

Automation of Data Management Processes in Cloud Storage

Volodymyr Shapoval¹, Liudmyla Zubyk¹, Yaroslav Zubyk², Oleg Kurchenko¹, and Valerii Kozachok³

¹ Taras Shevchenko National University of Kyiv, 60 Volodymyrska str., Kyiv, 01601, Ukraine

² National University of Water and Environmental Engineering, 11 Soborna str., Rivne, 33028, Ukraine

³ Borys Grinchenko Kyiv Metropolitan University, 18/2, Bulvarno-Kudriavska Str., Kyiv, 04053, Ukraine

Abstract

In the modern world, with the development of informational, scientific, and technical resources, data volumes are rapidly increasing. Cloud services become critically important for supporting and optimizing the management of large amounts of data. With the advancement of technologies, there is a need to enhance methods of managing vast amounts of information. Modern requirements for efficiency and security pose a challenge to business sectors, and it is precisely here that the automation of processes in cloud services becomes key to achieving a high level of functionality and protection. In this article, we will explore the importance of process automation in cloud services, how these technologies contribute to optimizing data management, and ensure security in processing a large volume of information.

Keywords

Databases, business sectors, cloud storage, security.

1. Introduction

In recent years, the volumes of data generated and processed have reached record levels. Business corporations, research institutions, government entities, and ordinary users mostly utilize cloud services for storing and processing their data. This is convenient, easy, and saves physical memory. However, how can the process of working with cloud storage be made more efficient and secure? Automation of data management processes comes to the rescue.

Cloud storage confidently expands its user base, growing in size and quantity every year. This allows for saving space on personal computers and smartphones when storing personal data, photos, videos, and work files. It also improves document logistics in the business sector, making the role of cloud services in managing large data volumes more prominent [1]. However, ensuring high

productivity and protecting the processing of large amounts of information over time becomes an increasingly complex task, the solution to which is the automation of data management in cloud services.

2. Formulation of the Problem

With the increasing volumes of data, the demand for quick and efficient access has risen. It is not only about storing large amounts of information but also ensuring that users can access it instantly. Cloud services, coupled with automation systems, become critically important for optimizing this process.

Cloud automation is the process of using software tools and scripts to perform tasks and workflows in a cloud-based infrastructure, such as provisioning, scaling, monitoring, and managing resources. Cloud automation can help you improve the efficiency, reliability,

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EMAIL: volodymyr.sh.05@gmail.com (V. Shapoval); zubyk.liudmyla@knu.ua (L. Zubyk); zubyk123@gmail.com (Y. Zubyk); oleg.kurchenko@knu.ua (O. Kurchenko); v.kozachok@kubg.edu.ua (V. Kozachok)
ORCID: 0009-0002-6676-2975 (V. Shapoval); 0000-0002-2087-5379 (L. Zubyk); 0000-0002-0802-3552 (Y. Zubyk); 0000-0002-3507-2392 (O. Kurchenko); 0000-0003-0072-2567 (V. Kozachok)



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security, and cost-effectiveness of your cloud operations [2].

Security and confidentiality become pressing concerns with large data volumes [3]. Information stored and processed in substantial quantities becomes an attractive target for cybercriminals [4, 5]. Ensuring a robust security system against unauthorized access and preserving confidentiality becomes a task of paramount importance [6].

Achieving synergy and integrating diverse sources of information is a crucial aspect of managing large volumes of data. Modern enterprises face the challenge of consolidating and analyzing data from various sources to gain a comprehensive picture and make strategic decisions based on informed analyses.

Furthermore, scalability is imperative. The infrastructure supporting the management of this data must be flexible and ready to handle dynamic changes in information volume.

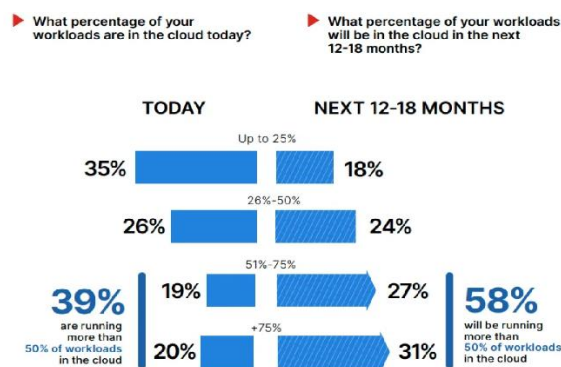


Figure 1: Fortinet's survey of the percentage of workloads businesses run in the cloud in 2022

Effective management of large data volumes also requires constant updates and optimization of IT infrastructure. This includes enhancing servers, increasing computational power, and continuously adopting new technologies [7].

