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An Approach to Managing Public Services that uses Big Data and Cloud Computing

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Abstract: ***Governmental regulations have accelerated the development of information technology and resource grouping. One area of "digital gold" that is extremely practical and scientific is large-scale data mining. This is not simply a contemporary issue; it also calls for the rapid expansion of public service. As a result, it is possible to fully realise the advantages of information, improve service effectiveness, and close the service gap. Due to its speedy accounting, low memory requirements, and effective resource allocation, cloud computing has grown in popularity. Big data was therefore used in this work to analyse the current state of public cloud services, and fuzzy evaluation was used to analyse accurate monitoring. Eventually, the structure of the public service was enhanced, and a strategy for the precise organisation of the complete big data-driven public service process was created. According to a fuzzy comprehensive assessment, the design value and data entropy of public cloud services were increasing exponentially; the average design value of the accurate organisation for cloud-based government services was around 4.35, and the average significance of data entropy was around 0.98. Furthermore, big data-driven precision organisation of social public social welfare outperformed traditional precision monitoring of cloud-based services for the public, with results that suggested effects were 7% higher and overall capacity was 9% higher than the compared techniques.***

I. INTRODUCTION

Society has steadily developed a comprehensive national basic public service system in recent years, which has enhanced technological skills and raised public satisfaction. Correctly meeting public service demand has grown to be a key strategy for resolving today's grave socioeconomic inequalities and achieving widespread prosperity in the new era. The emergence of new information technologies, including big data, cloud computing, and artificial intelligence, has made it clearer than ever that digitization and digital services are the future of business. The use of contemporary information technologies, such as big data, by the government to comprehend and address the requirements of the people for public services is receiving increasing attention [1].

Public services are managed under tight rules as a platform for serving the people. James O outlined the benefits of experiments in public administration and provided evidence of their rapidly changing value to theory and practice. He examined the advantages of causal effects and gave a thorough summary of how experiments and public administration theory relate [1]. In order to alter the current strategy for e-government, Mikel E offered a new paradigm built on a new open model. The pattern is built on the cooperation of several stakeholders and is focused on the design, manufacturing, and deployment of public services and mobile applications [2]. A full variety of public services were supplied to the patient by Glied S, ensuring that the hospital had the resources necessary to care for the patient and that the patient would have enough resource protection [3]. Cheng Y investigated the factors that influence nonprofit organisations' co-governance or public service planning and design participation. According to the findings, nonprofit organisations are more likely to take part in co-governance when they operate in stable and resource-rich areas [4].

The new model put forth by G Stojic can aid national, regional, and local governments in making decisions about passenger public transportation and may also be used to develop the direction and degree of a sustainable public transportation system [5]. Zheng Z used the Beijing Tianjin Hebei region as the research backdrop and examined the level of public welfare activities and service quality there from the perspective of "global tourism" to raise the level of tourism public service in this area [6]. Subjective factors and objective factors were Gong J's classifications for the influencing factors of public service. The study discovered that satisfaction with the public sector is significantly influenced by subjective characteristics [7]. Although the aforementioned studies discuss the value of public services, they do not use the information to manage public services.

Big data is an emerging technology with numerous applications. In terms of social function activities, Hong X discussed the pertinent procedures and data for each level. Data collection and update and data analysis application were two perspectives through which the application of big data in fine management was examined [8].

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Fan X used big data to identify the training object demands and developed the most recent teacher information through a cloud platform to gather quantitative data from teachers through various channels [9]. Liu H examined the effects of big data on current public services and precision management to determine various tactics that communities may use as well as the potential benefits that big data can offer to businesses in various economic sectors and functional areas within businesses [10]. Li Z presented a trusted search without verification data security storage and sharing method based on public service management [11]. A divergence-based strategy for evaluating the quality of big data distribution was developed by Cw A to increase the stability of the model in dynamic environments [12].

In order to reflect the metadata of actual data and satisfy users' attribute search demands, Li S built a large-scale searchable key-value storage system based on dynamic drives and studied a precise management service scheme that maps data to drives [13]. According to Nisar Q A, data decision-making competence is essential for enhancing the effectiveness and efficiency of decision-making, which benefits both precise management and public service [14]. The aforementioned research has described the precise function of big data in management, however, public service management still has a lot of shortcomings.

Communities now need to embrace the new trend of completely integrating digital technology into society and daily life and encourage innovation in public services and social activities to hasten the construction of a government decision-making mechanism based on digital technology. New techniques and means to address the needs of public services have emerged as a result of advancements in current information technology, such as precise dynamic monitoring and prediction of big data based on radio frequency data. This can assist all levels of government in finding solutions to public service issues and meeting the demand for public services, enhancing citizens' feelings of accomplishment, well-being, security, and identity.

