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Centralized Database and Automation: Key to Overcome the Challenge of Missing or Inaccurate Standard Settlement Instructions

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Abstract

To achieve effective and automated payment processes, straight-through processing (STP) has been implemented in the financial sector. The implementation of STP is, however, still hampered by the existence of incorrect or absent standing settlement instructions (SSIs). This research study explores the reasons of missing or incorrect SSIs in the banking sector, their effects, and potential fixes. The complexity of the situation is further increased by the examination of the variety of channels used by parties to transmit their SSIs. According to the report, incomplete or inaccurate SSIs are a significant cause of payment failures and unneeded expenses, hence a workable solution is required. The research recommends the implementation of a centralized SSI database that can be accessed by all parties involved in the payment process, as well as the automation of SSI updates to ensure accuracy and efficiency.

Keywords

Standard settlement instructions, swift messages, payment instruction, settlements, ssi database

1. Introduction

Significant changes have been made in the banking sector recently with the goal of developing automated and efficient payment operations. The adoption of straight-through processing (STP) is one of the key steps towards achieving this goal. Financial transactions can be processed seamlessly from beginning to end with STP, eliminating the need for manual intervention. STP seeks to increase operational effectiveness while lowering costs and minimising errors. Despite the advantages of STP, the existence of incorrect or absent standing settlement instructions (SSIs) still prevents the use of STP [1].

The information needed to process payments, such as the account numbers, names, and addresses of the parties engaged in the transaction, is contained in SSIs, which are essential to the payment process. Payment failures due to incomplete or incorrect SSIs can result in delays, added expenses, and reputational harm [2]. Many institutions fail to provide their SSIs in less popular currencies, and some fail to share updates or adjustments. As a result, counterparties are left with the tiresome process of searching down the proper information or, even worse, spending days or weeks trying to resolve the problem.

The situation is made more complicated by the variety of channels utilized by parties to communicate their SSIs. Businesses invest valuable effort in exploring numerous databases for the relevant data, only to occasionally discover after the fact that it is inaccurate or outdated. The purpose of this study article is to examine the factors that lead to missing or incorrect SSIs in the financial sector, as well as their effects and potential remedies.

2. Causes of Missing or Inaccurate SSIs

The reasons why SSIs are incomplete or incorrect can take many different forms and differ from institution to institution [3]. But some of the frequent causes include ineffective counterparty communication, a lack of SSI format standardization, and the absence of automated SSI updates.

2.1. Poor Communication

In financial organisations, SSIs that are missing or incorrect can often be traced back to poor communication. To properly perform financial transactions, it is essential to have access to the name, address, and SWIFT code of the counterparty bank via SSIs. Transaction process delays and failures might occur when there are problems in the SSI [4]. There are several ways that poor communication can lead to missing or inaccurate SSIs:

a. **Incomplete or outdated information:** Information that is out of current or incomplete is one of the most frequent reasons of missing or incorrect SSIs. Financial institutions could neglect to update the information when it changes, or they might not supply all the relevant information. As a result, counterparties may need to follow up with the correct information, which can take time and cause delays in the transaction process.
b. **Lack of standardized communication:** Financial institutions communicate their SSIs through a range of media, including phone, fax, and email. Due to the potential for inconsistent communication, counterparties may find it challenging to access the SSI data rapidly and effectively. They may therefore have to spend a lot of time going through numerous databases for the essential data, which may be inaccurate or out of date [5].
c. **Language barriers:** Financial institutions may function in various nations and lingua fracas. This may result in communication barriers that cause misconceptions or inaccurate information to be given. A financial institution might, for instance, give an SSI in a language that the counterparty does not understand, which could lead to mistakes being made during the transaction process [6].

d. **Lack of awareness:** Financial institutions might not understand how crucial it is to provide correct and current SSIs. This may lead to them not prioritising SSI updates or delaying their communication to counterparties. This could result in unneeded transaction delays and cost banking institutions money.

Financial institutions can take several actions to address the issue of inadequate communication as a root cause of missing or incorrect SSIs. They can put in place standardised routes for exchanging SSIs with counterparties [7]. To automate SSI updates and guarantee that the data is valid and current, they might also invest in technological solutions. They can also train their team on the value of delivering accurate and current SSIs as well as the effects doing so may have on the transaction process. Financial institutions may make sure that the transaction process is quick, accurate, and economical by addressing poor communication as a reason for missing or incorrect SSIs.

2.2. Lack of Standardization

Another significant factor for missing or incorrect SSIs in financial institutions is the absence of standardisation in communication channels and formats. For the proper processing of financial transactions, SSIs must include vital counterparty data such as names, addresses, and SWIFT codes [8]. However, there may be challenges in properly and effectively exchanging SSI information due to the absence of standardisation in communication routes and formats. There are several ways in which the lack of standardization can lead to missing or inaccurate SSIs:

a. **Communication channels:** Financial institutions can trade SSIs via phone, fax, email, or other modes of contact. This can make it challenging for counterparties to access the information rapidly and effectively, especially if it is not centralised in a single place.
b. **Formats:** SSIs can be sent in a variety of formats, which makes it challenging to handle the data accurately. For instance, certain organisations might utilise acronyms or abbreviations that are unfamiliar to other parties, which might cause miscommunications or the dissemination of inaccurate information [9].
c. **Localization:** Financial institutions may conduct business in several nations and areas with various market norms and regulatory restrictions. Due to this, SSIs may be delivered in a different language or format, which may result in transaction process issues.
d. **Lack of standardization guidelines:** It's possible that financial institutions don't have set standards or best practises for offering SSIs. This may result in inconsistent SSI communication, making it challenging for counterparties to obtain and effectively use the data.

