

Comparative Analysis of Citrix and VMware Horizon Virtual Desktop Infrastructure (VDI) Solutions in Organizational Environment

Dawit Tekle

HiLCoE , School of Computer Science and Technology
dawittek123@gmail.com

Fanthaun Bogale

HiLCoE , School of Computer Science and Technology
fantishb@gmail.com

Abstract:

The article discusses increasing reliance on Virtual Desktop Infrastructure (VDI) solutions within modern organizations necessitates a comprehensive understanding of the impact of various VDI platforms on organizational environments. Among the leading solutions, Citrix and VMware Horizon offer diverse features and functionalities. However, a significant gap remains in the research concerning a systematic comparison of these platforms and their effects on organizational performance. This research thesis aims to gather insights and experiences from IT managers, employees of the Ethiopian Roads Administration ICT departments, and other stakeholders regarding Citrix and VMware Horizon VDI solutions. The primary objective is to conduct a thorough qualitative and quantitative analysis of the impact of these VDI solutions on organizational environments. Key factors to be explored include the management consoles and tools preferred by IT administrators, the VDI solutions best equipped to meet the evolving demands of organizational environments, the effectiveness of provisioning common BYOD devices in both Citrix and VMware VDI environments, and the user-friendliness of each solution in terms of management and support.

The findings provide a comprehensive comparative analysis of Citrix and VMware Horizon, focusing on their implications for organizational environments. Insights gained from this study will enable organizations to make informed decisions when selecting a VDI solution that aligns with their specific needs, including deployment methods, performance, scalability, management capabilities, security, and user experience. Ultimately, this research will contribute to the existing knowledge base, addressing identified gaps in the literature and assisting organizations in optimizing their environments to enhance overall productivity and efficiency.

Keywords: VDI, Citrix, VMware Horizon, Organizational Environment

1. Introduction:

Virtual Desktop Infrastructure (VDI) is a technology visualizes desktop environments, allowing desktop operating system usually Microsoft Windows to operate and be managed from a data center [2]. The virtual desktop is transmitted over a network to a client device, enabling users to engage with the operating system and its applications as if they were installed locally. This client device can be a standard

PC, a thin client, or a mobile device. As Maukonen [8] pointed out that VDI enables users to access desktop environments hosted on centralized servers, thereby enhancing flexibility, security, and scalability. This approach not only streamlines IT operations but also supports remote work and collaboration, making it an essential component in modern enterprise architecture. As businesses increasingly adopt digital transformation strategies, understanding the intricacies of VDI becomes crucial for leveraging its full potential. Virtual Desktop Infrastructure (VDI) has emerged as a trans-formative technology in the realm of information technology, enabling organizations to deliver desktop environments to users on demand. As *Nair and Pramod* [11], delved that the architectural considerations necessary for effectively implementing VDI solutions, along with strategies for optimizing performance. Their comprehensive survey highlights the critical components of VDI systems, including resource management and scalability, which are essential for meeting the diverse needs of modern enterprises.

Digital transformation plays an important role in enabling companies to build sustainable supply chain capabilities and implement effective sustainability strategies. As the authors of Dong et al.[5], proved that a conceptual framework to explain how the adoption of these digital technologies can enable organizations to develop sustainable supply chain practices, increase their competitive advantage, and improve overall business performance. When comparing Citrix and VMware Horizon VDI solutions in organizational environment research, it is crucial to analyze key aspects such as performance, ease of deployment, scalability, user experience, and cost-effectiveness.

The article highlights the key benefits of adopting Virtual Desktop Infrastructure (VDI) in organizations: Furthermore, VDI simplifies IT management through centralized administration, making updates and configurations more efficient. This infrastructure also aids in business continuity, ensuring quick recovery from hardware failures or disasters due to centralized backups [23].

- **Improved Data Security and Compliance:** VDI centralizes data in secure data centers, reducing data breach risks and aiding compliance, especially in regulated industries.
- **Increased Workforce Flexibility and Mobility:** Employees can access their virtual desktops from any location and device, enhancing productivity and collaboration, particularly for remote work.
- **Centralized IT Management and Reduced Costs:** VDI streamlines IT management, allowing faster desktop provisioning and maintenance, which lowers the need for on-site hardware and support resources.
- **Enhanced User Experience and Productivity:** VDI offers a consistent, high-performance desktop environment, improving employee satisfaction and fostering efficient workflows.

2. Literature Review

The growing demand for flexible working environments has propelled the adoption of Virtual Desktop Infrastructure (VDI) solutions, with Citrix and VMware emerging as leading providers [32]. This literature review explores existing research on Citrix Virtual Apps and Desktops and VMware Horizon, highlighting key features, benefits, limitations, and comparative analyses.