II. BIG DATA AND CLOUD COMPUTING

The exponential expansion of data in the digital age has presented organisations with both enormous opportunities and difficulties. Massive amounts of structured, semi-structured, and unstructured data produced from numerous sources are referred to as "big data." It is a challenging undertaking to manage and glean insights from this data. On the other side, cloud computing provides scalable and adaptable computer resources over the internet. Big data and cloud computing have completely changed how data is managed, giving businesses access to previously unheard-of capacities for storing, processing, analysing, and gaining important insights from enormous datasets. This essay examines the ideas of big data and cloud computing, as well as its advantages and disadvantages [15].

A. Big Data

Big Data comprises the four dimensions of volume, velocity, variety, and veracity, also referred to as the four V'sv[16].

1) *Volume:* Large amounts of data that are greater than the capability of conventional storage and processing technologies are referred to as "big data." It contains information gathered from a variety of sources, including logs, sensors, social media, and transaction records.
2) *Velocity:* To extract valuable insights from big data, which is produced at an unprecedented rate, real-time or nearly real-time processing is necessary. High-velocity data includes things like social media feeds, streaming data from IoT devices, and financial activities.
3) *Variety:* Big data includes a wide range of data types, including unstructured (text, photos, and videos), semi-structured (XML, JSON), and structured (relational databases) data. This variety of data presents major management and analysis issues.
4) *Veracity:* Uncertainty and inconsistency are frequently present in big data. Veracity is a term used to describe how reliable and high-quality the data is. Techniques for data cleansing, validation, and integration are crucial for ensuring data trustworthiness.

B. Cloud Computing

The transmission of on-demand computing resources, such as servers, storage, databases, software, and analytics tools, over the internet is referred to as cloud computing. It removes the need for businesses to maintain their physical infrastructure and provides a number of significant advantages [17]:

1) *Scalability:* Cloud computing offers almost limitless scalability, enabling businesses to increase or decrease their computing capacity in response to demand. This flexibility makes it possible to handle massive data demands effectively, avoiding resource limitations.
2) *Cost-effectiveness:* Pay-as-you-go cloud computing eliminates the need for initial infrastructure investments. By supplying and de-provisioning resources as needed, organisations can reduce expenditures.

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3) *High Levels Of Availability And Dependability Are Often Provided By Cloud Service Providers:* Built-in systems for data redundancy, backup, and disaster recovery ensure little downtime and data loss.
4) *Collaboration and Accessibility:* Cloud computing makes it possible to collaborate easily and to access data and apps from any location, making it possible to make decisions in real-time and enabling remote work.

C. Synergy

Cloud computing and big data work together to uncover remarkable possibilities in a variety of ways [18].

1) *Scalability and Storage:* Cloud solutions offer the vast amounts of storage space required for big data. Huge datasets can be stored and accessed by organisations without concern for physical infrastructure constraints.
2) *Elastic Processing Power:* The ability to dynamically assign resources for the processing of big data workloads is a feature of cloud computing. The timely processing and analysis of data are ensured by this scalability.
3) *Data Processing Frameworks:* Several big data processing frameworks, like Apache Hadoop and Apache Spark, are supported by cloud computing platforms, allowing for the distributed and parallel processing of enormous datasets. These frameworks make use of the cloud's scalability and processing capacity.
4) *Analytics and Machine Learning:* A variety of analytics and machine learning tools and services are offered via cloud platforms. These services give businesses the tools they need to execute predictive analysis, create data-driven apps, and extract useful insights from huge data.

High-velocity streaming data can be processed and analysed in real-time by organisations using cloud-based stream processing platforms like Apache Kafka. Applications like fraud detection, IoT, and recommendation systems all depend on this capacity.

D. Challenges

Despite the many advantages of combining big data and cloud computing, there are still obstacles to overcome [16-18]:

1) *Data Privacy and Security:* Processing and storing sensitive data on the cloud poses security and privacy issues. Organisations are required to establish strong security measures and adhere to data protection laws.
2) *Data Transfer and Latency:* Sending and receiving significant amounts of data from and to the cloud might take some time, especially for businesses with low internet speed. Real-time analytics and decision-making can be impacted by high-latency connections.
3) Organisations must implement data governance policies and make sure that they are in compliance with all legal and regulatory requirements. The maintenance of data lineage, quality, and auditability is essential.
4) Big data and cloud computing management call for specialised knowledge and abilities. Organisations want experts who are familiar with cloud platforms, advanced analytics methods, and data processing frameworks.

Big data and cloud computing have revolutionised how businesses handle and extract knowledge from enormous databases. Big data storage, processing, and analysis are made possible by the infrastructure and tools provided by cloud computing, allowing businesses to gain insightful knowledge and make informed decisions. Even though there are difficulties, the advantages of this synergy, such as scalability, affordability, and real-time analytics, make it a crucial paradigm for businesses looking to make the most of their data assets in the digital era.

