Application of Cloud Computing in Social Media Live Streaming and E-commerce: A Case Study of TikTok

Caiming Chen[1, a], Fenglin Wang[1, b]

[1]Graduate School of Business, Universiti Sains Malaysia, Pulau Pinang, Malaysia

[a]andy_chen@student.usm.my, [b]wangfenglin@student.usm.my

Abstract

This research explores the application and impact of cloud computing in social media data processing, analysis, and operations through a case study of the globally popular social media app TikTok. We found that the high availability, scalability, and robust computing power of cloud computing offers technical support to TikTok, enabling it to provide a stable and smooth live streaming experience and accurate e-commerce services. However, some challenges and limitations remain in live streaming and e-commerce, such as content authenticity, user privacy, and data security. Our findings offer valuable insights for both theoretical research and practical applications while pointing out issues that require further study and resolution.

Keywords

Cloud Computing; Social Media; Data Processing; Live E-commerce; TikTok.

1. INTRODUCTION

As cloud computing technology evolves rapidly, powerful platforms like Microsoft Azure have ushered in unprecedented data processing and analysis transformations within social media. In this era of Big Data, each click, share, or comment on social media generates vast amounts of data encompassing rich user behavior patterns, interest preferences, and social network information. This information holds substantial value for social media platforms. However, the effective processing and analysis of these complex datasets, and the extraction of valuable insights, have always posed significant challenges to these platforms. With its elastic computing power, large-scale data handling and storage capabilities, and advanced data analytics tools and services, Azure provides a solution to this challenge.

Azure offers a comprehensive suite of solutions, including data collection, preprocessing, storage, processing, analysis, and visualization tools and services. These tools and services assist social media platforms in more efficient handling and analyzing data, deepening their understanding of users, optimizing products, and enhancing business efficiency and user satisfaction. However, despite the widespread recognition of Azure's potential, the understanding of how Azure can transform data processing and analysis methods in social media and the impacts of these changes on business operations and decision-making in social media still needs to be more profound.

This study plans to conduct in-depth empirical research into the application of Azure in social media. We will explore in detail how Azure changes the way social media processes and analyzes data and study the specific impacts of these changes on the operations and decision-making of social media businesses. We will utilize various tools and services provided by Azure, such as Azure Data Factory, Azure Data Lake Storage, Azure Databricks, Azure Machine Learning Service, and Power BI, to conduct comprehensive data processing and analysis.

2. LITERATURE REVIEW

All Over the past decade, cloud computing has emerged as a mainstream technology that is transforming the way we live and work, especially in the realm of social media, where the application of cloud computing has garnered significant attention. This section will review and summarize existing research on cloud computing, social media, and their cross-application.

Cloud computing is defined by the National Institute of Standards and Technology (NIST) as a model that allows shared computing resources, such as servers, storage, and applications, to be accessed over the Internet [1]. This model provides on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. The development and application of cloud computing have attracted much attention, particularly in the healthcare sector [2].

Social media platforms generate vast amounts of data daily, encompassing text, images, and videos. For instance, Twitter generates millions of tweets daily, and the processing and analysis of this data are crucial for social media platforms as they can help them understand user behavior and needs, thereby improving their services.

However, traditional data processing and analysis methods often need help to effectively handle the large amounts of data generated by social media. This is because these methods typically require vast computational resources and storage space and often cannot process data in real-time. Cloud computing, particularly core technologies such as distributed computing, big data analytics, and machine learning, provides an efficient solution for social media data processing and analysis [3].

Specifically, cloud computing platforms like Amazon Web Services (AWS), Google Cloud, and Microsoft Azure can help social media platforms process and analyze vast amounts of data using distributed computing and extensive data analysis tools. This enhances the efficiency of data processing and aids platforms in obtaining more profound insights, thereby making more informed business decisions [4].

On the other hand, cloud computing can also improve data security in social media. For instance, through the use of encryption and authentication technologies provided by AWS, cloud computing can protect user data. However, the privacy and security of user data remain issues that need to be addressed. Despite the provision of encryption and authentication technologies, data may still be at risk of leakage during transmission and storage[5].

Furthermore, the cost of cloud computing is a factor that needs to be considered. While cloud computing can save on hardware and maintenance costs, storing and processing vast amounts of data in the cloud may incur significant expenses [6].

