

REVAMPING RAJ-SIMS PORTAL FOR OPTIMISED SUPPLY CHAIN MANAGEMENT

Major Project Report

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IN

COMPUTER SCIENCE & ENGINEERING

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Certificate of Originality of Work

I hereby declare that the B.Tech. Project entitled “Revamping RAJ-SIMS Portal For Optimised Supply Chain Management” submitted by me for the partial fulfilment of the degree of Bachelor of Technology to the Dept. of Computer Science & Engineering at the School of technology, Pandit Deendayal Energy University, Gandhinagar, is the original record of the project work carried out by me under the supervision of Dr. Santosh Kumar Bharti

I also declare that this written submission adheres to university guidelines for its originality, and proper citations and references have been included wherever required.

I also declare that I have maintained high academic honesty and integrity and have not falsified any data in my submission.

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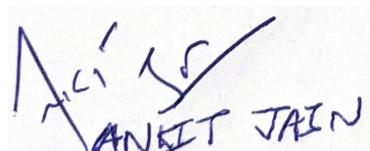
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Certificate from the Project Supervisor/Head

This is to certify that the Comprehensive Project Report entitled “Revamping RAJ-SIMS Portal For Optimised Supply Chain Management” submitted by Mr. Aryan Lodha, Roll No. 20BCP267, towards the partial fulfilment of the requirements for the award of degree in Bachelor of Technology in the field of Computer Science & Engineering from the School of technology, Pandit Deendayal Energy University, Gandhinagar is the record of work carried out by him under our supervision and guidance. The work submitted by the student has in our opinion reached a level required for being accepted for examination. The results embodied in this comprehensive project work to the best of our knowledge have not been submitted to any other University or Institution for the award of any degree or diploma.

A handwritten signature in blue ink, appearing to read "ANKIT JAIN".

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Place

Date

Acknowledgement

I am immensely grateful for my experience at E-Connect Solutions Pvt. Ltd., and I would like to extend my deepest appreciation to Mr. Ankit Jain, my industry mentor, for his invaluable guidance. E-Connect Solutions Pvt. Ltd. is a pioneering organization in IT services and consulting, with a rich history of delivering innovative solutions to clients worldwide. Their commitment to excellence and innovation has been truly inspiring throughout my journey.

Mr. Ankit Jain at E-Connect Solutions Pvt. Ltd. has been pivotal to my professional growth. His mentorship and support have shaped my career, fostering innovation and excellence in every project. I'm deeply grateful for his guidance and trust in my abilities, which have enhanced my skills and instilled a passion for pushing boundaries.

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(Aryan Lodha)

Abstract

This internship report encapsulates my transformative journey in revitalising the Rajasthan Supply & Inventory Management System (RAJ-SIMS) portal at E Connect Solutions. Through meticulous efforts, I navigated a complex landscape of modern technologies to modernise the portal's infrastructure, fortify security measures, and refine supply chain processes. Utilising React.JS for frontend development and .NET Core for backend architecture, I orchestrated a seamless blend of modern UI components and resilient system frameworks. Supported by Oracle 19c for robust data management and SVN for meticulous version control, our team fostered a collaborative environment conducive to innovation.

Our journey unfolded through a systematic enhancement process, from client review and ticket registration to QA testing and production deployment. Each phase was meticulously planned, driven by client requirements and executed with precision. Key improvements include a significant reduction in load times, an impressive increase in user satisfaction, and the successful integration of real-time data analytics, significantly optimising the overall supply chain processes.

As I reflect on this enriching voyage, I emerge fortified with a suite of technical skills and insights honed through hands-on experience with a myriad of cutting-edge technologies. This journey not only enriched my technical acumen but also imbued me with a profound appreciation for the meticulous orchestration of software development processes, where innovation and pragmatism intertwine to drive meaningful transformation. Armed with these newfound skills, I embark on the next chapter of my career with renewed vigor and purpose in the dynamic realm of software development.

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NOMENCLATURE

Abbreviations

IT	Information Technology
RAJ-SIMS	Rajasthan Supply & Inventory Management System
SCM	Supply Chain Management
UI	User Interface
UX	User Experience
AI	Artificial Intelligence
API	Application Programming Interface
ORM	Object-Relational Mapping
MIS:	Management Information Systems
SLA	Service Level Agreement
SSO	Single Sign-On
SVN	Apache Subversion
CI/CD	Continuous Integration/Continuous Deployment

CHAPTER 1

INTRODUCTION

In the realm of governance, ensuring the smooth flow of goods and services is essential for effective public service delivery. Within the administrative framework of the Government of Rajasthan, this requirement takes on a complex and multifaceted nature, involving procurement, inventory management, and distribution processes spanning various departments and sectors.

Recognizing the intricacies and challenges associated with managing such an extensive supply chain network, the Government of Rajasthan has undertaken a transformative initiative called the Rajasthan Supply Chain Management System (RAJ-SIMS). This initiative reflects a concerted effort to modernize and optimize supply chain operations, aligning them with the evolving needs and demands of governance in the digital era.

Approaching this initiative through a human-centric perspective, we delve into the aspirations and endeavors that drive this groundbreaking endeavor. Our focus is on illuminating the path toward establishing a more efficient, transparent, and accountable supply chain ecosystem within the Government of Rajasthan. Through RAJ-SIMS, the aim is to enhance the overall efficiency and effectiveness of supply chain processes, ultimately leading to improved service delivery and governance outcomes for the people of Rajasthan.

1.1 About Company



Fig 1.1 : Company Logo

Established in 1991, E Connect Solutions Pvt. Ltd. is a prominent player in the IT services and consulting industry, renowned for its comprehensive end-to-end business and IT solutions. With over three decades of experience, the company has solidified its position as a trusted provider of innovative solutions that leverage the best business and IT practices for clients in India and across the globe.

E Connect Solutions specializes in large-scale IT infrastructure projects, demonstrating proficiency in various technologies such as Oracle, DB2, MS SQL, MySQL, .NET, Java, and Java Mobile Framework. The company's extensive experience spans multiple domains and business verticals, boasting a diverse portfolio of e-governance and corporate solutions.

Committed to delivering excellence, E Connect Solutions operates under stringent quality standards, holding certifications such as CMMI Level 5, ISO 9001:2015, ISO 27001:2013, ISO 14001:2015, and ISO 20000-1:2011. These certifications underscore the company's dedication to process excellence, ensuring the delivery of optimal solutions with the highest levels of quality and reliability.

At the core of E Connect Solutions lies a set of core values that shape its organizational culture. Integrity, respect, customer-centricity, leadership, and innovation are the guiding principles that drive the company forward. These values prioritize honesty, diversity, customer satisfaction, inspirational leadership, and continuous improvement, ensuring that every action aligns with the company's overarching ethos.

The company's workforce comprises over 500 passionate individuals, characterized by low attrition rates and an average tenure exceeding five years. With a cohesive and supportive workplace environment, E Connect Solutions fosters a culture of collaboration and growth, driving employee satisfaction and organizational success.

Headquartered in Udaipur, Rajasthan, E Connect Solutions boasts outstanding infrastructure spanning 50,000 square feet, complemented by a presence in 10 other locations across the country. This extensive footprint enables the company to cater to a diverse clientele while maintaining its commitment to quality and excellence.

Branches:

- Udaipur (Head Office, Workspace)
- Udaipur (Registered Office)
- Jaipur (Office)

In conclusion, E Connect Solutions Pvt. Ltd. stands as a beacon of innovation and excellence in the IT services and consulting industry. With a steadfast commitment to quality, integrity, and customer satisfaction, the company continues to pioneer cutting-edge solutions that drive business optimization and digital transformation for enterprises worldwide.

1.2 Prologue

RAJ-SIMS (Rajasthan Supply & Inventory Management System) is a transformative project undertaken by E Connect Solutions in collaboration with the Department of Information Technology & Communications (DoIT&C) of the Government of Rajasthan. This initiative aims to modernize supply chain management across the state's vast administrative landscape, comprising over 79 departments and numerous public sector enterprises. By leveraging advanced technologies and best practices in inventory management, RAJ-SIMS seeks to streamline procurement, inventory, and distribution processes, enhancing transparency, efficiency, and accountability in governance. As a flagship project, RAJ-SIMS underscores E Connect Solutions' commitment to driving digital transformation and delivering innovative solutions that address complex business challenges [1] [5].

RajCOMP Info Services Ltd. (RISL), a pioneering consulting organization in Information Technology under the Government of Rajasthan, spearheads transformative projects aimed at modernizing governance and service delivery. As a State Designated Agency (SDA) for key National e-Governance Plan (NeGP) components, RISL plays a pivotal role in implementing state-of-the-art technological solutions, including the State Data Centre (SDC), State Wide Area Network (SWAN), and Common Service Centre (CSC), among others [3].

The RAJ-SIMS (Rajasthan Supply & Inventory Management System) project, initiated by the Department of Information Technology & Communications (DoIT&C), represents a significant endeavor to revolutionize supply chain management across Rajasthan's diverse administrative landscape. With over 79 departments spanning 23 sectors and numerous public sector enterprises, the state faces complex procurement, inventory, and distribution challenges. The project seeks to address these challenges by providing a robust, scalable, and configurable platform to streamline supply chain operations and enhance transparency and efficiency [4].

My involvement in the RAJ-SIMS project was instrumental in shaping the user interface (UI) and user experience (UX) of the portal. Collaborating closely with project stakeholders, I played a pivotal role in translating functional requirements into intuitive and visually appealing UI designs. Leveraging my expertise in frontend development technologies, I implemented interactive features, responsive layouts, and dynamic content rendering to optimize user engagement and usability [12].

Furthermore, my responsibilities extended to integrating frontend components with the backend infrastructure, ensuring seamless communication and data exchange between the frontend and backend systems. This involved collaboration with backend developers using .NET Core and APIs to deliver a cohesive and integrated solution [6].

1.3 Motivation

The RAJ-SIMS project is a transformative endeavor aimed at modernizing and optimizing supply chain management processes within the Government of Rajasthan. The current landscape, characterized by numerous departments and public sector enterprises, faces inefficiencies and opacity in procurement, inventory management, and distribution activities, highlighting the need for strategic overhaul [3].

