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BSc in Materials Engineering

DESIGN AND IMPLEMENTATION OF A BUSINESS INTELLIGENCE & ANALYTICS REPORTING SOLUTION FOR THE EXPORT AND IMPORT SECTOR

A PROJECT ON THE FREIGHT FORWARDING INDUSTRY

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Dedicated to all the future leaders of change, let's do it.

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“First say Yes and then learn how to do it.” (Richard Branson).

& "Always go the extra mile."

ABSTRACT

Every action an enterprise makes generates data. The real challenge lies in harnessing this data's potential to create value for customers, and stakeholders, and to gain a competitive edge in a fierce market. The exporting and importing industry bear the weight of this challenge firsthand. In an arena where meticulous attention to detail and pricing is paramount, organizations must navigate a path to excellence in customer service.

This master thesis delves into the freight forwarding industry, showcasing a project developed on Rangel. The focal point is data analytics and business intelligence. This study compiles advanced data visualization techniques, enhancing report readability and interaction, and enabling the extraction of invaluable insights. A comprehensive comparison of various business intelligence tools, evaluating their data visualization capabilities, scalability, user-friendliness, pricing, and key features, reveals several noteworthy options. Among these, Power BI emerges as the most fitting choice for organizations commencing their journey into a business intelligence-oriented culture. Adopting a user-centered design approach empowers the creation of reports finely attuned to the sector's unique needs.

In the culmination of this research, a Long-Short-Term Memory (LSTM) machine-learning model was built, capable of predicting freight prices with real data inputs. This model stands as a testament to the convergence of data science and logistics, offering a powerful tool for price prediction and resource optimization.

Ultimately, this work compiles rigorous research and a compelling project, forming a comprehensive blueprint for the implementation of a business intelligence solution that will elevate customer service standards within the freight forwarding industry.

Keywords: Business Intelligence, data visualization, data analytics, freight forwarding, machine learning

RESUMO

As organizações que se querem diferenciar encaram os dados como um subproduto ubíquo das atividades que executam no dia a dia. O verdadeiro desafio reside em aproveitar o potencial dos dados e informação para criar valor a clientes e *stakeholders* e obter uma vantagem competitiva num mercado competitivo e saturado. A indústria da importação e exportação encara este desafio de forma direta. Num campo onde a atenção meticulosa aos detalhes e aos preços é fundamental, as organizações precisam de traçar uma visão rumo à excelência no atendimento ao cliente.

Esta dissertação de mestrado, realizada na Rangel Logistics Solutions, explora a indústria do comércio internacional e dos transitários, revelando tendências esclarecedoras e relevantes da indústria. O trabalho desenvolvido foca-se na análise de dados e na implementação de uma solução de *business intelligence*. Este estudo reúne técnicas avançadas de visualização de dados, aprimorando a legibilidade de relatórios, incentivando a interação e permitindo a extração de insights. A presente dissertação contém uma análise comparativa de várias ferramentas de *business intelligence*, que avalia capacidades de visualização de dados, escalabilidade, facilidade de uso, preço e recursos-chave, revelando diversas opções notáveis. O Power BI destaca-se como a escolha mais adequada para organizações que se encontram a dar os primeiros passos em direção a uma cultura orientada para a *business intelligence*. A adoção de uma metodologia centrada no utilizador permitiu o desenvolvimento de relatórios especialmente ajustados às necessidades únicas do setor.

Por último, com a visão de acrescentar valor e se diferenciar, foi implementado na organização um modelo *machine learning* conhecido por Long Short term memory (LSTM), capaz de prever preços de frete dos clientes. Este modelo destaca-se como um testemunho

da convergência entre ciência de dados e logística, oferecendo uma ferramenta poderosa para previsão de preços e otimização de recursos.

Em última análise, o presente trabalho combina pesquisa académica rigorosa e um projeto convincente, formando um plano abrangente para a implementação de soluções de *business intelligence* que elevarão o serviço ao cliente dentro da indústria de comércio internacional e transitários.

Palavras chave: . Business Intelligence, visualização de dados, análise de dados, transitário, previsão

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GLOSSARY

Business Intelligence	Technologies and processes for data analysis to support decision-making.
Freight forwarder	A logistics intermediary that manages the transportation of goods.
Incoterm	A set of standardized trade terms for international transactions.
Neural Network	A computational model inspired by the brain, used in AI for pattern recognition.

ACRONYMS

BI	Business Intelligence
BU	Business Unit
LSTM	Long-Short term memory
ML	Machine Learning
MSE	Mean Squared Error
NVCC	Non-Vessel Operating Common Carrier

1

INTRODUCTION

This first chapter is devoted to framing the thesis's context and industry. Additional addressing the central issue and how it will be tackled. Following that, the research's problems, regarding the present thesis, are stated.

1.1 Business Context

1.1.1 Freight forwarding industry

Globalization has been a significant force driving economic growth and development worldwide. It has facilitated international trade and investments, leading to increased economic interdependence among countries. The globalization of trade and commerce has made it possible for companies to source materials and products from different parts of the world and sell their products to customers around the globe. In this context, freight forwarder companies play a crucial role in the global supply chain (SC), facilitating the transportation of goods across borders. This master thesis aims to explore how data can add value to the freight forwarding industry, focusing on a case study of a company that exports and imports from all over the world, in particular Rangel Logistics Solutions, with operation emphasis on the USA, China, and Africa. Along with other sectors of the economy sea and air traffic are heavily affected by external factors, such as oil crises, natural disasters, armed conflicts, terrorist attacks, economic recessions, and disease outbreaks, just as experienced with COVID-19 (Suau-Sanchez et al., 2020).

The present thesis focused on the international air and sea business unit (BU), which provides global ocean and air freight forwarding services. From China to the United States, the air and sea employees focus on ensuring cargo goes from the origin to the destination.

The export and import process is still highly bureaucratic and is ruled by strict laws to ensure security and fairness in world trading.

1.1.2 Data analytics and Business Intelligence

In today's world, every action of an enterprise generates data. Many companies face a challenge to use this data to their advantage, either to drive data decision-making or to improve operations efficiency. Alongside this, companies must use data to leverage their service value to the final customer, to improve client experience and competitiveness.

Freight forwarders face an enormous challenge managing and coordinating with all the stakeholders involved which results in a lack of visibility from their services.

As such, Business intelligence (BI) tools will be employed due to their capability to transform data into actionable insights, enabling comprehensive data analysis and facilitating the identification of trends, market dynamics, and patterns. The BI tools will be used to add value to Rangel's service through the implementation of a reporting system. These reports can be leveraged by clients to revise strategic plans, optimize resource allocation, and adhere to budgetary constraints more efficiently.

The work conducted during the development phase took place in two phases, and each contributed greatly to the success of the project. At first, a theoretical study and analysis were conducted, followed by the development of the project.

1.2 Thesis Motivation

In the current business landscape, enterprises must swiftly adapt lest they succumb to fierce competition within their industry. The domains of exportation and importation exemplify this cutthroat environment, where pricing, customer relations, and service quality reign supreme. To elevate the quality of customer service, businesses must augment the value they offer. The most efficacious and commendable approach to achieving this lofty objective resides in the realm of technology, business intelligence, and information systems.

Information systems epitomize the lifeblood of contemporary enterprises, furnishing a veritable platform for data management, process automation, and seamless intra- and inter-organizational communication. Within the purview of transport logistics, information systems emerge as pivotal conduits for administering the flow of goods, tracking shipments, and ensuring punctual delivery.

Together with an information system is the data generated by it. Real-time data provides enterprises with an opportunity to achieve a competitive advantage by improving operating efficiency, lowering costs, and increasing customer satisfaction. However, this data never reaches the final customer.

1.3 Problem Statement

The current master thesis addresses the problem of a real enterprise delivering a solution based on research. The organization's problem consisted of the lack of visibility and information they provided to their clients concerning their service. Considering both the context and the challenge of the company, the difficulties addressed were as follows:

- How can we benefit from the data stored in the information system?
- What can we do to provide service visibility to clients?
- How can we add value to customers by leveraging data?
- How can we select the most relevant metrics and KPIs for customers?
- How can we select the most appropriate visualization models to illustrate each metric intuitively?

Therefore, this master's thesis delves into how data can be leveraged to add value to final customers by implementing a reporting system capable of providing visibility and tracking operations with Rangel. Both the author and the firm believe in the hypothesis that delivering a structured report to clients will be an important factor when it comes to choosing Rangel as their freight forwarder.

The objective of this thesis project is to implement a solution of visibility and analysis for an organization and, at the same time, provide a methodology of how this can be done in other enterprises facing similar issues.

1.4 Thesis Structure

In order to better understand how this thesis is structured and why it is structured this way it is hereby presented the following chapters architecture and content:

Chapter 1 entails the business context in which this thesis is written alongside the motivation and the problem it solved.

Chapter 2 contains the background for this thesis and the state of the art for both the industry (freight forwarding) and technology (Business Intelligence, data analytics, and

machine learning). Moreover, focuses on the project at hand by including relevant research on metrics and measurable KPIs for organizational dimensions.

Chapter 3 explores the research and project methodology, along with the project's outcomes. The thesis is built this way to facilitate the comprehension of each methodology stage by illustrating how it was performed during the project development. In this chapter it is worth describing the enterprise in which the project solution was implemented, what they do, their clients, and their operations.

Chapter 4 looks into the achievements and results with a critical point of view by pointing out challenges and hurdles, improvement areas, and considerations about the project.

Lastly, chapter 5 concludes the work done during the master thesis by leaving some final remarks and synthesizing the most important key accomplishments and insights. It finalizes by providing future work and recommendations for the project and overall organization improvement.

1.5 Chapters' Highlights

To provide a better understanding of the research performed in this master thesis and a big-picture view, a simplistic figure was created (Figure 1). The present document follows the structure entailed in Chapter 1.4 and pursues the rationale illustrated in Figure 1.

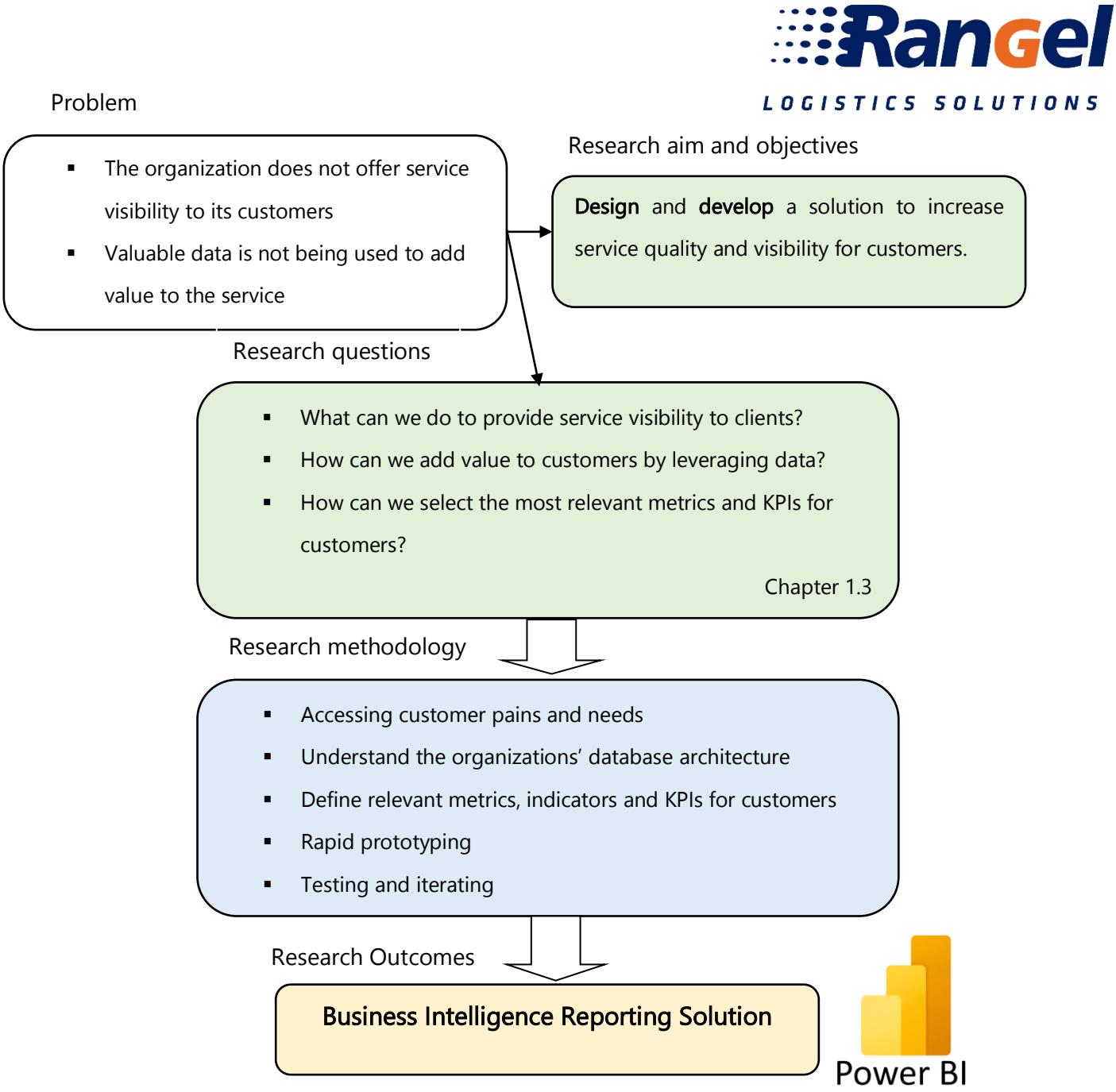


Figure 1- Research content summary

2

STATE OF THE ART

2.1 Current global supply chain and logistics outlook

The supply chain is one of the most used terms in recent years. Since the COVID-19 pandemic, the tension between China and the United States, and the war in Ukraine, supply chains have been suffering collateral damage. The past few years have exposed all of the vulnerabilities in the global supply chain. Highly volatile consumer demand and logistical problems with supply-side fluctuations have led to complex problems concerning supply chain management.

The current economic and political environment has slowed imports and exports around the globe. After the huge impact of COVID-19 on supply chains, the war in Ukraine, geopolitical tensions, a high inflationary environment, and, as a consequence, a monetary policy tightening and increasing levels of debt transportation of goods across borders has been going through difficult challenges. High commodity prices were the most conspicuous factor for the downturn in global trade in the last quarter of 2022. Although food and energy prices had receded from their post-conflict peaks, they remained high by historical standards (World Trade Organization, 2023).

Furthermore, regarding a matter that heavily affects the studied enterprise, supply chains also have been affected by port congestion which has an impact on transit time and decreases the service level and the persistence of high container freight rates. Containers shortages have driven the prices to record highs. Container demand is influenced by end-user spending on goods, shippers' desire to keep inventory on hand, and an economic re-opening that may shift spending back to services. Although there is capacity on container ships, the space available comes only at the high spot fees demanded by forwarders and ocean carriers (Dierker et al., 2022).

To overcome these issues, technology plays an imperative role in the evolution and differentiation of enterprises in an extremely competitive market such as freight forwarding. Enabling them to establish a competitive edge vis-à-vis their counterparts. Particularly pertinent is its undeniable influence on customer experience, whereby the contemporary industry concentrates its efforts on achieving comprehensive visibility and fostering meaningful connections with customers. This pursuit entails the integration of tools capable of augmenting the value inherent in their day-to-day operations.

2.2 Freight Forwarding Industry

The primary responsibility of an international freight forwarder involves consolidating small to medium-sized containerized cargo and executing commercial transactions with enhanced cost-effectiveness and efficiency. Freight forwarders assume a significant role in facilitating these economic operations and providing diverse logistical solutions to support small and medium-sized enterprises (Huang et al., 2019). International freight forwarders are responsible for managing and forwarding containers to every port in the world.

