QAHEaaS or Quality Assurance in Higher Education as a Service

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Abstract - **The rise of globalization has highlighted the issue of internationalization of quality assurance in education. The COMPASS-OK software application for (self) assessment and accreditation, developed at the Plovdiv University, maintains features for modeling of methods and procedures for quality assessment of education. Its successful application has raised the idea of extending it as a universal tool developed on the basis of cloud services – a tool which provides services to ensure the quality of education for educational institutions and accreditation agencies from around the world. This article offers a conceptual framework and discusses the advantages and benefits of such a development.**

Keywords - **quality assurance in higher education as a service, evaluation of the quality in higher education, quality assurance in the cloud.**

1. Introduction

The rise of globalization has brought major challenge in front of thehigher education – to train people able to serve the ever-changing knowledge economy. This has led to coop-competition among universities. On the one hand, they cooperate in various ways to offer quality educational product; on the other hand they compete to attract more students. A survey conducted by the European University Association shows prevailing attitude of universities and a number of activities directed towards internationalization of education [1].

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Internationalization is done in different ways [2, 3] but the most widespread ones are: student and faculty mobility, internationalization of programs and curricula, joint educational programs, dual degree programs, internationalization at home, where students from an educational institution are trained in foreign programs (of universities from abroad), etc.

Internationalization enriches the educational process with new nuances related to the cultural, legislative and institutional, economic and other differences between the educational institutions and the countries in which they operate. The question arises of sharing a common framework for quality of the international training, a general concept which would allow a comparison of the quality of the educational products and be a roadmap for future development.

Quality assurance in education is a process requiring a lot of resources – time, human and financial. It's almost a continuous process because, in general, numerous evaluation procedures are carried out in an educational institution, and they are carried out periodically, at certain intervals. Each accreditation organization has its own policies for quality assurance, including methodologies/criteria systems and procedures. On the one hand, the methodologies used follow established common frameworks, standards and quality criteria. They are often structured in a similar way, differing usually in the criteria used, the indicators and the ways in which they are evaluated. On the other hand, despite their differences, the procedures for quality assurance include uniform activities related to collecting, processing, evaluating and analyzing information. The question arises – *is it possible to offer a common platform that would support the educational institutions and the agencies evaluating them in organizing and carrying out procedures for quality assurance in education that would facilitate the internationalization process, make it more transparent and allow easy sharing of good practices.*

2. Internationalization of the processes related to quality assurance in higher education

The internationalization of education has raised the issue of sharing a common understanding of education quality. There are many organizations working on the issue of quality assurance in higher education. A few of these are the International Network for Quality Assurance Agencies in Higher Education (INQAAHE), the European Association for Quality Assurance in Higher Education (ENQA), the American Council for Higher Education Accreditation (CHEA), the Quality Assurance Agency for Higher Education (QAA) and so on. [4] raising the issue of creating a European Programme Label for internationalization of higher education.

2.1. Sharing a common understanding of the quality of education

The pursuit of commensurability of quality in the European Higher Education Area (EHEA) has naturally led to the creation of **common standards for quality assurance**. **European Standards and Guidelines for Quality Assurance (ESG)** [5] are the most significant result in this direction. ESG is a **set of standards and guidelines for internal and external quality assurance in higher education**. The first version of the document written in 2005 was adopted by the ministers responsible for higher education. The document's latest update was in 2015.

ESG are not specific quality standards, nor do they determine how to perform the quality assurance procedures. They provide guidelines covering the areas that are vital for the successful assurance of quality and learning environment in higher education. ESG focus on assuring quality related to learning and teaching in higher education, including the learning environment and the relevant links with researches and innovations. ESG apply to any higher education offered in the EHEA regardless of how the training methods or the place of supply. They are applicable to all higher education, including the transnational and cross-border types.

Quality assurance agencies that work in substantial compliance with ESG are listed in the **European Quality Assurance Register for Higher Education (EQAR)** [6]. The register lists 42 accreditation institutions from 22 countries, some of which are not members of the European Union, such as Russia, Norway, Croatia, Serbia, Estonia, Kosovo. They have all developed their own mechanisms for quality assurance based on the ESG.