Moreover, cloud computing alters how data processing and analysis are performed and provides new business opportunities for social media. For example, through cloud computing, social media platforms can rapidly develop and deploy new features, thus better adapting to market changes.

Although numerous studies have focused on the technical aspects of cloud computing, more have yet to address its specific impact on the operation and decision-making of social media businesses. For instance, how to leverage cloud computing to optimize content recommendation algorithms for social media or how to use it to enhance the effectiveness of ad placements. Another gap lies in the need for sufficient consideration of the application of cloud computing across different types of social media platforms in existing research. Different social media platforms may handle different types of data and user behavior, which could affect the application and effectiveness of cloud computing.

Therefore, this study aims to delve into how cloud computing changes the way social media processes and analyzes data and the specific impacts of these changes on the operations and decision-making of social media businesses to fill the aforementioned research gaps.

3. METHODOLOGY

3.1. Acquisition Work

A literature review will be conducted to delve into the transformation brought by cloud computing on the data processing and analytical procedures in social media through case studies and to analyze its impacts on business operations and decision-making. We will use online databases such as Google Scholar, IEEE Xplore, ACM Digital Library, etc., and search for keywords like 'cloud computing,' 'social media,' 'data processing,' etc., to locate relevant academic articles, conference papers, book chapters, and reports. We have referenced a study by Li et al. [7] who discussed the role of cloud computing in processing large-scale data during the COVID-19 pandemic, which provides insights into the applications of cloud computing in social media data processing. In addition, we will also review publicly available industry reports, news articles, blog posts, and other relevant resources to gain the latest industry trends and insights [8].

3.2. Data Collection and Preprocessing

Given the limitations of conducting interviews and independent data collection, we will utilize the case study method. For data collection, we will select representative social media platforms, such as TikTok, Facebook, and Twitter, as our case objects. We will collect publicly available data from these platforms, including user behavior, content, and business operation data [9]. This data will provide detailed information about user behavior and content, assisting our in-depth study on how cloud computing changes social media processes and analyzes data [10].

During the data preprocessing stage, we will employ appropriate information preprocessing methods to ensure the quality and consistency of the data. Different preprocessing steps will be adopted for different types of data. We will carry out data cleaning and transformation for user behavior data, remove duplicate data, handle missing values, and ensure data completeness and usability [11]. For content data, we will conduct preprocessing steps like text processing, image processing, etc., for subsequent data analysis and mining [12]. Through data preprocessing, we will have high-quality and reliable datasets ready for subsequent data analysis [13].

3.3. Data Processing and Analytical Methods

At the data processing and analysis stage, we will apply a case study-based method to deeply understand how cloud computing is altering the way social media processes and analyzes data through case analysis and investigate the influence of these changes on business operations and decision-making. We will reference related studies by Pääkkönen[14], who compared different stream processing technologies for handling semi-structured data, which provides valuable insights into handling social media data.

For qualitative data analysis, we will use content analysis to code and conduct theme analysis on the text, images, and other related content in the cases[15]. We will analyze the specific practices and strategies of cloud computing in social media data processing and analysis and explore its impacts on social media businesses. Through qualitative data analysis, we will delve into how cloud computing changes social media processes and analyzes data via case studies, providing empirical evidence and theoretical insights.

For quantitative data analysis, we will compare and analyze the data within and between the cases. We will focus on key metrics in cloud computing, such as data processing speed, storage

capacity, and scalability. Through statistical analysis of the quantitative data in the cases, we will uncover how cloud computing changes the way social media processes and analyzes data through case studies and study its effects on business operations and decision-making [16].

Table 1. Main Services of AWS

Service Name	Service Description
Amazon EC2	Provides scalable computing capacity in the cloud. It is designed to make web-scale cloud computing easier.
Amazon S3	Provides secure, highly durable object storage. You can use it to store and retrieve any amount of data, at any time, from anywhere.
Amazon RDS	Makes it easy to set up, operate, and scale a relational database in the cloud. It provides cost-efficient and resizable capacity while automating time-consuming database administration tasks.

Table 2. Advantages of AWS in Cloud Computing

Advantage	Description
Security	AWS provides a range of security measures, including data encryption, network security, identity and access management, etc., to protect user data and applications.
Scalability	AWS services can be easily scaled up or down to meet the needs of applications.
High Availability	AWS provides high availability and redundancy to ensure the continuity of applications and services.
Global Coverage	AWS has multiple data centers worldwide, providing localized services and data storage.

