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UML Design of Business Intelligence System for Small-Scale Enterprises

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Abstract

Small scale enterprises (SSEs) face numerous challenges in managing and processing their business data, which often leads to inefficiencies, errors, and suboptimal decision-making. To address these challenges, the design of a Business Intelligence (BI) system for SSEs using Unified Modeling Language (UML) diagrams is proposed. UML diagrams provide a visual modeling language that facilitates the design, analysis, and implementation of complex systems. The proposed BI system is designed to enable SSEs to gather, integrate, analyze, and present data from various sources, including sales, finance, operations, and customer relations. The agile methodology was used in the design of the mobile intelligence system (MoIS) utilizing the Scrum method because of its time-boxed iterations (sprints), cross-functional team collaboration, and regular feedback loops. The UML diagrams used in this design are use case diagrams, activity diagrams, class diagrams, and sequence diagrams. The use case diagrams identify the system's users and their interactions with the system, while the activity diagrams describe the system's processes and workflows. The class diagrams depict the system's data structures and relationships, and the sequence diagrams specify the interactions between system components. The proposed BI system provides SSEs with the necessary tools to make informed decisions, improve operational efficiency, and gain a competitive advantage. The UML-based design approach ensures that the BI system is well-structured, easy to maintain, and scalable. The effectiveness of the proposed BI system is demonstrated through a case study of an SSE in the retail industry. The results indicate that the BI system improves the SSE's decision-making processes and enables it to respond more quickly to changing market conditions. The proposed BI system using UML diagrams is a valuable contribution to the field of BI systems design and is expected to benefit SSEs in various industries.

Keywords: BIS for SSEs, SSEs data warehousing, UML design of BIS, Mobile intelligence system for SSEs

1. INTRODUCTION

Small-scale enterprises (SSEs) play an important role in the global economy by creating job opportunities, stimulating innovation, and contributing to economic growth as they are mostly established with less capital, little or no technical skills or regulatory requirements. Despite their significance, SSEs face numerous

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challenges, such as lack of access to information and limited resources, which hinder their growth and survival in today's competitive business environment [1]. In recent years, business intelligence systems (BIS) have emerged as a powerful tool for organizations to gain insights into their operations, customers, and market trends, which can help them make informed decisions and gain a competitive advantage [2]. However, the majority of BIS are designed for large organizations, and SSEs often lack the expertise and resources to adopt and implement such systems [3]. Hence, the adoption of BIS poses a significant challenge for SSEs due to their design being inherently skewed towards the needs of larger corporations, coupled with the SSEs' generally limited resources and expertise for effective implementation [1], [2].

Addressing this critical gap, the paper introduces a novel design for a BIS that is aligned to the unique needs of SSEs. Leveraging on UML, which is esteemed for its efficacy in providing clear graphical representations of system architectures, components, and interactions, the paper establishes a clear understanding and application of BIS among both technical and non-technical stakeholders within the SSE sphere. The design encapsulates four core components, that is, data warehousing, data mining, dashboard reporting, and decision support [3], each engineered to empower SSEs with a comprehensive suite of tools for data-driven insights and decision-making.

This innovative system design promises to revolutionize the way SSEs approach business intelligence by enabling a deeper understanding of their operational landscapes, customer base, and market dynamics. It is poised to unlock new avenues for strategic planning, operational optimization, and competitive differentiation, thereby addressing the pressing challenges highlighted in the gap identified in [4], [5], [6] that, there is a need to design BIS tailored to the unique context and characteristics of SSEs. Specifically, in the context of South Africa, where SSEs are a cornerstone of employment, poverty alleviation, and economic transformation, the need for a BIS that is both accessible and effective for SSEs is paramount [5], [6]. Traditional BI systems, with their complexity and cost-prohibitive nature, fall short of meeting the nuanced needs of SSEs, highlighting the urgency of designing BI systems that are attuned to the specific contexts and capacities of SSEs [5].

The research question central to this paper is how UML diagrams can be employed to design a BI system that resonates with the needs and capacities of SSEs in South Africa, seeking to pave the way for a paradigm shift in the adoption and utilization of BI technologies among SSEs. By proposing a system design that is practical and aligned with the realities of SSE operations, the paper will contribute significantly to the discourse on leveraging business intelligence for the empowerment of SSEs. The contribution of Píchová et. al. [7] is to provide essential information on management audit implementation for enterprises, their managers, professional

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auditors, and the general public, with a focus on small and medium-sized enterprises in the Czech Republic. A developed methodology concept is presented, along with an evaluation of whether it is appropriate to analyze multiple areas during management audit or focus only on management, and if the number of analyzed areas depends on the enterprise's size. Experimental modeling was used to address the main research objective, while a binomial test and correlation analysis were employed to evaluate the research question and hypothesis. Data was collected via a questionnaire survey and structured interviews targeting Czech SMEs, yielding a sample of 67 enterprises that perform management audit. Additionally, structured interviews with 12 professional auditors provided further insights into management audit implementation. They found that management audit, which may be regarded as a unique tool for comprehensive evaluations of the currently used enterprise management system, affects the factors for an effective managerial practice on a large-scale.

Hu et. al. [2] used the analytic hierarchy process to analyze the cost of multi-dimensional systems to obtain weight values to determine each importance. They employed experimental modeling, a binomial test, and correlation analysis to investigate management audit implementation in Czech SMEs. Data was collected through a questionnaire survey, which had an 83% response rate (610 enterprises), and structured interviews with 12 professional auditors. The results were based on a sample of 67 enterprises that perform management audits. Through these methods, the study provided valuable insights into the appropriateness of analyzing multiple areas during management audit and the dependency of the number of analyzed areas on the enterprise's size.