III. PUBLIC SERVICE MANAGEMENT COMPONENTS

A. Characteristics

In contrast to the conventional public service demand management paradigm, which focuses on supply and demand, the management of exact public service demand based on big data is more concerned with addressing national needs. Figure 1 illustrates the three key elements of big data required for the accurate management of public services. Information latency is one. In the conventional definition of public service demand, it is challenging to scientifically identify and analyse public service demand due to restricted information, information lag, and insufficient information, which substantially impedes scientific decision-making in the field of public services [15].

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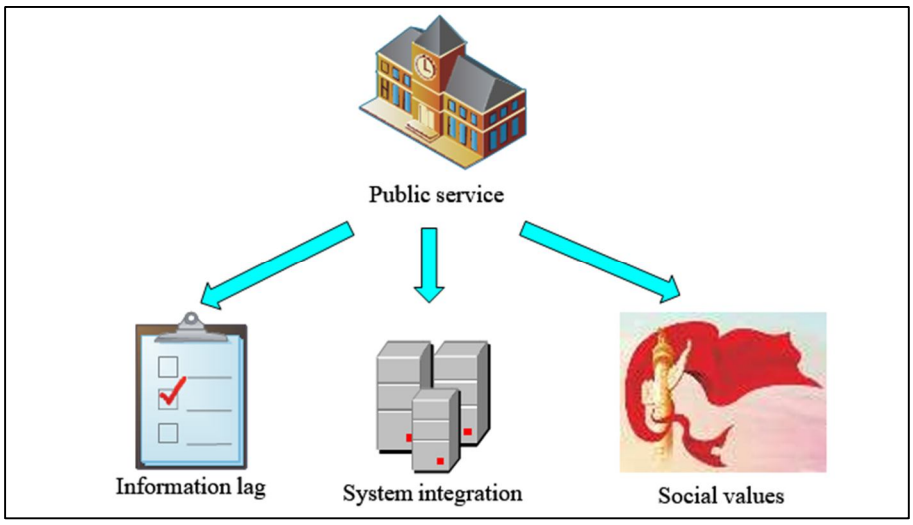

Figure 1: Characteristics of Public Services

Integration of systems is the second. A comprehensive system and platform integrating precise data, precise evaluation, precise calculation, and precise management of public service demands have been built based on integrating channels and adding data for this purpose. Social values are the third, and they serve as one of the benchmarks for evaluating, observing, and estimating the stage of social development. Through accurate information, collection, assessment, satisfaction, and governance, the big data-driven demand for public services can satisfy people's expectations for the diversity and complexity of public services, particularly in rural, underdeveloped, and weak places. This would increase the overall level of public services and assist the area in obtaining high-quality ones [19].

B. Challenges

There are currently five key issues with the management of government public services. The location is wrong, to start with. A requirement for the proper delivery of public services is the location of public functions. However, in actual administrative practice, the government's ambiguous position causes issues including sluggish operation and insufficient functions [16]. Although quick and short-term services are inescapable in the public sector, the supply efficiency of public services has been severely hampered by the ineffective demand management of essential services. The identification is also flawed in another way. An important safeguard for the efficient running of local public services is the accurate identification of social needs. It is simple to end up in a position where supply and demand are uneven and out of balance without having a clear definition of what constitutes demand. Third, the corrective measures are inadequate.

Local authorities frequently struggle to guarantee the accuracy of supply decisions because of the variety of demand information and the complexity of supply chains. Fourth, there is weak management. The government is hesitant to modernise the management idea, and it continues to use the conventional simple service management model while adjusting to how services are provided by all levels of government. Fifth, the outcome is inaccurate. The supply structure is unjustified on the one hand, and profit and loss and service continuity are not closely associated on the other.

C. Factors that Contribute to Issues

Figure 2 illustrates the four key causes of the current issues in the public sector. The system is not flawless, to start. In the implementation phase, the flawed public service delivery system not only contributes to the issue of inaccurate demand but is also challenging to precisely identify. Currently, the availability of public services is hampered by a lack of demand and faulty identification links, which severely lowers their effectiveness and performance. Second, the approval procedure is drawn out and the procurement method is uniform. It somewhat lengthens the time needed to meet the requests for public social services and decreases procurement efficiency. Third, there is little digitization. Each location has a different calibre of technologists and information processing specialists [17].

