

To what extent is cloud computing changing traditional IT in small and medium-sized enterprises, and what challenges and opportunities does it create?

Zhengshangfeng Zhan

HUST Middle School, Wuhan, China

13871381926@139.com

Abstract. This study explores how cloud computing influences operational efficiency and cost performance in Small and Medium-sized Enterprises (SMEs) compared to traditional IT systems. Under the digital transformation, SMEs face increasing pressure to improve flexibility and efficiency, reduce costs, and respond quickly to market changes. Though revisit academic journals, industry reports, and case studies from 2013 to 2025 in a systematic way. According to the research, cloud computing can significantly lower investments during the early stage and costs of continuous maintenance while promoting scalability, operational agility, and collaboration. It also shows improved data analysis, product development, and market responsiveness. Case studies about Marais USA and SMEs in Kampala show that the benefits of cloud adoption mainly depend on technological standard, strategic countermeasure, and regional infrastructure, with noticeable differences between developed and developing areas. However, there are still a lot of risks that need to be taken seriously. Not only data security and privacy remain major points, but system reliability and cross-platform interoperability also cause technical risks and skills gaps and financial investment also limit SMEs' ability to fully utilize cloud technologies. Although emerging approaches such as edge-cloud computing paradigm, multi-cloud strategies, and green generative AI show opportunities to enhance efficiency, resilience, and sustainability, but still require careful implementation and adequate technical capacity. Ultimately, cloud computing can provide substantial benefits to SMEs in cost reduction and flexibility of operations. The proof is that cloud computing is more significant to enhance the operation of SMEs than the traditional IT system although there are differences on its impact based on enterprise size, region and digitally degree. SMEs must take a strategic and professional view of the use of cloud computing potential realization if they are to play to their full, with the support of policy and technological progress.

Keywords: cloud computing, SMEs, operational efficiency, cost performance, digital transformation

1. Introduction

Cloud computing has become one of the major technologies in this digital era, reshaping the way enterprises store data, access software, and manage their daily operations. Unlike traditional systems, which require companies to put in a large investment to buy equipment and maintain facilities, even when equipped with

specialized technical personnel. Cloud computing provide shared computing resources on demand through the internet, reducing the cost during the stared period and making enterprises to extend resources according to demand. For SMEs which are lack financial resources and emerged technology keeping complex IT framework, cloud service is not only a new technology option, but also an opportunity to break up traditional modal and promote efficiency.

In the past decades, the cloud has already had a deep impact on the operation mode of SMEs. Some services in it, such as cloud storage, Software-as-a-Service (SaaS), and virtual computing environments, have enabled SMEs to adopt tools that were once accessible only to larger corporations. With the acceleration of global digital transformation, cloud computing has become an important driving force to push the modernization of SMEs, enhance competitiveness, and study new technologies, such as Gen AI and Green Generative AI Models.

However, with obvious advantages, there are still many challenges in the process of adopting cloud computing, which has important research implications. Apart from data leakage, system checkpoints, and platform incompatibility, these may weaken enterprise trust in cloud services. Enterprises also need to guard against hidden challenges (uncertainty of cost and the growing threat of network security). In addition, although cloud computing promises a variety of benefits, compared with traditional IT, the extent to which it actually improves depends on the factors of infrastructure, technological ability, and regional economic situation, and so on.

The reason I chose this topic is that I am interested in computer science. When I picked the topic of the relevant range, I happened to find this research direction. Additionally, as I plan to pursue further studies in the information systems field, understanding cloud technologies is crucial in the real world. Therefore, this research not only contributes to my academic development but also helps me build foundational knowledge for my future professional pathways.

The purpose of this research is to critically explore the impact of cloud computing on SME operational efficiency, analyzing the advantages and disadvantages that appear in practice. The paper is researched around:

"To what extent is cloud computing changing traditional IT in small and medium-sized enterprises, and what challenges and opportunities does it create?"

In order to tackle this question, the study analyzes it from multiple perspectives, which include cost efficiency and return on investment, security and privacy, reliability and interoperability of the system, and the role of technological innovation, such as multi-cloud strategies and AI. By comparing both supportive and opposing perspectives from the resources and combining real cases from different regions, this project aims to provide a relatively balanced evaluation of the impact of cloud computing.

The following report first combs existing literature, then discusses key findings (including cost, security, innovation, and regional differences), in the end concludes with an evaluation of cloud adoption's impact.

2. Literature review

2.1. Cloud computing vs. traditional IT

This section is focused on the literature on the differences between cloud computing and traditional IT.

