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Quality management in cloud services using remote assistance – a literature review

Unguraş Dorian^a, Mirabela Gaspar^b

^{ab}Cluj-Napoca Technical University, 28, Memorandumului street, Cluj-Napoca, 400114, Romania

Abstract

Cloud computing is today's edge of ICT, being present in quite all fields of economy, society and human life: education, medicine, industry, communication, etc., offering services and applications that are used daily by everyone connected to the internet. The quality of these services is a cutting subject for all stakeholders. This paper synthesizes some relevant researches focusing on *quality management* approaches in *software services* using *remote assistance* as tool and *cloud* as support of this service. As first step, the literature review focuses on cloud as being the most emerging and comprehensive subject on the deck, then extends the research on software services supported by cloud, identifying quality interventions in these cases and in the end, is looking for quality related demarches in remote assistance of these services. The research tries to identify how quality could influence cloud products in favor of the customer, targeting better cloud-connected services and applications. Proposing an exploratory research, the paper's intended contribution is placed mainly in clarifying the mentioned concepts and the way they are correlated in the practical world.

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1. Introduction

In recent years, the internet technology has been growing year by year and it is perhaps the biggest innovation from the last decades because it allows people interaction without the constraints of time and space. (Ardion Beldad, 2010). From the internet domain comes the cloud technology which has evolved most in the last years. The rapidly increasing growth of cloud computing makes it an exciting area for research (Haibo Yang, 2012). The first

appearance of the cloud is dated from the sixties and cloud computing has developed along several lines, with Web2.0 being the most recent evolution. One of the first milestones in cloud computing history was the arrival of Salesforce.com in 1999, which pioneered the concept of delivering enterprise applications via a simple website. Then in 2006, Amazon launched its Elastic Compute Cloud (EC2) as a commercial web service that allows small companies and individuals to rent computers on which to run their own computer applications. Another big milestone came in 2009, as Web2.0 hit its stride, and Google and others started to offer browser-based applications, with services such as Google Apps. (computerweekly.com, n.d.). The Cloud is worldwide known and it influences domains like education, medicine, informatics even oil and gas. It is a huge help for all the companies that have sensitive information that want to be stored somewhere safe and that can be accessed whenever the information is needed and always having someone helping on issues that may be encountered. This help for customers will be provided by technicians that will be available 24/7 and offering remote assistance for the customers of the cloud services. The quantity of information is growing daily and this technology is processing all the information and is offering infrastructure that can allow companies and users to access it in safe environments. Cloud computing is considered the 4th industrial revolution along with internet of things, big data, artificial intelligence and it has the potential to improve the quality of life and raise the global income. (Schwab, 2017)

Cloud computing is important and influential in people's lives, offering services and applications that are used daily by everyone that has connectivity to the internet. It is everywhere influencing domains like education, medicine and informatics. Anything that is stored on-line it belongs to cloud environment. The paper synthesizes some relevant researches focusing on quality management approaches in software services using remote assistance as tool and cloud as support of this service. As first step, the literature review focuses on cloud as being the most emerging and comprehensive subject on the deck. In the second then phase the research will extend on software services supported by cloud, identifying quality interventions in these cases. In the last step, the paper will look for quality related demarches in remote assistance of these software services. The research tries to identify how quality could influence cloud products in favor of the customer, targeting better cloud-connected services and applications. The added value of this paper is described by proposing an exploratory research intending to bring a contribution in clarifying the mentioned concepts and the way they are correlated in the practical world.

2. Background

2.1 Cloud computing

Cloud computing has different definitions from different sources and in a short description it can deliver hosted services over the internet. In addition, it can be categorized piece by piece. For example, we can call cloud the software and data center hardware. If there is available a service on the internet that must be paid for usage it can be called a public cloud. The service that is sold can be called utility computing. If there is a business or organization with data center infrastructure that is not available to public then it should be named private cloud. (Armbrust, Fox, & others, 2010) Cloud computing offers various benefits to users and companies. Margaret Rouse described these as being “self-service provisioning where users can spin up compute resources for any type of workload on demand.” Other benefits are “elasticity, meaning companies can scale up or down as computing needs increase or decrease and pay per use applies when compute resources are measured at a granular level, allowing users to pay only for the resources and workloads they use” (Margaret Rouse, 2017)

The Cloud is influencing and changing our lives in many ways and just a few studies have focused on its impact on everyday life and how important it is. The Internet is the most explosive domain and it is using cloud software products. There is high pressure on the existing storage products that are supporting the internet but the cloud infrastructure is offering help with the software products they can provide, one example is the server virtualization technology. (Qian, Luo, & others) Another example of the expansion of this technology is the influence on the social media environment where data collected from users it is secured and stored on the cloud. The business industry is benefiting and increasing by using data from social media platforms in combination with cloud-based information resources to get better insights on potential services, innovations and customer requirements. (Maamar Ferkoun, 2017).