2.2.1 Modes of Transport

Forwarders provide transportation services either by land, sea, or air, being trucks, cargo vessels, and planes as the chosen mode of transport. Regarding the three distinct modes, maritime transport remains the dominant mode for international trade due to its unparalleled capacity to move freight over long distances and for providing a low-cost solution. Additionally, this is the most efficient method to transport large volumes of commodities, such as oil, iron ore, coal and grain, and finished goods (Rodrigue & Browne, n.d.). Seaborne transport is critical to global trade, accounting for more than 80% of the volume of merchandise transferred between nations and more than 70% of overall trade value (OECD & European Union Intellectual Property Office, 2021).

2.2.2 Technology Adoption and Digital Transformation

Competitiveness has already shifted from organizations to supply chains (Stadtler & Kilger, 2005). Norman & Macdonald (2004) have noted the growing popularity of "Triple Bottom Line" (3BL) accounting in recent years, particularly within management consulting, investment, and NGO sectors. The core concept of the 3BL paradigm is that a company's

overall success and well-being should be assessed not solely through conventional financial metrics but also by evaluating its social, ethical, and environmental performance. This definition of sustainability is relevant to this research, given its potential influence on competitiveness, and is worth considering (Norman & MacDonald, 2004). Murilo et al. hypothesize that there is a link between digital technology and supply chain management capabilities and management. Also the impact of technology occurs through supply chain memory, also known as supply chain visibility or supply chain traceability (Alvarenga et al., 2023).

It is well accepted, in the literature, that the use of digital technology and process digitalization is connected with growing resilience and robustness capabilities for supply chains and logistics enterprises. Munir M. *et al* emphasizes that the use of technology increases information gathering, processing, and sharing, providing better visibility, transparency, and real-time information to supply chains (M. Munir et al., 2022). Al-Talib *et al.* states that the data quality, faster reconfiguration capacity, and decreased unexpected consequences are crucial factors that should take companies to adopt information systems and infrastructure (Al-Talib et al., 2020). Moreover, data and analytics are vital for enterprises to stay ahead of competitors and in line with the most important revolution of today, industry 4.0. Industry 4.0 states the importance of applying data and analytics all along the value chain with cloud technology, advanced analytics, and machine learning. Companies must build their strategy around pillars from Industry 4.0 to differentiate from competitors and innovate. Additionally, the fourth industrial revolution generates opportunities for sustainability and more sustainable business activities. Organizations can enhance their sustainability practices through data by reducing consumption, minimizing resource waste, and curbing emissions to achieve environmental gains (McKinsey, 2022).

Lastly, it is worth noting the sustainability impact of digitization and digital transformation in this heavy paper industry. A crucial concept to mention and the twin put in practice is twin transition. This approach recognizes a substantial, mostly untapped potential for technology and data to advance sustainability objectives. Instead of separately addressing digital and sustainability, a twin transition strategy integrates these essential elements to unleash significant benefits in terms of efficiency and productivity (World Economic Forum, 2022). This concept is important to this thesis due to its connection to the implementation of digital solutions.

2.3 Business Intelligence

Business Intelligence (BI) is described in the literature as a framework that turns information into data, which becomes learning material and, consequently enhancing enterprises' decision-making process (Solberg Søilen, 2016), (Heang & Mohan, 2019).

BI is a crucial factor when it comes to achieving strategic objectives (Raffoni et al., 2018). The literature has emphasized the positive impact of the information provided by Business Intelligence systems (Grublješič & Jaklič, 2015). Nevertheless, the main question is hence whether, following BI implementation, users accept, employ, and fully use their possibilities (Richards et al., 2019).

Srivastava et al. introduces the concept of business knowledge linked to BI, stating knowledge is delivered at the right time and place and in the requested exact form. Adding to this, security is an essential part of every BI solution, granting and managing access to specific information based on the user (Srivastava et al., 2022).

BI systems are an integrated set of tools that convert data into information to help businesses and decision-makers achieve more accurate results (Bahrami et al., 2012). Benefits of Business Intelligence include: single point access to data, customer driven solution, improves operational efficiency by providing real time reports, enables visual pattern detection and trend analysis, informs and qualifies sales force, enhances customer relationship and, improves overall performance (Saabith, 2022). Due to its variety of functionalities, BI can be implemented in many industries and sectors such as retailing, banking, logistics (Bolsunovskaya et al., 2023), airways (Iris & Nagalingham, 2023), manufacturing, hospitality, pharmaceutical and much more (Saabith, 2022)..

2.3.1 Data and Information

Two fundamental concepts that are important to differentiate are data and information. Data refers to a structured codification of single primary entities as well as transactions involving two or more primary entities (Vercellis, 2009). On the other hand, information results of a process of extraction and manipulation. Additionally, it has meaning for those receiving it in the right context or specific domain.

2.3.2 Data Visualization

The rising utilization of online data visualizations is enhancing the communication of crucial insights and facilitating user exploration, interaction, and extraction of valuable information from complex datasets (Lee et al., 2015).

Two important concepts when dealing with data visualization for customers are user experience and intuitive design relative to the user interface. User experience can be defined as the comprehensive encounter encompassing perception, reaction, and behavior that a user undergoes when engaging with a particular system, product, or service, whether it is accessed directly or indirectly (Son & Kim, 2023). On the other hand, intuitive design is focused on the overall ease of use and learning of a specific product or interface considering the time component and the pressure of information (Qu et al., 2022).

Hence the importance of visualizing data and retrieving valuable insights from it, many studies talk about the importance of making it easy to read, enjoyable and accessible to everyone. According to Geissler et al., the complexity of a stimulus is influenced by three factors: the number of elements, the degree of dissimilarity among elements, and the level of unity among elements (Q. Wang et al., 2014). This means that reducing information overload is key to enhance usability of reports and similar (Eriksson & Granhof, 2021).

Literature gives guidelines on how information can be read in a more intuitive way. Some pointers include utilizing alt text (Cesal, 2021; *WebAIM: Alternative Text*, 2021), how to structure tables (Hawkins, 2021), using clear color cues and predictable patterns (Tableau, 2022). Regarding people with partial blindness or low visibility, users with these kinds of disabilities are 60% less accurate to interpret a visualization and take 210% more time than their sighted peers to interact with it (Sharif et al., 2021). Also, colorblind users should be considered. Charts and visual tools can be adapted to better fit people with this visual impairment (Esteves, 2023).

Recent trends in this area include augmented reality (AR) and virtual reality (VR) for immersive data visualization and exploration. Literature shows that there are variances in the accuracy and depth of insights gained by users. An hybrid data exploration approach improves the understanding of data (Wang et al., 2020). Furthermore, users feel more satisfied and successful when utilizing VR data exploration tools. (Millais et al., 2018).

2.3.3 Business Intelligence Tools

There exists a diverse range of Business Intelligence tools in the market, enabling organizations to leverage the relevant data and visualization techniques to gain meaningful insights. It is crucial for organizations to possess the knowledge and ability to select the most suitable tools that align with their specific requirements and objectives (Guarda et al., 2022).

A comparison and evaluation of the most well-known BI tools is essential to make the best decision when it comes to selecting BI software. By reviewing literature and other sources table 2 was constructed. It provides a thorough evaluation of various Business Intelligence tools and software, considering meaningful criteria within the context of this document.

- **Data Visualization and Dashboarding**: Ability to present data in visually compelling ways and create interactive dashboards.
- **Interactive Visualization**: Interactive features that allow users to explore and interact with visual representations of data.
- **Reporting**: Robust reporting tools for generating informative and high-quality reports.
- **Data Preparation**: Efficient processing, sorting, collection, storage, and analysis of data.
- **Scalability**: Capacity of scaling the BI solution for the whole organization.
- **User Friendly**: Ease of use, learning, dealing, and understanding. The learning curve is also considered for this criterion.
- **Collaboration**: Seamless sharing and simultaneous collaboration on reports and dashboards.
- **Security**: Strong privacy measures and user-based information filtering capabilities.
- **Pricing**: Transparent and flexible pricing options. Licensing options and the monetary value were also considered.
- **Connectivity**: Seamless integration with various data sources and systems.
- **Python and R integrations**: Support for integrating and leveraging Python and R programming languages.
- **Other software integrations**: Compatibility with other software systems and tools.
- **Big Data supports**: Ability to handle and analyze large volumes of data efficiently.

The scale used in table 2, between 1 and 3, indicates the level of performance or effectiveness for each specific criterion. A score of 1 suggests that the software has limited

capability or is less effective in meeting the criterion, while a score of 3 indicates that the software excels and fully meets the requirements of that criterion.

Table 1- Comparison of different BI tools based on relevant criteria for the present document. Scale used: 1- Poor; 2- Good; 3- Very good.

	Power BI	Oracle analytics Cloud	MicroStrategy	TIBCO Spotfire	Qlik Q
Data visualization & Dashboarding	3	3	3	3	3
Interactive Visualizations	3	3	2	3	3
Reporting	3	3	3	3	3
Data Preparation	3	3	3	2	2
Scalability	3	3	3	2	3
User friendly	2	3	2	2	2
Collaboration	3	3	3	3	2
Security	3	3	3	3	3
Pricing	2	1	2	3	1
Connectivity	2	2	2	3	2
Python and R integration	3	3	3	3	3
Other Software Integrations*	3	2	2	2	2
Big Data support	1	3	3	3	3
Key Features	User-Friendly, Robust Capabilities, Microsoft tools integration	User-friendly, reporting, AI tools, Augmented analytics.	Enterprise-grade analytics, data visualization and dashboards, mobile access, reporting.	Interactive visualizations, informative reports, data visualization and Dashboards	Data visualization and preparation, functionality, collaboration

Table 2 - Continuation of table 1- Comparison of different BI tools based on relevant criteria for the present document.

	Tableau	SAP Business Objects	Pentaho	Sisense
Data visualization & Dashboarding	3	3	3	3
Interactive Visualizations	3	3	3	3
Reporting	3	3	3	3
Data Preparation	3	2	3	1
Scalability	2	2	3	3
User friendly	2	2	1	2
Collaboration	3	3	3	3
Security	3	3	3	3
Pricing	3	2	3	3
Connectivity	3	2	3	3
Python and R integration	3	3	3	3
Other Software Integrations*	3	3	3	2
Big Data support	3	3	3	3
Key Features	Data connectivity, self-service BI, Data visualization.	Flexible reporting, Integration, customization, ease of use	Data analysis, complete BI, integration, reporting.	Data Integration, data visualization and Dashboard, Customer service.

Table 1 and 2 are adapted from various authors (Guarda et al., 2022; Heang & Mohan, 2019; Kaur & SelectHub, 2023; Saabith, 2022; Srivastava et al., 2022).

The present work was developed using Power BI, software developed by Microsoft to empower business with a robust business intelligence tool that empowers organizations to turn raw data into actionable insights (Microsoft, 2023). Microsoft Power BI is a powerful tool that enables seamless integration of business knowledge. It facilitates the extraction of information from various databases, storage sources, cloud data sources, and Excel files. With its user-friendly interface and robust capabilities, Power BI allows for effortless integration into the business environment. The tool empowers users to create accurate and insightful dashboard reports that can be securely published without limitations in terms of speed and memory constraints. (Bernardino et al., 2019). Literature has many examples regarding the use of Power BI. It has been used and showed great results at crisis and risk communication in the largest national medical setting in the United States (Adam Lee et al., 2022).

2.4 Essential Freight Metrics and Key Performance Indicators

The importance of performance tracking and measurement of Key Performance Indicators (KPIs) and indicators are a consensus in the literature and have been for many years (Atikno et al., 2021). The classic management adage "You cannot manage what you do not measure" is the foundation of performance measurement concepts (Konsta & Plomaritou, 2012). Metrics help enterprises to evaluate whether they are moving in the right direction and if the strategy and objectives drawn are being fulfilled. Additionally, KPIs are a set of measurable key indicators that offer information on the extent to which strategic objectives are allocated to a company in order to achieve success. KPIs also help organizations measure the performance of individual business units, departments, and teams. Finally, this valuable data serves to compare results from past organizational performance keeping an indispensable historic record (Setiawan & Purba, 2020).

Indicators and metrics are fundamental for any organization, and they vary widely depending on the industry. Recent studies show that time oriented KPIs are an essential and crucial criterion while organizational are less crucial for the industry (Patidar et al., 2022).

2.4.1 The Economic and Financial Dimension

Economic and financial indicators have for long been the number one metric for top management and is highly connected with performance measurement for any business. According to an Oracle study financial metrics can be split into various categories, such as profitability, liquidity, efficiency, valuation, and leverage (NetSuite.com, 2023). Inside these categories, studies in the supply chain field found that ROI, ROE, ROA, profit margin and working capital are the prime financial measures to supply chain performance (Israel et al., 2023).

2.4.2 Service Quality Dimension

Service quality can be defined as the adaptation to client demands in delivering a service (Mai, 2021). Metrics that assess service quality are important for clients to evaluate the performance of freight service providers. In the context of performance evaluation, significant non-financial indicators encompass customer satisfaction, delivery reliability, strengthened partnerships, and gaining a competitive edge (Israel et al., 2023).

Indicators concerning delivery time have for long been accepted by the literature as essential for any supply chain (Neri et al., 2021). Transit time has a direct impact on the final delivery time of a product, which in turn impacts SC flexibility, the customer's final decision and satisfaction (Sopadang, 2017). Moreover, in order to differentiate from competition and appeal to customers the transport industry focuses on innovative transport technology. To measure performance and the effect of technology in this fields, literature suggest KPIs related to travel times, weight and quantities transported, automated loading and unloading docks and energy consumption (Duin & Thoben, 2022).

2.4.3 Markets Dimension

Performing trend analysis requires maintaining a comprehensive record of the countries to which your company exports and from which it imports. This tracking process is indispensable for gaining valuable insights into trade patterns and trends. It facilitates the identification of emerging market trends, shifts in consumer demand, and potential growth opportunities. By meticulously tracking and analyzing these export and import flows, organizations can gain valuable insights into the evolving dynamics of global trade, make informed business decisions, optimize supply chain operations, and stay ahead in a competitive marketplace (Rossel, 2021). Moreover, this comprehensive data tracking ensures that businesses can proactively respond to market changes, adjust their strategies, and establish fruitful relationships with trading partners in various countries (Stadtler & Kilger, 2005).

2.4.4 Sustainability and Environmental Dimension

Sustainability within a SC is a rather challenging thing to include (Jaehn, 2016). Sustainable freight transportation should focus on diminishing environmental emissions and social inequities. Regarding measuring environmental impact of an organization the literature suggest indicators which address resource consumption, recycling, waste management, environmental expenses and ethical conduct (Neri et al., 2021). Environmental indicators encompass greenhouse and flares gas emissions, eco-efficiency regarding total energy utilized ed in oil and gas during operations, and natural resource management (Kumar et al., 2023).

The concept of sustainability has evolved significantly in recent years, even though its definition is based on the triple bottom line (3 dimensions), specifically economic, social, and

environmental. The United Nations' 17 Sustainable Development Goals (*THE 17 GOALS | Sustainable Development*, n.d.) and the recent concept of ESG (Environmental, Social, and Governance) are drivers for mobilizing society and organizations towards a greener, more prosperous, equitable, and inclusive planet. In the business context, there are several models for assessing levels of maturity and compliance with these themes. One of the models that comprehensively addresses the concepts of resilience, innovation, and sustainability is the SuCEES (Sustainable Competitiveness Evaluation and Execution System) model, which includes a set of indicators covering this aspect (Cavaco, 2016).

Recent trends show that companies with higher profit margins are turning their operations more sustainable (Fulzele & Shankar, 2023). These investments have an impact on revenues and profits due to the investment in technological solutions for automation and the influence and effect on the final customer decision.