According to Blackburn [1], traditional IT often had on-premises solutions, where enterprises are required to build and maintain their servers, databases, and networks independently. The entire process consumes extensive physical space and resources for upkeep and management. In terms of software development, legacy IT systems often rely on the waterfall model, which often results in slower release cycles, releases, and updates, making it difficult to respond quickly to market changes. About data management, most of the data is

structured and stored in relational databases. Its data analysis process is often protracted and produces results always misaligned with realities. These studies have indicated that traditional IT is more suitable for large enterprises than small and medium-sized enterprises, as Small and Medium-sized Enterprises (SMEs) generally operate at a smaller scale, which may reduce the applicability of traditional IT for their operations. In this perspective, traditional IT has relatively stability and control but lacks of flexibility, which SMEs require. And its expensive outlay obstructs the innovations and execution of SMEs.

In contrast, cloud computing represents the modern IT paradigm, which offers seamless access to servers, networks, storage, development tools, and applications via the internet [2]. Compared to traditional on-premises IT, Small and Medium-sized Enterprises (SMEs) that use cloud computing could get various benefit, such as enriching the technology-supported operations, greatly reducing the cost impact on the business, and offering the opportunity to use shared resources [3]. The other major benefit of this system are that for SMEs, security and privacy of the system is acceptable [4], which forms a delicate balance between cost and security. If the modern IT paradigm makes the same extent, it usually needs to invest higher expenses and more technology. This intuitively shows the help of cloud computing to SMEs. However, this conclusion bases on the technology environment in 2013; with the data evolution, its applicability may be limited. In fact, as far as security and privacy are concerned, some companies are still slow to adopt it. Previous studies have shown that cloud computing has gradually become an important component of promoting SMEs' transformation. However, existing research also shows that the future development should focus more on security, privacy, and trust issues, which continue to affect broader adoption among SMEs.

In summary, compared with traditional IT, cloud computing is more suitable for SMEs' situations. However, the effectiveness of the resulting still largely depends on the organisation's technological readiness and strategy alignment. Based on the above comparison, the actual impact of cloud computing on SMEs in terms of private and hidden challenges will be discussed.

2.2. Challenges about cloud

This section is focused on the literature on challenges of cloud (about security, privacy, and hidden challenges).

2.2.1. Security and privacy

With the acceleration of digitalization of SMEs, due to a lack of knowledge of cyber threats and the resources for the implementation of security measures. Many SMEs face the risk of data breaches and financial losses, which will impact the company's brand and diminish customer trust [5]. At the same time, cloud computing represents a new computing model; security at all levels of cloud computing was greatly uncertain. So the ability of the cloud to solve privacy and security concerns has been doubted by SMEs. In today's environment, the organization must use various laws and regulations. In order to ensure the privacy of personal information. However, it is still not clear whether this model could provide enough protection or whether organizations will be found in violation of regulations because of this new model [6]. Although Avram is now dated, and the latest studies suggest that cloud system have significantly improved their safeguards. Nevertheless, recent data breaches show that the risks are not entirely illusory, for example, the Kido International Nursery Hack (UK) and AT&T Data Breaches [7]. Collectively, these studies indicate that security risks and uncertainty over cloud computing safeguards are still challenges for SMEs in the process of future development.

In conclusion, while cloud systems can bring efficiency, factors such as service disruptions, additional cost, and management complexity will still limit the operational efficiency improvements offered by cloud computing in SMEs, as not all of them have enough resources and ability to face them. Building a trusted cloud environment has become a key to promoting cloud adoption among SMEs. At the same time, there are

also some hidden challenges that need to be faced, for example, reliability and interoperability standards, and so on. So building a believable cloud environment is key to promoting cloud adoption; however, its uncertainties limit its full application.

2.2.2. Hidden challenges

Although cloud computing has been adopted by enterprises due to its flexibility and economic advantages, existing studies show some hidden challenges in practical applications. One major factor is reliability, which is one of the most critical concerns for enterprises. Similarly, as demonstrated by Avram [6], companies must be reliable and available the whole day to support 24/7 operations. Once occurs failure or outage occurs, SMEs must completely rely on emergency and recovery systems. So reliability has become a prerequisite for large-scale adoption of cloud computing.

Another issue is the effect that interoperability standards have on the quality and uniformity of the data and processes. However, the changes introduced by the business may be beyond the response pace of the IT, which could result in system lag, data inconsistency and interruption of workflows [6]. However, this research was published in 2014; fast pace developments of cloud interoperability standards OpenStack and Kubernetes may challenge its findings. But what can be said is that such risks are not being wholly eliminated, even if they are reduced.

