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# Leveraging Cloud Computing for Resource Optimization in Rural Financial Organizations: A Case Study of Credit Societies in Karnataka and Maharashtra

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**ABSTRACT**

**There is no research carried out so far on applications of cloud computing in credit societies and small financial organization. There is a need for such research to strengthen that sector especially in rural area. Research must plan to perform concurrent and seamless transaction processing, sharing of resources such as platforms, software and infrastructure under the chain of credit societies in rural area. The financial sector continues to evolve amidst technological advancements, regulatory reforms, and changing market dynamics. While facing various challenges and uncertainties, financial institutions have opportunities to embrace innovation, enhance operational resilience, and deliver value-added services to meet the evolving needs of consumers and investors in a rapidly changing global economy. Cloud computing service utilization is required under small scale finance service such as credit societies. One can find chain of credit society's presence but are not running in parallel and with synchronization. We must offer a solution where integration of resources and services can be achieved for seamless transactions and analytics.**

**Keywords: Cloud Computing, Financial Sector, Optimization.**

## INTRODUCTION

Cloud computing is the on-demand availability of computing resources (such as storage and infrastructure), as services over the internet. It eliminates the need for individuals and businesses to self-manage physical resources themselves, and only pay for what they use. The concept of cloud computing incorporates both a platform and a category of applications. A cloud computing platform functions by dynamically provisioning, configuring, and reconfiguring servers based on demand. The servers within the cloud environment may encompass either physical or virtual machines.

It presents an alternative to the utilization of local servers for the management of applications.Final users of a cloud computing infrastructure typically lack awareness regarding the physical whereabouts of the servers; instead, they simply start their application and begin their tasks. The definition of cloud computing can be explained like this, Cloud computing embodies a model created to enable easy network access on a per-need basis to a shared pool of flexible computational resources (such as networks, servers, storage, applications, and services) that can be quickly provisioned and de-provisioned with minimal managerial interaction or involvement with service providers. Cloud computing describes online-accessible services including storage, databases, software, analytics, and other platforms. Any service that can be provided without being in close proximity to the hardware is included. For its video streaming services, Netflix, for instance, leverages cloud computing. Another illustration is G Suite, which is totally cloud-based. For businesses involved in commerce, gaming, software, file sharing, billing, web hosting, and software development, the cloud has evolved into a standard amenity of daily life [1]. The cloud is regarded as a delicate platform to administer because of the vast resource management, elastic nature, and self-service approach. The market has more cloud service providers (CSPs) due to the increased need for resources across all industries. The main responsibilities of CSP are resource creation, resource management, and resource threat protection. They develop effective ways to use it to make money [2][3]. Due to the cloud's rapid expansion, many investors are placing investments in it. The general architecture of cloud computing is as shown in figure 1.

Due to the interconnectedness concept, the cloud architecture may be divided into five primary levels. The manifestation of energy, the manifestation of the material world, the modelling layer of the human mind, the replica of

reality, and the layer of continuity each reflect a degree of human thought. Additionally, it is the responsibility of every layer to guarantee that the operational layer is operating safely [9].