Council for Higher Education Accreditation (CHEA) is a private non-governmental organization that coordinates the accreditation activity in the United States. By the end of 2015 about 3,000 educational institutions have become its members. CHEA recognizes 60 organizations providing institutional and program accreditation. In 2016 CHEA published a document called The CIQG International Quality Principles: Toward a Shared Understanding of Quality [7]. It was developed by people from all over the world. The document reflects different aspects of quality and contains ideas and analyses useful to agencies for accreditation and quality assessment. It describes 7 basic principles - Quality and Higher Education Providers, Quality and Students, Quality and Society, Quality and Government, Quality and Accountability, Quality and Quality Assurance Bodies, Quality and Change. These principles are designed to serve as a basis for understanding quality and to offer a framework for international discussion of the quality in higher education. They can be used to form discussions about quality or assure quality of education at regional as well as international level.

2.2. Internationalization of the process of assuring quality of education

In 2015 ENQA conducted a study for the developing processes of internationalization in quality assurance in the EHEA. The report [8] considers and analyzes a number of issues related to the current state of internationalization in the EU, including the quality assurance (QA) agencies, methodologies for international assessment, resources allocated to internationalization, expectations, risks and benefits of the internationalization of the QA processes, improvement of the QA services, etc. **The study shows that governments support the internationalization of quality assurance** but focus on "at home" internationalization by **encouraging QA agencies to apply international standards and participate in international networks. Implementation of international standards in European Union is carried out using the ESG standard**. Analyses show that the budge of QA agencies for internalization is negligible as a whole and agencies do not expect increase in the financing of that sector in the coming years. Most activities are related to participation in international networks, cooperation with international partners and the involvement of foreign partners as quality experts.

The internationalization of quality assurance in higher education (HE) leads to some **positive results**. It expands the experience of national agencies, improves national mechanisms for quality assurance and increases the efficiency of QA activities. This leads to consistency in external quality assurance on international level, recognition of qualifications and academic degrees and more.

The **main risks** are caused by various factors. It is necessary to legitimize differences in quality [9] - even if common definitions and quality standards are used, there will be differences between institutions arising from financial, economic, social, cultural and other distinctions. There is a risk that universities might choose an agency whose accreditation framework is the easiest to comply with. Imported mechanisms or methods for quality assurance may also have a negative impact if they're not adequate for the educational institution undergoing assessment. Financial problems could also be an obstacle to the successful conduct of the process, etc.

2.3. Procedures for assuring the quality of education

Internal quality assurance in the European framework ESG sets multiple standards covering a wide range of areas for evaluation, including policies for quality assurance; development and approval of curricula; training, teaching and evaluation; admission, development, recognition and certification of students; teaching staff; learning resources and student support; information management; cyclical external quality assurance and so on. Each standard is accompanied by implementation guidelines that specify the quality expectations and outline various evaluation criteria.

Educational institutions and accreditation agencies use the standards and guidelines and they develop their own methodologies and criteria systems for self-assessment, as well as approaches for their evaluation. Generally, assessment methods have a hierarchical structure consisting of several levels and include various types of assessment components, such as areas for evaluation, criteria, characteristics and indicators. Indicators are at the lowest level. During evaluation, indicators are given specific evaluations, then the evaluation of the other assessment components are calculated based on the evaluations of the components at the lower level.

The **procedures for external evaluation and accreditation** approved in the European Union by ESG [5] follow a common base frame. Accreditation procedures in the US are conducted in a similar way [10].

Accreditation procedures are performed periodically every few years. Accreditation usually goes through several steps:

- **Self assessment**. The institution under evaluation provides a basis for conducting external quality assurance by carrying out preliminary self-assessment and preparing materials, such as self-assessment report or an equivalent document supporting the evidence, etc.
- **Site visit**. A group of external experts make a site visit to the institution under evaluation, check the provided information and, if necessary, collect additional information.
- **Assessment**. The expert group prepares a well-grounded report for the conducted assessment containing specific guidelines for future action aimed at improving the quality of education.
- **Post-accreditation control**. Procedures for follow-up control are carried out at the institution to monitor the implementation of the prescriptions made.

The conduction of sustainable international quality assurance involves the creation of mechanisms and tools that ensure transparency and fairness and allow adaptation to the educational institutions' needs. One of the possible solutions is to create a unitary **Quality Management Platform (QMP)** which implements various quality standards.

