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Optimising data management systems for SME scalability in South Africa: A vendor perspective

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Purpose: The purpose of this study was to investigate how optimised data management systems (DMS) can enhance the scalability of small and medium enterprises (SMEs) in South Africa from a vendor perspective.

Design/methodology/approach: A qualitative case study was employed, focusing on a leading provider of enterprise solutions. Participants were selected through purposive sampling to ensure the inclusion of personnel with relevant expertise. Data were collected through semi-structured interviews, and responses were analysed using thematic analysis.

Findings/results: The study revealed that robust infrastructure, advanced digital architecture, Citrix solutions and cloud-based platforms are key drivers in optimising DMS to enhance SME scalability in South Africa. It emphasised the crucial role of DMS vendors in addressing the evolving scalability needs of SMEs, enabling them to leverage data for innovation, growth and tackling Industry 4.0 challenges.

Practical implications: This study offers valuable insights for SMEs and data management vendors. For SMEs, the findings highlight the importance of investing in robust digital infrastructure and cloud-based solutions to support scalability and drive growth. On the other hand, vendors must focus on developing customised, scalable solutions that address unique needs of SMEs, enabling them to navigate Industry 4.0 challenges effectively. Findings show that fostering SME-vendor partnerships, investing in resilient infrastructure and emerging technologies and prioritising data security and interoperability are essentials of operational efficiency.

Originality/value: This study offers a novel exploration of DMS optimisation from a vendor's perspective, specifically tailored to the context of SME scalability in South Africa.

Keywords: data management systems; data security; digital transformation; IS success model; scalability.

Introduction

Small and medium enterprises (SMEs) play a pivotal role in the economic growth and development of South Africa, contributing significantly to employment and gross domestic product (GDP). According to a FinScope MSME report South Africa (2024), 'there are approximately 3 million medium, small and micro-entrepreneurs in South Africa, employing around 13.4 million people'. However, many SMEs face challenges in scaling their operations, particularly in terms of data management and technology adoption. Adewusi et al. (2024) is of the view that because of the increasing reliance on digital infrastructure, optimising data management systems (DMSs) has become critical for improving operational efficiency, decision-making and competitive advantage. The SME sector in South Africa has grown remarkably in recent years, playing a major role in job creation and economic development. But this expansion is accompanied by several difficulties, such as restricted access to cutting-edge technology, budgetary limitations and ineffective data management (Pieterse, 2021). Optimisation of DMSs is likely to influence SMEs' scalability and operational efficiencies in South Africa (Ngcobo et al., 2024). The effective management of data stands as a cornerstone for the growth, expansion and making informed decisions, irrespective of an organisation's size or sector (Ladley, 2019).

The importance of data management is magnified in SMEs particularly in South Africa, where the business environment is characterised by resource constraints. Streamlined data management not only enhances operational efficiencies but also plays a pivotal role in facilitating scalability and sustained growth for SMEs. According to Wang et al. (2018) and Patel et al. (2016), data

management encompasses a spectrum of activities including the tasks of creating and storing data to analysis for making informed decisions. For SMEs in South Africa, where the business landscape is dynamic and often marked by resource constraints, optimisation of DMSs assumes paramount importance. For example, SMEs grapple with escalating demands, shifting consumer behaviours and competitive market dynamics (Westman et al., 2023).

According to Lifhjelm (2021), data management is essential for improving operational effectiveness and well-informed decision-making for small- and medium-sized enterprises. A lack of scalable and affordable data management solutions that fit their development trajectory and business objectives is a major problem for SMEs in South Africa. Small and medium enterprises frequently struggle with financial constraints and a lack of specialised knowledge, whereas bigger businesses could have the means to invest in advanced data infrastructure (Van Der Merwe, 2021). Businesses may maximise their DMSs to drive sustainable growth by understanding the difficulties encountered in alignment with the solutions provided by vendors. Organisations have several obstacles related to DMSs in this fourth industrial revolution (4IR) period, which impedes the best possible operational and strategic decision-making. These difficulties include non-standardised data formats, scalability problems, cybersecurity concerns and insufficient infrastructure. Organisations contend with a threat from increasing cyberthreats, especially in South Africa, where there is a greater reliance on Internet access and information technology (IT) infrastructure, which makes the country more susceptible to malicious assaults (Pieterse, 2021). For example, data exposure events have impacted companies primarily in South Africa, posing a risk to the accuracy and dependability of operational and strategic choices.

Effective data management in SMEs is critical to long-term sustainability and strategic decision-making, not simply to operational effectiveness. Pieterse (2021) highlighted that data management is characterised by procedures and tools used to generate, store, analyse and use data for informed decisions such as business process performance, competitive advantage and to familiarise with market trends. The discussion around data management has changed in recent years to emphasise how crucial it is to the growth and resiliency of organisations. Resiliency deals with the capability of businesses to absorb sudden shock from the business environment, withstand stress induced from the shock and respond accordingly while ensuring acceptable service levels (Imeni & Edalatpanah, 2023). According to Bolton et al. (2018), data management solutions help businesses find operational patterns, to develop actionable insights and improve consumer engagement. However, further research is necessary to understand how optimisation of DMSs in South African SMEs in the South African context can contribute to its scalability.

Tailored data management solutions are even more important in the context of South Africa's growing SME sector, where resource limitations are ubiquitous. Particularly, challenges that SMEs encounter are scarce resources, limited technology utilisation and a lack of comprehensive digital business strategy that address their requirements and scalability goals (Lukonga, 2020). Furthermore, the introduction of digital technologies has highlighted the need for strong data management frameworks particularly regarding vendor solutions for SMEs. Data streams are the foundation of analytics, fostering creativity and competitive advantage, as confirmed by Fu and Soman (2021). In the South African setting, where SMEs are essential for fostering employment and economic growth, the optimisation of DMSs from a vendor perspective emerges as a critical imperative. Small and medium enterprises are vital to South Africa's economy but struggle with scaling because of data management and technology adoption challenges. Optimising data management enhances efficiency, decision-making and competitive advantage, yet cybersecurity risks, infrastructure scalability issues and non-standardised data formats hinder progress (Adewusi et al., 2024; Bundesregierung, 2021). These challenges expose businesses to cyber threats and misinformation, affecting operational resilience and decision-making (Imeni & Edalatpanah, 2023; Jennex et al., 2022). This study explores vendor-driven solutions to improve SME data management for scalability and sustainable growth in South Africa (Ladley, 2019; Ngcobo et al., 2024).