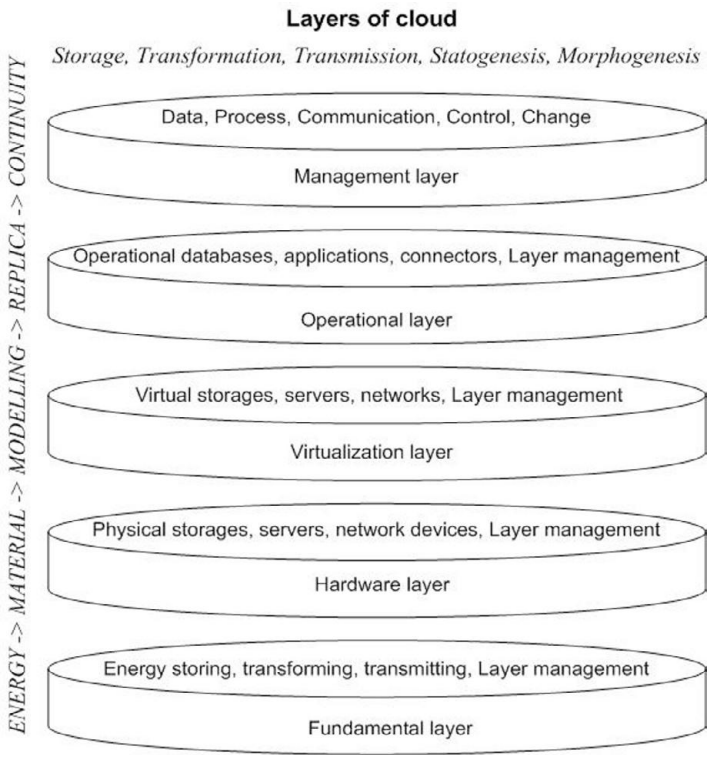


**Figure1: General Architecture of Cloud**

Although cloud was created in the 1960s, it wasn't until 2006 that it was used for industrial purposes in India. Many problems with security, service level agreements, and its infrastructure started to arise once it was used in corporate settings. Following that, cloud research drew more attention and began to expand annually, producing greater findings every time. For each inactive cloud element, several new cloud deployment models are created every year. The cloud's virtualization environment, hardware design, self-organizing, and optimising characteristics provide new problems and keep research on the forefront. Due to the interconnectedness of the difficulties, the cloud concerns are simple to resolve with a single, concise solution. Adding more servers may improve speed and throughput, but doing so will likely have a negative impact on revenue, investment, and efficient resource use [4]. One approach to resolving cloud issues would be to improve performance using the given resources. Optimization is nothing more than reducing the amount of resources accessible. Effective use of the cloud would result from certain adaptations to its fundamental elements and properties [5].

A mathematical model of decision-making is optimization. The CSP is the one who makes the decisions, provides the inputs, controls the factors, and optimises them. The CSP must make these decisions based on his thorough history from sources like Amazon Web Services, Google Trace Data, Planet Lab, etc. The user enters their requirements as numerical numbers. The CSP controls and is referred to as a control variable for the cloud factors that need to be optimised. Decision variables include the type of cloud service and the user base. The CSP is responsible for managing a variety of cloud resources, including virtual machine downtime, latency, processing speed, memory, storage, and server count [4]. Techniques for optimization are designed to make the most use of cloud resources. Additionally, this reduces costs for the provider. On the provider's end, the incoming load must be scrutinised for resource overuse and hacker prevention. There are several difficulties with the optimization method. It must manage the fluctuating demands on the cloud.

In computer simulation-based challenges, optimization is typically carried out utilising linear programming techniques. The steps for developing an optimization model include information gathering, problem formulation and description, model construction, model validation through performance assessment, and, finally, result interpretation. Numerous practical problems have been addressed using the optimization theory and methods in various ways. Given the developments in computing technology, optimization techniques are now crucial and commonplace in many technological applications. In order to properly manage an organization's capital and boost profitability, optimization techniques are a crucial set of instruments. Because optimization approaches are tailored to a particular kind of issue, classification of the optimization model is a crucial stage in the optimization process. The time required to perform an optimization is vital to consider since several optimization procedures are more expensive than the others. Depending

on the approach and level of expertise needed for the work, an optimization technique's setup time may vary. First order and second order optimization algorithms are two major categories for optimization approaches. On big information sets, first order optimization techniques are simple to determine and converge more quickly. When the second-order derivative is already known, second-order techniques are speedier. Otherwise, these approaches are always slower and memory- and computationally-intensive. The two types of optimization classes are search strategies and optimality criteria. Linear programming, nonlinear programming, integer programming, and separable programming are a few of the traditional techniques used in optimization. Calculations, theoretical equations, and random optimization approaches make up conventional methods.

This approach does not guarantee the existence of a global optimum, and it is always necessary to have full knowledge of the objective function. Numerous evolutionary optimization methods using dynamic programming and heuristics have recently been developed. The genetic algorithm, particle swarm optimization, artificial neural network, expert systems, ant colony optimization, fuzzy logic, and Neuro-fuzzy are a few examples of evolutionary approaches [6].

The allocation and management of resources is crucial to helping CSP turn a profit. It is the procedure through which CSP makes the available resources available across the internet to the required cloud users. The strategy addresses effective resource usage on the part of the provider and famine prevention on the part of the user [7]. The issue that arose during allocation is resolved via resource optimization. By using pre-determined threshold values for the user needs prior to allocation, this optimization facilitates the resource allocation process. This guarantees the security of the resource on the CSP side. The number of resources needed and the length of time the CSP will need those resources are included in the cloud request.

In order to avoid famine and under-utilization, the CSP must execute its resource optimization algorithm to decide the order in which to fulfil cloud requests [8]. Following are some irregularities in resource allocation that resource optimization should prevent, a) Resource conflict develops when two or more users attempt to access the same resource at the same time in excess of its threshold, b) Inadequate resources may occur as well as when resources are not allocated properly, c) Resource splinter situation develops when the resources are split up on remote servers and are unable to be allocated together immediately at the time to a cloud request, d) Over-provisioning is the practise of giving a user access to more resources than they have requested. According to the CSP, this is also referred to as over-utilization of resources; e) Under-provisioning is the situation in which a user receives fewer resources than what he needs. At the CSP side, it is referred to as under-utilization of resources. The cloud security is also playing a major role in the current cloud computing system. Private information is being stored on the cloud by an increasing number of businesses, and cloud data management is also growing. These trends began before the crisis and will persist as digital revolution and digitalization pick up speed.