Lastly, financial resources ought to be considered and are a big obstacle for SMEs. This finding underpins an on-going problem: resource scarcity impact not only on the purchasing of technology but also on training of staff and maintenance of digital solutions in the longer term, with consequences for competitiveness and potential for growth [5]. On the other hand, the research might be skewed towards developing countries, which do not represent worldwide SME tendencies.

Overall, certain evidences suggest that the SMEs are not only facing the safety of the cloud model, but also including hidden challenges in fields of reliability, interoperability, financial constraints, and so on, which indicate that finance and organization are important factors in cloud adoptions among SMEs.

Based on the above, the analysis of hidden challenges reveals that SMEs must comprehensively address multi-dimensional obstacles in technology, finance, and operations when adopting cloud computing. Although some early studies have decreased in reference due to technological iterations, these problems continue to hold warning significance for SMEs' cloud strategies today.

2.3. Cost and return on investment

Next, this part will analyze the influence of cost and return on investment on the adoption of cloud services by SMEs.

2.3.1. Cost

Recent studies comparing cloud computing and legacy IT indicate that cloud shows significant advantages in cost efficiency, flexibility, and resource utilization. In contrast, traditional computing needs higher original costs and ongoing operational expenses, as businesses must purchase and maintain their hardware, software licenses, and infrastructure [8].

Apart from these, it also has hidden costs, for example, security expenses, power and cooling requirements, and technology restrictions. Aging hardware is prone to failures, and legacy applications are difficult to adapt to modern platforms, resulting in system downtime and terrible operational efficiencies [9].

By contrast, cloud computing enables customers to pay only for the resources they consume. Amazon Web Services (2024) once pointed out that SMEs could right-size their environments and avoid overspending on idle infrastructure. It is clear that cloud service also reduces software licensing and maintenance costs for

SMBs, as optimized versions can even eliminate traditional costs, for instance, installing, patching, and operating databases or other applications internally [10]

Overall, cloud computing offers SMEs more cost and operational advantages than traditional IT, including lower upfront investment, reduced maintenance costs, and so on. Whereas traditional IT, with its higher hidden and ongoing costs, remains less adaptable to changing business needs.

Here are Tables 1 and 2 with more details:

Table 1. . Cost-effectiveness comparison: cloud computing vs. traditional computing

Cost-effectiveness	
Cloud Computing	Traditional Computing
Reduces upfront and ongoing hardware and software acquisition,maintenance,and upgrades costs. It enables you to pay only for your resources,allowing for cost optimization. It provides scalability,allowing you to scale up or down resources as needed easily.	Involves higher upfront costs for hardware,software licenses,and infrastructure. Requires ongoing investment in hardware maintenance,upgrades, and replacements. It may involve complex processes and time-consuming efforts to scale resources.

Table 2. Hidden costs comparison: cloud computing vs. traditional computing

Hidden Costs: But there are certain hidden costs associated with both models:	
Cloud Computing	Traditional Computing
Some hidden costs to consider include expenses related to bandwidth usage,data transfer, and additional security measures There is a possibility of vendor lock-in,where migrating to a different cloud provider can incur significant costs.	Provides more control and ownership over resources, potentially reducing reliance on third-party providers.However,it requires a comprehensive assessment of present and future needs to avoid over-or under- provisioning resources. This may involve higher management efforts and costs for maintaining and upgrading in-house infrastructure.

In summary, while cost reduction remains a key driver for SMEs adopting cloud computing, the balance between financial gain and operational risk remains unclear in current research. So although cloud computing reduces costs for SMEs, reliability and regulatory concerns still limit full adoption. Next, from a strategic perspective, the paper will further examine how cloud computing influences Return on Investment (ROI).

2.3.2. ROI

"Cloud ROI refers to the measurable financial and operational value an organization gains from adopting cloud computing services compared to the cost of implementation and ongoing usage, "as explained by. Enterprises often calculate ROI using the formula: $ROI = ((\text{Total cloud value} - \text{initial value of investment}) \div \text{cost of investment}) \times 100\%$ to calculate cloud ROI, which contains the whole profit they hope to achieve, including cost reduction, saving of the environment, and so on. About more details of studies, Spasojevic argues that ROI differences depend on the type of cloud service and the pricing model selected. For example:

- I Infrastructure as a Service (IaaS): Reduces capital expenses and data center costs while offering scalability, disaster recovery, but it still needs IT management.
- I Platform as a Service (PaaS): Provides faster development and declining infrastructure overhead; it focuses more on code and mainly depends on the use of automation and platform tools.
- I Software as a Service (SaaS): Provides instant access to managed applications; it is suitable for replacing legacy tools or enabling remote work. Cost-effectiveness changes focus on usage scale and

integration needs.