2.4.5 Laws and Regulation

International freight forwarding agents are ruled by strict laws and regulations that vary based on the countries involved and the nature of the goods being transported. Companies providing these services must comply with the regulations and inform their customers about it. The most important legal aspects which forwarders need to be aware are:

1. International Trade Laws: Import and export regulations, customs procedures, and trade agreements between countries.
2. Contract Laws: Freight forwarding agents enter into contractual agreements with their clients, which are governed by contract laws. These laws outline the rights and obligations of both parties.
3. Insurance Laws: Agents often deal with cargo insurance to protect the goods being transported. They must comply with insurance laws and regulations, ensuring appropriate coverage for potential risks, loss, or damage during transit.

One of the most important topics regarding regulations is the International Commercial Terms or Incoterms, established by the International Chamber of Commerce (ICC). The Incoterms consist of a set of trade rules which are employed in international sales contracts. For these rules to have a legal effect, incoterms must be explicitly integrated into the parties contracts (LLC, 2020). Yang J. suggests that the selection of incoterms are able to minimize total cost and improve logistics performance (Yang, 2021). So, agents play an important role when it comes to advising and informing their customers.

Incoterms reduce the uncertainty between buyer and seller, inherent in international transactions: commercial practices and interpretations that differ from one country to another. They define the moments form when the risk and the costs transfer from the seller to the buyer. Moreover, incoterms indicate the respective responsibilities and obligations for the delivery of the goods and the seller's obligations in relation to documentation. It is noteworthy that these terms are not mandatory. Incoterms are standardized and recognized clauses that enable the disputes to be avoided by clearly dividing obligations, risks and expenses between buyer and seller. Incoterms can be split into two categories: For all modes of transport and for sea and Inland waterway transport. Some of the most common include:

- EXW (Ex Works): The seller makes the goods available at their premises, and the buyer is responsible for all transportation arrangements, costs, and risks involved in delivering the goods from the seller's location to the final destination. The seller's responsibility ends once the goods are made available at their premises.
- FOB (Free on Board): The seller is responsible for delivering the goods to the agreed-upon port of shipment and covering the costs and risks until the goods are loaded onto the vessel. Once the goods are on board the vessel, the responsibility and costs transfer to the buyer.
- CFR (Cost and Freight): The seller is responsible for delivering the goods to the agreed-upon port of destination and covering the costs of transportation to that port. The risk of loss or damage transfers to the buyer once the goods are loaded onto the vessel.
- CIF (Cost, Insurance and Freight): The seller is responsible for delivering the goods to the agreed-upon port of destination and covering the costs of transportation and insurance to that port. The risk of loss or damage transfers to the buyer once the goods are loaded onto the vessel.

2.4.6 Relevant Metrics and KPIs

Table 1 summarizes the most important KPIs and metrics in the freight forwarding and transport industry. It also contains metrics able to measure supply chain performance and the productivity of the whole organization. Financial metrics are very versatile across industries in this regard.

The five dimensions encompass indicators applicable to the majority of enterprises within a supply chain. As freight forwarders are integral components of the supply chain, these KPIs align with their requirements and those of their respective clientele.

Table 3- Indicators and data for international freight forwarders' customers

Dimension	Indicators	Brief Description	Reference
Economic and Financial	ROI	Return on Investment measures the profitability of an investment by calculating the ratio of net profit to the initial investment.	(Israel et al., 2023; Neri et al., 2021; NetSuite.com, 2023)
	ROE	Return on Equity evaluates a company's profitability by measuring the return generated on shareholders' equity.	
	Profit Margin	Percentage of profit a company earns from its revenue, indicating its ability to control costs and generate earnings.	
	Working capital	Difference between a company's current assets and current liabilities- indicates its short-term financial health.	
	Operating Cash Flow Ratio	Measures of a company's ability to generate cash from its operating activities, providing insights into its financial stability and liquidity.	
	Current Ratio	Liquidity ratio that assesses a company's ability to pay its short-term obligations by comparing current assets to current liabilities.	
Service quality	Customer satisfaction Rate	Level of customer contentment with a company's products or services.	(Huang et al., 2019; Israel et al., 2023; Mai, 2021; C. Zhang & Zhang, 2010)
	First response time	Time taken by a company to respond to a customer inquiry or complaint, reflecting its customer service efficiency.	
	Deliver reliability	Measures how consistently a company delivers products or services on time, indicating its operational reliability.	
	Delivery time	Time taken for a shipment or service to reach the customer, reflecting the efficiency of the supply chain.	
	Transit time	Time taken for goods or services to move from one location to another, reflecting the efficiency of transportation.	
Markets	# of export by country	Number of goods or services shipped to different countries, indicating a company's global reach and market diversification.	(Stadtler & Kilger, 2005)
	# of import by country	Number of goods or services purchased from different countries, reflecting a company's international sourcing strategies.	
Sustainability and Environmental	Resource consumption	Number of resources used by a company in its production processes, indicating its environmental impact and efficiency.	(Duin & Thoben, 2022; Fulzele & Shankar, 2023; Kumar et al., 2023; Patidar et al., 2022)
	Emissions	Estimate of greenhouse gases and pollutants emitted by a company service, indicating its environmental impact.	
	Environmental expenses	Costs incurred by a company to manage and reduce its environmental impact.	
	Energy consumption	Estimation of energy used by a company in its operations and activities.	
Laws and Regulation	Incoterms	International trade terms that define the responsibilities and risks between buyers and sellers in a transaction, influencing the cost and delivery of goods.	(LLC, 2020; Yang, 2021)

2.5 Machine Learning in Freight Forwarding

Technological advancements in international trade operations are vital for the sustainable development of this sector. Process automation and supply and demand predictions are two ways in which Artificial Intelligence (AI) is being applied in the freight forwarding industry (Jang et al., 2023; Milenković et al., 2021). Freight transportation traffic control (N. S. Munir et al., 2023), empty container repositioning (Cai et al., 2023) and predicting arrival delay times (Pineda-Jaramillo et al., 2023) are other less common examples where researchers have used AI to help solve real world problems in the industry.

Risk management, reduced costs, increased ROI and increasing alignment to business needs are some benefits that AI brings to international trade (Sidharthan, 2020).

When it comes to budget and estimating costs, predicting freight expenses of a cargo is beneficial for any enterprise that executes export or import services (Kulkarni et al., 2023). Containers and cargo movement are characterized by their high uncertainty. Therefore, to enhance the efficiency of intermodal transport services, it is essential to make forecasts for this sector. In this topic incorporating machine learning (ML) models such as neural networks generates great results (Sulistyowati et al., 2018).

Previous studies have identified factors influencing shipping cost settings, including freight information factors such as "distance" and "ship volume," as well as additional cost factors like "delivery location" "fuel cost". Various models have been employed for price prediction in this context (Jang et al., 2023).

The present study uses Artificial Neural Networks (NNs) for predicting clients' freight costs. NNs are a class of a machine learning model inspired by the structure and functioning of the human brain, and consist of interconnected nodes or "neurons" organized in layers, where each neuron processes input data and passes it to the next layer until the output is generated (Schmidhuber, 2015). These networks are designed to recognize patterns, learn from data, and make predictions or decisions without being explicitly programmed for each task.

The work developed in the present thesis implemented a type of recurrent neural network, a Long Short-Term Memory (LSTM) recurrent neural network. LSTMs were used due to their robust capacity of storing, with high precision concrete numbers between an extended interval of time and for being specially designed to accurately identify and sequence events that are widely separated in noisy input streams (Schmidhuber, 2015).

3

PROPOSED METHODOLOGY AND THE BI AND ANALYTICS REPORTING SOLUTION

3.1 Rangel Logistics Solutions

Rangel Logistics Solutions, headquartered in Oporto, Portugal, is a global logistics partner. Founded in 1980 by Eduardo Rangel, the company rapidly made an impact on the market and has become a multinational enterprise. It contains global coverage and is supported by a network of partners from all over the world, Rangel is able to transport cargo between over 220 nations and territories by land, sea, and air.

Rangel identifies itself as a one stop shop solution, which represents an entity that delivers multiple services either through more or less formal collaboration between different administrative units or through the merger of different entities at the same level into a single entity (Minas, 2014). Rangel provides services in various countries apart from Portugal, namely in Africa from South Africa, Cape Verde, Mozambique, Angola to Zambia and Tanzania. In America, it is established in Brazil and Mexico. This company acts as a freight forwarder, and it offers a variety of different services. Services provided include customs broker, international road freight, air, and sea freight, express transport of goods, contract logistics, special logistics, and specialized logistics services for works of art and trade fairs. The multinational presence, the broad range of BUs, and the culture of digitalization and evolution made Rangel the perfect company for the present case study.

Rangel provides logistics solutions for many industries, including trade fairs, wines & beverages, food & perishables, consumer electronics, e-Commerce, and Industrial Logistics. It also serves as a specialized logistics partner, taking on the responsibility for handling complex projects that go beyond the standard scope of operations.

In 2022, Rangel has about 2.600 employees and more than 23 thousand clients. It has performed 8.6 million shipments and moved 1.165 thousand tons of cargo. All of this culminates in 250 million euros in gross revenue.

3.2 User Centered Design Methodology

There are different BI methods that can be used for building a customer centric solution (Saabith, 2022). Information can be shared through dashboards, reports, descriptive, statistical or visual analysis, and others. For the present case study, Power BI was used as a reporting tool..

As for any study performed in an enterprise or organization environment, the first step involved the onboarding process. This included getting to know the team and coworkers, understanding the core business of the organization and, more in depth, the business unit in which the author was developing the case study. It also encompassed discussing objectives and goals with human resources and fully understanding the scope of the project. Additionally, the author received training on the enterprise information system, BluJay, which was designed and tailored for Rangel's needs, and performed job shadowing on some operational employees to better comprehend the daily tasks and main activities the air and sea international business unit. The described process, besides making the onboarding phase more engaging and enriching, the author was able to gather valuable insights about how the organizations act and present themselves in the industry.

Regarding the project development, for the BI reports a User-Centered Design (UCD) approach was followed.

The UCD is a surround methodology that prioritizes users, their characteristics, and needs throughout the stages of planning, design, and evaluation (Dwanoko & Arin, 2021; ISO, 2019). It aims to build systems that are highly useful and accessible, with the goal of achieving user pleasure while avoiding any negative implications on performance (Vigoroso et al., 2020). As a result of its efficacy and user-friendly results (Surma-aho & Hölttä-Otto, 2022), UCD methodology has shown great results in visual communication (Vigoroso et al., 2020), product design (van Kuijk et al., 2019) and at the healthcare sector for patient monitoring at intensive care medicine (Gasciauskaite et al., 2023) and chronic neurological and mental health conditions (Polhemus et al., 2022). More recent studies also show the usage of this technique to develop virtual reality data visualization infrastructure (Gernez et al., 2023; Z. Wang et al., 2023) and integrating AI tools to evaluate design (Gupta et al., 2023).

The UCD method consisted of four different phases. The first phase was focused on accessing the customer's pains and needs and it was followed by defining the functional requirements of the system. The third step of the UCD method included the development of the report prototype to fit the customer's needs and wants. Lastly, in the fourth phase the BI report was internally tested, and security roles were implemented.

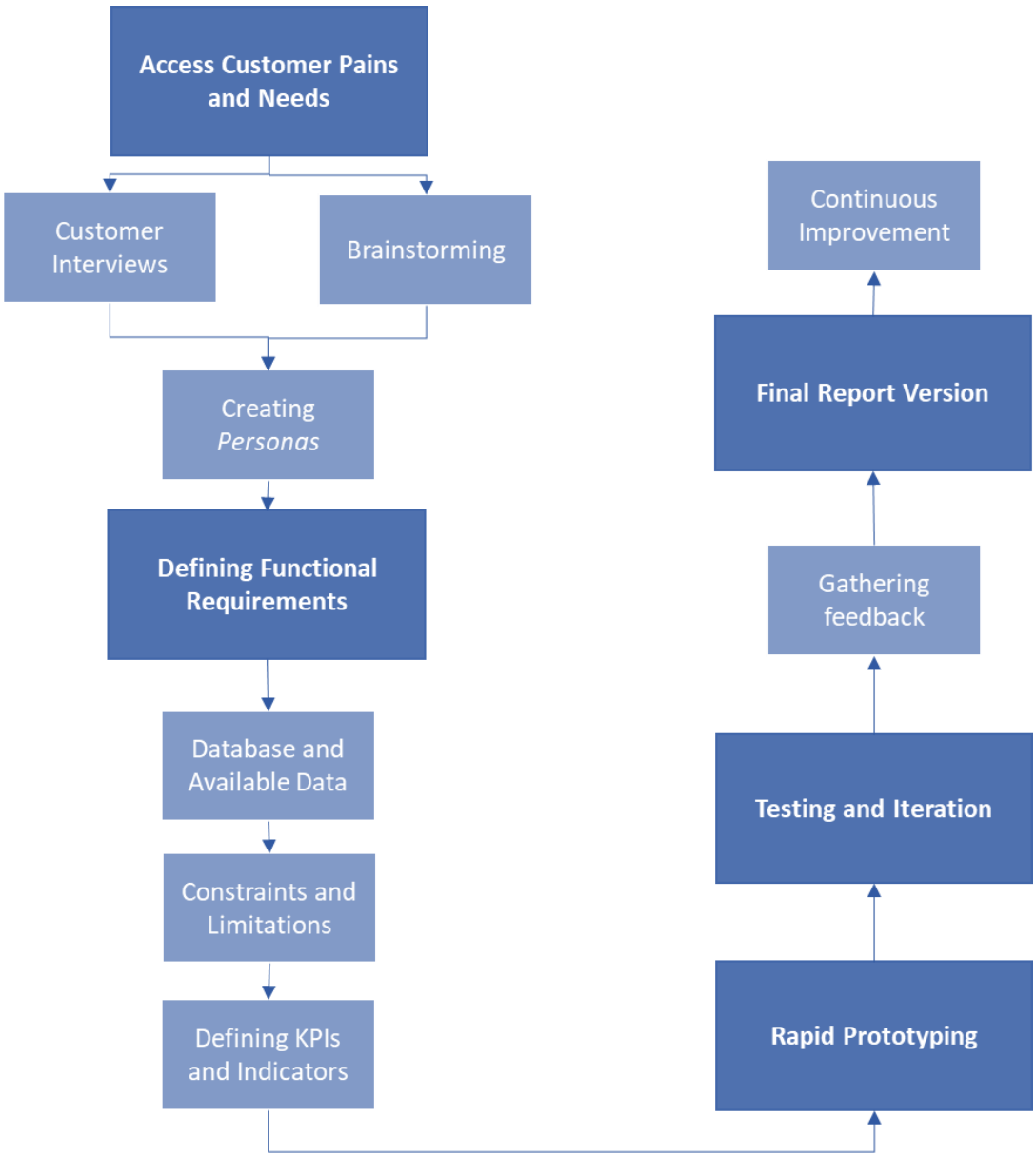


Figure 2- UCD Method schema.

3.3 Development of the Business Intelligence Solution

The UCD methodology served as a guide to develop a user-friendly and intuitive solution for customers. However, feedback from sources inside the company, that work with customers daily and deal with their pains, was extremely helpful.

The following chapter describes, in detail, the steps taken to achieve the final customer solution. From accessing the customers' needs and pains to building and developing the report.

3.3.1 Accessing Customer Needs

The first step regarding the UCD methodology is to understand and find out what are the customer needs (Dwanoko & Arin, 2021). To begin the present phase, first and foremost it is mandatory to answer the following questions: "Who is going to use the solution?" and "How is the solution going to be used?".

From the start, the answer to the first question is the customer. However, being the organization a Business to Business (B2B) business model, knowing who is going to be the final user, their role in the organization and in what circumstances is the solution going to be used are vital outlines.

