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Abstract

Improving project management in the government sector is a priority. Government agencies on the West Coast are actively adopting various technologies that can enable them to achieve project management goals. Despite the key role of cloud-based virtual technologies in providing a basis for improving project management, there is a persistent lack of consensus among information technology experts on the best practices for using cloud-based virtual technologies to improve project management. This study explored the consensus of information technology experts on the West Coast on best practices of using cloud-based virtual technologies to improve project management in West Coast governments. A Delphi technique was used, allowing for the collection of qualitative data from a purposive sample of a panel of 20 IT experts working on the West Coast. Data was collected in three cycles, consistent with the requirements of the Delphi technique. Data collected was transcribed and coded, followed by generating two themes. The two themes were developing user skills for project management personnel and effective compliance with data security standards, indicating the two best practices for using cloud-based virtual technologies to improve project management in West Coast government agencies. Based on the study findings, it was recommended that government agencies provide training opportunities for project staff to increase their knowledge of cloud-based virtual technologies for project management and emphasize compliance with data security standards.

Keywords: *Cloud-based virtual technologies, project management, data security, West Coast government agencies.*

1.1 Introduction

Cloud-based virtual technologies are becoming increasingly crucial in the modern public service landscape (Mabry et al., 2020; Khan et al., 2021). As a disruptive innovation, cloud computing technologies have gained substantial attention in academia and industry due to the provision of flexible and on-demand computing resources that enhance productivity (Alsaffar et al., 2016; Priyadarshinee et al., 2018; Liang et al., 2021). Thus, the central role of cloud-based technologies in public service delivery cannot be understated. Nevertheless, several governments across the globe are grappling with adopting and updating cloud-based virtual technologies to meet the current needs while remaining relevant in the future. For example, despite the United States being an advanced nation socioeconomically, reports of continued use of outdated technologies and the criticisms associated with the delays in exhibiting significant digital transformation are evident (U.S. Government Accountability Office, 2023).

The outdated technologies and obsolete languages such as COBOL that the US government agencies run and rely on were designed for the era when citizens' interactions with the government were primarily through mail, phone, or in person (Schank, 2021). The decades-old technologies are blamed for slowing down federal payments and services and increasing the vulnerability of citizens' information to cyberattacks (Shuib et al., 2019). Moreover, using outdated technologies presents significant security risks due to manufacturers' lack of updates or support, thus exposing government data to cyber-attacks or data loss (Correia et al., 2023). Moreover, government agencies have continued to report high inefficiency due to poor connectivity when citizens attempt to access government services (Colander, 2014; Daly, 2021). Therefore, the increased concerns indicate the need to emphasize the importance of establishing best practices for implementing cloud and virtual technologies in government agencies.

Scholarly literature indicates that several studies have been conducted on technological integration in the public sector in advanced and developing countries (Hakizimana & Muhe, 2019; Samsor, 2020) but there is still a persistent paucity of empirical evidence concerning the challenges that deter upgrading the technological systems adopted in government agencies, varying from country to country based on respective local contexts (Deshko et al., 2016; Shuib et al., 2019). Additionally, no research has assumed a particular focus on implementing cloud-based virtual technologies in West Coast governments. Most of the existing studies concentrated on factors delaying the adoption of advanced virtual technologies in developed economies and identified aspects such as ineffective change management systems (Duygan et al., 2022), inadequate resources (Shuib et al., 2019), and resistance to change, cultural challenges, and technical issues (Hakizimana & Muhe, 2019). The hurdles of cloud-based technology adoption continue to expose public entities to perennial struggles of ensuring organizational structures are adaptable to changes in the operational environment to establish and maintain organizational efficiency.

Studies have consistently shown that cloud-based virtual technologies the public sector's project management because they help to minimize costs, reduce waste, and increase efficiency (Alashhab et al., 2021; Agrawal, 2021; Abd et al., 2019; Gao et al., 2021). Optimizing the benefits associated with cloud-based virtual technologies depends on governments' knowledge of and ability to apply the best practices for using the technologies. The continued limited knowledge and lack of consensus among the technology experts create a situation in which advanced cloud-based virtual

technologies are not effectively utilize to optimize the outcomes of project management (Schank, 2021; Evans & Farrell, 2021). Government entities on the West Coast must comprehend the best practices for enhancing project management using cloud-based virtual technologies as a strategic approach toward optimizing project outcomes.

1.2 Problem statement

The problem is a lack of consensus among information technology experts on best practices for using cloud-based computing technologies to enhance project management, resulting in continued reliance on obsolete technologies that increase delays and costs of managing projects (Correia & Martens, 2023; Schank, 2021; Evans & Farrell, 2021). The lack of consensus has caused government agencies on the West Coast to exhibit limited attention toward adopting advanced technologies necessary to enhance project management. By 2023, West Coast governments were actively trying to provide an enabling environment to private sector organizations, facilitating the private sector organizations to adopt advanced technologies faster than the government. However, most government agencies lag and rely on obsolete technological systems (Bur, 2018; Schank, 2021). While private sector organizations continue building trust, concerns were raised about the public sector's overuse of outdated apps, outdated functioning, and costly network agencies (Shuib et al., 2019). The problem negatively affects government agencies' effective adoption of advanced cloud-based virtual technologies to enhance performance.