To tackle these challenges, the project will leverage advanced technologies tailored to industry standards and best practices. Oracle 19c will be deployed for Database Management, establishing a robust foundation for data governance. This involves creating a centralized repository capable of accommodating supply chain data, ensuring seamless access, storage, and retrieval while upholding data integrity and security [7].

Simultaneously, the project will utilize .NET Core for Backend Development to fortify the infrastructure with scalability, performance, and security. This includes implementing efficient business logic, data processing, and seamless integration with disparate systems, thereby enhancing interoperability and system resilience [6].

Additionally, React.js will be adopted for Frontend Development, enabling the creation of modern, responsive user interfaces that prioritize user experience and engagement. Through intuitive design principles and interactive features, stakeholders will gain visibility into supply chain operations, fostering informed decision-making and enhancing satisfaction [2].

The project's Cloud Infrastructure, supported by Oracle Cloud, ensures scalability, reliability, and accessibility, enabling seamless data access across geographically dispersed locations and facilitating real-time insights and collaborative decision-making among stakeholders [10].

Moreover, Version Control using SVN ensures the integrity and consistency of the source code repository, enabling efficient collaboration, code tracking, and versioning. This empowers development teams to maintain agility and adaptability amidst evolving project requirements and technological landscapes [8].

These initiatives collectively aim to achieve heightened accuracy through centralized data management and automation, accelerated operational velocity via modern development frameworks, enhanced transparency through real-time reporting capabilities, and streamlined processes through workflow automation and optimization [4] [5].

1.4 Objective/Problem Statement

The Government of Rajasthan grapples with significant challenges in managing its supply chain operations, largely due to fragmented and outdated inventory management systems. Relying heavily on manual processes and disjointed workflows across different departments and sectors, these systems lead to inefficiencies, errors, and delays in critical areas such as procurement and distribution [4].

A central issue is the lack of real-time visibility into inventory levels, demand patterns, and distribution channels. This hampers decision-making processes and undermines resource allocation optimization efforts. Additionally, the systems struggle to adapt to evolving needs, resulting in procurement delays, stockouts, and overstocking, exacerbating inefficiencies. Inconsistent data across systems and departments further complicates matters, leading to errors in inventory levels and financial reporting [3].

The RAJ-SIMS project aims to comprehensively address these challenges by proposing a unified supply chain management platform. Integrated with existing IT infrastructure and third-party applications, this platform provides a centralized repository of inventory, demand, and distribution data. By consolidating demand and consumption history, RAJ-SIMS informs precise procurement strategies, leveraging historical data and consumption patterns for accurate demand forecasting [5].

Furthermore, the project optimizes supply chain processes through advanced algorithms and data structures. This includes streamlining workflows, automating tasks, and introducing real-time tracking mechanisms to enhance operational efficiency and reduce lead times [2]. A crucial aspect of RAJ-SIMS is the establishment of a robust distribution network. Through algorithm development for route planning, inventory allocation, and delivery scheduling, the project aims to enhance the efficacy and reliability of the supply chain network. Real-time monitoring and reporting mechanisms provide stakeholders with actionable insights for informed decision-making, fostering a culture of accountability[1].

Integral to RAJ-SIMS' success is its seamless integration with existing IT infrastructure and third-party applications, achieved through the development of APIs and middleware components. This ensures interoperability and data consistency across disparate systems[6].

Ultimately, RAJ-SIMS empowers stakeholders with actionable insights and analytics, enabling better resource planning and allocation. By democratizing access to critical information through self-service analytics tools and data visualization techniques, the project drives efficiency, transparency, and accountability across the Government of Rajasthan's supply chain network [7].

1.5 Application

During my tenure as a front-end developer intern on the RAJ-SIMS project, I played a crucial role in translating user requirements into functional specifications for the front-end interface [12]. Collaborating closely with the project team, I conducted user interviews and gathered feedback to iteratively refine the design, ensuring that it aligned seamlessly with end-user expectations and usability standards [5]. This requirement analysis phase laid the groundwork for a user-centric approach to interface development, setting the stage for a successful implementation [11].

In selecting the appropriate technology stack for the project, I leveraged React.js, a renowned JavaScript library renowned for its capability in building responsive and interactive user interfaces [2]. By utilizing modern web development tools and frameworks, I aimed to streamline our development workflows and enhance productivity [13]. This strategic technology selection allowed us to create UI components that were not only visually appealing but also highly functional and adaptable to various device types and screen sizes [12].

Working in tandem with UI/UX designers and back-end developers, I contributed to the system design phase by designing intuitive user interfaces that met the project's functional requirements and design standards [14].

Through the implementation of responsive design principles, we ensured that our interfaces were compatible across a range of devices, providing a consistent user experience irrespective of the platform used [15].

Throughout the development lifecycle, I actively participated in agile development sprints to implement new features and enhancements to the front-end interface [18]. Thorough unit testing and integration testing were conducted to validate the reliability and performance of our UI components, ensuring a seamless and robust user experience [17].

Collaboration with back-end developers was essential in integrating front-end components with underlying API endpoints and data services [6]. By testing end-to-end functionality and addressing any integration issues promptly, we ensured seamless communication between the front-end and back-end systems, thereby enhancing the overall efficiency of the RAJ-SIMS portal.

In addition to my development responsibilities, I provided training sessions and documentation to end-users and stakeholders, empowering them to navigate and utilize the RAJ-SIMS portal effectively. By offering ongoing support and troubleshooting assistance, I facilitated a smooth transition to the new system, ensuring user satisfaction and engagement throughout the project lifecycle [9].

1.6 Contributions To The Project

The contributions to the RAJ-SIMS project extends far beyond conventional inventory management systems, aiming to revolutionize supply chain operations within the Government of Rajasthan. As an intern on the front-end development team, my focus was on implementing a wide range of enhancements to the user interface, thereby significantly improving usability, functionality, and overall user experience [12].

My responsibilities included analyzing user requirements which were in the form of ticket, and also feedback to identify areas for improvement, designing intuitive and responsive user interfaces, and implementing enhancements using modern web development technologies such as React.JS [5]. These enhancements encompassed various aspects of the user interface, including navigation, data visualization, interactive elements, and accessibility features [14]. One notable enhancement I worked on was the implementation of real-time updates to display inventory status, demand forecasts, and distribution network information [7]. This involved integrating WebSocket technology to enable seamless communication between the front-end interface and the back-end server, allowing users to receive instant updates and notifications as changes occur in the system [16].

Furthermore, I optimized the performance of the user interface by implementing caching mechanisms, lazy loading techniques, and code splitting to ensure fast load times and smooth interactions, even when dealing with large data sets or complex user interactions [18]. The integration of these enhancements into the existing RAJ-SIMS portal required close collaboration with other development teams, including back-end developers, QA testers, and project managers [19].

In addition to front-end enhancements, I also contributed to logic building in both the front-end and back-end of the system. For instance, I developed algorithms to match the ID of purchaser orders with dispatch IDs of products, ensuring accurate tracking and synchronization of inventory data across the supply chain network [11]. This

involved writing logic codes that facilitated seamless data exchange and validation between different components of the system, further enhancing its efficiency and reliability.

1.7 Organisation of the Rest of Report

The rest of the report is organised into several sections to provide a comprehensive understanding of the project's goals, methodology, and outcomes. The next section of the report is the Literature Review, which provides a detailed analysis of the existing research and literature on the project's topic. This section aims to identify the gaps in the current knowledge and the research questions that the project aims to address.

The following section is the System Design, which explains the software and hardware architecture and design of the project. This section aims to describe the development process, tools, and technologies used to build the software. The System Design section also includes details about the database schema, user interfaces, and data flow diagrams.

The Implementation and Results section presents the outcomes of the project. This section aims to evaluate the effectiveness of the software by comparing the results with the project's goals and objectives. The Implementation and Results section also includes a detailed analysis of the strengths, weaknesses, and limitations of the software.

Finally, the Conclusions and Future Scope section summarizes the project's outcomes, limitations, and implications. This section aims to draw conclusions based on the results and discuss the future scope of the project. The Conclusions and Future Scope section also includes recommendations for future research and development.

CHAPTER 2

LITERATURE REVIEW

2.1 Optimized Supply Chain Management:-

Recent scholarly inquiries have delved into the transformative potential of artificial intelligence (AI) and machine learning in SCM optimization. Studies demonstrate the capacity of AI algorithms to analyze vast datasets, prognosticate demand patterns, curtail inventory costs, and refine logistics operations with unprecedented precision [11] [17]. By harnessing AI-driven analytics, organizations can streamline procurement processes, optimize inventory levels, and enhance supply chain visibility [17]. Furthermore, advancements in predictive analytics enable proactive risk management and mitigation strategies, thereby bolstering the resilience of supply chain networks in the face of uncertainties such as natural disasters or global pandemics [11].

Concurrently, blockchain technology has emerged as a disruptor, heralding a new era of transparency and trust within supply chains through immutable transaction records and decentralized verification mechanisms [10] [13]. By leveraging blockchain's distributed ledger technology, organizations can establish secure and transparent supply chain ecosystems, thereby mitigating risks related to counterfeit goods, supply chain fraud, and unauthorized access to sensitive information [13]. Additionally, blockchain facilitates seamless collaboration and information sharing among stakeholders, fostering greater transparency and efficiency across the entire supply chain network [10].

2.2 UI/UX Design in Supply Chain Management:-

Simultaneously, scholarly debate has highlighted the critical importance of user interface (UI) and user experience (UX) design in improving SCM efficacy [15, 18]. Rigorous investigations have elucidated the nuanced interplay between design aesthetics and functional utility, emphasizing the importance of intuitive, responsive, and accessible interfaces in facilitating user interactions across SCM platforms [18]. User-centric design principles prioritize end-user demands and preferences, which results in enhanced usability, efficiency, and satisfaction [15].

Case studies examining industry stalwarts like Amazon, Alibaba, and Maersk have underscored the transformative impact of user-centric design in enhancing operational fluidity and user engagement within supply chain ecosystems [9] [14] [16]. Through streamlined interfaces, personalized recommendations, and seamless navigation, organizations can optimize user experiences and drive greater adoption of SCM technologies [9]. Furthermore, UI/UX design plays a crucial role in facilitating data visualization and decision-making, enabling stakeholders to glean actionable insights from complex supply chain data [14].

