Journal of Computer Networks, Architecture and High Performance Computing
Volume 6, Number 1, January 2024
https://doi.org/10.47709/cnahpc.v6i1.3407

Submitted : Jan 5, 2024
Accepted : Jan 14, 2024
Published : Jan 16, 2024

Optimizing Transportation Services: Using TOGAF for Efficiency and Quality

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ABSTRACT

In the rapidly expanding transportation industry, it is crucial to make focused and coordinated efforts to improve services with maximum efficiency. This paper seeks to explore the optimization of the Enterprise Architecture approach to effectively attain the primary objectives of the transportation industry, specifically the enhancement of service quality. The main emphasis is on implementing the enterprise architecture methodology of the open group architecture framework on a strategic basis. This paper examines how Enterprise Architecture can offer systematic and quantifiable solutions by identifying problems in infrastructure and operational processes. The research aims to provide comprehensive insights into how the Enterprise Architecture concept can optimize operational efficiency and streamline processes in the provision of transportation services. By implementing TOGAF, it is expected that the integration of systems will be seamless, technology usage will be optimized, and customer experiences will be improved. To summarize, this paper demonstrates the desire to improve transportation services. It explains how Enterprise Architecture methods, specifically within the TOGAF framework, can directly lead to advantages such as increased operational efficiency and improved service quality. This paper aims to be easily understood by a wide range of readers, including management, Information Technology professionals, and other stakeholders in the transportation industry. It avoids using overly technical language to ensure accessibility and comprehensibility.

Keywords: Enterprise Architecture; Information Technology; Increased Operational Efficiency; Transportation Industry; TOGAF;

INTRODUCTION

Among the most important industries for international trade and connectivity is transportation, is currently experiencing a period of unprecedented expansion. The surge is driven by the combination of technological advancements and changing market dynamics that consistently reshape the industry. Given the significant changes happening in this evolving environment, it is crucial to prioritize the enhancement of operational efficiency and service quality. The transportation sector has been transformed by technological advancements, such as intelligent logistics solutions and sophisticated fleet management systems, marking the beginning of a new era. These innovations offer increased efficiency and pose challenges that require a strategic and organized approach for smooth integration. Given the challenges presented by the changing industry, businesses must prioritize the implementation of Enterprise Architecture as a strategic necessity.

Enterprise Architecture offers a structured framework for effectively aligning business goals with the capabilities of information technology (Hindarto, 2023). Transportation organizations need to utilize technological advancements effectively to stay up-to-date and benefit from them. This systematic approach guarantees that the incorporation of new technologies harmonizes effortlessly with the overall business objectives, promoting a unified and adaptable operational setting. To summarize, the remarkable expansion in the transportation industry requires a proactive approach to address the challenges and opportunities arising from technological advancements and changing market dynamics. The implementation of Enterprise Architecture is a crucial and strategic necessity. The method helps organizations align their business goals with IT capabilities, thereby ensuring a robust and adaptable transportation system for the future.

Although the importance of optimizing transportation services is recognized, ongoing difficulties with infrastructure and operational processes prevent the smooth integration of the system, thereby hindering the achievement of efficiency improvements. This paper aims to overcome these obstacles by examining the application of Enterprise Architecture (Wedha & Hindarto, 2023), (Afarini & Hindarto, 2023), with a particular emphasis on utilizing TOGAF as a methodological framework. The objective is to provide strategic solutions that help the transportation industry overcome these challenges, promoting better integration, more efficient operations, and the successful implementation of efficiency improvements.

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This study employs a qualitative research approach, with a primary emphasis on conducting a comprehensive literature review that covers Enterprise Architecture (Afarini & Hindarto, 2023), TOGAF, and their specific implementations in the transportation industry. The investigation explores the theoretical underpinnings and real-world uses of these methodologies to achieve a thorough comprehension of their consequences. Furthermore, the research includes practical case studies and real-world applications of TOGAF, specifically in transportation environments. These empirical observations enhance the survey by providing concrete examples of how TOGAF effectively tackles challenges and improves operations in the ever-changing transportation industry. The research methodology aims to examine both the theoretical foundations and the practical application of TOGAF as a guiding framework to evaluate its effectiveness. Emphasis will be placed on applying it to optimize infrastructure and streamline operations, with the goal of extracting valuable insights and transportation best practices for real-world situations.