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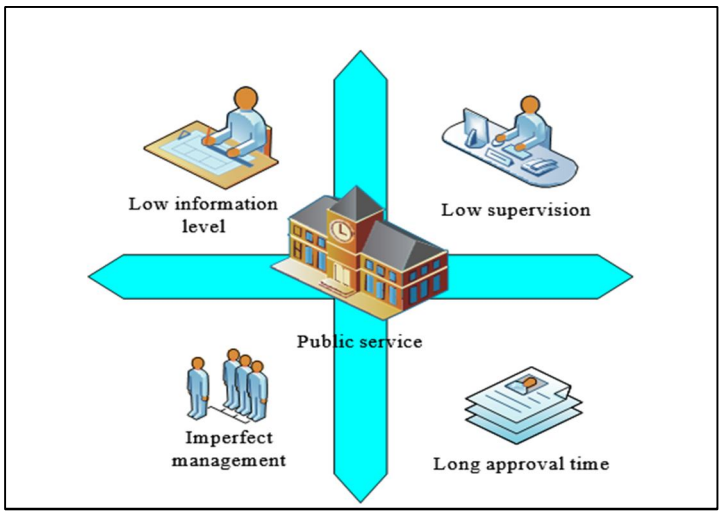

Figure 2: Factors that Contribute to Issues

Furthermore, big data and network-related technologies do not have adequate technical support or implementation. Governments at all levels are still in the research phase while providing services, and the level of information technology and regulatory capability needs to be raised. Fourth, oversight is inadequate. The application capability and level of information technology are not optimal, which impacts the quality of management and prevents the advancement of precise management, according to the results of the existing monitoring and service results [20].

IV. UNDERSTANDING THE ORGANIZATION OF PUBLIC CLOUD SERVICES IN DETAIL AS DEFINED BY BIG DATA

The five elements of the template for the precise administration of public cloud services powered by big data are shown in Figure 3. Big data technology has intrinsic benefits that traditional methods of determining the needs of the public sector in the digital age cannot match. A trustworthy source of information about the needs of the government is the vast volume of data compiled in the Service of Public Dataset. Big data processing innovation can simultaneously address the issue of low service utilisation of public data due to technical deposits and operational responsiveness. The need for government services can be precisely determined by using network infrastructure to evaluate the dependability of the provision of public information flow.

Big data-driven data collection of cloud-based governmental services can also combine and examine data about community service requirements from the perspective of data gathering, and evaluate the public's needs for offerings, goods, and regulations from the perspective of various request objects. Government agencies can more easily identify different cloud-based government services thanks to big data collecting techniques, enabling the accurate collection of information on service requirements for the general public. By gathering the necessary data regarding cloud-based public services, it can create a precise grouping of government service requirements and act as a benchmark data set for measuring service of public necessities.

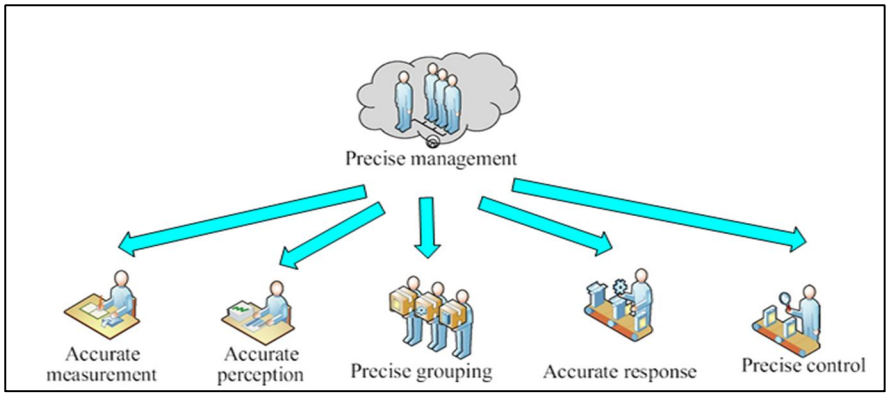

Figure 3: Big data-driven design of a comprehensive public cloud service organization

Following the integration and identification of service of public requirements, it is necessary to accurately measure the quality and quantity of service of public requirements using innovations like big data information gathering, insightful analysis, and parallel systems, and it is also necessary to empirically differentiate between the significance and urgency of service of public requirements. Based on more accurate service of public market information and the implementation of technologies such as big data user photos, it is determined to conduct a multiple-stage assessment of the service of public supply to build a basis for assessing the decline in service of public demand. Additionally, the process of successfully meeting governmental demands can precisely determine what the general public needs.

Meeting the needs of the public is one of the main goals of providing high-quality cloud-based services [20]. In order to improve the scientific decision-making capacity of cloud-based government services and the improvement of urban resource allocation effectiveness, accurate requirement organisation can be elevated [20]. This will ensure the reliability of cloud-based government services and will contribute to meeting government service requirements. As a result, quick-response cloud-based government services have grown from traditional public fulfilment services using perfectly matched digital technology and artificial intelligence. The strict regulation of government service supply is the most important factor for the further precise organisation of the service of public demand. To gather more precise data, it simultaneously combines a greater understanding of government service supply with the creation of a closed chain in the organisation of public services. By utilising deep learning techniques to create real-time forecasting and monitoring models of the public's supply, it is possible to gain comprehensive information on public services that is crucial for marketing [11, 12]. In addition to assisting the platform in providing accurate analysis and information, the development of a public research study and feedback platform and increased public engagement would also successfully and exhaustively reflect the requirements of cloud-based government services, enabling it to accurately construct a structure for accurate organisation and enhance service of public necessities.