It is a well-known fact that the financial crisis accelerated the use of cloud computing and the expenditure on public clouds. However, due to several issues with cloud data security, cloud data protection, and overall information security and cyber security, many companies will need to rethink their data management and, in particular, data security strategy for the hybrid and multi-cloud world we live in. On addition, the great majority (83 percent) of businesses still do not encrypt a lot of the sensitive data they keep in the cloud, despite the rise in assaults that target this data. The top investment that businesses implementing digital transformation initiatives want to make over the next three years is bolstering cyber security defences [9]. A paradigm shift in cyber security is redefining expenditure priorities as a result of the rising trend of remote and hybrid workplaces.As organisations want to increase resilience and people anticipate the ability to work from anywhere, cloud computing provides the underpinning technology for this shift.But many cloud solutions don’t come with built-in security measures.

**The Financial Sector**

The financial sector pertains to enterprises, companies, financial institutions, and banks that offer financial services and contribute to the economy. It covers a variety of sectors such as banking, investments, consumer finance, mortgages, real estate, money markets, insurance, and retail, among others. This sector is frequently conflated with the financial markets, although this is inaccurate. It mirrors the economic conditions and exerts significant influence on it. The generation of revenue is facilitated by various financial mechanisms such as interest rates, mortgages, loans, debt finance, and capital funds, thereby stimulating economic expansion. Within the economic landscape, the financial sector encompasses enterprises, firms, banking establishments, and additional financial entities that offer financial services and contribute to the maintenance of an economy. Elevated interest rates, either a deficiency or surplus of governmental regulations, and diminished consumer indebtedness may significantly impact the industry. During periods of economic downturn or financial turmoil, governmental authorities deliver prompt aid to the industry. The financial sector holds a notable significance within the economy through its provision of intermediary financial services, as well as its management, allocation, and transfer of financial capital.The government promptly provides assistance to the sector during an economic downturn or financial turmoil. Furthermore, it serves as an intermediary linking individuals who save money with those who borrow funds. Essentially, it acquires capital from savers through bank deposits and investments and then allocates it to borrowers, including individuals, households, businesses, or governmental entities.

**Objectives of the Research**
This research work is aimed at optimizing the resources of cloud computing along with providing the data security. The main objectives of research work are as follows:

1) To study various resource optimization techniques by applying cloud computing.
2) To study different financial sectors by focusing on small financial organizations in rural area.
3) To develop cloud based solutions such as Software as a Service for small credit societies so that they can perform seamless transaction processing concurrently.

**Scope**
As financial sector is very huge we are limiting our scope at small financial organizations like credit societies, farmer societies at rural level with respect to border area of Karnataka and Maharashtra. Financial Sector covers enormous variations of streams to provide economic assistance and growth benefits to industry of large scale, medium scale and small scale. Financial sector has evolved through number of options to perform business at regional level, state level, and national level and also to international level. Though financial sector caters under vast area we face obstacle to have synchronization of financial sector and technology seamlessness for grass root level.

Cloud computing is one of such example which can be utilised at small scale financial sectors such as co-op credit banking systems. We are limiting our scope at small financial organization like credit societies. Cloud computing can offer solutions for sharing resources such as infrastructure, platforms, software etc. With all such sharing of various resources cloud computing offers ease of business with less efforts but this has to be accommodated at every financial level. At co-op credit society level people are still performing most tasks manually since it can be achievable to implement automation using cloud under financial sector.

**Research Review**
This section gives recent literature review on resource optimization and data security in cloud computing.

**Applications of cloud computing in various sectors.**
The author mentioned that Cloud computing under Information Technology - Cloud computing offers a wide range of applications and benefits for information technology (IT) departments and professionals. Here are some key applications of cloud computing in the IT domain: Infrastructure as a Service, Platform as a Service, Software as a Service, Development and testing environments, Data analytics and Business Intelligence etc.

Cloud computing under health care industry - Cloud computing has transformative applications in the healthcare industry, offering numerous benefits such as improved patient care, enhanced data management, cost efficiency, and scalability. Here are some key ways cloud computing is utilized in the healthcare sector – Electronic Health Record, Telemedicine and Remote Patient Monitoring, Medical Imaging and Diagnostics.

Cloud computing within the sports industry has seen a rise in adoption in recent times. This adoption has led to a significant transformation in various aspects of the industry, ranging from tracking athlete performance to engaging fans and managing operations. The utilization of cloud computing technologies has proven to be an efficient solution for data storage and analytics within the sports sector. With the plethora of data being generated from sources like player tracking systems, ticket sales, and social media interactions, cloud computing offers a secure platform for storing and processing large volumes of data to extract actionable insights.

