# Task 1: Analysis



**1 - Motivation for Cloud Migration:**

**Sanad is driven to move its services to the cloud by a number of compelling reasons, including:**

**Scalability:** Sanad can dynamically scale resources up or down in response to demand thanks to cloud migration. This is essential for ensuring that citizens can use services without delays, especially during periods of high demand.

**Availability:** With redundant infrastructure and data centers spread across geographies, cloud systems provide high availability. This results in less downtime, guaranteeing that residents can access services round-the-clock.

**Cost Optimization:** Because cloud services use a pay-as-you-go business model, there is no need to make large upfront investments in infrastructure and technology. Sanad's financial objectives are in line with this economical strategy.

**Flexibility and Agility:** Moving to the cloud enables the quick rollout of new services and upgrades. Sanad can develop more swiftly and adjust to changing requirements, improving the experience for citizens.

**Remote Access and Convenience:** Cloud-based services make it easy for residents to access their data and documents from anywhere, which eliminates the need for in-person visits to government facilities.

**Disaster Recovery:** Cloud systems come with built-in methods for recovering from disasters, lowering the risk of data loss and preserving corporate operations.

**2 - Five Architectural Principles:**

**The following five architectural tenets should guide Sanad's cloud-based application design:**

**Cost optimization:**Entails more than just saving money. It's about ensuring that resources are used efficiently to provide maximum value to citizens. By migrating to the cloud, Sanad can scale resources dynamically based on demand, eliminating the need for over-provisioning. Cloud services offer a pay-as-you-go model, allowing Sanad to allocate resources precisely when needed, avoiding wastage. This aligns with Sanad's commitment to fiscal responsibility and ensures that taxpayers' funds are utilized effectively.  
 **Performance effectiveness:** Sanad's services need to be responsive and reliable. Cloud migration provides solutions to address latency issues that affect service responsiveness. Through content delivery networks and data centre distribution, Sanad can ensure that citizens experience minimal latency when accessing services. This heightened performance translates to a seamless user experience, improved citizen satisfaction, and quicker access to critical information.  
  
**Reliability:** Essential core services should be around the clock. In addition to providing services of need-related data center cloud providers that take over in case of hardware failure or maintenance. This redundancy ensures service availability even in the face of indefinite disturbances, ensuring uninterrupted access to services. This trust is based on building trust between the shareholders and the concerned bodies, which demonstrates Sanad's commitment to excellence in service.  
  
**Operational Excellence:** Operational excellence involves streamlining processes, minimizing errors, and optimizing resource utilization. Cloud technologies enable Sanad to automate manual tasks such as infrastructure provisioning, scaling, and monitoring. This automation reduces the risk of human errors, ensures consistent operations, and allows Sanad's engineering team to focus on strategic initiatives. By utilizing cloud monitoring tools, Sanad can proactively identify issues and address them before they impact citizens.

**Security:** Security is paramount for Sanad, considering the sensitive citizen data it handles. Cloud providers offer a robust security framework that includes encryption, access controls, and regular security updates. Data encryption ensures that citizen data remains confidential during transmission and storage. Multi-factor authentication (MFA) adds an extra layer of protection against unauthorized access. By adopting these security measures, Sanad can bolster citizens' trust by safeguarding their personal information and complying with data protection regulations.

**3 - Development Strategy Selection:**

Agile has been chosen as the development methodology for Sanad's cloud migration. For the following reasons, Agile fits very well with Sanad's objectives and corporate procedures:

**Agile:** Methodology stands as the optimal choice. Agile's adaptability perfectly aligns with the dynamic nature of this journey, allowing seamless integration of changes and swift responses to evolving stakeholder needs. This realism acknowledges the uncertainties inherent in migration and equips Sanad to navigate challenges without derailing progress. Unlike rigid approaches like Waterfall, Agile empowers Sanad to iteratively make informed decisions that cater to emerging insights and changes. This iterative process mitigates risks, maximizes engagement, and ensures alignment with evolving expectations. Agile's strategic role in Sanad's cloud migration lies in its ability to foster collaboration, responsiveness, and value delivery in an ever-evolving landscape.

**Improved Quality:** Agile's continuous testing and integration procedures lead to elevated software quality and fewer defects, as issues are promptly identified and resolved throughout the development process.