The main aim of this research is to conduct a comprehensive analysis of how Enterprise Architecture, specifically within the TOGAF framework (Judijanto & Hindarto, 2023), can be optimized to improve the effectiveness and excellence of transportation services. This entails the identification and resolution of obstacles in infrastructure and operational procedures. The study aims to provide valuable insights for industry practitioners, IT professionals, and stakeholders who want to align their strategies with the changing demands of the transportation sector.

What are the specific inquiries that will guide the research? To direct the investigation, two primary research inquiries will be tackled: What are the most effective ways to apply the TOGAF methodology to optimize infrastructure in the transportation industry?

How does the implementation of Enterprise Architecture, particularly within the TOGAF framework, enhance the efficiency of operational processes and elevate service quality in transportation?

To summarize, this introduction establishes the foundation for a thorough examination of how Enterprise Architecture, utilizing TOGAF, can effectively tackle challenges and enhance services in the ever-changing transportation industry. These sections examine the theory behind, practical uses, and case studies that together contribute to a detailed comprehension of the potential influence of the proposed methodology.

LITERATURE REVIEW

In recent years, enterprise architecture has emerged as a scientific field that examines organizational structure and relationships. Transport enterprises have unique characteristics, including a robust operational-technical link and a more vital planning and economic link that underpins all their activities. The article explores the relationship between transport enterprise architecture and personnel management, examining the application of typological analysis and personnel design methods (Petrov et al., 2022a). The Enterprise Architecture paradigm develops IT solution investment models to bridge the business-IT gap. This study examines published methods, IT investment assessment practices, and pros and cons (Ilin et al., 2021). The article examines operational, technical, planning, and economic links between enterprise architecture and personnel management in transport enterprises. It uses typological analysis and personnel design to understand transport companies' unique traits (Petrov et al., 2022b). An RFID-SMS is proposed for real-time inter-enterprise production and transportation monitoring and dispatching. RFID devices collect real-time data in job shops and vehicles. Processing this data manages production and makes dynamic dispatching decisions. RFID-SMS improves inter-enterprise production transparency under mass individualization in a printing machinery company prototype and case study (Ding et al., 2018). This study examines Samsun, Turkey, logistics firms' transportation demand management factors. Freight transportation and competition laws are studied. Freight transportation is more important than competition laws and regulations in demand management, according to the study. The "Strategy for Prioritizing High Occupancy Vehicles," which measures competitiveness and efficiency, is best. This study also shows how to increase demand for sustainable transport (Aytekin, 2024). Digital platforms in maritime logistics face data-sharing challenges, which this study examines. Platform enterprises should subsidize key participants with high privacy costs and low privacy and general participants according to it. Governments should also regulate data property rights (Xiao et al., 2023). Stakeholders and government pressure networked enterprises to increase ethical use of natural resources and ecosystem impact. Economic, market and environmental issues plague them. Big data analytics-based approaches to drive sustainable enterprises' flexibility and robustness address these vulnerabilities. This flexible, robust, and significant data-driven approach helps NEs grow sustainability and value. The use of the corporate environmental impact database proves its efficacy (Tamym et al., 2023).

These studies examine the evolution of enterprise architecture in transportation, focusing on personnel management, IT solutions to close the business-IT gap, and RFID-SMS for real-time production and transportation monitoring. The research also discusses transportation demand management, maritime logistics platform data-sharing

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issues, and big data analytics-driven ecological sustainability in networked companies. These studies show a shift from operational technical to strategic, managerial, and environmental aspects in transportation corporate architecture.

METHOD

This research employs a qualitative methodology, conducting an extensive literature review on Enterprise Architecture (Alwi et al., 2023), The Open Group Architecture Framework, and their implementations in the transportation sector. Real-world case studies of TOGAF applications in transportation settings are examined to provide tangible insights into practical effectiveness. The study emphasizes the application of TOGAF in optimizing infrastructure and streamlining operational processes, aiming to extract valuable lessons and contribute nuanced perspectives on the methodology's impact in enhancing efficiency within the dynamic context of the transportation industry.