It's also worth noting that cloud workloads are growing almost every month. About 39% of respondents are already running at least half of their workload on the cloud. Another 58% said they planned to run that much workload in the cloud in the next 12–18 months. By 2023, 31% of organizations expect to run 75% of their workloads in the cloud. Some 27% of them plan to run at least 50% of their business processes in the cloud by then [8].

In such a way, in a world where data volumes surpass all conceivable limits, efficient management of this information becomes the key to success. The challenges faced by

enterprises in managing large data volumes demand innovative and effective solutions. Cloud services, together with automation systems, not only enable the storage of vast amounts of data but also optimize their processing, ensuring a high level of efficiency and security. Addressing these challenges is a step towards achieving not only technological progress but also business success in the era of digitization [9].

3. Methods of the Research

Research methods—we will use Internet resources, and the opinions of specialists in the field of data science, and we will analyze everything. In other words, we will apply the method of observation and comparison.

4. Comparison of Different Cloud Services for Storage and Working with Data

Competition between big corporate players like Dropbox, Google Drive, and OneDrive, and the emergence of privacy-oriented providers like Sync.com, pCloud, and MEGA, has been a boon for consumers [10].

We have conducted extensive research, testing all the features of the above-mentioned services to assess whether they perform as advertised. We have analyzed the security of the services, including encryption protocols and secure storage methods. Finally, we have conducted technical tests to evaluate their performance in terms of speed, RAM usage, and processor utilization.

Sync.com stands out as a leading cloud service, consistently securing top rankings in numerous cloud storage assessments. Renowned for its exceptional security measures, it continues to enhance its offerings and introduce new features as the service evolves and expands.

To start with, Sync.com comes with zero-knowledge encryption as standard. This means that if there was a security breach or the authorities demanded access to your account, the intruder would only see scrambled data because you're the only one holding the encryption key. To add to this, Sync.com offers advanced sharing controls, including passwords, download limits, and expiry dates for sharing

links. Plus, Sync.com allows you to create and edit Microsoft Office documents (including Word, Excel, and PowerPoint documents) in a privacy-friendly collaboration environment, without breaking zero-knowledge encryption [10].

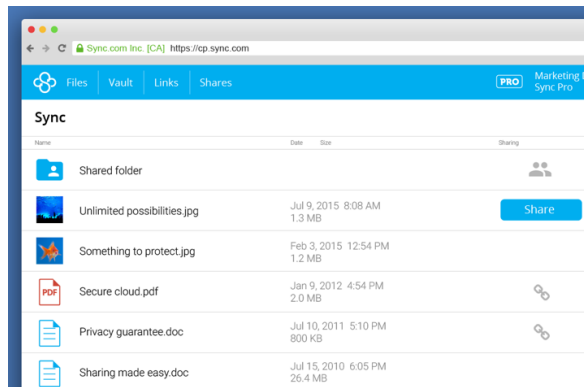


Figure 2: Sync.com graphical user interface

pCloud boasts several distinctive features presented within an elegant and secure framework. It is particularly well-suited for enthusiasts of multimedia content. This is attributed to the embedded pCloud music player, which ingeniously generates playlists based on artists, albums, or folders. Additionally, its video player is notably sophisticated, allowing users to adjust playback speed and convert video files to alternative formats. Furthermore, pCloud can create a virtual drive on your device, akin to Local Disk (C:), utilizing your cloud storage instead of relying on your hard drive's storage space.

If you're a creator who loves to post on social media, pCloud lets you back up images that you previously uploaded to your socials as part of its backup feature. This feature also lets you back up your entire device to the cloud, or even move all your files from another cloud service to pCloud.

pCloud doesn't offer zero-knowledge encryption out of the box, which is a downside. You'd have to pay for this protection—called pCloud Crypto. With pCloud Crypto, you get a specific folder to store your files that you want to be protected with zero-knowledge encryption. Anything outside of pCloud Crypto can still be read by pCloud's servers, allowing you to preview files or play content from within the app [10].