Table 3. Main Services of Azure

Service Name	Service Description
Azure Virtual Machines	Provides the ability to run applications in the cloud, with flexible choices of operating systems and various configuration options.
Azure SQL Database	Provides a fully managed SQL database service, which can automatically handle most database management functions, such as upgrades, backups, and recovery, etc.
Azure Storage	Provides massive, durable, secure, and highly available cloud storage, which can be used to store and analyze all types of data, including unstructured, structured, real-time, and batch data.
Azure Functions	Provides serverless computing services, which can run event-driven code without the need to pre-allocate or manage servers.

Table 4. Advantages of Azure in Cloud Computing

Advantage	Description
Security	Azure provides a range of security measures, including data encryption, network security, identity and access management, etc., to protect user data and applications.
Scalability	Azure services can be easily scaled up or down to meet the needs of applications.
High Availability	Azure provides high availability and redundancy to ensure the continuity of applications and services.
Global Coverage	Azure has multiple data centers worldwide, providing localized services and data storage.

3.4. Rationale for Method Selection

Our choice of a case-study-based research design and mixed data analysis methods aims at a comprehensive and in-depth exploration of how cloud computing changes the way social media processes and analyzes data through case analysis and examining the effects of these changes on business operations and decision-making. This choice is based on the following considerations: 1. Case representativeness: Choosing representative social media platforms as case subjects can provide useful data and cases, contributing to the reliability and validity of the research [17]. 2.Depth of understanding: The case-study-based research design and mixed data analysis methods can help us deeply understand how cloud computing changes the way social media processes and analyzes data through case analysis, providing rich details and depth of understanding. 3.Comprehensive analysis: By combining qualitative and quantitative data analysis, we can comprehensively understand how cloud computing changes the way social media processes and analyzes data through case analysis from multiple angles and levels, offering comprehensive analysis and understanding [18].

4. RESULTS AND DISCUSSION

4.1. Case Description

We selected TikTok as a case study for several reasons in this study. Firstly, TikTok is a globally popular short video social media application with a large user base, high engagement, and broad influence. Secondly, TikTok's live streaming feature and the rapid development of live commerce make it one of its core businesses, providing high research value. Finally, TikTok's operations rely on cloud computing technology, and its practices in handling large-scale data, providing real-time interaction, and supporting e-commerce sales offer a good case study for exploring the application of cloud computing in social media live streaming and live commerce.

Table 5. Main Features of TikTok

Feature	Description
Short Video Sharing	Users can create and share short videos ranging from 15 seconds to 1 minute.
Live Streaming	Users can share their activities in real-time and interact with the audience.
E-commerce	Users can sell products during live streams, and viewers can purchase directly.
Content Recommendation	TikTok uses algorithms to recommend content that users might be interested in.

As a leading global social media application, TikTok's success relies heavily on the support of cloud computing technology. Cloud computing provides TikTok with powerful data processing and storage capabilities, enabling it to handle massive amounts of user data and video content generated daily. This data includes user profiles, behavioral data, interaction data, and user-uploaded video content. Through cloud computing, TikTok can collect and process this data in real-time, providing users with personalized content recommendations and social experiences.

Furthermore, cloud computing provides critical technical support for TikTok's live streaming feature. Live streaming requires processing many real-time video streams, demanding significant computational and networking resources. The high availability and scalability of cloud computing enable TikTok to rapidly scale its resources to maintain smooth live streaming when facing a surge in user numbers. Additionally, the elastic resource management of cloud

computing allows TikTok to promptly reduce resources and save costs when the number of users decreases.

In live commerce, cloud computing's data analysis and mining capabilities enable TikTok to gain deep insights into user purchasing behaviors and preferences, providing precise user targeting and business product recommendations. Moreover, cloud computing's powerful computing capabilities allow TikTok to process a large volume of transaction data, providing merchants with real-time sales statistics and analysis.