Implementing best practices in virtual and cloud technologies could improve process efficiency, thereby avoiding delays in project completion and enhancing efficiency in minimizing waste and costs (Alzakholi et al., 2020; Caprolu et al., 2019). Hence, virtual and cloud computing technologies enable organizations to achieve the predetermined project objectives. Information technology experts' consensus on enhancing project management using cloud-based virtual technologies could influence the government project managers' use of the cloud infrastructure. The study may contribute to the knowledge needed to address the problem by exploring cloud-based virtual technologies to manage projects in West Coast government agencies. The research provided expert insights to justify the effectiveness of virtual and cloud technologies in accelerating project completion to achieve timelines and deliver the county government's projects within budget.

1.3 Objective

The objective of the study was to explore the consensus of information technology experts on the West Coast on best practices for using cloud-based virtual technologies to improve project management in West Coast governments.

2.1 Literature review

The literature review section recognizes that the study topic is grounded in literature, including both theoretical and empirical literature.

2.2 Theoretical Underpinnings of the Study

The study was underpinned by three theories: the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the stakeholder theory.

Technology Acceptance Model (TAM)

The technology acceptance model (TAM) is one of the most popular models used to explain people's willingness to adopt new technologies, developed by Davis (1989). TAM posits that people adopt technology based on perceived usefulness and ease of use (Silva, 2015). Technologies that are perceived to exhibit the two features attract more adoption attention than technologies that do not. TAM is relevant to this study because it explains that implementing cloud and virtual technologies depends on how governments perceive them as valuable and easy to use.

Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) clarifies factors that motivate technology usage and users' subsequent behavior (Venkatesh et al., 2003). The relevance of the theory to this study is that it helped to explain how performance expectancy, effort expectancy, social influence, and facilitating conditions (age, gender, experience, and voluntariness to use) influence using cloud and virtual technologies in West Coast governments. Recent research has shown that all the factors in the UTAUT have significant and positive correlations for Generation Z's user behavior toward mobile technology, with facilitating conditions having the strongest positive correlation (Persada et al., 2019). Moreover, Chopdar et al. (2018) conducted a cross-country analysis of the utilization of UTAUT to analyze the adoption of and perceived risks of UTAUT. The results supported the UTAUT variables in influencing user behavior towards mobile apps but indicated that cultural influences affect consumers'' perceived risk toward m-shopping apps.

Stakeholder Theory

The stakeholder theory emphasizes the necessity of considering interconnected relationships among various parties that have an interest or are affected by the actions of an entity (Shah & Guild, 2022). The adoption of technological solutions involves several stakeholders. Each stakeholder has specific domain knowledge and expertise. The success of technology solutions depends on varied knowledge and expertise. Technology users also come with various needs that public organizations must consider when implementing cloud-based computing technologies. The theory is relevant to the study because it explains the influence of multiple stakeholders in implementing and managing cloud and virtual technologies in the West Coast governments.

2.3 Empirical Review

Role of Cloud-based Virtual Technologies in Government Agencies

Virtual and cloud technologies have remained the focal point of government since the inception of computers (Irion, 2012). Researchers have expressed unprecedented interest in studying the role

of advanced cloud technologies in streamlining project management in the public sector (Paquette et al., 2010; Miller, 2009). The instrumental role of technology in the modern, fast-paced global landscape has made cloud and virtual computing environments the centers of attention as part of the solutions to ineffective and inefficient service delivery by government organizations (Bello et al., 2021; Abd et al., 2019; Nanos et al., 2019). However, scholarly attention to the best practices for optimizing cloud-based virtual technologies in government project management exhibits notable inadequacy.

The United States began implementing cloud computing platforms, architectures, and applications to enhance service delivery and meet the constituents' needs (Paquette et al., 2010). Governments are showing unprecedented efforts to support the implementation of cloud computing to improve information storage and sharing, manage, and databases, and ensure effective deployment of web services (Kraemer & King, 2006). Wyld (2010) and Miller (2009) recounted a recent case in which the United States President, Barrack Obama, and the Chief Technology Officer Vivek Kundra expressed that they had an unquenchable vision to explore cloud-based computing as a critical component in the transformation of federal information technology. The expression could be part of the motivation for increased urgency in implementing cloud computing capabilities in the United States.