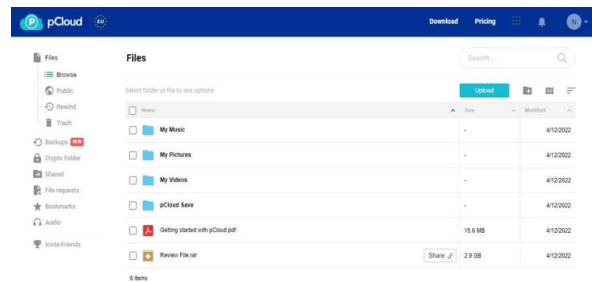


Figure 3: pCloud graphical user interface

Within the realm of cloud computing, Microsoft stands as a prominent force. With a comprehensive foray into virtually every computing market, it comes as no surprise that Microsoft has entered the arena of online storage through its OneDrive service. This service seamlessly integrates with other Microsoft offerings, such as Office, and is intricately woven into the Windows operating system.

The collaborative capabilities of OneDrive are noteworthy—allowing users to share documents stored in the cloud and enabling multiple users to collaborate in real time. Changes made by any contributor are immediately visible to all others, ensuring seamless cooperation, with automatic cloud-based saving. This robust system alleviates concerns about potential data loss due to hard drive failures, providing peace of mind, even for extensive documents.

However, there are also drawbacks to consider. OneDrive lacks zero-knowledge encryption, meaning that your data is accessible to Microsoft and any unauthorized parties who might gain entry to its servers, whether legally or otherwise. It's crucial to acknowledge that being a U.S. company, Microsoft's servers are located within the United States, exposing your data to potentially intrusive laws like the Freedom Act.

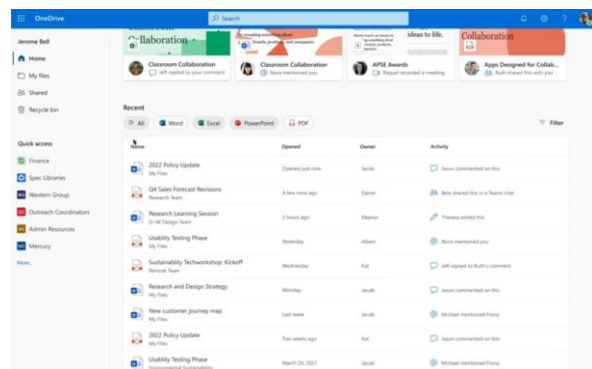


Figure 4: OneDrive graphical user interface

We have explored the top three cloud services for data management, as rated by experts. We have identified the features, advantages, and drawbacks of each, and now we can proceed to investigate methods for automating data management in cloud services to enhance speed and efficiency in working with them.

5. Methods of Automating Data Management in Cloud Services

As previously mentioned, data management automation in cloud services allows for increased efficiency, security, and convenience in working with large volumes and diverse types of data. To implement these capabilities, several methods can be utilized, with the best ones being:

- Using cloud databases.
- Database integration.
- Resource monitoring and management systems.
- Robotic Process Automation (RPA) tools.
- Data security.
- Data analysis systems.
- Backup and archiving.

Let's start with a detailed overview of each method and its impact on data management in cloud storage.

Cloud databases, as discussed in section 3 and similar ones, provide flexibility and high availability. They allow instant resource scaling according to business needs, enabling the storage and processing of large volumes of data without delays or loss of productivity.

One of the key advantages is the automation of backup processes. Cloud databases allow for the automatic creation of regular backups, storing information in a secure cloud repository. This provides guarantees for system recovery in case of data loss or other incidents. However, let's delve further into the details of backup automation.

Now, let's discuss the use of integration solutions. Data integration solutions work by extracting data from the various stored systems and loading it into a central repository. The data can then be analyzed and used to improve business processes [11].

Integration solutions enable the configuration of automated data exchange processes that operate in real-time or on a specified schedule. This helps avoid delays in

information updates and ensures data consistency across all systems.

There are several components involved in this process:

1. **Data profiling.** Data profiling tools identify the information within an existing system and store it in a central repository. This allows businesses to see all of their data in a single place.
2. **Data cleansing.** Data cleansing tools remove inaccuracies and inconsistencies from data, ensuring that it is clean and ready for use.
3. **Data transformation.** Data transformation tools make it possible for you to combine data from multiple sources into a single repository. This allows businesses to analyze the data and make informed decisions.
4. **Data mining.** Data mining tools allow businesses to find trends and patterns in their data. Teams can use this to improve business processes or identify new opportunities.