2.2 Cloud application domains

Important domains like education, medicine, communication, even oil and gas are influenced by the cloud field. In medicine patient's data are stored on the cloud and can be accessed from different places on this planet if there is an internet connectivity. In education, books and documentations and even student's situation from grades to absences are stored on the cloud. Informatics is the domain that founded cloud and it is changing parts of its infrastructure due to this technology because of the low cost and few hardware infrastructures needed. From virtual servers to virtual machines, all are replacing the hardware infrastructure of a big segment of telecom networks. In education "the approach of cloud computing technology is based on the services they offer, their implementation and architecture. Some schools use low-level cloud services for data storage but the use of cloud computing in education offers a lot of benefits like the economy of financial resources, elasticity of use, increased availability for educational applications and finally end-user satisfaction." (Isaila, 2014). In addition "every organization should have a cloud strategy on how to make best use of this new facility including educational institutions" (Rajaraman, 2014). The most important components that influence the IT field are based on cloud technologies like computational resources, storage and communications. Virtual machines are the ones that provide computational resources to cloud users and flexibility in configuring their settings while protecting the physical infrastructure of the provider's data center. Another important component, storage, allows users to store data at remote disks and access them anytime from any place if they have an internet connectivity. Data-Storage is the name of this service and it allows cloud applications to scale beyond their limited servers. Last technology presented, communication becomes a vital component of the cloud infrastructure and it is service oriented, configurable, schedule, predictable and reliable. "Communication as a service supports requirements like network security, dynamic provisioning of virtual overlays for traffic isolation or dedicated bandwidth, guaranteed message delay limits, communication encryption and network monitoring" (Syed A. Ahson, 2011)

2.3 Remote assistance

Remote assistance, which means no contact with the customer is a key feature of cloud services. The customer and the technician have no face to face contact interacting only by phone. In any domain that cloud is active, customers are expecting to have access 24/7 of all the information stored in cloud. Andrew Sanchez states "there is simply no substitute for a phone call to calm down customers and get their concerns addressed quickly, although remote assistance and system control is quickly making strides in the support arena." (Andrew, 2009) Customers will always want train professionals to solve their problems remotely because there won't be any time wasted and no frustration cumulated for the owners of the cloud products. The experience of the cloud customers with the technicians will be reviewed and analyzed so it can always be improved to achieve better results every time.

2.4 Quality of service

Quality of service applied to the cloud and remote assistance is something that is needed. Users that interact with this type of products have big expectations and requirements that must be met. "Quality is not an inherent attribute of a product or a service but can only be determined by considering the expectations of the customer". (Kern, 2014).

When manufacturing cloud products, the operation management of the services is missing so the quality can't be guaranteed. (Xu, 2012) For any quality demarche, it is necessary to identify which quality standards are relevant to make the cloud services and remote assistance better. (Eric Bauer, 2013) If the software quality is poor there will be loose of profits. For example, in United States a lot of organizations annually lose billions of dollars because of poor software quality. A good software quality must include standards, plans, management systems, policies and procedures well documented and organized. (Underwood, 2016) Even if the cloud has simplified the provision process of the storage capacity, it encountered several challenges in quality of services. QoS defines the performance, reliability, and availability offered by an application and the infrastructure that is hosting it. (Ardagna, Casale, & others, 2014) All this quality features presented above form the quality management field that could be applied in the cloud industry.

3. Researches and results

3.1 Research methodology

The study has been conducted on over 70 papers identified and published in the past years in cloud services domain. For this literature review, Google academic was used for the research of articles by using key words that were related with the scope of this paper. As a limitation, the year 2011 was used, and after reviewing over 70 papers, a number of 35 have been retained. They were sorted after topics like: cloud computing, software services, remote assistance. This works were analyzed and filtered by relevant criteria's like the number of citations, covered subdomains, authors' competence in the field. There will be presented systematic analyses and there will be identified ideas that are relevant in cloud domain. In fig 1 we can observe the intersection of the 3 main fields documented: cloud, remote assistance and software services and at the core of the figure it is the focus, the influence in all domains, quality management. Quality management in cloud services using remote assistance has not been documented and the research in this field could be in the middle of development.

After examining figure 1 a couple of questions can be asked. Is remote assistance following standards drawn by quality management? Are customers happy with the quality of service provided through remote assistance? Are cloud products fulfilling customers' needs? Tables will be used to answer this and other questions. Also, each important topic will analyze several clouds researches and extract important quotations, present how each topic has an influence on the other topics and in the end, relevant conclusions will be drawn.