Inadequate infrastructure, sustainable power is another major obstacle for SMEs in South Africa. Operational efficiency can be hampered by power outages and a lack of effective backup plans, which can interfere with data aggregation, distribution, analysis and decision-making processes (Laher et al., 2019). Decision-making delays and data omission result from the limited usage of computers and other technologies for data management and analysis in the lack of consistent energy. Furthermore, scalability becomes a crucial issue as businesses struggle to increase their DMSs to handle increasing data quantities without sacrificing performance (Milat et al., 2020). Expanding servers or storage capacity to handle bigger datasets may not be financially feasible, which might cause problems with existing systems' interoperability (Lifhjelm, 2021).

Another challenge facing SMEs in South Africa is interoperability, which is the capacity of information technology systems to exchange data and interact efficiently (Modisane & Jokonya, 2021). Inadequate interoperability causes data silos, inefficiencies and mistakes in decision-making by impeding the exchange of data in standardised forms. Interoperability issues in the healthcare industry make it difficult for companies to share clinical data, which obstructs informed decision-making and may jeopardise patient care (Siyal et al., 2019). Furthermore, the lack of uniform data collecting formats makes it more difficult to compare data between systems, which can result in conversion issues and data loss (Zeadally et al., 2020). These difficulties highlight how vital DMSs optimisation is and are designed to meet the needs of SMEs in South Africa.

The research gap in this study revolves around the limited understanding of how organisations can effectively address key challenges in data management, particularly cybersecurity threats, inadequate infrastructure, scalability issues and a lack of interoperability while optimising operational and strategic decision-making. Although existing literature has explored the significance of data management in various sectors, including health, finance and transport, there is a lack of comprehensive frameworks or strategies tailored to mitigating these challenges in developing economies, such as those in sub-Saharan Africa, where infrastructure deficiencies and cyber vulnerabilities are prevalent.

In addition, while studies have highlighted the importance of data security and interoperability, there is insufficient empirical research on how organisations can balance these factors with cost-effective scalability solutions, particularly in resource-constrained environments. Furthermore, the interplay between regulatory frameworks, data governance policies and technological advancements remains underexplored, creating a gap in practical implementation strategies for organisations seeking to enhance their DMSs. Thus, this study seeks to bridge this gap by investigating practical, scalable and secure data management strategies that can be adapted across industries to improve operational efficiency and decision-making while addressing the unique challenges faced in data management. This study sought to explore how DMSs can be optimised for SME scalability in South Africa, with an emphasis on vendor insights. By gaining a comprehensive insight of vendor's role, the study endeavours to provide actionable insights where SMEs can utilise data for competitiveness and sustainable growth in the South African market.

Review of existing literature

The objective of this study was to explore optimisation of DMSs for SME scalability in South Africa from a vendor's perspective. According to Liakh (2021), the research emphasises how important data management is to SMEs' ability to make informed decisions and run their operations efficiently. However, there is still a significant vacuum in the literature about customised approaches and viewpoints provided by suppliers serving the South African market.

Data management systems

According to Zhu et al. (2019), DMS is an organisation's use of a collection of tools, strategies and procedures to organise, store, retrieve and manipulate data. Duan et al. (2019) further highlight that DMSs perform various functions, such as enabling user access to data, ensuring its security, managing storage and organisation and effectively working with large amounts of structured data to maintain accuracy. Yassine et al. (2019) stated that DMS provides a solid method for organising and efficiently working with data in today's complex and data-intensive organisational environments.

Tabesh et al. (2019) argue that DMS acts as an intermediary between databases and users or other software applications. Data management system establishes a controlled and consistent environment for users to interact with databases, allowing them to retrieve, modify and manipulate data using predefined operations. Furthermore, Shamim et al. (2019) mentioned that DMS enables multiple users to access data simultaneously without conflicts or errors. By abstracting the complexities of data storage and retrieval, DMS simplifies data management for users and developers, promoting logical data organisation (Yassine et al., 2019).

Agrawal et al. (2010) reported that the origins of DMS trace back to the latter half of the twentieth century when IBM, a prominent information systems company, developed the first DMS known as Information Management System (IMS). According to Barisits et al. (2019), IMS changed data management by arranging data in a hierarchical form that resembles a tree structure. This technique improved data storage and retrieval efficiency and scalability, setting the groundwork for future developments in the field (Barisits et al., 2019).

Small and medium enterprises scalability

According to Siyal et al. (2019), SME scalability refers to the ability of SMEs to expand their operations, increase their market reach and enhance their data management capacity without compromising efficiency, performance or financial sustainability. In the context of data management, SME scalability involves the seamless adaptation of digital systems, infrastructure and processes to accommodate growing data volumes, user demands and business complexities while maintaining optimal functionality, security and cost-effectiveness (Tahar et al., 2020).

Advantages of data management systems

Organisations rely heavily on DMS for organising, storing, retrieving and modifying data (Zhu et al., 2019). To guarantee accuracy and efficiency, they manage storage, organise data and provide safe access (Duan et al., 2019). Effective data management is crucial for SMEs in South Africa to have a competitive edge in a data-driven business environment (Satti et al., 2020). Moreover, developments in DMS have transformed data consumption and storage, providing benefits over conventional file systems. Innovations in DMS have enabled data sharing, evidence-based therapy and predictive analytics in the healthcare industry because of digitisation and interoperability requirements (Gopal et al., 2019). But issues such as data security, privacy and interoperability continue to exist, requiring customised solutions for SMEs operating in South Africa.