Financial institutions can take several actions to address the lack of standardisation as a root cause of SSIs that are absent or incorrect. They can set up centralised databases or websites that enable counterparties to efficiently access and update SSIs. They can also use established communication formats and channels, such the SWIFT network, to exchange SSI data. Financial organisations might also set standards or best practises for SSI delivery to guarantee consistency and accuracy in the information's delivery.

2.3. Absence of Automated SSI updates

Another significant factor contributing to missing or incorrect SSIs [10] in financial institutions is the absence of automated SSI updates. Important data is contained in SSIs, such as bank account information and settlement instructions, which must frequently be updated owing to modifications in the banking connections of counterparties or other pertinent information. Lack of automated updates for SSIs can cause transaction process delays, mistakes, and higher transaction costs. The lack of automation in SSI updates can lead to several problems:

a. **Manual updates:** Without automation, upgrading SSIs must be done manually, which can be laborious and error prone. This may cause SSI updates to be delayed and raise the possibility of communicating erroneous information.
b. **Data inconsistency:** The manual updating of SSIs may result in inaccurate or out-of-date information. Different versions of SSIs may be used because of the inconsistent data between systems, which may cause confusion and mistakes [11].
c. **Lack of centralized database:** Counterparties are forced to rely on manual updates from various sources in the absence of a centralised database that maintains and updates SSIs. This may result in inconsistent information being delivered, which will make it challenging for counterparties to quickly access and update SSIs.

Financial institutions can take several actions to address the lack of automated SSI updates. They can create a central database that is open to all counterparties and automatically updates SSIs in response to information changes. To automate the process of updating SSIs and decrease the possibility of errors and delays, they can also employ APIs and other technical solutions. Financial institutions can also set up procedures and rules for the proper and timely updating of SSIs, making sure that counterparties are informed of any changes and are able to modify their procedures accordingly [12].

By addressing the absence of automated SSI updates, financial institutions can reduce errors and delays in the transaction process, leading to increased efficiency and lower costs. Automating the process of updating SSIs can improve the accuracy and consistency of the information provided and help to streamline the transaction process.

3. Impact of Missing or Inaccurate SSIs on Financial Institutions

Missing or inaccurate SSIs can have significant impacts on financial institutions and counterparties. These impacts can range from delayed or failed transactions to increased costs and reputational damage. In this section, we will discuss the impacts of missing or inaccurate SSIs in more detail.

a. **Delayed or failed transactions:** The transaction process is the area where missing or incorrect SSIs have the biggest direct effect. Transactions may be delayed or end in failure if counterparties lack the proper SSI information. Financial setbacks, missed chances, and harm to both parties' reputations can follow from this [13].
b. **Increased operational costs:** Finding missing or incorrect SSIs might involve a large amount of work, which raises operational costs. Financial institutions might need to set aside resources to manually manage and update SSIs or to investigate and correct mistakes brought on by incomplete or incorrect information. Over time, these expenses may accumulate and raise the overall cost of conducting company.
c. **Increased risk of errors:** The likelihood of problems throughout the transaction process might also be increased by missing or incorrect SSIs. Counterparties may provide inaccurate or out-of-date information, which might cause errors in the transaction. These mistakes may necessitate more efforts to investigate and correct since they may cause financial losses or reputational harm [14].
d. **Reputational damage:** The reputation of financial institutions and counterparties may suffer because of failed or delayed transactions brought on by missing or incorrect SSIs. Inaccurate or out-of-date SSIs might further harm parties' reputations by causing misunderstandings or confusion between them.
e. **Regulatory compliance:** Financial institutions are subject to various regulatory requirements, including the need to maintain accurate records and ensure compliance with anti-money laundering and other regulations. Missing or inaccurate SSIs can result in non-compliance, leading to fines or other penalties [15].

Financial institutions can take several actions to lessen the effects of incomplete or erroneous SSIs. To manage and update SSIs, these might be established as centralised databases or web applications, standardised routes and formats for

communication, and automatic updating procedures. Financial institutions can decrease the possibility of delayed or unsuccessful transactions, operating costs, and the danger of errors and reputational harm by assuring the correctness and accessibility of SSIs.

4. Solution

The problem of incomplete or incorrect SSIs in the financial sector can be solved in several ways. Implementing a central SSI database that all parties involved in the payment process can access is one of the most efficient alternatives.

Centralized SSI Database:

All parties involved in the payment process would be able to access the SSIs in a centralised database that would act as a repository for all SSIs. This would lessen the likelihood of payment failures and delays by ensuring that all parties have access to the accurate and current SSIs. A centralised database would also make it possible to automate SSI updates, guaranteeing that the data is consistently correct and up to date [16].

Automation of SSI Updates:

Another good solution to the issue of incomplete or incorrect SSIs is the automation of SSI updates. upgrades that are automated would do away with the necessity for human upgrades, decreasing the possibility of mistakes and delays. Additionally, automation could be used to evaluate SSIs and make sure they are accurate and current [17].