The objective of Afrianto et. al. [8] was to build applications that function to help provide information that makes it easy to control the process of entry and exit of goods and develop an inventory information system for retail entrepreneurs. They used an object-oriented system development methodology with Unified Modeling Language (UML) to create their system. The results included the design and construction of Inventory Information System POS (Point of Sales) through Context Diagrams and UML Diagrams (Use Case Diagrams, Activity Diagrams, Class Diagrams, and Sequence Diagrams). Black box testing confirmed that the system operated effectively and met the retail owners' needs.

Hadi et. al. [9] goal was to develop an intelligence business application that is service reusable for integration, analysis and for monitoring the performance of an SME in the manufacturing sector. They developed a business intelligence (BI) application for SMEs in the manufacturing sector to support decision-making and address competitive challenges. The application development involved analyzing transactional data and designing an analytic application using Extract-Transform-Load (ETL) and graphical data display to provide time-based access from various data sources. The study highlighted the relationship between BI processes and

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ERP modules, demonstrating how the application helps SMEs map their company's potential and support business decision-making.

Górski [3] described an integration flow diagram that extends a UML activity diagram. It can provide convenience in collecting data and processing business data, ensuring security in storing data and it will be stored in database. In the study, they 1+5 architectural views model was introduced for designing IT systems that facilitate service fulfillment through cooperation. This model features three new architectural views and extends the unified modeling language (UML) with two profiles: UML profile for integration flows and UML profile for distributed ledger deployment. The paper presents an integration flow diagram and proposes a smart contract design pattern for blockchain. Through three case studies, the 1+5 model has proven effective in designing both centralized integration environments with enterprise service bus (ESB) and distributed blockchain solutions with peer-to-peer (P2P) connections.

Mutmainna et. al. [1] studied information system of construction service web based on Papua GAPEKSINDO Association. This information system is based on web by using UML design method. Their study addressed GAPEKSINDO Association's data management issues by developing a web-based information system for data collection and processing. The researchers used the Unified Modeling Language (UML) design method, the Waterfall development method, and Black Box testing to create a system that offers convenience, security, and efficient data storage in a database, overcoming the limitations of Excel-based data management.

2. METHODS

This work employs an Agile methodology in the design of the MoIS for SSEs. Agile methodology is chosen for its flexibility, iterative nature, quick development, and its focus on user collaboration, making it well-suited for the dynamic requirements of SSEs. The specific method used from the agile family is the Scrum software development method as it improves software quality, emphasizes close collaboration between developers and customers, and fast responsiveness to changing requirements, time-boxed iterations called sprints, with regular meetings to review progress and plan future steps which is best suited for this work [10], [11]. Object-oriented analysis and design (OOAD) methodology was also used for this work to develop the Entity Relationship Diagram (ERD) [12]. The Scrum applied to developing MoIS consists of the following steps as seen in Fig 1, and it is explained in 2.1, 2.2, 2.3, and 2.4:

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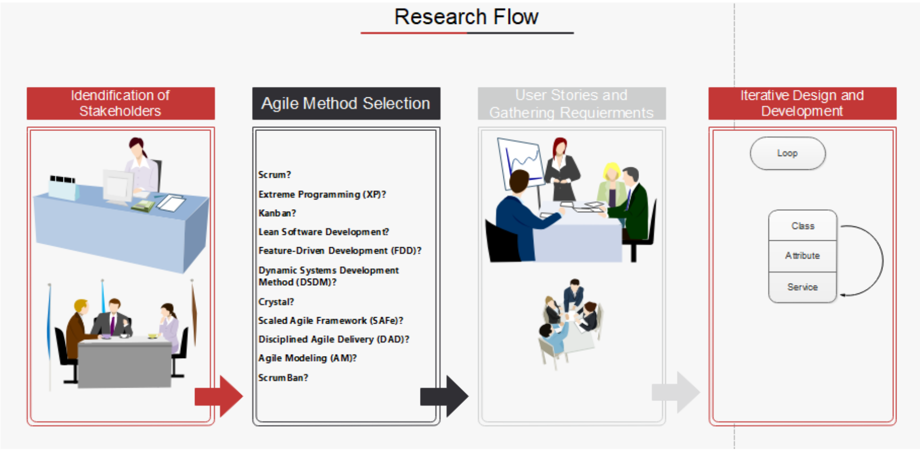

Figure 1. Research Flow

2.1 Identification of Stakeholder

A comprehensive literature review was conducted to understand current trends, challenges, and technology needed by SSEs. Concurrently, stakeholders, including SSE owners, IT staff, and other potential system users, were identified through targeted outreach. Engaging these stakeholders early and continuously ensures their needs and expectations are central to the development process.

2.2 Selecting Agile Method

Considering the project's scope and the identified stakeholders' needs, the Scrum method is selected for its emphasis on time-boxed iterations (sprints), cross-functional team collaboration, and regular feedback loops. This framework facilitates rapid development cycles, allowing for frequent reassessment of project goals and deliverables based on stakeholder feedback.

2.3 User Stories and Gathering Requirements

Requirements are gathered through interviews with stakeholders, focusing on both functional and non-functional needs of the envisioned MoIS. These requirements are then translated into user stories, which serve as the primary units of work for the development of the system. User stories are created to be specific, measurable, achievable, relevant, and time-bound (SMART), ensuring clarity and focus in the development process.