The construction industry, on the other hand, is characterized by its data-intensive nature, where diverse data sets are continually produced throughout the project lifecycle. These data sets are typically stored in separate locations, such as team servers, desktops, laptops, and smartphones, creating data silos.

**Applications of Cloud Computing under Financial Sector**
The author mentioned that Cloud computing offers a wide range of applications and benefits for the financial sector, including banking, insurance, investment firms, and financial services providers

**Cloud computing offers following services under financial sector:**
Cloud storage solutions enable financial institutions to securely store and manage large volumes of financial data, including customer records, transaction histories, and regulatory documents.

Cloud-based risk management and compliance platforms help financial institutions assess, monitor, and mitigate various types of risks, including credit risk, market risk, and operational risk.

Cloud-based CRM solutions enable financial institutions to manage customer relationships, track interactions, and personalize services across multiple channels, including email, phone, and online portals.

Cloud-based payment processing platforms facilitate secure and efficient payment transactions, including credit card processing, online payments, and peer-to-peer transfers.

**Software as a Service for Financial Management or Banking**
The author mentioned that Software as a Service (SaaS) solutions for financial management and banking offer a range of benefits to financial institutions, including improved operational efficiency, enhanced customer experience, and cost savings.

**Examples of SaaS applications tailored for financial management and banking:**
Accounting and Financial Reporting Software - SaaS accounting platforms provide financial institutions with tools for general ledger accounting, accounts payable/receivable management, budgeting, and financial reporting.

Treasury Management Systems - SaaS accounting platforms provide financial institutions with tools for general ledger accounting, accounts payable/receivable management, budgeting, and financial reporting. These platforms provide real-time visibility into cash flows, automate treasury operations, and facilitate decision-making related to investments, borrowing, and hedging.

**Existing scenario of credit society and digitization**
The existing scenario of credit societies and digitization is witnessing significant transformation driven by technological advancements, changing consumer behavior, and regulatory reforms. Credit societies, also known as cooperative credit societies or cooperative banks, play a vital role in providing financial services to underserved communities, small businesses, and rural populations.

Credit societies are increasingly adopting digital technologies to modernize their operations, enhance customer experience, and improve efficiency. Digital banking platforms, mobile applications, and online portals enable credit societies to offer a wide range of banking services, including account management, fund transfers, bill payments, and loan applications.

The digitization of credit societies is reshaping the financial landscape, driving financial inclusion, promoting innovation, and empowering communities with access to affordable and accessible financial services. By embracing digital technologies, credit societies can adapt to evolving market dynamics, meet customer expectations, and thrive in a rapidly changing digital economy.

**Cloud Computing applications for credit societies**
The author mentioned that Cloud computing offers several applications and benefits for credit societies, enabling them to modernize their operations, enhance customer experience, and improve efficiency. Cloud computing empowers credit societies to innovate, adapt to market changes, and deliver value-added services to their members while improving operational efficiency, reducing costs, and enhancing customer experience.

Credit societies can leverage cloud-based core banking systems to manage their operations, including account management, deposit and loan processing, and transaction processing. Cloud-based CBS solutions provide scalability, flexibility, and cost-effectiveness, allowing credit societies to adapt to changing business requirements and scale operations as needed. Cloud computing enables credit societies to deploy digital banking platforms, including online banking portals and mobile banking applications, to offer convenient and accessible banking services to their members.

**Cloud Computing and resource optimization**
Cloud computing offers significant opportunities for resource optimization across various industries and sectors. Here are several ways in which cloud computing enables resource optimization:

**Scalability**: Cloud computing enables organizations to adjust the scale of their resources according to the level of demand. They can dynamically allocate computing power, storage, and network resources to match workload requirements, optimizing resource utilization and reducing wastage.

**Elasticity**: Cloud services offer elasticity, enabling organizations to automatically adjust resource capacity in response to changes in workload patterns. This flexibility allows them to handle peak loads efficiently without over-provisioning resources during periods of low demand

## CONCLUSION

The research explores the potential of cloud computing to transform small financial organizations, particularly credit societies in rural areas. It identifies a significant gap in the current adoption of cloud technologies within this sector, underscoring the need for concurrent and seamless transaction processing, resource sharing, and data security. By leveraging cloud computing, credit societies can optimize resources, enhance operational efficiency, and offer modern

financial services to underserved communities. The study also emphasizes the importance of addressing challenges such as cybersecurity and the need for tailored solutions that cater to the unique needs of these organizations.

Through the adoption of cloud-based platforms, small financial institutions can achieve greater synchronization, reduce manual processes, and improve overall service delivery.

This research sets the groundwork for future studies and practical implementations aimed at fostering financial inclusion and economic growth in rural regions through technological innovation.

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