Standardization of SSI Formats:

Another strategy to lessen the probability of SSIs being lost or incorrectly recorded is the standardisation of SSI forms. By ensuring that everyone participating in the payment process uses the same format, standardisation would eliminate confusion and errors.

4.1. Technology used.

We will utilise Spring Boot as the backend and React as the frontend to construct a centralised SSI database web application. React is a JavaScript toolkit used to create user interfaces, while Spring Boot is an open-source Java-based framework that makes it easier to design online apps.

Backend Development:

a. **Define the Database Schema:** To save the SSI data, we must first establish the database structure. The required fields, such as Counterparty Name, Bank Name, Bank Address, SWIFT Code, IBAN, and other pertinent information, should be included in the database schema.
b. **Set up the Spring Boot Application:** The database schema must be defined before the Spring Boot application can be configured. To manage the database interaction, we can utilise Spring Data JPA. Through the creation of queries from method names, Spring Data JPA offers a straightforward technique for working with databases.
c. **Implement REST API Endpoints:** The implementation of REST API endpoints is the next step in providing access to the SSI data. The REST endpoints can be implemented using Spring MVC. All SSI retrievals, SSI retrievals by ID, SSI creation, SSI update, and SSI deletion should be available through the REST APIs.
d. **Secure the REST API:** To guarantee that only individuals with permission can access the SSI data, it is crucial to secure the REST API. In order to establish authentication and authorization, we can use Spring Security.

Frontend Development:

a. **Set up the React Application:** We may utilise establish React App, which offers a straightforward method to establish a new React application, to set up the React application. React Router can also be used to provide client-side routing.
b. **Create Components:** To show the users the SSI data, we must develop components. To construct responsive and mobile-friendly components, we can use React Bootstrap. Axios can be used to send API queries to the backend.
c. **Implement CRUD Operations:** To enable users to browse, create, update, and delete SSIs, CRUD activities must be implemented. To carry out these actions, we can utilise Axios to send API queries to the backend.
d. **Secure the React Application:** We need to secure the React application to ensure that only authorized users can access the SSI information. We can use JSON Web Tokens (JWT) to authenticate and authorize users.

4.2. Microservice Architecture

Microservice architecture is preferred over monolithic architecture for several reasons:

a. **Scalability:** Microservices make scaling simpler because each service can be scaled independently based on its own requirements. Monolithic architecture, on the other hand, often necessitates scaling the entire application, even if only a portion of it does.
b. **Flexibility:** Flexibility is made possible by microservices since each service may be independently built and deployed. As a result, updates, corrections, and new features can be added to the application without affecting other areas of it. In contrast, modifications to a single application component in a monolithic architecture might affect the entire system.
c. **Fault tolerance:** Microservices provide improved fault tolerance because an issue with one service does not always result in an issue with the entire application. Monolithic design, on the other hand, is more susceptible to system-wide failures if a single component fails.
d. **Technology diversity:** Since each service can be created using a distinct technology stack, microservices enable technology variety. This means that developers are not restricted to the technology stack used in the monolithic programme and can pick the optimal tool for each unique job.

The suggested architecture, which includes services like the SSI service, User service, Email service, API gateway, Eureka server, Product webapp service, and Config server, will enable independent development and deployment of each service given the benefits of microservice architecture. This will boost scalability and flexibility by allowing each service to be scaled independently based on its unique requirements. Additionally, fault tolerance will be improved, and it will be feasible to leverage a variety of technology stacks, making the application's development and deployment more effective.

Here is a brief explanation of each service in the proposed microservice architecture:

a. **SSI Service:** The standing settlement instructions (SSIs) database will be maintained by this service. It will make it possible for counterparties to access and amend their SSIs centrally, lowering the risk of incomplete or inaccurate SSIs. To offer SSIs to the parties making the requests, this service will collaborate with other services.
b. **User Service:** User management, including user authentication and authorization, will be handled by this service. It will guarantee that only approved individuals may access and edit the SSIs. To offer access control and security for the system, this service will relate to the SSI service and the API gateway.
c. **Email Service:** This service will take care of sending email notifications and alerts for different system events, such SSI updates and user registration, among others. This service will work with other services to send the appropriate parties automated emails.
d. **API Gateway**: The system's entry point for any external queries will be this service. It will handle request routing to the

proper services, maintain security, and manage access. To authenticate and authorise users, the API gateway will interface with the User service.

Table 1. Project microservices

S. no	Microservice	Database
1	SSI Service	MySQL
2	User Service	MySQL
3	Product Webapp	Nil
4	Email Service	MySQL
5	Eureka Service	Nil
6	API Gateway	Nil
7	Config Server	Nil

e. **Eureka Server:** For the microservices, this service will act as a service registration and discovery tool. It will enable services to identify other services in the system and register themselves. As a result, managing and maintaining the services will be simpler.

f. **Product Webapp Service:** The web application for the React-based product will be served through this service. To retrieve and update the SSIs from the SSI service, it will communicate with the API gateway. This service will be made available as an independent service.

g. **Config Server**: This service will provide centralized configuration management for all the microservices in the system. It will allow for easy configuration management and versioning of the system.