Considering the ways of conducting external evaluation and accreditation, as well as the need to adapt evaluation procedures to the specifics of the cultural, economic and social status of the different countries, the following key functionalities can be formulated for the QMP:

- maintenance of a register of quality assurance agencies;
- maintenance of a register of quality experts;
- modeling of objects that are subject to evaluation - institutions, professional fields, educational resources, learning management systems (LMS) and others;
- modeling of methodologies and criteria systems for quality assessment having different structures, evaluation elements and different valuation methods;
- modeling and management of procedures for (self) assessment and accreditation, including stages, units, participants with different roles, rights and responsibilities, etc.;
- automated accumulation of data and generation of documents for the respective evaluation procedures and objects, including self-assessment and evaluation reports, expert statements, references, etc.

3. Software application for (self) assessment and accreditation COMPASS-OK

COMPASS - OK is a software application for (self) assessment and accreditation developed at the Plovdiv University (PU) [11, 12]. It has been used

for the conducting of several institutional and program accreditations at the University.

The main features of the application are:

- modeling of methodologies for QA of education;
- configuration of (self) assessment and accreditation procedures;
- self assessment;
- assessment / accreditation;
- management of users and roles, etc.

The application supports several roles, each with specific access rights to the system functionalities. Conducting an accreditation procedure using COMPASS-OK involves several steps:

1. **Modeling the structure of the organization under evaluation**. The organization structure is modeled, specifying all units that will participate in the evaluation / accreditation procedure (faculties, departments, laboratories, etc.) At a later stage, the units and persons in charge of entering information and evidence are specified for each assessment component (indicator) of the methodology.
2. **Modeling a methodology**. A hierarchical (tree) structure of the methodology is created. Specific information (general information on the indicator, how to evaluate it, where to seek information, etc.) is entered for the different types of evaluation elements - areas for evaluation, criteria, characteristics, indicators.
3. **Configuring a procedure**. It includes:
   - selection of units that will participate in the evaluation procedure;
   - defining the stages of the accreditation procedure by setting time limits for self-assessment and evaluation;
   - defining users' roles;
   - defining the units for which a certain user can enter information.
4. **Self assessment**. It includes:
   - introduction of materials, evidence and summaries;
     - o a *material* is a presentation of a document, object, system, event, etc. It's characterized by a name and a type (link, file or location), a short description and the unit it refers to;
     - o *evidence for indicator* uses a material which must meet at least part of the indicator's requirements. The evidence includes a material and a description specifying what part of the material

(section/paragraph of a file or a web page or the whole material) is the relevant evidence.
     - o *summary* is a freestyle text description that is used for automated generation of the self-assessment report.
   - generation of summary evaluations and a self-assessment report.
5. **Assessment**. It's conducted by quality experts and includes:
   - review of the indicator information (description, evidence);
   - making well-grounded evaluations;
   - generation of expert statements and assessment report.

One of the biggest experiments conducted with COMPASS - OK was the institutional accreditation of the Plovdiv University held in 2012. More than 50 users from 17 university units (faculties, branches, college, department, university center and library) with different roles and responsibilities took part in the procedure. They provided 1456 materials (998 files totaling around 560 megabytes, 452 references, 6 other descriptions), 1310 summaries and 2549 pieces of evidence for the self-assessment report. The automatically generated self-assessment report of the PU had a volume of 960 standard pages (1800 characters per page), or 1007 pages with the cited (over 1387) sources. The formal self-assessment report of the PU created on the basis of the automatically generated one has a volume of 221 pages.

4. Cloud computing

The challenges related to storage, search, sharing, transfer, analysis and visualization of large volumes of data provoked the development of technologies, services and applications aimed at more efficient use of software and hardware resources. This led to the rapid development of various technologies united under the term cloud computing.

There are many definitions of cloud computing. They reflect the key aspects of cloud computing in different ways. The definition given by the American National Institute of Standards and Technology (NIST) is indicative. It says: „Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [13].

4.1. Fundamentals of cloud computing

Cloud computing is an emerging Internet-based computing paradigm. It utilizes 4 key technologies: Virtualization, Service-Oriented Architecture (SOA), Grid Computing and Utility Computing.

- **Virtualization** is a technique that allows the sharing of one physical instance of an application or resource between multiple organizations or tenants. **Multitenant architecture** offers **virtual isolation** between multiple tenants. Organizations can use and customize their applications in such a way as if each user has their own running instance.
- **Service-Oriented Architecture (SOA)** allows the use of applications as services to other applications, regardless of the Internet provider, the product or the technology. Therefore, it is possible to exchange data between applications of different providers with no additional programming or changes to the services.
- **Grid Computing** refers to distributed computing where a group of computers from different locations are connected together to achieve a common goal. These computer resources are heterogeneous and geographically dispersed. Grid Computing breaks down a complex task into smaller tasks that are assigned to the processors within the grid.
- **Utility Computing** is based on the pay-per-use model. It provides computing resources on demand as metered services.

