Faculty of Humanities and Social Sciences Systems, Technologies and Information Management

Universidade Fernando Pessoa
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Requirement for a Minimum Service Level Framework for Cloud Providers and Users

PhD in Information Sciences Specialization in Information Systems and Technologies

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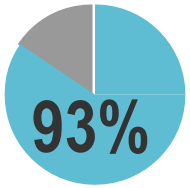
UFP, Porto 17th,December, 2018 - (Portugal)

THE Cloud Market: Facts & Predications



93% of organisations are using cloud services [1]

$130bn

Size of public cloud computing market [2]

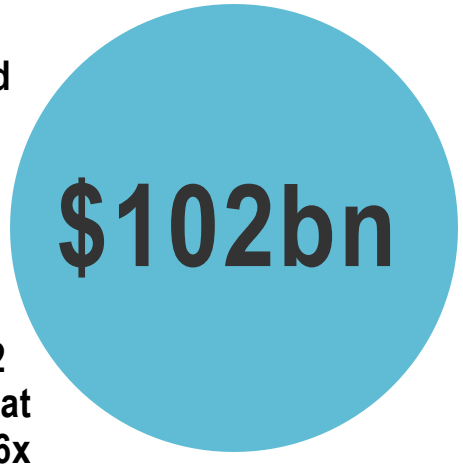
4.5x

↓

>6x

Cloud spend is growing at 4.5x rate of IT spend

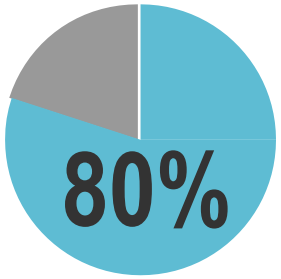
Between 2015 - 2022 it will grow at more than 6x the rate of IT spend [3]



Size of private cloud computing market

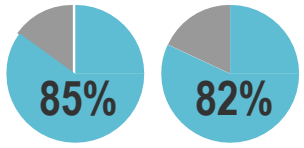
10%

of technology budgets spent on cloud-related services [4]

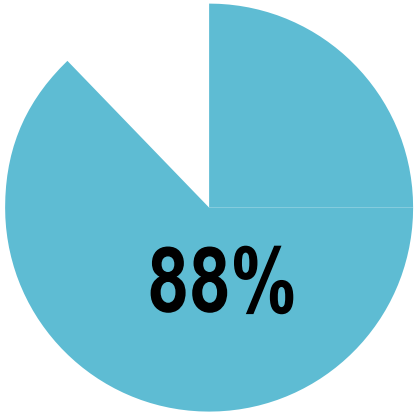


80% say high profile cyber-attacks have not deterred them from adopting cloud technology [7]

of tech CFOs say cloud computing will have the most measurable impact on their business in 2017. [5]



85% of enterprises have a multi-cloud strategy, up from 82% in 2016. [6]



88% of UK organisations interviewed use cloud, each using an average of 3 cloud-based services [8]

Sample 500 Blue chip Companies U.K Contemsa 2018

contemsa.

Summary of the Presentation

1. Introduction and Justification of the theme
- ❑Context
- ❑Problems, Challenges and the Research Question
- ❑Aim & Objectives

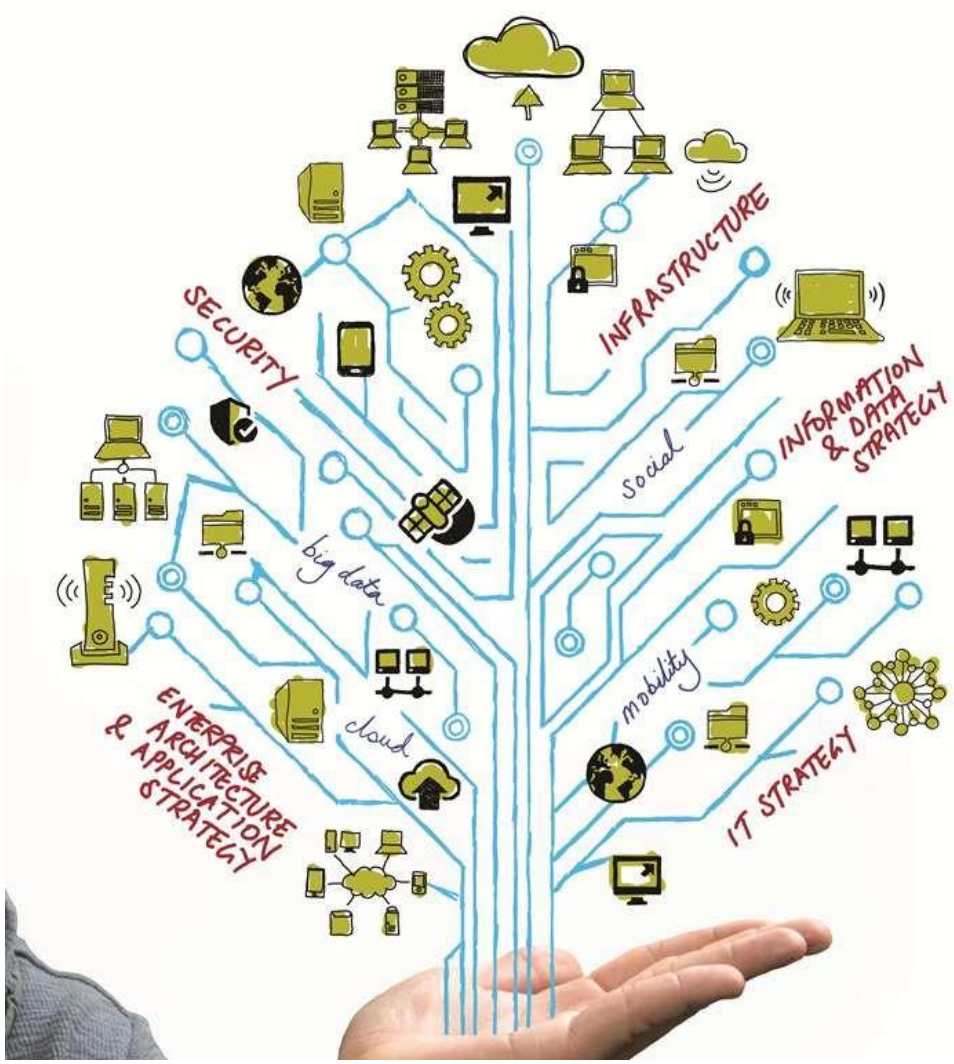
2. Framework
- ❑Theoretical (Literature Review)
- ❑Contextual
- ❑Empirical (Research Design, Proposed Model)