2.3 Integration of Technologies and Design Principles:-

The convergence of advanced technologies and design paradigms represents a paradigm shift in SCM dynamics [12] [19]. Fusion of AI-powered analytics with sleek, user-friendly interfaces exemplifies a synergistic approach towards SCM optimization [12]. Leading enterprises such as FedEx and Walmart epitomize this ethos, leveraging AI, blockchain, and human-centered design principles to reimagine supply chain architectures and elevate customer experiences [19]. Additionally, case studies of Alibaba and Maersk showcase innovative approaches to supply chain management [9] [10]. Alibaba leverages AI and big data analytics to optimize inventory management, pricing strategies, and logistics operations, while prioritizing user-friendly interfaces to enhance the overall shopping experience for consumers [9]. On the other hand, Maersk integrates blockchain technology to enhance transparency, traceability, and security throughout its supply chain network, facilitating informed decision-making and collaboration among stakeholders [10].

Such integrative approaches not only foster operational efficiency but also engender customer loyalty and sustainable growth trajectories [12]. By merging AI-driven data, blockchain technology, and intuitive design principles, firms may unleash new prospects for innovation, differentiation, and competitive advantage in the increasingly complex and interconnected global economy [12].

Moreover, the strategic alignment of technologies and design principles enables organizations to adapt and thrive in an ever-evolving business landscape, thereby ensuring long-term success and resilience in the face of disruptive forces and emerging trends [19].

Table 2.1 Case Studies of Enterprises

Case Study	Description	Impact
Amazon	<p>Optimizes inventory levels and minimizes lead times through AI-driven predictive analytics and robotic automation</p> <p>User-centric interfaces foster unparalleled user engagement and</p>	Innovative supply chain strategies have revolutionized e-commerce, setting new benchmarks for efficiency and customer satisfaction.
FedEx	<p>Ensures end-to-end visibility of shipments using blockchain technology and IoT-enabled sensors.</p> <p>This comprehensive approach enhances trust and reinforces FedEx's reputation as a reliable logistics partner.</p>	Adoption of blockchain and IoT technologies has revolutionized supply chain management, delivering tangible benefits in transparency, security, and efficiency.
Walmart	<p>Employs AI and data analytics to optimize inventory management and streamline operations.</p> <p>Coupled with user-centric UI/UX design principles, its supply chain initiatives enhance operational agility and customer satisfaction.</p>	The strategic investments in AI and data analytics have yielded significant improvements in supply chain productivity, cost reductions, and client satisfaction have contributed to strengthen the company's position as the retail industry leader.

Alibaba	Optimizes inventory management and logistics operations using AI and big data analytics. Its user-friendly interfaces prioritize seamless navigation, contributing to higher user engagement and loyalty.	Innovative supply chain strategies underscore the transformative potential of advanced technologies, resulting in reduced operating costs, enhanced customer satisfaction, and sustainable growth.
Maersk	Enhances transparency and traceability in its supply chain network using blockchain technology. Its user-friendly interfaces provide stakeholders with real-time visibility into shipment status and logistics operations.	Adoption of blockchain technology has fostered trust and transparency across its ecosystem, driving operational efficiency, cost savings, and customer satisfaction in the global shipping industry.

In contemporary software development, choosing the right technologies is crucial for projects aiming to be efficient, scalable, and reliable. Oracle 19c serves as a strong foundation for data governance and management due to its advanced features like high availability, security, and scalability. It ensures smooth storage, retrieval, and manipulation of crucial data for supply chain management. Studies show that Oracle 19c enhances performance and efficiency, making backend operations optimized and data processing streamlined.

Additionally, we utilize .NET Core for backend development and APIs. This framework provides a versatile platform for building scalable and secure web applications. With improved performance and cross-platform compatibility, .NET Core facilitates rapid development, making it ideal for robust backend components in supply chain management systems.

For the frontend, we've chosen React.js to create modern and responsive user interfaces prioritizing user experience. React.js offers dynamic UIs with efficient state management, resulting in faster rendering speeds and smoother user interactions. By leveraging React.js, we aim to deliver intuitive interfaces that enhance stakeholder satisfaction.

In terms of cloud infrastructure, we've opted for Oracle Cloud to host the Oracle 19c database. This strategic choice ensures scalability, reliability, and accessibility. Oracle Cloud offers a comprehensive suite of services, including robust security features and automated backups, ensuring high availability and data integrity. For version control, SVN (Apache Subversion) is utilized, providing a stable and mature platform for managing source code. SVN facilitates collaborative development and ensures the integrity of the source code repository.

Furthermore, Jenkins is integrated for continuous integration and deployment (CI/CD). This streamlines the software development lifecycle by automating build, test, and deployment processes. Jenkins improves development productivity and deployment reliability, leading to faster time-to-market and higher customer satisfaction. This integration allows us to achieve faster feedback cycles and greater agility in responding to changing requirements.

Table 2.2 Tools & Technologies Description

Technology	Description	Use in Project	Version
Oracle 19c	Robust database management system offering high availability, security, and scalability for centralized data governance.	Database Management	19c
.NET Core	Versatile framework for building scalable and secure backend services, APIs, and business logic.	Backend Development	3.1.32
React.js	Component-based JavaScript library for building modern and responsive user interfaces.	Frontend Development	18.1.0
Oracle Cloud	Comprehensive cloud infrastructure for hosting databases, storage, and compute resources, ensuring scalability and reliability.	Cloud Infrastructure	-
SVN (Apache Subversion)	Centralized version control system known for its simplicity and reliability, facilitating collaborative development and code management.	Version Control	1.14.7
Jenkins	Automation server for continuous integration and continuous deployment, streamlining software development processes and improving deployment reliability.	CI/CD	2.440

CHAPTER 3

SYSTEM DESIGN

3.1 Hardware Design

The hardware requirements of this project, it would require a server having the following specifications:

- Processor: Intel Xeon Gold or AMD EPYC series processors with multiple cores and high clock speeds
- RAM: Minimum 32GB DDR4 ECC RAM, scalable based on workload requirements
- Storage: Enterprise-grade SSDs in RAID configuration for high-speed data access and redundancy
- Network Interface: Gigabit Ethernet for fast and stable network connectivity.
- Operating System: Linux distribution (e.g., Ubuntu Server, CentOS) for stability and security

3.2 Software Design:

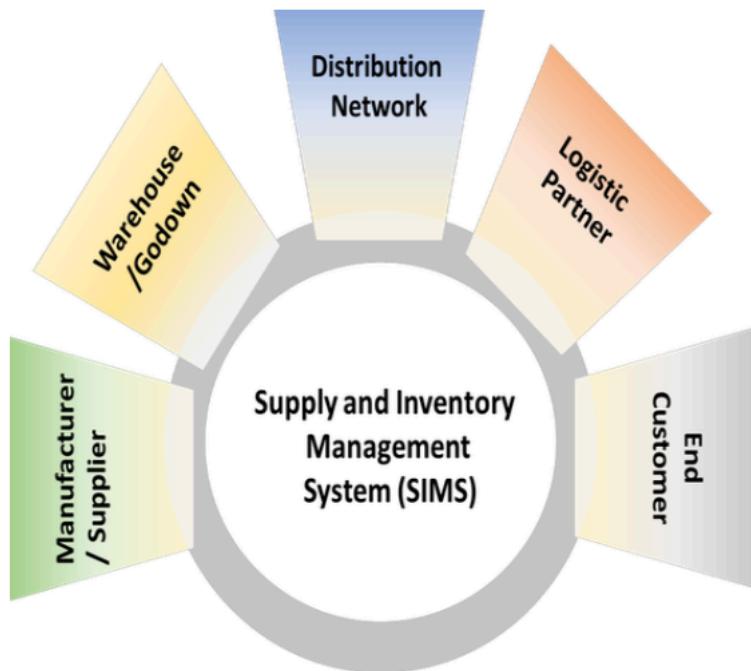


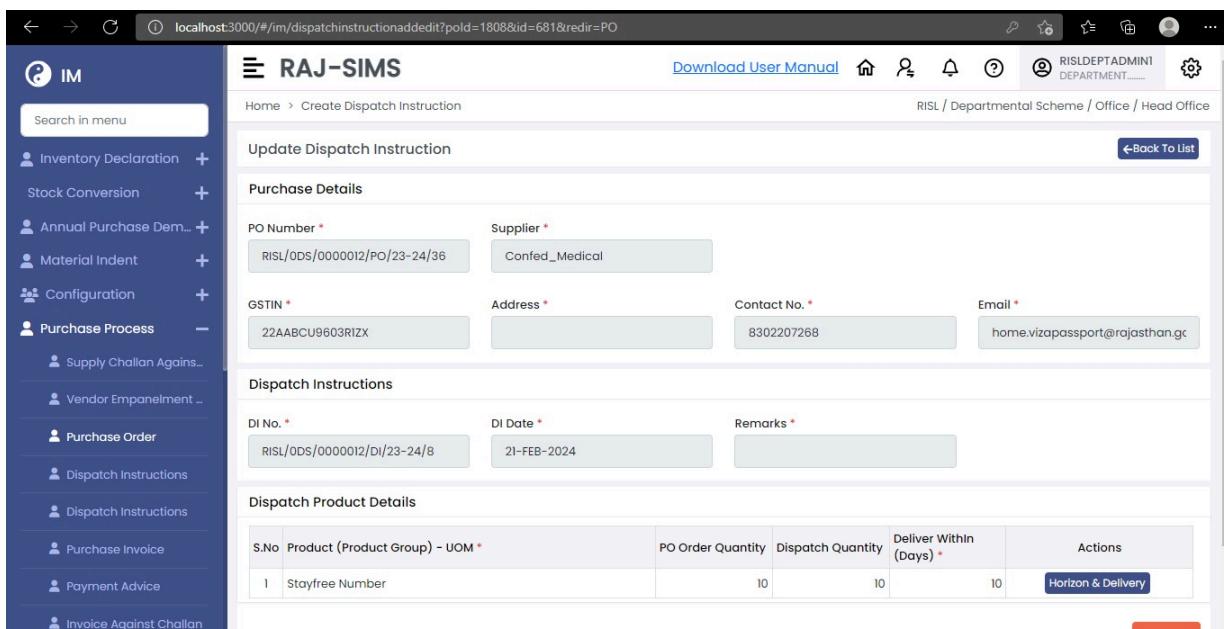
Fig 3.1 : RAJ-SIMS Project Background Information

The software design for RAJ-SIMS is meticulously crafted to meet the demands of modern supply chain management. The selection of React.js for the front-end was driven by its component-based architecture, which allows for reusable UI components, improving development efficiency and consistency. .NET Core was chosen for the back-end due to its cross-platform capabilities and robust performance. Oracle 19c was selected for the database because of its advanced features in handling large volumes of data and strong support for SQL queries. Alternative technologies like Angular and Node.js were considered but ultimately not chosen due to their steeper learning curves and less optimal performance in preliminary tests.

