Master Thesis
Software Engineering

January 2012

Cloud Computing Organizational Benefits

A Managerial Concern

Mandala Venkata Bhaskar Reddy
and
Marepalli Sharat Chandra

School of Computing
Blekinge Institute of Technology
SE-371 79 Karlskrona
Sweden

This thesis is submitted to the School of Engineering at Blekinge Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science in Software Engineering. The thesis is equivalent to 20 weeks of full time studies.

Contact Information:
Authors:
Mandala Venkata Bhaskar Reddy
E-mail: bhaskarreddymv@gmail.com, veme10@student.bth.se

Marepalli Sharat Chandra
E-mail: sharathchandra.marepalli@gmail.com , shmb10@student.bth.se

University advisor:
Kennet Henningsson
Department of Computer Science and Communication

School of Computing
Blekinge Institute of Technology
SE-371 79 Karlskrona
Sweden

Internet: www.bth.se/com
Phone: +46 455 38 50 00
Fax: +46 455 38 50 57

ABSTRACT

Context: Software industry is looking for new methods and opportunities to reduce the project management problems and operational costs. Cloud Computing concept is providing answers to these problems. Cloud Computing is made possible with the availability of high internet bandwidth. Cloud Computing is providing wide range of various services to varied customer base. Cloud Computing has some key elements such as on-demand services, large pool of configurable computing resources and minimal management effort to the users. The software organizations are looking for cloud benefits to address the project management problems.

Objectives: The study is to identify various cloud benefits for addressing project management problems faced by software industry. The study is also investigates various challenges or problems faced by the organizations while using cloud computing environment. The solutions or suggestions to overcome these identified cloud challenges are also produced in this study. Cloud benefits across different cloud types also found during this study.

Methods: Systematic literature review is conducted across eight databases to find different cloud benefits and challenges for the organizations to address the project management problems. Interview study is conducted across industrial experts working in cloud computing environment. Interview study is to check the status of cloud benefits and challenges found through systematic literature review and find new additions. The solutions and suggestions are also found to address the cloud challenges through both methodologies.

Results: A total of 21 cloud benefits and 12 challenges found across 43 primary studies through systematic literature review. 26 cloud benefits and 14 cloud challenges found through interview study among 7 cloud computing industry experts. 6 cloud benefits and 2 cloud challenges found through this study are not available in existing literature. Cloud benefits across different types are also discussed in this study.

Conclusion: This study identifies various cloud benefits and cloud challenges for organizations to address project management problems. Cloud utilizing organization has to differentiate its project management problems for identifying cloud type. Cloud utilizing organization has to take care of the challenges at the time of writing Service Level Agreements (SLAs) with the help of third party organization.

Keywords: Cloud Computing, Cloud benefits, Cloud challenges, Project management problems, Organizational issues.

ACKNOWLDEGEMENT

We would like to thank our supervisor, Kennet Henningsson for giving opportunity to do our master thesis under his supervision and his valuable guidance, feedback and support throughout the research study.
We would like to thank all participants who involved in the interview study. Without their involvement, this thesis research study would not have been possible. Last but not least, we would like to thank our parents and friends for their constant support and motivation.

CONTENTS

LIST of TABLES

LIST of FIGURES

GLOSSARY

Word/Phrase	Definition/Meaning
Cloud users	Customers who are using various cloud services and they include standalone users, small organizations and medium to large organizations.
Cloud utilizing organizations	Organizations which are using services provided by different clouds
Cloud building organizations/ Cloud providers	Organizations which are constructing clouds and providing resources to the users.
Cloud organizational benefits	Cloud benefits that are addressing the project management problems faced by organizations.
Cloud organizational challenges	Problems faced by the organizations while using cloud computing environment.
IEEE	Institute of Electrical and Electronics Engineers
ACM	Association for Computing Machinery
Challenge	Difficulty in a job that is stimulating to one engaged in it.
Benefit	Something that is advantageous or good
Problem solving capabilities	The capability of the cloud utilizing organization to solve the project management problem with the cloud services

1. INTRODUCTION

1.1. Back Ground

In the recent years, cloud computing has become a vital phenomenon in the software industry [8], [15]. The need for more technical resources at the low expenditure and the availability of the high internet bandwidth lead us towards the concept of cloud computing [5]. Cloud computing is being used by many people in the form of free e-mailing services such as Yahoo, Google, Rediff, Hotmail, etc. [3]. Cloud computing is characterized by the three main entities provided by it. The software, hardware and network entities collectively make cloud computing possible [4]. Cloud computing is gaining more interest in the scientific community as well because of its benefits [2].

Cloud computing is defined as " *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*" [14].

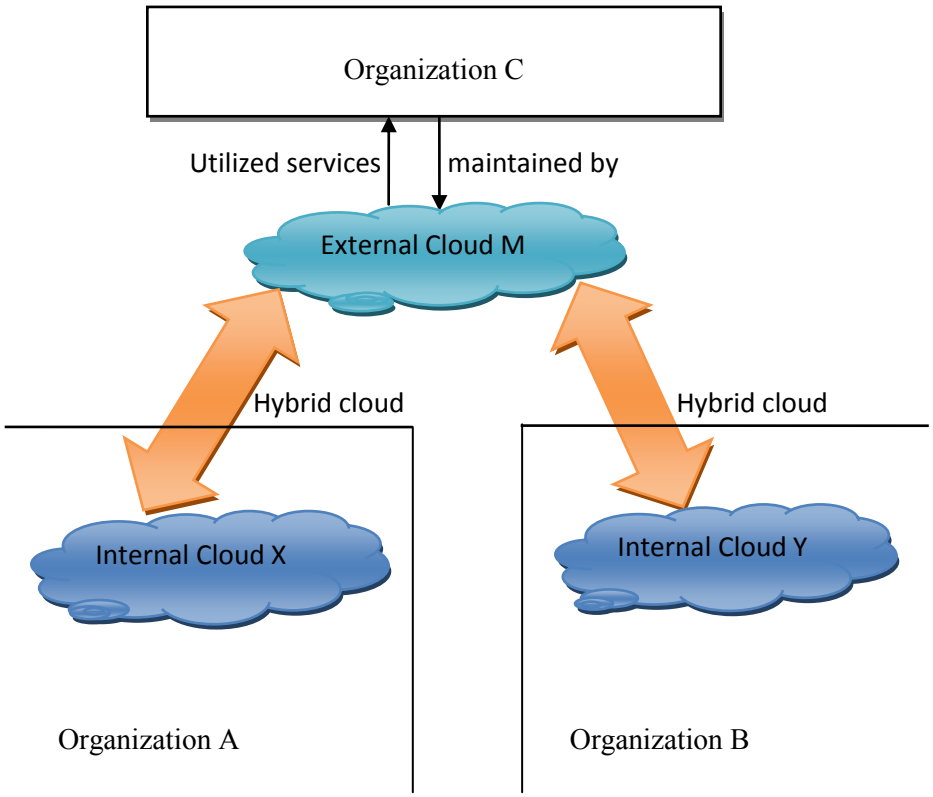

Figure1: Relation between Various Cloud Types [2]

Cloud computing is mainly categorized into three types, which are internal, external and hybrid clouds. Internal clouds reside within the organization environment and maintained by the organization itself. The services provided by the internal cloud are available to organization which is maintaining cloud but not to the public. An internal cloud is also known as a private cloud. The external cloud is provided by a third party and the services provided by cloud are available to the public. An external cloud is also known as public cloud. The hybrid cloud is provided by the multiple organizations and the services are utilized by the multiple organizations. The hybrid cloud is a combination of the private and public clouds [1], [7], [8], [10].

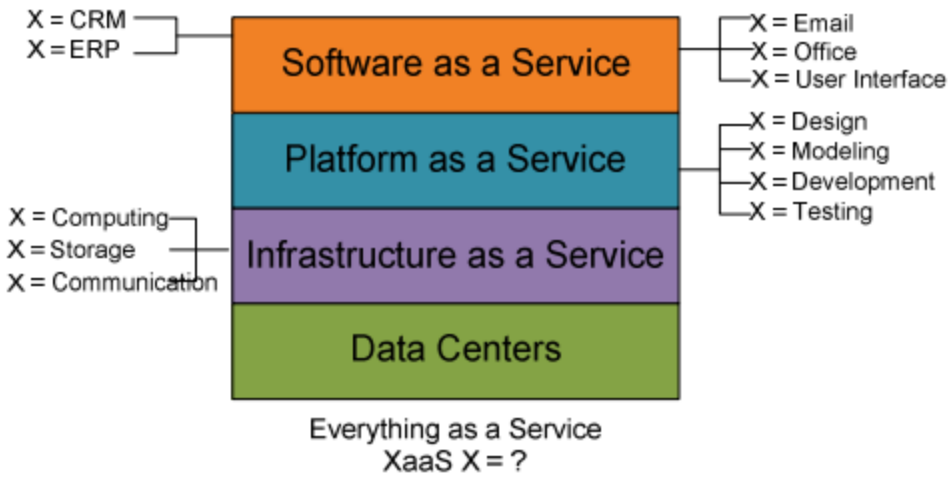

Figure2: Hierarchical View of Cloud Services [12]

Cloud computing is divided into four layer depending upon the services provided by cloud to the customers. Cloud incorporates following services: software as a service (SaaS), Platform as a service (PaaS), Infrastructure as a service (IaaS) and Data storage as a service (DaaS). In the SaaS, the software is provided as a service to the customers on demand. The end-users get rid of the deployment and maintenance of the software and they can access the additional features on their demand. They need not apply for the additional licenses. The Google Maps is a well-known example for the SaaS [1], [2], [3], [5], [6], [7], [8], [9], [10], [11], [12], [15].

In the PaaS, the development platform will be provided to the user with the application design, coding, testing, and deployment services. This enables the users to work collaboratively, across geographically distributed locations and there is no need for the software download and installation. The examples for the PaaS are Google applications engine, Microsoft Azure and Amazon Map Reduce, Engine Yard, Force.com, Heroku, MTurk, RightScale, S3, SimpleDB, SQS etc [1], [2], [3], [7], [8], [9], [10]. In the Iaas, the technical infrastructure such as computing power and Network connectivity between the data centers is provided to the users. The users can scale up the usage of the computational resources on their demand. The Amazon EC2 and Microsoft Azure Platform, Eucalyptus, FlexiScale, GoGrid, Nimbus, Rackspace Cloud, VPC is examples for this PaaS Layer [1], [2], [3], [7], [8], [9], [10]. In the Daas, the data storage is provided to the user as a service at the cheaper rates and on the demand. The data centers are built in less populated areas to reduce the energy rates and reduce the natural disaster probability. The data centers are the combination of many inter-connected servers [10].

Cloud computing challenges are overcome by cloud governance model [6]. Cloud cube model (CCM) is useful to build clouds according to the business needs of the customer [7]. The Hexagon model is useful to build cloud infrastructure based on the six elements, which are divided into three pairs: people (consumers and investors), business (popularity, valuation) and job variance (get the job done, innovation) [7]. The Capital Asset Pricing Model (CAPM) is useful to calculate the investment risks for cloud computing and profit achieved by cloud [7].

1.2. Related Work

Zhang and Zhou [11] proposed Cloud Computing Open Architecture (CCOA) by integrating virtual technology and power of Service Oriented Architecture (SOA). This architecture is based on seven principle and ten models. An extensible and configurable use of CCOA is explained through two case studies. This architecture will enable the cloud to provide infrastructure, software applications and business process in unique manner [11].

Zhang, Chen and Huo [15] discussing about various services provided by cloud computing and its characteristics. Cloud computing services include Software as a Service (SaaS), Utility Services, Network Service, Platform as a Service, Management Service Provider, Commercial Service Platform and integrating with internet. Cloud computing characteristics include Ultra Large-Scale, Virtualization, High Reliability, Versatility, High Extendibility, on Demand Service, and Extremely inexpensive nature of services. They also discussed about cloud security as hidden danger and presented industry situation with some examples. They provide data encryption as a solution to the cloud security [15].

Tsai, Sun and Bala Sorriya proposed a Service Oriented Cloud Computing Architecture (SOCCA) with overview survey of cloud computing architectures. SOCCA supports migration of applications from one cloud to another and also separates the role of service logic provider and cloud provider for redeployment of services to different clouds [12].

Dillon and Chang [10] discussed about cloud computing essential elements, adoption challenges and deployment models. Cloud computing essential elements include on-demand self service, broad network access, resource pooling, rapid elasticity and measured service. Cloud adaption challenges includes: security, costing model, charging model, service level agreement, and what to migrate. Cloud deployment models include private cloud, community cloud, public cloud, and hybrid cloud. They also discuss about three service models to categorize the cloud services. These service models include SaaS, PaaS, and IaaS.

Kim and Lee [3] discussed about adaption issues for cloud computing. These issues include outage, security, performance, compliance, private clouds, integration, cost and environment. They are also saying that these issues cause much loss to medium and large organizations depending upon adoption of cloud computing technology [3].

Ramgovind, Eloff and Smith [13] highlighting the key security considerations and challenges faced by cloud computing industry. These are saying that present trial and error control methods for managing security were involved with lot of investment. They are providing some guiding principles to save time and investment for the cloud owner. They are concentrating on cloud Governance and cloud transparency issues to deal with cloud security [13].

1.3. Problem Definition

Cloud computing has three types of potential users. They are stand alone users, smaller organizations and medium to large organizations. These users are adopting to cloud computing services based on the seven issues. They are availability of cloud services, security, performance, compliance, private clouds, integration of the services provided by the different clouds and cost of cloud services [3], [13]. Cloud computing is also having following challenges: on-demand services, resource pooling, broad network access, rapid elasticity, service measurement, and charging of the services [10].

Cloud computing services are utilized by different users based on their benefits. The organizations are utilizing the majority of cloud services produced by cloud computing organization. Cloud computing benefits are useful for cloud computing organization to improve their business activities. Cloud computing benefits are useful for the clients to make the use of cloud services for their development activities. Cloud computing benefits are further analyzed to add new features and services to existing cloud computing technology [3].

This master thesis aims to discuss different types of clouds used across software engineering industry, identifying the benefits of those clouds as a solution to the problems faced by the software engineering industry, problem solving capabilities of different clouds for the software industry and prioritizing the benefits provided by the different clouds.

1.4. Aim and Objectives

This research paper aim is to find out cloud computing benefits provided by cloud computing organizations, identifying cloud services for solving the problems faced by the software engineering industry and prioritizing cloud computing benefits according to cloud customer's (organizations) needs.

- To find different types of clouds used by customer organizations such as internal, external and hybrid clouds.
- To check the available cloud benefits are used for solving the software industry problems across cloud services, cloud types and cloud users.
- List the benefits according to priority of cloud customer organizations.
- Cloud benefits addressing the software industry problems related project management.
- The way in which cloud benefits are addressing the software industry problems.

1.5. Research Questions

Research Question 1. What are the current project management problems or issues that the software industry is facing?

Research Question 2. What are the benefits achieved by cloud computing environment to address various project management problems faced by software industry?

Research Question 3. What are the challenges arise due to cloud computing environment for the utilizing organization? What are the solutions available for these challenges?

Research Question 4. Comparison of cloud benefits provided by different cloud computing organizations across cloud users, cloud services and cloud types?

2. RESEARCH DESIGN

2.1. Overview of Methodology

The authors describing here about the research methodology followed for this research study. The research methodology consists of two phases, which are systematic literature review and interview study.

2.1.1. Phase-I

The systematic literature review is conducted to find out current project management problems faced by the software industry and how they are addressing those problems by using cloud computing environment. The systematic literature review is also used to find the cloud benefits for the software industry to address the project management problems and by which way the organizations maximizing the cloud benefits. The systematic review is conducted to find the available literature to address the identified research questions for this study. The results of this study is used to address the research questions RQ1, RQ2, RQ3, RQ4 and are also used to design the questionnaire for the interview study.

2.1.2. Phase-II

The interview study is conducted to find out the present status of the project management problems faced by the software industry and cloud benefits which are addressing those identified project management problems. It is also used to find different organizations and their solutions to maximize the cloud benefits. The questionnaire for the interview study is designed from the literature available from the systematic literature review. The interview study is to find new project management problems, new solutions to the project management problems and also find ways to maximize the cloud benefits for the organizations utilizing the cloud environment. This phase identified the present statues of the issues identified from systematic literature review and while addressing the issues related to RQ1, RQ2, RQ3, RQ4. Overview of the research methodology is described in figure 3.

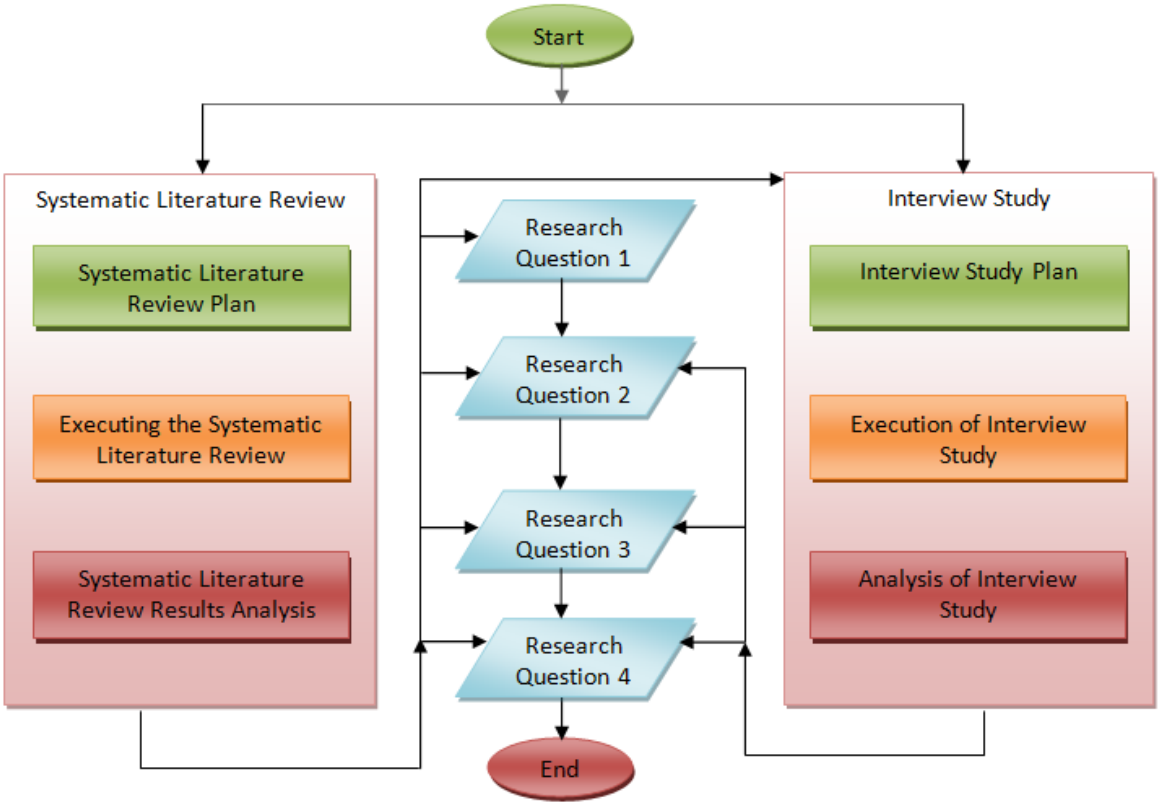

Figure 3: Overview of Research Methodology

2.2. Research Methodology Alternatives

We are discussing about possible research methodology alternatives in this section. The practical problems and obstructions associated with each research methodology for this research study were described in this section.

2.2.1. Experiment

Authors considered an experimental study to find cloud organizational benefits, challenges and solutions. Conducting of an experimental study is associated with the following problems:

- Identification of factors that are influencing the cloud architecture.
- Level of influences by each factor on cloud computing architecture.
- Controlling each factor while conducting an experiment.

Cloud computing researches were yet to cover these factors and their influence on the cloud. Cloud building or construction is an expensive and time taking process academic setup is not feasible and not appropriate to reflect cloud computing environment. The authors left with the option of conducting of an experiment in the industrial setup. The cloud computing environment is associated with the factors such as safety, security, privacy, high cost for building and wide range of customer base. These factors prevent authors from getting access to the industrial cloud.