3. Results
- ❑Presentation & Analysis

4. Conclusion and Recommendations
- ❑Work Contributions- Recommendation
- ❑Limitations of Work
- ❑Future of Work

5. Publications

Cloud Computing

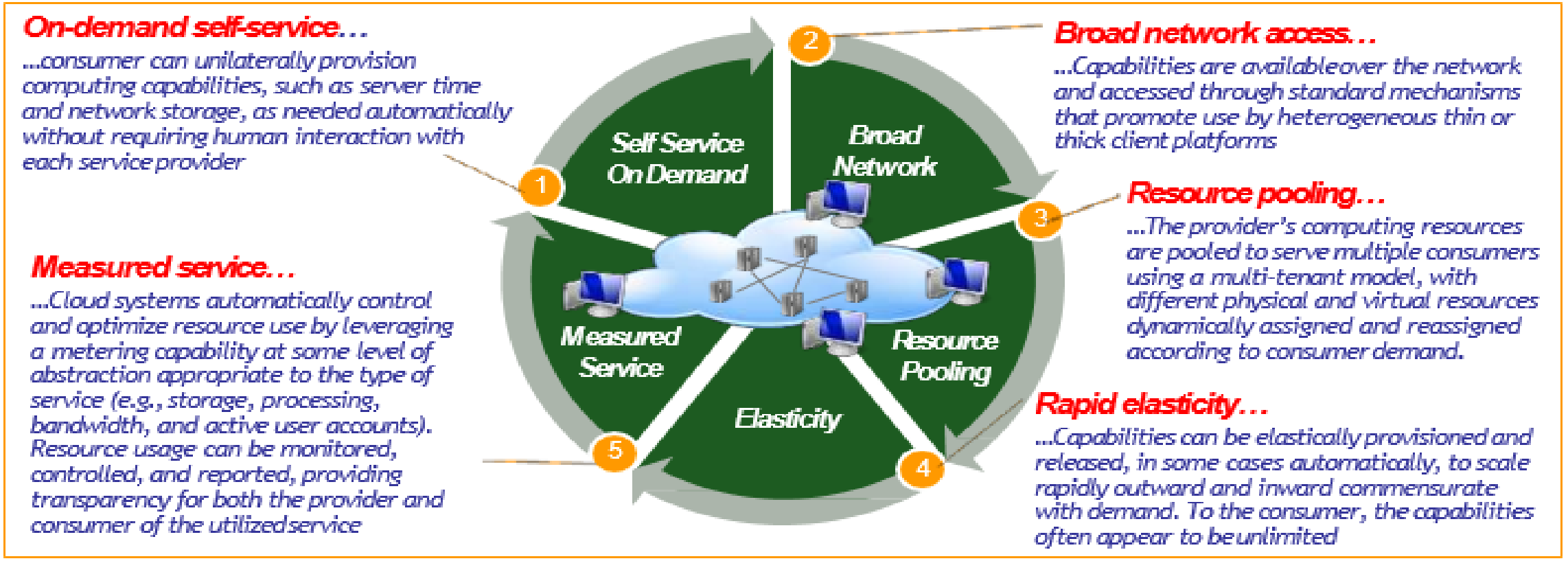


Justification of Research

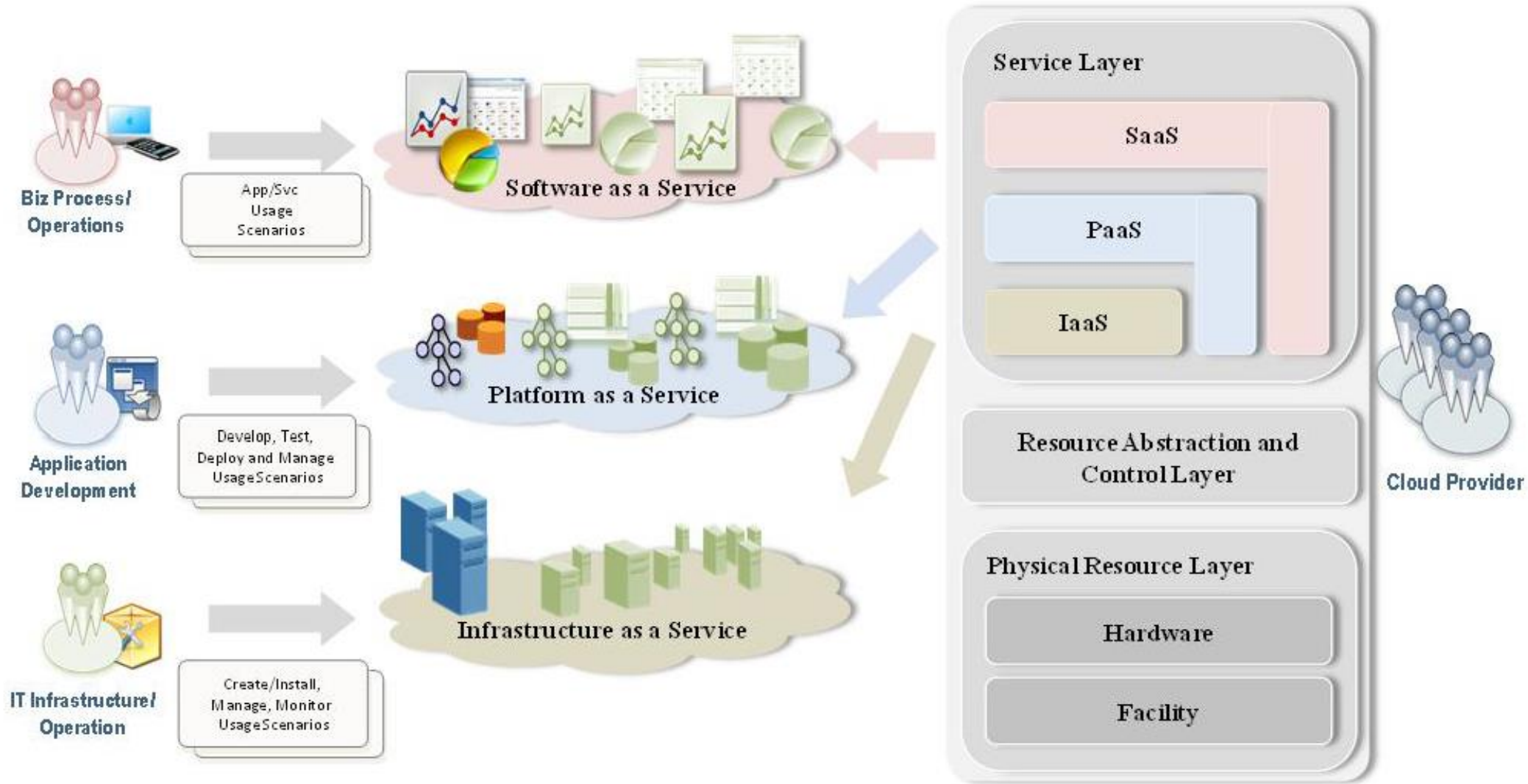
- Last 6 years worked as IT Strategy & Cloud Implementation Consultant in U.K
- Various sectors facing cloud adoption challenge
- Lack of Framework to adopt, compare, evaluate and benchmark the services offered by various cloud service providers
- **A MAJOR ADOPTION BARRIER!!!**

Introduction: Cloud Computing

- The term “Cloud Computing” is defined by the National Institute of Standards and Technology (NIST) as follows:-



Cloud Computing & Service Models



The Big picture: Cloud Models & Market Trends

Applications	Docs, Sheets, Slides; ZOHO Work · Online; EVERNOTE
Storage	Your stuff, anywhere; box
Computing	amazon web services; rackspace the open cloud company; Alibaba.com
Development platform	Windows Azure; salesforce force.com

Gartner U.K predicts by 2020 “Cloud Shift” will affect more than $1 Trillion in IT Spending

Cloud Shift Summary by Market Segment

Legacy Segment	Cloud Segment	Total Market Size in 2017	Total Cloud Shift in 2017	Cloud Shift rate through 2020
Business Process Outsourcing	BPaas	$119 Billion	$42 Billion	43%
Application Software	SaaS	$144 Billion	$36 Billion	37%
Application Infrastructure Software	PaaS	$177 Billion	$11 Billion	10%
System Infrastructure	IaaS	$294 Billion	$22 Billion	17%