Despite the criticality of cloud and virtual technologies in public service delivery, Irion (2012) claimed that only a handful of scholarly studies have investigated government cloud services in the United States. According to Kraemer and King (2006), most studies conducted in the past several decades focused on the impacts of information technology in corporate organizations, while only a few studies were based on government organizations. The contextual realities of profit-making organizations are different from those of government institutions. Researchers have primarily expressed concerns regarding the effects of information technology on the efficiency and effectiveness of services, widespread impacts on the works performed, and changes that organizations make to organizational structures (Klug & Bai, 2015; Badger et al., 2014). Although some studies that focused on governments' adoption of technologies sought to assess whether it is a catalyst or an instrument for instituting administrative reforms, there is no evidence of studies that assessed how to implement and manage information technology infrastructure in public institutions. Using empirical evidence to detail the best practices for utilizing advanced technologies could generate insights that government agencies apply to solve most of the challenges facing cloud computing in the modern era of advanced technologies.

Risk Management

Addressing risks associated with using cloud and virtual technologies in government offices is a crucial aspect of implementing and managing cloud and virtual technologies. Paquette et al. (2010) identified tangible and intangible risks associated with cloud computing even though cloud computing has become a strategic direction for most government agencies. The necessity for a prudent and in-depth risk management program cannot be understated. While Paquette et al. (2010) recommended a good risk management program to address the risks, the authors failed to present a model detailing the proper risk management program they proposed.

Aspects such as technical proficiency, standards, and policies cycle back security assessments as described in contractual agreements and the use of technology to protect technology. However, relying on technology or contractual agreements alone is inadequate to address the legal risk that data sovereignty exposes the government during service delivery. Governments implementing cloud computing are called upon to adopt strategies to retain dominance over government information (Winker, 2011). However, recent research has not presented an empirical assessment of governments' approaches to address the risks that data sovereignty causes.

Data Safety and Security in Cloud Environments

Government institutions remained wary of computer technologies, especially during the initial phases. Paquette et al. (2010) argued that implementing cloud computing is associated with several risks that can severely impact the information and services that the technology supports. Kshetri (2010) noted that most organizations in the developing world are unprepared to face the security risks associated with cloud technologies. Only 10% of the citizens in China, Singapore, Australia, South Korea, and India are confident about the security measures governments have implemented to address security concerns (Ahmad & Waheed, 2015). Smitha et al. (2012) argued that the openness that characterizes distributed computing environments of cloud-based computing makes security a paramount concern. The notable features of cloud services that have continued to trigger governments' problems for data sovereignty include virtuality, dynamics, and statelessness. Citizens and government officials are concerned about the extent to which they are safe within the interconnections of cloud computing. The concerns are genuine, considering the high risks that developing countries' information technology infrastructure is exposed to due to underdeveloped protective measures.

Adopting best practices is a crucial step that enables organizations to address the challenges that affect the usability of cloud-based virtual technologies. The most prevalent challenge that faces the implementation of cloud technologies is security. Recent research has examined the security and privacy concerns of cloud-based computing systems (Gill et al., 2022). The emerging technologies associated with cloud computing, such as distributed computing, utility computing, and grid computing, are exposed to security and privacy concerns due to the extensive sharing of information resources. Caprolu et al. (2019) noted that the several benefits of cloud-based computing are sometimes neutralized by security issues related to access control, data availability, data security, cyber-attacks, and data privacy.

Recommendations that Gill et al. (2022) offered to enhance the efficiency of security and privacy of cloud-based computing environments include ensuring the availability of data services, planning for privacy and confidentiality during the system development stages, and rapidly responding to the breach of data integrity. Governments have vast amounts of confidential information, which, if not secured and kept private, can lead to large-scale interference in government projects. Although the revolutionary technologies offer persuasive data integrity properties and advanced techniques for tackling security problems, it is essential to conduct a detailed analysis of security and privacy challenges that may impede the public sector's willingness to adopt cloud-based virtual technologies for project management.

Delays tend to occur in cloud computing environments, especially when cloud-based systems fail to handle several tasks and commands presented simultaneously. The consequence of delays is that they interfere with information flow and service breakdowns. Sekaran et al. (2019) identified that the heavy traffic requests from several cloud users' terminals cause heavy traffic/unbalanced loads. The heavy traffic causes cloud data centers and associated servers to cease transmitting information effectively. Cloud computing environments experiencing delays fail to achieve the timeliness dimension of service quality (Abd et al., 2019). Information technology experts have made an effort to solve the load imbalance issues. Cloud load balancers such as the dominant fiery algorithm and Cloud-Structured Language (SQL) effectively balance tasks in academic environments (Sekaran et al., 2019). However, it is not yet clear if the meta-heuristic algorithm can improve the response efficiency of cloud government cloud servers.