3.2.1 Front-End Design:

In crafting the front-end of the RAJ-SIMS portal, we opted for React.js, a powerhouse JavaScript library renowned for its versatility and efficiency in building user interfaces [2]. React.js operates on a modular and component-based architecture, which means we could create reusable UI elements, like buttons and forms, and easily integrate them throughout the application [19]. This approach not only made our code cleaner and more organized but also laid the groundwork for seamless scalability as the project evolves.

To provide a professional and uniform user experience, we incorporated Material-UI, a React UI framework based on Google's Material Design principles. Material-UI delivers a substantial toolset of pre-designed components and style choices, allowing us to create streamlined and visually attractive interfaces without recreating the wheel [8].



The screenshot shows the 'Create Dispatch Instruction' form in the RAJ-SIMS Admin Side Window. The left sidebar contains a navigation menu with items like 'Inventory Declaration', 'Stock Conversion', 'Annual Purchase Dem...', 'Material Indent', 'Configuration', 'Purchase Process', 'Supply Challan Again...', 'Vendor Empanelment', 'Purchase Order', 'Dispatch Instructions', 'Dispatch Instructions', 'Purchase Invoice', 'Payment Advice', and 'Invoice Against Challan'. The main content area is titled 'Update Dispatch Instruction' and includes sections for 'Purchase Details' (PO Number: RISL/0DS/0000012/PO/23-24/36, Supplier: Confed_Medical), 'GSTIN' (22AABCU9603R1ZX), 'Address' (Address: *), 'Contact No.' (Contact No.: 8302207268), and 'Email' (Email: home.vizapassport@rajasthan.gov). The 'Dispatch Instructions' section shows 'DI No.' (RISL/0DS/0000012/DI/23-24/8) and 'DI Date' (21-FEB-2024). The 'Remarks' field is empty. The 'Dispatch Product Details' section contains a table with one row: S.No (1), Product (Product Group) - UOM (Stayfree Number), PO Order Quantity (10), Dispatch Quantity (10), Deliver Within (Days) (10), and Actions (Horizon & Delivery). The top right of the page shows the URL 'localhost:3000/#/im/dispatchinstructionaddedit?pold=1808&id=681&redir=PO', the RAJ-SIMS logo, 'Download User Manual', and user information 'RISLDEPTADMINI DEPARTMENT.....'.

Fig 3.2 : RAJ-SIMS Portal (Admin Side Window) Front UI

In managing our APIs, we turned to Swagger, a powerful tool that simplifies API development, documentation, and testing. Swagger serves as a centralized platform where we could define our API endpoints, specify request and response formats, and automatically generate interactive API documentation. This not only streamlined our development workflow but also improved collaboration between our front-end and back-end teams, ensuring consistency and efficiency throughout the API lifecycle.[4]

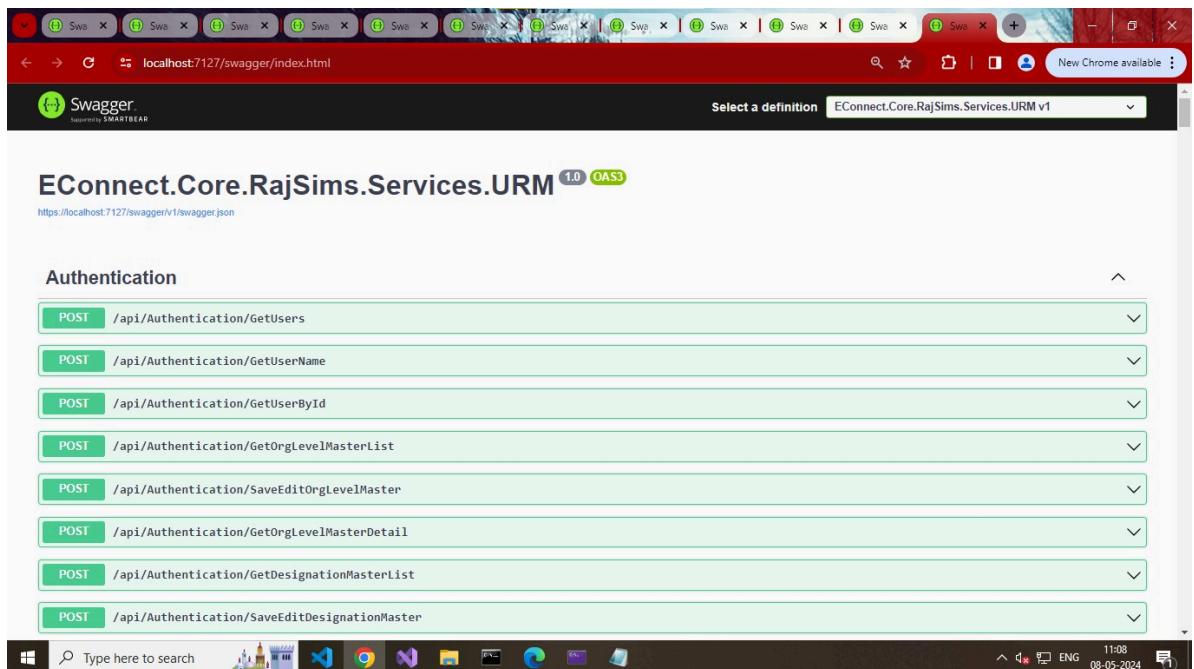
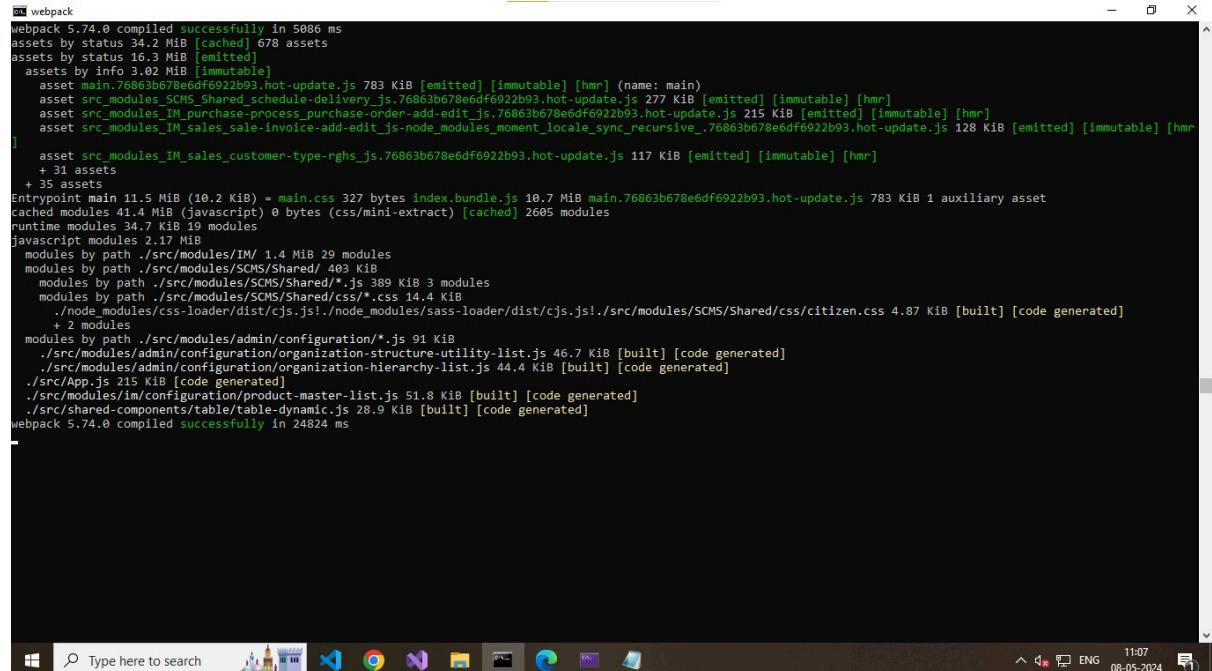


Fig 3.3 : Swagger for Testing & Controlling API Endpoints

On the technical side, we relied on React webpack to handle our project dependencies and optimize our front-end development process. React webpack automates the bundling and optimization of JavaScript files, CSS stylesheets, and other project assets, resulting in faster load times and improved performance for end-users[7]. By leveraging React webpack, we were able to streamline our development workflow, reduce potential bottlenecks, and deliver a seamless user experience across various devices and browsers.