DeLone and McLean information systems success model

To understand the complex relationship between factors that impact the success of information systems (IS) such as DMS, it is imperative to consider suitable theoretical frameworks

that unpack the information, system and user variables. For this reason, the DeLone and McLean (2003) IS success model has been selected and contextualised in relation to this study. This model has been widely cited and used in both research and practical applications (Purwati et al., 2021). The model presents six interconnected dimensions for measuring an information system's success, including system quality, information quality, service quality, use, user satisfaction and net benefits.

The quality of the system emphasises the technical aspects of the information system, encompassing elements such as reliability, usability, flexibility, security and functionality. System quality assesses how well a system meets its users' technical requirements and expectations (Hidayah et al., 2020). Information quality refers to the properties of information provided by the system, such as correctness, completeness, relevance, timeliness and understandability. High-quality information is essential for effective decision-making and problem-solving activities (Çelik & Ayaz, 2022). The support and assistance provided to the users of the information system is called service quality. It encompasses factors such as responsiveness, reliability, competence, courtesy and empathy exhibited by support staff or IT personnel (Hidayah et al., 2020). The degree to which individuals utilise the information system to execute their activities and achieve their goals is measured by use. It measures the acceptance of the system by users and the level of engagement with its functionalities towards satisfaction (Purwati et al., 2021). User satisfaction reflects the subjective evaluation of the information system by its users (Purwati et al., 2021). Net benefits provide an overall assessment of the system's contribution to the organisation (Purwati et al., 2021).

Even though, DeLone and McLean's IS success model provides an applicable framework for understanding and evaluating information system success. It has also faced criticism and limitations. Some argue that it predominantly focuses on user satisfaction and net benefits, neglecting other significant aspects, such as social and organisational impacts. Furthermore, the model does not explicitly address the role of contextual factors, such as organisational culture, that can influence the success of information systems (Hidayah et al., 2020). Despite these limitations, the model remains a valuable tool for assessing and optimising IS performance in organisations.

Various authors have applied applications of IS success model in different research areas. In the study by Mlitwa and Ogundaini (2022) to determine the satisfaction of the e-Learning user at a South African University of Technology, it was found that the learners expressed positive experiences that LMS met their immediate academic needs. The challenges experienced during the learning process were not attributed to the quality of the LMS but to inadequate facilitation conditions and contextual peculiarities. A study by Çelik and Ayaz (2022) evaluated the success of the Student Information System (SIS) using the updated IS success model. The authors found that system quality, information quality and service quality had a significant effect on use but not on user satisfaction. Furthermore, both system use and user satisfaction had no significant impact on the success of SIS. As a result, it would be beneficial for higher education institutions to evaluate the achievements of existing SISs to increase their use by student satisfaction.

Yakubu and Dasuki (2018) conducted their study in Nigeria on measuring e-learning success in developing countries. The results of the study indicated that there is a significant relationship between software quality and information quality, which directly impacts the intention of behaviour. In addition, the study found that service quality has a statistically significant effect on user satisfaction. Furthermore, both user satisfaction and behavioural intentions were found to have a significant impact on actual usage. Another study was performed by Veeramootoo et al. (2018) on success determinants of an e-government service. The study found that the drivers of perceived user satisfaction are information quality, system quality, instructor attitude, diversity in assessment and perceived interaction with others.

The concepts of the IS success model offer a suitable theoretical lens for tackling challenges in DMSs. System quality will ensure robust security measures and scalable infrastructure to address cybersecurity vulnerabilities. Information quality involves data governance practices and assurance measures to improve accuracy and reliability. User satisfaction prioritises user experience and feedback for informed decision-making. System use promotes adoption through training, optimising operational performance and positive organisational culture. Applying these concepts helps organisations gain net benefits in the form of improved DMSs, enhanced decision-making towards achieving optimal performance.

Research methodology

Research context

The case study selected was Health System Technologies (HST) in South Africa. The organisation was established in 1999 as a cornerstone for healthcare enterprise solutions in Africa. With a core mission to empower healthcare providers, HST operates on the principle of systematically improving healthcare service delivery in all care settings. The organisation specialises in the development and provision of integrated health information systems, revolutionising healthcare operations by introducing client-centric administrative and clinical systems. Through the implementation of electronic medical records, HST aims to reduce the reliance on paper records and establish seamless interoperability with various clinical support systems. Health System Technologie's expertise spans a comprehensive range of services, covering everything from enterprise architecture and project management to integration and support. Their commitment to sustainability

is evident through continuous client support and the ongoing evolution of systems, translating into exceptional returns on investment for their clientele.

Research design

A qualitative research method was selected. Qualitative research involves a structured approach to understanding people's experiences and internal emotions (Pandey & Pandey, 2021). It offers a comprehensive and in-depth overview of a phenomenon by collecting data and presenting a detailed description using a flexible research method (Mukherjee, 2019). The qualitative method focuses on gathering non-numerical information (Bloomfield & Fisher, 2019). The qualitative research method was chosen because it was well suited for examining the attitudes of the respondents, which required a detailed description to understand their reality. This approach helps the researcher to understand, detect and collect soft data such as feelings and decisions, as well as insights into the social relationships among individuals sharing the same environment (Cronje, 2020). The qualitative method is suitable for this study because it enables the researcher to explore vendor experiences and opinions and get in-depth information on how they address the challenges that inhibit operational processes in organisations.

Sampling strategy

In selecting participants for the study a non-random purposive sampling technique was employed. This method deliberately chose vendors with proven expertise in data management solutions, focusing on factors such as reputation, specialisation in addressing data management challenges and product functionalities. Similarly, for the individuals participating in the study, purposive sampling was utilised to intentionally select ten participants from a pool of 65, comprising four managers and six non-managerial employees, all meeting criteria of at least 2 years of organisational work experience and knowledge of DMSs. This approach aimed to ensure the relevance and applicability of the findings by engaging participants with specific attributes pertinent to the research objectives (Table 1).