As stated, the UCD is focused on the final user. With this goal in mind, retrieving information from the customers, which are the final users, is an essential step. Investigative and generative methods and tools were used in the present research (Interaction Design Foundation, 2023). Investigative methods included customer interviews, while generative ones consisted of brainstorming with the general manager, team leader, sales, and operations team.

Literature considers that customer interviews are a good way to gain qualitative insights (Özal & Münch, 2021). Interviews were conducted to retrieve customer feedback and understand what information and visualizations customers needed to have access to. Seven different managers and procurement specialists were interviewed. Interviewees were all from different industries such as logistics, beauty and well-being, construction, elevators, automotive and 3D printing. Data gathered at customer interviews process is described in table 3, which structures the interviews feedback regarding the questions asked:

- Data Storage and Analysis: Interviewees were asked if they keep a record of the services they order. And if they do, which software do they utilize to analyze and visualize that data.

- Indicators and KPIs: Customers were asked what KPIs, information or indicators about the service with Rangel would the customer want to visualize.
- Usefulness: Before asking the following question, the project scope was described. Interviewees were asked if this initiative would be helpful and add value for them.
- Final comments: This column summarizes any comment or additional insight made by the interviewed customer.

As it is common in the UCD methodology, data collected from the interviewees allowed to define two different personas (Bhattacharyya et al., 2019), as shown in table 4, each characterized by their own requirements and needs. Personas are defined by the literature as representations of people who have similar goals, motivations, and behaviors (Karolita et al., 2023).

Table 4- Customer interviews summary.

Interviewee	Age	Industry	Job title	Company Size (employees)	Data Storage and Analysis	Indicators and KPIs	Usefulness	Final comments
A	52	Automotive	Procurement specialist	50 to 249	Data is manually registered in Excel. Implemented simple automation in Excel to perform analysis.	Access to historical data and transit time.	Not very useful.	N/A
B	48	3D Printing	Procurement specialist	10 to 49	Data is stored in a non-standardized manner. Employers irregularly register information	Access to detailed historical data and real time data.	Adds value to the service.	Considered Machine Learning model very interesting
C	45	Construction	Manager	10 to 49	Orders are automatically registered in SAP	Access to historical data, transit time and market or cost trends.	Not useful.	If it includes some valuable insights it will be used frequently, but SAP is better because of already used integration
D	50	Beauty and Well Being	Warehouse Manager	1 to 9	Each employee has their own Excel file, where data is registered	Weight, freight, transit time and Lead time.	Adds value to the service.	Available to test the project when concluded
E	57	Automotive	Manager	50 to 249	Integrated system where information is automatically stored	Revenue, financial trends.	Useful for weekly team meetings.	Legal documentation available in reports.
F	38	Materials and components	Procurement specialist	250 +	Insert manually in a shared Excel file	Access to historical data, costs and response time.	Adds value to the service.	Saves times in calls
G	42	Aviation	Manager	10 to 49	Multiple excel files shared for all employees.	Access to historical data.	Adds value to the service.	Mentioned the need of real time data access and tracking system

Table 5- User personas.

Manager or Executive	Procurement specialist
Focused on indicators	Focused on detailed services
Evaluates trends	Evaluates transit time
Evaluates expansion opportunities	Prioritizes updated and if possible real time data
Examines total expenses	Compares previous prices
Broader vision and strategy outlook	Evaluates trends more focused on price and quantity
Enjoys user-friendly tools and reports with a clean design	Enjoys user-friendly tools and dense reports with detailed information.

3.3.2 Functional Requirements Definition

Subsequent of defining personas and customer needs, the first functional requirements that would be included in the report were determined. During this phase, managers, sales, and operations team, that manage customers' accounts and handle clients on a day-to-day basis, were consulted. Their feedback transmitted valuable insights that enabled to iterate the report indicators and KPIs initially established. Also, during this step data from customers interviewed was considered. Customer feedback was gathered to extrapolate some indicators and visuals.

Data needed to build the reports was stored in the complex database of BluJay, the information system used by Rangel. BluJay has two databases, one related to daily operations and other that linked to file maintenance. Both are relational databases, having data stored into tables with predefined relationships between them (GOOGLE, 2023). The operations database has more than 400 tables. These tables include information on shipments, invoices, customers, suppliers, and various operational aspects. In parallel, the file maintenance database boasts an impressive compilation of over 300 tables, underscoring its integral role in supporting the system's overarching architecture. The comprehensive understanding and assimilation of the database structure, alongside the wealth of information it harbors, constitutes an indispensable facet of the ongoing stage. The BI software that was going to be used was also decided in the current phase. After considering the different options listed in table 2, from the literature review, a final decision was made. This selection was not made

only by the author. It involved management and employees of the customer solutions team to decide. The verdict was based on the following framework and criterion:

- **Business needs and objectives**: Power BI satisfied all the needs and goals of the project.
- **Data source integration**: Excel files seamlessly integrate with Power BI.
- **Scalability and Performance**: Easy to share with customers and to collaborate. However, when dealing with high amounts of data it can get high latency.
- **User-Friendliness and Ease of use**: Customers are familiar with Microsoft tools and some use Power BI. Nevertheless, it is intuitive, and it can be built to be very user friendly.
- **Total Cost of Ownership**: Individual licenses are not expensive and can be easily afforded by the company.
- **In-house technical capacities**: Power BI was already used in the organization and employees already had skills that helped in the building of reports.

Considering the above criteria, Power BI was the obvious option. The fact that it was already used inside the organization played a big role in the selection. Other pondered software's were Tableau, Qlik Sense and Python, but none were as good as Power BI in the stated parameters.

While in the current phase, several limitations were encountered, impacting the ability to compute relevant KPIs. One notable restriction was the calculation of essential financial metrics. Although they are great at measuring the performance of the organization, it was not possible to calculate such values for the customer since data such as revenue or debt is internal information and does not enter the scope of this project. Moreover, the process of querying data from the information systems involved cumbersome steps, including transferring the data to an Excel file before exporting it to the reporting software. This barrier makes it impossible to share real time insights.

Furthermore, due to the absence of information linked to the service's start date, crucial indicators like response time and lead time could not be determined, limiting a comprehensive understanding of performance aspects. Lastly, the information system was only be implemented at the end of 2020. This resulted in a scarcity of historical data, which presented challenges in conducting a thorough and extensive analysis.

Despite these constraints, the author strived to work creatively and efficiently, exploring alternative approaches to gather insights and make informed decisions. All of the stated

constraints were passed on to management. Valuable progress was made in enhancing creating new data fields.

Besides, the design of the report was also considered essential and mentioned throughout the various phases of the UCD methodology. Feedback gathered revealed a strong appeal to a clean and simple design, not overwhelmed with information, as the literature suggests (Eriksson & Granhof, 2021), and to provide an interactive and immersive experience for the customer.

An essential requirement, however, this time from the enterprise where the project was developed, the reports had to be automatically updated and it should not include manual set-up subsequent of the implementation.

Table 5 showcases the functional requirements gathered, after analyzing customer interviews, brainstorming, internal feedback and considering constraints.

Table 6- Functional requirements divided by dimension.

Dimension	Metrics/ Data
Economic and Financial	Expenses
	Freight
Service Quality	Delivery time
	Transit time
	Trends
	Job details
	Weight
	Containers
Markets	# of export by country
	# of import by country
	Destinations
	Origins
Laws and Regulation	Incoterms
	Service type

3.3.3 Development of Interface Prototypes

The initial development phase started by prototyping. The creation of prototypes can be defined as the preliminary step preceding the realization and materialization of ideas into a final product (ideafoster, 2022; Murphy et al., 2021). Designing prototypes instead of delivering a final product makes it easier to find possible design defects, prevents going into production without feedback from managers and the end customer and it offers the chance to identify possible improvements.

Literature points out the relevance of early stakeholder engagement throughout the various phases of prototyping and deployment as essential to fully maximize end-user usability and engagement (Leach et al., 2019).

The prototyping step started with a technic known by sketching. In this technique the first layout and visualizations concepts are laid out (Lewis & Sturdee, 2023). This allowed to have a clear vision of the project throughout the rest of the development in a matter of hours. Following the sketching phase rapid prototyping produced the first draft of reports for the final testing phase. Rapid prototyping enables for models and report pages made in less than a week (ideafoster, 2022), which could be discussed in the weekly meeting with the team leader and other customer solutions engineers as well as retrieve feedback from salesman.

The final results of the rapid prototyping phase are shown in appendix A.1 and A.2. The process of building the first drafts of a complete report suffered various iterations and customer interviews were being executed at the same time, which made it possible to get feedback while building the first prototypes.

It is worth noting that customers should have been contacted again after the conclusion of the first prototypes to ensure their needs were satisfied and to produce the best output. However, this was not possible because the project will not be deployed right away. Therefore, it was not in the interest of the company to contact customers once again at the time this thesis was written.

3.3.4 Iteration and testing

The last phase of the UCD methodology incorporated testing and iterating based on feedback. During this step more sales employees and account executives were involved, as it was the general manager of the International Air and Sea business unit, who handles the most important clients and stakeholders. Additionally, the inclusion of the general manager assured that the project was aligned with the vision and strategic goals of the organization, due to his holistic view.

At this stage the project was also presented to the whole organization, which generated a lot of positive and constructive feedback by employees from different business units who engage with different customers daily. It is worth mentioning again that trusted customers should have been exposed to the testing and iteration phase. Although, as mentioned, it was not strategic or opportunistic to showcase the project for the organization,

at that moment in time. The feedback gathered from all the different sources, afterwards the report prototypes were built, enabled the author to construct the final version of the report.

The functional requirements initially defined were included in the final report and the design is simple and intuitive. The final edition of the report contains seven different pages, each one with its respective subject regarding Rangel's service and it follows the following structure:

- **Landing page**: Initial page that gave interaction to the client and explained the goal of the new service feature.
- **Detailed services page**: Page with information about every job the client has performed. Also contains important statistics with respect to transit time, the number of services and the different types of services alongside with spendings particulars. The chart enables trend analysis of the volume and freight costs.
- **Exploratory Tree Diagram page**: Most interactive page in the report with the goal of providing a fast solution to grab general information for inside reports or statistical analysis.
- **Markets page**: Highlights costs and spendings in different markets regarding to exporting and importing services. Moreover shows trends by year and by month in terms of quantity and amount of services.
- **Geographical page**: Most visual page in the report changing the maps when a line of the table is selected. This provides satisfaction to more visual users as well as it makes a more enjoyable experience (Eriksson & Granhof, 2021).
- **Glossary page**: Informative page with the goal of providing technical industry knowledge to the user regarding incoterms, service type and some additional statistics.
- **Artificial Intelligence forecasts page**: Report page that encompasses the machine learning model capable of making freight cost predictions based on historical data. This part of the report was not fully functional in the final report, nevertheless it stayed as a coming soon feature as a marketing move to attract customers.

Every report page contains a filter menu and a brief explanation of the pages' instructions and how to navigate on it.

Appendix A.3 demonstrates the final version of the reports. However, it is worth noting that this report version will not be the final edition. This project must be in perpetual enhancement and, follow the principals of continuous improvement. To attain quality in the

provided service, once the deployment of the reports, the customer's voice has to be listened and changes have to be made accordingly (Sukarma et al., 2023).

3.3.5 Freight Prediction Model Implementation Results

Ultimately, subsequent to the overall data visualization part of the report, a machine learning model to predict clients' freight costs was developed. The model, as mentioned in the state-of-the-art chapter, was built using LSTM recurrent neural networks, due to its ability to recognize patterns and perform time series forecasting.

To develop this model, it was followed a simple structured approach. The first step, and one of the most crucial in any machine learning application, was the preprocessing of data (Raschka, 2015). After importing the necessary libraries, being Pandas, NumPy and TensorFlow the most important, and reading the data present in an excel file. The goal at this stage is to transform the raw data into a structured format. Converting the data into a 3D array provides a more structured and organized way to represent and analyze the dataset rather than a two-dimensional array. This is especially true when dealing with time-series data and machine learning tasks. The array had 3 variables: freight, volume and inflation data, making this a multivariate time series analysis. Following this step, records were normalized, and then split into training, validation, and test set. The training set is used to optimize the model, the validation series is primarily used during the model training phase for hyperparameter tuning and model selection, and, finally, the test set is used to assess the final performance and generalization of the trained model after all tuning and adjustments have been made (Shah, 2020). Moreover, data is split to assure that the model performs well not only on the training set but is able to generalize to new data.

Next, the, already mentioned, LSTM model was defined. Afterwards the model was fitted and trained on the dataset. The mean squared error (MSE), shown in equation 1, was the elected metric, also called loss, to measure model performance due to its vast popularity in literature (Wu et al., 2019; Yu et al., 2023; N. Zhang et al., 2019). Following the training, the hyperparameters were tuned to produce the lowest possible loss and best model. Hyperparameters refer to adjustable variables that must be defined before utilizing a machine learning model on a dataset. Examples of this variables are the learning rate, number of hidden layers, neurons per layer and the batch size (Liao et al., 2022).
Figure XXX exemplifies the model development methodology.

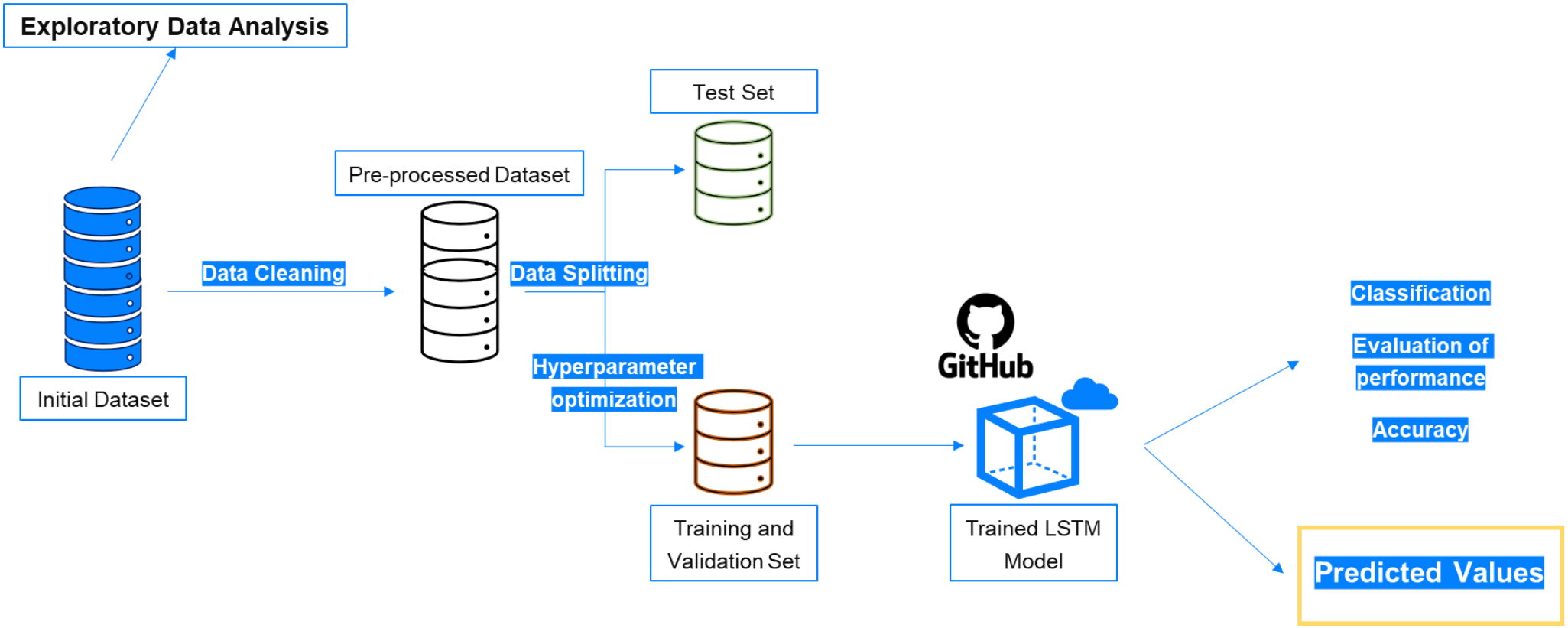


Figure 3 - Machine Learning model development methodology

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(yi - pi)^2 \qquad (1)$$

$yi = observed\ value\ or\ real\ value$
$pi = corresponding\ predicted\ value$
$n = number\ of\ observations$

The model's architecture consists of 3 main components: two LSTM layers and the dropout layer. The model follows the following architecture:

- The first layer is an LSTM layer with 64 units. This layer takes input sequences with a length of 31 time steps (or features).
- The second layer is another LSTM layer, but it differs in that it produces output only at the last time step. It has 32 units.
- The third layer is another LSTM layer, that produces output only at the last time step. It has 32 units
- The fourth layer is a Dropout layer.
- A dense layer with 64 units and a relu activation function.
- The output layer is a dense layer with one unit, which indicates that this model is predicting a single continuous value.