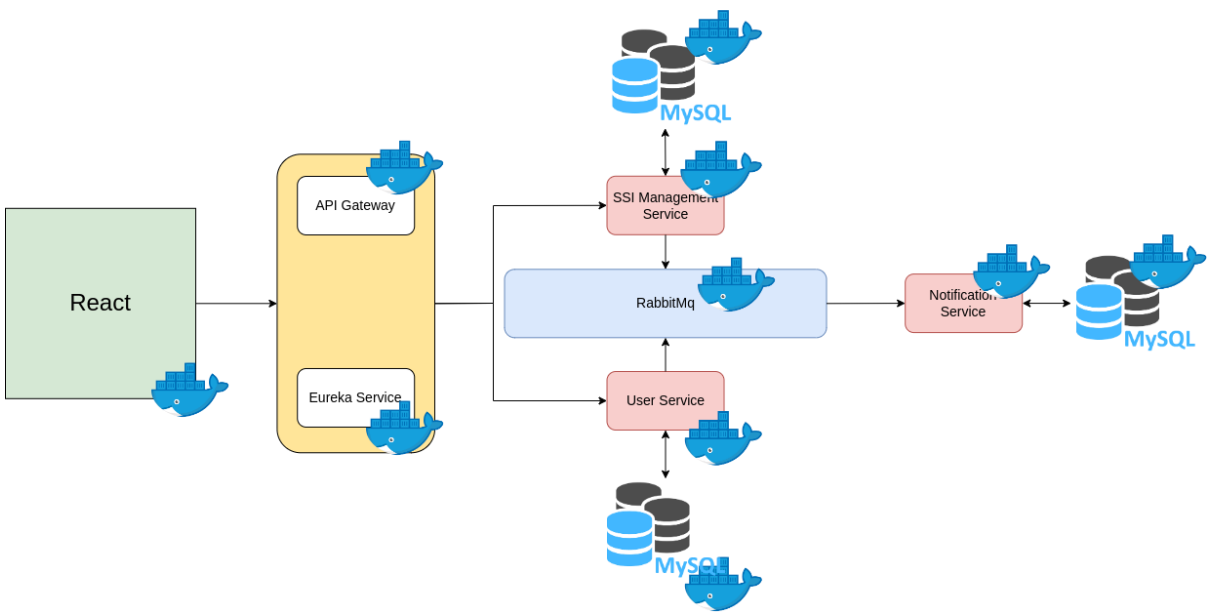

Figure 1. Project Architecture

4.3. Data Model

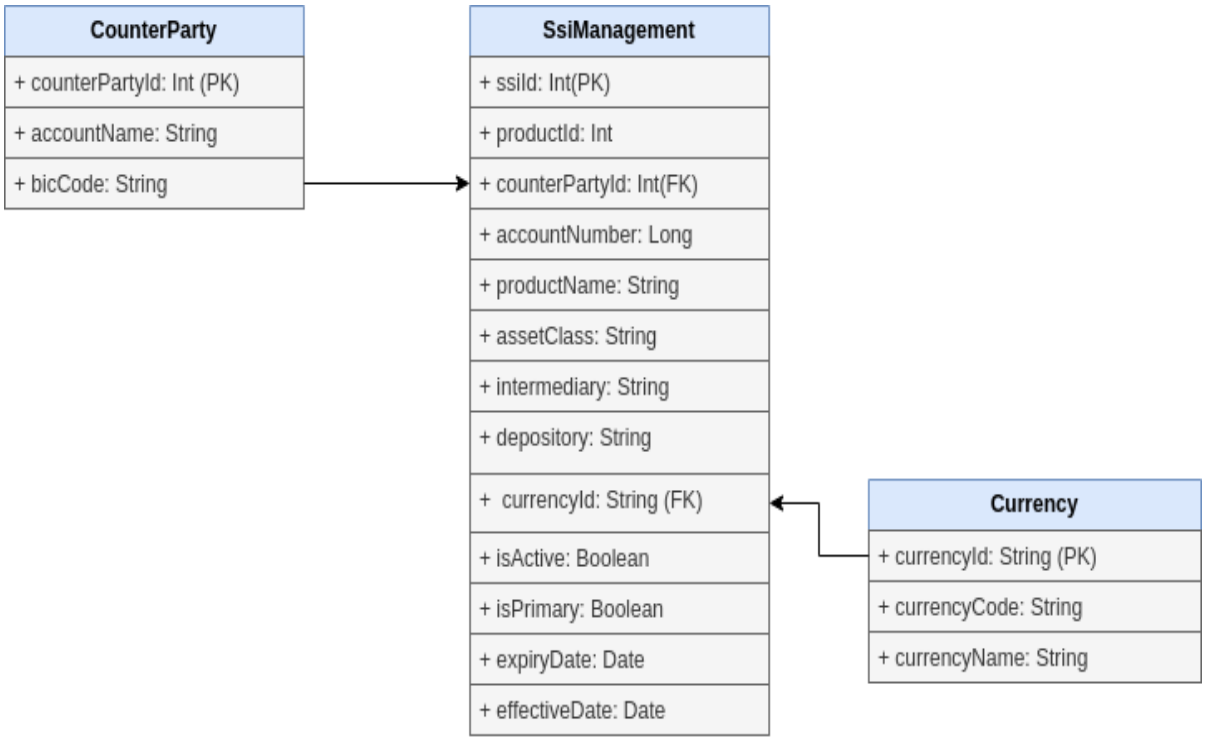

Figure 2. Data Model Diagram

Here is an explanation of the data model that can be used in this project:

The idea of Standing Settlement Instructions (SSIs) will be central to the data model for this project. The specifics of how a payment should be resolved between two counterparties are specified in an SSI, which is a series of instructions. An SSI normally contains details about the institution, the currency, and the account number.

