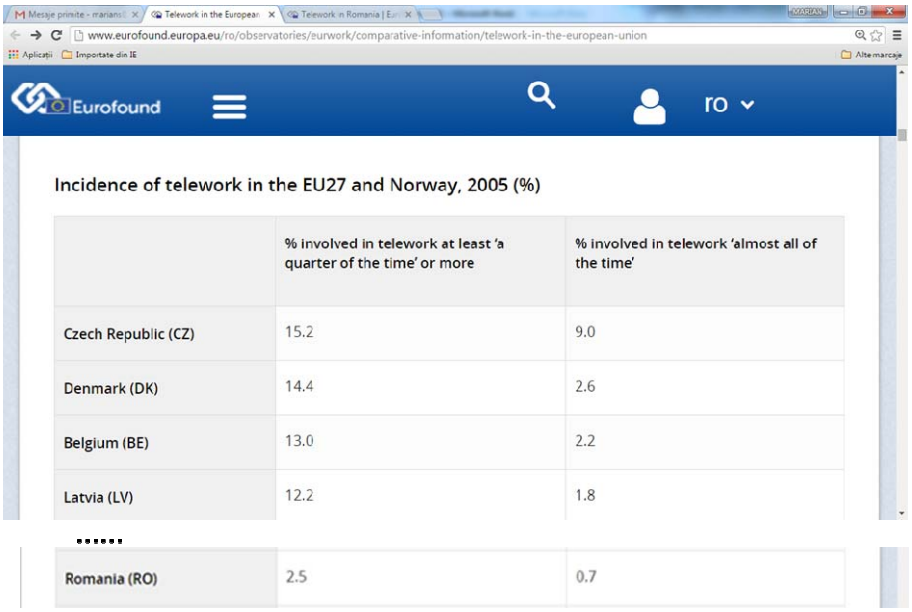

Fig. 4. Incidence of telework in Romania, 2005

Source: http://www.eurofound.europa.eu/ro/observatories/eurwork/comparative-information/telework-in-the-european-union

According to European studies like EWCS [4] and USA studies like TW [13] and TW [14], the weights of these expenses are: WC – 60%, TC – 30%, NC – 10%. According to a press release from September 2015 of INS (Institutul Național de Statistică), the average monthly cost of the work force in 2014 for Romania was 2.988 Lei/employee (about 680 Euro). In other words, for a teleworker, Romanian employers might have additional costs regarding technology (hardware and software) amounting to 204 euros/month (TC – 30% of TE). Comparatively, since the beginning of 2014 Google has significantly reduced prices (by 68%) for storage and services in their own cloud reaching as low as 0,026 $ /month/GB storage space.

On the other hand, as mentioned above, the most endorsed definition of Cloud computing formulated by NIST describes a convenient way to *access, through a network, a group of configurable computation resources* that are provided to the user fast and with minimum administration effort or interaction with the provider. Using a cloud solution, the employer (as proved by real projects) may reduce business costs by as much as 55%, depending on business size, activity specifics and so on. If we place this in the context of telework, the benefits of cloud computing are obvious, through reduction of costs for own technology, increased availability of services, flexibility in using technology, generalized employee mobility etc.

Analysing this first approach, we can't avoid noticing the two-way connection between telework and cloud computing, which significantly changes the financial perspective (financial recipe) of telework. Additionally, following a statistical approach of the evolution of the two paradigms in terms of market share, we notice a mutual dependence. According to TW [13] and TW [14], from 2006 to 2008 USA registered a spectacular increase of the number of teleworkers, from 28.7 mil. to 33.7 mil., while USA workforce market decreased by almost 10 mil. employees. It is not by chance that 2006-2008 is the pioneering time of cloud computing.

Cloud computing changes the telework perspectives – towards *Telework 2.0*. As starting point we propose the statement of Boland T. Jones – founder of PGi, who sends the following message: "the current workspace evolves, transforms – business professionals and their teams are more mobile, more flexible and more dispersed than ever. As leaders in the collaborative field for over 20 years, we are aware of the employees' and teams' need to together anytime and from anywhere they want". This flexibility of the teleworker in choosing the work schedule leads directly to an obvious trend of wider penetration of telework on the work market. PGi [11] study highlights the way telework changes the perspectives for businesses and employee attitude (see fig. 5).

In the current context, Cloud computing, through its technical and economic features matches closely the needs of global telework market. Practically, cloud solutions have transformed (or are about to) in real paradigms of modern management. There are a lot of cases where real businesses resorted to nosiness cost optimization through cloud computing solutions. As we mentioned above, such a solution may lead to savings in business processes that can go above 50%. One of the concrete examples is Cisco Systems Inc. that sends the following message: "*Telework Gets More Cost-Effective and Safer: Thank the "Cloud"*".

In other words, Cloud computing significantly changes telework perspectives, making this kind of work a habit that, in turn, is part of the daily routine. This way of computing brings a series of benefits, beyond the drawback related to data security, the need for internet connection or ecological issues. Employers no longer have to concern with administering their own data and network infrastructure, equipment purchases, or hiring the dedicated personnel. With Cloud computing, their only concern is the business and the way to manage the saving brought by clouding. If these employers have not yet moved to implement teleworking in their businesses, they should. If not now, then when?