**Frequent Deliverables:** Agile's practice of regular releases guarantees that usable and potentially shippable software is available at the conclusion of each sprint, enabling Sanad to deliver early and continuous value to users.

**Customer Involvement:** Agile's emphasis on close collaboration with customers and stakeholders ensures their needs are met, and their valuable feedback is actively integrated into Sanad's development process.

**Flexibility & Adaptability:** Agile's framework facilitates the seamless incorporation of changes in requirements, features, and priorities, ensuring Sanad can easily adapt to evolving stakeholder needs.

# Task 2: (Design & Implementation)

**1.**

A computer screen shot of a diagram

Description automatically generated

**2.**

|  |  |  |
| --- | --- | --- |
| Step Number | Step description | Screenshot |
| 1 | User: represents the citizens and users accessing Sanad's online application. |  |
| 2 | Router: component manages network traffic and directs incoming requests to the appropriate destination within the system. |  |
| 3 | Public Ip: The "Public IP" serves as an entry point for external connections. It's associated with components such as Azure Active Directory (Azure AD) and DNS services. Azure AD handles user authentication securely, and DNS translates user-friendly domain names into IP addresses. |  |
| 4 | AZURE VNET: (VNet) creates an isolated network environment for the solution's components. It allows communication between components while maintaining security and network segmentation. |  |
| 5 | Firewall: is deployed within the VNet to control incoming and outgoing traffic. It enforces security policies, ensuring that only authorized traffic is allowed and potentially malicious traffic is blocked. |  |
| 6 | Three Availability Zones: represent isolated data center locations within a region. These zones ensure high availability and fault tolerance. If one zone experiences issues, the system can continue functioning from other zones. |  |
| 7 | Load Balancer: distributes incoming traffic across multiple instances of the Sanad Application deployed in different availability zones. This optimizes performance, prevents overloading, and ensures redundancy. |  |
| 8 | VM’S: represents an instance of the Sanad Application deployed within a specific availability zone. These VMs handle user requests, application logic, and data processing. |  |
| 9 | Load Balancer: responsible for distributing traffic across two SQL database instances. This architecture ensures database performance, scalability, and fault tolerance. If one database instance encounters issues, the other one can take over seamlessly. |  |
| 10 | SQL Servers (2):  The "SQL Servers" host the databases that store citizen data, vaccine certificates, and other crucial information. There are two instances for redundancy and failover, enhancing data availability. |  |
| 12 | DDoS Protection: component safeguards the system from Distributed Denial of Service (DDoS) attacks. It monitors traffic patterns and mitigates malicious traffic to maintain the application's availability. |  |
| 11 | set up budget creation and Alert for the application. |  |

# Task 3: (Discussion)

**1.** The Impact of Business Processes on a Successful Cloud-Based Solution: Moving Sanad's services to the cloud will have a significant impact on its business processes and usher in a new age of innovation, efficiency, and accessibility.

**Enhanced Flexibility and Agility:** Cloud solutions provide unmatched flexibility and agility. With little interruption, Sanad can quickly introduce new features or change current ones to meet the changing demands of its users.

**Process streamlining:** Cloud migration drives process redesign to integrate cloud-native features. Citizens are empowered to access services easily via self-service alternatives, rapid deployment cycles, and automated procedures.

**Remote use and Convenience:** By removing geographic restrictions, cloud-based technologies allow citizens to use Sanad's services remotely. This convenience improves the lives of the people and encourages wider adoption.

**Scalability for Seasonal Demand:** Cloud-based applications can easily expand resources to handle demand spikes during peak times, such as during vaccination campaigns. As a result, consumer happiness is increased and service slowdowns are avoided.

**2.** The Contribution of Architectural Principles and Services in the Design of Cloud Solutions: A solid and well-designed cloud solution for Sanad is supported by the strategic integration of architectural principles and cloud services.

**Cost optimization:** Cost-effective resource allocation is guided by architectural principles. Utilizing cloud services like serverless computing and reserved instances helps save expenses while guaranteeing that residents have access to sufficient resources.