In addition, on-demand pricing, reserved instances, and spot pricing could also affect ROI with a significant variation.

In terms of SMEs, compared with local IT, the most huge part of the gains from the cloud model is that SMEs can respond rapidly when the business environment changes, including the alterations of Macro and micro economic conditions, consumer behavior, competitors' strategies, etc. [10]. According to the Business Value of Cloud Modernization, cloud services can increase data for analytics by 35% and reduce time to insight by 34%, which enables SMEs to react faster to competitors, leading to a 28% revenue growth [10]. But it does not mean the cloud model is better than a local IT system; it is just that the cloud system suits SMEs better. About the aspects of growth, flexibility, and resilience, the cloud often wins. However, about squeezing value out of what companies already own, local can still be selected. As Jacobs wrote at the end of his article: The best ROI comes from making an informed decision—not following the latest tech trend. Taken together, these studies highlight that in the comparison between cloud computing and traditional IT, neither model is inherently superior to the other; in contrast, the ROI mainly depends on how enterprises can match technology to their strategy and resources in the most effective way.

In order to directly show the cloud computing affects actual organization for SMEs, therefore, the next section examines case studies to illustrate these impacts.

2.4. Case study and example

This section is focused on the literature on some facts.

Hussein and Tumwine [11], in *Cloud Computing and Operational Efficiency: A Case Study of SMEs in Kampala*, examined the effect of operational efficiency of SMEs after the adoption of cloud computing in Kampala, Uganda. Although the adoption of cloud services at this area is still in early stages, the recent data indicated an increasing number of SMEs are interested in this model to improve operational efficiency, and nearly 35% enterprises said they are using cloud services for various functions, including data storage, communication, and project management. It is hard for SMEs to pay for legacy IT's early-stage investment and continuous maintenance. Similarly, cloud computing provides a cost-effective alternative, giving SMEs the potential to compete and develop in the increasing digital market.

With some other advantages, businesses utilizing cloud services experienced a 20% increase in data security effectiveness compared to those relying on traditional IT infrastructure. Furthermore, the conclusion of these results are limited by fundamental factories and economies of developing countries, as it might be hard to directly adopt developed markets of SMEs. This region only has 25% SMEs that have enough skill to use cloud technology. As of 2023, only 29% of SMEs in Uganda had implemented cloud computing solutions. About differences in many factors, like equipment and Market atmosphere, the transferability of these results to other regions remains uncertain. Overall, the study suggests that even though cloud computing can enhance the operational efficiency of SMEs, only a portion of SMEs have successfully adopted it due to a lack of awareness, limited concerns about the security and reliability of cloud services. Consequently, the model transformation of SMEs still faces many limitations and difficulties that must be addressed to achieve broader and more effective adoption.

As an SME in the United States, Marais USA, a footwear brand, combined cloud computing and e-commerce platforms to achieve significant operational improvements, reducing the production cycle by 50% and cutting shipping time from 30 days to just 10 minutes [12]. Cloud computing provides this brand with flexible infrastructure, enabling its platform to operate efficiently. Managing inventory, processing orders, and analyzing customer data enhances efficiency and customer satisfaction [13]. Over the decade following its

transformation, the brand has launched an average of six new products annually, swiftly responding to market demand. With the support of cloud computing, it continuously strengthens its market competitiveness [12].

Overall, these case studies illustrate that cloud computing has the potential to achieve business transformation for SMEs; nevertheless, the extent of success largely depends on regional and organizational factors, and so on. SMEs in developing countries may face barriers about skills, awareness, and infrastructure; however, SMEs in developed markets have more possibilities through cloud technology to enhance flexibility, responsiveness, and competitiveness.

2.5. Future

According to the previous reference to cost, ROI, and discussion of case studies, the future development trend of technology needs to focus on how to promote the efficiency and sustainability of SMEs.

As the demand for large-scale computation increases, the edge-cloud computing paradigm emerges as a new and attractive solution. Future computing systems will increasingly rely on cloud computing, edge computing, and their collaborative system. Cloud computing calculates high-demand projects to serve many remote users by a large number of online servers. At the same time, edge-cloud computing aims to bridge the gap between latency and scalability. Making nearly all the tasks be solved in an efficient way, such as Amazon Web Services, Microsoft Azure, and Google Cloud Platform [14]. Edge-cloud collaboration combines its advantages, with the edge devices managing language understanding and generation, and the cloud solving complex reasoning and deep learning tasks, achieving low latency and efficient data processing.