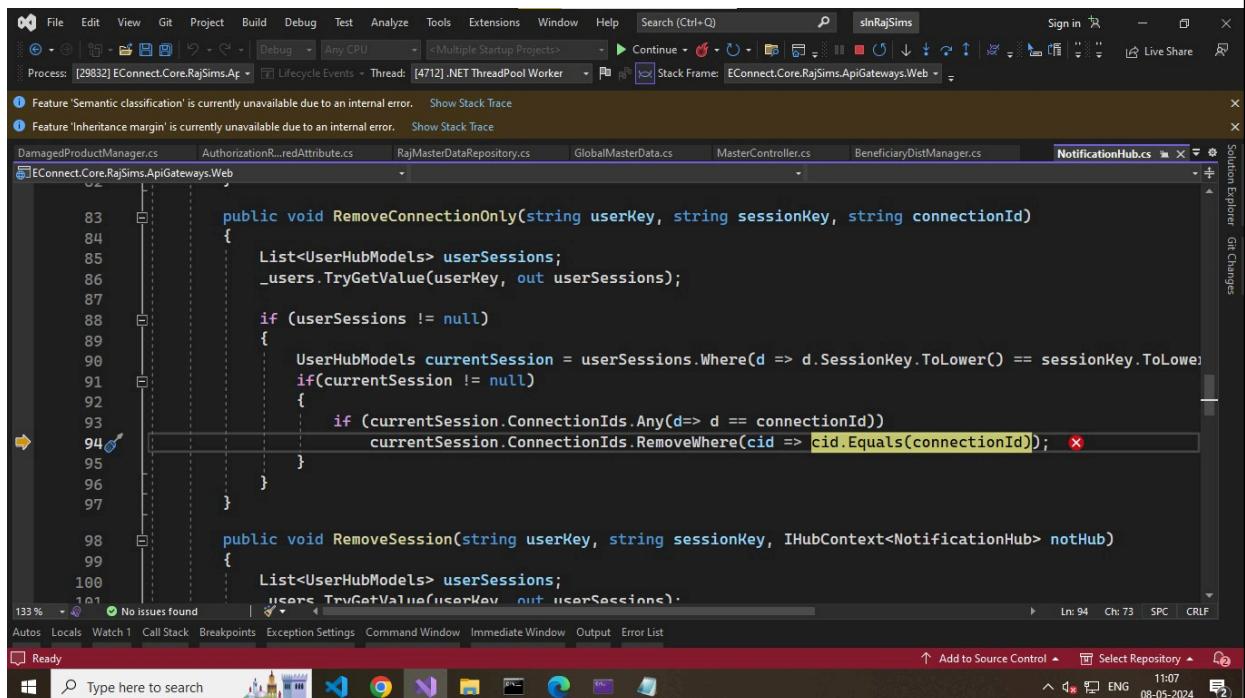
```

webpack
webpack 5.74.0 compiled successfully in 5086 ms
assets by status 34.2 MiB [cached] 678 assets
assets by status 16.3 MiB [emitted]
  assets by Info 3.02 MiB [immutable]
    asset main.76863b678e6df6922b93.hot-update.js 783 KiB [emitted] [immutable] [hmr] (name: main)
    asset src_modules_SCMS_Shared_schedule-delivery_js.76863b678e6df6922b93.hot-update.js 277 KiB [emitted] [immutable] [hmr]
    asset src_modules_IM_purchase-process_purchase-order-add-edit_js.76863b678e6df6922b93.hot-update.js 215 KiB [emitted] [immutable] [hmr]
    asset src_modules_IM_sales_sale-invoice-add-edit_js-node_modules_moment_locale_sync_recursive_.76863b678e6df6922b93.hot-update.js 128 KiB [emitted] [immutable] [hmr]
  ]
  assets by Info 3.02 MiB [immutable]
    asset main.76863b678e6df6922b93.hot-update.js 783 KiB [emitted] [immutable] [hmr] (name: main)
    asset src_modules_IM_sales_customer-type-rghs_js.76863b678e6df6922b93.hot-update.js 117 KiB [emitted] [immutable] [hmr]
  + 31 assets
  + 35 assets
Entry point main 11.5 MiB (10.2 KiB) = main.css 327 bytes index.bundle.js 10.7 MiB main.76863b678e6df6922b93.hot-update.js 783 KiB 1 auxiliary asset
cached modules 41.4 MiB (javascript) 0 bytes (css/mini-extract) [cached] 2605 modules
runtime modules 34.7 KiB 19 modules
javascript modules 2.17 MiB
  modules by path ./src/modules/IM/ 1.4 MiB 29 modules
  modules by path ./src/modules/SCMS/Shared/ 403 KiB
    modules by path ./src/modules/SCMS/Shared/*.js 389 KiB 3 modules
    modules by path ./src/modules/SCMS/Shared/css/*.css 14.4 KiB
      ./node_modules/css-loader/dist/cjs.js!./node_modules/sass-loader/dist/cjs.js!./src/modules/SCMS/Shared/css/citizen.css 4.87 KiB [built] [code generated]
      + 2 modules
  modules by path ./src/modules/admin/configuration/*.js 91 KiB
    ./src/modules/admin/configuration/organization-structure-utility-list.js 46.7 KiB [built] [code generated]
    ./src/modules/admin/configuration/organization-hierarchy-list.js 44.4 KiB [built] [code generated]
  ./src/App.js 215 KiB [code generated]
  ./src/modules/IM/configuration/product-master-list.js 51.8 KiB [built] [code generated]
  ./src/shared-components/table/table-dynamic.js 28.9 KiB [built] [code generated]
webpack 5.74.0 compiled successfully in 24824 ms

```

Fig 3.4 : React Webpack to Manage and Bundle Dependencies

3.2.2 Back-End Design:



```

public void RemoveConnectionOnly(string userKey, string sessionKey, string connectionId)
{
    List<UserHubModels> userSessions;
    _users.TryGetValue(userKey, out userSessions);

    if (userSessions != null)
    {
        UserHubModels currentSession = userSessions.Where(d => d.SessionKey.ToLower() == sessionKey.ToLower());
        if (currentSession != null)
        {
            if (currentSession.ConnectionIds.Any(d => d == connectionId))
                currentSession.ConnectionIds.RemoveWhere(cid => cid.Equals(connectionId));
        }
    }
}

public void RemoveSession(string userKey, string sessionKey, IHubContext<NotificationHub> notHub)
{
    List<UserHubModels> userSessions;
    _users.TryGetValue(userKey, out userSessions);
}

```

Fig 3.5 : API Method for RAJ-SIMS Portal

At the core of the RAJ-SIMS portal lies .NET Core, a versatile and high-performance framework for developing server-side applications and services. .NET Core offers robust support for cross-platform development and modern web application requirements, making it an ideal choice for powering the back-end of the RAJ-SIMS system [6]. Within the back-end architecture, Entity Framework Core serves as the Object-Relational Mapping (ORM) framework, facilitating seamless interaction with the Oracle 19c database.

3.2.3 Database Design:

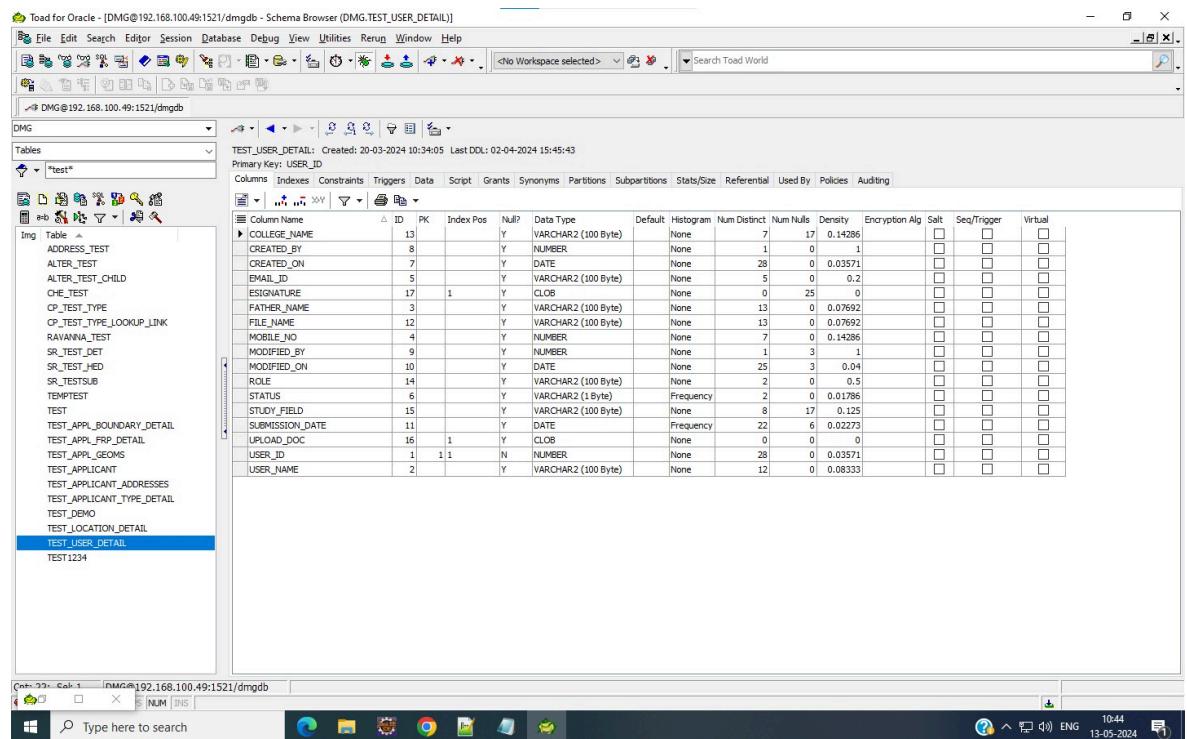


Fig 3.6 : Oracle Database Table Creation

The backbone of the RAJ-SIMS database infrastructure is Oracle 19c, a leading relational database management system renowned for its scalability, reliability, and performance. The database schema is meticulously designed to accommodate the diverse entities and relationships inherent in supply chain management, including inventory, suppliers, demands, and transactions [3]. To optimize query performance and ensure data integrity, sophisticated indexing and normalization techniques are employed, aligning with industry best practices.