2.2.2. Case study

The research objective can be achieved through the case study. This can be done by accessing industrial manuals of different cloud utilizing organization from cloud provider. Cloud provider has to look after safety and privacy of the cloud utilizing organizations. The authors have to work in the presence of cloud provider and have to cover different cloud providers to address research objective. Authors don't have resources needed to conduct this research methodology.
Authors left with the option of conducting interview study and which is done in this research study.

2.2.3. Survey

Cloud utilizing organizations have various benefits, challenges depending upon their requirements. The results are varied from one to the other cloud utilizing organizations. The authors have reflected these wide ranges of benefits and challenges in questionnaire. This is highly time consuming and less possible. Conducting survey among cloud providers is also not feasible because low level maturity of cloud computing industry. This research method was initially adapted by the authors and discard after above findings during the systematic review study.

2.3. Systematic Literature Review

According to Barbara Kitchenham, the systematic literature review (SLR) is "*a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest"*[16, 17]. Systematic literature review consists of three stages which are systematic literature review planning, conducting systematic literature review and reporting the systematic literature review. The systematic review planning involves the identification of systematic literature review needs, research questions identification for the research study and review protocol development. The review protocol is used as a guide for the whole systematic literature review process. Conducting the systematic literature review involves search strategy identification, primary study selection criteria and procedure, quality assessment of the research study, data extraction & monitoring

and data synthesis. Reporting systematic literature review involves analyzing the systematic literature review results

2.3.1. Planning the Systematic Literature Review

2.3.1.1. Identification of Systematic Review Needs

The authors want to find all the available literature related to cloud computing benefits which are addressing the project management problems faced by different organizations. The systematic literature review is also used to find the available literature, which is related to different ways in which the cloud services are addressing the present software industry problems related to project management. This study is also useful to find the literature available, which is related to categorization of the cloud benefits.

2.3.1.2. Research Question Identification

Research questions addresses by authors through this research study are:

Research Question 1. What are the current project management problems or issues that the software industry is facing?

Research Question 2. What are the benefits achieved by cloud computing environment to address various project management problems faced by software industry?

Research Question 3. What are the challenges arise due to cloud computing environment for the utilizing organization? What are the solutions available for these challenges?

Research Question 4. Comparison of cloud benefits provided by different cloud computing organizations across cloud users, cloud services and cloud types?

2.3.1.3. Search Strategy

The authors derived search terms (key words) from the research questions and exploring the similar terms available in the in spec database. The search terms are derived by considering the population, intervention, control and outcome. The population for this research study is cloud computing. The interventions for this research study are benefits, challenges, advantages, usage, utilizations and services. The controls for this research study are organization, industry and company. The search string is framed by using the identified search terms and with the help of Boolean operator OR & AND. The search string is modified according to the requirements of the various databases. For example some databases like in spec compendex will facilitate the use of "*", "?" in the keywords to perform efficient searching activity. The strength of the search string is validated against each and every database by selecting set of 20 studies relevant to our research study. We made modifications to the search string based on our search catch. The authors incorporated keywords for intervention and control to improve the relevance of the search hits found by the search string. Without intervention and control keywords the search resulted in nearly 5800 and highly irrelevant to our research study. During this process we may miss some relevant articles, but this was necessary to improve the relevance of search hits to our research study.

The authors found 1197 publications from the refined search string. The search string is only applied on the title and abstract. We used Zotero and Endnote tools for reference management activities such as collection, duplicate removal and organize.

2.3.1.3.1. Databases used: The authors used following data bases for this research study:

1. IEEE
2. ACM
3. In Spec & Compendex
4. Willey Inter Science
5. Springer
6. Scopus
7. Science Direct
8. Business Source Premier

The authors considering above mentioned databases to cover the research study, which is related to software engineering and project management. The authors conducted the search process on March 2011. The literatures available from 2000 to 2011 are considered for this research study.

2.3.1.4. Study Selection Criteria

The authors following below mentioned inclusion and exclusion criteria for this research study selection.

2.3.1.4.1. Inclusion criteria: The research papers available from January 1st 2000 to March 31st 2011 will be included for this systematic literature review study. The suitability of the articles is assets by using following criteria.

- Articles should be written in English
- Articles should be available in full text
- Articles should be peer review at least once
- Articles should be related to software engineering
- Articles related to cloud computing.

2.3.1.4.2. Exclusion criteria: The Exclusion criteria for this systematic literature review study are as follows:

- Articles which do not meet the specifications mentions in the inclusion criteria
- Articles that are repeated

The study selection procedure involves studying title, abstract and conclusion of each research paper and if it satisfies the inclusion criteria of the systematic literature review protocol then it will be considered for further systematic literature review study.

2.3.1.5. Quality Assessment

The quality assessment for this systematic review is done by the authors based on the four questions.

QA1: Is the article relevant to cloud computing?
QA2: Is the article describing about the cloud organizational benefits?
QA3: Is the article providing the organizational challenges while using cloud computing environment?
QA4: Is the article describing about various cloud types and their usage across the software industry?

The authors evaluated the quality of the research papers by studying the contents of the research paper individually. The primary study research paper will be evaluated based on the ranking given to them by studying introduction, method, results, analysis, discussion or conclusion. The ranking of each research paper will be based on the score given to the questions of quality assessment criteria. The scoring for each question is given based on addressing fully, partially and not addressing. The score for fully addressing will be '1', and for not addressing the score will be '0'.The authors used Cohen's kappa [85] as a statistical measure to evaluate homogeneity between two authors while conducting systematic literature review. We calculated Kappa coefficient at the time of inclusion & exclusion of articles for the primary

study and during the data extraction process. We used randomly selected articles from each database to calculate Kappa coefficient for inclusion & exclusion of articles. The homogeneity between two authors is assessed at the time of data extraction, by calculating kappa coefficient through selecting 20 random articles from the total of 43 primary studies.

2.3.1.6. Data Collection

The authors divided the primary studies according to the publications. Data from the articles of Business Source Premier, Science Direct, Scopus, Springer databases are extracted by the second author, and the remaining articles were extracted by the first author. The data extracted from each study by using data extraction form shown in Table 1.
The data extracted form from the primary studies will be analyzed to address the research questions.

Table 1: Data extraction Form

Data Extraction Form

General Information
Article Information
Publishing Year
Authors Name
Journal/Conference/Conference Proceedings
Abstract

Specific Information	
Study Content	Academic
	Industrial
Research Methods	Experiment
	Case study
	Research paper
	Systematic Literature review + survey
	Model
Peer reviewed (or) Not	
Relevance	Related to software research area
	Related to cloud computing
Cloud Benefits	Addressing software industry problems
	Specified according to different cloud types
Cloud Computing Challenges	What are the problems
	What are the solutions
	What extent problems are solved
Any guidelines to Cloud users (Organizations)	

2.3.1.7. Data Analysis

Data analysis involves collecting and summarizing the results of data extracted from primary studies. The methodology and outcomes of the primary studies are different from each other. And these studies are called as heterogeneous studies. The authors propose qualitative synthesis to be performed on the extracted data to overcome this heterogeneous nature. The authors will read and analyzed each research article during the qualitative synthesis. The results obtained from the systematic literature review will be analyzed to answer the research questions formulated for this research study. The authors will document the results from the primary study in accordance to the questions mentioned in review protocol.

2.3.1.8. Validation of Review Protocol

The critical and most important element of systematic literature review is review protocol. The validation process is essential to make review protocol transparent and fare enough. The search strings have been validated and checked by the authors with the help of librarian. The review protocol for this research study has been reviewed and validated by thesis supervisor who is experienced researcher in Blekinge Institute of Technology.

2.3.2. Conducting the Review

The authors conducted a review by formulating a search string for the systematic literature review. For the search string formation, the authors identify the relevant key words by searching the recently available relevant material in the cloud computing research area from Google Scholar and in spec databases. To identify keywords, the research question were broke into population, intervention, context and outcomes. The list of synonyms, abbreviations, alternative spellings was designed for the identified key words form Google Scholar database. Boolean OR applies to fix other words and Boolean AND applies to fix main terms. The authors formulated the search string by using keywords and Boolean variables. The strength of the search string is validated by the authors with the help of thesis supervisor and librarian. The search string is modified according to the validations. The search string used for this systematic literature review is as follows:

((cloud computing) AND (organization OR industry OR company OR industry) AND (technology OR services) AND (benefit OR advantage OR usage OR utilization))

The authors identified initial set of studies by using search string across different set of data bases mentioned in the systematic review plan. The identified studies were refined by using subject. This refine is done to reduce the non relevant studies for this systematic review. The refined subjects were as follows: Geosciences, Fields, Waves & Electromagnetic, Photonics & Electro optics, Transportation, Aerospace and Nuclear engineering. The authors found 1197 articles for the study selection by applying subject refinement. The authors applied inclusion and exclusion criteria on the identified articles, which is mentioned in the systematic literature review protocol. This is done by reading title, abstract and conclusion. The authors identified 43 articles for the primary study. The number of publications found across different databases during the systematic review process is shown in the table 2. The overview of the primary study selection is shown in figure 4**.**

The authors extracted data from identified primary studies by using data extraction form shown in table 1.

Table 2: Publications across different databases during search process

DATA BASE	NUMBER OF ARTICLES FOUND THROUGH SEARCH STRING	AFTER DETAILED INCLUSION&EXCLUTION CRITERIA
IEEE	137	6
ACM	172	7
INSPEC & COMPENDEX	292	9
SCOPUS	280	8
SCIENCE DIRECT	26	3
WILEY INTER SCIENCE	10	1
SPRINGER	54	2
BUSINESS SOURCE PREMIER	226	7
TOTAL	1197	43

The authors divided total set of articles among them for the data extraction process. The division is done according to the criteria mentioned in the systematic review plan. Quality assessment of the articles is done by the authors with interchanging the articles used in the data extraction process. The quality assessment of primary studies was shown in table-3. We used Cohen's Kappa [85] as a statistical measure to evaluate homogeneity among us. The authors calculated Kappa Coefficient for each data base individually during inclusion & exclusion of the articles. The articles were selected randomly from each data base to calculate Kappa coefficient. The authors found initial average moderate agreement value (**0**.61). We improved our understanding by consultation process and make changes to the inclusion & exclusion criteria. In the next iteration, we found strong agreement between us (0**.**80). According Emam [18] this value is considered as excellent. The agreement and disagreement between the two authors is also assessed by calculating Kappa coefficient. The authors selected 20 articles randomly from the total 43 primary studies. The authors found final agreement value (0.67) and which is considered to be Substantial.

The results obtained from systematic literature review were analyzed to address the research questions and it was discussed in the next section.

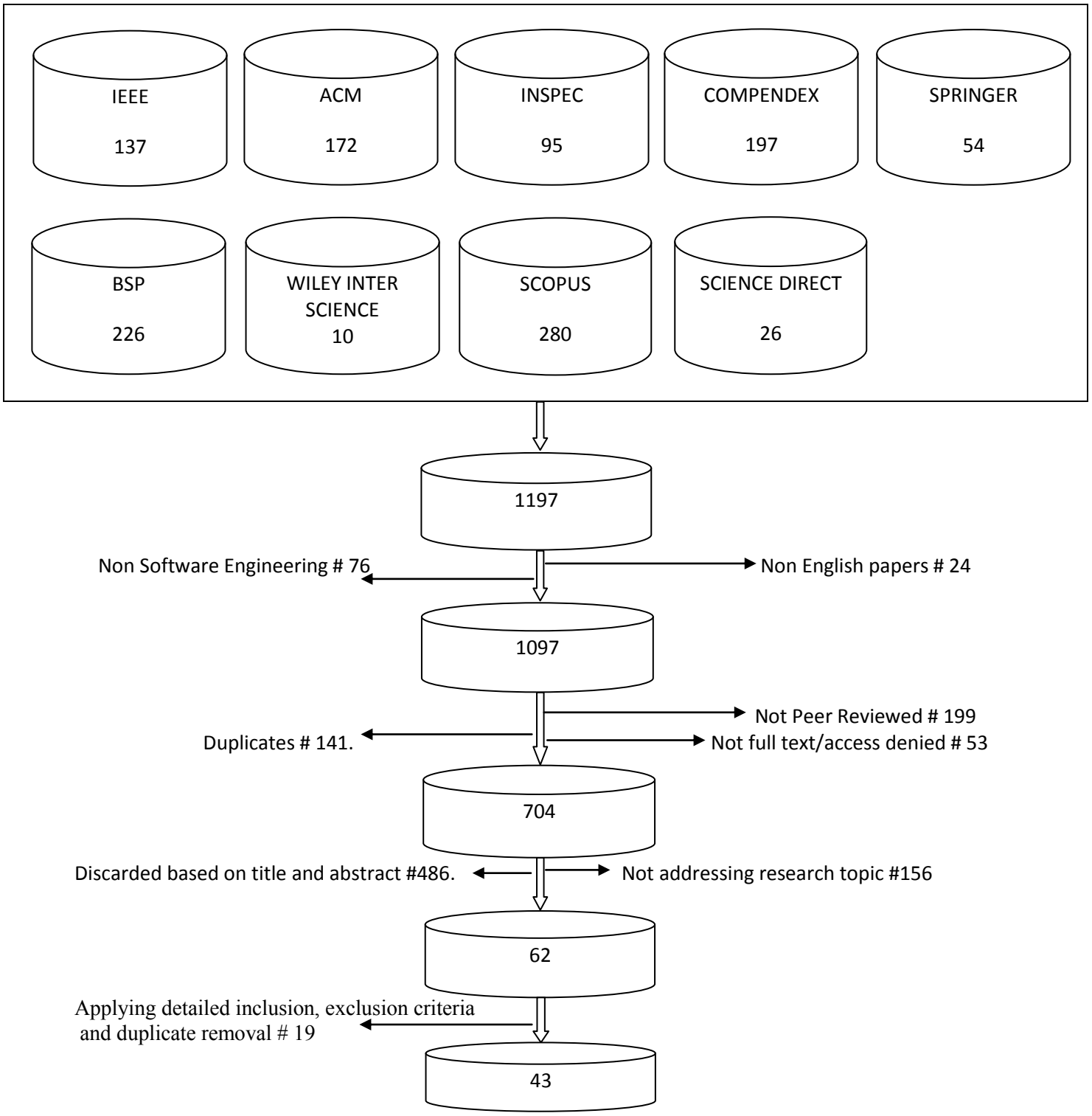

Figure 4: Primary study selection

Table3: Quality Assessment of Primary Studies

Reference Number	Related to Cloud Computing	Cloud Organizational Benefits	Cloud Organizational Challenges	Cloud Types	Total Value
[20]	Yes (1)	Yes (1)	No(0)	No(0)	2
[21]	Yes (1)	Yes (1)	No(0)	No(0)	2
[22]	Yes (1)	Yes (1)	No(0)	No(0)	2
[23]	Yes (1)	Yes (1)	No(0)	No(0)	2
[24]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[31]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[38]	Yes (1)	Yes (1)	No(0)	No(0)	2
[45]	Yes (1)	Yes (1)	Yes (1)	Yes(1)	4
[50]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[52]	Yes (1)	Yes (1)	No(0)	No(0)	2
[57]	Yes (1)	Yes (1)	No(0)	No(0)	2
[58]	Yes (1)	Yes (1)	No(0)	No(0)	2
[59]	Yes (1)	Yes (1)	Yes(1)	No(0)	3
[60]	Yes (1)	Yes (1)	No(0)	No(0)	2
[61]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[62]	Yes (1)	Yes (1)	Yes (1)	Yes(1)	4
[63]	Yes (1)	Yes (1)	No(0)	No(0)	2
[64]	Yes (1)	Yes (1)	No(0)	No(0)	2
[70]	Yes (1)	Yes (1)	No(0)	No(0)	2
[74]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[25]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[26]	Yes (1)	Yes (1)	No(0)	No(0)	2
[27]	Yes (1)	Yes (1)	Yes (1)	Yes(1)	4
[32]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[33]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[34]	Yes (1)	Yes (1)	No(0)	No(0)	2
[35]	Yes (1)	No(0)	Yes(1)	No(0)	2
[37]	Yes (1)	Yes (1)	No(0)	Yes(1)	3
[41]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[43]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[44]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[46]	Yes (1)	Yes (1)	No(0)	Yes(1)	3
[47]	Yes (1)	No(0)	Yes (1)	No(0)	2
[48]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[49]	Yes (1)	Yes (1)	Yes (1)	No(0)	3
[53]	Yes (1)	No(0)	Yes (1)	No(0)	2
[66]	Yes (1)	Yes(1)	No(0)	Yes(1)	3
[67]	Yes (1)	No(0)	Yes (1)	No(0)	2
[68]	Yes (1)	Yes(1)	Yes (1)	No(0)	3
[72]	Yes (1)	No(0)	Yes (1)	No(0)	2
[75]	Yes (1)	Yes (1)	No(0)	No(0)	2
[79]	Yes (1)	Yes (1)	Yes (1)	Yes(1)	4
[81]	Yes (1)	Yes (1)	Yes (1)	No(0)	3

2.3.3. Reporting review

This is a final stage of systematic literature review study and systematic review results reported in this stage based on the data gathered from different primary studies. The data is gathered from primary studies by using data extraction forms and synthesized by using appropriate data synthesis approaches. This data synthesis will be helpful to address the research questions mentioned in the review protocol. The systematic literature review results are reported with the help of data synthesis. The results obtained from the systematic literature review study are useful in designing interview study.

2.4. Interview study

Authors conducting an interview study to understand present status of the cloud computing benefits and challenges for the software industry, with respect to the systematic literature review results. This study will be helpful to know the modifications in the software industry with respect to the available cloud benefits in the literature. The industrial interviews are useful in finding the various types of clouds used in the software engineering industry, benefits of these clouds as a solution to the problems faced by the software industry, comparison of the benefits of the different clouds, and listing the benefits based on the priorities of cloud customers. The industrial interviews are helpful to get the material which is not published and with the industrial experts [19].

The interview study consists of three stages. Namely: planning, executing and reporting.

2.4.1. Planning interview study

The authors describing about the planning of the interview study in this section. The interview study planning comprises of collecting the data needed for interview study and interview study design. In the data collection, the authors are using the data gathered from systematic literature review. The systematic review results are analyzed to find the terminology used in the software industry. The terminologies collected are used in designing of the questionnaire for the interview study. The interview study design consists of identifying the interview study type, selection of subject, questionnaire design, scheduling of the interviews and validation of the interview study design.

Interview study type: According to Hove & Anda [82], there exit two types of interviews base on the size of the subjects and they are individual interviews & group interviews. In individual interviews, an interviewer and respondent talk about common interest theme. In the group interviews, much number of subjects discusses topics, which are introduced by one or two interviewers. The authors are using individual interviews and with the interest on cloud computing benefits for the organizations with respect to project management activities. According to Hove & Anda [82], the interviews are distinguished into structured and unstructured interviews. The structured interviews are having very specific questions to address the very specific objective of the interviewer. Al the answers can be quantified in the highly structured interviewers. In unstructured interviews, the interviewer has few specific questions in mind but has specific theme for the interview [84]. The combination of both structured and unstructured interviews is known has semi structured interviews [84]. The semi structured interviews are the combination of specific questions and open ended questions. The specific questions will be helpful to know the foreseen information and the open ended questions will be useful to gathered unexpected types of information [82]. The authors are using semi structured interviewing approach for the interview study design. This is because, the authors has to find present status of the cloud computing benefits in software industry with respect to the systematic literature review results and to know the modifications for the existing knowledge of cloud computing benefits.

Selection of subjects: The respondents of the interview study in other words interviewees are referred has a subject by the authors. In this case, the cloud computing experts from the software industry are used as subjects for this interview study. The criteria for selecting subjects for this interview study are listed below.