The total number of trainable parameters in this model is 40,321. The author notes that the effectiveness of this model depends on the specific dataset and problem it's applied to. The described architecture was selected after numerous tests and experiments with different configurations and hyperparameters.

Table 6 displays the recorded loss values for both the training and validation sets, providing insight into the model's performance during training. The various epochs examined in our experiments aimed to determine the optimal number. A comprehensive analysis of Table 6 in conjunction with Figures 1 and 2 leads to the conclusion that using more than 300 epochs does not yield a significant improvement in model performance. Furthermore, the observed low loss values indicate that the model effectively fits the provided data.

The model was evaluated on unseen data, the test dataset. The goal of this step was to evaluate model performance and check for any over or underfitting. Overfitting was noticed in the model since validation loss was increasing while training loss declined over time. Overfitting is a problematic behavior in machine learning where the model performs accurately on the training data but fails to generalize well to new, unseen data. Such an

overfit model may produce inaccurate predictions and lack the ability to perform effectively with diverse new data samples (AMAZON AWS, 2023; IBM, 2023). As mentioned, dropout techniques were used to fix the model overfitting. These strategies aim to assess the significance of features by assigning them relevance ratings, ultimately seeking to eliminate factors that have minimal impact on prediction outcomes (AMAZON AWS, 2023).

Table 7 - MSE values (Loss) for test and validation sets in different epoch numbers.

Epochs	Loss	Validation loss
10	0.7497	0.509
50	0.6655	0.4963
100	0.342	0.4852
300	0.0671	0.4487
500	0.0219	0.4584

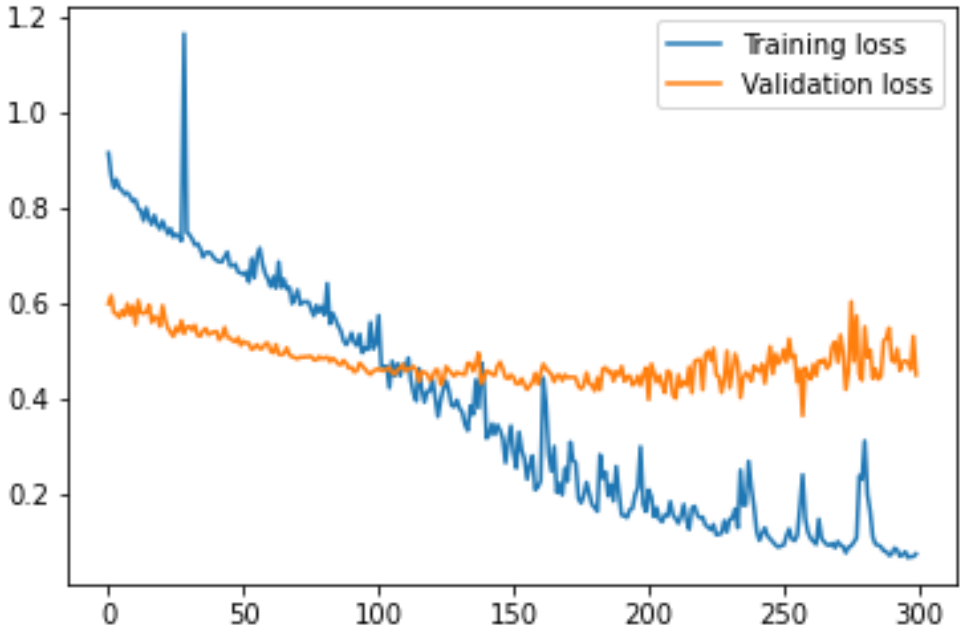


Figure 4 - Training and validation losses for 300 epochs (python chart)

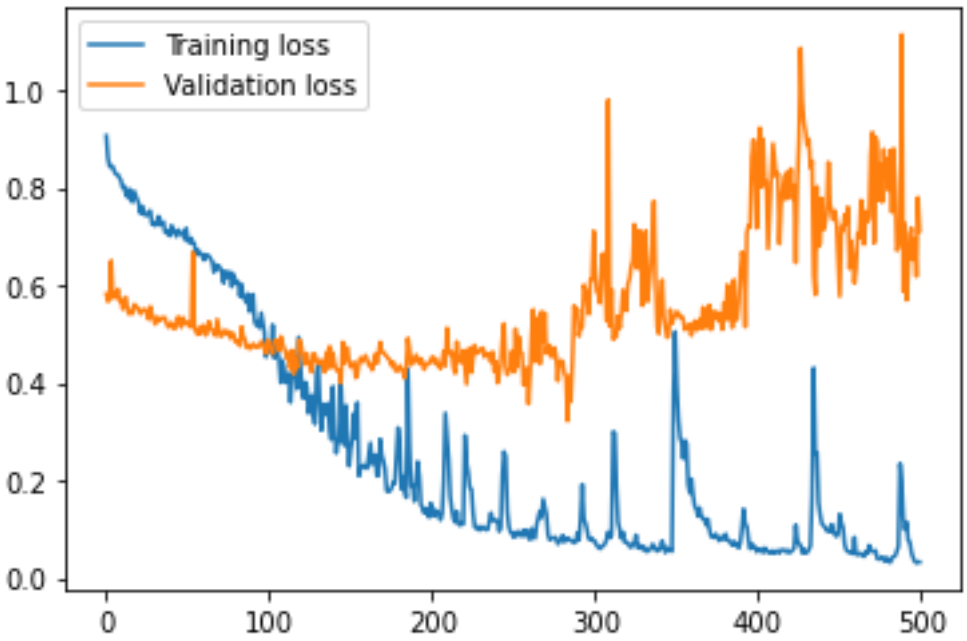


Figure 5 - Training and validation losses for 500 epochs (python chart)

3.4 Considerations Regarding the Design and Implementation of The Solution

The following section involves interpreting and explaining the results. Here, the author had the opportunity to delve into the implications of their findings and critically analyze them.

The final report, showcased in appendix A.3, was considered by the company managers as a very successful project and one that will add high value to the organizations' operations and client service.

3.4.1 The Application of Academic Research

Academic research was an essential point to support decisions regarding the KPIs and indicators showed in the report. This investigation enabled and enhanced the initial brainstorming phase, providing a general idea of state-of-the-art metrics used in enterprises. In this topic, it was noticed that a lot of KPIs are internal metrics and require data that is classified and not shared between nonpublic organizations. Despite their significance as financial KPIs, metrics like ROI and Current Ratio were deemed unsuitable for inclusion in this project. Sustainability metrics were also not included since data about emissions and resource consumption are not tracked by the International Air & Sea business unit. Rangel does not have its own fleet, which makes it a big challenge to track that information.

Literature also helped define how data was shown to the customer and the amount of information displayed. Through research the author learned to not overload the report with visuals and to create easy to read charts, tables, and visualizations.

Investigation guidance on how to develop the project and which methodology should be followed to achieve successful results. The UCD methodology enabled the author to understand customer needs, pains, and requirements. Moreover, it permitted to go beyond literature and conduct research in the field, engaging with customers and colleagues with managers also actively involved.

3.4.2 The Report

The project development and the use of the UCD methodology enabled the study to find important aspects regarding the freight forwarding industry and the general picture of export and import of goods included in international trade. First and foremost, the interest of clients in data with a lot of details, which can be sometimes considered as information

overload or unhelpful, is not the case for professionals in this industry. Specialists need the details to gain bargain power over other freight forwarders, and sometimes they cannot get it from a big picture outlook. However senior managers prefer to look at trends and check the big picture, since their job is about making strategic decisions and goals. The study also found that this industry still has a long way to grow and develop, mainly on the technology side. Cargo ships already have implemented systems to share real time location and it is also possible to know if a container is or is not already on board the ship. Yet, freight forwarders are not taking advantage of the available technology to improve customer service.

The present study also found that, for customers, the main driver for choosing a certain freight forwarder is the price. Clients usually choose the less costly option. Moreover, different forwarders have different prices for the same destination for the same ship or plane. The prices are influenced by factors such as the service level, the negotiation power a forwarder has with carriers, volume of cargo and their relationship. The geographical presence can also impact price, with local offices and networks. This results in a great necessity to differentiate from the competition. Projects that elevate customer service and provide visibility to clients can be a determining factor when choosing the freight forwarding agent.

In the final version of the report, both the author and the organization expressed high satisfaction with the outcome. However, due to misalignment with the current strategy and associated costs, the project was not deployed during the development of this master thesis. As a result, there was a lack of real customer testing and feedback.

The data used in the report had to be retrieved from the information system and then transferred to an Excel file before importing it into Power BI. This process proved time-consuming and required additional tools for automation. Despite using Power Automate (Omorodion, 2021) for this task, there were reliability issues, such as incorrect data retrieval and failure to send reports on multiple occasions. For instance, some reports were not updated even after new data was inserted into the information system. Additionally, approximately once a week, a user would not receive the report.

These challenges highlight the importance of streamlining data integration processes and ensuring reliable tools to deliver accurate and timely reports.

3.5 Discussion of Freight Prediction Model

Regarding the ML model, it was not the primary focus of the project, nor was it initially a requirement from the organization. The objective of building an ML model was an initiative from the author to add value to the project. Additionally, it demonstrate to clients that the organization integrates AI into its daily operations, showcasing innovation as an integral part of its core business.

Long-Short-Term memory recurrent neural networks were used to develop the present model because they have already produced great results with time series data and made precise predictions in literature (Che et al., 2018; Hewamalage et al., 2021; Kim & Won, 2018). As expected, the model performed well on the training dataset reaching low loss values even with the wide variation of data. On the validation set, it also showed a great performance until 300 epochs, where loss decreased alongside training loss. This indicates that the model's learning plateaus after 300 epochs, suggesting further training may not yield significant improvements.

The lack of records and the low amount of available data made it very challenging to obtain good and precise predictions. Even with the use of proven techniques such as regularization and dropout, the results were not reliable. By adding records to the information systems daily, the model will perform better and produce a more trustable output, meaning that in a few years the organization will have a functional and reliable machine learning model to share in their client's reports.

In summary, the implementation of an AI application and exposing it to customers elevates the service provided by the organization and gives credibility on innovation matters. The predictive capability provided by the developed machine learning model holds significant potential for assisting decision-making, resource allocation, and cost optimization within the freight forwarding industry. Future work in this area can include the prediction of transit times for different geographies and the prediction of individual freight services. All of this is based on economic factors and historical data.

4

CONCLUSIONS

This is the last chapter of the present master thesis. It resumes the study, concludes if the initial objectives were met, what did the author learn during the project development. Finishes with future work recommendations for the industry and the organization.

4.1 Final Remarks

The main objective of this thesis project was to develop a customer solution to increase visibility for customers in the export and import industry. The project and research showed how relevant for enterprises it is to innovate and differentiate from competitors through the use of technology, intelligence, and visibility.

The work performed in this mater thesis adds value to the current field of research. Key Insights that can be taken away include:

- Reports add value to the provided service and to the customer operations
- Metrics and KPIs form the freight forwarding industry were validated
- Personas were developed to better understand the customers
- The User Centered design methodology was validated as a good framework for technology applications focused on the client, and the final user
- A functional Machine Learning model was constructed with data from the organization to predict freight prices

The initially stated problems and objectives were successfully tackled and achieved respectively. The organization is benefiting from the data stored in their information systems and it's being leveraged to do increase the service value to their clients alongside visibility to the operations. Due to research and interviews relevant metrics and KPIs were selected and

included in the report. Through testing and iteration, the final project output is an easy to use, intuitive and valuable tool for Rangel's customers.

4.2 Lessons Learned

Without data analytics, businesses are blind and deaf. Data driven decision making is vital for any organization that wants to thrive and grow. This is the motto for innovative enterprises and followed in this master thesis project.

The project that generated the present thesis was built following a user centered design methodology. The focus of this method is to construct a solution that prioritizes users, their characteristics, and needs throughout planning, design, and evaluation. It aims to build highly useful and accessible systems and has shown great results in various fields, including visual communication. It is divided into four phases, being each one complementary. Firstly, user needs and pains were assessed. This was done with brainstorming sessions and performing customer interviews, which resulted in the definition of two personas. The manager with a more holistic view and a procurement specialist focused on services details and prices.

Next step was centered on defining the functional requirements for the solution. A business intelligence report was chosen as the best option to fulfill the customer's needs. Then it was essential to know what to include in the report. Here, data retrieved from customer interviews and brainstorming were used to select the most relevant indicators and KPIs to be showcased. Power BI was the selected software to deliver the reports and metrics shown are from important dimensions to this industry. Some metrics are freight expenses, delivery time and transit time.

Following the definition of the functional requirements, it was time to develop the prototypes. The thorough definition of functional requirements played a crucial role at this stage, acting as a guiding framework for designing the reports. It effectively outlined the necessary elements for each content section, ensuring a clear direction for the development process. Rapid prototyping enabled models and reports to be built in short time frames allowing for fast iteration based on feedback from employees who deal daily with customers and customers who were at the same time being interviewed.

Finally, some final considerations about the project development: more customers could have been interviewed to gather feedback from a larger sample of users and questionnaires, as google forms, could have been sent to customers and provided insights

on customers' needs beyond the scope of the project which would also have been beneficial to the organization. The machine learning model was a big challenge, and the author believes it increased the value of the present study, however, it was not the main goal of the project, and it was as time consuming as the development of the report on Power BI. Lastly, the non-deployment of the project did not contribute to providing the feeling of mission accomplished, testing the BI solution with real customers and receiving more valuable feedback on possible improvements.

The development of this master thesis has been a transformative journey, significantly enhancing the author's academic and professional growth. On the academic front, the researcher delved deeper into data visualization techniques, honing analytical skills while extracting valuable insights from the constructed reports. The quest for data involved leveraging SQL query knowledge, leading to proficiency in managing and manipulating relational databases—an essential skill in the realm of data science. Additionally, the project provided an invaluable opportunity to work with Power BI, a widely used and highly regarded business intelligence tool in various industries.

Furthermore, the most exhilarating aspect of the project was delving into the world of neural networks and machine learning models. Building and training a neural network model, specifically the LSTM architecture, was an intellectually stimulating process. The potential applications of such advanced models in the realm of freight forwarding and supply chain management hold promising prospects for driving innovative solutions and offering a competitive edge in the industry.

Overall, this journey has enriched the author's knowledge, skills, and passion for data analysis, data visualization, and machine learning, preparing him for continued growth and contributions to the field of data-driven decision-making.