V. FUZZY COMPLETE TECHNIQUE

The effectiveness of cloud-based government services is evaluated using the fuzzy appropriate assessment method in order to understand how well they manage huge data. By creating an affiliation matrix, a fuzzy detailed assessment aims to evaluate the quality of service provided by public organisations. The first step in creating the excellence of cloud-based public facilities is to construct the pointer set A, which may be gained as follows:

$$A = \{a_1, a_2, \dots\dots, a_m\} \quad (1)$$

$a_1, a_2, \dots\dots, a_m$ are the assessment pointers among them. The effect assessment index's observation set B is then constructed, and it looks like this:

$$B = \{b_1, b_2, \dots\dots, b_m\} \quad (2)$$

$b_1, b_2, \dots\dots, b_m$ are comments on cloud-based public facilities, respectively. After that, the assessment set C of the assessment pointers can be identified as follows in accordance with the assessment pointers and remarks:

$$C = \{c_{i1}, c_{i2}, \dots\dots, c_{im}\} \quad (3)$$

The evaluation matrix C for public service is established following the assessment set as follows:

$$C = (c_{ij})_{m\times n} = \begin{bmatrix} c_{11} & \cdots & c_{in} \\ \vdots & \vdots & \vdots \\ c_{m1} & \cdots & c_{mn} \end{bmatrix} \quad (4)$$

The matrix's fundamentals are standardised to fulfil Equation (5), and there are then:

$$\sum_{i=1}^{m} c_{ij} = 1, j = 1,2, \dots, n \quad (5)$$

The weight set H of the public assessment service over Equation (5) can be obtained as follows:

$$H = \{h_1, h_2, \dots\dots, h_m\} \quad (6)$$

$$\sum_{i=1}^{m} h_{ij} = 1, h_i \geq 0 \quad (7)$$

The standardisation and non-negativity are satisfied by the weight in equation (7). The fuzzy assessment vector X can be obtained by using fuzzy comprehensive assessment to evaluate the service excellence of the organisation as follows:

$$X = H_0 C = \{x_1, x_2, \dots\dots, x_n\} \quad (8)$$

According to the matrix's properties, the fuzzy evaluation matrix for X can be obtained as:

$$H = (h_1, h_2, \dots\dots, h_m) o \begin{bmatrix} c_{11} & \cdots & c_{in} \\ \vdots & \vdots & \vdots \\ c_{m1} & \cdots & c_{mn} \end{bmatrix} \quad (9)$$

The unipolar assessment design X_i can be determined using the assessment matrix as follows:

$$X_i = H_i oC_i = \{x_{i1}, x_{i2}, \ldots\ldots, x_{in}\}, i = 1,2, \ldots, s \quad (10)$$

The data entropy R of the service of public excellence can be intended as follows using the two-level assessment design:

$$R = \frac{1}{lnX} \sum_{i=1}^{x} X_i \ln X_i \quad (11)$$

VI. ANALYSIS OF THE PRECISE ORGANISATION OF PUBLIC CLOUD SERVICES AS DETERMINED BY BIG DATA

To better understand the effects of accurate organisation, this study endeavour assesses the impact of accurate organisation on cloud-based services used by the public that are influenced by big data. The first societies in a city that were investigated for their fulfilment by data-driven organisations were three. There were 100 members in each society, and levels of satisfaction were broken down into three groups: comfortable, overall, and dissatisfied. The specific survey findings are shown in Table 1.

Table 1: Big data influences three groups' contentment with precise organisation

Categories	Comfortable	Overall	Unsatisfied
Category 1	83	9	6
Category 2	89	6	8
Category 3	86	10	5

The data in the preceding Table shows that people in the three categories were generally satisfied with the level of cloud-based public services powered by big data. 83% of respondents in Category 1 were satisfied, 89% of respondents in Category 2, and 86% of respondents in Category 3. 86% of the three categories were satisfied overall, with only 6.5% not satisfied. Since cloud-based public services can not only give targeted service contracts but also bring diversified and accurate services, those in this category who were satisfied assumed that they could satisfy the majority of their cultural, living, and tourist needs. Even though big data technology would monitor requirement data in real-time and feed analytical results to a sizable database, many who were unsatisfied feared that their data would be monitored and maybe leaked.

VII. ANALYSIS OF THE TECHNICAL AND SERVICE LEVEL OF PUBLIC CLOUD SERVICES BASED ON BIG DATA

To comprehend the impact of big data-driven cloud-based services on the public, this study paper studied the technological level and service level of cloud-based public service during a week of practice. Figure 4 illustrates the detailed analysis. The information in the aforementioned Figure shows how public cloud-based services' technical and service standards have been rising over time. In terms of the technical level, the mean was 1.44, and the seventh day was 0.9 better than the first. The mean for the service level was 0.90, and the seventh day was 0.14 better than the first. The advancement in both service quality and technical level showed that big data-driven requirement recognition for cloud-based public services was more accurate and that it was possible to manage the quality of service for cloud-based public services by monitoring service of public requirements in real-time.