Implementing cloud and virtual technologies implies that some or most county government employees adopt the remote working model. Alashhab et al. (2021) noted that despite the rapid implementation of cloud-based computing applications as platforms for service delivery, the challenge concerning security guarantees is still undergoing research, particularly considering the security risks of working from home or remotely. Some recommendations that Abd et al. (2019) based their study on was that there is a need for additional research to assess Electronic Security (E-Security). E-Security based on modern face recognition techniques can enhance the detection of cases of cyber-attacks and privacy breaches. The remote working model implies that employees are actively transferring, using, and withdrawing vast amounts of data from various sources such as the Internet, flash memory cards, and removable hard discs (Gao, 2021). Wang and Alexander (2021) further emphasized the consequences of a possible lack of cyber security protection against hacker attacks targeting sensitive information; they recommended using significant technologies such as 5G, big data, and blockchain to fight cyber-attacks and risks.

3.1 Methods/Procedures/Methodology

Research Method

The study adopted a qualitative research methodology. Qualitative research involves collecting and analyzing non-numeric data that increases people's understanding of concepts, opinions, and viewpoints (Creswell, 2013). The proposed qualitative study aimed to unravel social realities that define people, such as beliefs, attitudes, and motivations of IT experts on the West Coast toward using cloud-based virtual technologies to enhance project management.

Research Design

The research design for the current study was the Delphi technique. Flostrand et al. (2021) defined the Delphi technique as a research design used to forecast a future state within the technology industry using a panel of subject-matter experts. Studies adopting the Delphi technique use a panel of subject matter experts when examining consensus on topics such as the future of a phenomenon or topic being studied or the best practices that define an operation in a given industry (Ćwiklicki & Pilch, 2021). The Delphi technique is typically conducted in three data collection and analysis rounds. The research design was suitable for the study because it provided an opportunity to

explore the future state of cloud-based computing technologies used in government institutions based on the opinions of the subject-matter experts.

Population and Sampling

The study's target population included executive information technology experts working on the West Coast. The executives were chosen because they have an in-depth understanding of information technology operations and project management. The sample for the current study included 20 information technology experts working for various organizations on the West Coast. The sampling technique for the study was purposive sampling. Etikan et al. (2016) defined purposive sampling as the non-probability sampling technique in which sample selection is based on the researcher's judgment of the participants' knowledge and experience.

Instrumentation

The study adopted semi-structured interviews because they permitted the collection of in-depth qualitative data while ensuring that the researcher led the interviewees to provide specific information pertinent to the study (Eppich et al., 2019). The study used credibility to establish confidence that the findings were authentic and believable from the participants' perspectives. Transferability was used to establish how the results can be generalized or transferred to other contexts or settings. The current study achieved transferability by vividly describing the research context and examining the study's central assumptions.

Participant Recruitment

The initial process of recruitment involved using LinkedIn to search for IT executives currently working for organizations on the West Coast at executive levels and requesting them to participate in the study. The LinkedIn platform displays the professional qualifications and experience of each user. The qualifying IT experts were directly messaged with the informed consent, which they were to sign electronically and send back with their phone numbers or email addresses. The contacts were later used to contact them during the data collection phase.

Data Collection and Analysis

The study involved conducting online interviews in three rounds. In each round, the researcher posed the interview questions to the participants and recorded their responses using the audio-recording device. Data was transcribed and coded; codes were used to generate themes that were analyzed using the six-step procedure for thematic analysis by Braun and Clarke (2006). Despite the study being qualitative research, mean values, standard deviation, and Kendall's coefficient of concordance (Kendall's *W*) were generated and used to measure agreement among the participants about the thematic aspects that became evident in the study (Habibi et al., 2014).

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4.1 Key Results and Findings

Demographics

There was a 100% response rate in cycle 1, an 85% response in cycle 2, and a 75% response rate in cycle 3. The study engaged more males in cycle 1 (55%) but more females in cycle 2 (53%) and cycle 3 (53%). However, the difference between the number of males and females stood at two in cycle 1, one in cycle 2, and one in cycle 3.

Developing Technology User Skills for the Project Personnel

Another theme that emerged from the study is developing user skills, which highlights the need for productive capabilities that project personnel acquire through learning and training. The participants' responses reflected the centrality of being aware of the best practices for cloud architecture and how it functions to ensure projects succeed. The study revealed that one of the reasons for poor utilization of cloud-based virtual technologies is the lack of adequate resources to conduct training for the workforce's skills development.

> West Coast government agencies have not fully provided the support and resources required to utilize cloud-based virtual technologies which explains the current ineffectiveness in project management. Most of the personnel do not have the required skills and experience since the agencies have not trained them on ways of promoting effective and responsible utilization of the technologies ($P1C_1$).

According to the study findings, training users of virtual tools is a critical milestone in creating project management personnel who can use the technologies to achieve project goals. However, West Coast government agencies' reluctance to train users regularly seems to reduce the ability of project teams to exploit virtual systems to realize results. P5C1 expressed that experience is necessary to enable project personnel to utilize virtual technologies, leading to the emphasis on the necessity of providing such training.

> I think that for government agencies leveraging cloud-based virtual for project management to enhance efficiency, they need to uphold guidelines such as educating and training users. As the successful management of projects through cloud computing is dependent on how experienced the team is, it is vital to train them ($P5C_1$).