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2.4 Iterative Design and Development

The development process is structured into two-week sprints. Each sprint begins with a planning meeting where the team selects user stories from the product backlog to focus on. The selected user stories guide the creation and refinement of UML diagrams, including use case diagrams, class diagrams, and sequence diagrams, to visualize the system architecture and interactions. Methods from OOAD were implemented at this stage.

3. RESULTS AND DISCUSSION

The diagrams in figure 2-7 together provide a holistic overview of the system's architecture, workflows, data structure, satisfy and answer our research question as stated in section 1 reproduced here as follows "how can UML diagrams be employed to design a BIS that resonates with the needs and capacities of SSEs in South Africa".

3.1 Enterprise Data Warehouse Architecture

Fig 2 shows the architecture of a data warehouse system. It shows how data from various sources (e-commerce, legacy systems, etc.) are extracted, transformed, and loaded (ETL) into an operational data storage and then into a central data warehouse. Each component of the diagram plays a critical role in the data management and business intelligence aspect of the system.

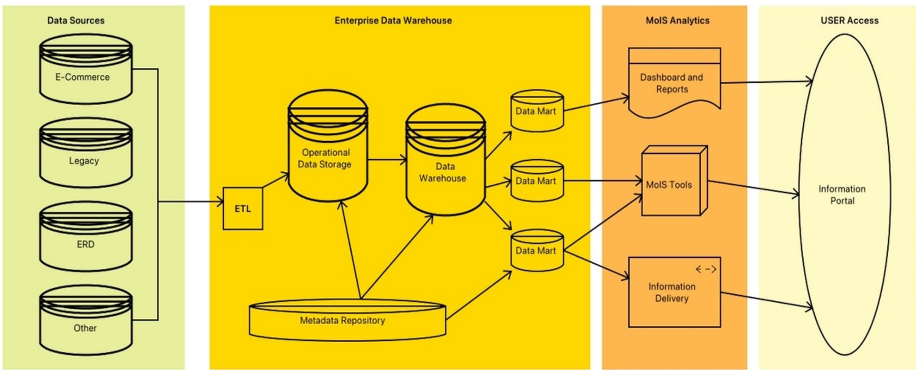

Figure 2. Data Warehouse architecture for SSEs

1) **Data Sources**: These are the various databases and storage systems where the initial raw data is collected. These sources might include:
    a) **E-Commerce**: Transactional data from online sales platforms.
    b) **Legacy**: Older systems that might hold historical data.

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   c) **ERD (Entity-Relationship Diagram)**: This might indicate databases designed according to an ERD, containing structured data.
   d) Other: Any additional data sources that don't fall into the above categories.
2) **ETL (Extract, Transform, Load):** This is a process by which data is taken (extracted) from the original sources, converted (transformed) into a format suitable for analysis and reporting, and then placed (loaded) into a data warehouse. Operational Data Storage: Before arriving at the central data warehouse, data might be temporarily stored in an operational data store (ODS), which is a database designed to integrate data from multiple sources for additional operations on the data.
3) **Data Warehouse:** This is the central repository of integrated data from one or more disparate sources. It stores current and historical data and is used for creating analytical reports and dashboards.
4) **Data Marts:** These are subsets of the data warehouse, often focused on a single subject area or business sector. Data marts are accessible by users who need specialized insights.
5) **Metadata Repository:** This component stores information about the data, such as its structure, format, and the relationships within it. This is crucial for managing the data warehouse, as it provides context for the data.
6) **MoIS Analytics (Mobile Intelligence System Analytics):** This section represents the analytical tools and applications that utilize the data stored in the data warehouse and data marts to produce meaningful insights. It includes:
   a) **Dashboard and Reports:** Visual representations of the data analytics, often used for decision-making.
   b) **MoIS Tools:** Specific tools or applications developed for MoIS that can process and analyze data.
   c) **Information Delivery:** This entails dissemination of processed data and insights to the end-users in a comprehensible format.
7) **Information Portal:** The gateway through which end-users access data analytics, dashboards, reports, and tools. It is the interface for user interaction with MoIS.
8) **USER Access:** The final point of interaction where the end-users, likely small-scale enterprise operators, engage with the system to make data-driven decisions. The components are interconnected in a way that supports the flow of data from the initial sources all the way to the end-user. The data is cleansed and structured via ETL processes, stored and managed in the data warehouse, and then utilized in analytical tools to generate insights. These insights are delivered through user interfaces designed for ease of access and understanding. In MoIS, this flow would be optimized for accessibility on mobile devices, providing small-scale enterprises with the ability to make informed decisions on-the-fly.

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3.2 Small Scale Enterprise Use Case Diagram

Figure 3 illustrates the use case diagram for System Security Engineers (SSEs), highlighting the key components and their interconnections, showcasing how different roles within the organization interact with the system. The diagram begins with the login function, serving as the system's entry point. Here, users authenticate themselves to access the Management of Information System (MoIS), a crucial step that underscores the importance of security and authorized access across various stakeholder groups. This commonality across roles emphasizes the login's significance as a gateway for authorized entry into the system.