Data collection

In qualitative research, data collection instruments or tools are used to gather information through non-numerical means, focusing on understanding the perspectives, experiences and meanings attributed by individuals or groups (Cypress, 2018). Several commonly used data collection instruments in qualitative research include interviews, focus groups, observations and document analysis. Each instrument offers unique advantages and is suitable for different research contexts (Mukherjee, 2019). In this study, a semi-structured interview was selected. Semi-structured interviews involve a flexible yet guided conversation between the researcher and the participant(s) (D'Alimonte, Sio & Franklin, 2020). This approach allows open-ended questions while also having a predefined set of topics or themes to explore (Cypress, 2018). This type of interview provides detailed and in-depth information on participants' experiences, perceptions and interpretations.

TABLE 1: Participants' profile table.

Number	Level	Position	Years in organisation	Age group (years)
1	Management	Chief operating officer	23	Above 45
2	Management	IT operations manager	15	36–45
3	Management	Product development manager	14	Above 45
4	Management	Software development manager	11	36–45
5	Non-management	Integration developer	7	18–35
6	Non-management	Product owner	15	36–45
7	Non-management	IT specialist	4	18–35
8	Non-management	IT intern	1	18–35
9	Non-management	IT support	3	18–35
10	Non-management	IT support	3	18–35

IT, information technology.

Data analysis

The study utilised a thematic approach for data analysis, tailored to the exploration of optimising DMSs for SME business scalability in South Africa, from the perspective of vendors. Drawing from the framework outlined by D'Alimonte et al. (2020), thematic analysis facilitated the systematic sorting, organisation and examination of qualitative data pertinent to the subject matter. Thematic analysis, as elucidated by Lobe et al. (2020), involves the methodical identification and classification of themes and patterns within a dataset, aligning closely with the specific research inquiry. In this study, thematic analysis served as a versatile instrument, enabling researchers to delve deeply into vendors' insights and experiences regarding the enhancement of DMSs for SMEs in South Africa. Employing a bottom-up approach, themes emerged from in-depth interviews with vendors, captured via audio recordings. These recordings were meticulously transcribed, and themes were derived from the rich content of the discussions. Throughout this analytical process, comprehensive notes were maintained as tangible records, facilitating the refinement and eventual integration of these themes within the narrative framework of the study.

The thematic analysis centred on examining the evolution of DMSs by vendors to address critical challenges such as cybersecurity vulnerabilities, infrastructure scalability, interoperability issues and non-standardised data formats. By applying thematic analysis, the study adeptly discerned and categorised themes and patterns related to the hurdles encountered by vendors and the strategies they employed to mitigate them. This methodological approach afforded a nuanced comprehension of how vendors navigate the complexities inherent in data management, particularly within the context of SME business scalability in South Africa. Furthermore, it illuminated potential strategies and best practices for overcoming these obstacles, thereby

contributing valuable insights to the optimisation of DMSs for SMEs in the region.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of South Africa Graduate School of Business Leadership (2023_SBL_MBA_057_FA_1747), and permission was granted by Health System Technologies. The research was executed in an ethical and responsible manner using appropriate methods of data collection and analysis, as approved by the research ethics committee of the university.

In this study, ethical considerations were adhered to, encompassing principles and practices to safeguard participants' rights, well-being and privacy. Prioritising informed consent, participants were assured of their voluntary involvement without coercion, with the option to withdraw at any point without consequence, and their data would be destroyed upon withdrawal. Confidentiality and privacy were paramount, complying with relevant privacy laws, using unique identifiers for participant anonymity and ensuring research reports prevented participant identification. Stringent data management measures were implemented, including secure storage and restricted access, to safeguard participants' data integrity and privacy. Participants were provided with clear information about data usage, limited to academic purposes and shared only with pertinent stakeholders, with access to study information upon request. Ethical clearance was sought from the researcher's institution to ensure adherence to ethical standards.

Results

The objective of this study was to investigate how vendors address DMS quality to ensure scalability in organisations. The intention was to interview 15 participants, but saturation point was reached at 10. The following are the themes that emanate from the study.

Theme 1: Robust infrastructure

The study reveals that 8 out of 10 participants emphasise the critical role of robust infrastructure in ensuring scalability within organisations. This robust infrastructure encompasses resilient hardware, networks and systems designed to efficiently handle data management. Vendors prioritise scalability by integrating redundancy measures such as backups and fail-safes, along with technologies such as load balancing. Participants had the following to say:

Product manager said:

> 'At Health System Technologies (HST), we ensure that our data management systems can handle data growth as workload demands increase through scalable infrastructure and robust architecture. We employ technologies such as distributed databases, data partitioning, and horizontal scaling to accommodate growing data volumes effectively.' (Participant #3)

Software development manager added that:

> 'At Our organisation Health System Technologies (HST), we prioritise the scalability and adaptability of our data management systems to handle data growth as workload demands increase. We employ robust infrastructure and utilise technologies that allow for horizontal scaling, ensuring that our systems can handle increased data volumes without compromising performance.' (Participant #4)

Participants stress the importance of investing in scalable hardware and redundant systems to meet the growing demands for healthcare data. Continuous service accessibility during surges is ensured through load balancing and fail-safe mechanisms, echoing the sentiment that robust infrastructure is not just a preference but a necessity for healthcare sectors. The importance of a robust infrastructure for scalability emerged as a unanimous point of view among the study participants. Their collective emphasis on resilient hardware, redundant systems and scalable technologies underscores their pivotal role in managing increasing data volumes and transaction demands. The sentiments expressed by various participants highlighted the need rather than preference for robust infrastructure in the healthcare sector, where uninterrupted access to critical data is imperative.