As cloud infrastructure continues to advance, the need for more complex skills will also increase, signaling the need for increased training and capacity development. The cloud-based technologies users will need advanced skills to use and optimize the cloud service to improve project performance. Participant $P10C_1$ said that issues concerning skill acquisition and development will continue to increase in the future. The participant further expressed a belief that acquiring the needed skills is a potential issue because effective cloud computing requires personnel who have advanced skills. Similar to $P10C_1$, it was also evident from another participant that effective training on cloud-based services creates a difference in the ability to use the tools to improve project management.

> The ability to understand issues involved in budgeting and procurement decisions is vital, the non-IT and IT personnel need to be provided with effective training in cloud-based services and the shift affecting policies and workflows for reduced issues to do with IT personnel management considering the lack of proper migration and training can result in operation problems ($P7C_1$).

Training cloud service users increases technical stability. The study revealed that when project personnel are equipped with the skills to use virtual tools, they enhance the reliability and consistency in the performance of the technology infrastructure that supports project-related activities.

> Technical stability is an essential component of utilization of cloud-based technologies. The revision and amendment of technology should not interfere with backward compatibility alongside the standard set originally ($P2C_1$).

The response above emphasizes that cloud-based technologies may not be effectively utilized in the absence of technical stability that results from user training. Skills development is a best practice in the use of cloud-based virtual technologies for project management. The study findings confirmed that the personnel responsible for project management in West Coast government agencies need to be trained on the use of cloud-based virtual technologies, which enables them to use the virtual tools effectively to improve project outcomes.

Continuous learning cannot be understated in the context of project management. The findings revealed that inculcating a culture of continuous learning indicates unprecedented skills development for project teams. The government can create a continuous learning spirit by providing relevant training programs, attendance at workshops and conferences, or opportunities for project personnel to engage with industry literature.

> We as technocrats must accept the need for continuous learning, especially in the modern era of rapid changes in technologies. When we engage in continuous learning, we not only acquire new skills but also stay updated and expand our knowledge base. Government organizations must also do the same ($P18C_1$)

The study findings show that the West Coast government agencies can achieve tremendous success in project management if they insist on the need to develop the skills of project personnel in cloud-based virtual technologies to manage projects. Being abreast of events enables the staff to explore details about recent events, which allows them to understand the dynamics of virtual technologies, hence using them effectively to improve project management prospects. The success of projects heavily depends on the developed skills as a concrete measure. However, the study further revealed that project personnel should focus on developing both technical and soft skills (P5C1). The participant explained that technical skills include proficiency in the use of the cloud infrastructure. In contrast, soft skills are non-technical and comprise of interpersonal abilities that enable project personnel to interact with others through leadership, cooperation, adaptability, and problem-solving.

During cycle 2, it was evident that fifteen participants (88.2%) agreed that developing user skills is a best practice in the utilization of cloud-based computing technologies for project management. However, 11.8% did not mention skills development/training as a best practice in using cloud-based virtual technologies to improve project management in West Coast governments. Nevertheless, all 17 participants (100%) agreed that skills development focusing on sharpening project personnel's use of cloud-based virtual technologies can enhance project management in the government sector.

Effective Compliance with Data Security Standards

The theme, 'effective compliance with data sectary standards,' underscored the need to intensify the safety and security of data in the cloud systems and comply with the data security requirements as part of the best practices for cloud infrastructure utilization. The participants expressed that their greatest concern is increased vulnerability to cyber-attacks that characterize the modern-day technology landscape.

> My strongest feeling is that vulnerability to cyberattacks and resistance or minimal acceptance of cloud-based virtual technologies, could be the main issues that influence their use in managing government projects in West Coast governments. It is difficult to guarantee 100% security measures, and incessant cyberattack strategies continue to advance with time ($P17C_1$).

However, the analyzed findings revealed that West Coast government agencies can optimize the outcomes of using cloud-based virtual technologies to manage projects if they process, store, and protect project data securely while abiding by particular laws, rules, and standards set by the industry or internal policies.

> Project management is anchored on huge volumes of data that must be protected by all means. I think the West Coast government can achieve protection by identifying the applicable governance for data security, security, and establishing procedures that eliminate unauthorized access to data, and other issues like malware and cybersecurity threats ($P13C_1$).

The response by another participant ($P1C_1$) revealed that without effective security measures in place, services offered by the technologies expose the computer systems to cyberattack vulnerabilities. The participant raised concern over the increased cybersecurity awareness currently yet people are skeptical of the dangers of online interactions and agency collaboration while managing projects. Participant $P2C_1$ expressed a belief that government agencies must comply with the set standards of cloud-based virtual technology utilization for standardization of services and easy audit of the systems. Moreover, the study insisted on the need to ensure the technologies used for project management meet the minimum requirements for security.

> Also, the technology setup should meet the minimum security requirements for it to be implemented by government agencies ($P2C_1$).