In summary all the original objectives were effectively achieved within the projected timeframe, and all stakeholders involved, including the author, the company, and the users, expressed contentment with the outcomes.

- Data and Business Intelligence can be used to add value to customers and increase visibility.
- In this industry, two main personas were identified (Chapter 3.3.1)
- The organization benefited from the project by presenting customers with an innovative solution containing Business Intelligence e Machine Learning
- However, to deliver a valuable report, information needs to be filled adequately and precisely. Also, a long historical record provides the customer with a better model

Figure 6 - Main Conclusions

4.3 Future Work and Recommendations

In conclusion of the work done in this master thesis, the author presents potential avenues for future work and provide strategic recommendations based on the findings and insights gained throughout this study. As the field of freight forwarding and data-driven decision-making continues to evolve, it is essential to identify opportunities for improvement and anticipate emerging trends that can enhance the organization's performance and customer satisfaction.

The freight forwarding industry and overall international trade are an antique and paper heavy industry, with a lot of regulations and laws necessary to ensure fairness and detect illegal activities. The organization in which this study occurred is still in the beginning of digitalization and the implementation of the information system has three years old meaning it contains room for improvement. Future work can be developed to:

- Integrate reports in the information system and transform this process into a more consistent and reliable solution.
- Implementing a Customer Relationship Management solution to facilitate and enhance the work done by the sales team. They already have access to essential KPIs, however it lacks tools to track customer behavior and satisfaction with a customer centric analysis.
- Integrating AI models to make predictions on various areas: estimating the number of services, revenue, and transit time, and improve the model to better fit the data.

The author finishes this master thesis by giving strategic recommendations to the organization's leadership and decision-making process. Rangel should focus on data-driven

decision making and continuous training and skill development of its employees. Investment in data infrastructure to provide, for example, real-time information regarding the clients goods. Encounter technology partners to build a relationship and incorporate them in the operations to increase customer service and establish a mindset of change and adaptability.

People are the heart and soul of any organization. Nurture, retain and develop their talent. The success of others is our own.

REFERENCES

Adam Lee, M. S., Lori Upton, R. N., Magdalena Anna Denham, E., & Williamson, J. (2022). COVID-19 data driven planning: The SouthEast Texas approach. *Journal of Emergency Management*, *20*(7), 39–56. https://doi.org/10.5055/jem.0642

Al-Talib, M., Melhem, W. Y., Anosike, A. I., Garza Reyes, J. A., Nadeem, S. P., & Kumar, A. (2020). Achieving resilience in the supply chain by applying IoT technology. *Procedia CIRP*, *91*, 752–757. https://doi.org/10.1016/j.procir.2020.02.231

Alvarenga, M. Z., Oliveira, M. P. V. D., & Oliveira, T. A. G. F. D. (2023). The impact of using digital technologies on supply chain resilience and robustness: The role of memory under the covid-19 outbreak. *Supply Chain Management: An International Journal*, *28*(5), 825–842. https://doi.org/10.1108/SCM-06-2022-0217

AMAZON AWS. (2023). *What is Overfitting? - Overfitting in Machine Learning Explained - AWS*. Amazon Web Services, Inc. https://aws.amazon.com/what-is/overfitting/

Atikno, W., Setiawan, I., & Taufik, D. A. (2021). Key Performance Indicators Implementation: Literature Review and Development for Performance Measurement. *IJIEM - Indonesian Journal of Industrial Engineering and Management*, *2*(3), 189.

Bahrami, M., Arabzad, S. M., & Mazaher, G. (2012). Innovation In Market Management By Utilizing Business Intelligence: Introducing Proposed Framework. *Procedia - Social and Behavioral Sciences*, *41*, 160–167. https://doi.org/10.1016/j.sbspro.2012.04.020

Bernardino, J., Lapa, J., Almeida, A., Bernardino, J., Lapa, J., & Almeida, A. (2019). *Commercial and Open Source Business Intelligence Platforms for Big Data Warehousing* (commercial-and-open-source-business-intelligence-platforms-for-big-data-warehousing) [Chapter]. Https://Services.Igi-Global.Com/Resolvedoi/Resolve.Aspx?Doi=10.4018/978-1-5225-5516-2.Ch007; IGI Global. https://www.igi-global.com/gateway/chapter/www.igi-global.com/gateway/chapter/231012

Bhattacharyya, O., Mossman, K., Gustafsson, L., & Schneider, E. C. (2019). Using Human-Centered Design to Build a Digital Health Advisor for Patients With Complex Needs: Persona and Prototype Development. *Journal of Medical Internet Research*, *21*(5), e10318. https://doi.org/10.2196/10318

Bolsunovskaya, M., Shirokova, S., Budkin, A., Leksashov, A., & Shirokova, A. (2023). BI Application Development and Their Use for Logistics, Transport and Service Companies. *Lecture Notes in Networks and Systems*, *509*, 1395–1405. Scopus. https://doi.org/10.1007/978-3-031-11058-0_141

Cai, M., Li, H., Guo, Z., & Lu, S. (2023). Data-Driven Empty Container Repositioning for Large Scale Railway Network With Fuzzy Demands. *IEEE Transactions on Fuzzy Systems*, *31*(2), 557–570. Scopus. https://doi.org/10.1109/TFUZZ.2022.3217884

Cavaco, N. (2016). *Design of a Sustainable Competitiveness Evaluation and Execution System (SuCEES)*. https://run.unl.pt/handle/10362/20211

Cesal, A. (2021, June 8). Writing Alt Text for Data Visualization. *Nightingale*. https://medium.com/nightingale/writing-alt-text-for-data-visualization-2a218ef43f81

Che, Z., Purushotham, S., Cho, K., Sontag, D., & Liu, Y. (2018). Recurrent Neural Networks for Multivariate Time Series with Missing Values. *Scientific Reports*, *8*(1), 6085. https://doi.org/10.1038/s41598-018-24271-9

Dierker, D., Greenberg, E., & Saxon, S. (2022, March 14). *Disruption in the containerized logistics value chain | McKinsey*. https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/navigating-the-current-disruption-in-containerized-logistics

Duin, H., & Thoben, K.-D. (2022). Towards a Framework to Assess the Impact of Innovative Transportation Technologies. *2022 IEEE 28th International Conference on Engineering, Technology and Innovation (ICE/ITMC) & 31st International Association For Management of Technology (IAMOT) Joint Conference*, 1–8. https://doi.org/10.1109/ICE/ITMC-IAMOT55089.2022.10033314

Dwanoko, Y., & Arin, F. (2021). Implementation of User Centered Design methodology for designing information systems introduction to culture based on mobile applications. *IOP Conference Series: Materials Science and Engineering*, *1098*, 062004. https://doi.org/10.1088/1757-899X/1098/6/062004

Eriksson, J., & Granhof, A. (2021). *Improving the User Experience in Data Visualization Web Applications*.

Esteves, S. (2023). *Accessibility in DataViz: An introduction*. Feedzai.

Fulzele, V., & Shankar, R. (2023). Performance measurement of sustainable freight transportation: A consensus model and FERA approach. *Annals of Operations Research*, *324*(1–2), 501–542. Scopus. https://doi.org/10.1007/s10479-020-03876-2

Gasciauskaite, G., Lunkiewicz, J., Roche, T. R., Spahn, D. R., Nöthiger, C. B., & Tscholl, D. W. (2023). Human-centered visualization technologies for patient monitoring are the future: A narrative review. *Critical Care*, *27*(1). Scopus. https://doi.org/10.1186/s13054-023-04544-0

Gernez, E., Nordby, K., Archer Dreyer, S., Burås, T., & Fauske, J. E. (2023). How virtual reality is used in industrial maritime design processes: Two case studies. *Ocean Engineering*, *283*. Scopus. https://doi.org/10.1016/j.oceaneng.2023.115091

GOOGLE. (2023). *What Is A Relational Database (RDBMS)?* Google Cloud. https://cloud.google.com/learn/what-is-a-relational-database

Grublješič, T., & Jaklič, J. (2015). *Conceptualization of the Business Intelligence Extended Use Model*. https://www.tandfonline.com/doi/epdf/10.1080/08874417.2015.11645774?needAccess=true&role=button

Guarda, T., Carvaca, A., Gozabay, R., Saquicela, M., & Tomalá, H. (2022). Business Intelligence Analytics Tools. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *13381 LNCS*, 352–362. Scopus. https://doi.org/10.1007/978-3-031-10548-7_26

Gupta, S., Epiphaniou, G., & Maple, C. (2023). AI-augmented usability evaluation framework for software requirements specification in cyber physical human systems. *Internet of Things (Netherlands)*, *23*. Scopus. https://doi.org/10.1016/j.iot.2023.100841

Hawkins, P. (2021, May 28). The Data Viz Practitioner's Guide to Table Design. *Nightingale*. https://medium.com/nightingale/your-guide-to-table-design-from-a-data-viz-practitioner-d83f14dbfdc6

Heang, R., & Mohan, R. (2019). *LITERATURE REVIEW OF BUSINESS INTELLIGENCE*.

Hewamalage, H., Bergmeir, C., & Bandara, K. (2021). Recurrent Neural Networks for Time Series Forecasting: Current status and future directions. *International Journal of Forecasting*, *37*(1), 388–427. https://doi.org/10.1016/j.ijforecast.2020.06.008

Huang, S. T., Bulut, E., & Duru, O. (2019). Service quality evaluation of international freight forwarders: An empirical research in East Asia. *Journal of Shipping and Trade*, *4*(1), 14. https://doi.org/10.1186/s41072-019-0053-6

IBM. (2023). *What is Overfitting? | IBM*. https://www.ibm.com/topics/overfitting

ideafoster. (2022, December 20). *Benefits of prototyping and most common techniques*. Ideafoster - Data Driven Fast Innovation | Digital Innovation Consultancy Firm. https://ideafoster.com

Interaction Design Foundation. (2023). *What is User Centered Design?* The Interaction Design Foundation. https://www.interaction-design.org/literature/topics/user-centered-design

Iris, N., & Nagalingham, S. (2023). Implementation of Business Intelligence Solution for United Airlines. *International Journal of Advanced Computer Science and Applications*, *14*(1), 843–852. Scopus. https://doi.org/10.14569/IJACSA.2023.0140192

ISO. (2019). *ISO 9241-210:2019 Ergonomics of human-system interaction—Part 210: Human-centred design for interactive systems*. ISO. https://www.iso.org/standard/77520.html

Israel, B., Mahuwi, L., & Mwenda, B. (2023). A review of financial and non-financial measures of supply chain performance. *International Journal of Production Management and Engineering*, *11*(1), 17–29. Scopus. https://doi.org/10.4995/ijpme.2023.18797

Jaehn, F. (2016). Sustainable Operations. *European Journal of Operational Research*, *253*(2), 243–264. Scopus. https://doi.org/10.1016/j.ejor.2016.02.046

Jang, H.-S., Chang, T.-W., & Kim, S.-H. (2023). Prediction of Shipping Cost on Freight Brokerage Platform Using Machine Learning. *Sustainability*, *15*(2), Article 2. https://doi.org/10.3390/su15021122

Karolita, D., McIntosh, J., Kanij, T., Grundy, J., & Obie, H. O. (2023). Use of personas in Requirements Engineering: A systematic mapping study. *Information and Software Technology*, *162*. Scopus. https://doi.org/10.1016/j.infsof.2023.107264

Kaur, R., & SelectHub, M. R. A. at. (2023). *Best BI Tools 2023 | Top Business Intelligence Software*. https://www.selecthub.com/c/business-intelligence-tools/

Kim, H. Y., & Won, C. H. (2018). Forecasting the volatility of stock price index: A hybrid model integrating LSTM with multiple GARCH-type models. *Expert Systems with Applications*, *103*, 25–37. https://doi.org/10.1016/j.eswa.2018.03.002

Konsta, K., & Plomaritou, E. (2012). Key Performance Indicators (KPIs) and Shipping Companies Performance Evaluation: The Case of Greek Tanker Shipping Companies. *International Journal of Business and Management*, *7*(10), p142. https://doi.org/10.5539/ijbm.v7n10p142

Kulkarni, P., Gala, I., & Nargundkar, A. (2023). Freight Cost Prediction Using Machine Learning Models. In A. J. Kulkarni, S. Mirjalili, & S. K. Udgata (Eds.), *Intelligent Systems and Applications* (pp. 507–515). Springer Nature. https://doi.org/10.1007/978-981-19-6581-4_40

Kumar, A., Shrivastav, S. K., Shrivastava, A. K., Panigrahi, R. R., Mardani, A., & Cavallaro, F. (2023). Sustainable Supply Chain Management, Performance Measurement, and Man-

agement: A Review. *Sustainability*, *15*(6), Article 6. https://doi.org/10.3390/su15065290

Leach, C. R., Diefenbach, M. A., Fleszar, S., Alfano, C. M., Stephens, R. L., Riehman, K., & Hudson, S. V. (2019). A user centered design approach to development of an online self-management program for cancer survivors: Springboard Beyond Cancer. *Psycho-Oncology*, *28*(10), 2060–2067. Scopus. https://doi.org/10.1002/pon.5193

Lee, B., Henry Riche, N., Isenberg, P., & Carpendale, S. (2015, September 23). *More Than Telling a Story: Transforming Data into Visually Shared Stories | IEEE Journals & Magazine | IEEE Xplore*. IEEE Xplore. https://ieeexplore.ieee.org/abstract/document/7274435

Lewis, M., & Sturdee, M. (2023). *The Joy of Sketch: A Hands-on Introductory Course on Sketching in HCI and UX within Research, Practice, and Education*. Conference on Human Factors in Computing Systems - Proceedings. Scopus. https://doi.org/10.1145/3544549.3574187

Liao, L., Heng, L., Shang, W., & Ma, L. (2022, April 9). *An Empirical Study of the Impact of Hyperparameter Tuning and Model Optimization on the Performance Properties of Deep Neural Networks | ACM Transactions on Software Engineering and Methodology*. https://dl.acm.org/doi/full/10.1145/3506695?casa_token=bnpciIVITb0AAAAA%3A_etZkC60MaSIfjNZph8ImL0NB4ZaPhLo1sHS3oUVAAd0yyqXUqDiWIWalDdriMCWLPq1R6W_TBvQVQ

LLC, A. L. (2020, June 18). *Incoterms in International Trade • Aceris Law*. ACERIS LAW. https://www.acerislaw.com/incoterms-in-international-trade/

Mai, D. (2021). Relationships between Service Quality, Brand Image, Customer Satisfaction, and Customer Loyalty. *Journal of Asian Finance Economics and Business*, *8*, 585–593. https://doi.org/10.13106/jafeb.2021.vol8.no3.0585

Mckinsey. (2022). *What is industry 4.0 and the Fourth Industrial Revolution? | McKinsey*. https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-are-industry-4-0-the-fourth-industrial-revolution-and-4ir

Microsoft. (2023). *What is Microsoft Power BI?* https://www.microsoft.com/pt-pt/videoplayer/embed/RWQAMw?jsapi=true&postJsllMsg=true&maskLevel=0

Milenković, M., Milosavljevic, N., Bojović, N., & Val, S. (2021). Container flow forecasting through neural networks based on metaheuristics. *Operational Research*, *21*(2), 965–997. https://doi.org/10.1007/s12351-019-00477-1

Millais, P., Jones, S. L., & Kelly, R. (2018). *Exploring data in virtual reality: Comparisons with 2d data visualizations*. *2018-April*. Scopus. https://doi.org/10.1145/3170427.3188537

Minas, R. (2014). One-stop shops: Increasing employability and overcoming welfare state fragmentation? *International Journal of Social Welfare*, *23*(S1), S40–S53. https://doi.org/10.1111/ijsw.12090