Regarding data collection, we mainly rely on publicly available materials and information, including TikTok's official reports, news articles, industry reports, and other publicly accessible research and analysis. These materials provide detailed and comprehensive information about TikTok's live streaming feature and the field of live commerce. To validate our data collection efforts, we will provide a detailed list of all the references and sources we consulted in the research report and a detailed explanation of how each material and information was obtained and used. For example, we will provide examples of the information we obtained from TikTok's official reports, including report titles, release dates, and main content. We will also provide examples of information obtained from news articles, industry reports, other publicly available research, and analysis, including material titles, authors, release dates, and main content. This way, readers can clearly understand the entire process of our data collection efforts and the sources and reliability of our data.

4.2. Results Analysis

Through the case analysis of TikTok, we discovered that cloud computing plays a crucial role in social media's data processing and analysis methods, business operations and decision-making, and data security.

Firstly, the high availability and scalability of cloud computing ensure the stability and reliability of TikTok's live streaming feature. As a global social media platform, TikTok faces massive users and high-concurrency viewing demands. With the technical support of cloud computing, TikTok can flexibly scale server resources to ensure high availability and smooth live streaming services. This highlights how cloud computing transforms the data processing methods of social media, where elastic resource management enables social media platforms to maintain efficient and stable services when facing large-scale users and data.

Secondly, cloud computing's computing and storage capabilities allow TikTok to process and analyze large-scale data. In the live streaming feature, TikTok can real-time process user interaction data, such as comments, likes, and gift-giving, enhancing the interactive experience for content creators and viewers. In the field of live commerce, TikTok can process user purchasing behavior data and live sales data, providing precise recommendations and personalized services for merchants. This further reveals how cloud computing changes the data analysis methods of social media, where the big data processing and analysis capabilities of cloud computing enable social media platforms to extract valuable information from massive user data to support their business operations and decision-making.

Cloud computing's technical support also enables TikTok to adopt advanced data analysis and mining methods. Through machine learning and natural language processing algorithms in cloud computing, TikTok can deeply analyze user behavior data and content data, gaining insights into user preferences and trends and providing personalized recommendations and customized services based on this information. This further enhances user experience and business value. This demonstrates how cloud computing helps improve data security for social media, where advanced technologies in cloud computing allow social media platforms to protect user data effectively and utilize it more efficiently.

Furthermore, we also observed that the application of cloud computing in TikTok's live commerce field extends beyond data processing and analysis, including supporting complex business processes and transaction operations. For example, cloud computing supports real-time inventory management, order processing, payment processing, etc., all of which are integral to live commerce. This further reveals the critical role of cloud computing in social media business operations and decision-making, where comprehensive technical support from cloud computing allows social media platforms to manage their business processes effectively, improving business efficiency and user satisfaction.

Table 6. Application of Cloud Computing in TikTok

Application	Description
Data Processing	Cloud computing provides powerful data processing and storage capabilities, enabling TikTok to handle massive user data and video content generated daily.
Live Streaming	The high availability and scalability of cloud computing enable TikTok to quickly expand resources to maintain the smoothness of live streaming when the number of users increases sharply.
Live E-commerce	The data analysis and mining capabilities of cloud computing enable TikTok to deeply understand user purchasing behavior and preferences, providing merchants with accurate user positioning and product recommendations.

Regarding data security, cloud computing also provides essential support for TikTok. Cloud computing's security mechanisms, such as data encryption, access control, and auditing, can effectively protect user data's security and privacy. Additionally, cloud computing's data backup and recovery capabilities ensure quick data and service recovery in case of data loss or system failure. This demonstrates how cloud computing enhances data security for social media, where the security technologies and mechanisms of cloud computing enable social media platforms to protect user data's security and privacy better.

Overall, our case analysis reveals how cloud computing transforms social media's data processing and analysis methods, influences business operations and decision-making, and enhances data security for social media. These findings provide important insights and guidance for further understanding and utilizing cloud computing's application in the field of social media.

Table 7. Impact of Cloud Computing on TikTok's Operations

Impact	Description
Improved Data Processing	**Cloud computing allows TikTok to handle large volumes of data in real-time, improving the user experience**
Enhanced Personalization	**Cloud computing enables TikTok to analyze user behavior and preferences, allowing for personalized content recommendations**
Streamlined E-commerce	**Cloud computing supports TikTok's live e-commerce operations, from inventory management to transaction processing**

4.3. Discussion

Our research results demonstrate the significant role of cloud computing in TikTok's live streaming feature and live commerce field. Through cloud computing support, TikTok achieves high availability, scalability, and powerful computing capabilities, providing a stable and smooth

live streaming experience and precise live commerce services. This brings significant value to TikTok's users and merchants.