- Is having an experience in software industry
- Is having an exposure to cloud computing environment
- Is willing to participate in the interview study

Questionnaire design: The systematic literature review results were analyzed to identify the terminology used by the cloud computing experts. The authors used this terminology to formulate the questions for the interview study based on the research questions of this thesis. The questionnaire consists of general questions, opinion/value questions, knowledge questions and behavior/experience questions. The general questions will be helpful to identify the background information about the subjects. The opinion/value questions will investigate about the thoughts of the subjects with respect to certain issues. The knowledge questions are helpful to identify about the factual information possessed by the subjects. Behavior/experience questions will be helpful to gather descriptions of experiences, actions and behavior [82]. The general questions used for this interview study are about designation, Software Industry experience, Cloud Computing experience, Educational back ground, Cloud type and Cloud name of the subjects. The cloud computing benefits, challenges and solutions used by the subjects in their respective clouds are investigated by opinion/value questions. The modifications to the existing solutions to the cloud computing challenges will be identified by knowledge questions. The experiences, actions and behavior of the cloud computing experts will be gathered by using behavior/experience questions. According to Patton [83], 'What' and 'How' questions should be asked, but 'Why' questions and questions to which 'Yes' and 'No' answers are possible should be avoided. The questionnaire designed by the authors keeping above mentioned criteria in mind. The questionnaire for the interview study is designed by using above mentioned question types and which is shown in appendix- A and appendix-B.
Scheduling of the interviews: The subjects for this interview study are cloud computing experts and they are busy with their day to day industrial activities. The authors need appropriate time to complete the interview study from each subject. The authors have to make necessary appointments with the interviewees of appropriate duration to complete interview study.
Validation of the interview plan: The authors validated the interview study plan with the help of interviewee-I. This includes validating the terminology used in the interview questionnaire and scheduling. The authors made appropriate changes according to the validations given by the interviewee I-1.

2.4.2. Conducting the Interview

The interview questionnaire is given to each subject before conducting the interview study. This will be helpful for the subjects to prepare well for the interview and raise their questions regarding the understanding of the interview questionnaire. The author-I will note down the interview proceedings, while author-II asking the questions to the subjects and vice versa. The authors used open ended questions to extract unexpected information from the subjects. The authors explaining their research motives at the start of the interview. The authors make a note of suggestions made by the subjects during the interview. Authors make clarifications if the subjects are having any queries.

2.4.3. Reporting the Interview Study

The results of the interview study are analyzed and documented. This will be helpful to compare with the systematic literature review results and identify the new information gathered from the interview study to the cloud computing research area.

3. RESEARCH RESULTS

3.1. Systematic Literature Review Results

The results obtained from systematic literature review are described in this section. We found 21 cloud organizational benefits, 12 cloud organizational challenges and 18 solutions for the identified challenges. These results were identified from 43 articles and they were listed below.

3.1.1. Overview of the Studies

3.1.1.1. Publication year and Databases searched

The authors found 43 articles that are related cloud computing organizational issues and searching across eight different databases. Figure 5 shows the number of articles found across different databases. All the articles were published from 2008 to 2011 year. The year wise distribution to number of articles found is shown in figure 5.

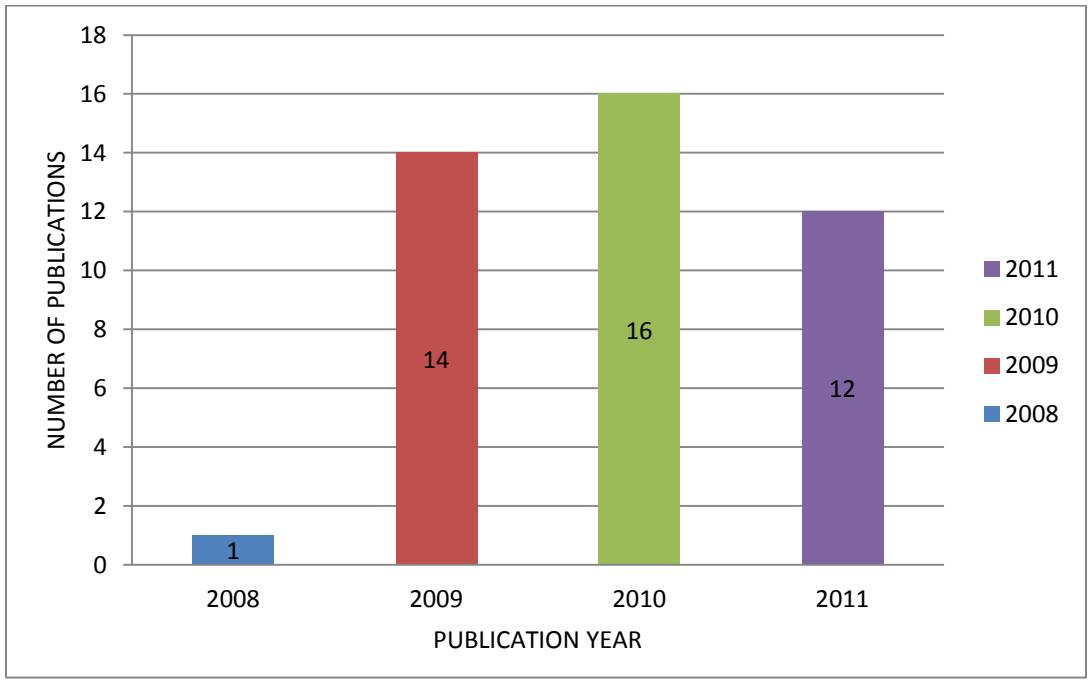

Figure 5: year wise distribution of primary studies.

Number of studies published across different databases was shown in figure 6 below

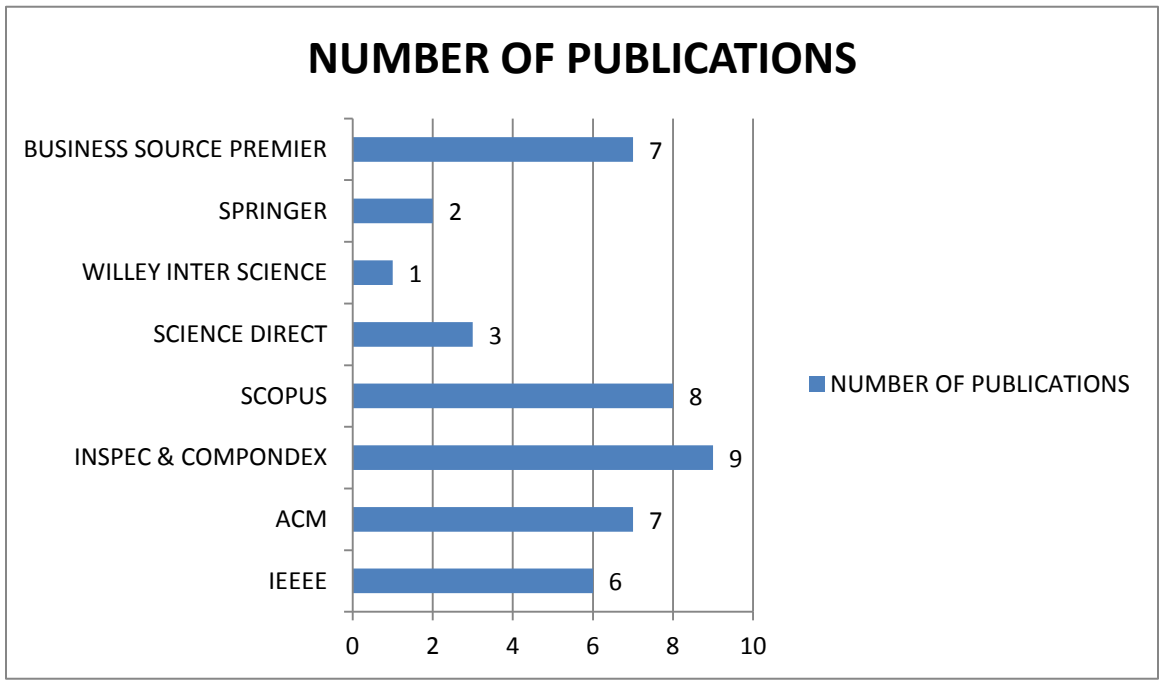

Figure 6: Distribution of publications across different databases

3.1.1.2. Context

Total primary studies were classified into academic & industrial studies. The authors got total 43 primary studies after applying the selection criteria. The total primary studies consist of 15 academic (non industrial) and 28 industrial studies. Figure 7 shows ratio of studies regarding academic verses industrial evidence.

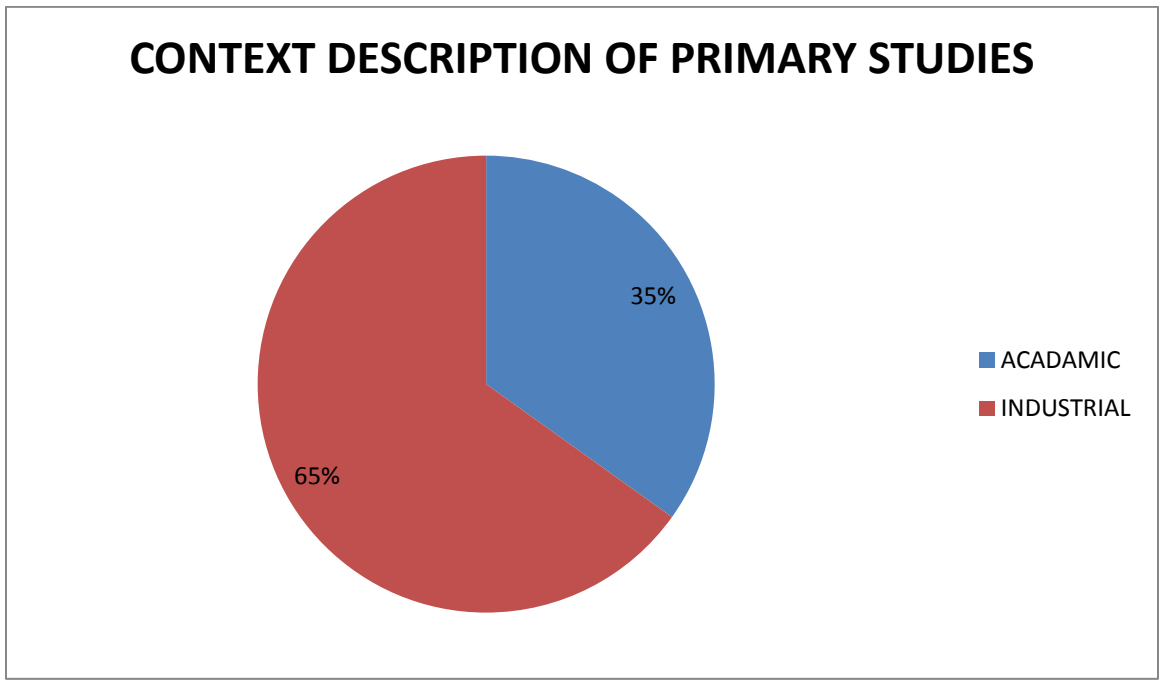

Figure 7: Ratio of academic & industrial studies

3.1.1.3. Research Methods

Research methods were extracted from the primary studies according to the classification mentioned in the data extraction section. Figure 8 shows the general overview of the research methods used in primary studies.

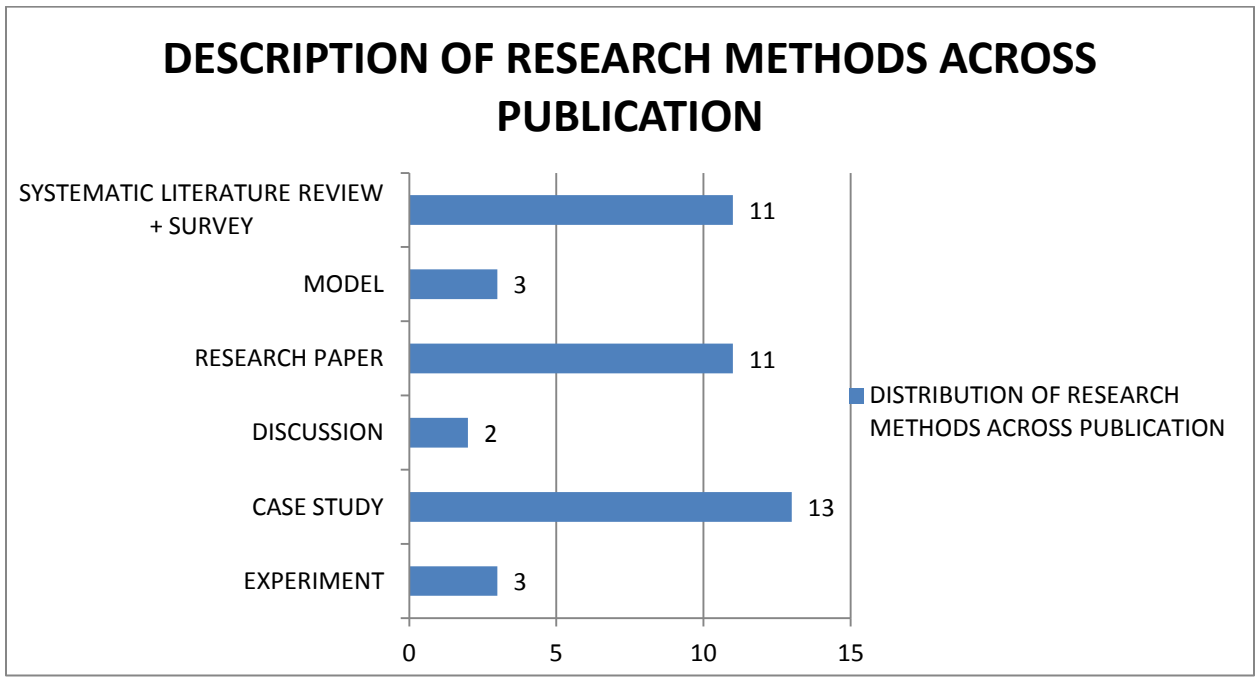

Figure 8: Description of research methods across publication

Experiment 3(6.9%), Case study 13(30.2%), Discussion 2(4.6%), Research paper 11(25.5%), Model 3(6.9%), and Systematic literature review + Survey 11(25.5%) were identified from the total primary studies.

3.1.2. Cloud Organizational Benefits

The organizational benefits from the cloud computing were identified from systematic literature review. These benefits are listed below.

3.1.2.1. New technology availability

The cloud computing industry has to upgrade its technologies from time to time and this is to keep up to the expectations of cloud utilizing organizations. This technology up gradation will be helpful to improve efficiency of cloud computing services and compete with the other organizations which are building clouds [27]. The cloud utilizing organizations don't have to invest in the technology up gradation and it will be taken care by cloud building organization and this will enable cloud utilizing organizations to keep up the expectations of the clients. This will be help full for the cloud utilizing organizations to deliver new class of applications and services. Those services include mobile interactive applications with location environment, context aware, responding to the real time information and data collection from independent sources. This will also help full for parallel batch processing of many users to the huge amount of processing power and data. The investment needed for technology up gradations, maintenances and customer feedbacks will be taken care by the cloud building organizations. The cloud utilizing organizations don't need any investment to keep up to the expectations of market trends [45, 46, 61]. The technology up gradation will not affect the end user and also not visible to the end user [38, 48].

3.1.2.2. Change of platforms easily

Cloud computing provides an environment for the utilizing organizations to shift platforms depending on the customer needs. The organizations don't have to spend on developing different platforms for their customer base and it will be taken care by the cloud building organizations. The cloud platforms were utilized efficiently among different organizations. This will enable cloud building organizations to provide cheaper services to the cloud utilizing organizations [33, 59].

3.1.2.3. Infrastructure availability

The cloud computing will enable cloud utilizing organizations to access hardware resources, software resources and physical resources. The hardware resources include data centers, desktop computers for development activities and other hardware devices such as scanners, printers and bar code readers etc..,. The software resources include different technology needed to run the development activities. The physical resources include electricity, buildings etc..,. The cloud utilizing organizations don't have to spend on the infrastructure development and it will be taken care by the cloud building organization [25, 46]. The cost and energy required to maintain the infrastructure will be reduced by efficient utilization of the resources among different cloud utilizing organizations [37, 46, 49, 81].

3.1.2.4. Fast deployment and easy access of the services

The cloud computing industry has to provide consistent and flexible services to the cloud utilizing organizations. This will enable cloud utilizing organizations to access the resources from various platforms & devices with the simplified plan [24, 31, 46, 48]. The cloud services will be easily accessed by the cloud utilizing organizations and also reduces return on investment uncertainties [81]. The problems occurred at the time of disasters are crashing will be managed by cloud building organization and it will be done in a short period of time. This will enable cloud utilizing organizations to access and deployed continuous services [25, 44]. Some cloud services are location independent and they can be accessed from anywhere in the world [21, 57, 81].

3.1.2.5. Reduction of installing/supporting/maintaining activities

The cloud services are easily accessible to the cloud utilizing organizations than maintaining and deploying equivalent service on the organization premises. The applications provided by different clouds are easily deployable and maintainable. The installing, supporting and maintaining activities were taken care by the cloud building organization and the services from those activities were utilized by the organizations from simple web browser [20, 48, 81]. The cost and effort for those activities will be taken care by the cloud building organization and the cloud utilizing organization has to plan for the utilization of the services [48, 60].

3.1.2.6. Measured service and pay per usage

Cloud computing environment consist of measuring and management components, which automatically measure, manage and optimize the resource utilization. This resource utilization monitoring, controlling and reporting, will be helpful to improve the transparency and trust between the cloud building organization and cloud utilizing organization [20, 22, 26]. The cloud utilizing organization has to pay for the applications which are utilized by them and will not pay the total purchasing cost of the application [25, 31, 37, 44, 74].

3.1.2.7. Eliminating the infrastructure investment

The capital expenditure needed for building cloud infrastructure will be taken care by cloud building organization. The cloud utilizing organizations don't have to pay for the infrastructure building and has to pay for usage of those resources. The total infrastructure cost will be shared among different organizations which are using different cloud resources. This will reduce the cost needed to pay for the resource utilization. This will enable smaller organizations to compete with the larger organizations by reducing cost for their development activities [26, 44, 46, 60, 74].

3.1.2.8. Low capital expenditure and less risk

The capital expenditure needed for infrastructure development and maintenance will be reduced by allowing cloud utilizing organizations to pay for the used resources. The infrastructure development and maintenance will be taken care by the cloud utilizing organization and it will reduce the time and effort needed by the cloud utilizing organizations to implement those activities. The capital expenditure of the infrastructure development and other activities will be shared among different cloud utilizing organizations. This will enable the organizations to reduce the cost of investment and increases the speed of application development. This will reduce the risk factors such as maintaining the services at the time of disasters, capital expenditure, need for return on investment and etc.., [20, 25, 26, 44, 46, 62, 64].

3.1.2.9. Lower impact of outages and upgrades

The cloud computing provides cost effective redundancies in storage services. This will enable the cloud utilizing organization to access un interrupted service during planed or unplanned outage. The hardware upgrades will not affect the cloud utilization organizations [23, 48].

3.1.2.10. Cheaper services

The cloud services are available to the organizations at a cheaper price than that of implementing those services through infrastructure organization premises. The cloud services were utilized among different organizations in an efficient way and this will reduce the cost of those services [33, 44, 66].

3.1.2.11. Efficiency

The efficiency of the cloud services will be improved by cloud building organizations through taking various measures such as increasing the operational efficiency by sharing resources among different organizations, by lowering the capital cost, reducing the cost for rebuilding by placing clouds at disaster free zones, and by reducing electricity loss through placing cloud data centers nearby power generation units [34, 44, 46, 64, 70].

3.1.2.12. Low cost for data mining

The data stored in the cloud storage will be accessed through different data mining applications. This data mining applications will work efficiently to reduce the cost, time and effort needed by the cloud utilizing organizations [25].

3.1.2.13. Consistency

Cloud computing provides consistent services even though it is used by different cloud utilizing organizations. The cloud building organizations has to maintain its consistency irrespective of load, disaster and crash [49].

3.1.2.14. On demand services

Cloud computing environment provides different services depending upon the cloud utilizing organizing request. The demand for the cloud services will be fulfilled irrespective of location and platform [20, 21, 29, 37, 46, 50, 52].