Cloud Computing architecture consists of multiple loosely coupled cloud components. Cloud architecture can be conditionally divided into two parts: Front End and Back End. **Front End** consists of interfaces and applications that customers need to access the cloud platforms, such as web browsers. **Back End** includes all the resources necessary for providing cloud services - data warehouse, virtual machines, security mechanisms, services, deployment models, servers, etc.

4.2 Cloud Service Models

There are 3 main types of models with respect to services: Infrastructure as a service (IaaS), Platform as a service (PaaS) and Software as a service (SaaS) [14].

Infrastructure as a service provides virtual machines, virtual memory, virtual infrastructure, as well as other hardware "assets" as resources that customers can rent and use. The IaaS service provider manages the whole infrastructure and the client is responsible for all other aspects of deployment - operating system, applications, user-system interactions and so on.

The **Platform as a service** provider provides virtual machines, operating systems, applications, services, environments for the development of software applications, databases and more. Customers can deploy their applications on the cloud infrastructure or develop applications using languages and tools supported by the PaaS services provider.

Software as a service is a complete operating environment with applications, management and the relevant user interface. In the SaaS model the application is provided to the client through a thin client type of interface (usually a browser), and the responsibility of the customer using the service includes entering and management of data and user interaction. Everything necessary - from the application to the infrastructure - is the provider's responsibility.

The lexicon of cloud services related to the "as a Service" terminology has expanded in recent years. Cloud vendors often describe their products "as a Service" to fit their particular product's function. Besides the 3 conventional models - SaaS, PaaS and IaaS, literature also describes other models of cloud services. They are in a XaaS format, or "<Something> as a Service" and normally can be attributed to one of the 3 main models. Such services include, for example, Identity as a Service (IDaaS), Compliance as a Service (CaaS) [15], Backup as a Service (BaaS), Database as a Service (DBaaS) etc. [16].

The **Quality assurance in higher education as a service (QAHEaaS)** will probably also find its place and application in the educational space.

4.3. Benefits of Cloud computing

The main advantages of using cloud computing are:

- **On-demand self-service**: the customer can request and use computing resources without having to interact with the cloud service provider;
- **Broad network access**: the customer can access the resources in the cloud by using different platforms (this includes heterogeneous operating systems, thick and thin platforms such as laptops, mobile phones, and PDA);

- **Resource pooling**: the cloud service provider creates resources which are combined into a system supporting multi-tenant usage. The physical and virtual systems are allocated and reallocated dynamically as needed.
- **Rapid elasticity**: resources can be provided quickly and flexibly. The system can add resources through horizontal or vertical scaling. From a customer perspective, the resources of the cloud should appear limitless and be purchasable at any time and in any amount.
- **Measured service**: the use of the cloud system resources is measured and reported based on certain indicators. Customer only pay for the resources they used.

5. Quality assurance in higher education as a service

Each educational institution annually holds tens or hundreds of evaluation procedures of various types. Most procedures are performed periodically - every few months or years. Educational and accreditation agencies periodically change the rules for organizing and conducting the evaluation procedures and the methodologies used. Procedures themselves are also complicated - with different participants communicating in different ways, with different rules, procedures and criteria systems. The development and implementation of an individual solution serving the needs of a particular educational institution requires large investments - for the purchase of hardware, development of specialized software, staff training and more. The subsequent maintenance of the application is also a cost - for staff to administer the application and maintain the information infrastructure.