In addition, multi-cloud computing has also become a main trend in future cloud strategies. While both multi-cloud and hybrid cloud involve different computing environments, they are not the same. Multi-cloud combines different service producers, while hybrid cloud combines private and public cloud resources. Likewise, "The benefits of multi-cloud computing include flexibility, cost optimisation, increased resilience and vendor lock-in avoidance", it was said by Adeyomola Kazeem [15]. It allows users to access the best services from different platforms and avoid vendor lock-in, ensuring higher performance and better disaster recovery. Furthermore, workloads can be distributed across multiple regions and providers to enhance availability and disaster recovery. However, the disadvantages of multi-cloud computing include complexity, increased security risks, and higher personnel costs due to the need for skilled professionals. It is clear that multi-cloud computing requires significant technical capability and strategic management, even though it enhances flexibility and resilience [15].

In Gen AI, although Chat GPT is one of the most famous Gen AI services, the expense of a large model size and a high running cost are the major issues. So, its future development trends are to adopt domain-specific applications to further improve efficiency, and modular Large Language Models (LLMs) interfacing with Knowledge Graphs (KGs), which can reduce the complexity of the Gen AI system for cost reduction. The resulting AIGC services can be more transparent, and personalisation is easier to offer.

In the same way, the advantages of Green Generative AI Models are a low carbon footprint, low computational complexity, and logical transparency, which can also be used in cloud servers to reduce carbon footprints and save electricity bills [14]. These studies indicated that Green Generative AI Models can create huge benefits; it is clear that this line needs more effort in the future. More recent practices [16] show some SMEs try to integrate Green AI. For instance, SMEs utilizing AI-powered systems to preempt equipment failures report reduced downtime and lower maintenance costs, which enhances productivity.

According to the studies of Sahar Ahmadisakha and Vasilios Andrikopoulo [17], cloud computing has significant potential in promoting sustainability. It uses cloud-based software to promote energy efficiency. Several works point out that cloud computing can enhance resource optimization and energy efficiency,

thereby reducing energy consumption and carbon emissions to support environmental sustainability. However, its architectural strategies require further solutions. Key cloud characteristics, such as PR17 (transparency) and PR8 (provider selection flexibility), should be examined for their potential positive or negative impact on sustainability and their role in cloud delivery models.

These technologies coupled with cloud computing have great potential for SMEs, and can perform such high-demanding tasks with low cost and high efficiency. And the balancing of skill, resource, and demand is still to be met more appropriately, which means further specialised research on the SMEs is still required for these technologies to fully unleash their potential.

3. Discussion

3.1. Introduction

Scope of the study is limited to investigating the effect of cloud computing on cost efficiency and business performance of SMEs. The outcomes of the study show that cloud computing nearly always leads to increased operational efficiency and flexibility, however the levels of enhancement amongst these usability dimensions vary under different circumstances. Although they are generally benefiting from reduced costs for most SMEs and improved collaboration, some are being challenged by hidden costs, by interoperability standards and reliability. This part will draw on both supportive and critical perspectives from the literature review are considered to provide some balanced views. It should be noted that most existing studies were conducted in developing regions, which limited their universality for global SMEs. Additionally, the pace of cloud technology evolution means that findings from earlier studies [4, 6] may not fully reflect current capabilities, so this paper just uses it as a reference.

3.2. Cost efficiency and ROI

Most studies agree that cloud computing offers significant cost advantages compared to traditional IT. For instance, Krishnakumar [8] noted that cloud systems could eliminate excessive expenditure and provide a lower beginning investment. (AWS) Sol, John [10] further shows that pay-as-you-go pricing allows firms to adjust their environments and avoid resource wasting. However, AWS would have a severe bias towards cloud services as they are a cloud service provider, and are insentience to people becoming customers. These findings suggest that cloud computing improves cost efficiency and resource utilisation, but with AWS being a big factor within this, this statement unfortunately carries bias, and the reality may not be as efficient as we are told to believe.