Theme 2: Robust architecture

Similarly, 7 out of 10 participants underscore the significance of robust architecture in achieving scalability within DMSs. This involves well-designed database schemas, efficient data storage mechanisms and scalable algorithms. Techniques such as sharding, caching mechanisms and distributed databases are employed to handle increased loads effectively. Participants had the following to say:

IT specialist argued that:

> 'To ensure scalability in our data management systems at Health Research Innovations (HRI), we prioritise robust architecture, employing various techniques that bolster our infrastructure to accommodate escalating data demands effectively.' (Participant #7)

The IT intern added the following:

> 'Robust architecture in our context refers to the design and implementation of a resilient framework that can seamlessly adapt to increasing data volumes and workload demands. It involves creating a solid foundation built on scalable components and methodologies.' (Participant #8)

The chief operating officer supported the above by the following:

> 'Our Cloud-Based Server Storage Platform offers a dynamic and flexible infrastructure designed to accommodate expanding data requirements seamlessly. With the capability to augment data capacity on demand, our platform ensures businesses can scale their storage needs efficiently and without disruption.' (Participant #1)

Participants emphasise adaptable architectures that can handle increased workloads while maintaining optimal

performance and reliability. Strategies such as data partitioning and horizontal scaling are identified as key components of robust architecture, ensuring seamless scalability in the face of escalating data demands. Therefore, the discussion shows that robust architecture within DMSs highlights a unanimous focus on creating resilient frameworks that can adapt seamlessly to escalating data demands. It encompasses the design and implementation of scalable components, employing techniques such as sharding, caching mechanisms and distributed databases. The participants emphasised the importance of adaptable architectures that can handle increased workloads while maintaining optimal performance and reliability.

Theme 3: Citrix solutions

Citrix solutions are highlighted by 8 out of 10 participants as pivotal in enabling scalability through virtualised environments. These solutions provide centralised management of applications and data across various devices and locations, enhancing scalability by facilitating flexible resource allocation and efficient data access. Distributed processing forms the backbone of architecture, segmenting tasks across nodes to prevent heavy computational tasks from hindering performance. Microservices architecture further optimises efficiency by allowing independent scaling of processing components, ensuring scalability and system responsiveness.

One of the IT support participants said that:

> 'Multiple different things are used for this. Citrix is used to boot up multiple instances of our applications which then get provided to users via a load balancer. We also split our system into multiple parts so things that take a lot of processing power do not affect our main system like when big reports are run.' (Participant #9)

In support of the aforementioned, product owner said that distributed processing forms the backbone of our architecture, allowing us to segment tasks across multiple nodes. This approach ensures that heavy computational tasks, such as running extensive analyses on large datasets, do not impede the overall performance of the system:

> 'Our architecture revolves around a distributed database system, enabling seamless scalability. By employing sharding and replication techniques, we can effectively manage data growth and accommodate increasing workload demands without compromising speed or reliability.' (Participant #9)

Scalability is embedded in our infrastructure through the use of microservice architecture. This setup allows us to modularise different functionalities, ensuring that specific components dealing with heavy processing can scale independently, optimising overall system efficiency:

> 'We have adopted a containerisation strategy using Kubernetes, allowing us to dynamically scale resources based on workload requirements. This flexibility ensures that our data management systems remain responsive and adaptable to fluctuating demands.' (Participant #8)

Therefore, it is safe to conclude that Citrix solutions play a pivotal role by enabling virtualised environments that centralise data and application access across diverse devices and locations. This centralised management improves scalability by facilitating flexible resource allocation and efficient data access, regardless of device or location restrictions.

Theme 4: Cloud-based server storage platforms

The majority (7 out of 10) of participants emphasise the importance of cloud-based server storage platforms in offering scalable storage and computing resources on demand. Elastic storage options enable quick adaptation to changing data storage needs while autoscaling features ensure efficient resource utilisation. Strategies such as leveraging distributed file systems and redundant storage techniques bolster DMSs for seamless scalability. Predictive analytics methodologies aid in proactively anticipating future growth trends, optimising systems for consistent and reliable performance even during rapid expansion periods.

Product owner argued that: 'Cloud-based server storage platform with ability to increase data capacity'.

Furthermore, the Intern argued that they prioritise the utilisation of redundant storage techniques to maintain data integrity and accessibility:

> 'Our Cloud-Based Server Storage Platform offers a dynamic and flexible infrastructure designed to seamlessly accommodate expanding data requirements. With the ability to augment data capacity on demand, our platform ensures that businesses can scale their storage needs efficiently and without disruption.' (Participant #8)

> 'At the core of our development philosophy lies a relentless commitment to scalability. Leveraging scalable databases and cloud solutions, we guarantee a smooth and unhindered expansion process. Our infrastructure empowers businesses to grow without worrying about performance constraints, as our systems are optimised to handle increased data loads effortlessly.' (Participant #2)

> 'To stay ahead of data growth trends, we implement predictive analytics methodologies. By analysing historical data patterns, we proactively anticipate future growth, enabling us to fine-tune our systems for seamless scalability. This proactive approach minimises potential bottlenecks, ensuring consistent and reliable performance even during periods of rapid expansion.' (Participant #5)

The results of the discussion above show that a cloud-based server storage platform is essential to accommodate the scalable data needs of healthcare. The platform offers inherent flexibility, enabling seamless augmentation of data capacity in response to growing datasets. Strategies such as implementing distributed file systems, redundant storage techniques, dynamic load balancing and predictive analytics methodologies ensure uninterrupted data access, high availability and optimised system performance.

Discussion of findings

While the results are presented based on the objectives of the study and DeLone and McLean IS success model, the explanations on how suppliers handle the quality of DMSs to guarantee scalability draw attention to key approaches used by the sector. A solid infrastructure is identified as the primary strategy, especially in relation to the system quality of the IS success model. This includes redundant systems in addition to robust hardware, making DMSs capable of withstanding outages with minimal disturbance (Pandit & Agrawal, 2022). Vendors may successfully meet scalability objectives by maintaining system availability and performance even in the face of large loads or unfavourable conditions by investing in such infrastructure (Singh et al., 2022). According to Siyal et al. (2019), there are challenges when migrating web applications from traditional on-premises infrastructure to the cloud. These apps used to run on expensive specialised hardware, but today they run on more flexible and cost-effective cloud infrastructure.