Accenture Consultancy U.K Projections, 2018

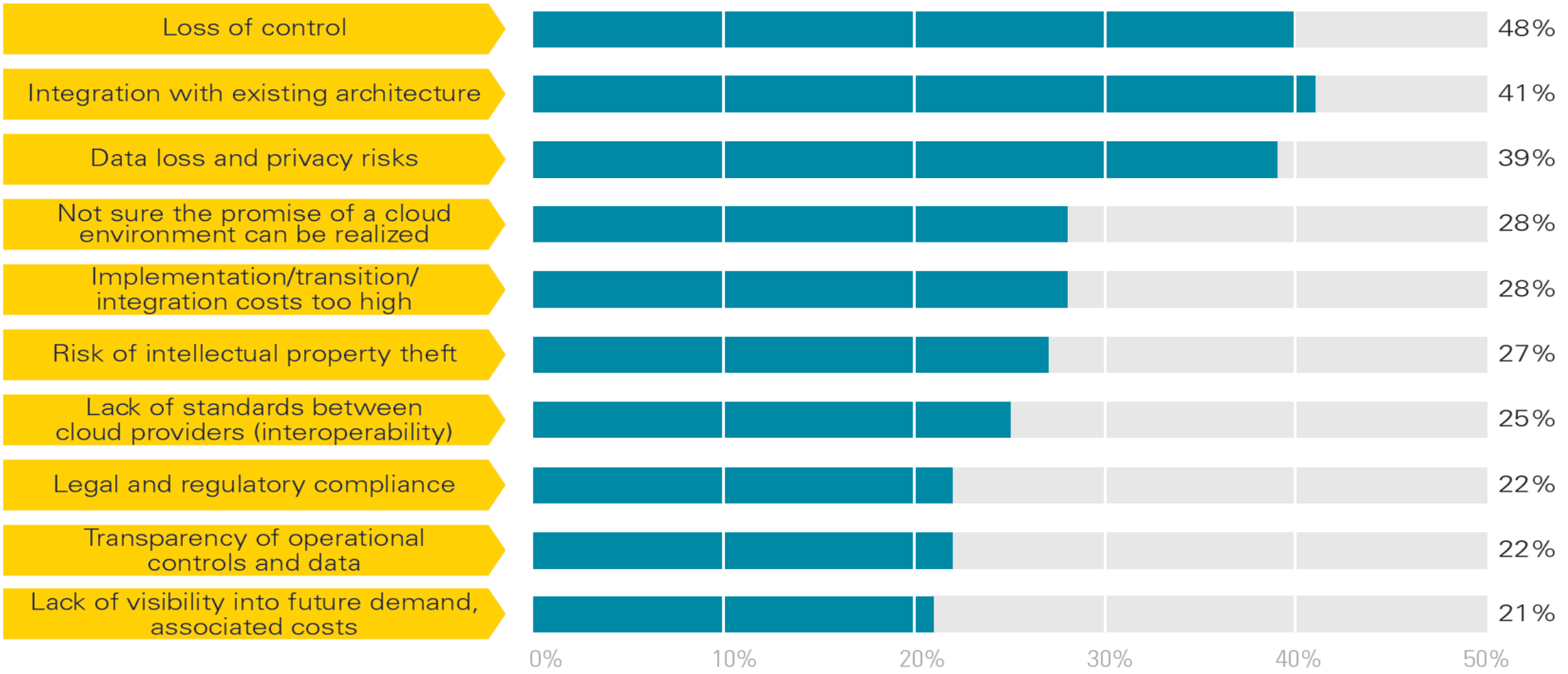
Cloud Computing: Challenges

- Poor or lack of standards between cloud providers to ensure QoS (Quality of Service)
- The security, privacy and integrity of the data in the cloud computing is a major concern and consider as a major barrier to adoption of the technology
- Lack of or no control over their data and where Internet is used as a communication media to access data which raises serious concerns regarding the data availability
- Lack of clarity in-terms of regulatory laws to protect data and intellectual property especially with implementation of GDPR

Cloud Computing: Challenges

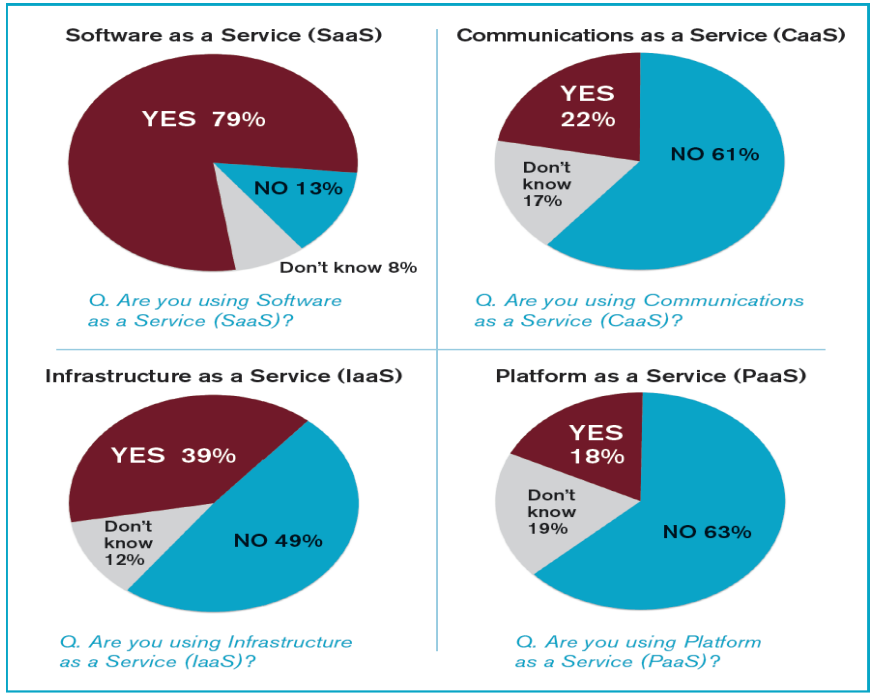
- Audit mechanism is not followed by the cloud industry leading to poor QoS (Quality of Service)
- Incident Response standards are variable across the providers
- Identity Management issues are leading to data and security breaches
- Notorious Nine The Cloud Computing Threats are major challenges
- Integration with existing infrastructure is an adoption challenge
- Lack of Governance & Compliance standards

Customers’ biggest concerns



KPMG International’s 2016 Global Cloud Provider Survey (n=179)

Adoption of Cloud Technology in HE



	SaaS	IaaS	CaaS	PaaS
Private	54%	46%	51%	58%
Public	38%	31%	34%	27%
Hybrid	15%	28%	23%	8%
Community	2%	3%	6%	4%
Don't know	8%	13%	11%	12%

Servers	66%
Data Storage	63%
Hardware	31%

Q. What applications do you use for IaaS? (Check all that apply.)

eCampus News: www.vion.com

Concerns in Adoption of Cloud Technology in HE

Security	68%
Data ownership	52%
Limited customization	45%
Privacy	41%
Governance	38%
Ease of switching vendors	37%
Offsite (offshore) data storage	37%
Contract issues	36%
Compliance	34%
Vendor service	27%
Connectivity	23%
Portability	16%
Upkeep	11%
Don't know	5%

Q. What are the challenges or problems with using cloud services?

Research Question

Q) **Is it possible to implement a Minimum Service Level framework for educational institution's users (students, staff and employees); offering a uniform standards of service clearly defining a benchmark for all the cloud providers across the industry regardless of their hosting locations?**

Aim of Research

To implement a **Minimum Service Level Framework**; for educational institution's users (students, staff and employees); offering a uniform standards of service clearly defining a benchmark for all the cloud providers across the industry regardless of their locations.

Specific Objectives

- To identify different flaws and weaknesses in the current Service Level agreement offered by the cloud providers.
- To investigate the requirements of the educational institution’s users and challenges they face in the adoption and usage of cloud computing as a service.
- To propose a Conceptual framework; which will act as a Minimum Service Level framework for the educational institution.
- To provide guidelines and recommendation for each criteria in the framework to ensure better of Quality of Service

Research Design - Methodology

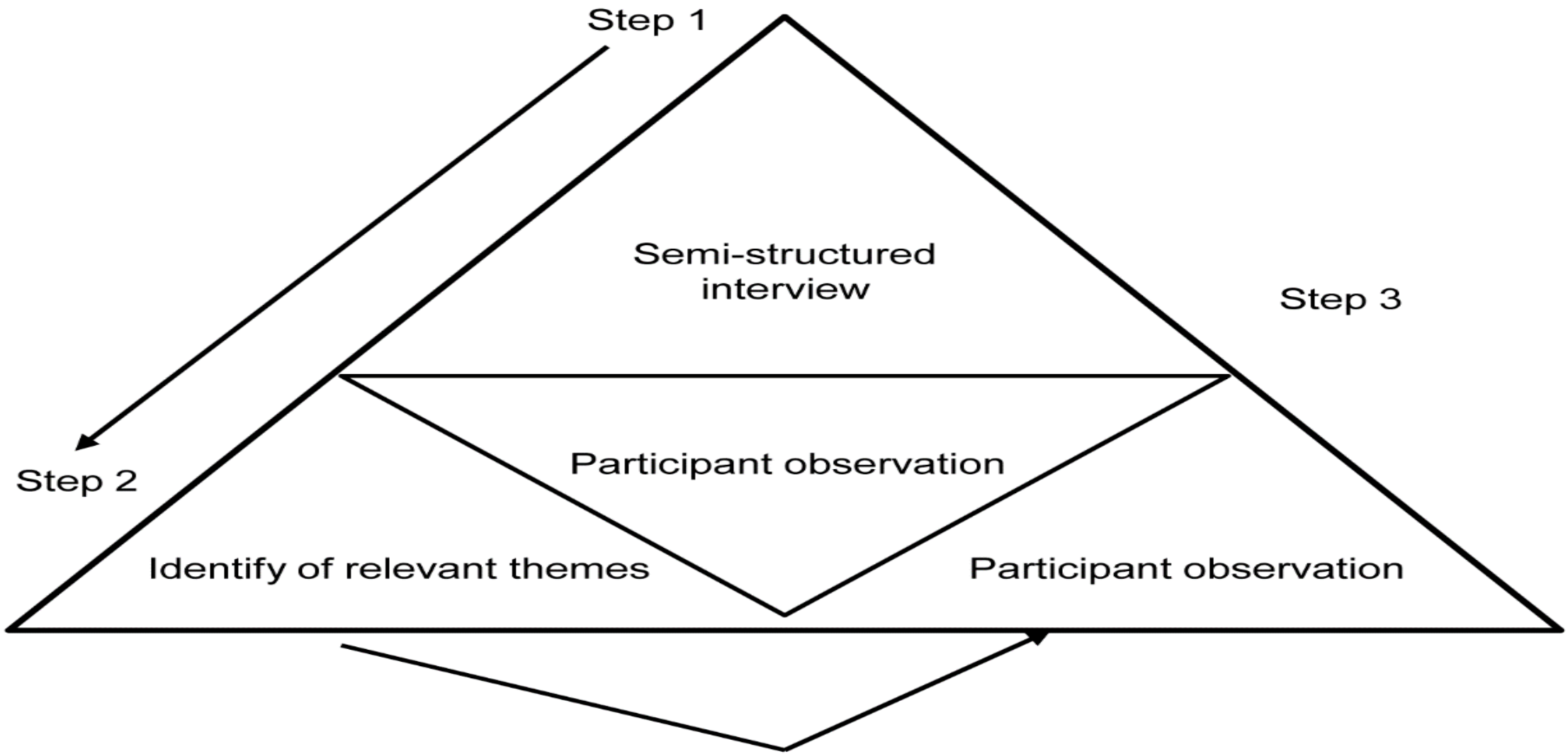
- For this research the methodology that will be deployed in order to collect qualitative data is Grounded Theory-Case Study

