

Exploring Innovation Research Methodologies in a Variety of
Multidisciplinary Fields and Their Prospective Future Impact
February 2024

A Critical Review for Job Opportunities and Challenges in Cloud Computing

Neetu Amlani
S.S. Maniar College
Nagpur

Dr. Swapnil Deshpande
S.S. Maniar College
Nagpur

Abstract

Cloud Computing is an enormously growing field which provides computing services over the internet like servers, storage, networking, analytics etc. With the trend of shifting from traditional methods to adoption of the latest technology, numerous career opportunities have arisen. There are several areas like Engineering, Security, Architecture, Management etc. which contribute to job prospects there by increasing the employability scale. Present paper is a review exploring the career development prospects provided by Cloud Computing across different domains.

Keywords: Cloud Computing, Services, Career Opportunities, Job roles.

Introduction

Cloud Computing offers flexible resources which include software, platform or infrastructure in the form of services on the basis of payment as per the usage. With increasing demand for this field, cloud computing has revolutionized the ICT industry too [1]. In the field of

Business, cloud computing helps in improving the efficacy of the business and also encouraging new transformations in the business. Because of its benefits like scalability, unlimited storage, anytime accessibility cloud computing is being rapidly adopted by business owners [2]. Real World Applications of cloud computing are E-commerce, Big Data Analytics, software development and IOTs. Cryptography technology also implements Cloud Computing. Prerequisites for logging in to a cloud computing services are obtainability, unification and confidentiality. Job prospects are titled as Cryptography Security and Research Consultant, Client software Engineer etc. [16].

One of the main aims of Cloud Computing is to utilise the distributed resources in a much better way and also to resolve extensive computational issues. Resources are shared among the swarm that can access the applications as well as data from everywhere [8]. Cloud computing is a system with spectacular properties. In order to gain maximum potential from this

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

field, these properties must be known to the masses. Lack of awareness about the benefits and skills required for usage of cloud computing created hurdles for widespread of this technology.[9] Not only existing entrepreneurs but also new upcoming entrepreneurs with small and medium startups also use cloud computing because of its advantages. Thus employing people as data analyzers, cloud security Engineers, Infrastructure Engineers etc. Cloud computing features efforts and cloud management which provides quick services [13]. Cloud computing offers an accessible platform for cyber threats and ML applications, thereby promoting the organizations to create and deploy the technologies easily and at low costs.[15] Organizations can train potential employees for the same and can set internships for spreading the awareness about job prospects in this field.

Literature Review:

Cloud computing is a new innovation in hosting and providing services on the Internet. Cloud computing is attractive to business owners because it eliminates the need for customers to plan and allows organizations to start small and scale only when demand for the service increases.

Cloud computing has more opportunities in IT industry and there are still many challenges to be solved.

This survey covers the cloud computing environment. In this survey paper we only considered literature from last six-year. Figure 1 shows the workflow for selection of papers. First shortlisted the papers which comes under the considered categories then after select papers that are most relevant to theme of this review.

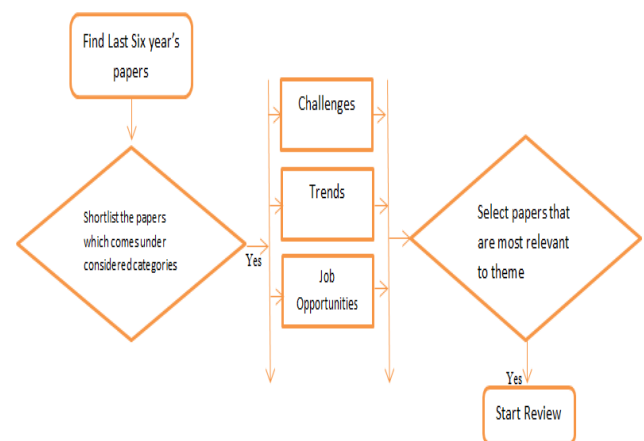


Fig 1: Paper selection workflow

Stephen et.al.[1] describes about cloud computing as well as its opportunities and challenges in various fields such as healthcare, education and business.

Amanpreet Kaur et.al.[2] focuses on various aspects of cloud computing and the overall management of the cloud in an efficient, reliable and sustainable way. They

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

recognize different opportunities, identify research challenges and present future research in cloud computing. They also investigate energy related issues, in cloud computing environments. Various algorithms used in energy saving technologies in cloud data centres are analysed.