3.2.4 Architecture:

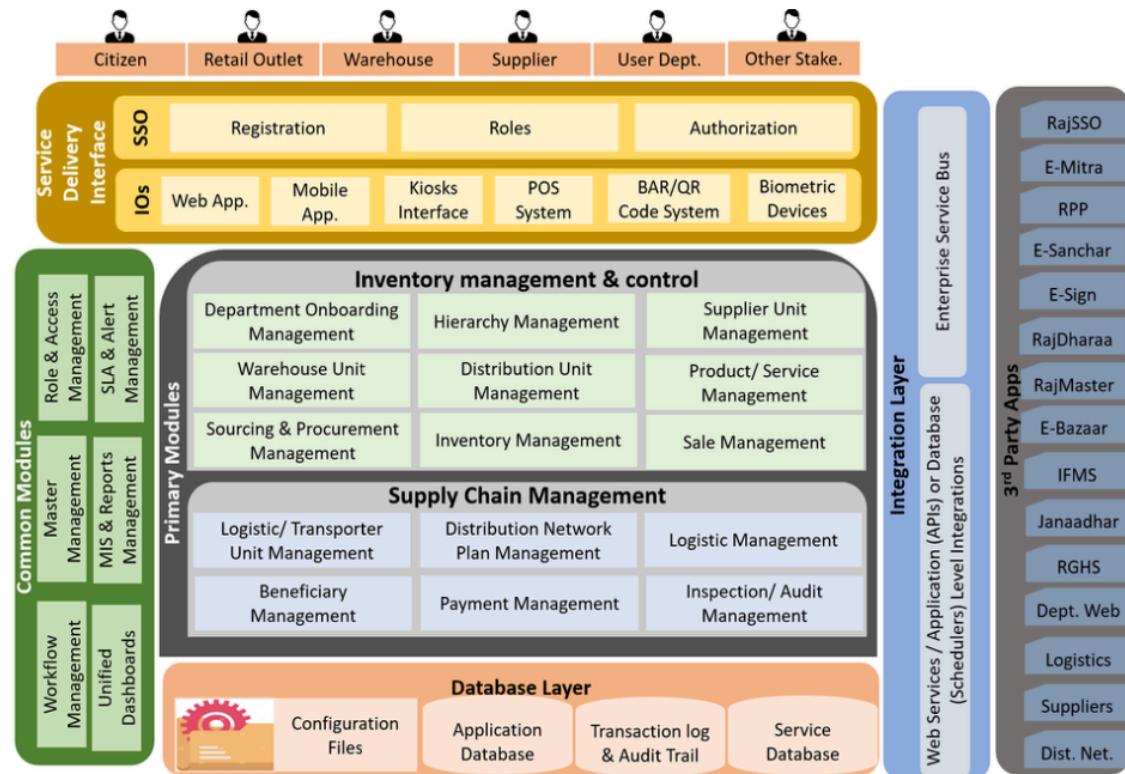


Fig 3.7 : Indicative Application Architecture of RAJ SIMS Portal

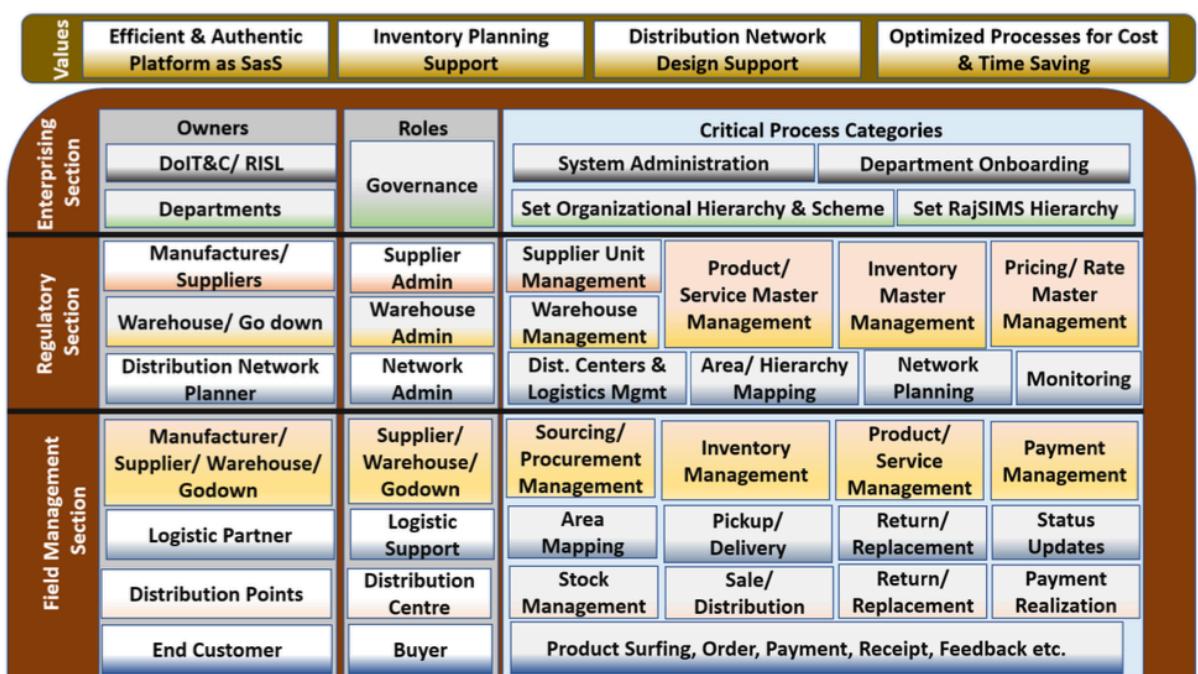


Fig 3.8 : Indicative Functional Requirement Solution Framework

Stakeholders:

Stakeholders encompass a diverse range of entities, including citizens, retail outlets, warehouses, suppliers, government user departments, and other relevant parties. Each stakeholder plays a crucial role in the supply chain ecosystem, interacting with different layers of the application to fulfill specific functions and requirements [11].

Layers:

The application architecture comprises several layers, each serving distinct purposes in facilitating seamless operations and interactions [14]. These layers include front-end interfaces (web apps, mobile apps, kiosks), point-of-sale systems, barcode/QR code systems, biometric devices for authentication, government service platforms like E-Mitra and RPP, and single sign-on mechanisms (RajSSO) for streamlined access across multiple applications [14].

Central Functional Modules:

Central functional modules form the backbone of the application, encapsulating key functionalities related to department management, inventory control, supplier management, procurement, sales, distribution, and various other aspects of supply chain management. These modules are designed to be modular, allowing for scalability and customization based on specific departmental or organizational requirements.

Database Layer:

The database layer houses critical data repositories essential for the functioning of the application. Configuration files store settings and parameters, while the application database stores transactional data and operational information. Additionally, specialized databases like transaction logs, service databases, supplier databases, and distribution network databases are maintained to ensure data integrity and accessibility.

Integration Layer:

The integration layer facilitates seamless communication and data exchange between different components of the application. This layer encompasses web services, APIs, and database-level integrations that enable interoperability with external systems and third-party applications. An enterprise service bus (ESB) serves as a central hub for orchestrating data flows and integrating various services and applications.

Common Modules:

Common modules provide essential functionalities that are shared across different components of the application. These include workflow management for orchestrating business processes, master data management for maintaining consistent data across the system, role, and access management for ensuring security and compliance, and service delivery interfaces for presenting unified views and experiences to users.

Unified Dashboards:

Unified dashboards offer centralized monitoring and reporting capabilities, allowing stakeholders to gain insights into system performance, service levels, and critical metrics. Management information systems (MIS) and reports management modules enable the generation of custom reports and analytics, while SLA and alert management modules facilitate the monitoring of service level agreements and trigger notifications for exceptional events.

SSO (Single Sign-On):

The single sign-on mechanism simplifies user authentication and access control, allowing stakeholders to seamlessly navigate between different applications and services without the need for repeated logins. RajSSO provides a secure and unified authentication experience, enhancing usability and security across the entire ecosystem.

CHAPTER 4

IMPLEMENTATION DETAILS AND RESULTS

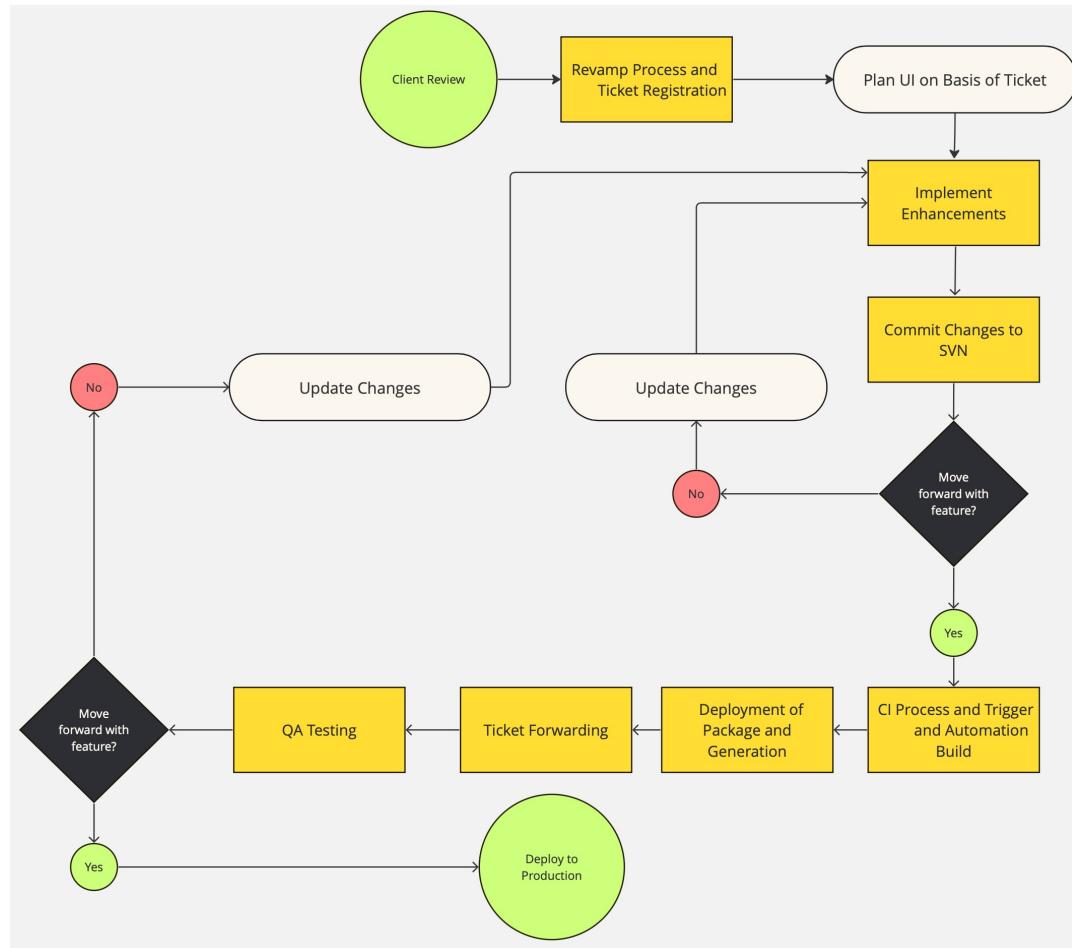


Fig 4.1 : Workflow of General Approach for Enhancements on RAJ-SIMS Portal

The user workflow diagram outlines the journey of a ticket from its creation to deployment, ensuring smooth software development. It starts with users raising tickets for changes they need. Once received by the development team, each ticket undergoes careful review to understand its purpose and requirements. The team then analyzes the feasibility and resources needed for the changes.