Virtual Desktop Infrastructure (VDI) solutions offer significant flexibility and scalability for modern enterprises, enabling secure and efficient remote work capabilities. Deploying VDI solutions in the cloud provides enhanced scalability and cost efficiency but requires careful planning to optimize costs and ensure sustainability [6].

This paper [6] provided a detailed comparative analysis of leading cloud providers, such as Amazon Web Services (AWS), Microsoft Azure, and Citrix Cloud, focusing on cost optimization strategies and sustainable practices. The discussion integrates technical details, performance metrics, sustainability considerations, and future trends to provide a comprehensive guide for running cost-effective and environmentally friendly VDI solutions in the cloud.

2.1. Citrix VDI Solution Features

Citrix Environment is a comprehensive digital Environment solution that provides secure and unified access to a wide range of resources, including applications, desktops, and content, from any location and any device [42]. This solution aggregates and integrates Citrix Cloud services, enabling end-users, referred to as subscribers, to access all the resources available to them through a single, centralized platform.

Citrix Virtual Desktop Infrastructure (VDI) provides a secure, scalable, and high-performance platform for delivering virtual desktops to users across various environments. By utilizing centralized management and advanced virtualization technologies, Citrix VDI simplifies desktop deployment and administration while ensuring seamless access on any device or network. Key features such as the Flex-cast Management Architecture (FMA), HDX technology for enhanced user experience, and hybrid cloud support make Citrix VDI an optimal solution for enterprises seeking to improve productivity, security, and operational flexibility.

Delivery Controller: The central management component that tracks user sessions, brokers connections, authenticates users, and manages desktop application delivery. It communicates with hypervisors or other services to host the virtual machines.

Virtual Delivery Agent (VDA): Installed on physical or virtual machines to enable registration with the Controller and manage the connection between the machine and the user device. The VDA communicates with the Controller's Broker Service.

Citrix Environment App: Installed on user devices, it provides secure, self-service access to applications, desktops, and documents.

Citrix Director: A web-based tool for IT support teams to monitor the environment, troubleshoot issues, and provide user support. **Citrix License Server:** Manages the licensing for Citrix products used in the deployment.

2.2. VMware Horizon VDI Features

VMware Horizon is a comprehensive Virtual Desktop Infrastructure (VDI) solution designed to manage, deploy, and maintain virtual desktops and applications for end-users. It provides a robust infrastructure that supports remote access, flexibility, and productivity across various devices and locations.

VMware Horizon offers a rich set of features designed to enhance Virtual Desktop Infrastructure (VDI) environments by delivering secure, flexible, and scalable virtual desktops and applications. Key features include centralized management, allowing IT teams to efficiently deploy, monitor, and manage desktops and apps across private, hybrid, or multi-cloud environments using a unified cloud-based console.

VMware Horizon's infrastructure is designed to provide a scalable and secure platform for delivering virtual desktops and applications. The architecture includes key components such as the Horizon Connection Server, which acts as the central management and brokering component, authenticating users and facilitating connections to virtual resources. It supports advanced technologies like Instant Clone for rapid desktop provisioning, App Volumes for streamlined application delivery, and Dynamic Environment Manager for personalized user settings [35].

Kushwaha et al. [23] explore desktop virtualization, focusing on its transformative potential through Virtual Desktop Infrastructure (VDI). Key benefits include enhanced security via centralized data storage, reduced hardware costs from thin client use, and improved flexibility for remote work. However, challenges such as high initial setup costs, reliance on strong network infrastructure, and potential latency issues are significant. The authors call for further research to overcome these technical limitations and explore innovative VDI use cases across industries.

Ahmed et al. [3] highlight VDI's role in creating flexible learning environments, enabling students to access resources from various devices while promoting collaboration. Financial benefits include reduced hardware costs and simplified IT management, although challenges like robust infrastructure and data protection remain critical for successful implementation. The literature emphasizes VDI's potential to revolutionize education by enhancing accessibility and supporting personalized learning experiences. The authors in [43] outline advantages such as better resource utilization and improved management capabilities while noting drawbacks like performance challenges and setup complexity. Their cost analysis addresses initial investments and ongoing operational costs, examining how scalability affects performance and offering optimization techniques.

A study on VDI solutions for enterprises emphasizes flexibility and scalability in supporting remote work [6]. It discusses the benefits of deploying VDI in the cloud, including cost efficiency, while stressing the need for careful planning. Comparative analyses of providers like AWS and Microsoft Azure offer guidance on cost optimization and sustainable practices.

Gupta and Kumar et al. [14][7] explore various desktop virtualization approaches, highlighting benefits and challenges. Gupta's research identifies issues in resource allocation and performance. The literature advocates for comprehensive cost-benefit analyses to inform technology investments.