The core entities in the data model for this project would be:

a. **Counterparty:** This entity represents an external party, such as a bank or a financial institution. It will include information such as the name of the counterparty and its unique identifier.

b. **SSI:** This entity represents a standing settlement instruction. It will include information such as the currency, the account number, and the institution details.

c. **User:** This entity represents a user of the system, such as a bank employee or an administrator. It will include information such as the name, email address, and login credentials.

d. **Role:** This entity represents a role assigned to a user. It will include information such as the name of the role and its associated permissions.

e. **Audit Log:** This entity represents a log of all the changes made to the SSIs in the system. It will include information such as the date and time of the change, the user who made the change, and the details of the change.

The relationships between these entities can be represented as follows:

a. A Counterparty can have multiple SSIs.

b. An SSI belongs to a Counterparty.

c. A User can have multiple Roles.

d. A Role can be assigned to multiple Users.
e. A User can perform multiple changes to the SSIs, and each change will be logged in the Audit Log.

This data model will allow for efficient management of SSIs and provide the necessary audit trail for any changes made to the system. It can be implemented using a relational database management system such as MySQL or PostgreSQL.

4.4. Data Flow

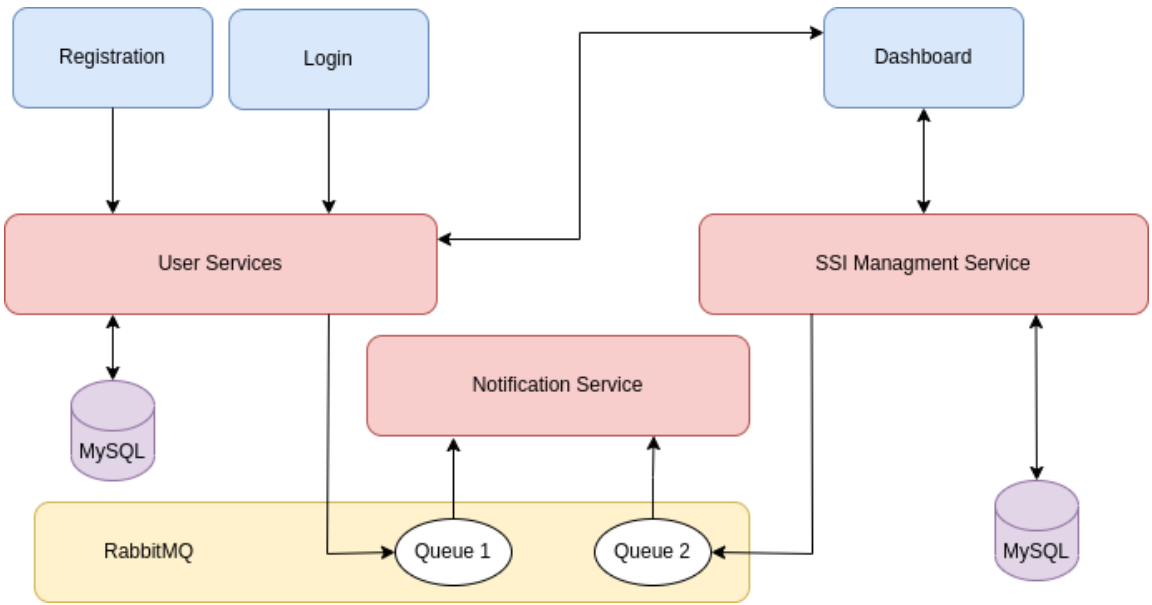

Figure 3. Data Flow Diagram

Here's an explanation of the data flow that can happen in this project:

a. **User logs in to the Product Webapp Service:** The user logs in to the Product Webapp Service, which is a React app that allows users to view and update their SSIs. The login credentials are authenticated by the User Service.
b. **User requests for an SSI:** The user requests for an SSI from the Product Webapp Service. The request is forwarded to the API Gateway.
c. **API Gateway requests SSI from SSI Service:** The API Gateway forwards the request for the SSI to the SSI Service.
d. **SSI Service retrieves SSI from the database:** The SSI Service retrieves the SSI details from the database based on the request parameters.
e. **SSI Service sends SSI back to API Gateway:** The SSI Service sends the SSI details back to the API Gateway.
f. **API Gateway sends SSI back to Product Webapp Service:** The API Gateway sends the SSI details back to the Product Webapp Service, which displays the details to the user.
g. **User updates SSI:** The user updates the SSI details and submits the changes. The changes are forwarded to the API Gateway.
h. **API Gateway sends changes to SSI Service:** The API Gateway forwards the changes to the SSI Service.
i. **SSI Service updates SSI in the database:** The SSI Service updates the SSI details in the database based on the changes.
j. **SSI Service sends notification email:** The SSI Service sends a notification email to the relevant parties informing them of the changes made to the SSI.
k. **SSI Service logs changes in Audit Log:** The SSI Service logs the changes made to the SSI in the Audit Log.

I. This data flow represents a typical scenario where a user requests for an SSI, updates the SSI, and the changes are logged and notified to the relevant parties. The microservices architecture allows for efficient handling of requests and updates, while the use of API Gateway and Eureka Server ensures seamless communication between the services.