In line with Khayer et al. [3], the practical ROI of cloud computing depends on both the local environment and careful management of financial and technological resources. Nevertheless, Ehrenhart [5] mentions that some hidden costs, security expenses, technology restrictions, and ageing hardware, and so on, should be highlighted. These might cause a decrease in efficiency. However, Ehrenhart's claims may not represent SMEs globally due to the sample size. Jacobs argues that "the best ROI comes from making an informed decision—not following the latest tech trend". Since cost efficiency alone cannot justify cloud transformation, SMEs need to integrate cloud technologies with their operational goals. Moreover, these experiments all stem from highly mathematical countries and can not directly suit SMEs, which only have limited resources. Compared to the positive views of AWS, the efficiency of cost is affected by the specific environment; this cognition reveals a fundamental contradiction between standardised cloud solutions and the various real-world needs of businesses.

Overall, although cloud computing can usually create higher cost and resource efficiency, the actual feedback of SMEs depends on the matching of wise choices to operational goals and careful consideration of hidden costs. Especially, Most studies only focus on developed countries, which limits the universality of the research results. In some developing countries, the actual benefits may be greatly reduced because of low infrastructure, limited technical and management barriers. So, true ROI depends heavily on context — especially region and infrastructure readiness.

3.3. Security, privacy, and reliability

The debate on the cloud method has evolved significantly over time. While Avram [6] raised valid early concerns by pointing out doubts regarding the ability of this new technology to solve privacy security issues, recent developments such as multi-factor encryption and ISO/IEC 27001 certification from Faruque et al. [5] suggest these risks have been largely mitigated for most SMEs. However, Kido International Nursery Hack (UK) and AT&T Data Breaches (March & July 2024) still remind us that safety hazards are not completely eliminated. This comparison suggests that while cloud solutions are safer than before, SMEs can not completely rely on this system.

Beyond security issues, reliability and interoperability challenges still persist. Reliability is important, particularly for SMEs that depend on continuous service to support 24/7 operations. System downtime and lack of recovery mechanisms can disrupt the organisation for the whole day [6]. Similarly, interoperability standards play a crucial role in maintaining data integrity and workflow across different cloud platforms. Although technologies, such as OpenStack and Kubernetes, relieve some problems, data compatibility and transmission in time still has obstacles in practical applications.

In addition, financial resources limited SMEs' technology acquisition, worker training, and long-term maintenance, which reduce competitiveness and potential development [5]. This demonstrates that while cloud technology is evolving, human capital remains a bottleneck in the digital transformation of SMEs. So the imbalance between technology and funding allocation increases the difficulty of the transformation of SMEs.

In general, awareness of risk and trust among SMEs still drives adoption rates. Developing a trusted, dependable cloud ecosystem is also critical for ensuring the sustainable development of SME digital transformation. Although cloud computing provides great flexibility for SMEs in their operations, reliability and regulatory compliance are the two major concerns hindering their adoption.

3.4. Technological innovation and adaptability

Cloud computing increasingly integrates with emerging technologies, such as Artificial Intelligence (AI), automation, and multi-cloud systems. According to Wang et al. [14], this integration can reduce computational complexity and improve logical transparency. Their team also analyses that Edge-cloud collaboration and cloud have a useful influence on language and reasoning abilities, respectively. These offer SMEs new competitive advantages. However, despite the advantages of these technologies in theory, these benefits still rely heavily on SMEs having adequate training and financial resources, which is often unrealistic for small firms in developing regions. For example, while automation reduces manual IT overhead, the high cost of integration may still disadvantage smaller SMEs, limiting equality of access. Moreover, a part of SMEs face challenges about technologies, awareness, and infrastructure, which could be evidenced by Hussein and Tumwine's [11] studies. This shows that although cloud computing based on technologies theory can have a lower operational burden, the real cost–benefit varies greatly between resource-rich SMEs that can scale quickly and resource-limited SMEs whose adoption path is restricted by financial and technical.

Therefore, while emerging technologies can enhance operational performance and competitiveness, the realization of their benefits still depends on whether SMEs can address cost, skills, and infrastructure gaps. This is the same as findings in Khayer et al. [3], who emphasise that technological adoption does not bring inclusive benefits and requires strategic matching with operational goals. Theoretically, technological innovations are useful for promoting efficiency and so on; in practice, they may aggravate the digital gaps among SMEs.

In summary, while technological innovation, like technology integration, can bring efficiency and competitiveness to SMEs, whether the result will be widespread empowerment or a strengthened differentiation fundamentally depends on the response to gaps in cost and technological. Otherwise, existing inequalities will be strengthened.