The development of a complex cloud service for quality assurance supporting different types of evaluation procedures, methodologies and quality standards would be beneficial to many educational institutions and agencies for evaluation and accreditation. This would allow each university to "export" its evaluation procedures to the cloud (fig. 1), organize them in a way that complies with the relevant institutional policies, procedures and methodologies, invite quality experts from other countries, draw know-how or offer their own know-how, promote its activities, make the QA procedures more transparent and so on. Universities would be able to use the service according to their specific needs, paying according to their actual consumption, without having to make large investments in infrastructure and software development.
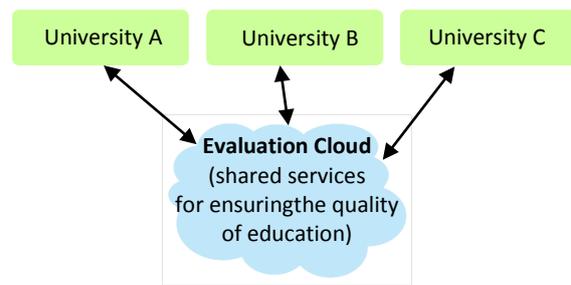

Fig. 1. Evaluation cloud

The nature and specifics of the (self) assessment and accreditation procedures put multiple functional requirements to the development of such a complex universal service. The most important requirements are:

- **to provide means for defining different types of methods and criteria systems for quality assessment** (based on certain educational standards and specifications);
- **to provide means for modeling the structure of objects under evaluation** - educational institutions, distance learning centers, etc.
- **to allow the assessment of various objects** - educational institutions, professional fields and specialties, curricula; software tools used in the training process; electronic tests; e-learning environments, etc .;
- **to enable modeling of (self) assessment procedures** in accordance with the practices of the different institutions;
- **to facilitate the work of experts in the analysis and evaluation** of the characteristics of the object under evaluation (according to the criteria of the methodology used);
- **to automate the documents' preparation, processing and exchange** (between the educational institutions' officials in charge and between the institution under evaluation and the evaluating institution);
- **to enable educational institutions to conduct self assessment**;
- **to generate documents** necessary for (self) assessment and accreditation, including self-assessment and evaluation reports, expert statements, prescriptions, reports, orders, tables, etc.
- **to allow flexible management of users**, setting of individual rights of access/management of different functionalities;
- **to provide real-time information** about the status of the procedures;
- **to maintain archives** for past, upcoming, open and closed procedures and others.

Participants in the procedures for quality assurance should have different access rights to resources and activities in the evaluation procedures, depending on many factors, such as:

- **participant's role** - evaluator, quality expert, administrative staff, management staff, student, observer, etc .;
- **participant's personal rights** – for example, the right to participate in the procedure for a certain period of time, the right to upload institutional documents only, the right to provide information only on specific indicators of the methodology, etc .;
- **procedure type** – for self assessment, assessment or accreditation;
- **procedure status** - in progress or completed, etc.

This involves the availability of a specialized component - **QA engine**, designed to process all user requests and taking into account the above-discussed factors, to provide relevant customized user view of the procedure (fig. 2).

Undoubtedly, the development of a unitary platform ensuring the quality of education would accelerate the internationalization of the process. The use of cloud computing as a technological basis for developing such a platform has the following advantages:

- **There's no need of large initial investments for building its own infrastructure**: Developing a software system of a large scale may require a lot of resources. In general, large investments are required to purchase hardware, software, for training and maintenance of highly qualified specialists. Major investments require advance planning and financing, and often occur slowly over time.
- **Just-in-time Infrastructure**: If necessary, the use of additional infrastructure can be requested at any time. The lack of this option in the past has made successful applications victims of their own success, due to the inability to scale the infrastructure.
- **Potential for shrinking the processing time**: Parallelization is the one of the well-known techniques to speed up processing. Having available an elastic infrastructure provides the application with the ability to exploit parallelization in a cost-effective manner reducing the total processing time [17].
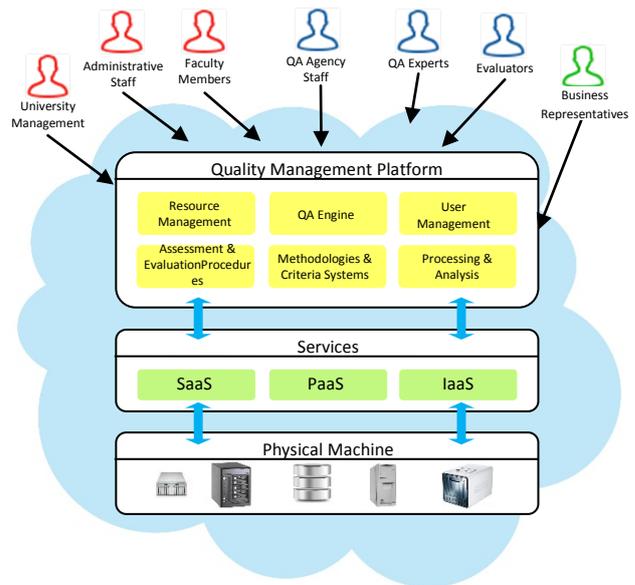