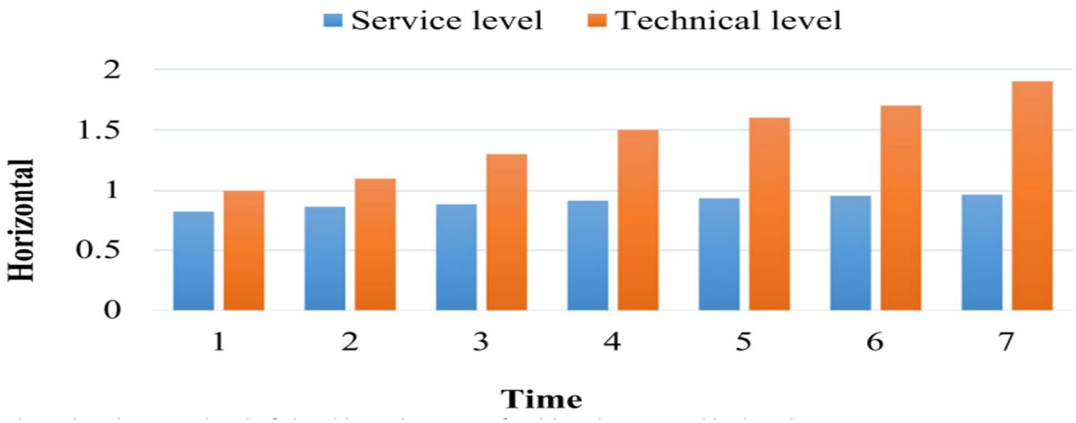

Figure 4: Analysis of the technical and service level of public cloud services based on big data

VIII. EXPERIMENTAL EVALUATION OF A THOROUGH FUZZY ASSESSMENT METHOD

In order to understand the organisational impact of cloud-based public services, this paper used a fuzzy appropriate evaluation approach to examine the model value and knowledge entropy of accuracy organisation. Figure 5 shows a thorough analysis. The statistics in the accompanying Figure demonstrate that as time went on, the model and data entropy of public cloud-based services increased in value. The associated level of entropy was approximately 0.98, and the average design value of accurate organisation of cloud-based public services was roughly 4.35. This proved that the accurate organisation of cloud-based public services using big data was successfully done. Additionally, the exact organisational structure was more in tune with the needs of the people and could better handle the problem of the people's various needs. According to data entropy, information on community requests was gathered under cloud-based public service extremely quickly and accurately, enabling a more precise fulfilment of public requirements.

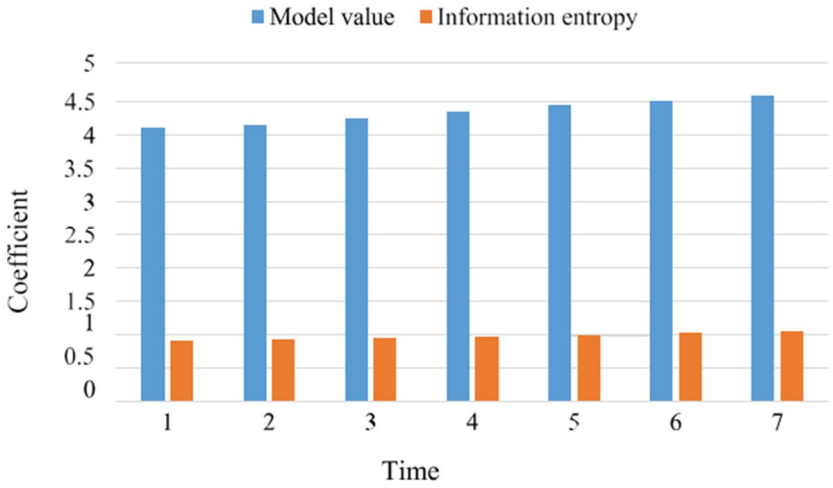

Figure 5: Experimental evaluation of a thorough fuzzy assessment method

IX. COMPARISON OF THE EFFECTIVENESS AND REACTION TIME

The effectiveness and reaction times of the public cloud-based services are compared in this section. Job searching, education, insurance, healthcare, entertainment, and relaxation are some of these services. This experiment was conducted as follows: Participants in this experiment were recruited at random from a pool of cloud clients. To provide these clients with the cloud services they demand, they will utilise the framework to purchase the services they need and will keep track of how quickly the chosen user's cloud-based service responds. It was also compared to the response time of comparable services provided by other public cloud platforms in order to associate and assess the efficacy of the cloud-based public service to provide cloud services. The test results for the reaction time and constant efficacy necessary to provide these cloud-based services are shown in Figures 6 and 7. The findings of the first test are shown in Figure 6a, while the outcomes of the second test are shown in Figure 6b. Similar to this, 7(a) and 7(b), respectively, can be used to illustrate the third and fourth tests' results in Fig. 7.