Figure 1. Business Model Canvas (BMC) for TOGAF-Based Enterprise Architecture in Transportation

Figure 1, To provide a comprehensive description of business structures within the transportation industry, the Business Model Canvas (BMC) (Manning & Renzi, 2023) is a tool applicable in the context of TOGAF-based Enterprise Architecture. The value proposition obtained through the implementation of EA, the alliances formed, and the resources required to facilitate the application of TOGAF in the transportation industry's paradigm shift are all crucial components of this BMC (Kumar & Daga, 2023). Improving service quality and operational efficiency is the value proposition of BMC for TOGAF-based EA in the transportation sector. Transportation organizations can develop measurable and integrated architectures, as well as detect and rectify vulnerabilities in operational processes and infrastructure, through the adoption of TOGAF. As a result, technological optimization, harmonious system integration, and enhanced customer experience are all attainable. Collaborations with government entities, technology providers, and industry stakeholders are all examples of partnerships within BMC (García Lechuga et al., 2023). Collaboration holds significant value in the transportation sector as it promotes standardization, facilitates the adoption of TOGAF, and guarantees a more comprehensive comprehension of optimal methodologies. Technology and platforms, supporting infrastructure, data and analytics, and personnel trained in the management of architectural transformation are all essential BMC resources for TOGAF-based EA in transportation.
Furthermore, competent management, licensing, and funding are critical components of BMC. The implementation of TOGAF-based EA on the organizational structure of transportation companies can be visually represented using this BMC. This encompasses an enhanced comprehension of the processes by which value is generated, resources are

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allocated, and strategic alliances are established to facilitate the technological advancements required within the swiftly progressing transportation sector.

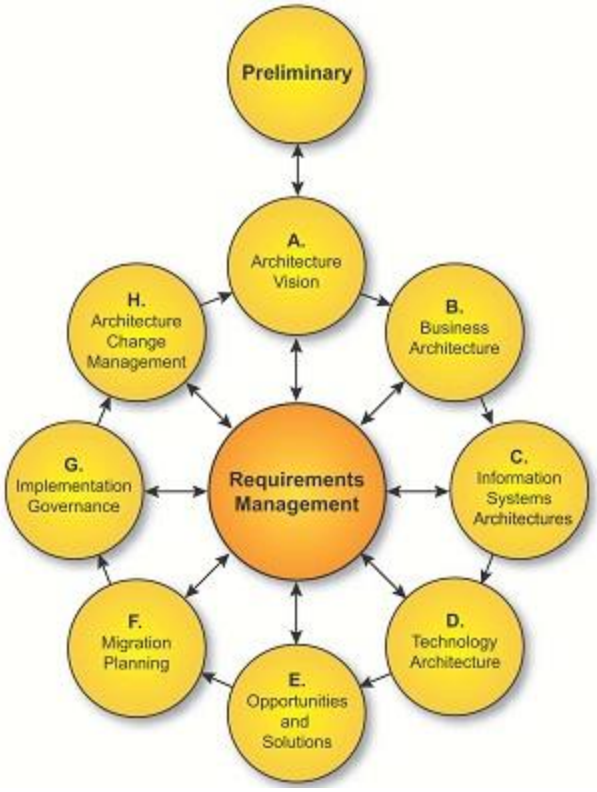

Figure 2. TOGAF-Based Framework

TOGAF, or The Open Group Architecture Framework, is a comprehensive methodology for Enterprise Architecture. It encompasses a structured approach to developing, maintaining, and implementing an enterprise architecture. In the context of the transportation industry, adopting TOGAF involves a series of well-defined phases, known as the Architecture Development Method (ADM) (Kornyshova & Barrios, 2021).

1. Preliminary Phase:

The journey begins with the Preliminary Phase, where the organization assesses its readiness for EA adoption. This phase involves establishing the organizational context, defining the scope, and obtaining leadership commitment. For the transportation sector, this sets the groundwork for aligning business objectives with the upcoming architectural initiatives.