Amir Taherkordi et.al.[] present about cloud computing its related subfields and introduce the problems and future research directions in each field. Provide broader understanding of cloud computing design issues, energy consumption. Also discusses about challenges and directions for future research.

Hazzaa N. Alshareef[] provides an overview of cloud computing, its advantages, current developments, challenges and future trends. Also discusses cloud computing architecture, service model, service selection, resource usage and cloud based resource planning. Also discusses the problems or challenges in cloud computing such as data security, security breaches, and load balancing. Many methods have been put forward, discussed and analysed to solve these problems.

Rafia Islam et.al.[] provide a better understating basic concepts of cloud

computing and present relevant research in this growing field, architectural standard, applications and research problems. Also share benefits and future challenges of cloud computing.

Siraj Munir et.al.[] examines five key aspects of cloud computing, including load balancing, resource scheduling, resource allocation, resource sharing and scheduling. A brief comparison of current challenges and methods for load balancing and future needs are also discussed. This paper also provides detailed information about planning issues, detailed analysis and comparison of resource planning methods and resource allocation strategies.

Methodology

This review aims to explore the new career opportunities offered by the field of cloud computing. For this Review, several research papers on cloud computing have been studied and analysed

1. Concept of Cloud Computing:

With the spread of digitalization, cloud computing has come up as a keystone of modern IT infrastructure. Cloud computing provides flexible and cost-effective solutions for storing, handling, processing and accessing data. There are

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

five types of clouds are Public, Private, Hybrid, community and Multi cloud.

2. Architecture of Cloud

Computing: The architecture of cloud computing is categorised into the following two parts-

i. FrontEnd

ii. BackEnd

i. **FrontEnd** : It refers to the client-side or client-end of Cloud Computing system which includes all applications and user interfaces required to use the cloud computing resources or services.

ii. **Backend**: It means the cloud itself which contains the resources or services along with large storage , network traffic control mechanism , virtual machines and last but not the least deployment models.

➤ Services offered by the cloud can be categorised as follows-

a. IaaS (Infrastructure as a Service):

Also referred as Hardware as a service. It delivers massive computing resources like storage capacity, processing and network. Reliability, security and payment as per the usage are the crucial benefits of this service. E.g. AmazonEC2.

b. **PaaS (Platform as a Service)**: This service provides API i.e. Application Program Interface for the cloud. This service provides an environment which is as demanded by the user for developing, testing, delivering and managing the software applications. Eg. Google App Engine.

c. **SaaS (Software as a Service)**: It offers the service which is directly used by the end-user. SaaS is software deployed over the Net. This service aims to replace applications running on a Personal Computer. Major advantage of this service is pay as you go. E.g. Salesforce.com

➤ **Runtime Cloud** - This cloud takes care of the execution and the Runtime environment for the Virtual machine.

➤ **Storage** - The backend also offers flexible and extensible storage along with management of the data stored.

➤ **Security**- Backend security implies application of several security mechanisms for achieving the security of cloud resources as well as system, data and infrastructure.

➤ **Database**- Backend offers a database for storing the structured data. For example Google Cloud SQL, Amazon RDS etc.

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

➤ **Network-** This provides the networking infrastructure which is required for implementation of the cloud.

For E.g. DNS, VPN etc.

➤ **Analytics-** This offers analytical tools for the data stored on the cloud. This may include warehousing, machine learning etc.

3. Advantages of Cloud Computing

Few advantages of cloud computing are:

- Data security- Cloud protects the data stored on the cloud from data theft, unauthorized access.
- Rapid Application deployment – Cloud computing helps development of new applications with quick deployment.
- Cost saving- As the need for expensive hardware, software and maintenance is reduced, cloud computing saves the cost.
- Ease of Access from anywhere – Cloud computing provides data access from anywhere and anytime.
- Disaster Recovery- Cloud provides backup and recovery and therefore ensures complete data recovery in no time.
- Higher Performance – Data centres are updated with latest

high-performance technologies which enable better connectivity and high performance.

4. Work associated with Cloud Computing

As per a report submitted by NASSCOM (National Association of Software and Service Companies), by 2025, the demands for cloud computing skills are anticipated to bloom in Indian IT industry. The field of cloud computing will create more than 2.5 million jobs in India.

In this digitized era, every entrepreneur is trying to shift to cloud from the traditional methods. This field of cloud computing offers services to enormous fields which include business, education, management, technology etc. Proliferation of services offered by the cloud has boosted the human-computer interaction.

Present scenario is shown in the following figure.