- Grounded theory provides mechanism to collect data from a particular area from those individuals who have relevant experience in that field

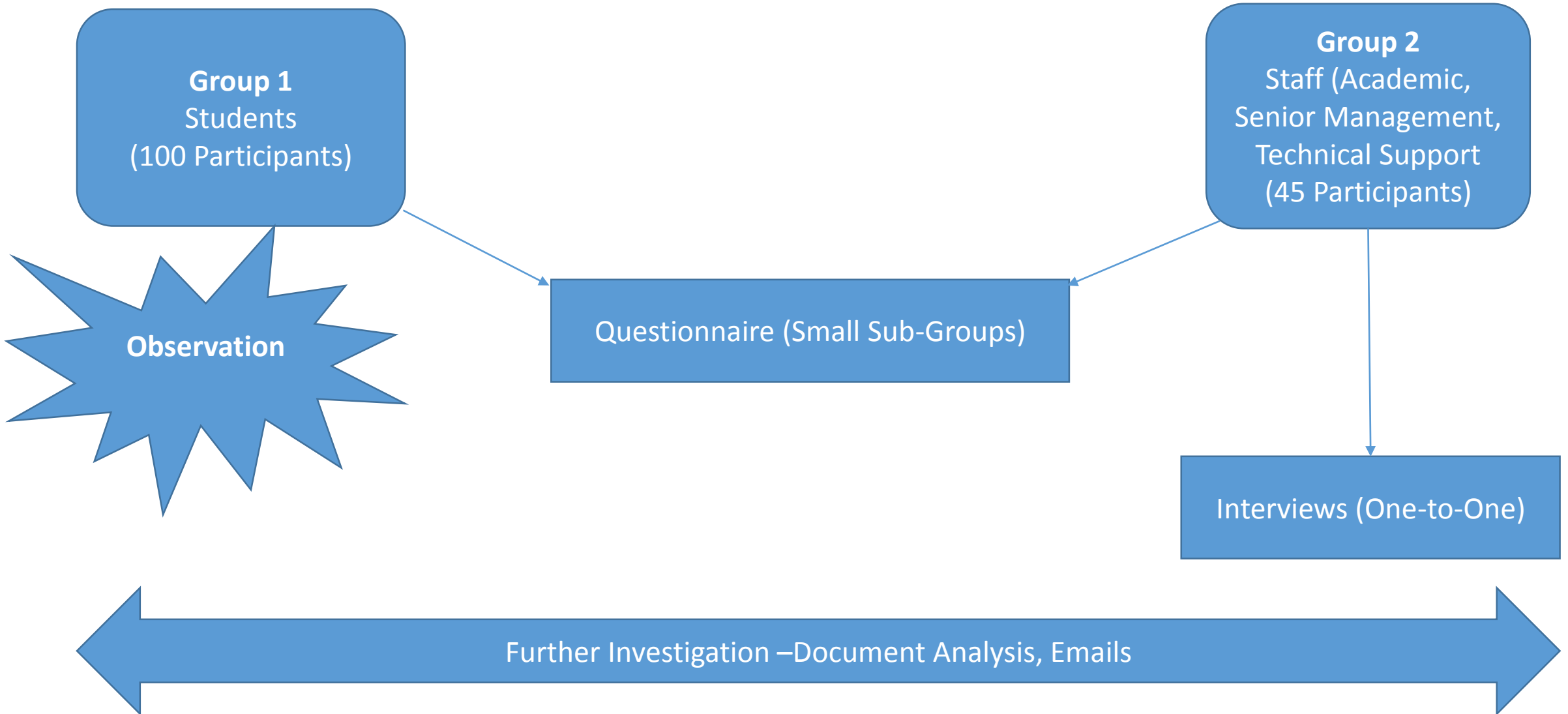
- Semi-structure interviews, questionnaire, document analysis and observation will be used to collect data

- To collect data from the participants, provide a mechanism to identify the data by using open coding and provide relationships between different key areas and entities.

Research Design- Methodology



Research Design-Methodology



Results - Analysis

- Sample of 145 respondents (Group 1. 100 students divided in groups of 10)
- Group 2: 45 respondents (Academic Staff, Management and Technical Staff)
- Two Questionnaire was designed for Group1 & Group2 (Questionnaire 1- 8 Questions, Questionnaire 2- 9 Questions = 17 Questions)
- Questionnaire was easy to understand with 95% response
- Initial the questionnaire was designed to collect basic understanding of respondents about cloud computing knowledge, cloud service they have used, functional areas where HE is using cloud services.

Results- Analysis

- One-to-one Interviews were conducted with Group2 (Academic Staff, Management, Technical Support staff). 9 Questions in the interview scripts
- During the interview more detailed answers and explanation was gathered from respondents.
- Data collected from Questionnaire and interviews were examined to understand the picture