The impact of VDI on interaction and work performance is significant, allowing remote access from centralized servers while enhancing employee engagement and promoting sustainability through reduced commuting [33]. Lee et al. [30] emphasize user-centered design principles to improve user satisfaction and task efficiency in VDI environments. Finally, Fernandes et al. [27] examine how organizations collaborate

using VDI technologies, highlighting their role in driving innovation and economic growth.

3. Related Works

3.1. Comparative Analysis of VDI Technologies VMware, Citrix and AVD

Patil et al.'s [4] 2021 study, "A Comparative Study of Cloud Desktop Virtualization Technologies," offers an in-depth analysis of various cloud desktop virtualization solutions. The study compares key technologies, including VMware Horizon, Citrix Virtual Apps and Desktops, Microsoft Azure Virtual Desktop (AVD), and Amazon Work-spaces.

VMware Horizon is noted for its centralized management and robust scalability but is limited by high costs and complex setup.

Citrix excels in user experience and security but is also expensive and requires significant IT expertise. AVD is recognized for its cost-effectiveness and seamless integration with Microsoft services, although it has limited customization options. Amazon Work-spaces provides an easy setup and cost-effectiveness but offers less control over infrastructure.

The study evaluates these technologies based on scalability, security, cost, and user experience, concluding that organizations must carefully assess their specific needs to choose the most suitable solution, as each technology has unique strengths and weaknesses.

3.2. Comparative Study of Desktop Virtualization in Cloud Computing.

As Kwek et al.'s [9] proved in their related works analysis of various desktop virtualization solutions within cloud environments. This related work compares multiple technologies, evaluating their performance, scalability, security features, and cost-effectiveness. It highlighted how different virtualization approaches can cater to diverse organizational needs, such as remote access, resource management, and user experience. The authors also discuss the challenges associated with implementing these solutions, including network dependency and the complexity of management and provides insights into the strengths and weaknesses of various desktop virtualization technologies.

3.3. Employee Perceived Satisfaction in using Citrix Environment Technology

Al Fehaidi and Khan [32] conducted a study to evaluate employee satisfaction and performance with Citrix Workspace technology in a Saudi company, using the Technology Acceptance Model (TAM) as the theoretical framework.

Correlation analysis: The research focused on understanding employees' perceptions of the technology's ease of use, usefulness, and its impact on remote work productivity.

Findings revealed a strong positive correlation between user satisfaction and performance, with perceived ease of use and usefulness being critical factors influencing acceptance.

The study also highlighted that Citrix Workspace enhanced remote work

capabilities by providing secure access to applications and systems, thus improving overall employee productivity. However, it identified barriers such as limited familiarity with the technology and infrastructure challenges that could hinder its full adoption.

This research contributes to understanding how employee satisfaction with workplace technologies like Citrix Workspace can drive performance improvements in remote work settings.

3.4. Comparative Analysis of Desktop Virtualization Using VMware, Citrix

The author of [37] provided an in-depth evaluation of three popular desktop virtualization platforms VMware, Citrix, Hyper-V, and VirtualBox. The authors conduct a comparative analysis based on various criteria, including performance, scalability, ease of use, and feature sets.

Key findings highlight the strengths and weaknesses of each platform. VMware is noted for its robust performance and extensive feature set, making it suitable for enterprise environments. Hyper-V is praised for its integration with Windows environments and cost-effectiveness, while VirtualBox is recognized for its user-friendly interface and flexibility, particularly in smaller setups. The paper aims to guide organizations in selecting the most appropriate virtualization solution based on their specific needs and resources.

4. Methodology

4.1. General Research Methodology

This study employs a mixed-methods research design to comprehensively evaluate the capabilities and performance of Citrix and VMware Horizon VDI solutions. Following the framework established by Mishra and Alok [15], qualitative data will be collected through interviews and focus groups with IT administrators to gain insights into their preferences for management tools and the adaptability of each solution to organizational needs.

Quantitative data will be gathered through surveys to assess the effectiveness of BYOD provisioning and overall user satisfaction. The research will also reference the methodologies outlined by Takonaand Dubey and Kothari [17], which emphasize the importance of triangulating data sources for robust findings. As Gupta and Gupta [36], further support the use of mixed methods, highlighting their effectiveness in capturing diverse perspectives within complex research contexts.

4.2. Research Design

The study utilizes a cross-sectional survey design, allowing for the collection of data at a single point in time. This approach facilitates the examination of differences between user experiences with Citrix and VMware VDI solutions across various organizations.

The survey will be structured to include both closed-ended and open-ended questions, enabling the collection of quantitative data while also allowing for qualitative insights. This research employs a quantitative approach to evaluate the comparative effectiveness of Citrix and VMware Virtual Desktop Infrastructure (VDI) solutions in organizational environments.