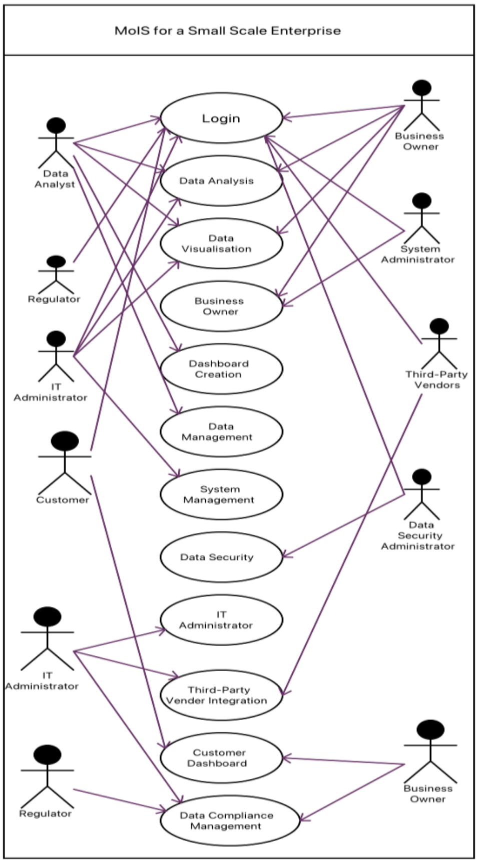

Figure 3. MoIS use case diagram for SSEs.

The diagram further outlines functionalities like Data Analysis and Data Visualization, pivotal in processing and presenting data in an insightful manner. These functions, accessible post-authentication, cater to a broad range of users from data analysts to system administrators indicating their versatile application

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within the system. Another notable feature is Dashboard Creation, which allows for the customization of data views. Influenced by Business Owners, this functionality reflects their demand for tailored data presentation to support decision-making processes.

Data Management is another critical component, focusing on the organization, storage, and maintenance of data. It highlights the collaborative effort between IT Administrators and Business Owners, showcasing a synergy between technical expertise and managerial oversight in managing data effectively. System Management addresses the overarching operation and maintenance needs of the system, with a direct linkage to IT Administrators and Business Owners who play vital roles in ensuring the system's performance and alignment with business objectives.

A cornerstone of the diagram is Data Security, underscoring the paramount importance of protecting data integrity and confidentiality. This function is heavily influenced by the Data Security Administrator, emphasizing their crucial role in the system's security framework. The diagram also showcases features like Third-Party Vendor Integration and the Customer Dashboard, indicating the system's ability to extend its capabilities through external services and offer customized user experiences, thereby highlighting its adaptability and focus on customer needs.

Lastly, Data Compliance Management ensures the system's adherence to legal and regulatory standards, connecting directly to the Regulator's role in setting compliance criteria. This function underscores the system's commitment to maintaining high standards of data governance and regulatory compliance, an essential aspect of its operation and trustworthiness.

3.3 Sequence Diagram for Business Owner

The sequence diagram delineates the systematic interactions and data flow from initiation at login to the final step of data sharing within the Management of Information System (MoIS) from the perspective of a Business Owner. It meticulously outlines the sequential steps a Business Owner undertakes to perform data analysis, illustrating the interconnectedness of system components that facilitate a coherent and logical progression of actions. This process is designed to empower the Business Owner with the capability to make informed, data-driven decisions efficiently. The diagram serves as a pivotal tool for grasping the system's usability and the user experience it offers, specifically tailored for System Security Engineers (SSEs).

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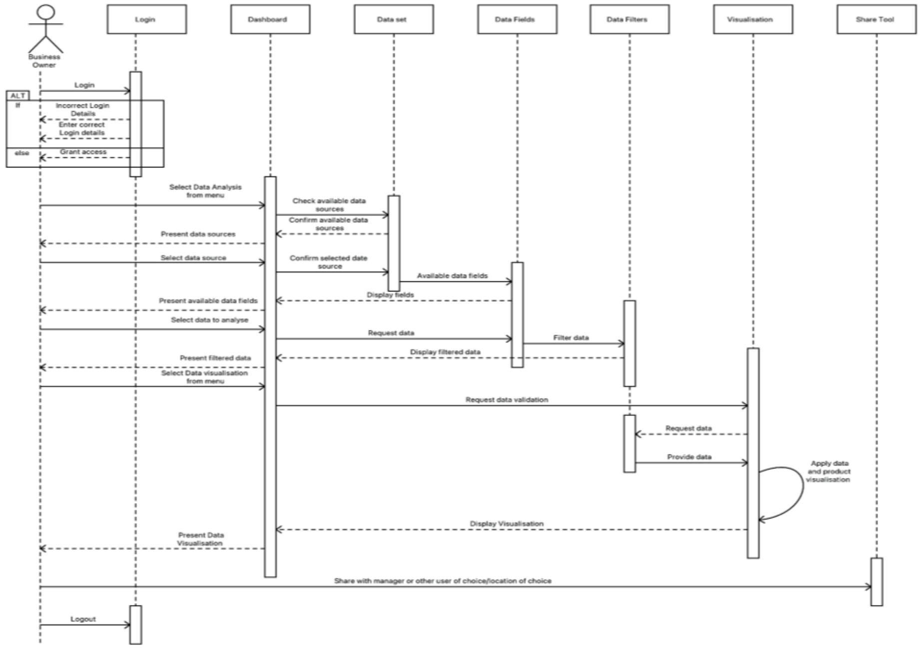

Figure 4. Sequence Diagram for MoIS Business Owner

Figure 4 meticulously maps out the sequence diagram for the Management of Information System (MoIS), specifically tailored to the workflow of a Business Owner, elucidating the communication flow and the pivotal roles of its integral components. At the forefront of this sequence is the Business Owner, designated as the pivotal user, whose journey through the system commences with the act of logging in. This role is inherently linked with administrative access, empowering the individual to navigate and harness the system's fundamental capabilities. The diagram thoughtfully acknowledges potential hurdles in the login process by incorporating an alternate path for incorrect login attempts, ensuring a smooth transition to successful system access.