After planning, the development team begins coding and testing the changes. Feedback loops are crucial during this phase to ensure the changes meet user expectations. Once development is complete, rigorous testing is conducted to ensure quality. At a decision point, stakeholders assess if the changes are ready for deployment. If approved, the changes are packaged and integrated using automated

processes. Finally, the changes are deployed to the production environment for users to access and utilize.

A key aspect involved the development of a comprehensive Ticket Registration Form. This form serves as a pivotal tool for users to initiate and track various tasks and issues within the system. By meticulously designing the Ticket Registration Form, we aimed to streamline the process of logging and managing tickets, ensuring that users can efficiently communicate their requirements and concerns. The form encompasses fields for capturing essential details such as ticket category, priority level, description of the issue, and relevant attachments. Additionally, intuitive validation mechanisms were implemented to ensure the accuracy and completeness of user inputs, thereby minimizing errors and optimizing the ticket management workflow. Through the seamless integration of the Ticket Registration Form into the RAJ-SIMS portal, users can initiate and monitor their requests with ease, enhancing overall operational efficiency and user satisfaction.

Software Engineering System 2.0

Ticket Details Form

Ticket No. : RSIMS002076 Status : Open Sub Phase Completed : -

Reporting Details Reported on 09/05/2024 by Keerti Toshniwal

Reported On : 09/05/2024	Reported By : Keerti Toshniwal	Organisation : -
Module : Inventory Management Module	DU / WU : -	Size : 0
Process (DRQ) : -	Acceptance Criteria : -	Test Case Id : -
Master Ticket : -	Platform / Browser : Chrome	Target Date : 11/05/2024
Phase Detected (Env.) : Development		
Raised For : -		

Ticket Details A Bug which says Private book Seller on Development

Title : Private book Seller on Development	Category : UICosmetics	Priority : High
Type : Bug		

1. Private Book Seller Demand Approval: Remove the cross button from the GST Rate dropdown.
 2. Payment through RPP:
 A. Disable the Bank Name, Inst Number, and Inst Date fields for RPP payment type.
 B. For all other payment modes, the Inst Date should default to the current date, and future and back dates should not be allowed.
 C. After deleting a payment record in RPP, the details should not be visible on page refresh.
 D. On RPP payment, the display status should show as success, failed, or pending, instead of submit and approve.
 E. Remove the delete and edit buttons for other payment types from the action field.
 3. Private Book Seller: The Update button is not functioning properly. After updating a record, the status should display as "submitted".

User : KTPBS1 and rtbdu16

Re-Creation Steps :

Fig 4.2 Ticket Details Form Raised

The screenshot shows a software interface for 'Software Engineering System 2.0'. At the top, there is a header with the system name and a user 'Ankit Jain' with a 'Logout' button. Below the header, a table displays a list of 17 tasks. The first 16 tasks are listed under 'Ticket No. : RSIMS002026' and the last task under 'Ticket No. : RSIMS002027'. The tasks are: 7. Test Case Preparation, 8. Test Case Review, 9. Test Case Execution, 10. Bug Fixing, 11. Bug Verification, 12. Internal Release, 13. UAT, 14. Customer Meeting, 15. Internal Operations Meeting, 16. Project Support/ Troubleshooting, and 17. Customer Support. The table includes columns for 'Status' (e.g., Open, In Progress, Fixed), 'Sub Phase Completed' (e.g., Design/ Impact Analysis), and dates (e.g., 08-May-2024). Below the table, an 'Action History' section shows a list of 4 actions with columns for '#', 'Date', 'Action By', 'Action To', 'Action', 'Status', 'Moderation', 'Fixing', 'Testing', 'Accept', 'Remarks', and 'Attachment'. The actions are: 1. Register (Sakshi Swarnkar, Open, Under Evaluation), 2. Assign (Sakshi Swarnkar, Divya Tanwar, Open, Evaluated, In Progress), 3. Forward (Divya Tanwar, Raunak Bhanawat, Open, Evaluated, In Progress), and 4. Fix & Test Release (Raunak Bhanawat, Sakshi Swarnkar, Open, Evaluated, Fixed, In Verification). A note in the remarks says 'please check after Dev Update.'.

Fig 4.3 Detailed Action History of Ticket Raised

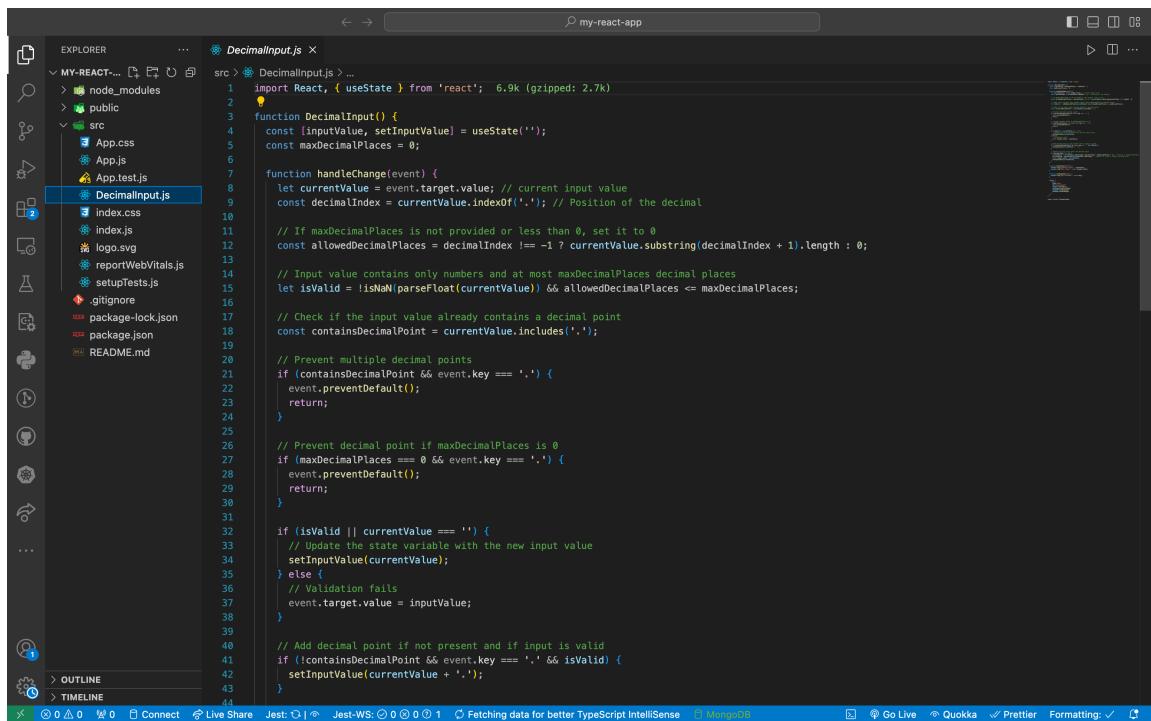
In the pursuit of refining the software design for the RAJ-SIMS application, notable advancements have been achieved, significantly benefiting both organizational operations and user experience. Foremost among these enhancements is the notable improvement in user interface (UI) accessibility and intuitiveness. By leveraging contemporary tools like Material-UI, the interface has undergone a transformation, becoming more intuitive and user-friendly. Users now navigate the platform with greater ease, resulting in heightened satisfaction and productivity [21].

Moreover, a pivotal transformation lies in the augmentation of data visualization capabilities and workflow streamlining features. The introduction of dynamic dashboards and interactive reporting mechanisms has revolutionized user interactions with the system. This facilitates real-time insights into supply chain operations, enabling prompt and informed decision-making processes. Consequently, user confidence in the system has been bolstered, fostering a culture of proactive, data-driven decision-making within the organization [4].

Additionally, the optimization of database infrastructure has significantly expedited data retrieval and processing. This translates to expedited access to critical information, reduced wait times, and an overall enhancement of user productivity across multifarious departments. Security measures have also been bolstered through the implementation of role-based access control, ensuring that sensitive data remains protected and accessible only to authorized personnel [5].

Furthermore, the introduction of centralized monitoring and reporting capabilities has empowered users with greater visibility and control over supply chain operations. Through the tracking of key performance indicators and the generation of customized reports, users are equipped with comprehensive oversight, enhancing accountability and transparency within the organizational framework [7].

Additionally, a notable ticket involved the implementation of decimal logic, restricting input to specific or limited numbers after the decimal point based on maximum decimal places. Furthermore, if the maximum decimal places were set to 0, the system would prohibit the entry of decimal values altogether [8].



```

import React, { useState } from 'react'; 6.9k (gzipped: 2.7k)
function DecimalInput() {
  const [inputValue, setInputValue] = useState('');
  const maxDecimalPlaces = 0;
  function handleChange(event) {
    let currentValue = event.target.value; // current input value
    const decimalIndex = currentValue.indexOf('.'); // Position of the decimal
    if (maxDecimalPlaces < 0) {
      const allowedDecimalPlaces = decimalIndex === -1 ? currentValue.substring(decimalIndex + 1).length : 0;
      if (inputValue === '') {
        let isValid = !isNaN(parseFloat(currentValue)) && allowedDecimalPlaces <= maxDecimalPlaces;
        if (isValid) {
          setInputValue(currentValue);
        }
      }
    }
    if (decimalIndex >= 0 && decimalIndex < currentValue.length - 1) {
      let isValid = !isNaN(parseFloat(currentValue)) && allowedDecimalPlaces <= maxDecimalPlaces;
      if (isValid) {
        setInputValue(currentValue);
      }
    }
    if (decimalIndex < 0) {
      let isValid = !isNaN(parseFloat(currentValue)) && allowedDecimalPlaces <= maxDecimalPlaces;
      if (isValid) {
        setInputValue(currentValue);
      }
    }
  }
  return (
    <input type="text" value={inputValue} onChange={handleChange} />
  );
}

```

Fig 4.4 : A Ticket Code to Upgrade Decimal Value in Dispatch Quantity

In the realm of specific updates, diligent monitoring and management of UI enhancements and bug fixes have been facilitated through the SVN repository. This meticulous attention to detail underscores a commitment to fine-tuning the user experience and ensuring optimal system functionality [22].