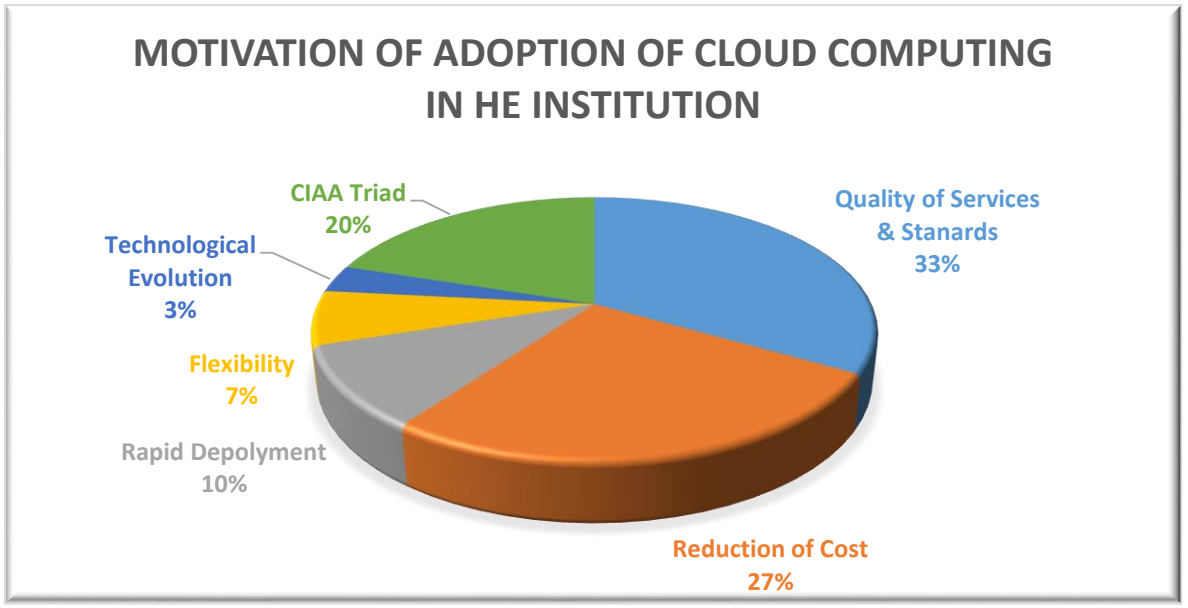
Result-Analysis Group 1

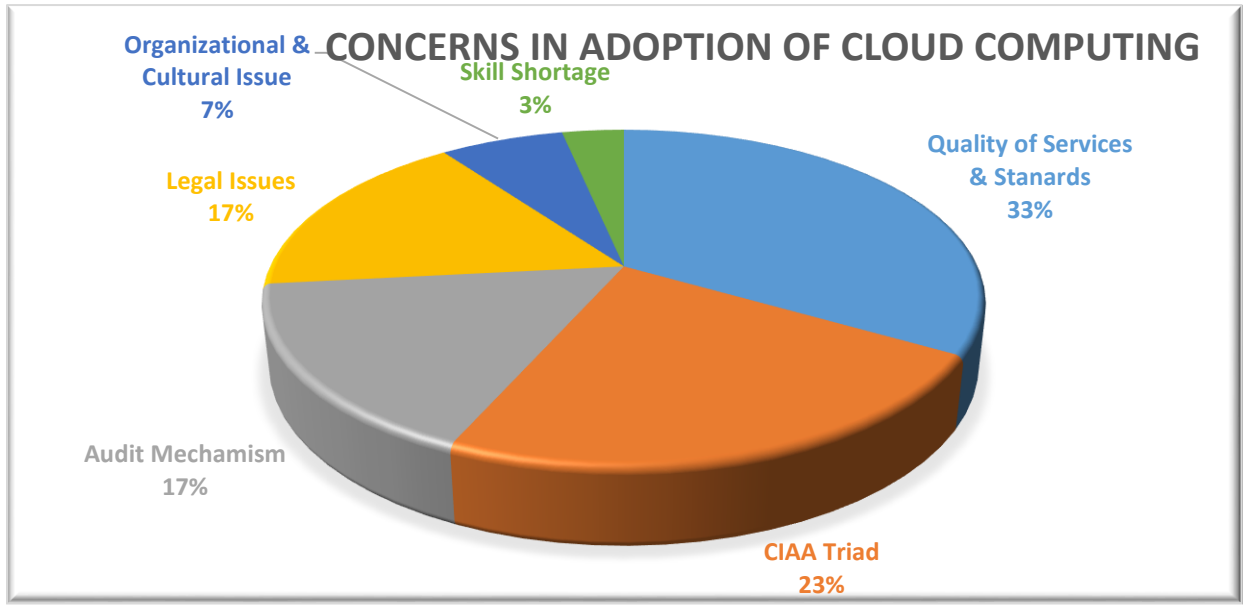
100% respondents are familiar with cloud computing technology

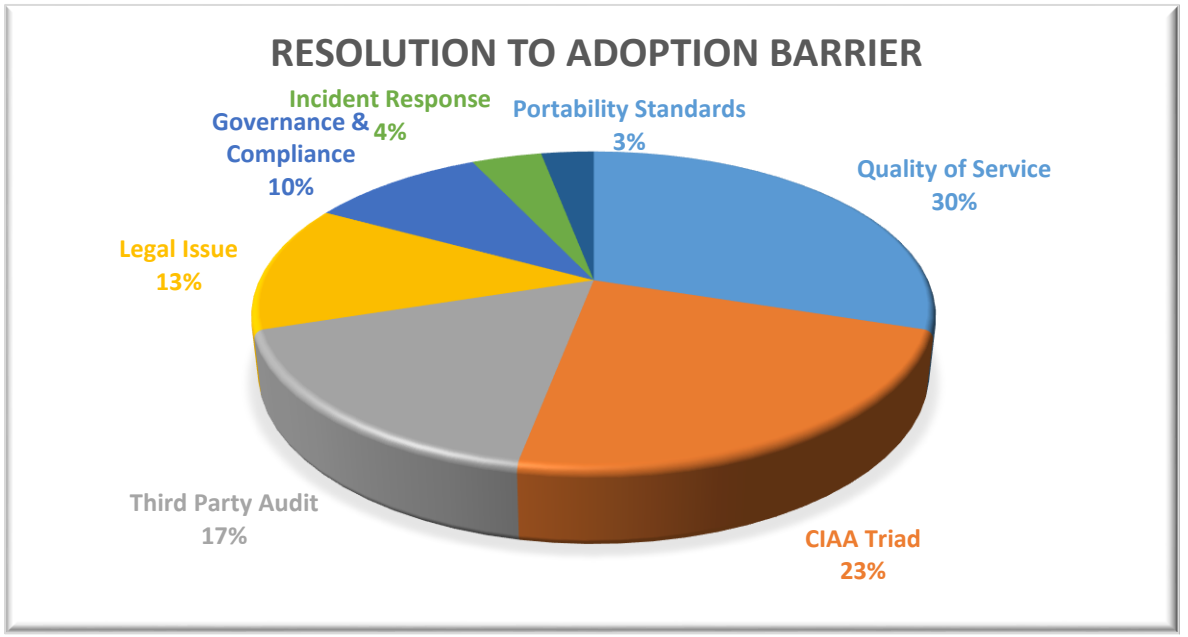
90% of respondents know that HE is making use of third party cloud computing services.

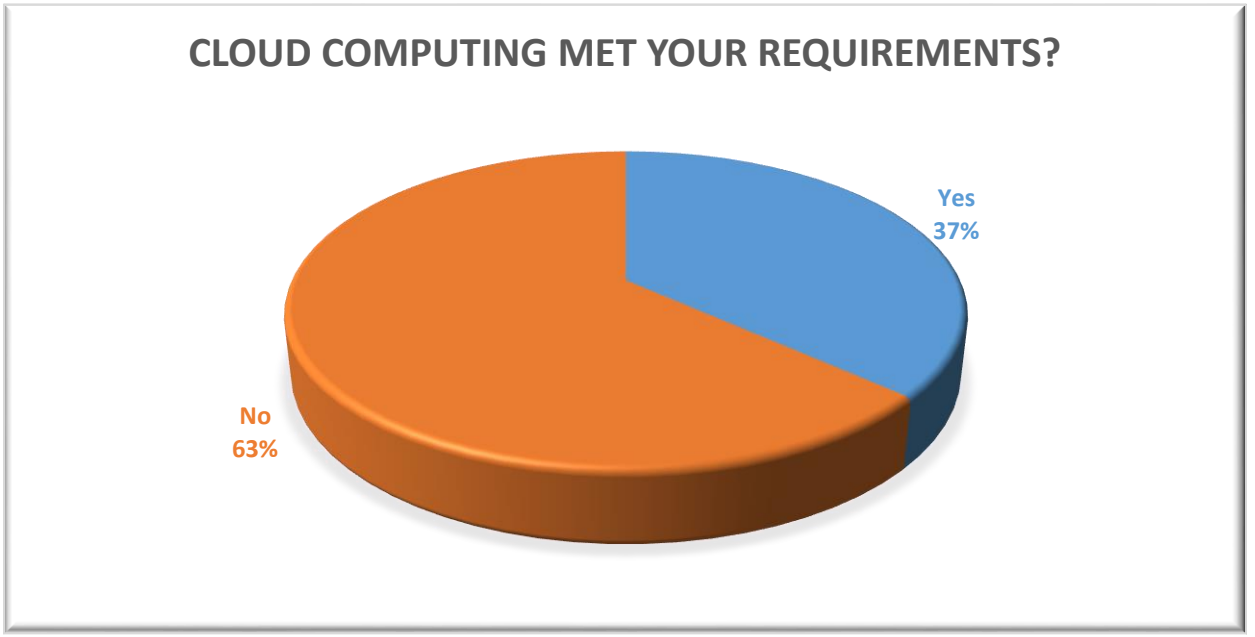
Respondents were able to identify the functional areas that are using cloud computing technology such as Email, Web Hosting, Research, Library Portal service.