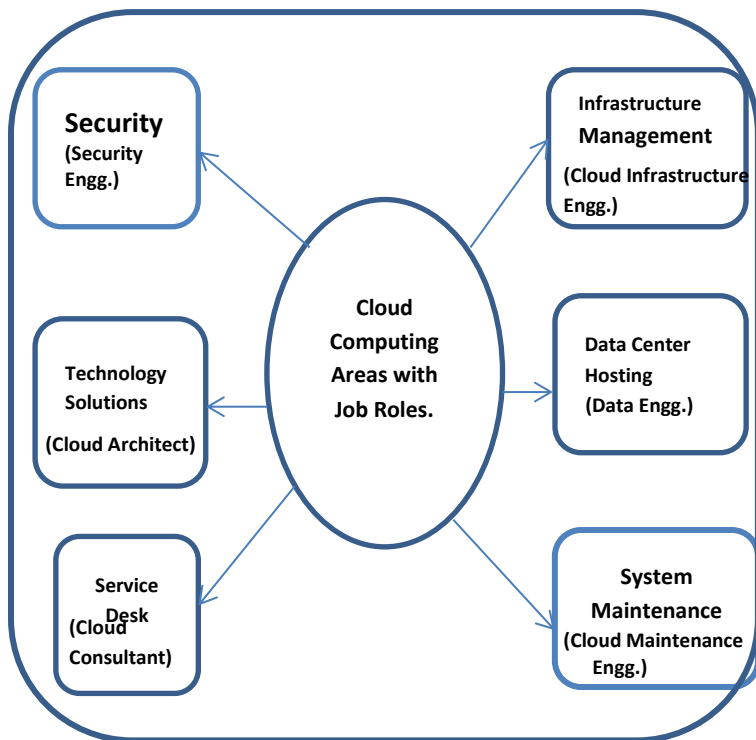


Fig. 2: Cloud Computing Areas with Job Roles

Cloud Computing unwraps abundant prospects across many domains.

Following are the domains with job roles offered by cloud computing:

1. **Security:** Cloud Security reflects the policies of cyber security, the best practices and controls which are followed to secure the applications, infrastructure and data in cloud environment. Cloud security aims to provide network as well as storage protection against access management, internal and external threats etc. In the area of Security, enduring the cloud security is the crucial task. Also

maintaining the compliance standards is covered under this head. The Job titled “Cloud Security Engineer” is responsible for this said task.

2. **Technology Solutions:** For providing the solutions at technological end, the job role “Cloud Architect” is designated. Cloud Architect is responsible for designing and implementing the cloud solutions and services.

3. **Service Desk:** Service desk a communication centre which provides a single point of contact between companies or an organization and its customers or end-users. This generates a job titled “Cloud Consultant” who advises the clients on different cloud strategies and best practices.

4. **Infrastructure Management:** Cloud infrastructure management works like a command Center for cloud environments. For the management of infrastructure of the cloud, CIE is the job designation. “**Cloud Infrastructure Engineer**” builds and maintains the cloud infrastructure and network.

5. **Data Centre Hosting:** Data Centre is a repository that hosts computing facilities. Data centre hosting is the method of deploying and hosting a data centre on

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

external service provider's organization. **"Data Engineer"** is the job profile which is responsible for hosting a data centre.

6. System Maintenance: The process of maintaining, control and oversight of cloud computing structure, resources and services in Private, Public and Hybrid cloud environments is called Cloud Management. **Cloud Maintenance Engineer** along with the Maintenance Staff develops and implements new strategies for enhancing the system performance and maintenance.

Other opportunities are:

7. DevOps Cloud Engineer: A cloud DevOps engineer is proficient in developing and operating cloud based applications and services.

8. Full Stack Developer: A full stack developer develops both front-end and back-end applications by using the cloud framework.

The management and utilization of computing resources by the organizations has been transformed by cloud computing, which has increased the need for qualified experts to handle its complexity. To improve user experience and manage upcoming issues, there is an increasing

need for personnel with cloud computing competence in addition to technical

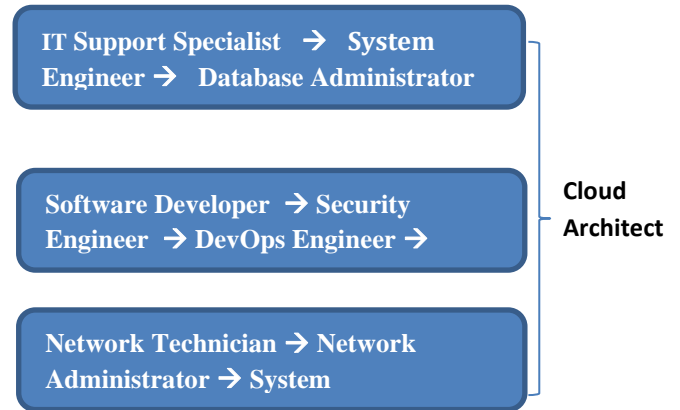


Fig. 3. Job Roles to become Cloud Architect

Fig. 3. Shows how IT support specialist , software developers , Network Technicians can reach the position of Cloud Architect by escalating stepwise.