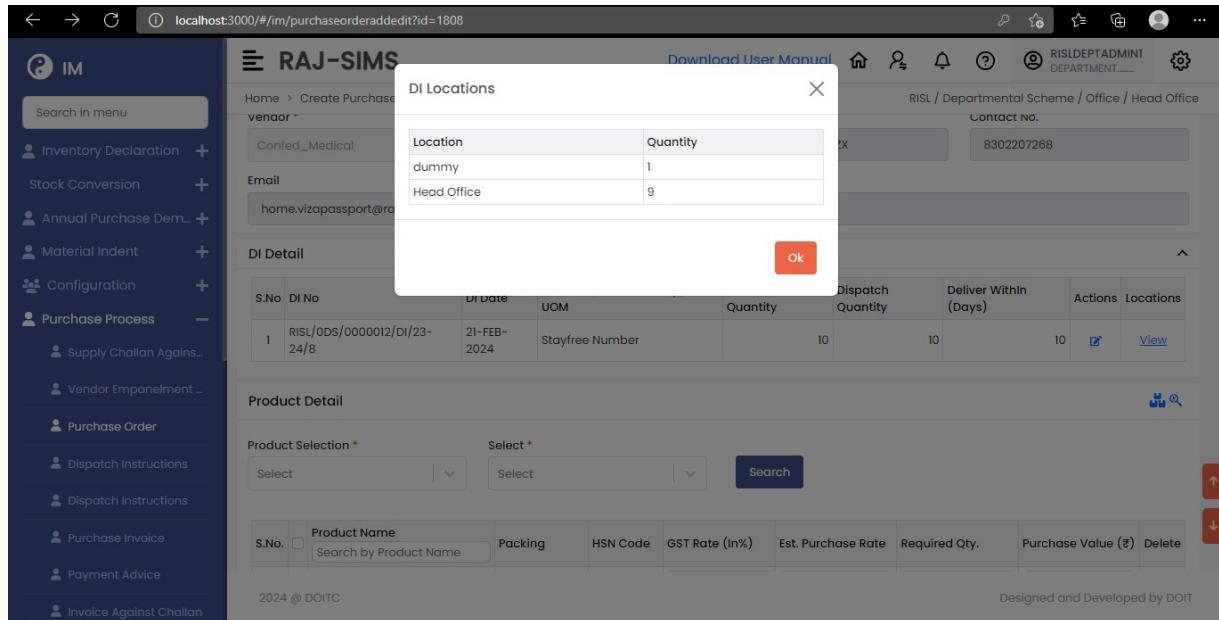


Fig 4.5 : Implementation of Pop-up Modal Enhancement for Location based on Client Ticket

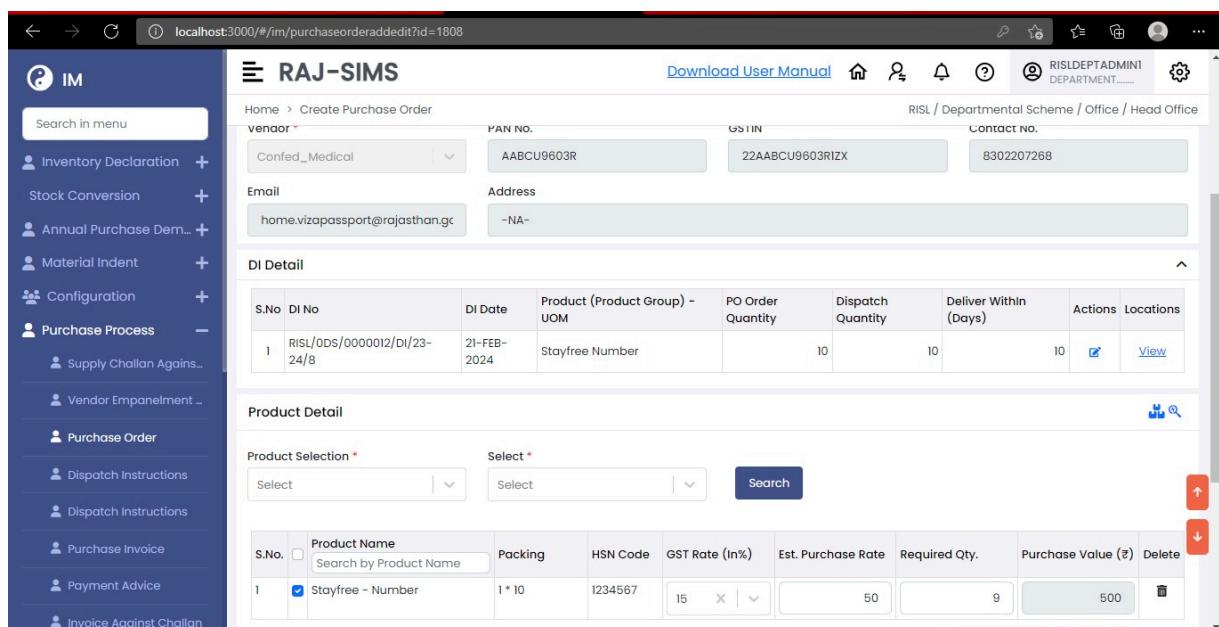
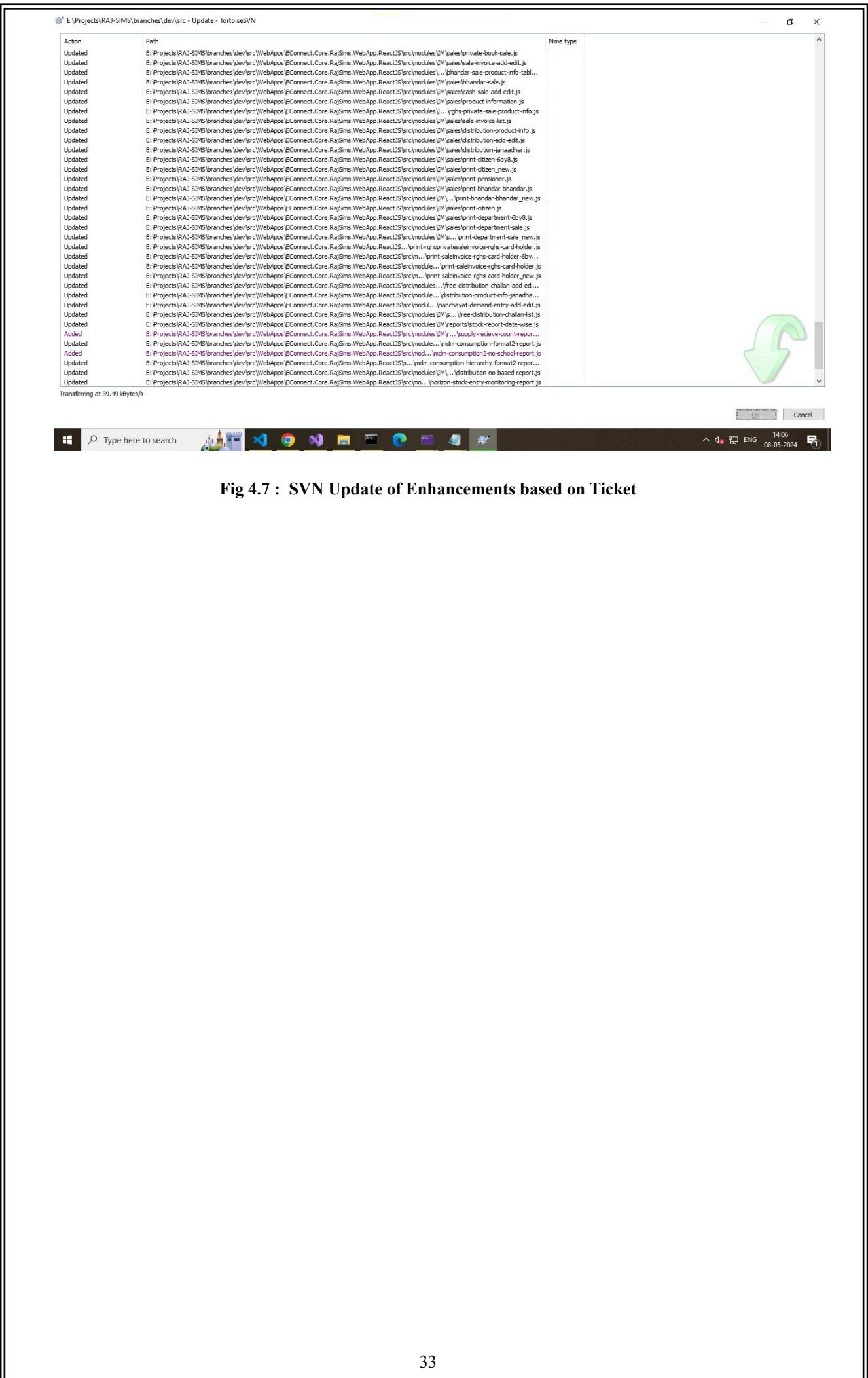


Fig 4.6 : Updated Matching of Dispatch ID with specific Purchase Order No. Based on Client Ticket



CHAPTER 5

CONCLUSION AND FUTURE SCOPE

As a front-end developer, I've been deeply involved in crafting the user experience of the RAJ-SIMS application, and it's been an incredibly rewarding journey. Working alongside my team, we've strived to create an interface that not only meets but exceeds the expectations of our users. By using technologies like React.JS and .NET Core, we've built a platform that's not just functional, but also intuitive and visually appealing [23, 24].

My focus has always been on making sure that every aspect of the RAJ-SIMS interface feels natural and easy to use. From designing layouts that adapt seamlessly to different devices, to implementing interactive features that guide users through complex tasks, I've aimed to create an experience that feels effortless and enjoyable. And with tools like Material-UI, we've been able to add a touch of elegance to the design, making the application both functional and beautiful [21].

One of the things that excites me most about our work on RAJ-SIMS is the opportunity to leverage cutting-edge technologies to enhance its capabilities. By integrating AI-driven analytics and blockchain technology, we're opening up new possibilities for optimizing supply chain management processes and increasing transparency. These advancements have the potential to revolutionize the way businesses operate, and I'm proud to be a part of it [4, 18].

Immediate next steps include further optimization of database queries to enhance performance and expanding the portal's functionality to include predictive analytics for inventory management. Long-term, this project is expected to significantly improve the SCM for the Government of Rajasthan, resulting in more timely deliveries and better resource allocation. My role is to stay curious and open-minded, always on the lookout for ways to make the user experience even better [5].

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