3.1.2.15. Flexibility & Scalability

Cloud computing environment provides different flexible services that can be accessed from anywhere in the world and with different device [24, 61, 81]. The measuring of the cloud services will be helpful to know the resource utilization and it will be helpful to scale up or down the cloud services depending upon the cloud utilizing organization needs [20, 25, 37, 44, 46, 52, 58, 61, 81].

3.1.2.16. Simplified Planning

Cloud computing environment will reduce the burden on cloud utilizing organizations by reducing the need for detailed capacity planning, and flexible & scalable resources [48].

3.1.2.17. Reliability

Cloud computing environment provides reliable services to the cloud utilizing organizations with the help of multiple redundant sites. This will be useful to the organizations for disaster recovery [44, 81].

3.1.2.18. Sustainability

Cloud computing will improve the sustainability of the cloud services by reducing energy consumption and efficient utilization of the various resources such as memory, processing speed and man power. The cloud utilizing organization will reduce the costs associated with expansion of the organization [44, 81].

3.1.2.19. Low barriers to entry

Cloud computing environment can lower the IT barriers for the utilizing organizations by reducing the cost for technical infrastructure, reducing return on investment uncertainties, reducing the in-house IT staff and providing easily accessible and scalable services for the cloud utilizing organizations. [31, 44, 46, 81].

3.1.2.20. Easy to use

Cloud computing environment provides some useful concepts to the cloud utilizing organizations and which will enable them to access services quickly and easily [63].

3.1.2.21. Improved improbability

Cloud computing provides an environment which can't be accessed by unauthorized person and prevent from locating the mission that stores some wanted data. This will reduce the chance of steeling the digital assets [34].

3.1.3. Cloud Organizational challenges & solutions:

3.1.3.1. Security concerns

In the cloud computing environment, cloud utilizing organization has to depend on the cloud building organizations for proper security measures. The cloud building organizations has to take care of the multiple users working on the cloud from accessing each other's data. Cloud building organizations has to focus on the following key elements while providing the cloud services to the cloud utilizing organizations [31, 32, 41, 43, 47, 48, 59, 61, 62, 81].

- Data security
- Network security
- Data locality
- Authentication & Authorization
- Data integrity checks
- Identity management

3.1.3.1.1. Data security: In the traditional on premise application deployment model, the data of the organization will reside within the boundaries and it is controlled by physical, logical, personal security and access control policies. In the case of cloud computing environment, the data of cloud utilizing organization will be stored in the cloud and which is outside the boundary of utilizing organization. The cloud building organization has to ensure the data security and preventing security breaches from unauthorized access. The data security issue can be overcome by assigning individual cryptographically strong secure shell Keyes to gain the access to the cloud. The data at different place of the cloud will be

encrypted by default. All the data accesses are logged and routinely audited. This can be ensured by the following test and validation assessments.

- Cross-Site scripting
- Access control weaknesses
- OS & SQL injection flaws
- Cross-Site request forgery
- Cookie manipulation
- Hidden field manipulation
- Insecure storage
- Insecure configuration

Any vulnerability detected during those test's can be lead to financial loss and Sensitive information leakage for the cloud utilizing organization [32, 45, 72, 75].

3.1.3.1.2. Network security: The data obtained from the cloud utilizing organization is processed and stored at the cloud storage. The data flow over the network need to be secured by the cloud building organizations to prevent leakage of sensitive information. This can be done by using strong network traffic encryption techniques such as Secure Socket Layer (SSL) and Transport Layer Security (TLS). The network security of the cloud is assessed by following tests [72].

- Network penetration & Packet analysis
- Session management weaknesses
- Insecure SSL trust configuration

Any vulnerability detected during those validations will represent user credential access; sensitive data access and active session hijack [32].

3.1.3.1.3. Data locality: In the cloud computing environment, the cloud utilizing organizations does not know where the data is stored. This complains will influence behavior of the cloud utilization organization. In some cases sensitive data can't leave the country because of local laws and sensitivity of the information. This can be overcome by third party data checkups [32, 74, 75, 79].

3.1.3.1.4. Authentication & Authorization: Cloud building organizations has to authenticate each and every person who is using the cloud from the cloud utilizing organization. They will provide authorizations to the users based on the service usage and payment. The cloud building organization has to prevent unauthorized users by checking authorization. The cloud utilizing organization has to remove or disable accounts of the ex-employees on day-to-day basis [32, 53, 79].

3.1.3.1.5. Data integrity checks: Data integrity is essential for the cloud utilization organizations to gain the access to the right information and preventing others from accessing the data or services. This can be overcome by third party data integrity checkups [32, 48, 53, 75, 79]. The data integrity can be improved with the help of cryptographic model [72].

3.1.3.1.6. Identity management: Identity management deals with the different individuals of the cloud utilization organization and controlling the access to the cloud services. This identity management involves three perspectives

- Pure identity paradigm: identity creation, deletion, and management are performed irrespective of services accessibility.
- User access paradigm: the data & services can be access by the user through logging into the cloud
- Service paradigm: the user can access data and resources based on the service authorization given to them.

While creating an identity management infrastructure, cloud building organization has to support wide variety of platforms by installing infrastructure & individual systems based on the open standards and platform independent. Identity management system has to support wide variety of security and privacy properties [32, 68].

3.1.3.2. Privacy concerns

Cloud computing environment has several privacy problems such as disclosure of sensitive information when exchanging data through cloud services. The sensitive private information includes usage data, unique device identities, and personal identity information and so on. The other problem with cloud computing environment is that the unauthorized people getting access to the personal data resided in cloud because of vulnerabilities. Cloud computing environment has to provide adequate protection for the information while moving from one resource to another resource and changes made while using some cloud services. The privacy concerns were overcome by identity management system usage and third party data checkups [43, 68, 74, 75, 81].

3.1.3.3. Trust

Abstraction of the data storage from the cloud utilizing organization is one of the major concerns. The breach of data will not be known to cloud utilizing organization. This can be overcome by appointing third party data checkups and data flow analysis. The level of trust can be modified by implementing a business model and work flow process through the use of hybrid or private clouds [24, 35, 41, 44, 61].

3.1.3.4. Loss of control

Cloud utilizing organization will pay for the services which are used but not owned the infrastructure. This may cause standstill for the business activities which are based on those cloud services. This can be overcome by setting up service level agreements to meet the organizational requirements and designate the responsibility for the loss in the revenues if they cause outage in the cloud services. The accurate budget planning and legal issues may not possible at this stage of cloud computing market maturity. This issue will be overcome by continual diligence and oversight of cloud computing resources with the help of third party organizations [41, 44, 75].

3.1.3.5. Maintaining service reliability

Cloud building organizations has to provide services for the wide variety of the customer base and they have to provide continuous services irrespective of scalability, disasters and load factor. This can be overcome by frequent load factor checkups by the third-party organizations to provide reliable services to the cloud utilizing organizations. The cloud services were provided from multiple redundant sites to overcome problem associated with disaster or crash [41, 43, 48].

3.1.3.6. Quality of services

Quality of the cloud computing services should be formalized to get reliable and effective services from cloud building organization. This is to reduce the uncertainties in providing the cloud services. The cloud utilizing organizations has to follow some requirements in the service level agreements for better quality of services. The requirements are as follows:

- include understanding the current legislation and make agreement with the cloud service provider according to the legal requirements
- assets suitable for keeping beyond organizational boundaries will be identified
- identify reliable cloud service provider and audit his complains with the third-party organization
- Understand the security capabilities of the cloud provider and information management mechanisms of the cloud building organizations [35, 40, 41, 53, 81].

3.1.3.7. Responsibility of cloud failure

Cloud utilizing organization can use different cloud services provided by the cloud infrastructure and will not control the infrastructure itself. The responsibility of the cloud failure will be left with none. This issue is taken care by the cloud utilizing organization at the time of service level agreement by including responsible person for the revenue loss caused by cloud failure [41].

3.1.3.8. Portability & choice of the cloud

Cloud building organizations has to provide portable cloud services that can movie data from one location to another location. If this is not the case then cloud utilization organization has to stick with those cloud vendors irrespective of quality, reliability. This issue is taken care by cloud utilizing organization before entering into an agreement with the cloud provider. The portability and choice of the cloud has to be verified by third-party organization [43]. Data migration from cloud to cloud will be effectively implemented by using migration model [72].

3.1.3.9. User profile storage

The storage required to maintain individual profiles of wide variety of cloud users is tedious and memory consuming. This can be overcome by the cloud building organizations with the help of implementing distributed modeling of the cloud architecture, explicit information collection and private user model. This will enable the cloud users to have unique individual experience with their specific interest [67].

3.1.3.10. User satisfaction

Cloud utilizing organization has less satisfaction level due to various factors such as abstraction of services, lack of transparency and less visible dependability. The satisfaction level of cloud utilization organization will be improved by third-party data checkup, use of service level agreement and frequent feedback from the customer [35, 50, 81].

3.1.3.11. Data backup & disaster recovery

Cloud utilization organizations don't have control over the cloud infrastructure. This will impact the business perspectives at the time of disaster or crash. This will be overcome by providing cloud services from multiple redundant sites. Cloud infrastructure is frequently checked by third-party organization. The service level agreement has to include above mentioned issues with designating responsibility of revenue loss caused by disaster [32, 48, 53, 81]. Fault tolerance of cloud services will be improved with the help of availability model [72].

3.1.3.12. Legal issues

The legal requirements for the data privacy will be varied from country to country. Cloud utilization organization has to understand these requirements and place them in the service level agreement signed with cloud provider [40, 53, 75, 81].

3.2. Interview Results

Interview study is conducted in three phases to address the research objectives. The authors conducted interview study among seven participants from seven different companies. The IT related experience of the participants varied from six years to fifteen years. The cloud computing experience of the participants is varied from one to three years and this is because major activities in the cloud computing industry is taking place from the past three years. This is also reflected in the publications available through systematic literature review. The designation of each participant is depending on the purpose of the cloud construction and usage. Table-4 reflects the information about interview study participants. Interview study is conducted through different media and duration depending upon participant's flexibility. Interview study is designed to conduct for the duration of thirty to forty-five minutes and is extended to the one hour duration depending upon the willingness of the participants. Interview study is confine to

seven participants only and this is because of various factors such has maturity of the cloud computing industry, cloud computing experts were busy with day-to-day activities, expensive nature of the cloud construction, and willingness & behavior of the participants. The authors gathered basic information of the participants in the first phase of the interview study. This includes educational qualification, industrial experience, company name, designation, and cloud type. The information collected in the first phase of the interview study is reflected in table-4.

Table 4: Information about Interview Study Participants

ID	Designation	Total IT Experience	Cloud Computing Experience	Educational Qualification	Specialization	Company Name	Cloud Type	Cloud Name
I-1	Global Development Operation Manager	15	1	Bachelor	Computer Science Engineering	Premier Farnell	Public	Force.com
I-2	Software Design Engineer	6	2	Master	Software Engineering	Microsoft	Public	Azure
I-3	Global Sales Representative	6	3	Master	Marketing	Soft Layer	Hybrid	Cloud Layer
I-4	Business Development	7	2	Master	Business Administration	Layered Tech	Hybrid	The Matrix
I-5	Business Development	10	2	Bachelor	Business Management	Rackspace	Public	The Rackspace
I-6	Global Sales Representative	8	1	Master	Marketing	INetU	Hybrid	INetU Gated Community Cloud
I-7	Consultant	11	2	Bachelor	Business Management	GoGrid	Hybrid	Xen

In the second phase of the interview study, the authors collected information about organizational benefits that are achieved by the clouds. This is to check reflection of systematic literature review results and find new organizational benefits. The organizational benefits collected from the interview study are listed below:

- Improved improbability
- Easy to use
- Low barriers to entry
- Sustainability
- Reliability
- Flexibility & Scalability
- On demand services
- Consistency
- Low cost for data mining
- Efficiency
- Cheaper services

- Lower impact of outages & upgrades
- Low capital expenditure & less risk
- Eliminating the infrastructure investment
- Measured service and pay per usage
- Reduction of installing/supporting/maintaining activities
- Fast deployment & easy access of service
- Infrastructure availability
- Change of platforms easily
- New technology availability
- Speed marketing / accessing of innovation
- Error reduction by standardization
- Interchangeable physical servers
- Traffic management
- Onsite/Offsite storage
- Additional productivity

The authors found various challenges and solutions from the existing clouds through third phase of the interview study. The organizational challenges found through interview study are listed below:

- Security concerns
- Privacy concerns
- Trust
- Loss of control
- Maintaining service reliability
- Quality of services
- Responsibility of cloud failure
- Portability & choice of the cloud
- User profile storage
- User satisfaction
- Data backup & disaster recovery
- Legal issues
- Load balancing
- Network performance issues

The solutions and suggestions informed by the cloud computing experts to overcome the organizational challenges faced by the cloud computing environment were listed below:

- Adhering to the compliance policies: Organizations have their presents across the globe. There are additional legal requirements, and compliance issues required to be met by the organizations depending upon the work place. The organizations have to adhere to the compliance policies based upon understanding of the legal requirements needed to be fulfilled.

- Required level of customizations: Cloud utilizing organization has to check for the required level of customizations depending upon their needs. This is essential because the cloud provider has wide verity of customer base.

- Service level agreements: Cloud utilizing organization has to look for the clearly defined cloud services and acceptable terms for their implementation during the service level agreements (SLAs).

- Integrate applications: Cloud utilizing organization has to differentiate their applications depending upon their sensitivity. This differentiation is to use the cloud services or not for the application building. Cloud utilizing organization has to integrate either the application which are using or not using cloud services.

- Cloud utilizing organization has to start with small size of the cloud service and grow organically depending upon on their needs. This will be helpful in identifying the operational problems and controlled them during the execution process.

3.3. Comparison of The Results

This chapter is intended to describe and analyze the results gathered from systematic literature review and interview study. This will be helpful to understand which cloud organizational benefits & cloud organizational challenges were acknowledged by both studies and identify new cloud organizational benefits and cloud organizational challenges.

3.3.1. Overall Results from Systematic Literature Review and Interview Study

Authors comparing the results of systematic literature review and interview study in this section. Authors found 21 cloud organizational benefits and 12 cloud organizational challenges during the systematic literature review. Interview study provided with 26 cloud organizational benefits and 14 cloud organizational challenges. The figure 9 provides overall contribution systematic literature review and interview study to this research objective.

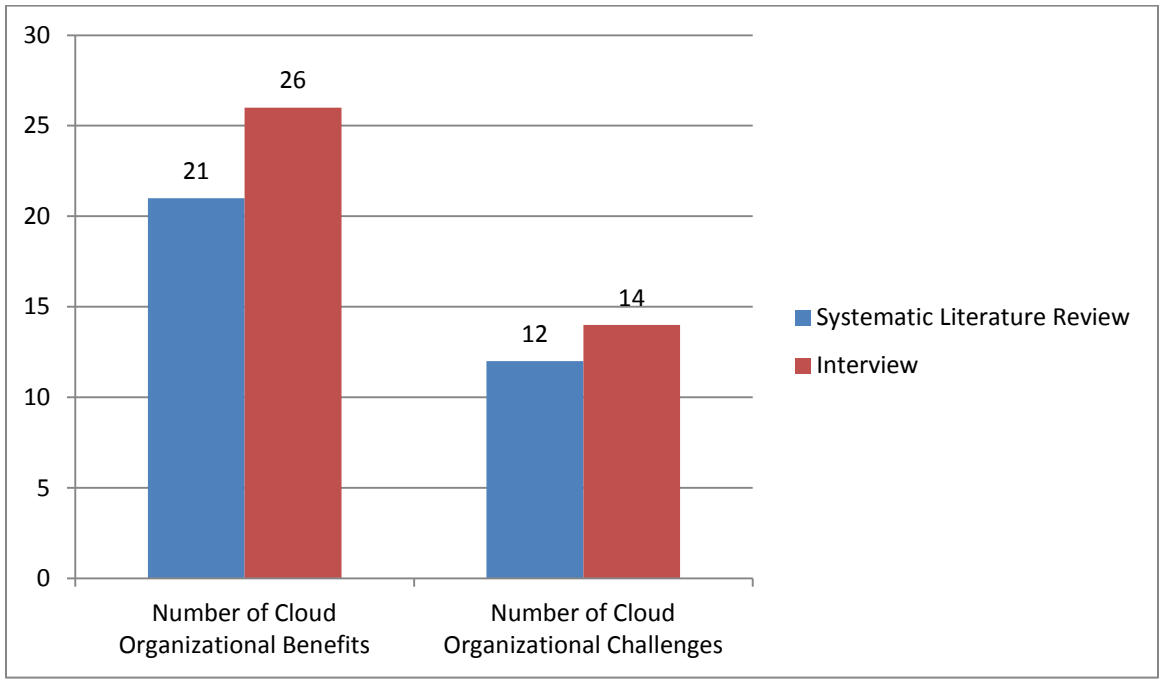

Figure 9: Over all Contribution by Systematic Literature Review and Interview Study

3.3.2. Consolidated Cloud Organizational Benefits

The authors presenting consolidated organizational benefits from both the research studies in this section. The consolidated organizational benefits contain total 27 cloud organizational benefits. The cloud organizational benefits provided by systematic literature review are 78% of the total research results. The cloud organizational benefits provided by the interview study are 96% of the total research results. There exits 74% of cloud organizational benefits reflected in both the research studies. 6 (22%) new cloud organizational benefits found through interview study. The figure 10 shows the percentage of contribution from each methodology to the total cloud organizational benefits.

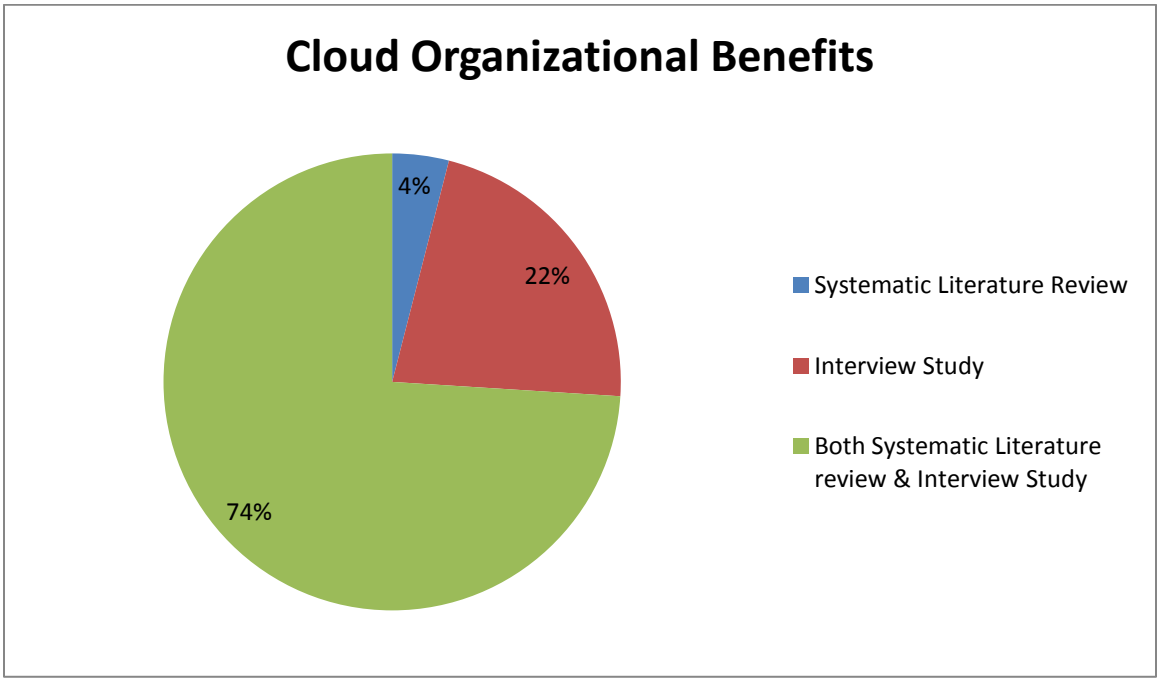

Figure 10: Percentage of Contribution for the Total Cloud Organizational Benefits

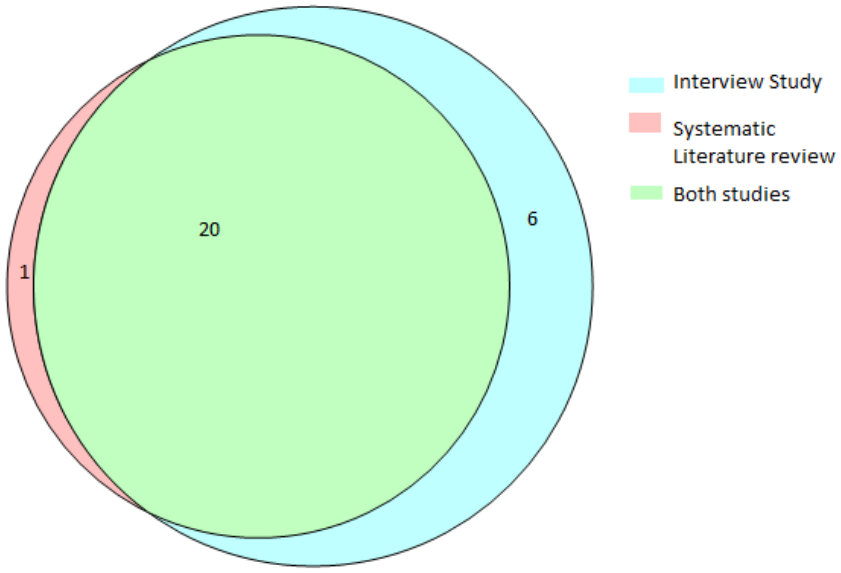

Figure 11: Contribution of Cloud Organizational Benefits from different Methods.