3.5. Case study insights

The case study about Kampala SMEs [11] demonstrates that nearly 35% enterprises use this system to store data, communicate, and manage projects. This case study show that cloud computing reinforced cost benefits, but highlights regional barriers, such as poor infrastructure, which would reduce ROI. As of 2023, only 29% of Ugandan SMEs had implemented cloud solutions, and just 25% possessed the necessary technical skills. This indicates that cloud computing benefits are not commonly achievable and are mainly dependent on local infrastructure, institutional support, and human capital.

In contrast, evidence from developed economies shows a more mature and successful implementation pattern. Marais USA, by integrating cloud and e-commerce systems, gained a significant operational improvement, which reduced shipping times from 30 days to just 10 minutes and cut the production cycle by 50% [12]. During the next decade, this brand quickly responded to market demand to enhance flexibility and competitiveness by cloud supporting. However, these outcomes are the result of a specific environment, reflecting high digital preparation and stable infrastructure, and cannot be directly extended to SMEs in developing countries.

Studies of Hussein and Tumwine [11] and Marais USA show that the theory of cloud computing is not suitable for any situation, but relies on regional context and institutional readiness at a strong level. This juxtaposition demonstrates that although this system has the potential to promote the transformation of industry, regional, and organizational factors, and so on, it needs to be achieved, especially in a developing country. Comparing these cases highlights that SMEs must consider different practical factors when planning cloud adoption strategies, and for leaders to make up for infrastructural, and the critical role of local infrastructure, digital literacy, and institutional support in shaping cloud adoption outcomes. SMEs must to consider different practical factors when planning cloud adoption strategies, and for leaders to make up for infrastructural.

3.6. Future outline

The development of cloud computing is driven by emerging paradigms, technologies, and sustainability factors, all of which hold significant potential for SMEs. Among them, as a new and attractive way, the edge-cloud computing paradigm emerges. Wang [14] point out that in order to balance latency and scalability, computing systems will increasingly rely on the collaboration between cloud and edge computing in the future to ensure more efficient data processing. What should be highlighted is that the efficiency of edge-cloud computing relies on whether its fundamental facilities and skills; however, it is challenging for SMEs.

Multi-cloud strategies also represent a main direction for future cloud development. Compared with hybrid cloud, which combines private and public cloud resources, multi-cloud combines services from different

providers, offering flexibility, cost optimization, and improved resilience [15]. Cloud computing enhances availability and recovery through distributing across regions and platforms. Nevertheless, this view ignores higher complexity, security risks, and the need for professionals, which mean that enterprises require stronger technical and strategic management. While multi-cloud brings benefits, its complexity and staffing requirements may make it hard practical for SMEs that lack resource teams.

Generative AI (GenAI) shows another emerging area, in order to fall complexity and cost, future trends point toward domain-specific applications and modular Large Language Models (LLMs) interfacing with knowledge graphs, which provide more personalized services [14]. What is more, when SMEs invest in GenAI, they need to weigh the benefits of personalized services and the costs of technology, which is important for assessing efficiency and operational impact in the research question. That is why the value cloud computing creates through GenAI will not be average distributed unless SMEs can undertake the corresponding requirements.

At the same time, the models of Green Generative AI, as suggested by Haq et al. [16], which can produce low carbon footprints and have high transparency, could help SMEs promote efficiency while reducing environmental impact and energy costs. Apart from this, recent evidence shows that SMEs which integrate AI-powered systems for predictive maintenance can also enhance productivity, reduce time-wasting and lower operational costs [16].

Finally, cloud computing itself offers considerable potential to support environmental sustainability. Studies indicate that cloud-based solutions can optimize resource allocation, improve energy efficiency and reduce carbon emissions [17]. However, architectural strategies and cloud characteristics, such as transparency (PR17) and provider selection flexibility (PR8), require further investigation to understand their positive and negative implications for sustainable operations. Even though Cloud computing has potential in resource optimization and energy efficiency, poor architectural choices or service provider strategies may create new management risks.

Overall, although AI tools can lower technical barriers and improve efficiency, if enterprises are unable to fully adopt these technologies, complexity and cost issues may still be a challenge. So the success of future adoption depends on bridging skill gaps and reducing the cost of technological integration. So in order to tackle this barrier, adoption may more depend on suitable AI-based optimization tools, to ensure the cloud innovations can promote operational efficiency, flexibility and sustainable growth.

3.7. Mini-conclusion for the discussion

Existing literature and case studies indicate that, compared to traditional IT, cloud computing provides clear advantages for SMEs, particularly in reducing costs, improving flexibility and efficiency. Cloud services allow SMEs to access advanced technologies and shared resources without heavy investment in infrastructure in a quick way. The relative case also shows that cloud adoption can accelerate product development, improve operational performance and enhance customer experiences, as seen in cases like Marais USA and SMEs in Kampala, which both showed significant results.