To conduct a comprehensive comparative analysis of Citrix and VMware Horizon VDI solutions in the context of organizational environment, this research employed mixed- methods approach [41] in combining quantitative and qualitative research designs

The quantitative component involved the collection and statistical analysis [44] of performance metrics, scalability data, and user experience ratings to objectively evaluate the features and functionalities of the two VDI platforms.

The qualitative aspect will leverage in-depth technical interviews to gain a deeper understanding of deployment, management capabilities, security measures, and the overall impact of Citrix and VMware Horizon on the organizational environment.

- **Quantitative Component:** It involves collecting and statistically analyzing performance metrics, scalability data, and user experience ratings to objectively assess the features of both platforms.
- **Qualitative Component:** In-depth technical interviews will provide insights into deployment, management capabilities, security measures, and the overall organizational impact of the two VDI solutions. The qualitative aspect will leverage in-depth technical interviews to gain a deeper understanding of deployment, management capabilities, security measures, and the overall impact of Citrix and VMware Horizon on the organizational environment.

4.3. Research Sample Size Distribution

- ◆ For this study, the research employed a convenience sampling approach to recruit participants. Convenience sampling involves selecting participants who are readily available and willing to take part in the research [29].
- ◆ Convenience sampling involves selecting participants who are readily available and willing to take part in the research. This sampling method was deemed appropriate given the exploratory nature of the study and the challenges in accessing the target population.
- ◆ The research leveraged their personal and professional networks, as well as online platforms, to identify and invite 113 potential participants who met the inclusion criteria.

- ◆ Convenience allowed the researchers to efficiently gather a substantial amount of preliminary data to inform the development of future, more rigorous studies on this topic.

4.4. Research Data Collection Methods.

This research will use multiple data collection methods to analyze two VDI solutions:

- ✓ **Questionnaires:** Distributed via Google Forms and printed copies to ICT departments of the Ethiopian Roads Administration (ERA) and Ethiopian Civil Works Corporation (ECWC).
- ✓ **Interviews:** Conducting in-depth technical interviews to assess strengths and weaknesses.
- ✓ **Literature Review:** Reviewing case studies and success stories from Citrix and VMware Horizon.

Data analysis tools will include:

- **Spreadsheet Software:** Microsoft Excel and Google Sheets for basic organization and visualization.
- **Statistical Software:** Tools like Quirkos, MAXQDA, SPSS, and R for advanced statistical analyses.

5. Data Analysis and findings

5.1. Cronbach's Alpha Readability of the datasets.

Cronbach's Alpha, also known as coefficient alpha, is a statistical measure used to assess the internal consistency or reliability of a set of scale or test items. High Cronbach's Alpha value suggests a strong correlation (0.956) among the variables being measured, indicating a reliable relationship among them.

5.2. Technical Feature Set Related Evaluation

Using a questionnaire survey a methodological framework ensured that a rigorous and objective assessment, enabling a thorough understanding of how these solutions impact IT administration, user experience, and overall environment efficiency as implied in the organizational settings.

Citrix feature set Analysis - a feature set comparison utilizing a 5-point Likert scale ranging from very poor to excellent, each rating level represents a distinct evaluation of the features being assessed.

A rating of 1, indicating very poor, suggests that the feature set lacks essential functionalities, is inefficient, or significantly underperform compared to expectations. VMware feature set Analysis most the respondents evaluation tends to Very Good(3) this implies. "very good" would typically represent the highest level of satisfaction or agreement with the features being assessed but with less mean value compare to Citrix.

5.3. VDI solutions Feature Frequency of Usage Comparison

Based on respondents the frequency usage rating for Desktop Virtualization and

Provisioning in Citrix VDI is 3.91 out of 5. This suggests a relatively high level of usage and significance attributed to desktop virtualization and provisioning within the Citrix VDI setup. Frequency usage within VMware VDI solutions, highlights the significance of application virtualization, desktop virtualization, provisioning, remote access, and mobility features in the context of VMware VDI deployments. This analysis provided the significance of application virtualization, desktop virtualization, provisioning, remote access, and mobility features in the context of VMware VDI deployments.

5.4. VDI Challenges and Severity Comparison

For licensing cost, the severity ratings range from 1 to 5, with a mean of 3.91 and a standard deviation of 1.110. A moderate level of concern among users regarding the licensing cost associated with Citrix VDI solution. terms of latency or performance issues, the severity ratings range from 1 to 5, with a mean of 0.92 and a standard deviation of 0.925. Similarly, showed compatibility issues associated with VMware VDI solution received moderate severity ratings. The ratings range from 1 to 4, with a mean of 2.98 and a standard deviation of 0.788. This indicates that users perceive compatibility issues to be of moderate concern.