Upon gaining entry, the Business Owner is met with the dashboard, a centralized interface that facilitates the selection of data analysis functions. This pivotal moment in the sequence highlights the dashboard's role as the nexus for interaction with the system's myriad components. The subsequent step involves the selection of a data set, where the system unveils the available data sources for analysis, enabling the Business Owner to pinpoint the precise dataset that aligns with their analytical objectives.

As the journey progresses, the focus narrows to the selection of data fields. Here, the system showcases the available fields within the chosen data set, from which

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the Business Owner selects those relevant for their analysis. This granularity is further enhanced by the application of data filters, allowing the refinement of the analysis based on specific criteria, thereby sharpening the precision and relevance of the insights generated.

The culmination of this analytical process is realized in the visualization phase, where the processed data is transformed into various graphical formats, such as charts or graphs. This step not only encapsulates the analytical journey but also translates complex datasets into digestible visual insights, enabling a clearer comprehension of the data analyzed.

The final piece of the sequence is embodied in the Share Tool, a feature that underscores the system's collaborative essence by enabling the Business Owner to share these visual insights with other stakeholders, like managers. This functionality highlights the MoIS's commitment to fostering a collaborative environment conducive to data-driven decision-making.

This elaborate sequence not only delineates the step-by-step interaction within the MoIS but also accentuates how it adeptly supports the Business Owner in navigating data analysis and insight sharing. It underscores the system's efficacy and efficiency in bolstering operational decision-making for System Security Engineers, showcasing a well-designed infrastructure that seamlessly integrates various components to facilitate a logical and interactive workflow.

3.4 Sequence Diagram for Customer

Figure 5 offers a comprehensive overview of a customer's journey through a system, from the initial login to the finalization of a purchase. It meticulously outlines the roles of various components and their interconnections, illustrating a seamless process flow that caters to the end user's needs. The sequence begins with the customer, the primary actor, who initiates the process by attempting to log into the system. To accommodate potential issues, an alternative path is in place for handling incorrect login details, ensuring that users can rectify mistakes and gain access smoothly.

Once successfully logged in, the customer interacts with the dashboard. This dashboard acts as the central hub for accessing the system's diverse functionalities, guiding the user through their purchasing journey. As the customer browses, they select items for purchase, adding them to their cart. This phase incorporates a loop that allows for the addition of multiple items and introduces an alternative path to address scenarios where an item might not be available, enhancing the shopping experience by ensuring continuity and providing options. The system's inventory component plays a crucial role at this stage, checking stock levels and adjusting them as items are added to the cart. This dynamic interaction ensures an accurate reflection of available items, preventing the selection of out-of-stock products.

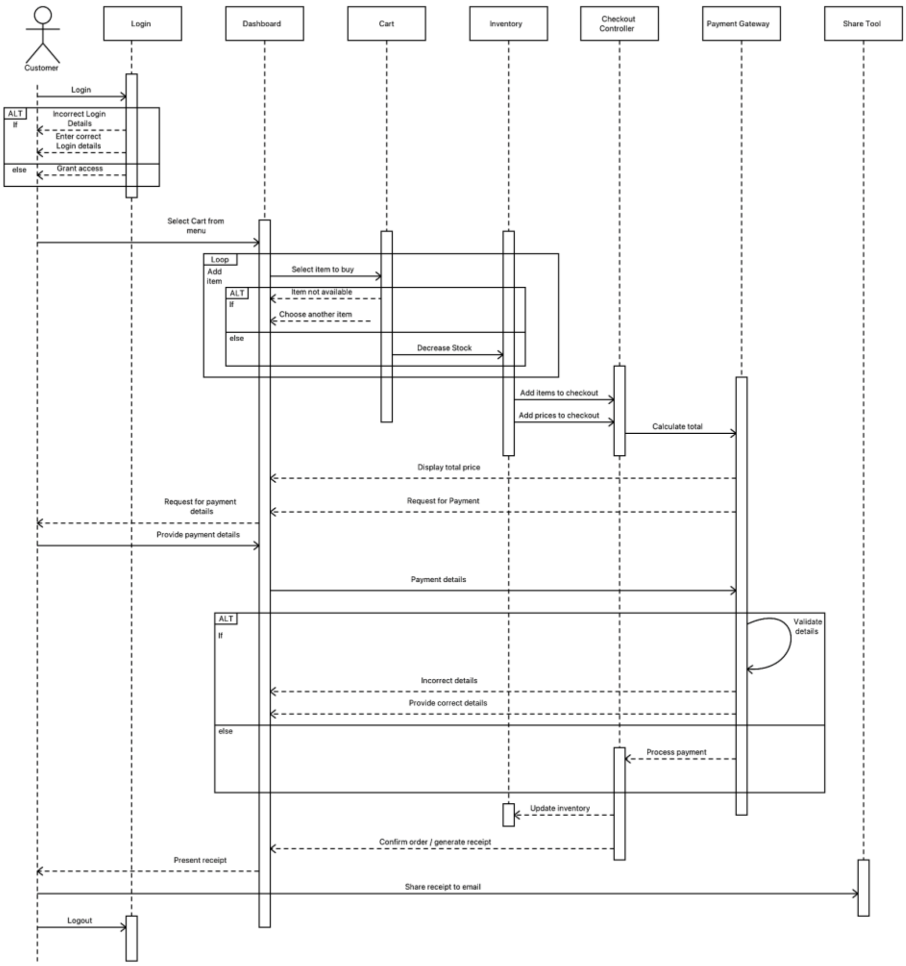

Figure 5. Sequence Diagram for Customer

The checkout controller emerges as a pivotal component, orchestrating the checkout process. It itemizes the customer's purchases and calculates the total cost, facilitating a transparent and efficient transaction process. Following this, the customer is directed to the payment gateway, where they submit their payment details. The system includes safeguards, with an alternative path for incorrect

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payment information, ensuring that payment issues can be resolved without disrupting the overall purchase process.