Additional skills required for professionals in field of Cloud are:

1. Expertise the cloud service platform.
2. Knowledge of Programming Languages.
3. Good Command over APIs.
4. Database Management
5. Network Management
6. Fundamentals of Machine Learning
7. Basics of Artificial Intelligence
8. Cloud Security

Fig.4. Shows the in-demand skills for jobs in the field of cloud computing.

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

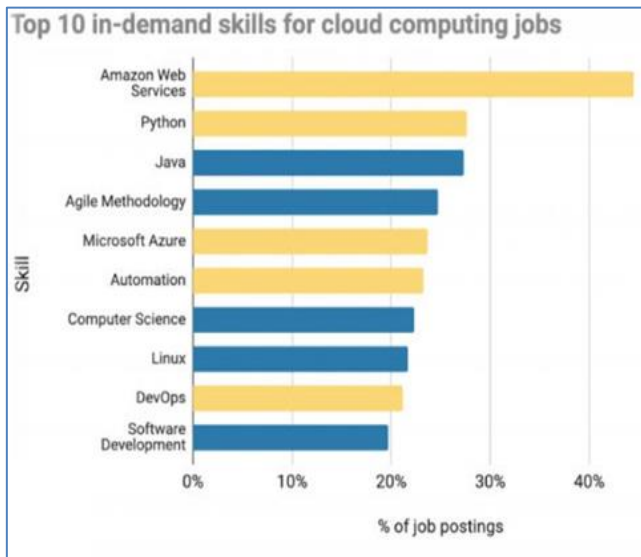


Fig.4: In-Demand Skills for Cloud Computing jobs. (Knowledge Hut)

This shows percentage of job postings Vs Skills. As the skills escalate the job postings show remarkable hike.

Conclusion

In this digitalized era, cloud computing has embraced almost all fields because of its services and ease of use and all time availability. Thus cloud computing unwraps the potential employability. In near future the field of cloud computing is expected to gain deep grounds and thereby offer more job prospects for skilled professionals. To spread the awareness among the budding IT experts, knowledge of cloud computing must be introduced at early stage in the education system at Secondary School Level. Then interested

candidates can adopt proper skill channels to enter this field to contribute as potential employees.

Challenges in Job opportunities in Cloud Computing

Working with the cloud can be time consuming due to its complexity and great demand for research. It calls for great deal of subject-matter, knowledge and proficiency. Despite of large number of experts in this sector, many positions are still vacant as there aren't many skilled cloud engineers, developers and other specialists. Up-skilling is required for the experts to actively comprehend and administer and develop cloud based applications with fewest possible problems and highest possible reliability.

Acknowledgment

This review and the research behind it would not have been possible without the exceptional support of Dr. Maneesh Deshpande. His generosity and expertise comments improved this study in innumerable ways and saved us from many blunders; those that inevitably remain are entirely our responsibilities. We are also grateful to our Head of the Department, M.Sc. IT , Dr. Diwakar Tripathi, for his

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

kind support, guidance and co-operation throughout the work.