3.3.3. Consolidated Cloud Organizational Challenges

Consolidated organizational challenges from both the research studies are presented in this section. The research result consists of total 14 cloud organizational challenges gathered from both the research studies. All the research results found through systematic literature review were acknowledged by interview study. 2(14%) new cloud organizational challenges found through interview study. Figure 12 shows percentage of contribution from each research study to the total cloud organizational challenges.

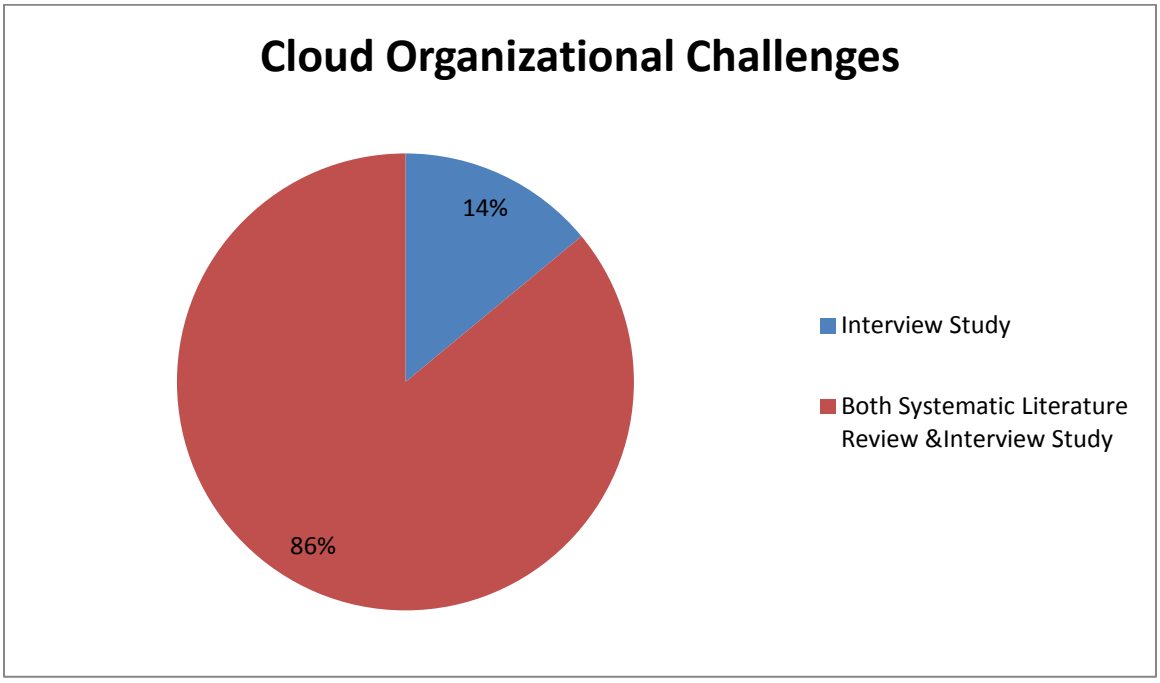

Figure 12: Percentage of Contribution for the Total Cloud Organizational Challenges

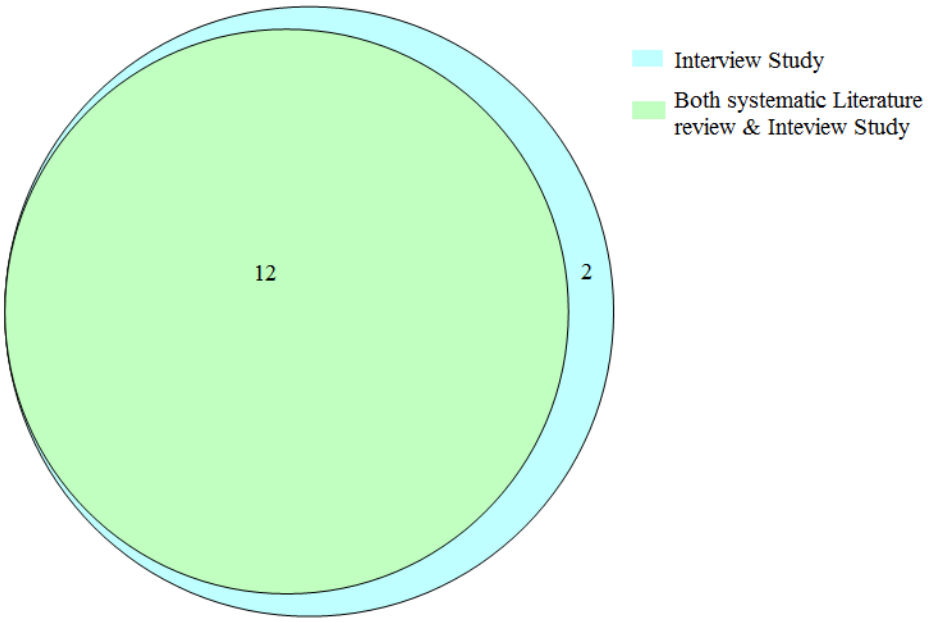

Figure 13: Contribution of Cloud Organizational Challenges from Different methods.

4. ANALYSIS

The research results are analyzed to address the research questions framed during the research design.

4.1. Problems Faced by Software Industry

The software industry has lot of project management problems but the authors were confined to project management problems that are addressed by cloud computing environment. This is because to reduce the scope of the research question. The authors found various project management problems during this research study and they are listed below:

- Raising operation cost [20, 22, 25, 26, 31, 44, 74]
- Change of platforms from project to project [33, 59]
- Less sustainability of the resources [44, 81]
- Time constraint for building applications [11, 24, 25, 44, 46, 48, 57, 81]
- Frequent technology up gradation [27, 38, 45, 46, 48, 61]
- Licensing issues [31, 44, 77, 81]
- Frequently changing customer satisfaction levels [24, 25, 36, 44, 61, 81]
- Varying location of customer base [20, 21, 29, 46, 50, 52]
- Attrition rate of human resources [20, 25, 44, 46, 48]
- High capital investment [20, 25, 26 ,44, 46, 62, 64]
- Innovating marketing trends [23, 48]
- Hardware and software installing and maintaining activities [20, 48. 60, 81]
- Infrastructure investment [26, 44, 46, 60, 74]

Cloud utilizing organizations has to categorize its applications based upon the operational budget, security, privacy, customer satisfaction levels and legal requirements. Cloud utilizing organizations have to categorize applications into three types for their development by using cloud computing environment. The applications which are concerned with security issues, legal requirements and customer satisfaction levels need to be developed in private cloud. The applications concerned with operational cost and not related to security issues are to be developed by using public cloud. The applications associated with large storage space, platform change and developing location has to be implemented by using hybrid clouds [62].

4.2. Project Management Problems Addressed by Cloud Computing

Cloud computing environment provide wide range of services to its customer base depending upon the requirements of could utilizing organizations. The cloud computing services were shared among cloud utilizing organizations and measure the services used by the cloud utilizing organization. Cloud computing environment will share the infrastructure cost, maintenance cost, and licensing cost among different cloud utilizing organizations and frequently up grade technologies according to the marketing trends. This will be help full in addressing project management problems such as operational cost [20, 22, 25, 26, 31, 44, 74], infrastructure investment [26, 44, 46, 60, 74], technology up gradation [27, 38, 45, 46, 48, 61], frequently changing customer needs [24, 25, 36, 44, 61, 81], high licensing cost [31, 44, 77, 81], innovating marketing trends [23, 48], attrition rate of human resource [20, 25, 44, 46, 48], and time constraint for building applications [11, 24, 25, 44, 46, 48, 57, 81]. The project management problems such as platform change for project to project, time constraint for building applications, attrition level, and frequent technology up gradation were fully addressed by cloud computing environment. The project management issues such as operational cost, resource sustainability, customer satisfaction levels, varying customer location, capital investment and market innovations were partially addressed by cloud

computing environment. The challenges faced by cloud utilizing organization while using cloud computing environment were described in section '3.1.3'.

4.3. Cloud Organization Benefits and Categorization

Authors found 21 cloud organizational benefits from the systematic literature review and 26 cloud organizational benefits from interview study. 20 cloud organizational benefits were reflected in systematic literature review and interview study. Simplified planning was reflected as a cloud organizational benefit in the available literature but not in the interview study. This is because the interview study is conducted among cloud providers. Error reduction by standardization, increase in productivity, inter changeable physical servers, traffic management, onsite/offsite storage infrastructure availability and quick marketing / accessing of innovations were found through interview study. Cloud organizational benefits and challenges from interview study were listed in section '3.2'. Cloud organizational benefits from systematic literature review and cloud organizational challenges from systematic literature review were described in '3.1.2' and '3.1.3' sections respectively. Cloud organizational benefits are not confined to software industry and they can be utilized by other industry. The available literature in this research area was not helpful to categorize the cloud organizational benefits across different cloud users. Cloud organizational benefits can be categorized into three types and they are private cloud benefits, public cloud benefits and hybrid cloud benefits [37, 45, 62].

4.3.1. Issues with public clouds

This cloud is helpful for small and medium size companies. This cloud will offer a fertilized hardware management and flexibility without infrastructure investment. Hardware/Software maintenance issues were managed by cloud provider those issues will be helpful for the startup companies [45, 62]. However public clouds have challenges such as security, privacy, no control over the cloud resources and network related issues. Public clouds also provide uninterrupted location independent services by multiple redundant sites [37, 21, 45, 62].

4.3.2. Issues with private cloud

Private clouds also known as internal cloud and they were design to specific purpose of an organization. The resources and services of the private cloud will be controlled by the organization which is utilizing the cloud. Issues such as security, performance and reliability will be controlled by cloud utilizing organization according to their needs. This cloud is associated with capital investment and maintenance [37, 45, 62].

4.3.3. Issues with hybrid clouds

Hybrid cloud is a combination of public and private clouds this cloud will address the limitations of public and private cloud. It provides more flexible services compared to the public and private clouds. Cloud utilizing organization will control part of the cloud infrastructure. Hybrid cloud provides tighter control and security over the cloud services compared to public clouds. It also facilitates scalable and on demand services. In this cloud, cloud utilizing organizations has to determine which application has to use public & private cloud components. The integration between public & private cloud components will be checked at the time of writing Service Level Agreements (SLAs) by cloud utilizing organization. This cloud has benefits such as low operational cost; speed accessing has innovation and meeting the customer satisfaction levels [37, 45, 62].

4.3.4. Prioritization of cloud organizational benefits

Cloud organizational benefits can be prioritized based on the purpose of usage and addressing project management problems. Cloud computing provides various technological benefits such as new technology availability, improved improbability, low impact of technology outages and upgrades, changing of

platforms, infrastructure availability & easy access and faster deployment and no need of installing/maintaining the hardware and software to address the project management problems related to technology. Cloud computing environment provides economical benefits such as measured services, cheaper services availability, low data mining cost, cost savings by resource sustainability improvement, reducing the capital expenditure and eliminating the infrastructure investment to address the project management problems related to cost savings. Cloud computing environment provides managerial benefits such as consistent services, flexibility, scalability, sustainability, simplified planning, reliability, easy to use and low barriers to entry to address the project management problems related to management activities. Cloud utilizing organization has to prioritize the use of cloud depending upon the requirements.

4.4. Comparison of Different Industrial Clouds

In this section, Authors comparing the different clouds provided by different cloud computing organizations with respect to cloud services. The research question '4' is addressed in this section. Clouds benefits of each cloud are gathered from literature are listed below:

4.4.1. Amazon EC2 [45, 66]

4.4.1.1. **Cloud Provider Name:** Amazon

4.4.1.2. **Cloud Type:** Public

4.4.1.3. **Cloud Services:** It provides computation, storage and other functionality that enables organizations to deploy applications and services on their demand [45, 66].

4.4.2. Windows Azure [45]

4.4.2.1. **Cloud Provider Name:** Microsoft

4.4.2.2. **Cloud Type:** Public

4.4.2.3. **Cloud Services:** It will provide platform service for the general purpose windows applications development on .NET framework and other ordinary languages supported in windows systems. It also provides storage services for database management systems [45].

4.4.3. Google App Engine [45, 46]

4.4.3.1. **Cloud Provider Name:** Google

4.4.3.2. **Cloud Type:** public

4.4.3.3. **Cloud Services:** It provide platform to build and host web applications. It also provides SaaS for the Google application, email services and web security services [45, 46].

4.4.4. IBM Blue Cloud [46]

4.4.4.1. **Cloud Provider Name:** IBM

4.4.4.2. **Cloud Type:** Public

4.4.4.3. **Cloud Services:** It provides tools that allow companies to manage large scale applications and databases. Cloud provider offers consulting services for integrating cloud infrastructure with the cloud utilizing organizations infrastructure. Cloud provider trying to improve cloud applications and software development methods to address cloud computing challenges with the help of students & researchers from several universities and Google [46].

4.4.5. Hadoop [46, 73]

4.4.5.1. **Cloud Provider Name:** Apache

4.4.5.2. **Cloud Type:** Public

4.4.5.3. **Cloud Services:** This cloud provides an open source software framework that will be helpful to develop data base and programming tool for cloud computing. This cloud will provide formidable development ecosystems for cloud computing applications and it is used by organizations like IBM, Facebook, Yahoo and others [46, 73].

4.4.6. Eucalyptus [73]

4.4.6.1. **Cloud Provider Name:** University of california (Santa Barbara)

4.4.6.2. **Cloud Type:** Private

4.4.6.3. **Cloud Services:** It is developed to do cloud computing research and it will be helpful to easy expansion, easy installation and maintenance for the Ubuntu Linux users [73].

4.4.7. Tsinghua Cloud [36]

4.4.7.1. **Cloud Provider Name:** High Performance Computing Institute of Tsingua University.

4.4.7.2. **Cloud Type:** Private

4.4.7.3. **Cloud Services:**

- Carrier: It is a distributed file system aiming to provide convenient storage services with high performance and availability for the Tsingua University.
- Corsair: This service is design to provide data sharing, data storage, mapping service, search engines, client tools and user services.
- Nova: This service is aimed to reduce the burden on computing environment configuration, easy access of computing resources for the students and increase productivity [36].

Cloud services provided by different clouds are varied from customer to customer based on their need. The research activity available till now is not sufficient to compare the performance of different clouds while solving different project management problems faced by the software industry. We identified various cloud benefits across different clouds through this research study. The literature related to extent to which cloud benefits addressing various problems faced by industry is not found through this study. The participants of the interview study expressed their unwillingness to share data by sitting issues related to security & privacy of their clients.

5. DISCUSSION

Authors summarized the findings of the study in this section. They identified 27 cloud organizational benefits and 14 cloud organizational challenges while addressing the project management problems related to software industry. Authors confined to project management problems related to software industry and addressed by cloud computing environment. This is done to reduce the context of research question '1'. The categorization of the project management problems is done into three parts: technological, economical and managerial. Authors identified flowing cloud organizational benefits to address the project management problems: improved improbability, easy to use, low barriers to entry, sustainability, reliability, flexibility & scalability, on demand services, consistency, low cost for data mining, efficiency, cheaper services, lower impact of outages & upgrades, low capital expenditure & less risk, eliminating the infrastructure investment, measured service and pay per usage, reduction of installing/supporting/maintaining activities, fast deployment & easy access of service, infrastructure availability, change of platforms easily, new technology availability, speed marketing / accessing of innovation, error reduction by standardization, interchangeable physical servers, traffic management, onsite/Offsite storage, additional productivity. The problems arise due to cloud computing environment were:

security concerns, privacy concerns, trust, loss of control, maintaining service reliability, quality of services, responsibility of cloud failure, portability & choice of the cloud, user profile storage, user satisfaction, data backup & disaster recovery, legal issues, load balancing, network performance issues. The problems mitigated and solved by cloud computing are explained through cloud organization benefits. The problems arise due to cloud computing are explained as cloud organizational challenges.

The cloud benefits are categorized into private, public and hybrid cloud services. The categorization of cloud benefits across different cloud users is not possible because of insufficient data available in the literature. Cloud services are utilized by different organizations across different industry. There is no sufficient evidence to find software industry specific cloud benefits. The cloud benefits are prioritized into technological, economical and managerial based on project management problems addressing. We identified seven different clouds from different organizations and listed out cloud benefits of each cloud. Available literature is not sufficient to address the extent to which the cloud benefits addressing the project management problems of the software industry. There is difference between systematic literature results and interview results as mentioned in 3.3 sections. This difference is due to variance in cloud types and up gradation in cloud computing technology. The contradiction in results is due to cloud type variance.

Research question '4' was addressed partially with the available literature. This is because of the less mature cloud computing research area and this was reflected in publications.

5.1. Validity Threats

Authors encountered some validity threats while conducting this study. These threats were discussed in this section with the available solutions.

The formation of search strings will influence the searching process. The search of the literature available in the field is done through the matching of the search string with the keywords in the literature. This risk is overcome by forming the search string by the equivalent words for the keywords. The search string was formulated based on the Kitchenham guidelines [16, 17]. The terms such as grid computing, virtual computing and utility computing were excluded for the search string formation and this is to reduce the scope of the literature available from systematic review. This exclusion will influence the search results of the literature review.

The review protocol of the systematic review will influence the reliability of the results. We followed Kitchenham guidelines [16, 17] to design review protocol to reduce ambiguity in research results. The review protocol was validated by thesis supervisor. The search string formation and its usage across different databases were examined by librarian of BTH, Sweden.

We included peer reviewed articles for this thesis study. The research activity in cloud computing increasing day-to-day and there exit a lot of literature in the form of company blogs, unpublished reports and gray literature. The exclusion of non peer reviewed articles will influence the research results of this thesis.

The terminology in cloud computing industry may vary from the literature. The designing of the questionnaire for the interview study based on the literature will influence the research results. This threat is overcome by following the suggestions given in [82, 83] to design questionnaire for the interview study. The interview study is validated with the help of participant I-1.

The interview study is conducted among cloud computing experts and they are busy with their day-to-day activities. This threat is overcome by designing flexible schedule and mode of communication for conducting interview. The authors conducted some interviews through chat rooms available across different company websites to reduce the time wastage for participants.

The experience of the participants will influence the interview study results. The information related to cloud expertise was collected through questionnaire to overcome this threat.