A noteworthy feature of this journey is the share tool, which comes into play post-purchase. This tool allows customers to share their receipts via email, adding a layer of convenience and enabling easy confirmation of transactions. This aspect underscores the system's commitment to a user-friendly experience, highlighting its capacity to support customers through every step of their interaction, from login to purchase.

3.5 Sequence Diagram for Regulator

Figure 6 offers a detailed depiction of the engagement between a regulatory representative and a compliance system within a Management of Information System (MoIS) crafted for System Security Engineers (SSEs). It lays out each component's role and how they interlink to ensure regulatory compliance. At the outset, the process is initiated by the regulator representative, an actor representing an external authority or auditor charged with the responsibility of ensuring the business's adherence to specific regulations. The initial step involves the regulator attempting to log into the system. To account for any discrepancies in login details, an alternative pathway (ALT) is provided, ensuring that access is only granted upon the submission of correct credentials. Upon successful login, the regulator gains access to a dashboard. This dashboard serves as a centralized user interface, offering a comprehensive overview of various compliance-related data and functionalities, enabling the regulator to efficiently navigate through the compliance landscape of the business.

Central to this process is the Data Compliance Table, a component that functions as a repository or a structured format for storing and retrieving compliance-related data. Here, the regulator selects the type of compliance data they wish to examine, which may range from tax reports to data security compliance documents. This selection phase is crucial, as it determines the specific compliance aspects to be scrutinized. The system then proceeds to verify the availability of the requested compliance data by querying its data sources. This step underscores the system's capability to not only store but also validate current data against the specific requirements or queries posed by the regulator. Following the verification step, the regulator makes formal requests for specific reports, such as tax reports or other compliance-related documents. The system responds by presenting the requested data, thereby facilitating a transparent review process for the regulator. The interaction concludes with the regulator logging out of the system, having completed the review of the necessary compliance data. This meticulous process highlights the MoIS's robust compliance system, designed to ensure seamless interaction between regulatory representatives and the compliance infrastructure,

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thereby supporting adherence to regulatory standards and enhancing the overall security posture of the SSEs.

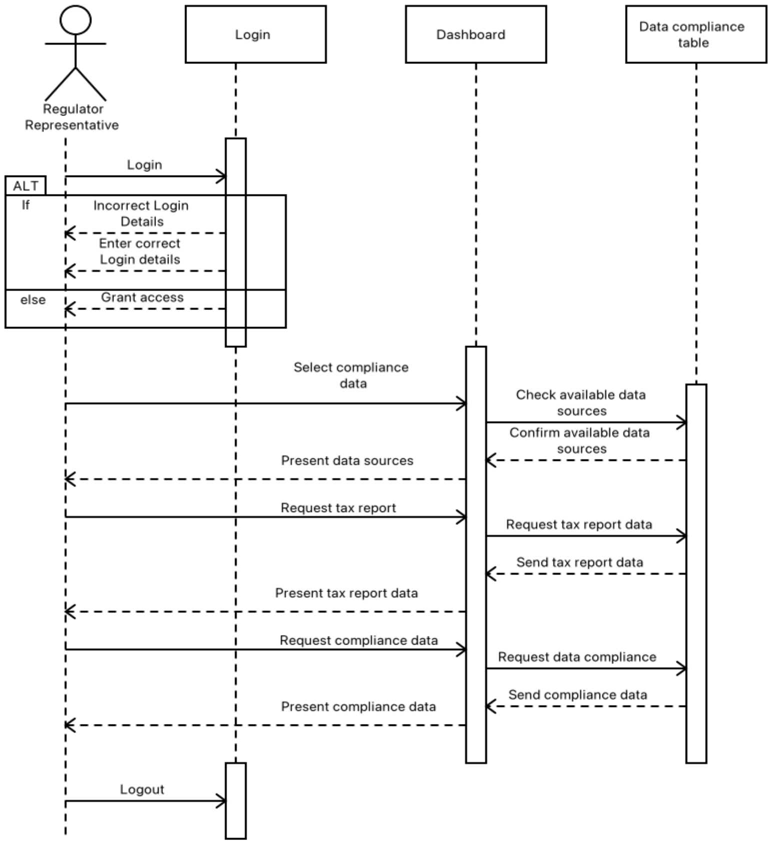

Figure 6. Sequence Diagram for Regulator

3.6 MoIS Entity Relationship Diagram (ERD) for SSEs

The Entity-Relationship Diagram (ERD) serves as a comprehensive blueprint of the Management of Information System (MoIS) database architecture, delineating the intricacies of data interaction, report generation, and system setting configurations across various user roles and permissions. This diagram is pivotal for System Security Engineers (SSEs) as it lays the groundwork for a structured, secure, and regulation-compliant data layer, enabling efficient resource management and adherence to regulatory benchmarks. Figure 7 meticulously outlines the components of the ERD, showcasing the interrelations and functionalities that underpin the system's operational dynamics.