However, SMEs are facing many uncertainties and challenges during the process of promoting cloud service. Security and privacy risks, certain potential issues, and financial constraints still limit its widely adoption. The ROI of cloud computing is unessential; its benefits largely depend on how enterprises manage technology with strategy, resources, and operational preparation. Different regional and organizational factors also influence outcomes, especially SMEs in developing countries often face greater barriers.

Looking ahead, emerging technologies such as edge-cloud collaboration, multi-cloud strategies, and Green Generative AI have the potential to improve efficiency, resilience, and sustainability. But it also requires

enterprises to have enough support in terms of technical capability, security, and cost. Overall, while cloud computing transforms measurable gains in cost and flexibility, its influence still depends on SME size, region, and digital maturity, which means SMEs need to reinforce strategic adoption and resources allocation, and cloud computing still have many places need to be improved.

4. Conclusion

This essay explores the benefits of cloud computing compared to traditional IT systems for Small and Medium-sized Enterprises (SMEs). Through consulting several academic journals, industry reports, and case studies spanning 2013 to 2025 in a systematic way, the study review cloud computing's impact on different aspects. For example, cost efficiency, operational flexibility, security, and overall return on investment.

The research proves that cloud computing can bring down the investing cost at the beginning and the running cost for Small and Medium Enterprises (SME), providing a sound and cost-effective solution compared with the traditional Information Technology (IT). Its on-demand payment model and resource sharing system allow SMEs to expand their operations quickly, adapt to market changes, enhance collaboration, and data-driven decision capabilities. Flexibility emerged as a particularly strong advantage, enabling SMEs to implement new processes or products with minimal infrastructure constraints. However, the extent of cost savings and return on investment varies significantly depending on enterprise size, financial resources, and digital maturity. Especially for enterprises located in different regions. About the future of development of cloud computing, the main focus is on multi-cloud computing and artificial intelligence to promote operational efficiency. But there are also many risks in the face of huge benefits; if these technologies are not fully adopted, the burden on SMEs may be increased. Because development in this area usually requires professional technical support and enough costs, while ordinary SMEs can not undertake them.

Apart from obvious advantages, security and privacy are the major barriers to widespread adoption, which need to be improved. Issues such as data protection, system reliability, and cross-platform interoperability continuously troubles SMEs, particularly in some technological infrastructure-limited regions, for instance, in developing countries. Additionally, a long-term adoption requires sufficient internal technical capacity and strategic alignment. Cloud computing is a tool that can only tackle some difficulties, and its benefits depend on careful planning and management, instead of relying too much on it.

Overall, cloud computing provides substantial benefits for SMEs in terms of cost reduction, operational scalability, and flexibility. Nevertheless, its widespread implementation continues to depend on addressing security, interoperability, and resource-related challenges. According to today's development trend, it can be judged that there are many emerging technologies, such as edge-cloud collaboration, multi-cloud strategies, and AI-driven solutions, that offer opportunities in the future to enhancing efficiency, resilience, and sustainability. During the next decade, if SMEs hope to strengthen their capacity of SMEs about cloud computing applications, these companies are prepared to invest in skills, infrastructure, and strategic planning, which can not be ignored.

Although existing research has deeply discussed the influencing factors and outcomes of cloud computing of SMEs, future academic research on cloud computing and SMEs still remains significant gaps, requiring further studies and investigation:

- Differentiated adoption paths: Current research often puts SMEs in the same group, which ignores remarkable differences in resources, regions, and organizational structures, and so on. They limited the global applicability of the research results. So the next step for people is to constitute smaller frameworks, explore

the gaps between main successful factors and barriers, especially for those mini-companies (fewer than 20 staff).

- Emerging technologies: Even though integrating AI (generative AI, edge computing, and green computing) and cloud computing is a significant trend, SMEs still face a lack of AI skills. In the future, they need to explore certain issues, such as which organizational models can effectively alleviate technology integration when humans meet capital bottlenecks, and whether SMEs own the related adoption capabilities and management skills, and so on, particularly around the question of the digital gap.

In the end, having a suitable strategic structure should be pay more attention, which not only could help SMEs make more informed adoption decisions, but also support makers to design more transformation measures.

From a individual perspective, I deepened my understanding of the complex bonds between technology, business strategy, and organizational capacity by researching and writing. It showed that technological applications are about potential benefits, managing risks, resource allocation, and planning for long-term sustainability.

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