5.5. Overall Satisfaction on VDI Solutions

Dependent Variables; summarized the comparison between Citrix VDI and VMware VDI in terms of overall satisfaction on scalability and resource allocation, and overall satisfaction in accommodating organizational and user workloads. For Citrix VDI, the minimum satisfaction score is 3, the maximum is 5, with a mean of 4.08 and a standard deviation of 0.647 for both metrics. The data suggests that users have higher overall satisfaction with Citrix VDI compared to VMware VDI in terms of scalability, resource allocation, and accommodating organizational and user workloads

5.6. Correlation Analysis

Correlation between variables related to Citrix and VMware VDI. For instance, the research examine the relationship between user experience and performance metrics or the correlation between cost factors and satisfaction levels results of the correlation analysis will be discussed in detail in next results and discussion chapter of research.

5.7. Theme Categorization and Coding

Coding is fundamental step in qualitative data analysis that involves systematically assigning labels or codes to segments of data. The research identifies patterns, themes, or concepts within the data and assigns relevant codes to capture these elements.

6. Results and Discussion

6.1. Demographic Data Summary

The demographic respondent statistics the sample consists primarily of male respondents (80%), with an average age between 36-45 years old (61%), a mix of bachelor's and master's degree holders (55% and 45% respectively), mostly mid-level to senior-level professionals (76%), from the same organization (67%), and with

an average work experience of 6-10 years (40%).

6.2. VDI Features Comparison Findings Summary

It offers a high degree of scalability, enabling organizations to easily expand their VDI deployments. Also in figure 6.1 result show that the collaboration and sharing capabilities being the most positively perceived (78.4%, 74.4%, and 72% respectively).

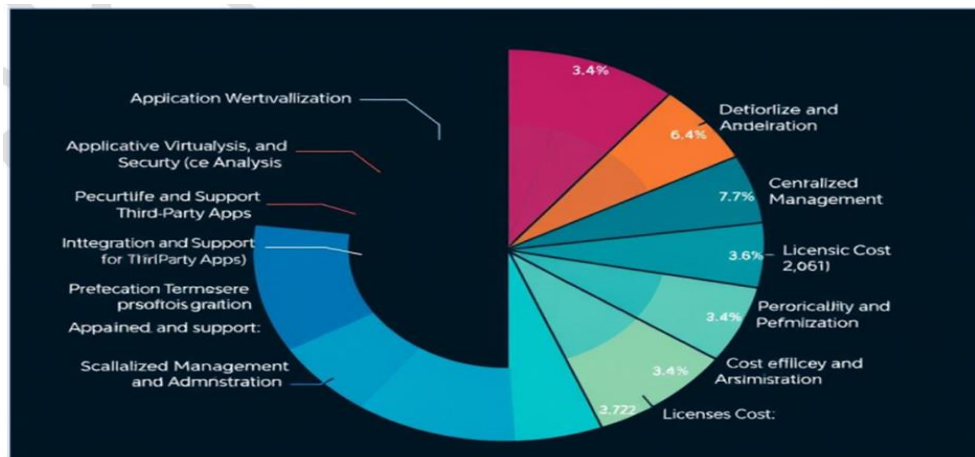


Figure 6.1 VDI Feature set Comparison Result

The licensing cost and the cost and efficiency and resource optimization features are perceived to be the least effective (52.2%). VMware VDI solution is perceived to be moderately effective across the cost efficiency and resource optimization, and the identified cost savings being the most positively perceived (77%).

6.3. VDI Challenges Comparison

In figure 6.2 above the Citrix solution is generally perceived to have higher licensing costs (78.2%), lower latency or performance issues (18.4%), and fewer compatibility issues (4.6%), while the VMware Horizon solution is perceived to have moderate flexibility and remote access capabilities (61.6%), some latency or performance issues (41.8%), and moderate compatibility issues (59.6%).