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It was evident from the study that security issues have been among the critical issues that face many technological systems that offer service to a huge number of people. Thus, $P2C_1$ added that hacking and data interference are possible security problems and suggested that being prepared for such incidences is critical for utilizing cloud-based virtual technologies. When responding to the question of future issues that may affect the use of cloud-based virtual technologies to manage projects in West Coast governments, $P3C_1$ singled out data security and privacy issues. The participant noted that while there are many advantages of cloud-based virtual for project management, West Coast government agencies should be concerned with cyberspace attacks that target projects' critical data.

> Security risks associated with cloud-based virtual technologies can restrict the use of specific applications, thus interfering with workflows. In particular, I fear that malicious cloud providers and information theft can impact the management of projects when using cloud-based virtual on the West Coast ($P3C_1$).

The study findings provided sensitive data security and privacy concerns as part of the reasons for the limited utilization of cloud-based virtual technologies to manage projects. Given the response by $P2C_1$, government agencies may not fully utilize cloud services for project management due to possible vulnerabilities to cyberattacks.

> Concerns of minimal trust in system adoption with the anticipated vulnerability of sensitive data security and privacy have limited full utilization of the cloud-based virtual technologies in managing projects ($P4C_1$).

In the face of impending data security threats, the study revealed that the West Coast government agencies lack clear and effective security standards that can enhance the levels of collaboration.

> The cloud-based virtual technology environment requires a constant list of mandates, regulatory requirements, and standards that have not been fully implemented at West Coast government agencies. Therefore, the current conditions have not offered proper guidance on cloud environment protection, which explains the disjointed attitude towards the technologies by agencies ($P6C_1$).

The participants expressed concerns over West Coast government agencies' exhibiting sloppiness in adhering to recommended guidelines, which indicates how they never take information security practices seriously.

> The agencies are responsible for enhancing sensitive data security and privacy but the current situation does not reflect the set and recommended guidelines. I have some experience working for governments, I mean sometimes it is a struggle, I think because of their unsecured systems well. You cannot do some things and we must go mechanical processes ($P5C_1$).

Yet, as $P1C_1$ had stated, optimizing efficiency and results requires government agencies to comply with data protection, access management, and monitoring and safeguarding set of guidelines. Evidently, the current efforts by the West Coast government agencies may not guarantee eligibility

in applying best practices to secure sensitive government information. Nevertheless, the study established that ensuring data security through encryption and secure access controls is a priority in cloud-based project management. Despite the security concerns that arise in the environments that use cloud-based computing technologies, the study findings show that correctly protected cloud infrastructures are the future of project management in the government sector.

> My observation as a technologist is that cloud-based virtual technologies will be sustained for project management because they provide options to enhance security. The cloud infrastructure is vital in the future of West Coast government agencies' project management prospects as it will limit access to sensitive information except project managers and team members who can log in to their cloud accounts and change their passwords even if they lose their devices (P5C1).

The participants expressed that failure to comply with industry regulations and data protection laws when using cloud-based virtual technologies will impede the future of cloud-based virtual technologies for improving the outcomes of project management in governments. P9C1 concurred with P12C1 that attaining goals such as reducing costs, enhancing agility, and maintaining compliance with standards ensures the future of the technology is protected properly. Moreover, P18C1 stated that the issue of noncompliance to recommended guidelines with no uniformity in applying the set standards and code of practice can be a future issue and could negatively influence the utilization of cloud-based virtual technologies in West Coast governments. Thus, the study findings emphasized that government agencies using cloud-based virtual technologies for project management should comply with control features and best practices linked to data/information security to improve transparency and trust among the project personnel involved in managing projects.

> I believe that the moment every government agency using cloud-based virtual technologies complies with the above standards or set guidelines, information security could be optimized and strengthened by virtue of the enhanced trust and transparency required while working in an online environment ($P6C_1$).

The participants identified the best practices for ensuring data safety and security in compliance with the standards. $P17C_1$ determined that government agencies on the West Coast cannot assume the need for data back and recovery procedures.

> Yes, they may have backup and recovery procedures, but sometimes we have lost data after a cybersecurity attack which pegs the question of how effective are they in recovering data. An improvement is necessary. Having a robust backup and recovery mechanisms is core and safeguards against data loss due to unexpected events ($P17C_1$).

The study findings recognized user authentication as another best practice in data security and safety. Using multi-factor authentication to identify specific people with permissions to access the cloud systems and project data eliminates unwanted parties from accessing the data. To minimize security risks, $P1C_1$ said that the West Coast government agencies are bestowed with the responsibility of identifying and authenticating users, assigning access rights, developing and enacting access control policies for every cloud computing resource, ensuring interminable access

to vital data even when the system experiences errors and failures, as well as preventing accidental data disclosure. Thus, effect cloud-based virtual technologies enable government organizations to achieve improved risk management when managing projects to avoid interruptions by facilitating timely risk identification. The study findings confirmed that cloud-based technologies support the identification and tracking of project risks.