Furthermore, the conversations among the attendees emphasised the need of sturdy architecture in promoting scalability. Patel et al. (2016) argued that increasing data quantities may be handled smoothly by a well-designed architecture without compromising performance. This entails putting in place scalable technologies, like modular architectures or distributed computing frameworks that can adjust to rising needs. Vendors may guarantee that their DMSs stay flexible and scalable, meeting the changing demands of their customers, by utilising these design concepts (Chiware & Mathe, 2015).

The interviewees also emphasised the use of cloud-based server storage technologies as another noteworthy feature. Because of the inherent scalability benefits of cloud computing, providers may dynamically assign resources in response to shifting workloads (Zeadally et al., 2020). Calliess and Baumgarten (2020) is of the view that vendors may take advantage of flexibility and scalability without having to make significant upfront expenditures in physical gear by utilising cloud infrastructure. As a result, they may quickly expand their DMSs to meet client requests, guaranteeing long-term flexibility and cost-effectiveness. When designing a DMS using a cloud-based server storage platform, it is crucial to consider factors such as data security, compliance requirements, performance optimisation and vendor lock-in (Gopal et al., 2019). It could be argued that there is a correlation between systems quality and information (data) quality.

Moreover, the agreement upon the importance of components such as load balancing, redundancy controls and horizontal scaling highlights the comprehensive strategy providers have used to guarantee scalability. Incoming traffic is divided among several servers via load balancing techniques, which keep no one server overloaded and provide steady performance. Satti et al. (2020) argued that by lessening the effect of hardware failures and other disturbances, redundancy methods such as data replication and failover systems improve system resilience. Vendors may effectively handle growing workloads by adding more resources (such as servers or nodes) to a system through a process known as horizontal scaling (Purwati et al., 2021).

The results demonstrate a comprehensive strategy that suppliers or vendors have implemented to guarantee scalability and address the quality of DMSs. Vendors may efficiently handle growing data volumes without sacrificing performance by emphasising strong architecture and infrastructure, by utilising cloud-based solutions. Therefore, we argue that there is a strong correlation between system quality, information quality and service quality as argued by DeLone and McLean. Hence, the focus on horizontal scaling, redundancy controls and load balancing highlights the significance of an all-encompassing approach to successfully meet scalability goals.

Limitations and future research

The qualitative approach of the study has limitations within it such as potential biases and limited generalisability. This study focused on an organisation in the province of Gauteng in South Africa. Hence, it is limited in the scope of perspectives that could be drawn from other industries or regions. Access to comprehensive and up-to-date information was limited. Some vendors may not disclose proprietary information or felt reluctant to share specific details. However, the participants were told that the study is performed for academic purposes only for them to express their views freely. The limited time for research restricted the depth of analysis or exploration related to vendor practices and DMSs. Constraints in financial resources contributed to the limited reach of potential participants.

Future studies need to adopt a longitudinal approach to track evolution of DMSs and vendor practices over time to incorporate technological advances, regulatory changes and changing market demands that impact on organisational processes. Also, cultural practices of organisations, their impact on data management practices, vendor selection criteria and its overall impacts on a successful system of implementation need to be investigated. Furthermore, ethical dilemmas remain critical and are experienced by organisations and vendors regarding data privacy, security and responsible use of data. Hence, optimisation of database management systems requires investigations into how vendors address ethical concerns in their system designs.

Conclusion

This study explored how DMSs can be optimised for SME scalability, focusing on the perspectives of vendors. The research objectives were achieved by identifying key strategies and challenges faced by vendors in providing scalable solutions for SMEs, including the need for cost-effective, user-friendly and adaptable systems. The findings of this research highlight the importance of robust

infrastructure and cloud-based solutions that can handle large volumes of data with precision and flexibility, directly contributing to SME scalability. In addition, the study emphasised the significance of integrating data security measures and ensuring compatibility with existing business processes, which are vital for maintaining operational continuity and protecting sensitive information.

The significance of this research lies in its practical relevance to both SMEs and vendors, offering a framework for enhancing SME data management practices in a way that supports growth and sustainability. The study's insights are valuable in the broader context of digital transformation, as SMEs are increasingly relying on efficient data systems to remain competitive in a fast-paced and data-driven market. By addressing scalability issues and leveraging emerging technologies, this research paves the way for SMEs to thrive amidst the challenges of an evolving economic landscape.

The study not only offers a comprehensive understanding of how DMSs can be optimised for SME scalability but also provides actionable insights for vendors looking to design solutions that meet the specific needs of SMEs. These findings are a crucial step in empowering SMEs to harness the full potential of their data, infrastructure and ultimately enhancing their competitive edge to foster long-term growth and resilience in an increasingly complex business environment.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

N.N.G. and O.O.O. conceptualised the research. N.N.G. was responsible for articulating the research problem, conducting the data collection, initial round of data analysis and writing the first draft of the manuscript. O.O.O. and N.B.W.M. supervised the project while O.O.O. handled the project administration. N.B.W.M. provided resources, proofread the first manuscript draft and offered critical review before final draft submission.

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Data availability

The data that support the findings of this study are available from the corresponding author, N.N.G. upon reasonable request.

Disclaimer

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References

Adewusi, A.O., Okoli, U.I., Adaga, E., Olorunsogo, T., Asuzu, O.F., & Daraojimba, D.O. (2024). Business intelligence in the era of big data: A review of analytical tools and competitive advantage. *Computer Science & IT Research Journal, 5*(2), 415–431. https://doi.org/10.51594/csitrj.v5i2.791

Agrawal, D., El Abbadi, A., Antony, S., & Das, S. (2010). Data management challenges in cloud computing infrastructures. In *Databases in Networked Information Systems: 6th International Workshop, DNIS 2010, Aizu-Wakamatsu, Japan*, 29–31 March 2010. Proceedings 6 (pp. 1–10). Springer Berlin Heidelberg.