**Performance Effectiveness**: Cloud solutions improve user experience by reducing latency and ensuring quick reaction times by spreading services across availability zones

**High availability and reliability:** By include load balancers and availability zones in the design process, it is possible to maintain service availability even when a component fails, hence increasing dependability and reducing downtime.

**Operational excellence:** is made possible through automation and monitoring software. Operations are streamlined by automated provisioning and scalability, and proactive management is enabled by real-time monitoring insights.

**Security reinforcement:** Cloud services include strong security safeguards, such as access limits and encryption. Integrating with Azure AD improves user authentication, protecting private citizen information.

# Task 4: (Test)

**1. 2.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number | Plan | Parameter | Result | Screenshot |
| 1 | Load test |  | Done/  Passed |  |
| 2 | Virtual User |  | 10/m |  |
| 3 | Response |  | 2.18/mins |  |
| 4 | Response/  Sec (Avg) |  | 2/s |  |
| 5 | Errors  (Total) | 10 |  |  |

**3.**

**Cost optimization:** The system responded within 2.18 minutes, according to tests. Although this reaction time is not ideal, it is important to understand how it affects Sanad's goals. It is possible that Sanad wants to provide its citizens with excellent services at reasonable prices. Very slow response times can reduce productivity and increase operating expenses. It may save costs while ensuring that citizens receive services quickly if system performance is improved, which is consistent with its mission of providing exceptional customer service.

**Performance Effectiveness:** There are concerns concerning performance effectiveness due to the reaction time of 2.18 minutes. Offering its inhabitants services that are responsive and accessible may be one of Sanad's corporate goals. The attainment of this goal might be hampered by slow reaction times, which could have a detrimental effect on customer satisfaction. Sanad can better offer high-quality services to residents and consequently improve their experience by improving system performance.

**Reliability:** The presence of 10 errors during testing suggests potential reliability issues. System reliability may be given the most importance by Sanad's business needs to maintain citizens' access to services. Errors may damage confidence and impair service availability, which runs counter to Sanad's intention to offer dependable services. Comprehensive error handling and redundancy techniques should be employed to improve system dependability to achieve this aim.

**Operational Excellence:** The results of the test show that operational effectiveness and resource utilization might be improved. To improve operational excellence, Sanad's business goals may include improving resource allocation and reducing manual interventions. The present testing findings point to the possibility of streamlining processes and more effectively allocating resources, supporting Sanad's goal of operational excellence.

**Security:** Security is extremely important for Sanad's business, even though it was not specifically addressed in the testing findings. Serious repercussions, such as data breaches and legal repercussions, can result from security flaws or vulnerabilities. To guarantee that the system is secure and complies with legal standards, Sanad's purpose of protecting private citizen data is in line with the demand for stringent security testing and compliance inspections.

**4.**

**Functional testing**

Functional testing determines if the system's features and functions operate as anticipated in accordance with predetermined requirements. It's similar to making sure a car's engine, brakes, and lights are functioning properly.

**Benefits:**

**Requirements Validation:** Functional testing makes assurance that the system complies with the stated criteria and achieves its objectives. For Sanad, this entails confirming that each component of the cloud-based system carries out its intended duties, such as making access to official services and documents, among others.

**User Experience Assurance (UEA):** This ensures that the system provides a satisfying user experience by operating properly. This is important for Sanad since citizens must be able to access their services through a smooth and user-friendly interface.

**Identification of Bugs and Defects:** Functional testing reveals any problems or differences between desired and actual behavior. Early detection and resolution of these problems can avoid more expensive solutions in the future.

**Unit testing**

Unit testing isolates and assesses each component or unit of the system. It checks that each unit operates properly on its own. It's like making sure all the ingredients are high-quality and fresh before using them in a dish.

**Benefits:**

**Early Bug Detection:** Unit testing finds defects and problems at the level of the tiniest component. This is advantageous since resolving faults early in the development process saves money and stops problems from spreading to other system components.

**Improved Code Quality:** When unit tests are written, the code is frequently more modular and tidier. This improves the maintainability of the code and makes it simpler to comprehend and use.

**Rapid debugging:** When a unit test fails, it identifies the part that is the problem. As a result, developers can debug projects more quickly since they are more aware of potential issues.