2. Phase A: Architecture Vision:

Phase A, the Architecture Vision phase, focuses on creating a high-level view of enterprise architecture. In the transportation industry, this involves defining the architectural vision by identifying key stakeholders, business drivers, and business goals. This phase sets the direction for subsequent optimization efforts in infrastructure and operational processes.

3. Phase B: Business Architecture:

Business Architecture (Phase B) entails developing a detailed business architecture within the transportation sector. This includes defining business processes, organizational structures, and key business entities. Aligning these elements with TOGAF ensures that the business architecture supports the overarching goals of optimizing transportation services.

4. Phase C: Information Systems Architecture:

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Phase C centers on developing the Information Systems Architecture. In transportation, this phase involves specifying the data requirements, application systems, and their interactions. Ensuring alignment with the overall enterprise architecture framework is crucial for creating a cohesive and integrated information systems architecture.

5. Phase D: Technology Architecture:

Technology Architecture (Phase D) focuses on defining the hardware, software, and network infrastructure required to support the transportation systems. This phase ensures that the technology components align with the business and information systems architectures, promoting a seamless and efficient technological environment.

6. Phases E, F, and G: Implementation and Migration Planning, Governance, and Architecture Change Management:

These phases involve developing detailed plans for the implementation of optimized infrastructure and streamlined operational processes in the transportation industry. Governance mechanisms are established to oversee and guide the implementation, ensuring adherence to architectural standards. Architecture Change Management addresses any necessary adjustments to maintain alignment with evolving business needs.

7. Phase H: Architecture Repository:

The Architecture Repository (Phase H) serves as a central repository for all architectural artifacts. In the transportation sector, this ensures that documentation related to optimized infrastructure, operational processes, and service quality enhancements is systematically organized and accessible.

By systematically progressing through these TOGAF phases, the transportation industry can effectively leverage Enterprise Architecture to optimize infrastructure and streamline operational processes. TOGAF provides a standardized and adaptable framework, aligning technological advancements with business objectives to enhance the efficiency and quality of transportation services.