Across the data lifecycle, data integration solutions are critical for maintaining data quality and making the most of every piece of available information [11].

One of the key advantages is the creation of a unified control point for data exchange. Integration platforms such as Apache Camel, MuleSoft, or Dell Boomi provide tools for easy integration between different systems. This allows for the automated extraction of data from various cloud services or local systems, regardless of their architecture or format.

Monitoring systems in cloud services play a critical role in ensuring efficiency and stability. Cloud monitoring is a method of reviewing, observing, and managing the operational workflow in a cloud-based IT infrastructure. Manual or automated management techniques confirm the availability and performance of websites, servers, applications, and other cloud infrastructure. This continuous evaluation of resource levels, server response times, and speed predicts possible vulnerability to future issues before they arise [12]. Systems like AWS CloudWatch, Google Cloud Monitoring, or Azure Monitor allow real-time tracking of the state of various components and services, enabling timely responses to any issues.

This technique tracks multiple analytics simultaneously, monitoring storage resources and processes that are provisioned to virtual machines, services, databases, and applications. This technique is often used to host Infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS) solutions. For these applications, you can configure monitoring to track performance metrics, processes, users, databases, and available storage. It provides data to help focus on useful features or to fix bugs that disrupt functionality [12].

So what is the biggest benefit of leveraging cloud monitoring tools?

In our mind, this is the automatic detection of anomalous activity, helping operators respond promptly to problems and avoid potential service failures.

Scaling for increased activity is seamless and works in organizations of any size. It comes in handy here, as it enhances resource utilization efficiency and ensures optimal system performance.

For example, in cloud services, there are automatic scaling capabilities based on established metrics or rules. When certain parameters, such as CPU load or request volume, exceed predefined thresholds, the system can automatically expand resources, adding new servers or increasing the capacity of existing ones. This prevents disruptions during peak loads and saves costs during periods of less intensive requests.

Automated scaling also contributes to cost optimization, as resources can dynamically change according to the actual needs of the system. This is a crucial element of resource management strategies aimed at ensuring not only efficient resource utilization but also cost savings for the enterprise.

Robotic Process Automation (RPA) uses automation technologies for tasks of human workers, such as extracting data, filling in forms, moving files, et cetera. It combines APIs and User Interface (UI) interactions to integrate and perform repetitive tasks between enterprise and productivity applications. By deploying scripts that emulate human processes, RPA tools complete the autonomous execution of various activities and transactions across unrelated software systems [13].

This form of automation uses rule-based software to perform business process activities at a high volume, freeing up human resources to

prioritize more complex tasks. RPA enables CIOs and other decision-makers to accelerate their digital transformation efforts and generate a higher Return On Investment (ROI) from their staff [8].

Now let's take a look at how RPA works. RPA software tools must include the following core capabilities:

- Low-code capabilities to build automation scripts.
- Integration with enterprise applications.
- Orchestration and administration including configuration, monitoring, and security [13].

Automation technologies, such as RPA, possess the capability to access data from older systems and seamlessly integrate with various applications through front-end connections. This enables the automation platform to emulate human actions, executing repetitive tasks like logging in and transferring information between different systems. Although back-end connections to databases and enterprise web services contribute to automation, the true strength of RPA lies in its rapid and uncomplicated front-end integrations.

There are numerous advantages to utilizing RPA. It doesn't necessarily demand the expertise of a developer for configuration; user interfaces with drag-and-drop features simplify the onboarding process for non-technical personnel.

As RPA lightens the workload for teams, staff members can be reassigned to more critical tasks requiring human input, resulting in heightened productivity and ROI.

Bots and chatbots operating continuously contribute to reduced customer wait times, leading to increased customer satisfaction rates.

By relieving teams of repetitive and high-volume tasks, RPA enables individuals to concentrate on more thoughtful and strategic decision-making, positively impacting employee happiness.

Programming RPA robots to adhere to specific workflows and rules diminishes human error, especially in tasks requiring precision and compliance with regulatory standards. RPA also facilitates easy progress monitoring and prompt issue resolution through the provision of an audit trail.