Munir, M., Jajja, M. S. S., & Chatha, K. A. (2022). Capabilities for enhancing supply chain resilience and responsiveness in the COVID-19 pandemic: Exploring the role of improvisation, anticipation, and data analytics capabilities. *International Journal of Operations & Production Management*, *42*(10), 1576–1604. https://doi.org/10.1108/IJOPM-11-2021-0677

Munir, N. S., Hossain, N., Zame, R. R., & Sarowar, G. (2023). *Vehicle Detection of Bangladesh using YOLOv7 with Hyper-parameter Tuning*. 2023 3rd International Conference on

Artificial Intelligence and Signal Processing, AISP 2023. Scopus. https://doi.org/10.1109/AISP57993.2023.10135057

Murphy, A. R., Watson, B. C., Tomko, M. E., Hilton, E. C., & Linsey, J. S. (2021). *A review of design-related literature concerning cognitive processes, prototyping strategies, and modeling processes*. *6*. Scopus. https://doi.org/10.1115/DETC2021-66994

Neri, A., Cagno, E., Lepri, M., & Trianni, A. (2021). A triple bottom line balanced set of key performance indicators to measure the sustainability performance of industrial supply chains. *Sustainable Production and Consumption*, *26*, 648–691. https://doi.org/10.1016/j.spc.2020.12.018

NetSuite.com. (2023, March 22). *30 Financial KPIs to Track Now*. Oracle NetSuite. https://www.netsuite.com/portal/resource/articles/accounting/financial-kpis-metrics.shtml

Norman, W., & MacDonald, C. (2004). Getting to the Bottom of "Triple Bottom Line." *Business Ethics Quarterly*, *14*(2), 243–262. https://doi.org/10.5840/beq200414211

OECD & European Union Intellectual Property Office. (2021). *Misuse of Containerized Maritime Shipping in the Global Trade of Counterfeits*. OECD. https://doi.org/10.1787/e39d8939-en

Omorodion, K. A. (2021). *Power BI Automated Reports using Power Automate*. https://www.mssqltips.com/sqlservertip/6964/schedule-export-email-power-bi-reports-power-automate/

Özal, N., & Münch, J. (2021). How to Conduct Customer Interviews? A Workshop Format for Teaching Customer Interview Skills. *Lecture Notes in Business Information Processing*, *407*, 118–133. Scopus. https://doi.org/10.1007/978-3-030-67292-8_9

Patidar, A., Sharma, M., Agrawal, R., & Sangwan, K. S. (2022). Supply chain resilience and its key performance indicators: An evaluation under Industry 4.0 and sustainability perspective. *Management of Environmental Quality: An International Journal*, *34*(4), 962–980. https://doi.org/10.1108/MEQ-03-2022-0091

Pineda-Jaramillo, J., Bigi, F., Bosi, T., Viti, F., & D'ariano, A. (2023). Short-Term Arrival Delay Time Prediction in Freight Rail Operations Using Data-Driven Models. *IEEE Access*, *11*, 46966–46978. Scopus. https://doi.org/10.1109/ACCESS.2023.3275022

Polhemus, A., Novak, J., Majid, S., Simblett, S., Morris, D., Bruce, S., Burke, P., Dockendorf, M. F., Temesi, G., & Wykes, T. (2022). Data Visualization for Chronic Neurological and Mental Health Condition Self-management: Systematic Review of User Perspectives. *JMIR Mental Health*, *9*(4). Scopus. https://doi.org/10.2196/25249

Qu, J., Guo, H., Wang, W., Dang, S., & Liu, H. (2022). A Study on the Intuitive Design of Target Search Tasks under Time and Information Pressure. *Brain Sciences*, *12*(11), Article 11. https://doi.org/10.3390/brainsci12111464

Raffoni, A., Visani, F., Bartolini, M., & Silvi, R. (2018). Business Performance Analytics: Exploring the potential for Performance Management Systems. *Production Planning & Control*, *29*(1), 51–67. https://doi.org/10.1080/09537287.2017.1381887

Raschka, S. (2015). *Python Machine Learning*. Packt Publishing Ltd.

Richards, G., Yeoh, W., Chong, A. Y. L., & Popovič, A. (2019). Business Intelligence Effectiveness and Corporate Performance Management: An Empirical Analysis. *Journal of Computer Information Systems*, *59*(2), 188–196. https://doi.org/10.1080/08874417.2017.1334244

Rodrigue, J.-P., & Browne, M. (n.d.). *Chapter 10 International Maritime Freight Transport and Logistics*.

Rossel, R. (2021, October 14). *Trend Analysis: What Is It and Why Is It Important?* 365 Data Science. https://365datascience.com/trending/trend-analysis/

Saabith, A. S. (2022, October). *Business Intelligence Tools–Systematic Review*. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=EcSKk_UAAAAJ&citation_for_view=EcSKk_UAAAAJ:LkGwnXOMwfcC

Schmidhuber, J. (2015). Deep learning in neural networks: An overview. *Neural Networks*, *61*, 85–117. https://doi.org/10.1016/j.neunet.2014.09.003

Setiawan, I., & Purba, H. (2020). A Systematic Literature Review of Key Performance Indicators (KPIs) Implementation. *Journal of Industrial Engineering and Management*, *1*, 200–208. https://doi.org/10.7777/jiemar.v1i3.79

Shah, T. (2020, July 10). *About Train, Validation and Test Sets in Machine Learning*. Medium. https://towardsdatascience.com/train-validation-and-test-sets-72cb40cba9e7

Sharif, A., Chintalapati, S. S., Wobbrock, J. O., & Reinecke, K. (2021). Understanding Screen-Reader Users' Experiences with Online Data Visualizations. *The 23rd International ACM SIGACCESS Conference on Computers and Accessibility*, 1–16. https://doi.org/10.1145/3441852.3471202

Sidharthan, S. (2020). *International Trade Automation for Import and Export Businesses*. https://www.applexus.com/blogs/import-export-foreign-trade-automation

Solberg Søilen, K. (2016). A place for intelligence studies as a scientific discipline. *Journal of Intelligence Studies in Business*, *5*(3). https://doi.org/10.37380/jisib.v5i3.136

Son, Y., & Kim, W. (2023). Development of methodology for classification of user experience (UX) in online customer review. *Journal of Retailing and Consumer Services*, *71*, 103210. https://doi.org/10.1016/j.jretconser.2022.103210

Sopadang. (2017, April 11). *Sopadang: Sustainable supply chain performance measurement. A case study of the Sugar Industry*. https://scholar.google.com/scholar_lookup?title=Sustainable%20supply%20chain%20perfor-mance%20measurement%20a%20case%20study%20of%20the%20sugar%20industry&publication_year=2017&author=A.%20Sopadang&author=S.%20Wichaisri&author=R.%20Banomyong&author=R.%20Banomyang

Srivastava, G., S, M., Venkataraman, R., V, K., & N, P. (2022). A review of the state of the art in business intelligence software. *Enterprise Information Systems*, *16*(1), 1–28. https://doi.org/10.1080/17517575.2021.1872107

Stadtler, H., & Kilger, C. (Eds.). (2005). *Supply chain management and advanced planning: Concepts, models, software and case studies* (3. ed). Springer.

Suau-Sanchez, P., Voltes-Dorta, A., & Cugueró-Escofet, N. (2020). An early assessment of the impact of COVID-19 on air transport: Just another crisis or the end of aviation as we know it? *Journal of Transport Geography*, *86*, 102749. https://doi.org/10.1016/j.jtrangeo.2020.102749

Sukarma, L., Hendra, F., Alfatiyah, R., Indriyati, R., & Supriyono. (2023). *The manufacturing technology general framework: A continuous improvement approach towards achieving manufacturing excellence*. *2630*. Scopus. https://doi.org/10.1063/5.0126803

Sulistyowati, R., Suhartono, Kuswanto, H., Setiawan, & Astuti, E. T. (2018). Hybrid forecasting model to predict air passenger and cargo in Indonesia. *2018 International Conference on Information and Communications Technology (ICOIACT)*, 442–447. https://doi.org/10.1109/ICOIACT.2018.8350816

Surma-aho, A., & Hölttä-Otto, K. (2022). Conceptualization and operationalization of empathy in design research. *Design Studies*, *78*. Scopus. https://doi.org/10.1016/j.destud.2021.101075

Tableau. (2022). *Data Visualization Tips For Engaging Design | Tableau*. https://www.tableau.com/learn/articles/data-visualization-tips

THE 17 GOALS | Sustainable Development. (n.d.). Retrieved September 25, 2023, from https://sdgs.un.org/goals

van Kuijk, J., Daalhuizen, J., & Christiaans, H. (2019). Drivers of usability in product design practice: Induction of a framework through a case study of three product development projects. *Design Studies*, *60*, 139–179. Scopus. https://doi.org/10.1016/j.destud.2018.06.002

Vercellis, C. (2009). *Business Intelligence: Data Mining and Optimization for Decision Making* (1st ed.). Wiley. https://doi.org/10.1002/9780470753866

Vigoroso, L., Caffaro, F., & Cavallo, E. (2020). Occupational safety and visual communication: User-centred design of safety training material for migrant farmworkers in Italy. *Safety Science*, *121*, 562–572. Scopus. https://doi.org/10.1016/j.ssci.2018.10.029

Wang, Besançon, L., Rousseau, D., Sereno, M., Ammi, M., & Isenberg, T. (2020). *Towards an Understanding of Augmented Reality Extensions for Existing 3D Data Analysis Tools*. Conference on Human Factors in Computing Systems - Proceedings. Scopus. https://doi.org/10.1145/3313831.3376657

Wang, Q., Yang, S., Liu, M., Cao, Z., & Ma, Q. (2014). An eye-tracking study of website complexity from cognitive load perspective. *Decision Support Systems*, *62*, 1–10. https://doi.org/10.1016/j.dss.2014.02.007

Wang, Z., Wu, Y., González, V. A., Zou, Y., del Rey Castillo, E., Arashpour, M., & Cabrera-Guerrero, G. (2023). User-centric immersive virtual reality development framework for data visualization and decision-making in infrastructure remote inspections. *Advanced Engineering Informatics*, *57*. Scopus. https://doi.org/10.1016/j.aei.2023.102078

WebAIM: Alternative Text. (2021, October 10). https://webaim.org/techniques/alttext/

World Economic Forum. (2022, October 26). *What is the 'twin transition'—And how can it speed sustainable growth*. World Economic Forum. https://www.weforum.org/agenda/2022/10/twin-transition-playbook-3-phases-to-accelerate-sustainable-digitization/

World Trade Organization. (2023). *Global Trade Outlook and Statistics*. https://www.wto.org/english/res_e/publications_e/trade_outlook23_e.htm

Wu, C.-H., Lu, C.-C., Ma, Y.-F., & Lu, R.-S. (2019). *A new forecasting framework for bitcoin price with LSTM*. *2018-November*, 168–175. Scopus. https://doi.org/10.1109/ICDMW.2018.00032

Yang, J.-H. (2021). A study on the reasonable choice and utilization of incoterms 2020 rules from the perspective of logistics and supply chain management. *Journal of Korea Trade*, *25*(1), 152–168. Scopus. https://doi.org/10.35611/jkt.2021.25.1.152

Yu, Y., Lin, Y., Hou, X., & Zhang, X. (2023). Novel optimization approach for realized volatility forecast of stock price index based on deep reinforcement learning model. *Expert Systems with Applications*, *233*, 120880. https://doi.org/10.1016/j.eswa.2023.120880

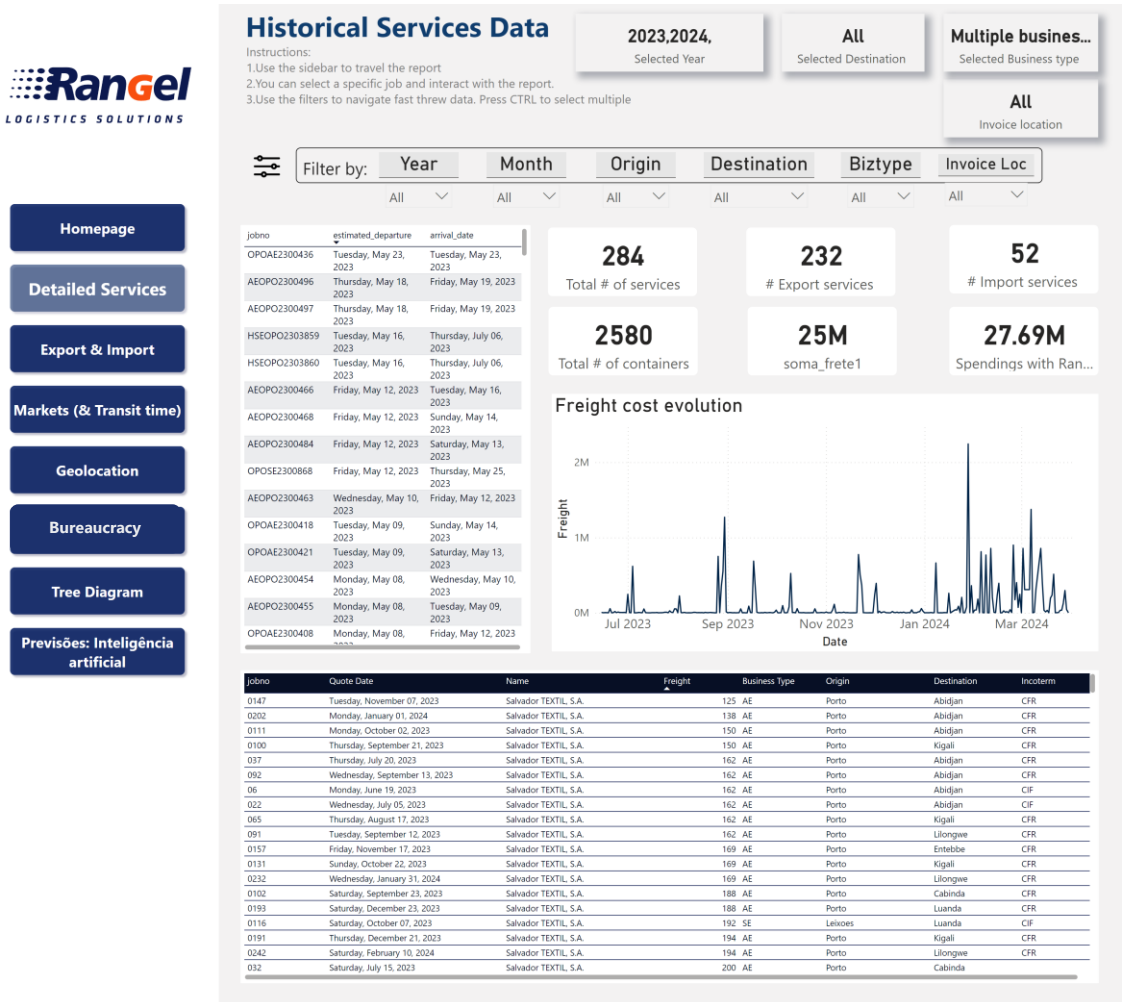
Zhang, C., & Zhang, L. (2010). *Logistics Service Quality Evaluation*.