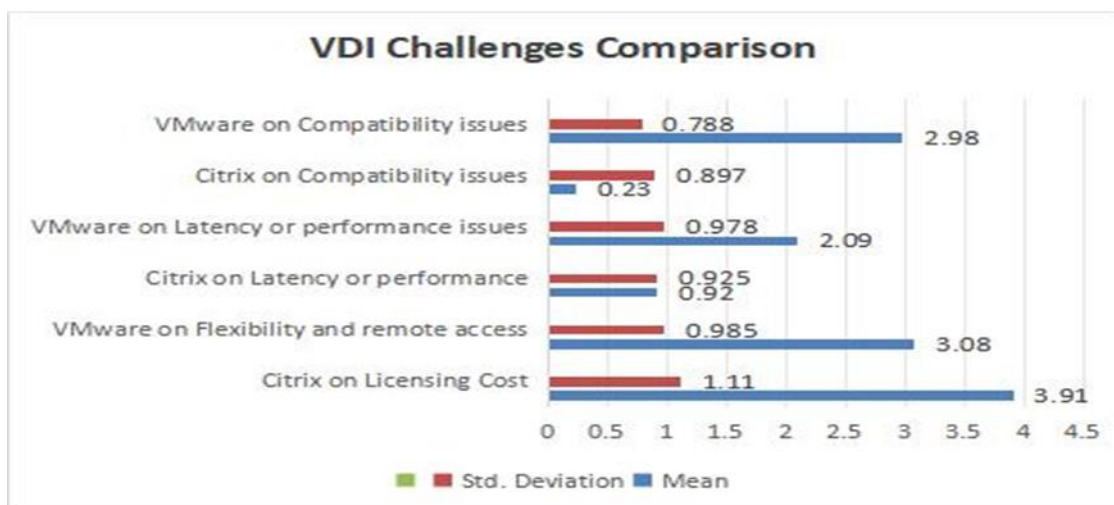


Figure 6.2 VDI challenges comparison

6.4. Correlation Analysis Result Summary

The correlation analysis also indicated that Level of education and Citrix VDI solutions users: Pearson Correlation: 0.856 (between level of education and Citrix VDI

solutions users) Sig. (2-tailed): 0.986 The correlation coefficient between level of education and Citrix VDI solutions users the level of education and Citrix VDI solutions users is 0.856, indicating a strong positive correlation.

The correlation coefficient of 0.856 suggests a relatively strong linear relationship between level of education and Citrix VDI solutions users the two variables.

The Kendall's tau_b correlation coefficient between level of education and Citrix VDI solutions users the level of education and Citrix VDI solutions users is 0.856, indicating a relatively strong positive correlation.

6.5. Overall Satisfaction Comparison on VDI Solutions

In **Figure 6.3** the data suggests that organizations are more satisfied with the Citrix VDI solution's scalability, resource allocation, and ability to accommodate their workloads, with an 81.6% satisfaction level, compared to the VMware VDI solution, which has a 61.8% satisfaction level.

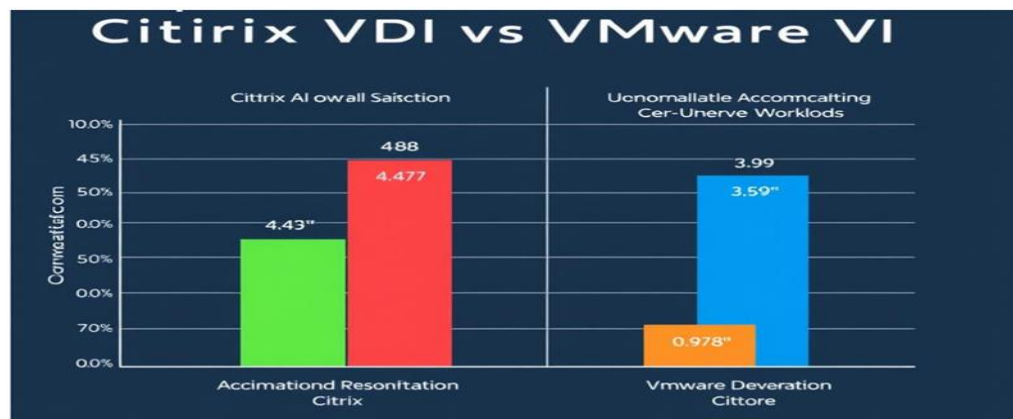


Figure 6.3 overall satisfaction comparison on VDI

6.6. Results of Thematic Analysis

This thematic analysis, which conducted a comparative evaluation of Citrix and VMware Horizon VDI solutions, reveals several key themes that organizations must weigh when selecting the optimal virtual desktop infrastructure for their needs. The analysis was based on 15 semi-structured interviews conducted between December 2023 and February 2024, which identified 10 major themes.

❖ Responsibilities within the Organization

ERA: Participants included IT managers and technical staff, emphasizing roles focused on technology evaluation and implementation. This suggests a strong technical expertise within the organization.

ECWC: Participants consisted of a mix of IT and operational leaders, indicating a broader perspective on technology's impact on organizational performance and employee experience.

❖ Prior Experience with VDI/Remote Work

ERA: Many participants reported extensive prior experience with VDI solutions, indicating familiarity with various deployment models and a proactive approach to

technology adoption.

ECWC: Participants exhibited a range of experiences, with some having limited exposure to VDI prior to implementation. This variability suggests a learning curve for some employees as the organization embraced remote work.