Result Analysis- Group 1









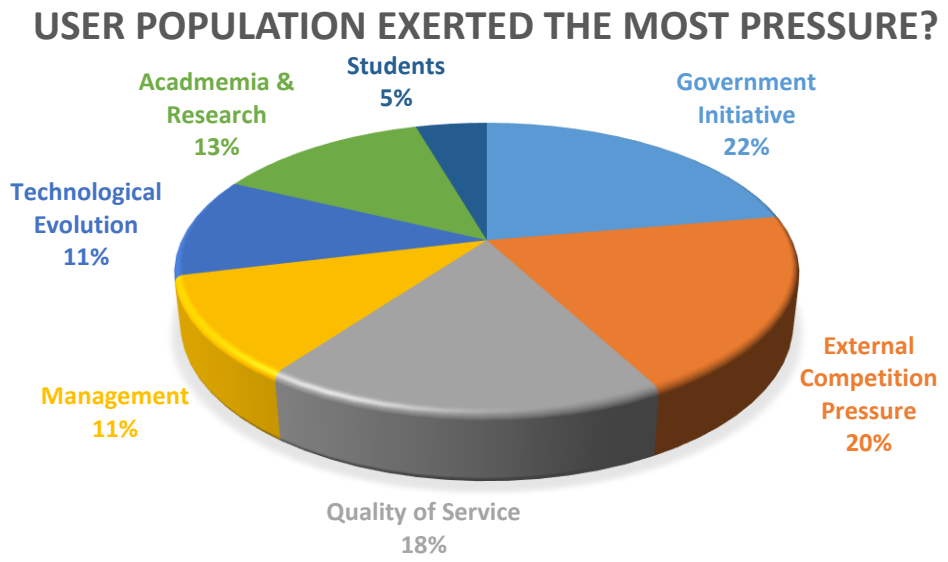
Result-Analysis Group 2

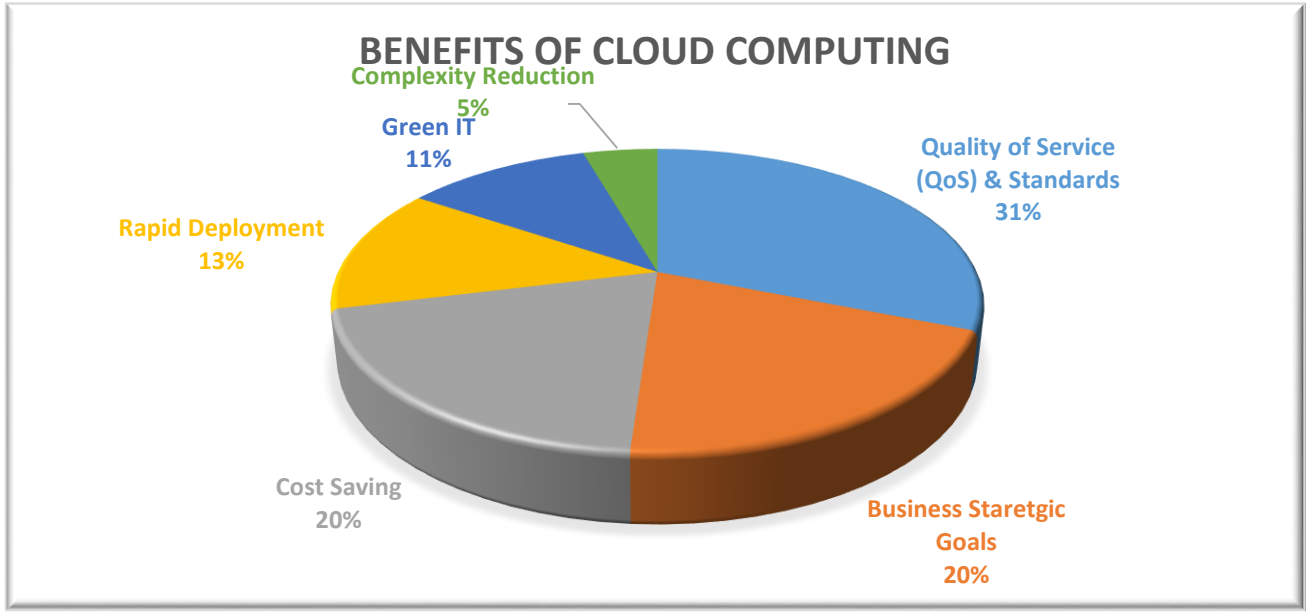
100% respondents are familiar with cloud computing technology

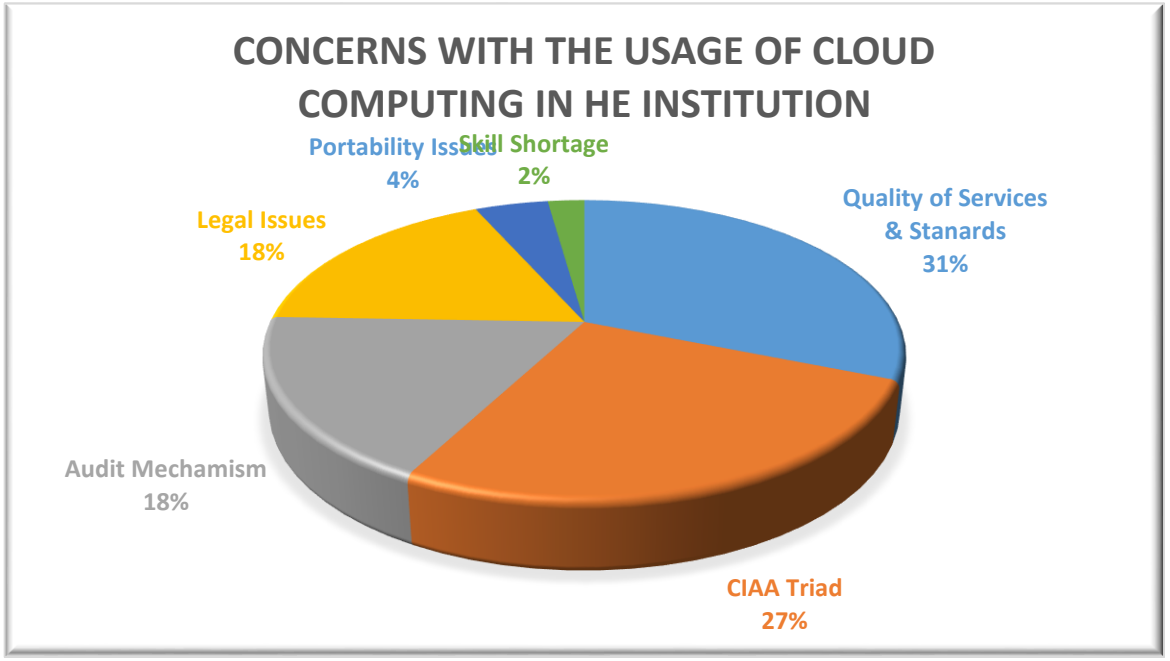
90% of respondents know that HE is making use of third party cloud computing services.

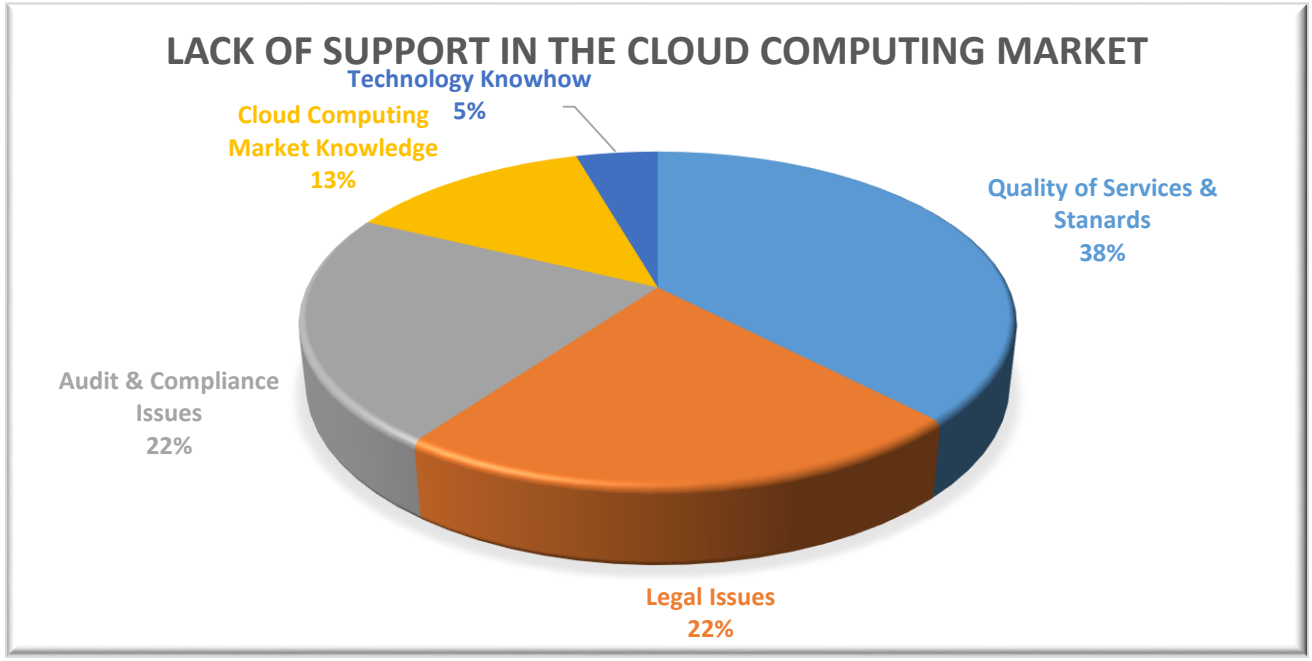
Respondents were able to identify the functional areas that are using cloud computing technology such as Email, Web Hosting, Research, Library Portal service.