RESULT

Application Architecture

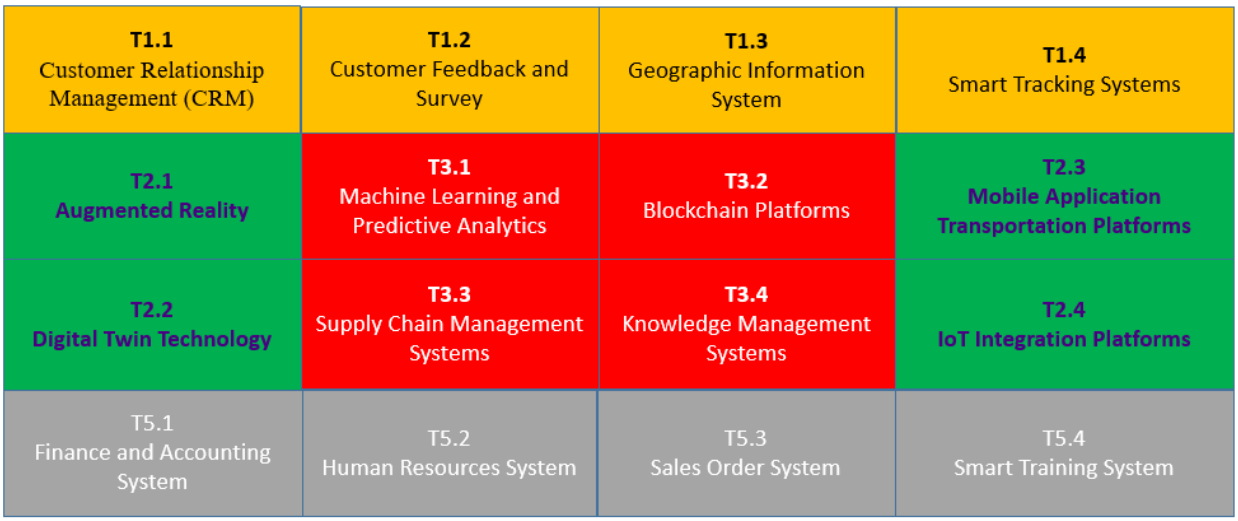

Figure 3. Proposed Application Architecture Transportation

Figure 3, Customer-related applications, such as Customer Relationship Management (CRM), Customer Feedback and Surveys, Geographic Information Systems (GIS), and Smart Tracking Systems, aim to strengthen the relationship between companies and customers. CRM helps track customer interactions, understand their preferences, and manage information related to them. Meanwhile, feedback and survey systems provide a platform for customers to share their views, providing valuable input for companies to improve products and services. GIS combines location data to understand customer behavior patterns based on location, while intelligent tracking systems offer better visibility into delivery and service, ensuring customer satisfaction.

On the technology support side, Augmented Reality (AR) applications, Digital Twin Technology, Mobile Application Transportation Platforms, and IoT Integration Platforms provide new experiences to customers. AR improves customer interactions with products, while digital twin technology enables accurate digital simulations,

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aiding product understanding and potential problems. Mobile transportation platforms make it easier for customers to book transportation services, while IoT integration expands connectivity, delivering connected experiences in products and services.

Other support applications such as Machine Learning and Predictive Analytics, Blockchain Platforms, Supply Chain Management Systems, and Knowledge Management Systems help companies manage data, make smarter decisions, and increase efficiency. Machine Learning and predictive analytics predict customer behavior, while blockchain platforms ensure data transparency and security. Supply chain management systems help optimize logistics and delivery processes, while knowledge management systems improve information sharing and internal company innovation. Overall, these applications work together to strengthen customer engagement, increase operational efficiency, and support business growth.

Information Architecture

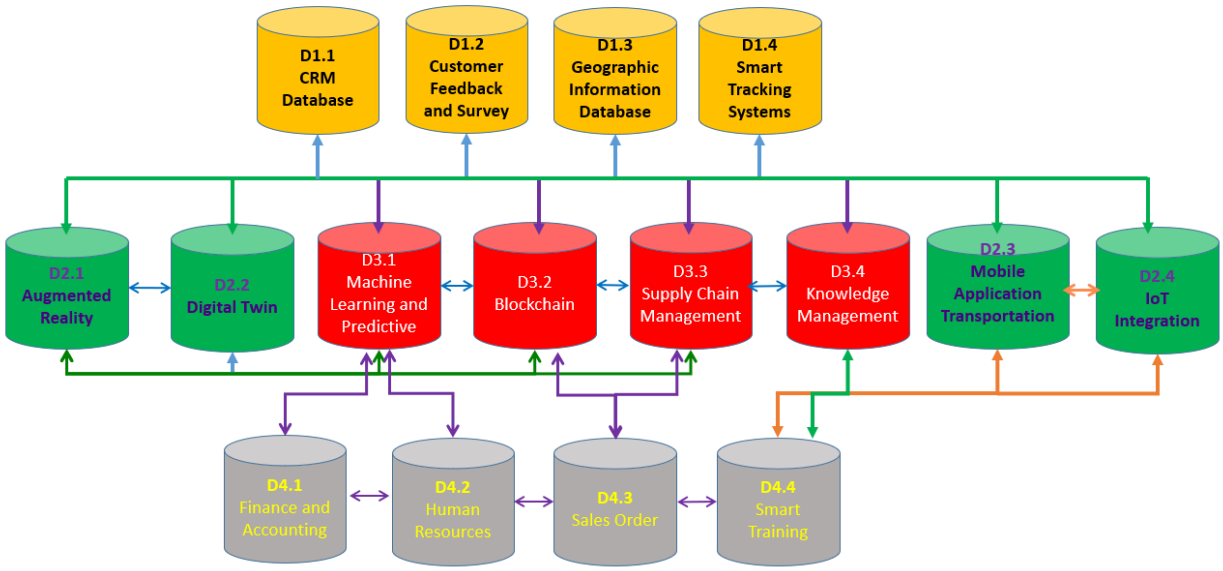

Figure 4. Proposed Information Architecture Transportation

Figure 4, Databases pertaining to customers, such as Customer Relationship Management (CRM) databases, Customer Feedback and Survey databases, Geographic Information databases, and Smart Tracking databases, play a crucial role in storing and managing customer-related information. CRM databases are utilized for documenting customer interactions, including their contact information and preferences. On the other hand, feedback and survey databases store valuable responses and feedback that contribute to product and service enhancements. The Geographic Information database store's location data for analyzing customer behavior patterns according to their geographical location, while the Smart Tracking database records information pertaining to delivery and service to guarantee customer contentment.