6. CONCLUSION and FUTURE WORK

This thesis presents various project management problems that can be addressed by cloud computing technology, cloud organizational benefits and cloud organizational challenges for the software industry. The cloud benefits categorized into private, public and hybrid cloud types. The problems arise due to cloud computing environment were explained as cloud organizational challenges. Cloud benefits are prioritized into technological, economical and managerial by the way they are addressing project management problems of software industry. The cloud services of different organizations were described with the available literature. The authors found six cloud benefits (22%) and two cloud challenges (14%) through this research study and these results were not reflected in the existing literature. Cloud benefits identified through this research study are speed marketing/ accessing of innovation, reduction of errors by standardization, interchange able physical servers, traffic management, onsite/offsite storage and additional productivity. Cloud challenges identified through this research study are load balancing and network performance issues.

This study shows that cloud utilizing organization has to differentiate their project management problems based on factors such as security operational budget, customer satisfaction levels and time constraints. This differentiation will be useful to determine which cloud type is used for organization. Cloud utilizing organization has to take care of identified cloud challenges at the time of writing Service Level Agreements (SLAs). Cloud benefits are varied from one to other organization. Cloud utilizing organization has to use the cloud services based on the project management problems faced by them. The project management has to identify third party organization for measuring the quality of services across various clouds. Third party organization selection is based on their previous work records. The project management team can improve their cloud usage and its services by implementing above recommendations.

6.1. Future Work

Cloud benefits and challenges are varied from one organization to the other. Cloud computing environment varied from provider-to-provider. Such varied reflections will be possible through conducting case study across different clouds. Case study can be done by accessing industrial manuals of different cloud providers. Quality of research study can be improved by having access to such type of material. Cloud benefits provided by the organization to different users will be extracted by conducting an experimental study. The experimental study can be conducted at the industrial setup of cloud provider. We didn't manage to get the resources of cloud provider. The factors influencing cloud computing architecture are also essential to control the experimental study. The available literature from this research study is not covering this research area and it can be attained by conducting case study. Cloud benefits can be maximized and cloud challenges can be mitigated by controlling these factors in experimental study. The extent to which various cloud benefits addressing software industry problems is not addressed through this research study. This is due to unavailability of the literature and unwillingness of information sharing by interview participants. This can be addressed by conducting case study by accessing industrial manuals and industrial expert views while providing various cloud services to different clients.

7. REFERENCES

[1]. V. Chang, D. Bacigalupo, G. Wills, and D. De Roure, "A Categorization of Cloud Computing Business Models," *Proceedings of the 2010 10th IEEE/ACM International Conference on Cluster, Cloud and Grid Computing*, 2010, p. 509–512.

[2]. C.A. Lee, "A perspective on scientific cloud computing," *Proceedings of the 19th ACM International Symposium on High Performance Distributed Computing*, 2010, p. 451–459.

[3]. W. Kim, S.D. Kim, E. Lee, and S. Lee, "Adoption issues for cloud computing," *Proceedings of the 11th International Conference on Information Integration and Web-based Applications & Services*, 2009, p. 3–6.

[4]. M. Pokharel and J.S. Park, "Cloud computing: future solution for e-governance," *Proceedings of the 3rd International Conference on Theory and Practice of Electronic Governance*, 2009, p. 409–410.

[5]. Y. Khmelevsky and V. Voytenko, "Cloud computing infrastructure prototype for university education and research," *Proceedings of the 15th Western Canadian Conference on Computing Education*, 2010, p. 1–5.

[6]. Z. Guo, M. Song, and J. Song, "A Governance Model for Cloud Computing," *Management and Service Science (MASS), 2010 International Conference on*, p. 1–6.

[7]. V. Chang, G. Wills, and D. De Roure, "A Review of Cloud Business Models and Sustainability," *2010 IEEE 3rd International Conference on Cloud Computing*, 2010, p. 43–50.

[8]. M.D. Dikaiakos, D. Katsaros, P. Mehra, G. Pallis, and A. Vakali, "Cloud computing: Distributed internet computing for it and scientific research," *Internet Computing, IEEE*, vol. 13, 2009, p. 10–13.

[9]. I. Foster, Y. Zhao, I. Raicu, and S. Lu, "Cloud computing and grid computing 360-degree compared," *Grid Computing Environments Workshop, 2008. GCE'08*, 2009, p. 1–10.

[10]. T. Dillon, C. Wu, and E. Chang, "Cloud Computing: Issues and Challenges," *Advanced Information Networking and Applications (AINA), 2010 24th IEEE International Conference on*, 2010, p. 27–33.

[11]. L.J. Zhang and Q. Zhou, "CCOA: Cloud computing open architecture," *2009 IEEE International Conference on Web Services*, 2009, p. 607–616.

[12]. W.T. Tsai, X. Sun, and J. Balasooriya, "Service-Oriented Cloud Computing Architecture," *Information Technology: New Generations (ITNG), 2010 Seventh International Conference on*, 2010, p. 684–689.

[13]. S. Ramgovind, M.M. Eloff, and E. Smith, "The management of security in cloud computing," *Information Security for South Africa (ISSA), 2010*, p. 1–7.

[14]. P.Mell and T.Grance, "Draft nist working definition of cloud computing-v15", 21.Aug2009, p. 1.

[15]. S. Zhang, S. Zhang, X. Chen, and X. Huo, "Cloud Computing Research and Development Trend," *2010 Second International Conference on Future Networks*, 2010, p. 93–97.

[16]. Kitchenham, B., Procedures for Performing Systematic Reviews, tech. report, Software Engineering Group Department of Computer Science Keele University, 2004.

[17]. B. Kitchenham, O. Pearl Brereton, D. Budgen, M. Turner, J. Bailey, and S. Linkman, "Systematic literature reviews in software engineering-A systematic literature review," *Information and Software Technology*, vol. 51, no. 1, p. 7–15, 2009.

[18]. K. E. Emam, "Benchmarking Kappa: Interrater agreement in software process assessments," *Empirical Software Engineering*, vol. 4, no. 2, pp. 113–133, 1999.

[19]. S. E. Hove and B. Anda, "Experiences from conducting semi-structured interviews in empirical software engineering research," 2005.

[20]. H.Peet Rapp, "Audting the Cloud," *Financial Executive,* Vol. 26 , no. 4, pp. 62-63, 2010.

[21]. R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility," *Future Generation computer systems*, vol. 25, no. 6, pp. 599–616, 2009.

[22]. D. Hui , & C. Yu , "Cloud Computing, Accounting, Auditing, and Beyond," *CPA Journal*, Vol. 80, no. 10, pp. 66-70, 2010.

[23]. Jim. MCGeever, "Dispelling Myths That Limit Organizational Change," *Financial Executive*, Vol. 25, no. 9, pp. 67-68, 2011.

[24]. S. Payton, "FLLUFFY LOGIC," *Financial Management,* pp. 22-25, 2011.

[25]. A. Guazzelli, K. Stathatos, and M. Zeller, "Efficient deployment of predictive analytics through open standards and cloud computing," *ACM SIGKDD Explorations Newsletter*, vol. 11, no. 1, pp. 32–38, 2009.

[26]. M. D. De Assuncao, A. Di Costanzo, and R. Buyya, "Evaluating the cost-benefit of using cloud computing to extend the capacity of clusters," in *Proceedings of the 18th ACM international symposium on High performance distributed computing*, pp. 141–150, 2009.

[27]. M. Creeger, "CTO Roundtable: Cloud Computing," Queue, Vol. 7, no. 5, pp. 1-2, 2009.

[28]. A. Haeberlen, "A case for the accountable cloud," *ACM SIGOPS Operating Systems Review*, vol. 44, no. 2, pp. 52–57, 2010.

[29]. Q. Yuan et al., "A Leasing Instances Based Billing Model for Cloud Computing," *Advances in Grid and Pervasive Computing*, pp. 33–41, 2011.

[30]. Y. Guan, "A Statistical CPID Algorithm on Cloud Computing," in *Future Computer and Communication, 2009. FCC'09. International Conference on*, 2009, pp. 101–104.

[31]. M. Pastaki Rad, A. Sajedi Badashian, G. Meydanipour, M. Ashurzad Delcheh, M. Alipour, and H. Afzali, "A Survey of Cloud Platforms and Their Future," *Computational Science and Its Applications–ICCSA 2009*, pp. 788–796, 2009.

[32]. S. Subashini and V. Kavitha, "A survey on security issues in service delivery models of cloud computing," *Journal of Network and Computer Applications*, 2010.

[33]. R. Vasan, "A Venture Perspective on Cloud Computing," *Computer*, vol. 44, no. 3, pp. 60-62, 2011.

[34]. S. Ouf, M. Nasr, and Y. Helmy, "An enhanced e-learning ecosystem based on an integration between cloud computing and Web2. 0," in *Signal Processing and Information Technology (ISSPIT), 2010 IEEE International Symposium on*, pp. 48–55.

[35]. W. Dou, L. Qi, X. Zhang, and J. Chen, "An evaluation method of outsourcing services for developing an elastic cloud platform," *The Journal of Supercomputing*, pp. 1–23.

[36]. W. M. Zheng, "An Introduction to Tsinghua Cloud," *SCIENCE CHINA Information Sciences*, vol. 53, no. 7, pp. 1481–1486, 2010.

[37]. A. Shi, Y. Xia, and H. Zhan, "Applying cloud computing in financial service industry," in *Intelligent Control and Information Processing (ICICIP), 2010 International Conference on*, pp. 579–583.

[38]. C. Kloch, E. B. Petersen, and O. B. Madsen, “Cloud Based Infrastructure, the New Business Possibilities and Barriers,” *Wireless Personal Communications*, pp. 1–14, 2011.

[39]. M. Xu, D. Gao, C. Deng, Z. Luo, and S. Sun, “Cloud Computing Boosts Business Intelligence of Telecommunication Industry,” *Cloud Computing*, pp. 224–231, 2009.

[40]. M. Fouquet, H. Niedermayer, and G. Carle, “Cloud computing for the masses,” in *Proceedings of the 1st ACM workshop on User-provided networking: challenges and opportunities*, 2009, pp. 31–36.

[41]. A. Gupta, “Cloud computing growing interest and related concerns,” in *Computer Technology and Development (ICCTD), 2010 2nd International Conference on*, pp. 462–465.

[42]. N. Stinchcombe, “Cloud computing in the spotlight,” *Infosecurity*, vol. 6, no. 6, pp. 30–33, 2009.

[43]. R. Maggiani, “Cloud computing is changing how we communicate,” 2009.

[44]. L. A. Bean, “Cloud computing: Retro revival or the new paradigm?,” *Journal of Corporate Accounting & Finance*, vol. 21, no. 5, pp. 9–14, 2010.

[45]. Q. Zhang, L. Cheng, and R. Boutaba, “Cloud computing: state-of-the-art and research challenges,” *Journal of Internet Services and Applications*, vol. 1, no. 1, pp. 7–18, 2010.

[46]. S. Marston, Z. Li, S. Bandyopadhyay, J. Zhang, and A. Ghalsasi, “Cloud computing-The business perspective,” *Decision Support Systems*, 2010.

[47]. W. Scott, “Cloud security: is it really an issue for SMBs?,” *Computer Fraud & Security*, vol. 2010, no. 10, pp. 14–15, 2010.

[48]. J. Wu, L. Ping, X. Ge, Y. Wang, and J. Fu, “Cloud Storage as the Infrastructure of Cloud Computing,” in *2010 International Conference on Intelligent Computing and Cognitive Informatics*, 2010, pp. 380–383.

[49]. Y. Vigfusson and G. Chockler, “Clouds at the crossroads: research perspectives,” *Crossroads*, vol. 16, no. 3, pp. 10–13, 2010.

[50]. C. Morin, J. Gallard, Y. Jégou, and P. Riteau, “Clouds: a New Playground for the XtreemOS Grid Operating System,” 2009.

[51]. R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, “CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms,” *Software: Practice and Experience*, vol. 41, no. 1, pp. 23–50, 2011.

[52]. R. Smith, “Computing in the cloud,” *Research Technology Management*, vol. 52, no. 5, pp. 65–68, 2009.

[53]. M. Schnjakin, R. Alnemr, and C. Meinel, “Contract-based cloud architecture,” in *Proceedings of the second international workshop on Cloud data management*, 2010, pp. 33–40.

[54]. S. Mansfield-Devine, “Danger in the clouds,” *Network Security*, vol. 2008, no. 12, pp. 9–11, 2008.

[55]. M. Taylor, J. Haggerty, D. Gresty, and R. Hegarty, “Digital evidence in cloud computing systems,” *Computer Law & Security Review*, vol. 26, no. 3, pp. 304–308, 2010.

[56]. O. Krieger, P. McGachey, and A. Kanevsky, “Enabling a marketplace of clouds: VMware’s vCloud director,” *ACM SIGOPS Operating Systems Review*, vol. 44, no. 4, pp. 103–114, 2010.

[57]. N. Hawthorn, “Finding security in the cloud,” *Computer Fraud & Security*, vol. 2009, no. 10, pp. 19–20, 2009.

[58]. M. Taylor, J. Haggerty, D. Gresty, and D. Lamb, “Forensic investigation of cloud computing systems,” *Network Security*, vol. 2011, no. 3, pp. 4–10, 2011.

[59]. P. Field, “Get More from the cloud,” *ITNOW*, vol. 52, no. 3, p. 18, 2010.

[60]. A. Joint, E. Baker, and E. Eccles, “Hey, you, get off of that cloud?,” *Computer Law & Security Review*, vol. 25, no. 3, pp. 270–274, 2009.

[61]. S. C. Misra and A. Mondal, “Identification of a company’s suitability for the adoption of cloud computing and modelling its corresponding Return on Investment,” *Mathematical and Computer Modelling*, 2010.

[62]. T. Wlodarczyk, C. Rong, and K. Thorsen, “Industrial Cloud: Toward Inter-enterprise Integration,” *Cloud Computing*, pp. 460–471, 2009.

[63]. R. Blandford, “Information security in the cloud,” *Network Security*, vol. 2011, no. 4, pp. 15–17, 2011.

[64]. S. Pritchard, “Keeping Tabs on Your Data’s Address,” *Infosecurity*, vol. 8, no. 1, pp. 15–19, 2011.

[65]. A. Gupta and L. K. Awasthi, “Peer enterprises: A viable alternative to Cloud computing?,” in *Internet Multimedia Services Architecture and Applications (IMSAA), 2009 IEEE International Conference on*, 2009, pp. 1–6.

[66]. A. Iosup, S. Ostermann, N. Yigitbasi, R. Prodan, T. Fahringer, and D. Epema, “Performance analysis of cloud computing services for many-tasks scientific computing,” *IEEE Transactions on Parallel and Distributed Systems*, vol. 22, no. 6, pp. 931–945, 2011.

[67]. H. Guo, J. Chen, W. Wu, and W. Wang, “Personalization as a service: the architecture and a case study,” in *Proceeding of the first international workshop on Cloud data management*, 2009, pp. 1–8.

[68]. J. Wang, Y. Zhao, S. Jiang, and J. Le, “Providing privacy preserving in cloud computing,” in *Test and Measurement, 2009. ICTM’09. International Conference on*, 2009, vol. 2, pp. 213–216.

[69]. E. R. Gomes, Q. B. Vo, and R. Kowalczyk, “Pure exchange markets for resource sharing in federated clouds,” *Concurrency and Computation: Practice and Experience*.

[70]. N. A. Sultan, “Reaching for the ‘cloud’: How SMEs can manage,” *International Journal of Information Management*, vol. 44, 2010.

[71]. G. Papadopoulos, J. Schwartz, and J. Woods, “Redshift: A radical change in the fabric of computing,” *Business Strategy Review*, vol. 20, no. 1, pp. 78–83, 2009.

[72]. G. Zhao, C. Rong, M. G. Jaatun, and F. E. Sandnes, “Reference deployment models for eliminating user concerns on cloud security,” *The Journal of Supercomputing*, pp. 1–16, 2010.

[73]. T. Xia, Z. Li, and N. Yu, “Research on cloud computing based on deep analysis to typical platforms,” *Cloud Computing*, pp. 601–608, 2009.

[74]. V. Tchifilionova, “Security and Privacy Implications of Cloud Computing–Lost in the Cloud,” *Open Research Problems in Network Security*, pp. 149–158, 2011.

[75]. K. Sloan, “Security in a virtualised world,” *Network Security*, vol. 2009, no. 8, pp. 15–18, 2009.

[76]. P. Heap, “Software ownership: Where does it lie when it comes to M&A and outsourcing?,” *Computer Fraud & Security*, vol. 2010, no. 2, pp. 11–13, 2010.

[77]. C. Hoefer and G. Karagiannis, “Taxonomy of cloud computing services,” 2010.

[78]. A. Khajeh-Hosseini, D. Greenwood, J. W. Smith, and I. Sommerville, “The cloud adoption toolkit: Supporting cloud adoption decisions in the enterprise,” *Software: Practice and Experience*, 2010.

[79]. K. Townsend, “The Great Data Center Debate,” *Infosecurity*, vol. 8, no. 1, pp. 24–27, 2011.

[80]. I. Abbadi, “Toward Trustworthy Clouds’ Internet Scale Critical Infrastructure,” *Information Security Practice and Experience*, pp. 71–82, 2011.

[81]. S. Vassilaras and G. S. Yovanof, “Wireless Going in the Cloud: A Promising Concept or Just Marketing Hype?,” *Wireless Personal Communications*, pp. 1–12, 2011.

[82]. S. E. Hove and B. Anda, “Experiences from conducting semi-structured interviews in empirical software engineering research,” 2005.

[83]. M. Q. Patton, *Qualitative research and evaluation methods*. Sage Publications, Inc, 2002.

[84]. H. J. Rubin and I. Rubin, *Qualitative interviewing: The art of hearing data*. Sage Publications, Inc, 2005.

[85]. J. L. Fleiss and J. Cohen, “The equivalence of weighted kappa and the intraclass correlation coefficient as measures of reliability,” *Educational and psychological measurement*, 1973.

[86]. R. P. Weber, *Basic content analysis*, vol. 49. Sage Pubns, 1990.

APPENDIX A: QUESTIONNAIRE 1

Phase1: Basic Questions

1. What is your company name?
2. What is your cloud type?
3. What is your educational qualification and specialization?
4. What is your total software industry experience?
5. What is your cloud computing experience?
6. What is your cloud name?
7. What is your job designation?

Phase2: Cloud Benefits

8. What are the various services provided by your cloud to different organizations?
9. Weather the cloud benefits identified trough systematic review is provided by your cloud?
10. What are new cloud benefits provided by your cloud (which are not available in literature)?
11. How to maximize the cloud benefits? What do you suggest for utilizing organizations (customers)?
12. Each cloud benefits identified through systematic review is used in their organization is verified

Phase3: Cloud Challenges

13. What are the challenges faced by your customer (utilizing organization) while using cloud?
14. How do you overcome these challenges?
15. What do you suggest cloud organizations to overcome these challenges?
16. Each cloud challenges identified through systematic review is verified for its usage in the organization.

Note: The interview study is conducted in semi structured way and made appropriate changes according to the answers given by the participant.

This questionnaire is forwarded to each participant before conducting an interview study with them.

APPENDIX B: QUESTIONNAIRE 2

This questionnaire is used to collect data from each participant while conducting an interview study.

Questionnaire

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on "Cloud Computing Organizational Benefits & Challenges".

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Educational Qualification	Choose an item.
Specialization	
IT Experience	Choose an item.
Company Name	
Designation	
Cloud Computing Experience	Choose an item.
Cloud Type	Choose an item.
Cloud Name	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☐
➢ **Change of platforms easily**	☐
➢ **Infrastructure availability**	☐
➢ **Fast deployment and easy access of services**	☐
➢ **Reduction of installing/support/maintaining activities**	☐
➢ **Measured service and pay per usage**	☐

- **Eliminating the infrastructure investment** ☐
- **Low capital expenditure and less risk** ☐
- **Lower Impact of outages and upgrades** ☐
- **Cheaper services** ☐
- **Efficiency** ☐
- **Low cost for data-mining** ☐
- **Consistency** ☐
- **On demand services** ☐
- **Flexibility and Scalability** ☐
- **Simplified Planning** ☐
- **Reliability** ☐
- **Sustainability** ☐
- **Low barriers to entry** ☐
- **Easy to use** ☐
- **Improved improbability** ☐

Other Benefits that you come across while working with the cloud environment.