The implementation of robotic process automation software is non-disruptive to underlying systems since bots operate on the presentation layer of existing applications. This makes it feasible to deploy bots in situations where an application programming interface is absent or resources for deep integrations are limited.

The “data security” method involves the implementation of intelligent data processing systems that utilize advanced analysis and forecasting technologies to enhance the security and efficiency of data management.

One of the key features of this new approach to data security in cloud services is the use of AI. AI plays a pivotal role in threat intelligence and proactive defense mechanisms within data security frameworks. Advanced AI algorithms continuously analyze vast amounts of data from various sources, including threat intelligence feeds, dark web monitoring, and historical security incidents. This enables the system to identify potential threats before they manifest and allows for preemptive measures to be taken, preventing security breaches.

Another crucial aspect of AI in data security involves the development of Explainable AI (XAI) systems. As data security measures become more complex, understanding the decision-making processes of AI algorithms becomes paramount. XAI provides transparency by explaining how AI systems arrive at specific conclusions, making it easier for cybersecurity experts to validate and trust the results. This transparency also aids in regulatory compliance, as it becomes essential to demonstrate the logic behind security-related decisions.

Continuous monitoring and adaptive learning are fundamental components of AI-driven data security. These systems not only detect anomalies but also adapt their models based on evolving threats and changing patterns. Through continuous learning, AI algorithms improve their accuracy in distinguishing between normal and suspicious activities, reducing false positives and enhancing the overall effectiveness of security measures.

Furthermore, AI contributes to the development of predictive analytics in data security. By analyzing historical data and identifying patterns, AI systems can predict potential future security threats. This

proactive approach allows organizations to implement preemptive measures, strengthening their defense mechanisms and minimizing the impact of potential security incidents.

Collaborative threat intelligence is another area where AI excels in data security. AI systems can facilitate information sharing and collaboration among different organizations, enabling a collective defense against sophisticated cyber threats. This collaborative approach enhances the overall cybersecurity posture of the entire ecosystem, as organizations can learn from each other’s experiences and share insights into emerging threats.

Thus, the integration of AI into data security measures goes beyond anomaly detection and encryption. It extends to proactive threat intelligence, explainability, continuous monitoring, adaptive learning, predictive analytics, and collaborative defense strategies, creating a comprehensive and robust framework for safeguarding sensitive information in the digital landscape.

Emerging technologies allow for the implementation of dynamic data encryption at the task or task level. Instead of constant encryption of all data, the system automatically identifies specific pieces of information that require additional protection. This ensures an optimal balance between security and productivity, adapting to specific requirements and usage scenarios.

The integration of blockchain technologies with data management systems in clouds becomes an innovative solution to ensure the reliability and integrity of data. Each transaction or change in a cloud service can be recorded in a distributed ledger, providing trust in information and irreversible changes. This is particularly crucial for critical business data and information subject to regulatory requirements.

Innovative systems enable the creation of personalized data protection strategies for each user or role within an organization. This means that different data categories can have varying levels of protection depending on their value and confidentiality. By addressing each user individually, the system becomes more adaptive and efficient in risk management.

These innovations in data security within cloud services not only elevate the level of

information protection but also empower businesses to be more flexible and effective in managing large volumes of data in the modern digital environment.

Security is the top benefit of cloud computing, according to 60% of C-Suite executives—ahead of cost savings, scalability, ease of maintenance, and speed [8].

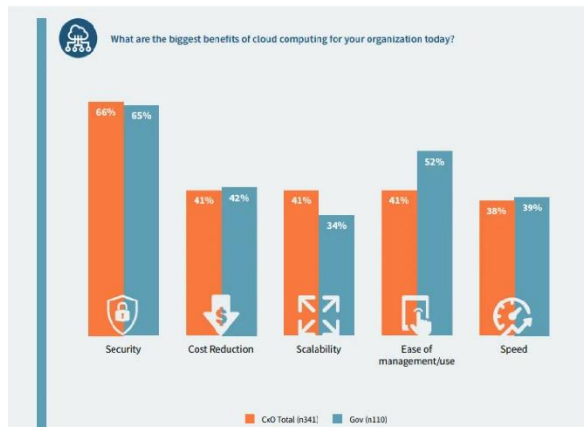


Figure 5: Oracle’s Security in the Age of AI Report

It makes sense, considering they also cited human error as the most significant threat to security. The cloud supports automation, which reduces the risk of human errors that cause security breaches [8].