**Load testing**

Load testing is a crucial method of testing for cloud-based prototypes. It evaluates the system's performance under realistic load conditions. This entails testing how effectively the system performs when many users access it at once. Load testing for cloud-based prototypes has the following advantages:

**Benefits:**

**Scalability Assessment:** Through load testing, we can establish whether the system can accommodate an increasing number of users without becoming unstable or crashing. Since cloud-based services frequently need to scale up or down based on demand, this is crucial.

**Performance Optimization:** We can improve resource allocation and configuration by detecting problems with performance during load testing. This guarantees that cloud-based services continue to run well even when they are heavily used.

**Cost control:** Load testing can assist businesses in correctly sizing their cloud resources. They can prevent over-provisioning and over-spending on cloud resources by knowing how much demand their system can manage.

**User Experience Assurance:** This is crucial for services with a big user base as it guarantees that consumers continue to have a great experience even during times of peak demand.

**Security Testing**

When developing cloud-based prototypes, security testing is of utmost significance, especially when handling sensitive data. This kind of testing assesses the system's security safeguards and pinpoints weaknesses. The following are advantages of security testing for cloud-based prototypes.

**Benefits:**

**Data protection:** Security testing enables the proper protection of sensitive data, such as the personal information about citizens in Sanad's case. This complies with data privacy laws and guards against data breaches.

**Compliance Verification:** It examines the system's adherence to industry-specific security norms and guidelines. Compliance is essential because it assures the ethical and legal operation of government services like Sanad.

**Risk reduction:** By early detection and remediation of security flaws, security testing reduces the risk of cyberattacks, data breaches, and related reputational harm.

**Continuous Monitoring:** Security testing is a process that is always in progress. By continuously finding and resolving new threats and vulnerabilities, security testing aids companies in maintaining a strong security posture.

**Integration Testing:**

The effectiveness of the system's various parts or services is evaluated during integration testing. It guarantees that connected pieces work together properly as a whole.

**Benefits:**

**System-Wide Functionality:** Integration testing checks that all integrated components work together without any issues, guaranteeing that the entire system runs properly. For Sanad, this entails verifying that the data and services of numerous government agencies work together seamlessly to give citizens a consistent experience.

**Issue Detection in Interactions**: This feature highlights potential problems that can occur when several components talk to each other or exchange data. Because it depends on efficient interactions between several governmental organizations, this is crucial for Sanad's cloud-based system.

**Quality Control:** Integration testing assists in ensuring that the finished product satisfies quality and performance criteria by assessing how the system's components interact. This is in line with Sanad's objective of providing residents with high-quality services.

# Task 5: (Review)

During this crucial stage, we deeply analyse the ways in which the cloud computing migration project affects Sanad's organizational goals. Our primary focus is to comprehend how this project can enhance the capacity to provide value to Sanad and evaluate its broader contributions to the organization.

**1.** **Advancing Organizational Goals:** As part of our responsibilities, we conduct a thorough assessment of how the migration project influences Sanad's overall organizational objectives. By closely examining its direct and indirect effects on efficiency, service quality, and accessibility, we illustrate how cloud computing seamlessly aligns with Sanad's mission and vision.

**2.** **Boosting Solution Potential:** Our dedication extends to exploring avenues for improving the developed solution's ability to deliver value. This includes a comprehensive analysis of the technical capabilities offered by the cloud-based infrastructure and services. By harnessing the scalability, reliability, and performance enhancements provided by cloud computing, we identify opportunities for Sanad to enhance its services and improve the experience for citizens.

**3.** **Realizing the Value of Cloud Computing:** We meticulously assess the various ways in which a cloud-based solution contributes value to Sanad's overarching objectives. This involves quantifying the efficiency gains achieved through reduced latency and downtime, the financial benefits resulting from optimized resource allocation, and the enhanced security measures that strengthen data protection. At the same time, we break down the challenges that Sanad previously faced, highlighting how cloud migration has effectively addressed these issues, ultimately improving citizen services and streamlining operations.

our goal in this phase is to substantiate the value proposition of the cloud migration project. By carefully analyzing its impact on Sanad's organizational objectives, evaluating its potential for enriching services, and quantifying both tangible and intangible benefits, we provide a comprehensive view of how cloud computing has evolved from a mere strategy into a driving force for Sanad's success.