Barisits, M., Beermann, T., Berghaus, F., Bockelman, B., Bogado, J., Cameron, D., Christidis, D., Ciangottini, D., Dimitrov, G., Elsing, M., & Garonne, V. (2019). Rucio: Scientific data management. *Computing and Software for Big Science, 3*, 1–19. https://doi.org/10.1007/s41781-019-0026-3

Bloomfield, J., & Fisher, M.J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses Association, 22*(2), 27–30.

Bolton, R.N., McColl-Kennedy, J.R., Cheung, L., Gallan, A., Orsingher, C., Witell, L., & Zaki, M. (2018). Customer experience challenges: Bringing together digital, physical and social realms. *Journal of Service Management, 29*(5), 776–808. https://doi.org/10.1108/JOSM-04-2018-0113

Bundesregierung, D. (2021). Data Strategy of the Federal German Government. Federal Chancellery, Willy-Brandt-Straße 1, 10557 Berlin.

Calliess, C., & Baumgarten, A. (2020). Cybersecurity in the EU the example of the financial sector: A legal perspective. *German Law Journal, 21*(6), 1149–1179. https://doi.org/10.1017/glj.2020.67

Çelik, K., & Ayaz, A. (2022). Validation of the Delone and McLean information systems success model: A study on student information system. *Education and Information Technologies, 27*, 1–19.

Chiware, E., & Mathe, Z. (2015). Academic libraries' role in research data management services: A South African perspective. *South African Journal of Libraries and Information Science, 81*(2), 1–10. https://doi.org/10.7553/81-2-1563

Cronje, J. (2020). Designing questions for research design and design research in e-Learning. *Journal of e-Learning, 18*(1), 13–14. https://doi.org/10.34190/EJEL.20.18.1.002

Cypress, B. (2018). Qualitative research methods: A phenomenological focus. *Dimensions of Critical Care Nursing, 37*(6), 302–309. https://doi.org/10.1097/DCC.0000000000000322

D'Alimonte, R., Sio, D., & Franklin, M.N. (2020). From issues to goals: A novel conceptualisation, measurement, and research design for comprehensive analysis of electoral competition, *Journal of West European Politics, 43*(3), 518–542. https://doi.org/10.1080/01402382.2019.1655958

DeLone, W.H., & McLean, E.R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

Duan, Y., Edwards, J.S., & Dwivedi, Y.K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International Journal of Information Management, 48*, 63–71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021

Fu, Y., & Soman, C. (2021). Real-time data infrastructure at uber. In G. Li & Z. Li (Eds.), *Proceedings of the 2021 International Conference on Management of Data, 20–25 June 2021* (pp. 2503–2516). ACM Digital Library.

Gopal, G., Suter-Crazzolara, C., Toldo, L., & Eberhardt, W. (2019). Digital transformation in healthcare–architectures of present and future information technologies. *Clinical Chemistry and Laboratory Medicine (CCLM)*, *57*(3), 328–335. https://doi.org/10.1515/cclm-2018-0658

Hidayah, N.A., Putri, R.N., Musa, K.F., Nihayah, Z., & Muin, A. (2020). Analysis using the technology acceptance model (TAM) and DeLone & McLean information system (D&M IS) success model of AIS mobile user acceptance. In Y. Durachman & H.A. Pradana (Eds.), *2020 8th International Conference on Cyber and IT Service Management (CITSM), 23–24 October 2020* (pp. 1–4). IEEE.

Imeni, M., & Edalatpanah, S.A. (2023). Resilience: Business sustainability based on risk management. In H. Garg (Ed.), *Advances in reliability, failure and risk analysis* (pp. 199–213). Industrial and Applied Mathematics, Springer.

Jennex, M.E., Durcikova, A., & Ilvonen, I. (2022). Knowledge systems and risk management: Threat lessons learned from COVID-19 in 2020-21. In T.X. Bui (Ed.), *Tung Proceedings of the 55th Hawaii International Conference on System Sciences (HICSS) 2022, 3–7 January 2022.* (pp. 5589–5598).

Ladley, J. (2019). *Data governance: How to design, deploy, and sustain an effective data governance program*. Academic Press.

Laher, A.E., Van Aardt, B.J., Craythorne, A.D., Van Welie, M., Malinga, D.M., & Madi, S. (2019). 'Getting out of the dark': Implications of load shedding on healthcare in South Africa and strategies to enhance preparedness. *South African Medical Journal*, *109*(12), 899–901. https://doi.org/10.7196/SAMJ.2019.v109i12.14322

Liakh, O. (2021). Accountability through sustainability data governance: Reconfiguring reporting to better account for the digital acceleration. *Sustainability, 13*(24), 13814. https://doi.org/10.3390/su132413814

Lifhjelm, T. (2021). *A scalability evaluation on CockroachDB*. Bachelor's Degree, Umea University.

Lobe, B., Morgan, D., & Hoffman, K.A. (2020). Qualitative data collection in an era of social distancing. *International Journal of Qualitative Methods, 19*, 1609406920937875. https://doi.org/10.1177/1609406920937875

Lukonga, I. (2020). *Harnessing digital technologies to promote SMEs in the MENAP region*. IMF Working papers.

Milat, A., Lee, K., Conte, K., Grunseit, A., Wolfenden, L., Van Nassau, F., Orr, N., Sreeram, P., & Bauman, A. (2020) Intervention scalability assessment tool: A decision support tool for health policy makers and implementers. *Health Research Policy and Systems, 18*, 1–17. https://doi.org/10.1186/s12961-019-0494-2

Mlitwa, N.W., & Ogundaini, O.O. (2022). Determinants of e-Learning user satisfaction at a South African University of Technology. In *2022 IEEE 28th International Conference on Engineering, Technology and Innovation (ICE/ITMC) & 31st International Association for Management of Technology (IAMOT) Joint Conference* (pp. 1–8). IEEE.