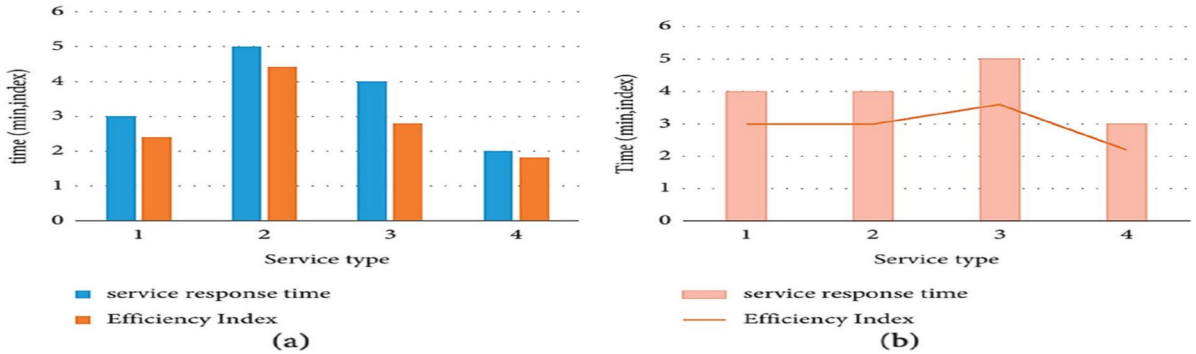

Figure 6: Response time and effectiveness of cloud-based services (first and second) comparison

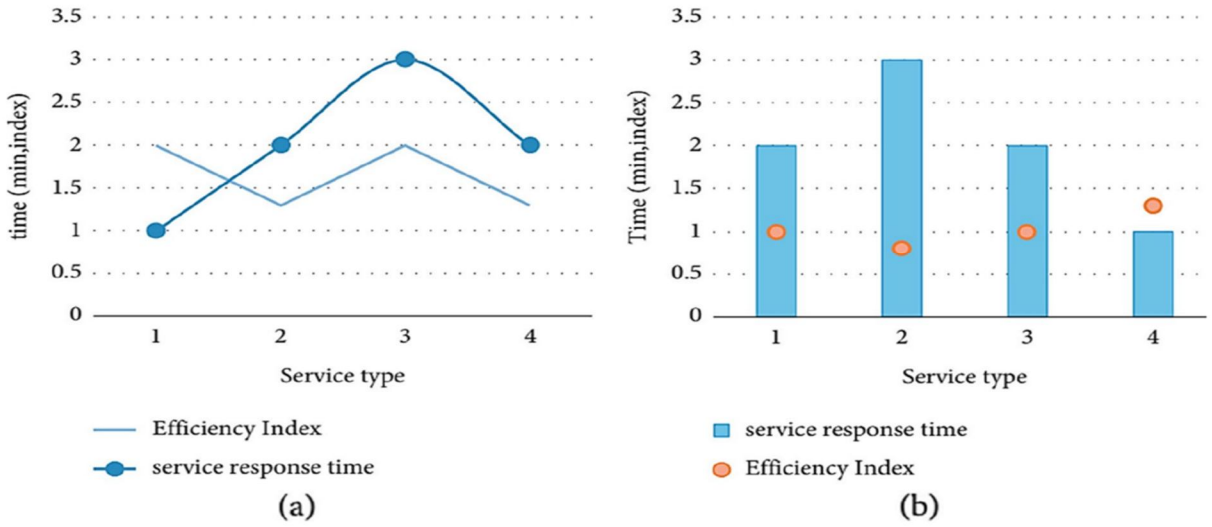

Figure 7: Response time and effectiveness of cloud-based services (third and fourth) comparison

These numbers show that the typical response times for public cloud-based services are 3.51 minutes, 4.52 minutes, 4.5 minutes, and 2.51 minutes, respectively.

To understand the true impact of the accurate organisation of cloud-based service publics powered by big data, this study looked at the organisational benefits and overall efficacy of the traditional accurate organisation of cloud-based service publics. The aforementioned graph demonstrates that, in terms of organisational effectiveness and overall efficacy, big data-driven accurate organisation of cloud-based service publics was more effective than the traditional correct organisation of cloud-based service publics. Organisation efficacy outperformed conventional efficacy by 7%, and efficacy outperformed conventional efficacy by 9%. Public service is improving quickly as a result of big data and the performance of cloud-based services. A statistical analysis of the public's service needs was carried out using big data technology for data collection and recognition. The objective is to compile the service needs of the populace and then give accurate organisation based on those needs. This can effectively guarantee organisational accuracy while fostering the improvement of the quality of public cloud-based services.