References

1. Amanpreet Kaur, V.P. Singh, Sukhpal Singh Gill, "The Future of Cloud Computing: Opportunities, Challenges and Research Trends", 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud), DOI: 10.1109/I-SMAC.2018.8653731, 2018.
2. Amir Taherkordi, Feroz Zahid, Yiannis Verginadis, and Geir Horn, "Future Cloud Systems Design: Challenges and Research Directions", IEEE Access, Volume: 6, DOI: 10.1109/ACCESS.2018.2883149, pp. 74120 – 74150, November 2018.
3. Stephen, A. Arul Anitha, L. Arockiam, "Cloud Computing: Opportunities and Challenges", ReTeLL, Vol. 21, June 2019.
4. Blesson Varghese, Rajkumar Buyya, "Next Generation Cloud Computing: New Trends and Research Directions", Future Generation Computer Systems, doi.org/10.1016/j.future.2017.09.020, Volume 79, Part 3, pp. 849-861, February 2018.
5. Colin Ting Si Xue, Felicia Tiong Wee Xin, "Benefits and Challenges of the Adoption of Cloud Computing in Business", International Journal on Cloud Computing: Services and Architecture (IJCCSA) Vol. 6, No. 6, December 2016.
6. Dibyendu Mahato, Dr. Ajay Jain, "Discussing the Challenges and Future Trends of Cloud Computing", International Journal of Mechanical Engineering, DOI: <https://doi.org/10.56452/7-12-34>, Vol. 7 No. 12, December 2022.
7. Hazzaa N. Alshareef, "Current Development, Challenges and Future Trends in Cloud Computing: A Survey", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 14, No. 3, 2023.
8. Matthew N.O. Sadiku, Sarhan M. Musa, and OMonowo d. Momoh, "Cloud computing: Opportunities and challenges", IEEE Potentials, Volume: 33, Issue: 1, pp. 34 - 36 Jan.-Feb. 2014.
9. Majed Balkhi, "Opportunities of Cloud Computing", International

Exploring Innovation Research Methodologies in a Variety of Multidisciplinary Fields and Their Prospective Future Impact

February 2024

- Journal of Innovation and Scientific Research, Vol. 4 No. 1, pp. 33-41, Jul. 2014.
10. Mbaso Joaquim Molo, Joke A. Badejo, Emmanue Adetiba, Vingi Patrick Nzanu, Etinosa Noma-Osaghae, "A Review of Evolutionary Trends in Cloud Computing and Applications to the Healthcare Ecosystem", Applied Computational Intelligence and Soft Computing, Article ID 1843671, doi.org/10.1155/2021/1843671, 2021.
 11. Nasser Taleb, Elfadil A. Mohamed, "Cloud Computing Trends: A Literature Review", Academic Journal of Interdisciplinary Studies, Doi: 10.36941/ajis-2020-0008, Vol 9 No 1, January 2020.
 12. Ozcan Ozyurt, Fatih Gurcan, Gonca Gokce Menekse Dalveren and Mohammad Derawi, "Career in Cloud Computing: Exploratory Analysis of In-Demand Competency Areas and Skill Sets", Applied Sciences, <https://doi.org/10.3390/app12199787>, volume 12, Issue 19, 2022.
 13. Prantosh Kumar Paul, Mrinal K. Ghose, "Cloud Computing: Possibilities, Challenges and Opportunities with Special Reference to its Emerging Need in the Academic and Working Area of Information Science", Procedia Engineering, Volume 38, pp. 2222-2227, 2012.
 14. Prince Kwame Senyo, Erasmus Addae, Richard Boateng, "Cloud Computing Research: A Review of Research Themes, Frameworks, Methods and Future Research Directions", International Journal of Information Management, Volume 38, Issue 1, pp. 128-139, February 2018,
 15. Rafia Islam, Vishnu Vardhan Patamsetti, Aparna Gadhi, Ragha Madhavi Gondu, Chinna Manikanta Bandaru, Sai Chaitanya Kesani, Olatunde Abiona, "The Future of Cloud Computing: Benefits and Challenges", Int. J. Communications, Network and System Sciences, doi.org/10.4236/ijcns.2023.164004, 2023.
 16. Sameer A. Nooh, "Cloud Cryptography: User End Encryption", International Conference on Computing and Information Technology, Volume:

**Exploring Innovation Research Methodologies in a Variety of
Multidisciplinary Fields and Their Prospective Future Impact
February 2024**

- 01, Issue: ICCIT- 1441, pp. 397 - 400, 9th & 10th Sep. 2020.
17. Seema Pathak, Anil Kumar Tiwari, Khirodra Bhoi, “Cloud Computing: New Trends and Research challenges”, Research Journal of Engineering and Technology, DOI: 10.5958/2321-581X.2020.00013.6, Vol 11, issue 2, April- June, 2020.
18. Siraj Munir, Syed Imran Jam, “Current trends in cloud computing”, Indian Journal of Science and Technology, doi.org/10.17485/IJST/v13i24.358, 13(24): pp. 2418-2435, 2020.
19. Jamsheela O., Mohd Abdul Hameed, “Recent Trends in Cloud Computing”, International Journal of Computer Sciences and Engineering, vol.7, issue5, doi.org/10.26438/ijcse/v7i5.184618 51, pp.1846-1851, May 2019.