❖ *Perceptions of VDI Solutions*

ERA: Participants perceived Citrix VDI as a superior solution, praising its integration capabilities and robust features. The focus was on performance and adaptability to organizational needs.

ECWC: While expressing satisfaction with VMware, ECWC participants highlighted user experience and performance as critical factors. The perception here leans towards evaluating solutions based on end-user impact and operational efficiency.

❖ *VDI Implementation Process*

ERA: The implementation process was characterized by strong leadership involvement, with IT managers taking a central role in evaluating and selecting VDI solutions. This collaborative approach facilitated a smoother transition.

ECWC: Participants noted a more decentralized approach, with varied roles contributing to the implementation process. This suggests a need for cross-departmental collaboration but may also reflect differing levels of involvement and expertise among staff.

❖ *Organizational Factors*

ERA: The organization's size and technology strategy were cited as key factors influencing VDI adoption. A clear alignment between VDI solutions and organizational goals was evident, supporting effective decision-making.

ECWC: Factors such as industry-specific challenges and existing IT infrastructure played a significant role in shaping VDI adoption. The organization's focus on community engagement and social responsibility also influenced the selection of technology solutions.

The thematic analysis highlighted distinct differences between ERA and ECWC in their experiences and perceptions of VDI solutions. ERA's approach is characterized by strong technical expertise and a focus on integration and performance, while ECWC emphasizes user experience and collaborative implementation. Understanding these organizational nuances is essential for tailoring VDI solutions that meet the unique needs and goals of each organization, ultimately enhancing satisfaction and effectiveness in remote and hybrid work environments.

❖ *Benefits of VDI in Organizational Environment*

The thematic analysis revealed key goals and objectives among participants regarding the implementation of VDI solutions. These objectives were primarily driven by the need to address specific business challenges and improve organizational performance. **Enhanced Remote Work Capabilities:** A significant goal identified was the desire to improve remote and flexible work capabilities for employees. Participants emphasized the importance of providing a consistent and reliable

experience for remote workers to maintain productivity and engagement.

Improved Accessibility and Mobility: Participants noted that enhancing end-user accessibility and mobility was critical. The VDI solution was seen as a means to enable employees to access their work environments seamlessly, regardless of location, thereby supporting a more flexible work culture.

User Experience Focus: There was a strong emphasis on improving user experience. Participants expressed the need for a VDI solution that could deliver high performance and responsiveness, which is essential for maintaining employee satisfaction and productivity.

Increased Productivity and Operational Efficiency: Many participants cited the goal of increasing employee productivity and operational efficiency. By modernizing their IT infrastructure through VDI implementation, organizations aimed to streamline operations and reduce the time and resources needed for IT management. The analysis of goals and objectives for VDI implementation reveals a strong focus on enhancing remote work capabilities, improving user experience, and increasing operational efficiency. Participants from both ERA and ECWC articulated their needs for a modern, scalable VDI solution that aligns with their strategic objectives.

❖ *Based on Performance and Scalability VDI Environment.*

Based on the thematic analysis and participant feedback regarding performance and scalability in VDI environments.

ERA Organization

Performance: Participants from ERA reported high satisfaction levels with Citrix VDI, highlighting its robust performance in delivering a consistent user experience across remote and hybrid work settings. The solution was praised for its ability to handle high workloads and provide seamless access to applications.

Scalability: Citrix VDI was viewed as highly scalable, allowing ERA to easily adapt to changing workforce demands and rapidly provision virtual desktops for new employees or temporary staff. The integration with existing infrastructure also facilitated smooth scaling.

ECWC Organization

Performance: While participants acknowledged the strengths of VMware VDI, there were mixed reviews regarding its performance compared to Citrix. Some noted that VMware offered good overall performance, but it did not match the high satisfaction levels reported for Citrix VDI.

Scalability: VMware VDI was mentioned as capable of supporting the organization's growth. However, some participants indicated challenges in scaling the legacy infrastructure effectively, which impacted their experience with VMware.

In summary, the ERA organization, utilizing Citrix VDI, excels in both performance and scalability. Participants expressed strong satisfaction with the solution's ability to support remote work and adapt to organizational needs.

In contrast, while ECWC uses VMware VDI effectively, it does not achieve the same level of satisfaction regarding performance and scalability as noted by participants from ERA. Organizations aiming for high performance and scalability in their VDI environments may prefer Citrix VDI based on this analysis.

Security and Authentication Methods

Based on the thematic analysis and participant feedback regarding security and authentication methods in VDI environments.

ERA Organization on Citrix VDI Solution:

Security: Participants from ERA highlighted the strong security features of Citrix VDI, including advanced encryption, secure access controls, and comprehensive monitoring. The solution's ability to protect sensitive data while providing remote access was a significant advantage.