> Despite data security and privacy uncertainties, the fast progression towards integrating artificial intelligence (AI) and machine learning algorithms could provide automation features for enhanced risk prioritization. Also, the security perspective of multi-cloud approach with technology for use intrusion detection and prevention could provide seamless incident investigations which could guarantee future minimal resistance to change ($P1C_1$).

The study further showed that once risks have been identified, it is necessary to take them through assessment. Teams can use data analytics to assess the potential impact and likelihood of project risks.

> The agencies should perform due diligence in regards to the systems' effective functionality, resilience and security through effective planning, development, operations work, and deployment ($P1C_1$).

The cloud environment and associated services are instrumental in developing mitigating strategies for risks. The study findings confirmed that cloud-based tools assist in developing and implementing risk mitigation strategies.

> I believe that cloud-based virtual technologies are the future of the West Coast governments' project management endeavors because of their ability to minimize the risks associated with project management (P5C1).

The participant further stated that it is evident that in the current digital age, information is a valuable asset and cloud-based virtual offers integrated analytics of data that can be analyzed and customized to maintain and control data. Therefore, the quick data recovery aspect of cloud-based virtual technologies in times of disaster or emergency cases will ensure the adoption of this tool. Another participant ($P6C_1$) expressed a belief that the West Coast governments understand the need to integrate security measures if they must optimize the core role of cloud services to manage projects.

> I believe the government agencies on the West Coast are well-informed of the associated security risks of the flexibility offered by the technologies and are committed to being fully equipped in integrating security measures for optimized multi-agency operations.

All the participants (100%) agreed that compliance with data security standards is a best practice in using cloud-based virtual technologies to manage projects in West Coast governments. The study findings showed that government agencies using cloud-based virtual in project management have the mandate to adhere to some guidelines that enable data protection ($P4C_2$). $P6C_2$ responded that the issue of security and data privacy is a critical component and a concern for many agencies.

Enabling privacy and data protection will ensure that more and more agencies and bodies can incorporate cloud-based services into their project management systems. When asked about the role of compliance with data security standards on project management performance, the participants (100%) agreed that organizations that comply with data security standards eliminate attacks and breaches of standards, thus minimizing project interruptions and eventually guaranteeing performance.

The coefficient of Concordance (Kendall's *W*)

The researcher analyzed Kendall's *W* for the two thematic aspects arising from the study. Table 1 shows the results of the analysis.

Table 1: The coefficient of concordance.

	Mean	**Standard deviation**	**Kendall's *W***
Do you agree that developing user skills for project personnel is a best practice in using cloud-based virtual technologies to manage projects in West Coast government agencies?	6.4667	0.51640	0.719
Do you agree that effective compliance with data security standards is a best practice in using cloud-based virtual technologies help to manage projects in West Coast government agencies?	5.7333	0.45774	
Aggregate mean	5.6	0.487	

The mean standard deviation is 0.487; the value depicts a low variability in the participants' options between 1 and 7, indicating a consensus among the information technology experts who participated in the study. Kendall's *W* is 0.719. The concordance coefficient is greater than 0.7, which indicates a strong consensus among the information technology experts that cloud-based virtual technologies result in the six thematic aspects presented in the study. The individual means and aggregate mean are close to 6, indicating that most of the participants agreed with the statements about developing user skills and compliance with data security standards statements. Furthermore, the study revealed that developing user skills for project management (mean=6.5333; standard deviation=0.5164; Kendall's *W*=0.701) and effective compliance with data security standards (mean=4.8; standard deviation=0.414; Kendall's *W*=0.701) are crucial elements in the performance of project management in government agencies on the West Coast.

5.1 Discussion

User training was identified as a best practice in the government agencies' use of cloud-based computing technologies. Past studies such as Markova et al. (2019) and Gupta et al. (2010) acknowledged the need to train the workforce on the use procedures for the technologies being adopted. According to Alcivar and Abad (2016), adequate proficiency will not only guarantee maximizing the benefits of cloud-based virtual but also minimize potential barriers to its adoption. Additionally, choosing the right model is crucial to implementing cloud-based virtual that is

suitable for project management. Since cloud computing avails various models, government agencies must understand their project requirements and select the best approaches for each. Limited knowledge of how cloud-based technologies imply ineffective use of the tools. Project stakeholders who cannot use the virtual services effectively do not have adequate capacity to participate in project management. The gaps they leave contribute to the nonperformance of projects.

The study confirmed that there is a consensus among information technology experts that effective compliance with data security standards is the best practice in using cloud-based virtual technologies to enhance project management (W=0.719; W>0.7*)*. it was also evident from the study that the participants agreed that effective compliance with data security standards is key in enhancing project management in West Coast governments (W=0.701). Existing literature shows that data security and compliance safeguard users of cloud-based virtual technologies. Several studies, such as Khawaja (2012), Basu et al. (2012), and Takabi et al. (2010) have emphasized that data security should be a priority during project management. Despite the increased call for data security and safety, one of the issues that the study showed may influence the use of cloud-based virtual is misunderstanding the processes for data protection and security. In most cases, governments may find it challenging to comprehend fully how data protection and security works in cloud-based virtual considering the prevalent misconceptions (Tang et al., 2019). Some may believe that outsourcing IT resources will lead to them surrendering control over their infrastructure, therefore risking their project management processes.