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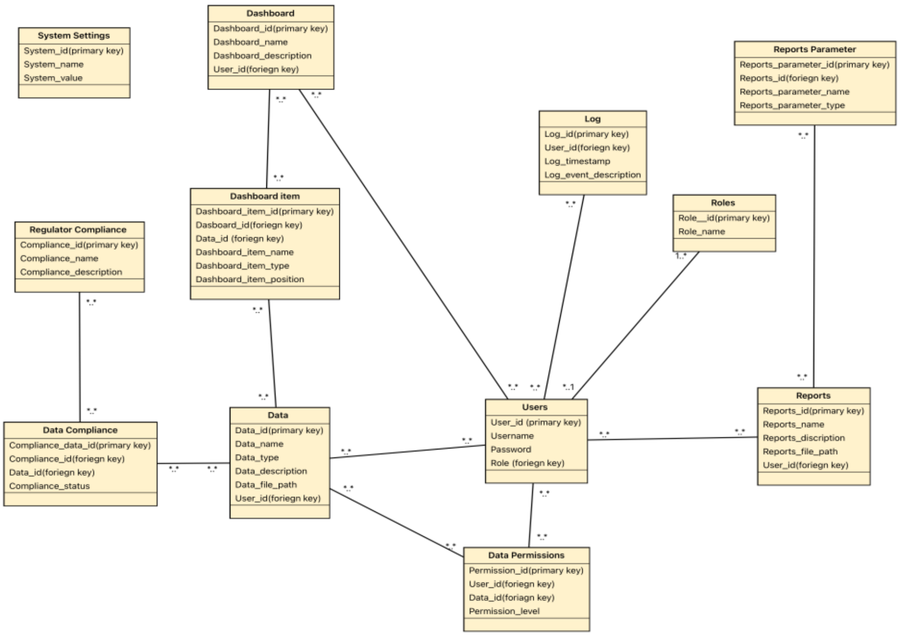

Figure 7. ERD for MoIS

At the core of this structure is the System Settings entity, a repository for global system configurations. It catalogs each setting by its unique ID, name, and value, ensuring that system-wide parameters are centrally managed and accessible. The Dashboard entity, pivotal to user interaction, offers a tailored view containing various items like widgets or reports, establishing a direct relationship with the Dashboard Item entity. Each Dashboard Item, in turn, links to the actual data it represents, embodying the modular components within a user's dashboard.

The architecture incorporates a specialized focus on compliance through the Regulator Compliance and Data Compliance entities. This store information is relevant to ensuring that both the dashboard displays, and the system's data points meet stringent regulatory standards, a critical consideration for SSEs operating within regulated environments. The Data entity captures the essence of the system's stored information, detailing attributes such as ID, name, type, description, and file path, which are foundational to the system's data management capabilities. Parallelly, the Users entity catalogues user profiles, linking each to the Roles entity through a foreign key. This connection defines the spectrum of access and permissions available to a user, highlighting the system's role-based access control mechanism. The Roles entity further clarifies the hierarchy and access privileges within the system, indicating a versatile framework capable of supporting multiple user types. Access specificity is managed by the Data

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Permissions entity, which delineates the accessibility of data across users, ensuring granular control over data access levels.

Additionally, the Reports and Reports Parameter entities contribute to the system's reporting framework, enabling the generation of detailed reports and the application of customizable parameters for data filtering and presentation. Lastly, the Log entity acts as a digital ledger, recording user actions and system events with timestamps and descriptions for audit trails and security monitoring purposes. This detailed ERD illustration underscores the MoIS's robust data architecture, emphasizing its strategic design to support user-specific interactions, ensure data integrity, and facilitate regulatory compliance, thereby optimizing the operational efficiency and security measures critical for SSEs.

3.7 Discussion

The intricacies of system design and data management within the realm of System Security Engineers (SSEs) are exemplified through the use of various diagrams and data structures, such as use case diagrams, sequence diagrams, interaction flows, and Entity-Relationship Diagrams (ERDs). These tools collectively offer a comprehensive blueprint for understanding the operational framework and user interaction with Management of Information Systems (MoIS). Specifically, the use case diagrams, including those illustrating SSE components and customer interactions, serve to clarify the roles and functionalities within the system. They highlight the essential processes from login procedures to data analysis, dashboard management, and the finalization of transactions. These diagrams not only underscore the multifaceted nature of the system but also showcase the importance of a user-centric design in facilitating seamless navigation and operation within the system.

Furthermore, the sequence diagrams and interaction flows delve deeper into the specifics of user engagement with the system, detailing the step-by-step processes that users, such as business owners and regulatory representatives, undertake within the MoIS. These detailed walkthroughs are crucial for understanding the system's usability and the user experience. By mapping out the interaction between users and the system from initial login to data analysis, report generation, and compliance checks these diagrams elucidate the logical flow of actions and the interconnectivity of system components. They reveal the system's capability to cater to diverse user needs, ranging from operational decision-making to regulatory compliance and data sharing.

The emphasis on compliance and regulatory adherence is particularly noteworthy. As depicted in the interaction flows involving regulatory representatives, the system is intricately designed to meet regulatory standards and facilitate compliance checks. This aspect is vital for SSEs, operating in environments where

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adherence to legal and regulatory requirements is paramount. The compliance system's architecture, which allows regulators to efficiently access and review compliance data, underscores the importance of building systems that not only meet operational needs but also comply with external regulatory standards. This dual focus ensures that the system remains both effective and lawful, catering to the critical needs of security and regulatory oversight.