Result Analysis- Group 2

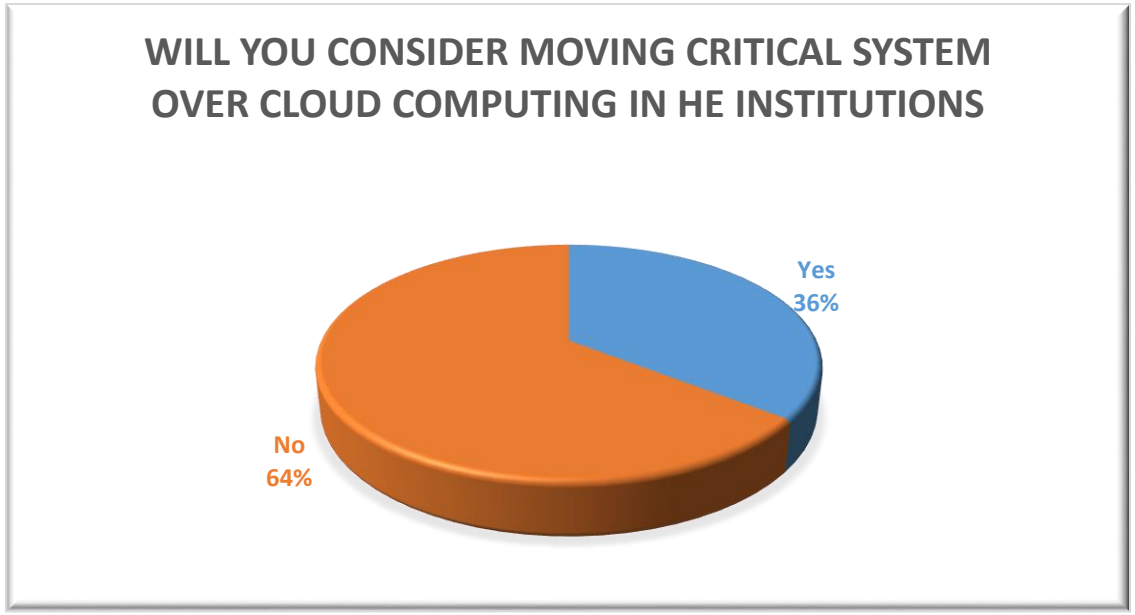


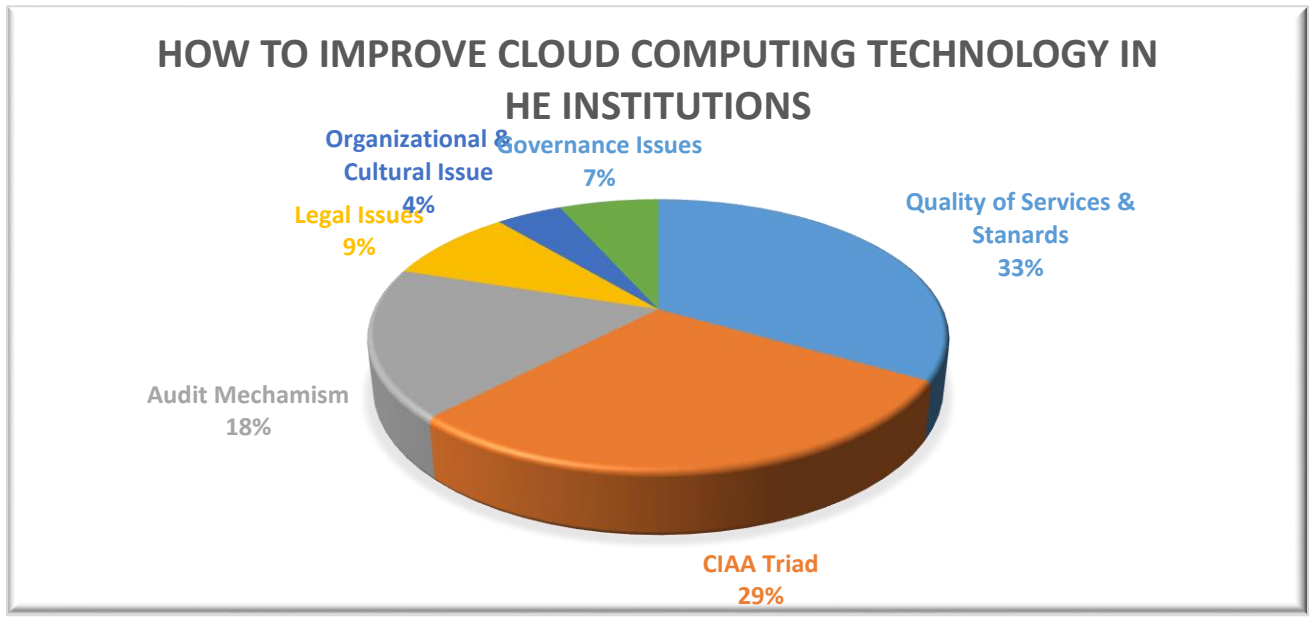


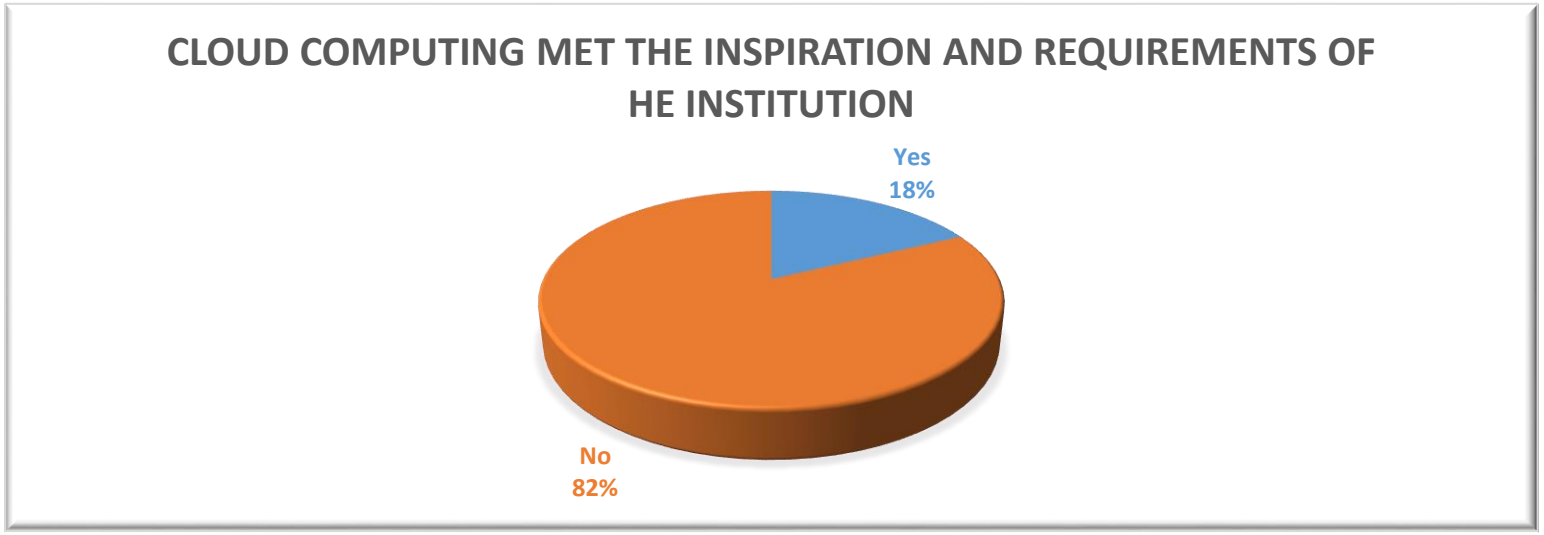




Result Analysis- Group 2







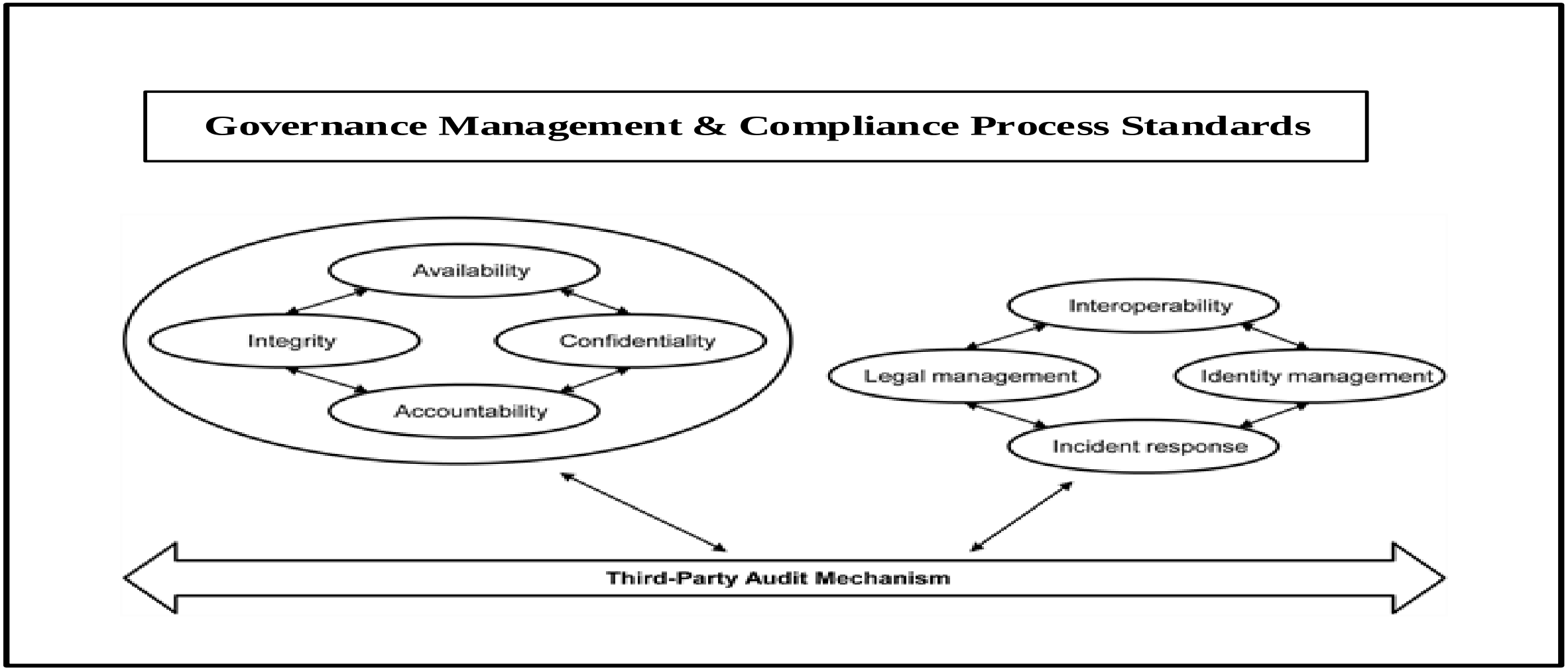
Results Analysis- (Interview-Main Themes)

- Framework to adopt, compare, evaluate cloud providers
- CIAA Problems
- Lack of Audit Mechanism
- Legal Barriers- GDPR
- Portability and Interoperability Issues
- Governance and Compliance Issues
- Incident Response Mechanism
- Authorization and Authentication Issues
- Identity Management

Proposed Solution- MSL Framework

- Framework of Quality of Service Standards
- Comprehensive improvement on CIAA
- Need a third party audit mechanism
- Legal compliance to safeguard data
- Governance and Compliance standards
- Address portability and interoperability issues
- Improvement in incident response mechanism
- Identity Management system

MSL Framework- Proposed Solution



Conclusion
Cloud Computing Implementation Evaluation Criteria

- The purpose of the “Cloud Computing Implementation Evaluation Criteria” is to provide a set of standards for cloud service providers and cloud users as to what security features is a requirements in the implementation of cloud computing in the organization.
- **1: Minimal Standards**: As the name suggest provides minimal protection and meets minimum requirements standards in terms of CIAA standards and other key requirements.
- **2: Medium Standards:** The second phase contains mediocre protection and meets some requirements in terms of CIAA standards and other key requirements..
- **3: Enhanced Standards:** The last phase contains enhanced protection and meets all the requirements in terms of CIAA standards and other key requirements.

Note: All Requirements from respondents are integrated into the Evaluation Criteria

Cloud Computing Implementation Evaluation Criteria

Appendix V- Cloud Computing Implementation Evaluation Criteria

	Minimum Service Level Framework		
	Minimum Standard	Medium Standard	Enhanced Standards
Data Security & Encryption Standard			
Authentication Standards			
Authorization Service Standards			
Incident Management & Reporting			
Interoperability & Portability Standards			
Identity Management Standards			
Data Availability Standards			
Data Governance & Compliance Management			
Data Protection & Legal Support			
Infrastructure Protection Standards			

Cloud Computing Implementation Evaluation Criteria: Minimum Standards

	Minimum Service LevelFramework									
	Minimum Standards									
	Data Security & Encryption Standard	Authentication Standards	Authorization Standards	Incident Mng & Reporting	Interoperability & Portability Standards	Identity Management Standards	Data Availab ility	Data Compliance	Data Protect ion	Infrastructure Protection
FIPS										
Format Encryption										
Stored Secure Hash										
Data Encryption Standard										
Revoke User Access										
Network Authentication										
Password Management										
WS-Security										
Role Management										
% ofTimely Incident Reportsto Customer										
Hardware Virtualized										
RAID 1										
RAID 2										
Policy Management										