Authentication Methods: Citrix VDI supports multi-factor authentication (MFA) and integration with various identity management solutions, enhancing security for remote users. Participants appreciated the flexibility in authentication options, which aligns with organizational security policies.

ECWC Organization on VMware VDI Solutions

Security: While VMware VDI also offers solid security features, some participants noted that their experience with legacy systems posed challenges in implementing the latest security protocols. Overall, VMware VDI provides essential security measures, but there were concerns regarding some aspects of data protection and compliance.

Authentication Methods: VMware VDI supports various authentication methods, including SSO (Single Sign-On) and MFA. However, some participants indicated that the integration of these methods with existing systems could be complex, impacting their effectiveness.

6.7. Discussion

The findings of this research align with the comparative insights provided by Patil et al. [4]. Citrix VDI solutions are recognized for superior performance, characterized by lower latency and fewer compatibility issues, thanks to advanced features like HDX protocols and robust integration with hypervisors and cloud platforms (e.g., AWS, Azure, Google Cloud). This supports Patil et al.'s observation that Citrix excels in delivering a seamless user experience and efficient resource utilization, making it ideal for high-performance and flexible environments. In contrast, VMware Horizon offers moderate flexibility and remote access but experiences occasional latency and compatibility issues due to its reliance on proprietary ecosystems like VMware ESXi. Patil et al. [4] highlight that while VMware integrates well within its ecosystem, this vendor lock-in can limit adaptability in multi-cloud or hybrid environments. Citrix's support for multiple hypervisors and advanced provisioning services enhances its performance scalability for large deployments. However, Citrix typically comes with higher licensing costs compared to VMware Horizon, which offers competitive pricing models. Cost considerations are critical in selecting VDI

solutions, with Citrix's higher costs potentially deterring smaller organizations. Yet, its superior performance makes it a preferred choice for enterprises prioritizing reliability and user experience. Conversely, VMware Horizon's cost-effectiveness and integration with existing VMware technologies make it practical for those already invested in that ecosystem. In conclusion, Citrix is better suited for organizations seeking high performance and flexibility across multi-cloud environments, albeit at a higher cost. VMware Horizon provides a balanced solution for those looking for moderate flexibility and cost efficiency within a proprietary framework. This analysis reinforces Patil et al.'s emphasis on aligning VDI selection with organizational priorities such as cost constraints, scalability needs, and performance requirements.

7. Conclusion and Recommendation

The use of virtual desktop infrastructure (VDI) solutions is increasingly common among organizations seeking to enhance efficiency, security, flexibility, and cost savings. By centralizing management, improving security, facilitating mobility, and optimizing resource utilization, VDI has become a valuable tool for businesses with modern, distributed workforces. This comparative analysis aimed to identify key factors for organizations when selecting a VDI solution to meet their specific needs. The thematic analysis highlighted drivers of VDI adoption, such as improved remote work capabilities, enhanced end-user productivity, and enabled IT modernization. Organizational context—such as size, industry, and culture—significantly influences VDI implementation and outcomes. Participants noted both benefits and challenges, including cost, performance, compatibility, and security considerations.

Based on the findings, several actionable recommendations for ERA and ECWC are proposed:

Assess Organizational Needs: Conduct a thorough evaluation of IT infrastructure, user requirements, and operational goals to identify the most suitable VDI solution. For ERA, this may include assessing the need for high-performance computing for data analysis, while ECWC might prioritize secure access to sensitive conservation data.

Evaluate Cost-Benefit Analysis: Consider both short-term costs (e.g., licensing fees) and long-term benefits (e.g., reduced hardware expenses, improved productivity) when selecting a VDI platform. ERA and ECWC should balance these factors against their budget constraints and operational priorities.

Invest in Training and Support: Provide adequate training for IT staff and end-users to maximize the benefits of VDI solutions and address compatibility or performance issues. **Monitor and Adapt:** Continuously assess user satisfaction and system performance, adjusting. Ongoing monitoring and optimization of VDI performance, security, and user experience are essential to maximizing benefits.

In the future, further research is needed to explore the long-term impacts of VDI on employee satisfaction, productivity, and organizational performance.

Cloud-Native VDI Solutions: Explore the potential of cloud-native VDI

solutions to offer greater scalability and cost efficiency compared to traditional on-premises deployments, which could be beneficial for ERA's remote fieldwork and ECWC's collaborative projects.

User Experience and Satisfaction: Conduct longitudinal studies to assess how VDI solutions impact user satisfaction and productivity over time, identifying areas for improvement. This would be particularly valuable for ERA and ECWC, where user experience directly affects research outcomes and conservation efforts.

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