The Entity-Relationship Diagram (ERD) further complements our understanding by offering a structural overview of the database and its relation to the system's users. It delineates how data is organized, accessed, and managed within the MoIS, providing insights into the system's data layer. The ERD highlights the significance of structured data management and role-based access control in ensuring data integrity, security, and compliance. This architectural framework is essential for SSEs, who require a reliable system that efficiently organizes and secures data while providing flexible access and reporting capabilities. The ERD demonstrates the system's preparedness to handle complex data relationships and permissions, essential for a robust security posture and operational efficiency.

The detailed exploration of use case diagrams, sequence diagrams, interaction flows, and the ERD offers invaluable insights into the design and functionality of MoIS for SSEs. These analytical tools underscore the importance of a user-centric approach, emphasizing seamless interaction, data security, compliance, and efficient data management. They collectively illustrate a system designed to support varied user roles, from business owners to regulatory representatives, ensuring operational efficacy, regulatory compliance, and security. This comprehensive analysis not only highlights the system's capabilities but also sets a benchmark for designing and implementing secure, efficient, and compliant information systems in the field of system security engineering.

4. CONCLUSION

This paper has effectively leveraged an engineering approach to present the architectural framework of a Management of Information System (MoIS), addressing the research question introduced at the outset. Through the utilization of Unified Modeling Language (UML) diagrams, it has demonstrated how Business Intelligence Systems (BIS) can significantly enhance the operational efficiency of System Security Engineers (SSEs), with a focus on South Africa and, by extension, other developing countries. The similarities in SSEs' roles, trade practices, and organizational structures across these regions underscore the relevance of this study. The use of UML diagrams has proven instrumental in designing a BIS that is both accessible to a wide audience and tailored to the specific needs of SSEs, bridging the gap between complex BI systems and their practical application.

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The paper's findings contribute substantially to the BI systems domain, offering a scalable and efficient UML-based design approach that promises to empower SSEs in developing countries by leveraging data for improved business operations. This work not only marks a significant advancement in the field but also sets the stage for future research and development efforts aimed at refining and implementing BI systems for SSEs. The next steps involve developing the BI system according to the UML framework and conducting User Acceptance Testing (UAT) with stakeholders. This future work is poised to validate and enhance the system's practicality, ensuring that the designed solution effectively meets the operational needs of SSEs and fulfills its promise of fostering a more data-driven approach to business in developing countries.

REFERENCES

[1] S. N. A. Mutmainna, M. R. Widiantoro, and S. Robo, "Information System of Construction Service Web Based on Papua Gapeksindo Association," *J. Teknol. Dan Open Source*, vol. 4, no. 1, pp. 98–105, 2021.
[2] N. Hu *et al.*, "Cost Management Model Based on Multidimensional System," *Cyber Security Intelligence and Analytics: Proceedings of the 2020 International Conference on Cyber Security Intelligence and Analytics (CSIA 2020)*, Volume 2, Springer, 2020, pp. 202–209.
[3] T. Górski, "The 1+ 5 Architectural Views Model in Designing Blockchain and IT System Integration Solutions," *Symmetry*, vol. 13, no. 11, p. 2000, 2021.
[4] C. Kikawa and B. M. Kalema, "A Statistical Analysis of Business Intelligence Acceptance by SMES in the City of Tshwane, Republic of South Africa," *Academy of Entrepreneurship Journal,* vol. 25, no. 2 pp. 1–19, Jun. 2019.
[5] A. E. S. Muleya, "A Business Intelligence Systems Adoption Framework for the Small, Medium, and Micro-Enterprises Grocery Retail Sector: A Case of Tshwane Metropolitan Municipality," *Doctoral dissertation,* 2021.
[6] M. Moyo and M. Loock, "Conceptualising a Cloud Business Intelligence Security Evaluation Framework for Small and Medium Enterprises in Small Towns of the Limpopo Province, South Africa," *Information*, vol. 12, no. 3, Art. no. 3, Mar. 2021, doi: 10.3390/info12030128.
[7] R. Píchová and D. Raušer, "Use of Management Audit by Small and Medium-Sized Enterprises in Business/Managerial Practice," *Eur. Res. Stud. J.*, vol. 22, no. 2, pp. 309–322, 2019.
[8] Y. Afrianto, N. B. Ginting, S. Suratun, and Y. Nelawati, "Sistem Informasi Inventory POS (Point of Sales) Berbasis Web Pada Counter Cellular," *JURTEKSI J. Teknol. Dan Sist. Inf.*, vol. 6, no. 2, pp. 125–134, 2020.
[9] A. F. Hadi and R. Permana, "Development of Business Intelligence On Enterprise Resource Planning For Business Small And Medium," *J. Ekobistek*, vol. 8, no. 2, 2019.

p-ISSN: **2656-5935** http://journal-isi.org/index.php/isi e-ISSN: **2656-4882**

[10] G. Guerrero-Ulloa, C. Rodríguez-Domínguez, and M. J. Hornos, "Agile Methodologies Applied to the Development of Internet of Things (IoT)-Based Systems: A Review," *Sensors*, vol. 23, no. 2, Art. no. 2, Jan. 2023, doi: 10.3390/s23020790.

[11] T. T. Chikohora and B. M. Esiefarienrhe, "A Hybrid Framework for the Implementation of Business Intelligence Systems in Small Scale Enterprises," *J. Inf. Syst. Inform.*, vol. 4, no. 1, pp. 40–54, 2022, doi: 10.51519/journalisi.v4i1.221.

[12] B. M. Esiefarienrhe and M. Mokeresete, "Using Software Applications To Enhance E-Government Service Delivery In Botswana," *J. Inf. Syst. Inform.*, vol. 4, no. 3, Art. no. 3, Oct. 2022, doi: 10.51519/journalisi.v4i3.262.