Vendor Management										
Problem Report										
Data Obscuring										
Data Seeding										

Cloud Computing Implementation Evaluation Criteria: Medium Standards

	Minimum Service LevelFramework									
	Medium Standards									
	Data Security & Encryption Standard	Authentication Standards	Authorization Standards	Incident Mng & Reporting	Interoperability & Portability Standards	Identity Management Standards	Data Availability	Data Compliance	Data Protection	Infrastructure Protection
FIPS										
Format Encryption										
Stored Secure Hash										
Data Encryption Standard										
AES 128										
Key Access Policy										
Revoke User Access										
Network Authentication										
Password Management										
WS-Security										
Digital Certificate										
Smart Cards										
Role Management										
Entitlement Review										
Principal Data Management										
% of Timely Incident Reports to Customer										
Classification of Incident										
Hardware Virtualized										

Cloud Computing Implementation Evaluation Criteria: Enhanced Standards

	Minimum Service Level Framework Enhanced Standards									
	Data Security & Encryption Standard	Authentication Standards	Authorization Standards	Incident Mng & Reporting	Interoperability & Portability Standards	Identity Management Standards	Data Availa b ility	Data Compliance	Data Protect ion	Infrastruct ure Protection
FIPS										
Encrypt II										
Key Access Policy										
Cryptographic Hardware										
Content Aware Encryption										
Format Encryption										
Stored Secure Hash										
Object Security										
Hide Privilege Access										
Data Encryptio n Standard										
AES 128										
AES 192										
AES 256										
Encrypt Log Files & meta data										
Revoke User Access										
ISO/IEC 29115										
Entity Authenticatio n Assurance Framework										
Digital Certificate										

Limitation of Work

- The service level agreement contains highly confidential details that were not disclosed to the researcher.
- Lack of access to the cloud service provider was limitation to the work.
- Cloud users even senior management were not aware in full the details of service level agreement details
- Participants have lack of technical and legal knowledge to interpret the service level agreement

Future Work

- The MSL (Minimum Service Level) Framework is used in the HE case study can be extended to other areas.
- The same framework can be tested in other areas apart from the education sector such as banking, health services, government sectors and critical sensitive sectors such as military and nuclear installation as well.
- The framework offers the ability to be extended further from a Minimum Service Level framework to medium or maximum secure service level framework depending on the needs of the business application and client end-user requirements.

Publications

1. Khan, S. Gouveia, L. (2018). Evaluation of Minimum Service Level (MSL) Framework in HE institution in UK: An Exploratory Study. International Journal of Cyber Security & Digital Forensics, Vol 11, No 4, 2018.
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