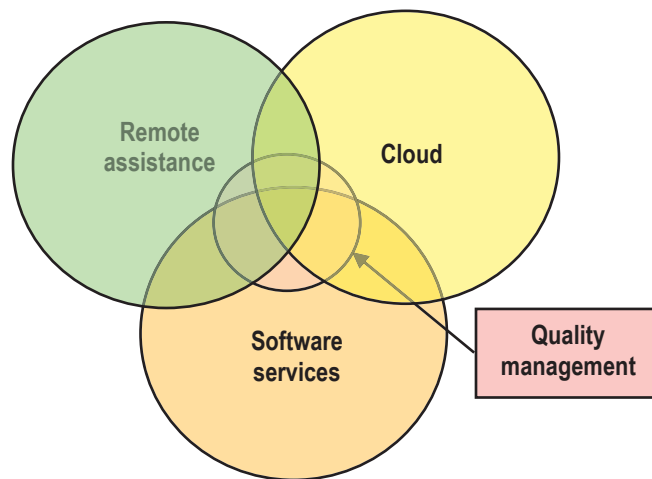


Fig. 1 Key features covered in this paper

3.2 Cloud influence

Cloud computing was the main research of this topic because of his influence in all the other domains, and it is considered the element that integrates all the fields presented in this paper. The research was conducted in 2 phases. In the first phase the main follow was on the cloud general elements like definitions, performance, products, storage and quality of service provided. The first table presents these elements. Cloud is evolving and growing, infrastructure is advancing and security has become very important. Julia Amin is stating that there is an increase in users that are using cloud computing services and vendors supply features with quality of services. The cloud service provider "Amazon" has had a growth from 5000 users that where using cloud in 2009 to 10.000.000 users in 2013. (Michael Tremante, 2013) From these information's we can understand better the impact of cloud services in

society and in different domains and we can view the needs of good infrastructure and security for this huge growth of customers. Abaker and Ibrahim demonstrated that cloud computing is eliminating the needs of expensive hardware, dedicated space and software. Cloud technology with big data and internet of things (IOT) are representing the 4th industrial revolution. (Abaker, Hashem, & others, 2015) If in the past companies were working with speeds of 1Mbits, now with all the network infrastructure change the speed rise to 1Gbits. Cloud has been increasing rapidly and the users are using this technology in different fields from medicine to education has been growing extremely fast. Cloud computing has managed to eliminate a good part of hardware infrastructure, dedicated space and software, managing to cut costs in the infrastructure and investing and focusing on qualified personnel and customer’s needs. Also, big investments have been made in high security and privacy because cloud software products are storing sensitive customer’s data. The important software applications available to users and businesses from cloud are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and all are delivered as a service remotely through the internet. (Sultan, 2010).

Table 1 will answer to some important questions regarding cloud and its services, performance and influence. Will users trust cloud technology when it comes to give and store personal data on the cloud? Will there be enough space for all the information provided by millions of people that use cloud software?

Table 1 Cloud computing key researches and relevant details

Influential quotations & references	Main topics	Conclusions
The increasing tendency of network service users to use cloud computing encourages web service vendors to supply services (Jula, Sundararajan, & Othman, 2014)	Cloud definition, cloud computing characteristics, cloud computing service models, cloud computing deployment models	Cloud computing services are increasing rapidly and the number of users that are using the services is growing
The performance of cloud computing is always a critical factor to be considered by any user groups (Yang & Tate, 2009)	Cloud performance, business issues, applications, knowledge management	The emergence of performance, network and data management in the cloud field is growing
Security and privacy issues present a strong barrier for users to adapt into Cloud Computing systems. (Zhou, Zhang, & others, 2010)	Data integrity, control, audit, privacy on demand, legal issues, data transfer across the borders	For users to get familiar with cloud computing systems there must be available a high security and privacy of personal contents so that personal data is secured
Eliminates the need to maintain expensive computing hardware, dedicated space, and software (Abaker, Hashem, & others, 2015)	Big data, cloud computing, relationship between big data and cloud, big data storage system	Expensive hardware will be eliminated and big data, virtualization and other technologies will take over with few expenses

In the second phase of this of this paper the research focused on cloud applications and how they are interacting and helping in different domains like medicine, education and management. Table 2 is presenting a couple of papers with the specified influenced fields, main topics and conclusions. In recent years’ cloud, has evolved in the medical field so the patient’s medical history can be stored on cloud and every doctor can access that medical file and the patient can be treated properly and not risking any misjudge treatments. “Also it's possible to tie multi-location practices together seamlessly, allowing staff in one office to reach their colleagues in another location via their extension just as they would if they were all working together in the same place.” (Rose de Fremery, 2017) Education is using cloud computing for storing resources, data and information that students and teachers can access from any part of the world. Customer requirements are meet with parameters like response time and service

initiation that belong to quality of service. Response time is the elapsed time from the moment the customer accesses the cloud service until the end of demand. (Linlin, Garg, & Buyya, 2011)