The databases that support technologies like Augmented Reality, Digital Twin Technology, Mobile Application Transportation database, and IoT Integration database play a crucial role in storing the necessary data to support these technologies. An Augmented Reality Database is responsible for storing the required digital components to enhance customer experiences, whereas Digital Twin Technology relies on a database that stores digital representations of products. The Mobile Application Transportation database stores information regarding routes, users, and transportation services, while the IoT Integration database stores data obtained from diverse connected devices to facilitate data integration and analysis.

Additionally, auxiliary databases such as Machine Learning and Predictive Analytics databases, Blockchain databases, Supply Chain Management databases, and Knowledge Management databases are responsible for storing data pertaining to respective technologies. Machine Learning and Predictive Analytics databases are utilized for the storage of training data and the results of predictive analysis. On the other hand, Blockchain databases are employed for the storage of encrypted transactions and unchangeable records. The Supply Chain Management database houses

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data pertaining to the flow of goods and services, inventory management, and the coordination of logistics. On the other hand, the Knowledge Management database stores information that is utilized for fostering innovation and facilitating decision-making processes.

The backend databases, including the Finance and Accounting database, Human Resources database, Sales Order database, and Smart Training database, serve as the central components of business operations. The Finance and Accounting database houses financial records and company transactions; the Human Resources database encompasses information regarding employees, salaries, and attendance. In contrast, the Sales Order database retains data pertaining to orders and sales. The Smart Training database stores comprehensive training data for the purpose of enhancing employee growth and advancement. Each type of database plays a crucial role in supporting different operational, technological, and customer relationship aspects within an organization.