CHALLENGES WHILE WORKING WITH YOUR CLOUD		**THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE**	**WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE**
➢ **Security Concerns**	☐	1. By data encryption 2. By data integrity checks 3. By staff back ground checks 4. By authentication methods 5. By ensuring correct security policy 6. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	1. By storing user profile information at the client side 2. By identity management infrastructure (IMI) in clouds 3. By providing the services according to the user profile 4. Auditing the cloud by third	

		party companies 5. By maintaining the accountability within the cloud bye employees	
➢ **Trust**	☐	1. By providing data access logs 2. By third party checkups 3. By providing training activities 4. By frequent feedbacks from customers 5. By providing data backup facilities 6. By staff background checkups 7. By improving the performance and services	
➢ **Loss of Control**	☐	1. By providing training to customers 2. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☐	1. By third party checkups frequently 2. By data failure and disaster management 3. By data checkups at the client side 4. By improving the performance based on the customer feedbacks 5. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☐	1. Improving services performance by analyzing the frequent customer feedbacks 2. By third party checkups 3. Checkups at the client side	

➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☐		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

APPENDIX C: List of Excluded Articles

Table 5: List of Excluded Articles from Primary Studies

Reference Number	Excluded Articles
[28]	A. Haeberlen, "A case for the accountable cloud," *ACM SIGOPS Operating Systems Review*, vol. 44, no. 2, pp. 52–57, 2010.
[29]	Q. Yuan et al., "A Leasing Instances Based Billing Model for Cloud Computing," *Advances in Grid and Pervasive Computing*, pp. 33–41, 2011.
[30]	Y. Guan, "A Statistical CPID Algorithm on Cloud Computing," in *Future Computer and Communication, 2009. FCC'09. International Conference on*, 2009, pp. 101–104.
[36]	W. M. Zheng, "An Introduction to Tsinghua Cloud," *SCIENCE CHINA Information Sciences*, vol. 53, no. 7, pp. 1481–1486, 2010.
[39]	M. Xu, D. Gao, C. Deng, Z. Luo, and S. Sun, "Cloud Computing Boosts Business Intelligence of Telecommunication Industry," *Cloud Computing*, pp. 224–231, 2009.
[40]	M. Fouquet, H. Niedermayer, and G. Carle, "Cloud computing for the masses," in *Proceedings of the 1st ACM workshop on User-provided networking: challenges and opportunities*, 2009, pp. 31–36.
[42]	N. Stinchcombe, "Cloud computing in the spotlight," *Infosecurity*, vol. 6, no. 6, pp. 30–33, 2009.
[51]	R. N. Calheiros, R. Ranjan, A. Beloglazov, C. A. F. De Rose, and R. Buyya, "CloudSim: a toolkit for modeling and simulation of cloud computing environments and evaluation of resource provisioning algorithms," *Software: Practice and Experience*, vol. 41, no. 1, pp. 23–50, 2011.
[54]	S. Mansfield-Devine, "Danger in the clouds," *Network Security*, vol. 2008, no. 12, pp. 9–11, 2008.
[55]	M. Taylor, J. Haggerty, D. Gresty, and R. Hegarty, "Digital evidence in cloud computing systems," *Computer Law & Security Review*, vol. 26, no. 3, pp. 304–308, 2010.
[56]	O. Krieger, P. McGachey, and A. Kanevsky, "Enabling a marketplace of clouds: VMware's vCloud director," *ACM SIGOPS Operating Systems Review*, vol. 44, no. 4, pp. 103–114, 2010.
[65]	A. Gupta and L. K. Awasthi, "Peer enterprises: A viable alternative to Cloud computing?," in *Internet Multimedia Services Architecture and Applications (IMSAA), 2009 IEEE International Conference on*, 2009, pp. 1–6.
[69]	E. R. Gomes, Q. B. Vo, and R. Kowalczyk, "Pure exchange markets for resource sharing in federated clouds," *Concurrency and Computation: Practice and Experience*.

[71]	G. Papadopoulos, J. Schwartz, and J. Woods, "Redshift: A radical change in the fabric of computing," *Business Strategy Review*, vol. 20, no. 1, pp. 78–83, 2009.
[73]	T. Xia, Z. Li, and N. Yu, "Research on cloud computing based on deep analysis to typical platforms," *Cloud Computing*, pp. 601–608, 2009.
[76]	P. Heap, "Software ownership: Where does it lie when it comes to M&A and outsourcing?," *Computer Fraud & Security*, vol. 2010, no. 2, pp. 11–13, 2010.
[77]	C. Hoefer and G. Karagiannis, "Taxonomy of cloud computing services," 2010.
[78]	A. Khajeh-Hosseini, D. Greenwood, J. W. Smith, and I. Sommerville, "The cloud adoption toolkit: Supporting cloud adoption decisions in the enterprise," *Software: Practice and Experience*, 2010.
[80]	I. Abbadi, "Toward Trustworthy Clouds' Internet Scale Critical Infrastructure," *Information Security Practice and Experience*, pp. 71–82, 2011.

APPENDIX D: List of Included Articles

Table 6: List of Included Articles for Primary Studies

Reference Number	Included Articles for Primary study
[20]	H.Peet Rapp, "Audting the Cloud," *Financial Executive,* Vol. 26 , no. 4, pp. 62-63, 2010.
[21]	R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility," *Future Generation computer systems*, vol. 25, no. 6, pp. 599–616, 2009.
[22]	D. Hui , & C. Yu , "Cloud Computing, Accounting, Auditing, and Beyond," *CPA Journal*, Vol. 80, no. 10, pp. 66-70, 2010.
[23]	Jim. MCGeever, "Dispelling Myths That Limit Organizational Change," *Financial Executive*, Vol. 25, no. 9, pp. 67-68, 2011.
[24]	S. Payton, "FLLUFFY LOGIC," *Financial Management,* pp. 22-25, 2011.
[25]	A. Guazzelli, K. Stathatos, and M. Zeller, "Efficient deployment of predictive analytics through open standards and cloud computing," *ACM SIGKDD Explorations Newsletter*, vol. 11, no. 1, pp. 32–38, 2009
[26]	M. D. De Assuncao, A. Di Costanzo, and R. Buyya, "Evaluating the cost-benefit of using cloud computing to extend the capacity of clusters," in *Proceedings of the 18th ACM international symposium on High performance distributed computing*, pp. 141–150, 2009.
[27]	M. Creeger, "CTO Roundtable: Cloud Computing," Queue, Vol. 7, no. 5, pp. 1-2, 2009.
[31]	M. Pastaki Rad, A. Sajedi Badashian, G. Meydanipour, M. Ashurzad Delcheh, M. Alipour, and H. Afzali, "A Survey of Cloud Platforms and Their Future," *Computational Science and Its Applications–ICCSA 2009*, pp. 788–796, 2009.
[32]	S. Subashini and V. Kavitha, "A survey on security issues in service delivery models of cloud computing," *Journal of Network and Computer Applications*, 2010.
[33]	R. Vasan, "A Venture Perspective on Cloud Computing," *Computer*, vol. 44, no. 3, pp. 60-62, 2011.
[34]	S. Ouf, M. Nasr, and Y. Helmy, "An enhanced e-learning ecosystem based on an integration between cloud computing and Web2. 0," in *Signal Processing and Information Technology (ISSPIT), 2010 IEEE International Symposium on*, pp. 48–55.
[35]	W. Dou, L. Qi, X. Zhang, and J. Chen, "An evaluation method of outsourcing services for developing an elastic cloud platform," *The Journal of Supercomputing*, pp. 1–23.
[37]	A. Shi, Y. Xia, and H. Zhan, "Applying cloud computing in financial service industry," in

	Intelligent Control and Information Processing (ICICIP), 2010 International Conference on, pp. 579–583.
[38]	C. Kloch, E. B. Petersen, and O. B. Madsen, "Cloud Based Infrastructure, the New Business Possibilities and Barriers," *Wireless Personal Communications*, pp. 1–14, 2011.
[41]	A. Gupta, "Cloud computing growing interest and related concerns," in *Computer Technology and Development (ICCTD), 2010 2nd International Conference on*, pp. 462–465.
[43]	R. Maggiani, "Cloud computing is changing how we communicate," 2009.
[44]	L. A. Bean, "Cloud computing: Retro revival or the new paradigm?," *Journal of Corporate Accounting & Finance*, vol. 21, no. 5, pp. 9–14, 2010.
[45]	Q. Zhang, L. Cheng, and R. Boutaba, "Cloud computing: state-of-the-art and research challenges," *Journal of Internet Services and Applications*, vol. 1, no. 1, pp. 7–18, 2010.
[46]	S. Marston, Z. Li, S. Bandyopadhyay, J. Zhang, and A. Ghalsasi, "Cloud computing-The business perspective," *Decision Support Systems*, 2010.
[47]	W. Scott, "Cloud security: is it really an issue for SMBs?," *Computer Fraud & Security*, vol. 2010, no. 10, pp. 14–15, 2010.
[48]	J. Wu, L. Ping, X. Ge, Y. Wang, and J. Fu, "Cloud Storage as the Infrastructure of Cloud Computing," in *2010 International Conference on Intelligent Computing and Cognitive Informatics*, 2010, pp. 380–383.
[49]	Y. Vigfusson and G. Chockler, "Clouds at the crossroads: research perspectives," *Crossroads*, vol. 16, no. 3, pp. 10–13, 2010.
[50]	C. Morin, J. Gallard, Y. Jégou, and P. Riteau, "Clouds: a New Playground for the XtreemOS Grid Operating System," 2009.
[52]	R. Smith, "Computing in the cloud," *Research Technology Management*, vol. 52, no. 5, pp. 65–68, 2009.
[53]	M. Schnjakin, R. Alnemr, and C. Meinel, "Contract-based cloud architecture," in *Proceedings of the second international workshop on Cloud data management*, 2010, pp. 33–40.
[57]	N. Hawthorn, "Finding security in the cloud," *Computer Fraud & Security*, vol. 2009, no. 10, pp. 19–20, 2009.
[58]	M. Taylor, J. Haggerty, D. Gresty, and D. Lamb, "Forensic investigation of cloud computing systems," *Network Security*, vol. 2011, no. 3, pp. 4–10, 2011.
[59]	P. Field, "Get More from the cloud," *ITNOW*, vol. 52, no. 3, p. 18, 2010.

[60]	A. Joint, E. Baker, and E. Eccles, "Hey, you, get off of that cloud?," *Computer Law & Security Review*, vol. 25, no. 3, pp. 270–274, 2009.
[61]	S. C. Misra and A. Mondal, "Identification of a company's suitability for the adoption of cloud computing and modelling its corresponding Return on Investment," *Mathematical and Computer Modelling*, 2010.
[62]	T. Wlodarczyk, C. Rong, and K. Thorsen, "Industrial Cloud: Toward Inter-enterprise Integration," *Cloud Computing*, pp. 460–471, 2009.
[63]	R. Blandford, "Information security in the cloud," *Network Security*, vol. 2011, no. 4, pp. 15–17, 2011.
[64]	S. Pritchard, "Keeping Tabs on Your Data's Address," *Infosecurity*, vol. 8, no. 1, pp. 15–19, 2011.
[66]	A. Iosup, S. Ostermann, N. Yigitbasi, R. Prodan, T. Fahringer, and D. Epema, "Performance analysis of cloud computing services for many-tasks scientific computing," *IEEE Transactions on Parallel and Distributed Systems*, vol. 22, no. 6, pp. 931–945, 2011.
[67]	H. Guo, J. Chen, W. Wu, and W. Wang, "Personalization as a service: the architecture and a case study," in *Proceeding of the first international workshop on Cloud data management*, 2009, pp. 1–8.
[68]	J. Wang, Y. Zhao, S. Jiang, and J. Le, "Providing privacy preserving in cloud computing," in *Test and Measurement, 2009. ICTM'09. International Conference on*, 2009, vol. 2, pp. 213–216.
[70]	N. A. Sultan, "Reaching for the 'cloud': How SMEs can manage," *International Journal of Information Management*, vol. 44, 2010.
[72]	G. Zhao, C. Rong, M. G. Jaatun, and F. E. Sandnes, "Reference deployment models for eliminating user concerns on cloud security," *The Journal of Supercomputing*, pp. 1–16, 2010.
[74]	V. Tchifilionova, "Security and Privacy Implications of Cloud Computing–Lost in the Cloud," *Open Research Problems in Network Security*, pp. 149–158, 2011.
[75]	K. Sloan, "Security in a virtualised world," *Network Security*, vol. 2009, no. 8, pp. 15–18, 2009.
[79]	K. Townsend, "The Great Data Center Debate," *Infosecurity*, vol. 8, no. 1, pp. 24–27, 2011.
[81]	S. Vassilaras and G. S. Yovanof, "Wireless Going in the Cloud: A Promising Concept or Just Marketing Hype?," *Wireless Personal Communications*, pp. 1–12, 2011.

APPENDIX E: List of Cloud Organizational Benefits across Primary Studies

Table 7: List of Cloud Organizational benefits Extracted from different studies

Number of Benefits	Cloud Organizational Benefits	Reference Numbers
1	New technology availability	[27, 38, 45, 46, 48, 61]
2	Change of platforms easily	[33, 59]
3	Infrastructure availability	[25, 37,46, 49, 81]
4	Fast deployment & easy access of service	[21, 24, 25, 31, 44, 46, 48, 57, 81]
5	Reduction of installing/supporting/maintaining activities	[20, 48, 60, 81]
6	Measured service and pay per usage	[20, 22, 26, 25, 31, 37, 44, 74]
7	Eliminating the infrastructure investment	[26, 44, 46, 60, 74]
8	Low capital expenditure & less risk	[20, 25, 26, 44, 46, 62, 64]
9	Lower impact of outages & upgrades	[23, 48]
10	Cheaper services	[33, 44, 66]
11	Efficiency	[34, 44, 46, 64, 70]
12	Low cost for data mining	[25]
13	Consistency	[49]
14	On demand services	[20, 21, 29, 37, 46, 50, 52]
15	Flexibility & Scalability	[20, 24, 25, 37, 44, 46, 52, 58, 61, 81]
16	Simplified Planning	[48]
17	Reliability	[44, 81]
18	Sustainability	[44, 81]
19	Low barriers to entry	[31, 44, 46, 81]
20	Easy to use	[63]
21	Improved improbability	[34]

APPENDIX F: List of Cloud Organizational Challenges across Primary Studies

Table 8: List of Cloud Organizational Challenges Extracted from different studies

Number of Challenges	Cloud Organizational Challenges	Reference Numbers
1	Security concerns	[31, 32, 41, 43, 45, 47, 48, 53, 59, 61, 62, 68, 72, 74, 75, 79, 81]
2	Privacy concerns	[43, 68, 74, 75, 81]
3	Trust	[24, 35, 41, 44, 61]
4	Loss of control	[41, 44, 75]
5	Maintaining service reliability	[41, 43, 48]
6	Quality of services	[35, 40, 41, 53, 81]
7	Responsibility of cloud failure	[41]
8	Portability & choice of the cloud	[43, 72]
9	User profile storage	[67]
10	User satisfaction	[35, 50, 81]
11	Data backup & disaster recovery	[32, 48, 53, 72, 81]
12	Legal issues	[40, 53, 75, 81]

APPENDIX G: List of Cloud Organizational Benefits across Interview Study

Table 9: List of Cloud Organizational Benefits Extracted from Interview Study

Number of Benefits	Cloud Organizational Benefits	ID
1	New technology availability	I-2, I-3, I-4, I-5, I-6, I-7
2	Change of platforms easily	I-1, I-3, I-5, I-7
3	Infrastructure availability	I-2, I-3, I-5, I-7
4	Fast deployment & easy access of service	I-1, I-2, I-5, I-6, I-7
5	Reduction of installing/supporting/maintaining activities	I-1, I-2, I-5, I-7
6	Measured service and pay per usage	I-2, I-3, I-4, I-5, I-7
7	Eliminating the infrastructure investment	I-3, I-7
8	Low capital expenditure & less risk	I-2, I-4, I-6, I-7
9	Lower impact of outages & upgrades	I-2, I-4, I-5, I-6
10	Cheaper services	I-2, I-3, I-7
11	Efficiency	I-2, I-3, I-4, I-6, I-7
12	Low cost for data mining	I-2, I-3
13	Consistency	I-4, I-5, I-7
14	On demand services	I-2, I-3, I-4, I-5, I-6, I-7
15	Flexibility & Scalability	I-2, I-3, I-4, I-5, I-6, I-7
16	Reliability	I-3, I-5, I-6
17	Sustainability	I-4, I-7
18	Low barriers to entry	I-3, I-4, I-7
19	Easy to use	I-4, I-3, I-5, I-6
20	Improved improbability	I-2, I-3
21	Additional productivity	I-1, I-3
22	Speed marketing / accessing of innovation	I-1, I-3
23	Error reduction by standardization	I-5, I-7
24	Interchangeable physical servers	I-3, I-7
25	Traffic management	I-3, I-5, I-6, I-7
26	Onsite/Offsite storage	I-3, I-4, I-5, I-6

APPENDIX H: List of Cloud Organizational Challenges across Interview Studies

Table 10: List of Cloud Organizational Challenges Extracted from Interview Studies

Number of Challenges	Cloud Organizational Challenges	ID
1	Security concerns	I-1, I-2, I-3, I-4, I-6, I-7
2	Privacy concerns	I-1, I-2
3	Trust	I-2, I-6
4	Loss of control	I-1, I-2, I-5
5	Maintaining service reliability	I-1, I-2, I-5
6	Quality of services	I-1, I-2, I-4, I-5,
7	Responsibility of cloud failure	I-2, I-5
8	Portability & choice of the cloud	I-1, I-2
9	User profile storage	I-2, I-7
10	User satisfaction	I-1, I-2
11	Data backup & disaster recovery	I-2, I-3
12	Legal issues	I-1, I-2
13	Load balancing	I-2, I-3, I-5, I-7
14	Network performance issues	I-2, I-3, I-6, I-7

APPENDIX I: KAPPA COEFFICIENT CALCULATION

Kappa Coefficient

The agreement and disagreement between two authors is assessed by calculating Cohen's Kappa Coefficient

Kappa Coefficient is calculated by $K = \frac{P(A) - P(E)}{1 - P(E)}$

Where P (A) = Probability of observed agreement between authors

P (E) = Probability of expected agreement

Where N is the total number of articles taken for Kappa Coefficient calculations

The P (A) and P (E) are calculated as follows

$$P(A) = \left[\frac{\text{No. of papers both authors say yes} + \text{No. of papers both authors say no}}{N}\right]$$

$$P(E) = \left[\frac{(\text{No. of papers for which author 1 say yes})}{N} \times \frac{(\text{No. of papers for which author 2 say yes})}{N}\right] + \left[\frac{(\text{No.of papers for which author 1 say No})}{N} \times \frac{(\text{No.of papers for which author 2 say No})}{N}\right]$$

Table 11: Overview of the articles selected by the authors

		Author 2	
		Yes	No
Author 1	Yes	X1	X2
	NO	X3	X4

Where X1= Number of articles for which both the authors say yes

X2= Number of articles for which author 1 say yes and author 2 say no

X3= Number of articles for which author 1 say no and author 2 say yes

X4= Number of articles for which both the authors say no

$$P(A) = \frac{(X1 + X4)}{(X1 + X2 + X3 + X4)}$$

$$P(E) = \frac{\Big(\big((\mathrm{X1} + \mathrm{X2}) \times (\mathrm{X1} + \mathrm{X3})\big) + \big((X3 + X4) \times (\mathrm{X2} + \mathrm{X4})\big)\Big)}{(X1 + X2 + X3 + X4)}$$

Kappa Coefficient $\mathrm{K} = \frac{\mathrm{P(A)} - \mathrm{P\ (E)}}{1 - \mathrm{P\ (E)}}$

Table 12 : Overview of Kappa coefficient calculation during inclusion & exclusion criteria

Database	Number of Articles selected for Kappa Coefficient calculation	Probability of Agreement (P(A))	Probability of Random Agreement (P(E))	Kappa Coefficient (K)
ACM	20	0.93	0.54	0.84
IEEE	20	0.85	0.49	0.70
BSP	30	0.8	0.6146	0.5337
Science Direct	26	0.96	0.571	0.6146
Wiley Inter Science	10	1	0.52	1
Springer	51	1	0.854	1
In spec and Compendex	20	0.87	0.45	0.76
Scopus	20	1	0.68	1

The authors calculated average of kappa coefficients from all data bases and they found final agreement value (0.8). The authors found above mentioned agreement value after final iteration of kappa coefficient calculation.