The study revealed that how West Coast government agencies are using cloud-based virtual technologies for project management is not consistent with the required guidelines. The government agencies are solely responsible for failing to provide necessary support and resources for experiential cloud-based technology learning opportunities for agencies to be at the same operational level. As a result, different government agencies have limited themselves only to where they are supposed to conform to applicable recommended guidelines and regulations (Alassafi et al., 2016). The agencies lack centrally provided resources for enhanced consistency in recommended policies, standards, and best practice guidelines. Currently, West Coast government agencies may be finding it difficult to handle complex projects that demand seamless, secure data storage. Successful implementation of the technologies should integrate measures that guarantee sensitive data security, which is a feature that is much needed with the multi-agency collaboration feature (Caprolu et al., 2019). Establishing a process to monitor and hold teams accountable as they utilize cloud-based virtual technologies' services could also offer the potential for an effective, efficient, and secure project management solution.

Project management is open to risks that may hamper the overall performance of the process (Holzmann et al., 2022). Nevertheless, Paquette et al. (2010) argued that technology has continued to provide avenues through which organizations can manage risks and protect projects from possible failures. With effective cloud services, project managers in the government sector can easily achieve effective contingency planning. Based on the study findings, planning for contingencies is facilitated by real-time project data and collaboration features (Evans & Farrell, 2021). The best way through which real-time project data can be generated is through using cloud-based services. Cloud-based virtual technologies are fitted with capabilities that enable them to identify risks and recommend best practices for mitigating the risks.

6.1 Conclusion

The study sought to obtain the consensus of the information technology experts on the West Coast about enhancing project management using cloud-based virtual technologies in West Coast governments. Fundamentally, the study intended to obtain a consensus among the technology experts on the potential of cloud-based virtual technologies to improve project management, best practices for the use of cloud-based technologies to achieve improved project management, and the future of cloud-based virtual technologies to continue improving project management in West Coast government agencies.

The information technology experts expressed a consensus that the best practices for using cloud-based virtual technologies to enhance project management are skills development and compliance with data security standards. In analyzing the responses to the cycle 3 interview questions, it was evident that there was a unanimous agreement/consensus that skills development is a best practice in using cloud-based virtual technologies in managing projects. The mean value of 6.4677 (~6) in Table 1 implies that most of the experts mostly agreed with the statement on skills development as the best practice in using cloud-based virtual technologies. Similarly, Kendall's W of 0.719 (Table 4) provides further evidence of the consensus. Additionally, the mean is 5.40001 (~5-somewhat agree), while Kendall's W is 0.701 (W>0.7). The values further confirmed the consensus among the information technology experts that skills development helps to further improve project management in West Coast government agencies.

7.1 Recommendations (for practice/ policy)

The findings revealed that there is a consensus among information technology experts about the best practices, including skills development and compliance with data security standards, that users of cloud-based virtual technologies should apply to achieve improved project management. In connection with the finding, it is instrumental for government agencies to provide adequate training for project management staff to increase their capability to improve project management using cloud-based virtual technologies (Markova et al., 2019). Skills development through training enables project staff to understand the best ways of using advanced cloud infrastructure to optimize the outcomes of business operations (Gupta et al., 2010). Equipping the project staff with knowledge and skills may enhance access to project resources, free government administrators from the burden of managing too many user requests, and accelerate project completion.

Data security is a sensitive aspect of project management (Khawaja, 2012; Takabi et al., 2010). The cloud infrastructure may provide increased data security or expose the users to data security perils. The study findings revealed that data safety is the best practice that organizations should pay attention to when using cloud infrastructure to manage projects. Government agencies using cloud-based virtual technologies for project management should comply with the standards to address e-government problems. Specifically, the agencies should comply with the general data protection regulations that require collaboration in breach notification and cautious data handling (Alassafi et al., 2016). Therefore, government agencies on the West Coast should comply with data security standards to prevent the ramifications associated with cyberattacks during project management.

8.1 Areas for further research

First, future researchers should consider conducting studies that compare the consensus among information technology experts on using cloud-based virtual technologies to manage projects in public and private organizations. Second, future studies may recruit participants from government agencies to increase the credibility of the findings and compare the similarities and differences between the current study's findings from the experts working on the West Coast and those working in government agencies. third, future researchers may consider applying mixed methods to collect data capturing numeric and non-numeric aspects. Adopting mixed methods is advantageous because it helps to generate data that captures quantitative and qualitative elements of the research phenomenon, hence increasing the robustness of the findings.

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