The data analysis system can automatically gather information from various sources in cloud services. This includes structured and unstructured data from databases, file systems, applications, and other resources. The data can be processed automatically and is ready for analysis, effectively saving time and resources.

This system utilizes advanced analysis algorithms to identify patterns and trends in large volumes of data. This allows for obtaining deep insights that can serve as the foundation for strategic decision-making and forecasting future events.

The data analysis system can automatically generate analytical reports and dashboards, presenting essential key performance indicators and analysis results. This helps quickly identify trends and issues, enhancing decision-making efficiency at all levels of the organization.

Additionally, this system can operate in real-time, enabling organizations to instantly respond to changes in large datasets. Furthermore, through predictive analysis, the

system can provide recommendations for optimizing business processes and strategies.

Automating data management in cloud services through a data analysis system is a crucial component for companies seeking to efficiently leverage vast amounts of information. It not only streamlines decision-making processes but also provides business analysts and managers with valuable insights for the strategic development of the company.

Backup is a crucial part of a data security strategy because it provides for recovering data from hardware failure, data corruption, or other loss [14]. Data management systems in cloud services can automatically create backups of all critical data, storing them in secure accounts. This allows for data recovery in case of accidental deletion, loss, or cyber-attacks.

An essential aspect of effective backup is the regularity of the process. Data management automation systems can establish backup schedules, ensuring regular and recurring data preservation. This not only guarantees the relevance of copies but also reduces losses in unforeseen events.

Data archiving helps manage space limitations and long-term data retention [14]. Automated systems can automatically move older, less active data into archives, freeing up active storage for more current information. This optimizes resources and provides access to necessary information when needed.

Automation systems should provide monitoring capabilities for backups and archives, notifying about any anomalies or failures in the copying processes. Additionally, having contingency plans for data recovery is crucial and can be automatically triggered when necessary [15–22].

This approach not only minimizes the risks of data loss but also enables companies to effectively utilize their resources and focus on the strategic use of information for development and innovation [23–27].

6. Conclusions

In conclusion, the comparison of leading cloud services for storage and data management reveals a diverse landscape catering to different user preferences and needs. Sync.com stands out for its robust security features,

including zero-knowledge encryption and advanced sharing controls, making it a preferred choice for privacy-conscious users. pCloud distinguishes itself with multimedia-centric features, a virtual drive option, and social media backup capabilities. However, its lack of default zero-knowledge encryption may be a drawback for users prioritizing enhanced data privacy.

On the other hand, Microsoft OneDrive's integration with the Microsoft ecosystem and seamless collaboration tools make it a compelling choice for users heavily invested in Microsoft products. However, the absence of zero-knowledge encryption raises concerns about data privacy, especially given the jurisdiction of U.S.-based servers.

Transitioning to methods for automating data management in cloud services, the discussed approaches offer diverse benefits. Cloud databases provide flexibility and high availability, allowing for instant resource scaling and automated backup processes. Integration solutions enhance data exchange processes, ensuring real-time updates and data consistency. Resource monitoring and management systems, such as AWS CloudWatch or Azure Monitor, contribute to efficiency and stability by tracking various components and predicting potential issues.

Robotic Process Automation (RPA) tools streamline repetitive tasks, freeing up human resources for more complex activities. RPA's ease of configuration and non-disruptive implementation make it an attractive option for organizations aiming to enhance productivity and ROI. Data security measures, including AI-driven anomaly detection and dynamic data encryption, address evolving threats, providing a balance between security and productivity.

Furthermore, the integration of blockchain technologies enhances data reliability and integrity in cloud services, catering to businesses with critical data subject to regulatory requirements. Data analysis systems automate the processing of diverse data sources, offering deep insights and real-time responses to changes. Lastly, backup and archiving systems, when automated, ensure regular data preservation, reduce the risks of data loss, and optimize storage resources for improved strategic decision-making and innovation.

In summary, the combination of robust cloud services and advanced automation methods provides users and organizations with a powerful toolkit for secure, efficient, and strategic data management in the modern digital environment. Users must carefully weigh the features and trade-offs of each cloud service and automation method based on their specific requirements and priorities.

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