Technology Architecture

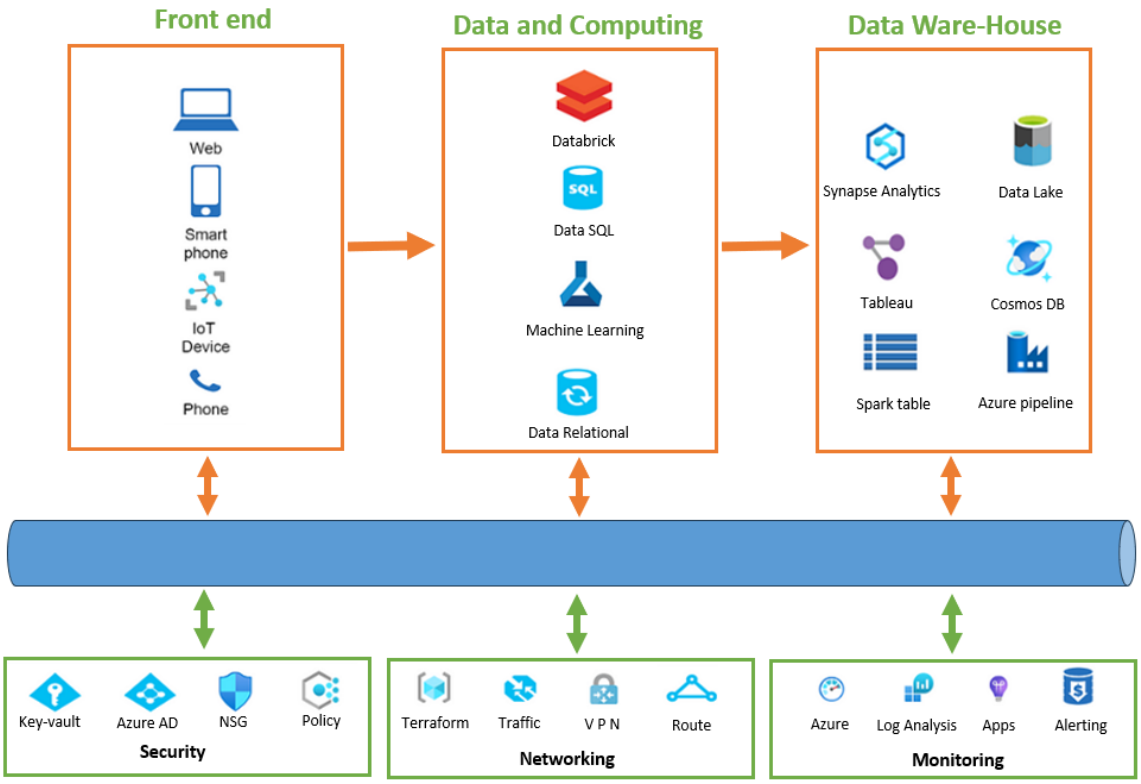

Figure 5. Proposed Technology Architecture Transportation

Figure 5, The technology architecture you referred to is an intricate and cohesive framework for overseeing multiple facets within the realm of information technology. The front end of the system consists of a platform that encompasses web applications, mobile applications, and IoT devices. These components serve as a user interface through which users can interact with the system. The Data and Computing section encompass a range of technologies, including Databricks, SQL Data, and Machine Learning, which collaborate to efficiently handle, analyze, and manipulate data, regardless of its size. The Data Warehouse utilizes advanced solutions like Synapse Analytics, Data Lake, Tableau, and Cosmos DB to store, manage, and analyze data efficiently. It is supported by tools such as Spark Table and Azure Pipeline for data processing and management. In terms of security, multiple layers of protection are implemented to safeguard data and infrastructure. This includes the utilization of Key Vault, Azure AD, NSG (Network Security Group), and security policies. The Networking section employs tools like Terraform to oversee network infrastructure, encompassing traffic management, VPN (Virtual Private Network), and connection routing in order to facilitate secure

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and efficient connectivity. The Monitoring section emphasizes the utilization of Azure services, Log Analysis, associated applications, and alerting features to actively identify and address issues and modifications in the environment instantaneously. The architecture is designed to guarantee security, availability, and optimal performance in managing various aspects of data, computing, user interface, security, connectivity, and monitoring in a complex, integrated technology environment.

DISCUSSIONS

How can the TOGAF methodology be effectively applied to optimize infrastructure within the transportation industry?

There are several parts to using the TOGAF (The Open Group Architecture Framework) method to improve infrastructure in the transportation industry. These parts need to be strategically aligned with business goals, IT principles, and architectural principles. TOGAF is a complete framework that offers a methodical way to approach enterprise architecture. To use it effectively, you need to know a lot about the specifics of your industry. Creating a clear and complete architectural vision is a vital part of using TOGAF to improve infrastructure. This means that stakeholders, IT experts, and business leaders need to work together to come up with a shared understanding of the current state of the transportation system and its goals for the future. The Architecture Vision phase in TOGAF gives you a structured way to create this vision, which sets the stage for later improvements to the infrastructure. To make things even easier, TOGAF's Architecture Development Method (ADM) helps with the complicated parts of transportation infrastructure. Because ADM is iterative, optimization can be done in stages, which works for an industry that is constantly changing. The methodology starts with an assessment of the organization's resources and readiness in the preliminary phase. It then moves on to the subsequent phases, which address issues like data architecture, technology architecture, and infrastructure optimization in a logical order.

It is essential to use TOGAF's standardized architecture content metamodel in order to optimize infrastructure. This metamodel lists the necessary architectural artifacts and makes sure that each one fits with the overall architectural vision. In the transportation field, this means going into detail about how the physical infrastructure (like roads, ports, and terminals) and the digital infrastructure (like sensor networks, data storage, and communication systems) work together. TOGAF also stresses how vital governance and compliance are during the whole process of building an architecture. In the transportation industry, rules and safety standards are fundamental. This makes sure that optimizing infrastructure follows all legal and operational rules. The Architecture Governance phase of TOGAF gives you a way to make sure everyone is following the rules, keeping an eye on progress, and changing the architecture as needed. To sum up, creating a shared vision, building architecture in stages and iterations, following standard content metamodels, and strong governance practices are all essential parts of using the TOGAF methodology to improve infrastructure in the transportation industry. This method not only aligns new technologies with business goals but also considers how flexible and multifaceted the transportation sector is. In the end, it creates a solid and effective infrastructure framework.