Fig. 2. Quality Management Platform

6. Conclusion

The internationalization of education is one of the reasons that provoked educational institutions and accreditation agencies to seek a common perspective on the concept of "education quality". Many organizations and networks are working on the creation and sharing of common frameworks and methodologies for QA in education. Each year, educational institutions and accreditation agencies devote significant resources to secure the ever-changing QA procedures. The software application for (self) assessment and accreditation COMPASS-OK was developed at the Plovdiv University. Its use has automated and significantly facilitated the accreditation procedures at the University. We believe that the multiplication of this result, through the development of cloud services for quality assurance would be of great benefit to all participants:

- automation of the activities related to conducting accreditation procedures;
- supporting the process of internationalisation of QA;
- improvement of the national mechanisms for quality assurance;
- expanding the experience of national agencies for evaluation and accreditation;
- similarity of external quality assurance in many countries;
- no big investments are required to purchase software and hardware;
- services are paid depending on consumption, etc.

The use of Cloud Computing is a natural choice for the implementation of this kind of application because it provides reliability, unlimited resources if necessary, and payment based on consumption.

References

[1]. European University Association. (2013). Internationalisation in European higher education: European policies, institutional strategies and EUA support. *European University Association asbl: Brussels*.

[2]. Arabkheradmand, A., E. Shabani, etc., *An Introduction to the Internationalization of Higher Education*, University Press of America, 2015, ISBN-10: 0761864709.

[3]. Grigorova, K., *Internalization of education – another way to improve quality*, Scientific works of the University of Ruse - 2014, vol. 53, series 6.1, pp. 111-115, ISSN: 1311-3321 (in Bulgarian).

[4]. Hans de Wit, *Internationalisation of Higher Education in Europe and its assessment, trends and issues*, Nederlands-VlaamseAccreditatieorganisatie, 2010, Nederland.

[5]. Thune, C. (2005). Standards and guidelines for quality assurance in the European Higher Education Area. *Report, European Association for Quality Assurance in the European Higher Education*.

[6]. *European Quality Assurance Register for Higher Education (EQAR)*.
Available at: https://www.eqar.eu.

[7]. *The CIQG International Quality Principles: Toward a Shared Understanding of Quality* (2016), CIQG International Quality Group, Washington, United States of America.

[8]. Grifoll, J., A. Hopbach, A. McClaran, etc., *Quality Procedures in the European higher education area and beyond* – Internationalisation of quality assurance agencies, 4th ENQA Survey, Brussels, Belgium, 2015. ISBN 978-952-5539-78-3.

[9]. Kinser, K., & Lane, J. (2015). The Problems with Cross-Border Quality Assurance. *International Higher Education*, (73), 18-19.

[10]. Judith S. Eaton, *An Overview of U.S. Accreditation*. (2015). Council for Higher Education Accreditation.

[11]. Hadzhikolev E., Hadzhikoleva S., Totkov G., Doneva R., *Automation of the Procedures for (Self) Evaluation of the Quality in Higher Education*, National conference "Education in the information society", 31 May – 1 June 2012, Plovdiv, 9-18, ISSN: 13140752 (in Bulgarian).

[12]. Hadzhikolev, E., S. Hadzhikoleva, *Component Model of Methods for Evaluation of the Quality in Education*, National conference "Education in the information society", 30-31 May 2013, Plovdiv, 248-257, ISSN: 13140752 (in Bulgarian).

[13]. Mell, P., & Grance, T. (2010). The NIST definition of cloud computing.*Communications of the ACM*, *53*(6), 50.

[14]. Hogan, M., A. Sokol, *NIST Cloud Computing Standards Roadmap*, NIST SP 500-291, National Institute of Standards and Technology, 2013.

[15]. Sosinsky, B., *Cloud Computing Bible*, ISBN 978-0-470-90356-8, Wiley Publishing, 2011.

[16]. Hausman, K., S. Cook, T. Sampaio, *Cloud Essentials*, ISBN: 978-1-118-40873-5, John Wiley & Sons Publ., 2013.

[17]. Liang Zhao, SherifSakr, Anna Liu, Athman Bouguettaya, *Cloud Data Management*, Springer International Publishing Switzerland, 2014, ISBN: 978-3-319-04765-2.