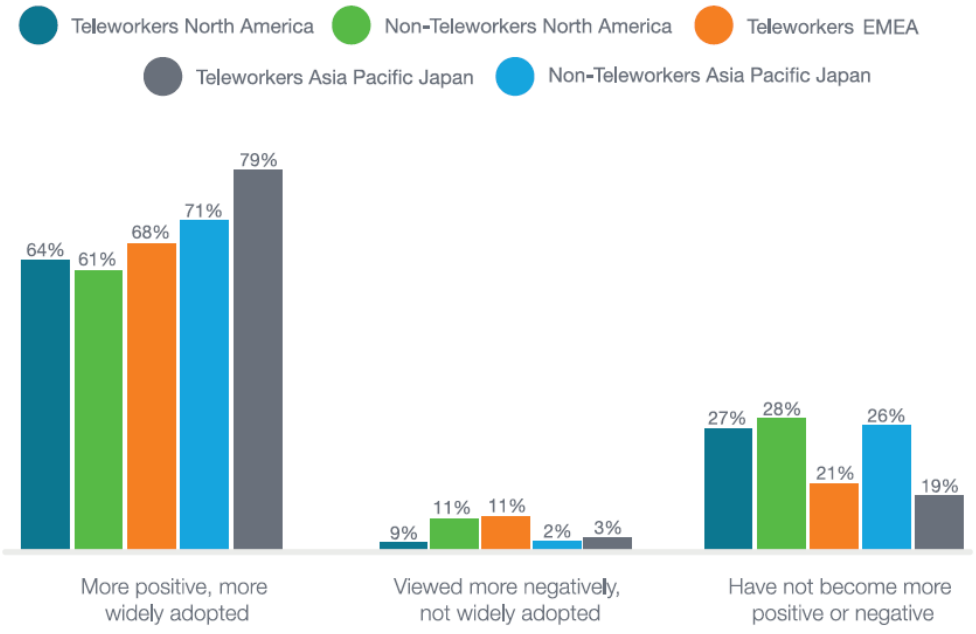

Fig. 5. Changing perspectives and attitudes through telework

Source: http://blog.pgi.com/2015/06/pgi-global-telework-survey/, Answers to question: "*How are perspectives about telecommuting changing in your company?*"

Lastly, we can reaffirm that Cloud computing is not completely new, since it is based on technologies like system virtualization, web services and parallel and distributed computing. The essential characteristics are scalability, multi-tenant regime, and resource availability. There are still drawbacks in cloud systems, which make them a bit controversial. Still, exploiting Cloud computing solutions on a large scale opens a new perspective to telework. We currently see a rebirth of distance work forms through Cloud computing solutions and we call this new beginning *telework 2.0*.

Conclusions. In conclusion, we must say that there are already projects regarding integration of Cloud computing benefits with mobile devices, leading to Mobile Cloud computing. Considering the reduced capabilities of smartphones and tablets, most of the tasks will be performed in the Cloud. This only extends the ramifications of telework in the sense of a completely flexible way of working regarding the place of work. Telework via Cloud computing not only has the advantages of reduced costs for hardware and dedicated personnel, but also has a much bigger impact on the environment (synergic impact of combined use of telework through cloud), a saving from power consumption. Therefore we have less burn processes, so less environment pollution. In other words, the Cloud can be "eco" and in some circumstances it can even be "green" (see the larger research area Green computing).

Speaking of absolutely flexible telework we must correlate the size of the research with what was initially called domotics and imotics (home/office automation), and is now called Internet of things (IoT). Internet of things is the network of physical objects around us that have electronic components, software, sensors and systems allowing connection to networks (preferably internet, which allows transfer of information). Each object can be identified as a usual computer, being able to use internet infrastructure. Current estimations say currently there are over 5 billion objects connected to IoT and the number will grow 10 times in the next 5 years.

All these constitute premises for a future research direction, which, beyond Green computing and Eco-computing, correlates the content and conclusions of this paper defining a new research field called *Green Telework through Internet of Things* or *transition to telework 3.0*.

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ПЕРЕОСМИСЛЕННЯ ТЕЛЕРОБОТИ ЧЕРЕЗ ХМАРНІ ОБЧИСЛЕННЯ – TELEWORK 2.0

У даній роботі ми прагнемо проаналізувати дві парадигми, з точки зору взаємної рекурсії між ними: телероботи і хмарні обчислення. Основна мета цієї наукової роботи – визначення рівня підтримки кожної парадигми для іншої і синергетичний ефект, породжений їх взаємозалежністю. Ми будемо підходити до функціональних, юридичних та екологічних аспектів питання. В результаті, ми прагнемо виділити як шлях хмарних обчислень може революціонізувати все, що являє собою телеробота і як телеробота може бути переглянута через перехід до більш високого рівня – телероботи 2.0.

Ключові слова. телеробота, хмарні обчислення, бізнес реінжиніринг, Зелені телероботи, управління.

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ПЕРЕОСМЫСЛЕНИЕ ТЕЛЕРАБОТЫ ЧЕРЕЗ ОБЛАЧНЫЕ ВЫЧИСЛЕНИЯ – TELEWORK 2.0

В данной работе мы стремимся проанализировать две парадигмы, с точки зрения взаимной рекурсии между ними: телеработы и облачные вычисления. Основная цель этой научной работы – определение уровня поддержки каждой парадигмы для другой и синергетический эффект, порожденный их взаимозависимостью. Мы будем подходить к функциональным, юридических и экологических аспектов вопроса. В результате, мы стремимся выделить как путь облачных вычислений может революционизировать все, что представляет собой телеработа и как телеработа может быть пересмотрена через переход к более высокому уровню – телеработы 2.0.

Ключевые слова. телеработа, облачные вычисления, бизнес реинжиниринг, Зеленый телеработы, управление.