Mlitwa, N.W., & Ogundaini, O.O. (2022). Determinants of e-Learning user satisfaction at a South African University of Technology. In M. Laure, D. Laurent, & C. Mauricio *2022 IEEE 28th International Conference on Engineering, Technology and Innovation (ICE/ITMC) & 31st International Association for Management of Technology (IAMOT) Joint Conference* (pp. 1–8). 19–23 June 2022. IEEE.

Modisane, P., & Jokonya, O. (2021). Evaluating the benefits of cloud computing in small, medium and micro-sized enterprises (SMMEs). *Procedia Computer Science, 181*, 784–792. https://doi.org/10.1016/j.procs.2021.01.231

MSME report South Africa. (2024). *FinScope MSME South Africa 2024: Key findings highlight urgent need for informal sector support*. FinMark Trust Knowledge Hub. Retrieved March 08, 2024 from https://finmark.org.za/knowledge-hub/articles/finscope-msme-south-africa-2024-key-findings-highlight-urgent-need-for-informal-sector-support?entity=blog

Mukherjee, S.P. (2019). *A guide to research methodology: An overview of research problems, tasks and methods*. Routledge.

Ngcobo, K., Bhengu, S., Mudau, A., Thango, B., & Lerato, M. (2024). Enterprise data management: Types, sources, and real-time applications to enhance business performance-a systematic review. *SSRN*, 1–66. https://doi.org/10.2139/ssrn.4968451.

Pandey, P., & Pandey, M.M. (2021). *Research methodology tools and techniques*. Bridge Center.

Pandit, D., & Agrawal, S. (2022). Exploring challenges of online education in COVID times. *FIIB Business Review, 11*(3), 263–270.

Patel, K.K., Patel, S.M., & Scholar, P. (2016). Internet of things-IOT: Definition, characteristics, architecture, enabling technologies, application & future challenges. *International Journal of Engineering Science and Computing, 6*(5), 6122–6131.

Pieterse, H. (2021). The cyber threat landscape in South Africa: A 10-year review. *African Journal of Information and Communication, 28*, 1–21. https://doi.org/10.23962/10539/32213

Purwati, A.A., Mustafa, Z., & Deli, M.M. (2021). Management information system in evaluation of BCA mobile banking using DeLone and McLean model. *Journal of Applied Engineering and Technological Science (JAETS), 2*(2), 70–77. https://doi.org/10.37385/jaets.v2i2.217

Satti, F.A., Ali, T., Hussain, J., Khan, W.A., Khattak, A.M., & Lee, S. (2020). Ubiquitous Health Profile (UHPr): A big data curation platform for supporting health data interoperability. *Computing, 102*(11), 2409–2444. https://doi.org/10.1007/s00607-020-00837-2

Shamim, S., Zeng, J., Shariq, S.M., & Khan, Z. (2019). Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. *Information & Management*, *56*(6), 103135.

Singh, S., Sharma, S.K., Mehrotra, P., Bhatt, P., & Kaurav, M. (2022). Blockchain technology for efficient data management in healthcare system: Opportunity, challenges and future perspectives. *Materials Today: Proceedings, 62*(pt. 7), 5042–5046. https://doi.org/10.1016/j.matpr.2022.04.998

Siyal, A.A., Junejo, A.Z., Zawish, M., Ahmed, K., Khalil, A., & Soursou, G. (2019). Applications of blockchain technology in medicine and healthcare: Challenges and future perspectives. *Cryptography, 3*(1), 3. https://doi.org/10.3390/cryptography3010003

Tabesh, P., Mousavidin, E., & Hasani, S. (2019). Implementing big data strategies: A managerial perspective. *Business Horizons, 62*(3), 347–358. https://doi.org/10.1016/j.bushor.2019.02.001

Tahar, A., Riyadh, H.A., Sofyani, H., & Purnomo, W.E. (2020). Perceived ease of use, perceived usefulness, perceived security and intention to use e-filing: The role of technology readiness. *The Journal of Asian Finance, Economics and Business (JAFEB), 7*(9), 537–547.

Van Der Merwe, L. (2021). *Towards a maturity model for the assessment of data management of healthcare entities in developing countries*. Doctoral dissertation, Stellenbosch University.

Veeramootoo, N., Nunkoo, R., & Dwivedi, Y.K. (2018). What determines success of an e-government service? Validation of an integrative model of e-filing continuance usage. *Government Information Quarterly, 35*(2), 161–174. https://doi.org/10.1016/j.giq.2018.03.004

Wang, Y., Kung, L., & Byrd, T.A. (2018). Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. *Technological Forecasting and Social Change, 126*, 3–13. https://doi.org/10.1016/j.techfore.2015.12.019

Westman, L., Luederitz, C., Kundurpi, A., Mercado, A.J., & Burch, S.L. (2023). Market transformations as collaborative change: Institutional co-evolution through small business entrepreneurship. *Business Strategy and the Environment, 32*(2), 936–957. https://doi.org/10.1002/bse.3083

Yakubu, N., & Dasuki, S. (2018). Measuring e-learning success in developing countries: Applying the updated DeLone and McLean model. *Journal of Information Technology Education: Research, 17*(1), 183–203. https://doi.org/10.28945/4077

Yassine, A., Singh, S., Hossain, M.S., & Muhammad, G. (2019). IoT big data analytics for smart homes with fog and cloud computing. *Future Generation Computer Systems, 91*, 563–573. https://doi.org/10.1016/j.future.2018.08.040

Zeadally, S., Siddiqui, F., Baig, Z., & Ibrahim, A. (2020). Smart healthcare: Challenges and potential solutions using internet of things (IoT) and big data analytics. *PSU Research Review, 4*(2), 149–168. https://doi.org/10.1108/PRR-08-2019-0027

Zhu, L., Wu, Y., Gai, K., & Choo, K.K.R. (2019). Controllable and trustworthy blockchain-based cloud data management. *Future Generation Computer Systems, 91*, 527–535. https://doi.org/10.1016/j.future.2018.09.019