However, we must also acknowledge that cloud computing still faces some challenges and limitations in the live streaming feature and commerce field. One of the challenges is ensuring the authenticity and compliance of live content. Live streaming platforms must take effective measures to prevent false advertising and fraudulent behavior, protect user rights and maintain the platform's reputation. Additionally, protecting user privacy and data security is another crucial concern, and live streaming platforms need to strengthen data protection and compliance measures to ensure user information's security and legal use.

Moreover, the widespread application of cloud computing also raises concerns about the energy consumption of data centers. Data centers consume significant electricity, supporting large-scale computing and storage demands and impacting the environment. Therefore, achieving green cloud computing and reducing data center energy consumption is another critical challenge for the development of cloud computing.

In conclusion, cloud computing plays a positive and driving role in developing TikTok's live streaming feature and commerce field. By fully utilizing the technological advantages of cloud computing, TikTok can provide a better user experience and business value. However, cloud computing application in the live-streaming field still requires further research and exploration to address existing challenges and limitations.

Table 8. Challenges and Solutions in Applying Cloud Computing to Social Media

Challenge	Solution
Data Security and Privacy	**Implement robust security measures, including data encryption, access control, and regular audits**
Compliance with Regulations	**Stay updated with local and international regulations and ensure compliance**
Energy Consumption	**Implement energy-efficient technologies and practices in data centers**

5. CONCLUSION

This study profoundly explores the application of cloud computing in social media live streaming and live-stream e-commerce through a case study of TikTok. The high availability, scalability, and powerful computing capabilities of cloud computing provide technical support for TikTok, enabling it to offer stable live-streaming experiences and accurate live-stream e-commerce services, generating substantial value for its users and merchants.

Firstly, the high availability and scalability of cloud computing ensure the stability and reliability of TikTok's live streaming feature. TikTok can flexibly scale server resources to meet the needs of mass simultaneous live-stream viewership. Secondly, the computing and storage capabilities of cloud computing provide TikTok with the ability to process and analyze large-scale data. In live streaming, TikTok can handle user interaction data in real time, improving the interactive experience for content creators and viewers. In live-stream e-commerce, TikTok can process user purchasing behavior and live-stream sales data, providing merchants with precise recommendations and personalized services. Lastly, cloud computing's technical support allows TikTok to use advanced data analysis and mining methods, enhancing user experience and commercial value.

However, we note some challenges and limitations in applying cloud computing in live streaming and live-stream e-commerce. One challenge is ensuring the authenticity and compliance of live-streamed content. Platforms must take effective measures to prevent false

advertising and fraudulent activities, protect user rights, and maintain the platform's reputation. Additionally, protecting user privacy and data security is critical, necessitating strengthened data protection and compliance measures to ensure user information's safe and legal use.

The main contribution of this study is revealing the application of cloud computing in social media live streaming and live-stream e-commerce through empirical research, providing valuable insights for theoretical studies and practical applications. Our findings not only help social media platforms better understand and utilize cloud computing to enhance user experience and commercial value but also provide references for policymakers and researchers to address challenges and limitations in the application of cloud computing in the live streaming sector.

Furthermore, this study has some limitations. Firstly, our research primarily focuses on the case of TikTok and may only partially reflect the situation of some social media platforms. Future research could consider including more social media platforms to improve the generalizability of the findings. Secondly, our study heavily relies on publicly available data, which may not encompass all user behavior and business operation data. Future research can explore collaborations with social media platforms to obtain more comprehensive and in-depth data. Lastly, our study mainly examines the technical aspects of cloud computing, potentially overlooking other influencing factors such as user behavior and market environment. Future research can consider conducting analyses from multiple perspectives and levels to provide a more comprehensive understanding.

There are several future research directions. Firstly, further investigation can be conducted on the application of cloud computing in other social media functionalities and domains, such as short video editing and AI recommendations. Secondly, research can explore how cloud computing influences social media platforms' business and revenue models, such as advertising placement and membership services. Lastly, research can examine how cloud computing affects user behavior and user experience in social media, such as content consumption and social interaction.

In conclusion, the impact of cloud computing on social media is profound, requiring ongoing attention and research in this field to understand better and leverage the potential of cloud computing and enhance the user experience and commercial value of social media.

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