5. Project Snapshots

Here are some snapshots from the project which is deployed on aws ec2 instance with the help of docker.

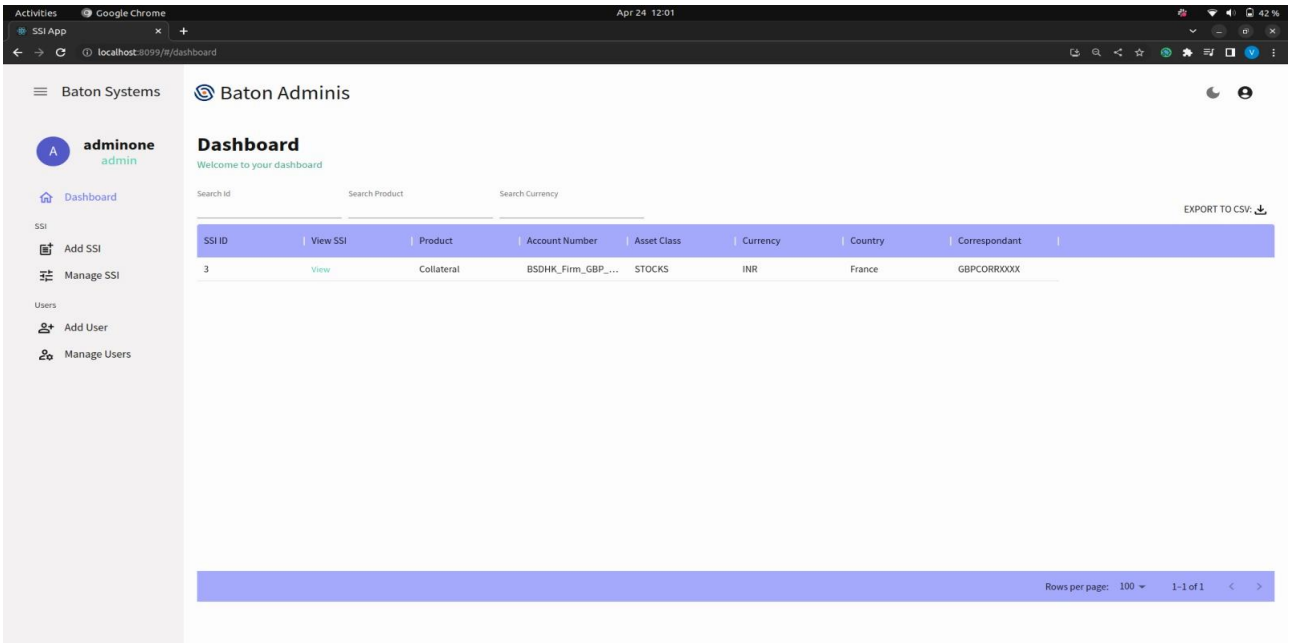

Figure 4. Dashboard UI

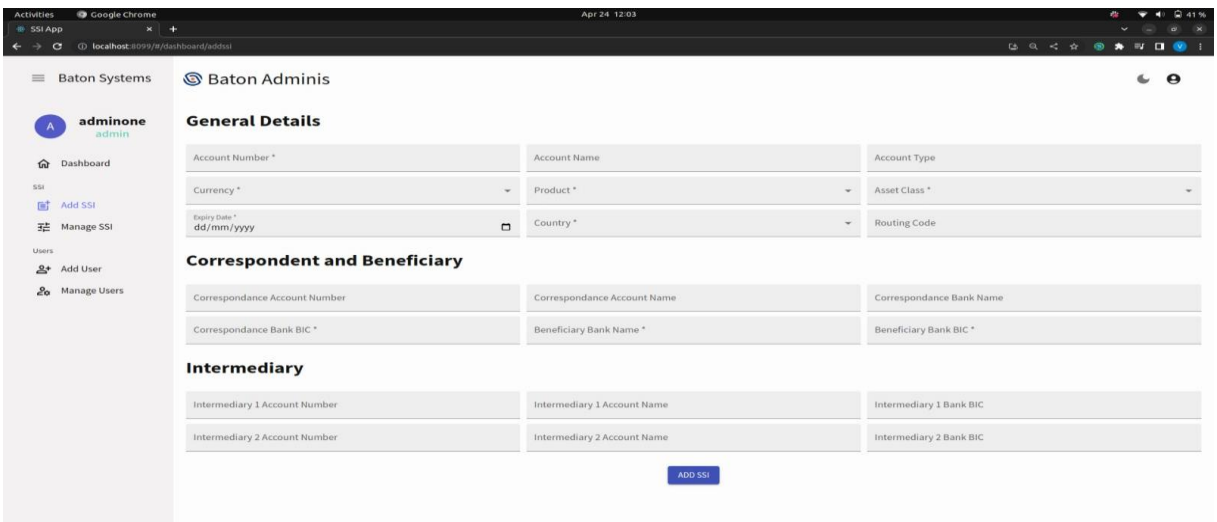

Figure 5. Add SSI UI

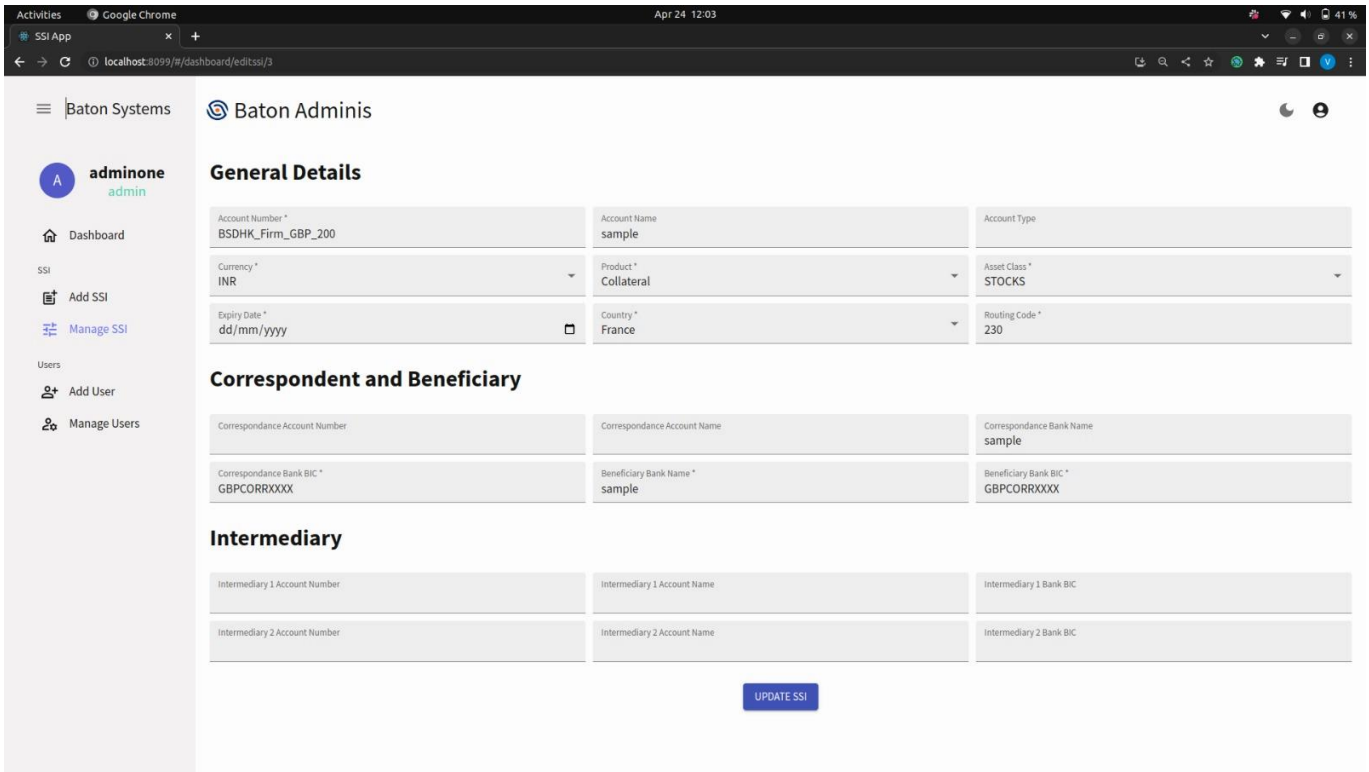

Figure 6. Edit SSI UI

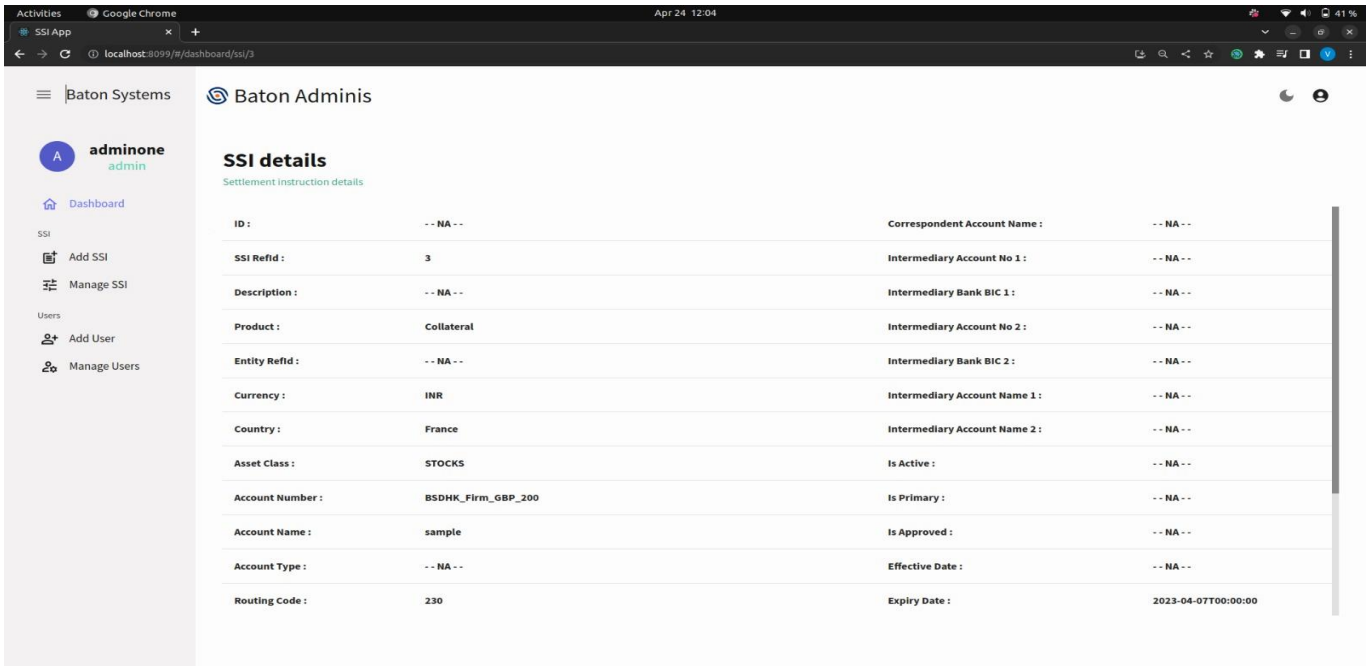

Figure 7. View SSI UI

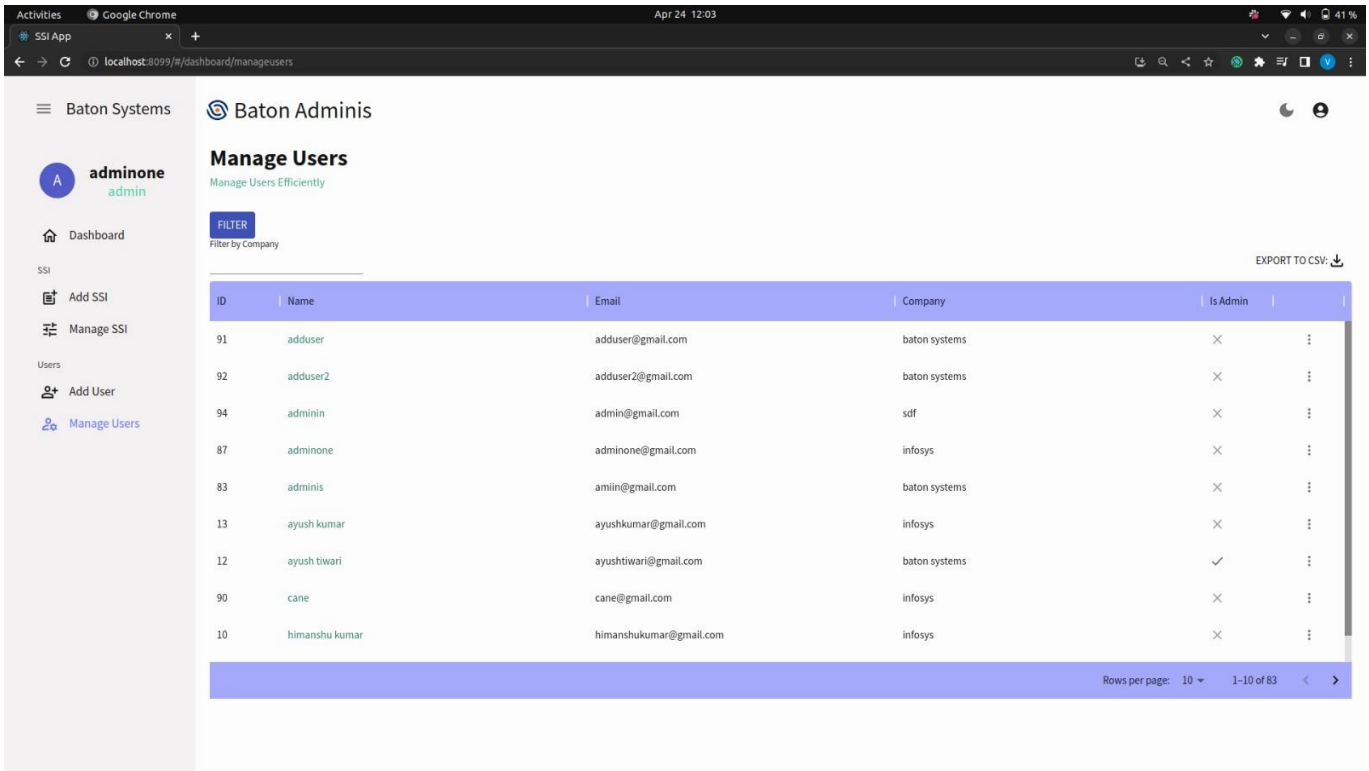

Figure 8. Manage Users UI

6. Conclusion

The adoption of straight-through processing (STP) has revolutionized the banking sector by enhancing the efficiency of payment operations. However, the persistence of missing or inaccurate standing settlement instructions (SSIs) remains a critical challenge that hinders the seamless implementation of STP. This research has identified key factors contributing to the prevalence of incomplete or incorrect SSIs, including poor communication, lack of standardization, and the absence of automated SSI updates. Poor communication, arising from incomplete or outdated information, lack of standardized communication, language barriers, and a lack of awareness, emerges as a significant cause of missing or inaccurate SSIs. Financial institutions can address this issue by implementing standardized communication routes, utilizing technological solutions for automated SSI updates, and emphasizing the importance of accurate and current SSIs through staff training. The lack of standardization in communication channels, formats, and guidelines also plays a crucial role in the prevalence of missing or inaccurate SSIs. To mitigate this challenge, financial institutions can establish centralized databases, employ established communication formats such as the SWIFT network, and set industry-wide standards for SSI delivery.

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