In what ways does the adoption of Enterprise Architecture, specifically within the TOGAF framework, contribute to the streamlining of operational processes and the improvement of service quality in transportation?

Implementing Enterprise Architecture, specifically within the TOGAF (The Open Group Architecture Framework) framework, is crucial for optimizing operational processes and improving service quality in the transportation industry. TOGAF offers a methodical and standardized approach that harmonizes business strategies with IT capabilities, promoting a thorough comprehension of the complex interconnections among different elements in the transportation ecosystem. TOGAF's Architecture Development Method (ADM) significantly contributes to the optimization of operational processes. Through the utilization of this incremental and structured method, transportation sector organizations can methodically examine, devise, and execute alterations to their operational procedures. These areas encompass route planning, fleet management, logistics coordination, and maintenance scheduling. The methodology enables the smooth integration of digital technologies and data-driven solutions, promoting effective communication and coordination across various operational aspects.

Furthermore, TOGAF's focus on developing a strong and flexible technology framework improves the effectiveness of operational procedures in transportation. This requires the integration of state-of-the-art technologies, including real-time analytics, the Internet of Things, and artificial intelligence, to enhance the efficiency of resource allocation, monitor the performance of vehicles, and forecast maintenance requirements. The outcome is an improved and flexible operational structure that can readily adjust to evolving circumstances and requirements. Furthermore, the application of the Enterprise Architecture approach, under the guidance of The Open Group Architecture

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Framework (TOGAF), enhances the level of service quality in the transportation industry by prioritizing a customer-centric approach. The methodology promotes the recognition and ranking of crucial customer touchpoints and experiences. Organizations can optimize user satisfaction by analyzing the customer journey in the transportation service and adjusting their operational processes accordingly. This could entail enhancements in ticketing systems, instantaneous information distribution, and customized services, ultimately resulting in an enhanced overall customer experience.

The standardized content metamodel in TOGAF enhances service quality by ensuring consistency and coherence across different service components. This entails the synchronization of digital and physical infrastructure to fulfill service level agreements, adhere to industry standards, and integrate feedback loops for ongoing enhancement. Ultimately, implementing Enterprise Architecture within the TOGAF framework provides a methodical, comprehensive, and customer-focused strategy for optimizing operational procedures and enhancing service excellence in the transportation sector. Organizations can utilize TOGAF's systematic approach to manage the intricacies of the transportation industry effectively. This involves integrating cutting-edge technologies and giving priority to customer satisfaction, resulting in a more streamlined and customer-centric operational structure.

CONCLUSION

Information Architecture and Technology Architecture, two crucial components of a transportation enterprise, are exhaustively covered in the text above. The database structure facilitating customer and technology-related applications within the framework of a transportation company is illustrated in Figure 4, which is the Information Architecture. In addition to supporting technologies like augmented reality, digital twins, mobile transportation applications, and IoT integration, databases that store customer-related data include intelligent tracking, customer surveys, GIS, and CRM. Specific technology-related data is stored in supplementary databases, including those for blockchain, machine learning, supply chain management, and knowledge management. Conversely, the intricate framework for overseeing diverse facets of information technology is exemplified by Technology Architecture (Figure 5). The user interface consists of elements such as mobile and IoT devices, web applications, and Data and Compute. To manage and analyze data, this section employs technologies including Databricks, SQL Data, and Machine Learning. To preserve availability, security, and optimal performance in complex technology environments, the Security, Network, and Monitoring section details the protection layers, network management, and monitoring tools in place. By leveraging advanced technology and integrating data effectively, this demonstrates a commitment to bolstering customer relationships, enhancing operational efficiency, and facilitating business expansion.

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