X. CONCLUSION

As a result of the comprehensiveness, accuracy, and relevance of big data information, it is incorporated into cloud-based services offered by organisations that support accurate organisations with technological support. By creating a refined big data-based service of public organisation model and a cloud-based service of public big data material with a defined structure and morphology. It not only streamlines the public service process, but it also significantly increases its effectiveness. utilising big data expertise to provide technical support for a precise organisation that is both scientific and effective. More specifically, the organisation function of contemporary technology in the field of public service, along with the assistance and support of monitoring data, streamlines the effective operation of all service associations. This guarantees the dependability and accuracy of service organisation effectiveness as well as the wholesome development of cloud-based public services for local governments. We'll create a public service management system in the future that combines machine learning, cloud computing, and the Internet of Things for better administration.

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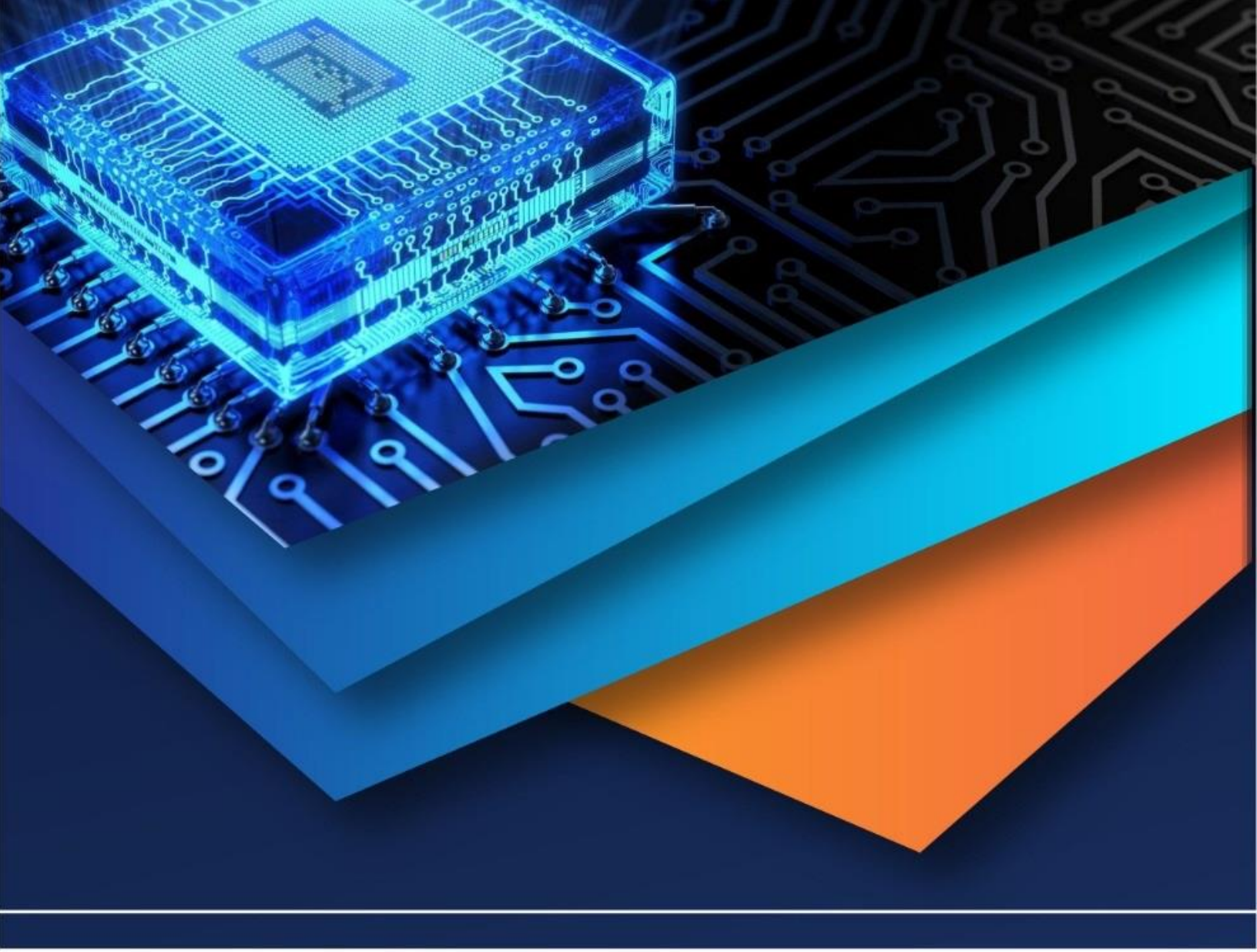

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