Table 2 Fields influenced by cloud and their benefits

Influential quotations & references	Main topics	Conclusions
The potential of cloud computing for improving efficiency, cost and convenience for the educational sector is being recognized (Sultan, 2009)	Cloud computing, education and the cloud, cloud concerns	Educational establishments want to manage their resources with the help of cloud computing
Delivers an integrated telemedicine service that automates the process from data collecting to information deliver as a computing utility (Rolim & Koch, 2010)	Medicine influenced by the cloud, content service application, utility computing provider	Using computing utility to restrain clinical diagnostics and monitoring capabilities
An important driver of availability equivalence is the extent of capacity planning and capacity management by cloud providers (Edgar A. Whitley, 2012)	Cloud computing, cloud computing desires, security, management, planning, service dimension of cloud desires, efficiency	Management is a key feature of cloud computing helping improving the quality of the services
Quality of service parameters such as response time and service initiation must be taken in account in relationship with the customers (Linlin, Garg, & Buyya, 2011)	Quality of service, Software as a service, cloud computing, virtual machines	Quality of service is helping cloud computing to fulfil customer requirements

Continuing the research in this second phase the focus moves to remote assistance and how it is influenced by quality. The last table is presenting these two domains but unfortunately the influence that quality has in remote assistance has not been documented and researched so much and there will be presented just 3 papers that are related to these topics.

From the research conducted the conclusion can be drawn that the cloud field is growing and evolving extremely fast with high performance and bigger infrastructures. Because there are so many companies that offer cloud services, customers that are purchasing cloud products are expecting different requirements to be satisfied. For the requirements of the customer to be full field all cloud companies applied to the management environment, to quality of service which defines a list of objectives to be completed, a performance analysis result and is relying on customer's feedbacks. In cloud environments, an important role is played by trust. For a product to be trustworthy it must offer availability, reliability and data integrity and all this features are obtained with quality of service. If cloud products do not reach these expectations, customers will reject them. Remote assistance is used in medicine, education, communication and in every domain, that is using cloud software products. Remote assistance is a new era of resolving issues that customers might encounter with the software and cloud products. Paul Manuel presents some ideas that are relevant when describing this feature. The first one is that no contact with the customer will be needed as this is done by connecting remotely to the products. The second one, there will be no extra charges, remotely assistance is included in the support offer of many companies that offer cloud products. It will be easy for engineers to solve issues that they can handle instead of giving indications to customers. And the last one is that over 90% of companies that offer cloud products are also offering remote assistance help (Manuel, 2011)

Table 3 Remote assistance and quality

Influential quotations & references	Main topics	Conclusions
Contribute with a solution that integrates concepts of wireless sensor networks and cloud computing to create a platform to support automated data gathering in telemedicine environment (Rolim, Koch, & others, 2010)	Remote assistance, remote services, remote patients, remote communities	Proposing an automated solution for obtaining data collection from patients, and analysing the information collected remotely with the help of cloud software products
For maintaining the quality, performance, speed, efficiency and cost of the software, the Software Quality Assurance activities, principles and its methods are implemented in the early stages of software engineering development phases (Murugan & S. Prakasam, 2013)	Software engineering, software quality assurance	When a software is developed in the early stages it must follow principles and methods implemented for maintaining quality and performance
Cloud computing promises to provide high quality, on-demand services with service-oriented architecture (Wang, Liu, & others, 2012)	Cloud computing, cloud service, quality of cloud service	When delivering on demand services and service software oriented, cloud computing must provide high quality performance characteristics

4. Conclusions

This paper concluded that cloud services are in a continuous process of growth and more users are using their applications and products just because of the benefits they offer in almost every field that is impacting daily activities.

Since the growth of the cloud businesses and the growth of users that use this technology are exploding, the questions that should be put are: will there be enough space for everybody to have their data and information on the cloud? And can the infrastructure of the cloud handle this growing? The answer is yes because there is an ongoing process of renewing the infrastructure and moving from hardware to software infrastructure.

Also, there are new cloud technologies documented and in the medicine field it seems that there will be implemented automated data collection from patients.

No paper was identified researching or documenting quality management in cloud services using remote assistance.

There is a lack of documentation and researches conducted in the direction of quality management or quality of service used in remote assistance. Why quality hasn't been introduced yet in remote assistance used on the cloud services? Some of the analyzed papers have presented ideas on how to implement quality in remote assistance and what are the benefits of it so it is just a matter of time until this will be accomplished.

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