The authors also calculated kappa coefficient to assess the homogeneity during data extraction process. They selected 20 articles randomly from the total 43 primary studies for kappa coefficient calculation. The articles selected for kappa coefficient calculation are [22, 24, 26, 32, 35, 37, 41, 43, 47, 48, 50, 57, 58, 61, 64, 66, 70, 75, 79, 81]. It is calculated by considering technology availability from cloud benefits, privacy concern from cloud challenges and different cloud types factors. They made changes to data extraction process through consultation for improving agreement value. They found agreement value (0.67) after the final iteration.

Table 13: Describing strength of agreements across kappa values [18]

Kappa Value	Strength of agreement
K < = 0.44	Poor
0.44 < = K < = 0.62	Moderate
0.62 < = K < = 0.78	Substantial
K > 0.78	Excellent

APPENDIX J: ANALYSIS OF POPULATION, INTERVENTION, CONTROL AND OUTCOME

Table 14: Analysis of Population, Intervention, Control and Outcome

Population	Cloud Computing
Intervention	Benefits
	Challenges
	Advantages
	Usage
	Utilizations
	Services
Control	Organizations
	Industry
	Company
Outcome	Cloud Organizational Benefits & Challenges

APPENDIX K: INTERVIEW STUDY TRANSCRIPTS

Chat Link:

https://docs.google.com/document/d/1G7g6gPwfyJYdAL04NDcqhQOvJQoiB6I5JmNllk8F1y8/edit

Questionnaire 1

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on "Cloud Computing Organizational Benefits & Challenges".

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
KRISHNA AERABATI	
Educational Qualification	**Bachelor**
Specialization	
Computer Science Engineering	
IT Experience	**15**
Company Name	
PREMIER FARNELL	
Designation	
GLOBAL DEVELOPMENT OPERATIONS MANAGER	
Cloud Computing Experience	**1**
Cloud Type	**Public**
Cloud Name	
force.com	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☐
➢ **Change of platforms easily**	☒

➢ **Infrastructure availability**	☐
➢ **Fast deployment and easy access of services**	☒
➢ **Reduction of installing/support/maintaining activities**	☒
➢ **Measured service and pay per usage**	☐
➢ **Eliminating the infrastructure investment**	☐
➢ **Low capital expenditure and less risk**	☒
➢ **Lower Impact of outages and upgrades**	☐
➢ **Cheaper services**	☐
➢ **Efficiency**	☐
➢ **Low cost for data-mining**	☐
➢ **Consistency**	☐
➢ **On demand services**	☐
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☐
➢ **Reliability**	☐
➢ **Sustainability**	☐
➢ **Low barriers to entry**	☐
➢ **Easy to use**	☒
➢ **Improved improbability**	☐

Other Benefits that you come across while working with the cloud environment.

Quick Access to innovation.

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	7. By data encryption 8. By data integrity checks 9. By staff back ground checks 10. By authentication methods 11. By ensuring correct security policy 12. Data checkups by third part companies	#5

➢ **Privacy Concerns**	☒	6. By storing user profile information at the client side 7. By identity management infrastructure (IMI) in clouds 8. By providing the services according to the user profile 9. Auditing the cloud by third party companies 10. By maintaining the accountability within the cloud bye employees	By adhering to the respective complaince policies
➢ **Trust**	☐	8. By providing data access logs 9. By third party checkups 10. By providing training activities 11. By frequent feedbacks from customers 12. By providing data backup facilities 13. By staff background checkups 14. By improving the performance and services	
➢ **Loss of Control**	☐	3. By providing training to customers 4. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☒	6. By third party checkups frequently 7. By data failure and disaster management 8. By data checkups at the client side 9. By improving the performance based on the customer feedbacks 10. By removing the barriers to customer exchange from one cloud to other	By doing lot of upfront research/homework before choosing the cloud.

➢ **Quality of Services**	☒	4. Improving services performance by analyzing the frequent customer feedbacks 5. By third party checkups 6. Checkups at the client side	#1
➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☒		There are not many established cloud providers at the moment, but this will prove more challenging in the future
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	

- **Data backup & disaster recovery** ☐

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

If organisations have presence in more than one region(US, EU, APAC etc), there are additional compliance/legal rules that must be met. A thorough understanding and adherence of complaince policies is a must.

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Make sure your provider offers required levels of customisation, you or your organisation will need.
Make sure the Service Agreements (SLAs) are clearly defined and are acceptable to you or your organisation.
Since you will not be moving everything to cloud, make sure your existing apps integrate well with the cloud.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 2

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Muthukaruppan Annamalai	
Educational Qualification	**Master**
Specialization	
Software Engineering	
IT Experience	**6**
Company Name	
Microsoft	
Designation	
Software Design Engineer	
Cloud Computing Experience	**2**
Cloud Type	**Public**
Cloud Name	
Azure	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☐
➢ **Infrastructure availability**	☒
➢ **Fast deployment and easy access of services**	☒
➢ **Reduction of installing/support/maintaining activities**	☒
➢ **Measured service and pay per usage**	☒
➢ **Eliminating the infrastructure investment**	☐
➢ **Low capital expenditure and less risk**	☒
➢ **Lower Impact of outages and upgrades**	☒
➢ **Cheaper services**	☒

➢ **Efficiency**	☒
➢ **Low cost for data-mining**	☒
➢ **Consistency**	☐
➢ **On demand services**	☒
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☐
➢ **Reliability**	☐
➢ **Sustainability**	☐
➢ **Low barriers to entry**	☐
➢ **Easy to use**	☐
➢ **Improved improbability**	☐

Other Benefits that you come across while working with the cloud environment.

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	13. By data encryption 14. By data integrity checks 15. By staff back ground checks 16. By authentication methods 17. By ensuring correct security policy 18. Data checkups by third part companies	
➢ **Privacy Concerns**	☒	11. By storing user profile information at the client side 12. By identity management infrastructure (IMI) in clouds 13. By providing the services according to the user profile 14. Auditing the cloud by third party companies 15. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☒	15. By providing data access logs 16. By third party checkups 17. By providing training activities 18. By frequent feedbacks from customers 19. By providing data backup facilities 20. By staff background checkups 21. By improving the performance and services	
➢ **Loss of Control**	☒	5. By providing training to customers 6. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☒	11. By third party checkups frequently 12. By data failure and disaster management 13. By data checkups at the client side 14. By improving the performance based on the customer feedbacks 15. By removing the barriers to customer exchange from one cloud to other	Through replicated services
➢ **Quality of Services**	☒	7. Improving services performance by analyzing the frequent customer feedbacks 8. By third party checkups 9. Checkups at the client side	-Help the customer to live debug the applications -Provide access to debug logs and etc.

➢ **Responsibility of cloud failure**	☒	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☒		
➢ **User profile storage**	☒		
➢ **User satisfaction**	☒	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☒		

- **Legal issues** ☒

Other Challenges & Solutions that you come across while working with the cloud environment.

Load balancing, Network performance issues

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

My advice would be to start small and grow organically. Debugging is one of the major issues since you don't directly control the machines. Figuring out all these blockers and organically growing will ease the process.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 3

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Jared D	
Educational Qualification	**Master**
Specialization	
Marketing	
IT Experience	**6**
Company Name	
Soft Layer	
Designation	
Global Sales Representative	
Cloud Computing Experience	**3**
Cloud Type	**Hybrid**
Cloud Name	
Cloud Layer	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☒
➢ **Infrastructure availability**	☒
➢ **Fast deployment and easy access of services**	☐
➢ **Reduction of installing/support/maintaining activities**	☐
➢ **Measured service and pay per usage**	☒
➢ **Eliminating the infrastructure investment**	☒
➢ **Low capital expenditure and less risk**	☐
➢ **Lower Impact of outages and upgrades**	☐
➢ **Cheaper services**	☒

➢ **Efficiency**	☒
➢ **Low cost for data-mining**	☒
➢ **Consistency**	☐
➢ **On demand services**	☒
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☐
➢ **Reliability**	☒
➢ **Sustainability**	☐
➢ **Low barriers to entry**	☒
➢ **Easy to use**	☒
➢ **Improved improbability**	☒

Other Benefits that you come across while working with the cloud environment.

Additional productivity
Speed marketing/ accessing of innovation
Interchangeable physical servers
Traffic management
Onsite/Offsite storage

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	19. By data encryption 20. By data integrity checks 21. By staff back ground checks 22. By authentication methods 23. By ensuring correct security policy 24. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	16. By storing user profile information at the client side 17. By identity management infrastructure (IMI) in clouds 18. By providing the services according to the user profile 19. Auditing the cloud by third party companies 20. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☐	22. By providing data access logs 23. By third party checkups 24. By providing training activities 25. By frequent feedbacks from customers 26. By providing data backup facilities 27. By staff background checkups 28. By improving the performance and services	
➢ **Loss of Control**	☐	7. By providing training to customers 8. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☐	16. By third party checkups frequently 17. By data failure and disaster management 18. By data checkups at the client side 19. By improving the performance based on the customer feedbacks 20. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☐	10. Improving services performance by analyzing the frequent customer feedbacks 11. By third party checkups 12. Checkups at the client side	

➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☒		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

Load balancing
Network performance issues

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 4

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Steve	
Educational Qualification	**Master**
Specialization	
Business Administration	
IT Experience	**7**
Company Name	
Layered Tech	
Designation	
Business Development	
Cloud Computing Experience	**2**
Cloud Type	**Hybrid**
Cloud Name	
The Matrix	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☐
➢ **Infrastructure availability**	☐
➢ **Fast deployment and easy access of services**	☐
➢ **Reduction of installing/support/maintaining activities**	☐
➢ **Measured service and pay per usage**	☒
➢ **Eliminating the infrastructure investment**	☐
➢ **Low capital expenditure and less risk**	☒
➢ **Lower Impact of outages and upgrades**	☒
➢ **Cheaper services**	☐

➢ **Efficiency**	☒
➢ **Low cost for data-mining**	☐
➢ **Consistency**	☒
➢ **On demand services**	☒
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☐
➢ **Reliability**	☐
➢ **Sustainability**	☒
➢ **Low barriers to entry**	☒
➢ **Easy to use**	☒
➢ **Improved improbability**	☐

Other Benefits that you come across while working with the cloud environment.

Onsite/Offsite storage

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	25. By data encryption 26. By data integrity checks 27. By staff back ground checks 28. By authentication methods 29. By ensuring correct security policy 30. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	21. By storing user profile information at the client side 22. By identity management infrastructure (IMI) in clouds 23. By providing the services according to the user profile 24. Auditing the cloud by third party companies 25. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☐	29. By providing data access logs 30. By third party checkups 31. By providing training activities 32. By frequent feedbacks from customers 33. By providing data backup facilities 34. By staff background checkups 35. By improving the performance and services	
➢ **Loss of Control**	☐	9. By providing training to customers 10. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☐	21. By third party checkups frequently 22. By data failure and disaster management 23. By data checkups at the client side 24. By improving the performance based on the customer feedbacks 25. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☒	13. Improving services performance by analyzing the frequent customer feedbacks 14. By third party checkups 15. Checkups at the client side	

➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☐		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 5

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Nicole Cook	
Educational Qualification	**Bachelor**
Specialization	
Business Management	
IT Experience	**10**
Company Name	
Rackspace	
Designation	
Business Development	
Cloud Computing Experience	**2**
Cloud Type	**Public**
Cloud Name	
The Rackspace	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☒
➢ **Infrastructure availability**	☒
➢ **Fast deployment and easy access of services**	☒
➢ **Reduction of installing/support/maintaining activities**	☒
➢ **Measured service and pay per usage**	☒
➢ **Eliminating the infrastructure investment**	☐
➢ **Low capital expenditure and less risk**	☐
➢ **Lower Impact of outages and upgrades**	☒
➢ **Cheaper services**	☐

- **Efficiency** ☐
- **Low cost for data-mining** ☐
- **Consistency** ☒
- **On demand services** ☒
- **Flexibility and Scalability** ☒
- **Simplified Planning** ☐
- **Reliability** ☒
- **Sustainability** ☐
- **Low barriers to entry** ☐
- **Easy to use** ☒
- **Improved improbability** ☐

Other Benefits that you come across while working with the cloud environment.

Error reduction by standardization
Onsite/Offsite storage
Traffic management

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☐	31. By data encryption 32. By data integrity checks 33. By staff back ground checks 34. By authentication methods 35. By ensuring correct security policy 36. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	26. By storing user profile information at the client side 27. By identity management infrastructure (IMI) in clouds 28. By providing the services according to the user profile 29. Auditing the cloud by third party companies 30. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☐	36. By providing data access logs 37. By third party checkups 38. By providing training activities 39. By frequent feedbacks from customers 40. By providing data backup facilities 41. By staff background checkups 42. By improving the performance and services	
➢ **Loss of Control**	☒	11. By providing training to customers 12. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☒	26. By third party checkups frequently 27. By data failure and disaster management 28. By data checkups at the client side 29. By improving the performance based on the customer feedbacks 30. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☒	16. Improving services performance by analyzing the frequent customer feedbacks 17. By third party checkups 18. Checkups at the client side	

➢ **Responsibility of cloud failure**	☒	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☐		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

Load blancing

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 6

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Duane Zoscin	
Educational Qualification	**Master**
Specialization	
Marketing	
IT Experience	**8**
Company Name	
INetU	
Designation	
Global Sales Representative	
Cloud Computing Experience	**1**
Cloud Type	**Hybrid**
Cloud Name	
INetU Gated Community Cloud	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☐
➢ **Infrastructure availability**	☐
➢ **Fast deployment and easy access of services**	☒
➢ **Reduction of installing/support/maintaining activities**	☐
➢ **Measured service and pay per usage**	☐
➢ **Eliminating the infrastructure investment**	☐
➢ **Low capital expenditure and less risk**	☒
➢ **Lower Impact of outages and upgrades**	☒
➢ **Cheaper services**	☐

➢ **Efficiency**	☒
➢ **Low cost for data-mining**	☐
➢ **Consistency**	☐
➢ **On demand services**	☒
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☒
➢ **Reliability**	☐
➢ **Sustainability**	☐
➢ **Low barriers to entry**	☐
➢ **Easy to use**	☒
➢ **Improved improbability**	☐

Other Benefits that you come across while working with the cloud environment.

Traffic management
Onsite/Offsite storage

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	37. By data encryption 38. By data integrity checks 39. By staff back ground checks 40. By authentication methods 41. By ensuring correct security policy 42. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	31. By storing user profile information at the client side 32. By identity management infrastructure (IMI) in clouds 33. By providing the services according to the user profile 34. Auditing the cloud by third party companies 35. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☒	43. By providing data access logs 44. By third party checkups 45. By providing training activities 46. By frequent feedbacks from customers 47. By providing data backup facilities 48. By staff background checkups 49. By improving the performance and services	
➢ **Loss of Control**	☐	13. By providing training to customers 14. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☐	31. By third party checkups frequently 32. By data failure and disaster management 33. By data checkups at the client side 34. By improving the performance based on the customer feedbacks 35. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☐	19. Improving services performance by analyzing the frequent customer feedbacks 20. By third party checkups 21. Checkups at the client side	

➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☐		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☐		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

Network performance issues

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.

Questionnaire 7

We are master degree students studying at Blekinge Institute of Technology, Sweden. We are doing our thesis on “Cloud Computing Organizational Benefits & Challenges”.

The purpose of this questionnaire is to understand the organizational benefits, challenges from the cloud computing to the customers (companies utilizing the cloud services). This will be helpful for us to complete master thesis.

By Systematic Literature Review, we analyzed some of the benefits and challenges of cloud computing for the organizations which are utilizing the cloud services. Firstly, please tick the benefits and challenges which you come across while working with your cloud environment. Secondly, present the solutions to the challenges which you come across while working with your cloud environment and lastly, there is a free place for any other benefits and challenges that you come across while working with your cloud environment.

GENERAL QUESTIONS	
Name	
Nellie	
Educational Qualification	**Bachelor**
Specialization	
Business Management	
IT Experience	**11**
Company Name	
GoGrid	
Designation	
Consultant	
Cloud Computing Experience	**2**
Cloud Type	**Hybrid**
Cloud Name	
Xen	

BENEFITS OF YOUR CLOUD	
➢ **New technology availability**	☒
➢ **Change of platforms easily**	☒
➢ **Infrastructure availability**	☒
➢ **Fast deployment and easy access of services**	☒
➢ **Reduction of installing/support/maintaining activities**	☒
➢ **Measured service and pay per usage**	☒
➢ **Eliminating the infrastructure investment**	☒
➢ **Low capital expenditure and less risk**	☒
➢ **Lower Impact of outages and upgrades**	☐
➢ **Cheaper services**	☐

➢ **Efficiency**	☒
➢ **Low cost for data-mining**	☒
➢ **Consistency**	☐
➢ **On demand services**	☒
➢ **Flexibility and Scalability**	☒
➢ **Simplified Planning**	☐
➢ **Reliability**	☐
➢ **Sustainability**	☒
➢ **Low barriers to entry**	☒
➢ **Easy to use**	☐
➢ **Improved improbability**	☐

Other Benefits that you come across while working with the cloud environment.

Traffic management
Interchangeable physical servers
error reduction by standardization

CHALLENGES WHILE WORKING WITH YOUR CLOUD		THE SOLUTIONS USED IN CLOUD TO OVERCOME THE CHALLENGE	WHAT ARE THE OTHER SOLUTIONS USED IN YOUR CLOUD TO OVERCOME THE CHALLENGE
➢ **Security Concerns**	☒	43. By data encryption 44. By data integrity checks 45. By staff back ground checks 46. By authentication methods 47. By ensuring correct security policy 48. Data checkups by third part companies	
➢ **Privacy Concerns**	☐	36. By storing user profile information at the client side 37. By identity management infrastructure (IMI) in clouds 38. By providing the services according to the user profile 39. Auditing the cloud by third party companies 40. By maintaining the accountability within the cloud bye employees	

➢ **Trust**	☐	50. By providing data access logs 51. By third party checkups 52. By providing training activities 53. By frequent feedbacks from customers 54. By providing data backup facilities 55. By staff background checkups 56. By improving the performance and services	
➢ **Loss of Control**	☐	15. By providing training to customers 16. By measuring the use of service and providing the information to customer	
➢ **Maintaining service Reliability**	☐	36. By third party checkups frequently 37. By data failure and disaster management 38. By data checkups at the client side 39. By improving the performance based on the customer feedbacks 40. By removing the barriers to customer exchange from one cloud to other	
➢ **Quality of Services**	☐	22. Improving services performance by analyzing the frequent customer feedbacks 23. By third party checkups 24. Checkups at the client side	

➢ **Responsibility of cloud failure**	☐	By defining responsibilities to the employees and checking them	
➢ **Portability and choice of the cloud**	☐		
➢ **User profile storage**	☒		
➢ **User satisfaction**	☐	By implicit information feed backs	
➢ **Data backup & disaster recovery**	☐		

- **Legal issues** ☐

Other Challenges & Solutions that you come across while working with the cloud environment.

Load balancing
Network performance issues

ANY SUGGEESTION TO ORGANIZATIONS WHICH WANTS TO USE THE CLOUD RESOURCES FROM YOUR EXPERIENCE.

Thank you for taking the time to fill out this questionnaire your contributions is greatly appreciated.