Zhang, N., Shen, S.-L., Zhou, A., & Xu, Y.-S. (2019). Investigation on Performance of Neural Networks Using Quadratic Relative Error Cost Function. *IEEE Access*, *7*, 106642–106652. Scopus. https://doi.org/10.1109/ACCESS.2019.2930520

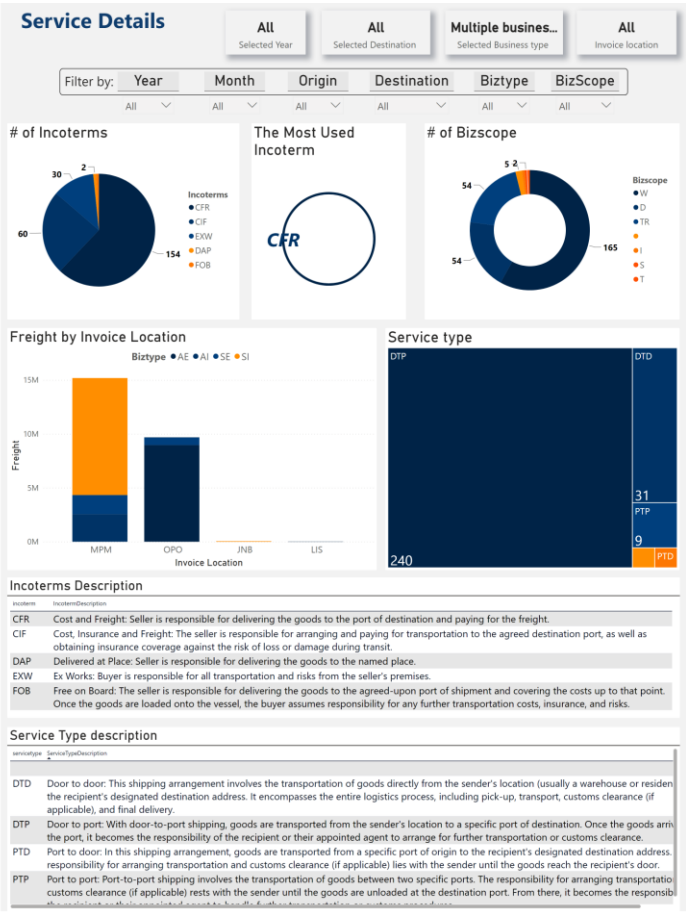
A

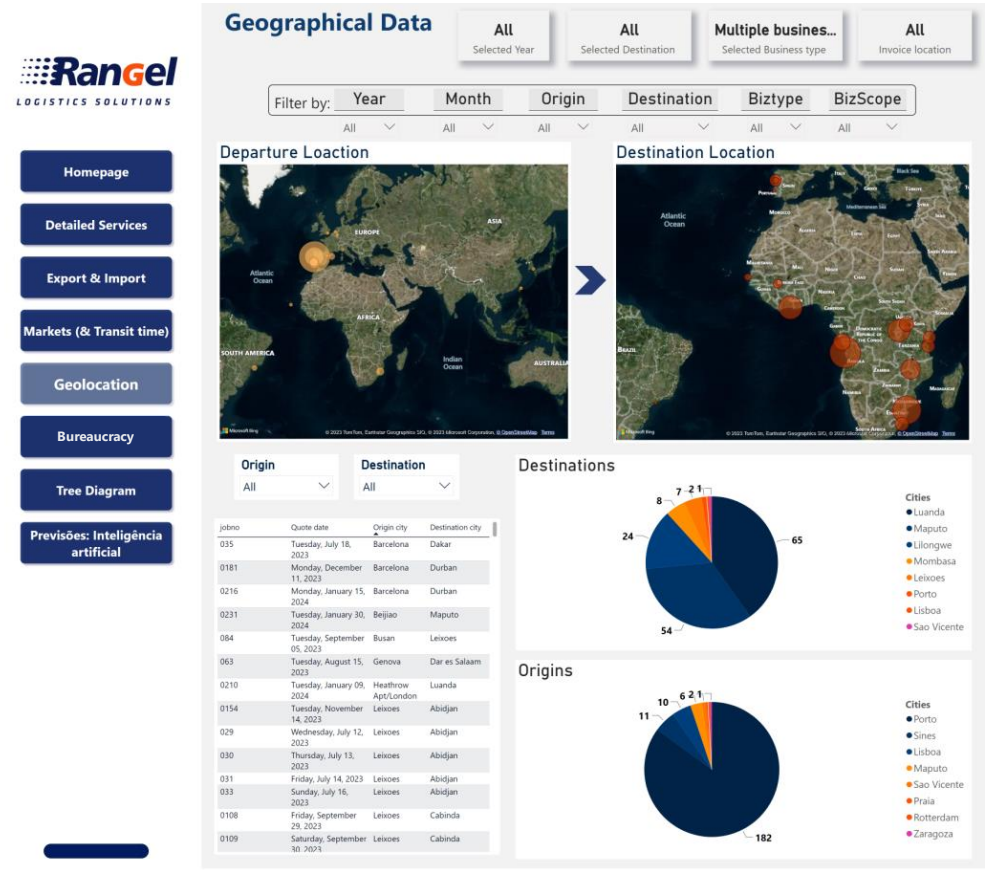
Appendix A: Prototypes

A.1 First prototype phase results

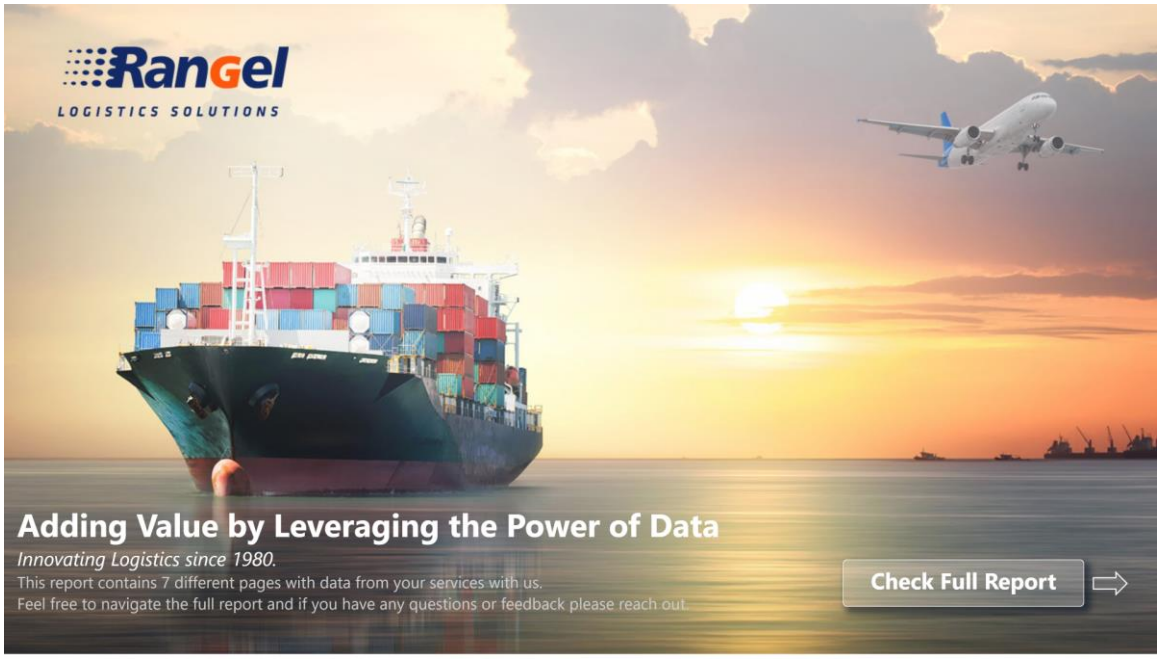


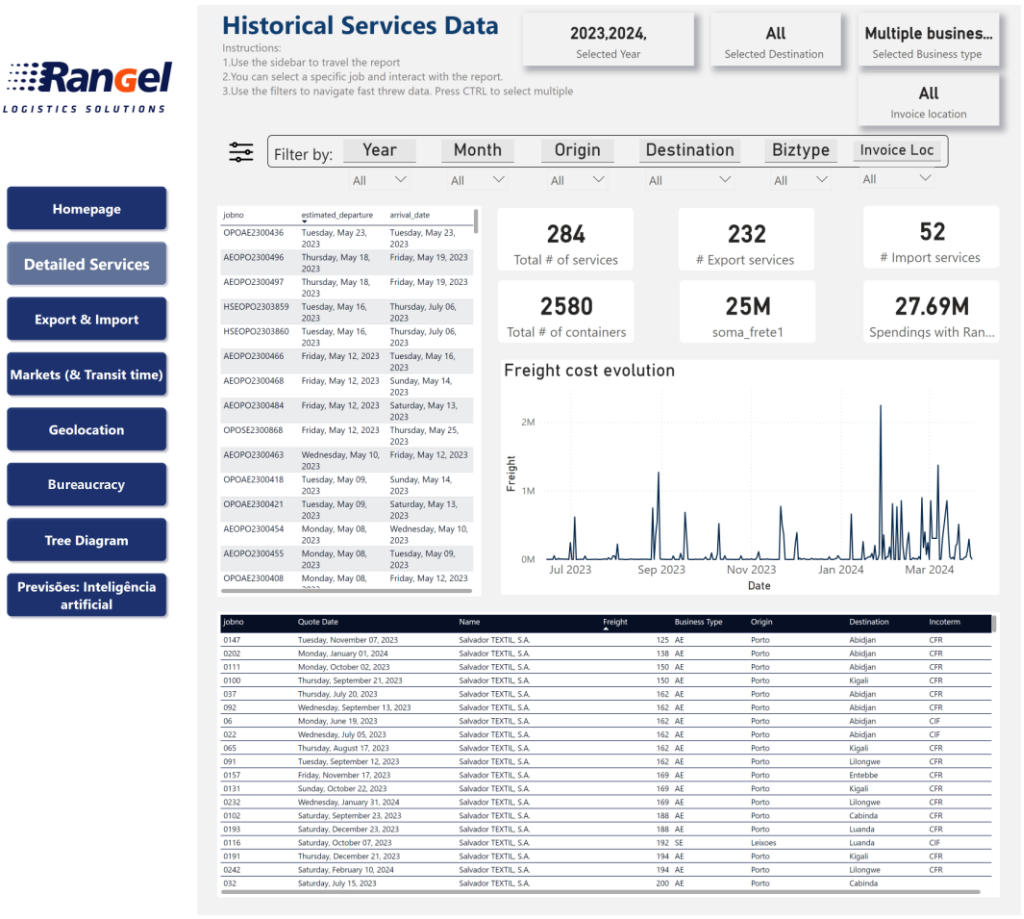

Export and Import
All
Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
Biztype
BizScope
284
Total # of Jobs
232
# of Exports
52
# of Imports
2580
Total # of containers
# of containers by Year and Quarter
Quarter Qtr 1 Qtr 2 Qtr 3 Qtr 4
# of containers
Year
# of Biztype
biztype AE SE AI SI
26 (9.15%)
63 (22.18%)
169 (59.5...)
Costs by Business type
26 (9.15%)
26 (9.15%)
63 (22.18%)
169 (59.51%)
Freight by Destination by Business type
Luanda
Maputo
Abidjan
Kigali
Lilongwe
Durban
Dar es Salaam
Mombasa
Leixoes
Porto
destino
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial


Service Details
All
Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
Biztype
BizScope
# of Incoterms
Incoterms
CFR
CIF
EXW
DAP
FOB
The Most Used Incoterm
CFR
# of Bizscope
Bizscope
W
D
TR
I
S
T
Freight by Invoice Location
Biztype AE AI SE SI
Freight
Invoice Location
MPM
OPO
JNB
LIS
Service type
DTP
DTD
PTP
PTD
240
31
9
Incoterms Description
CFR Cost and Freight: Seller is responsible for delivering the goods to the port of destination and paying for the freight.
CIF Cost, Insurance and Freight: The seller is responsible for arranging and paying for transportation to the agreed destination port, as well as obtaining insurance coverage against the risk of loss or damage during transit.
DAP Delivered at Place: Seller is responsible for delivering the goods to the named place.
EXW Ex Works: Buyer is responsible for all transportation and risks from the seller's premises.
FOB Free on Board: The seller is responsible for delivering the goods to the agreed-upon port of shipment and covering the costs up to that point. Once the goods are loaded onto the vessel, the buyer assumes responsibility for any further transportation costs, insurance, and risks.
Service Type description
DTD Door to door: This shipping arrangement involves the transportation of goods directly from the sender's location (usually a warehouse or residen the recipient's designated destination address. It encompasses the entire logistics process, including pick-up, transport, customs clearance (if applicable), and final delivery.
DTP Door to port: With door-to-port shipping, goods are transported from the sender's location to a specific port of destination. Once the goods arri the port, it becomes the responsibility of the recipient or their appointed agent to arrange for further transportation or customs clearance.
PTD Port to door: In this shipping arrangement, goods are transported from a specific port of origin to the recipient's designated destination address. responsibility for arranging transportation and customs clearance (if applicable) lies with the sender until the goods reach the recipient's door.
PTP Port to port: Port-to-port shipping involves the transportation of goods between two specific ports. The responsibility for arranging transportatio customs clearance (if applicable) rests with the sender until the goods are unloaded at the destination port. From there, it becomes the responsibi
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial

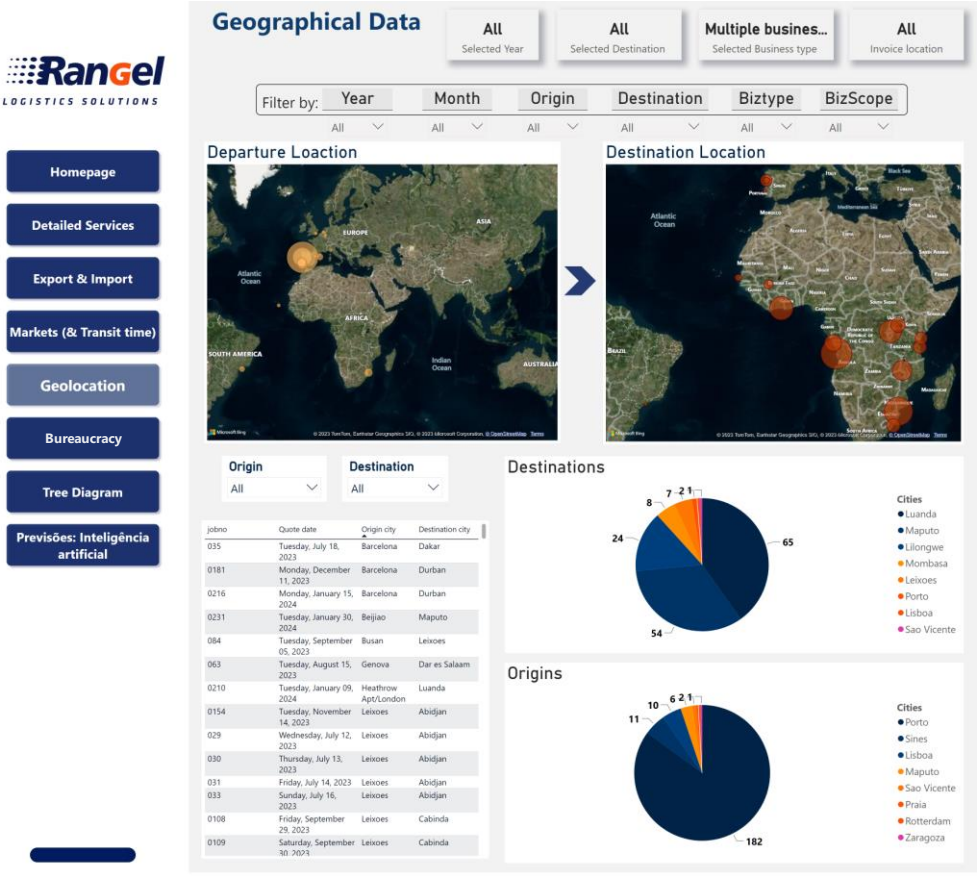


A.2 Second prototype phase results




Historical Services Data
Instructions:
1.Use the sidebar to travel the report
2.You can select a specific job and interact with the report.
3.Use the filters to navigate fast threw data. Press CTRL to select multiple
2023,2024,
Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
Biztype
Invoice Loc
All
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial
jobno
estimated_departure
arrival_date
OPOAE2300436 Tuesday, May 23, 2023 Tuesday, May 23, 2023
AEOPO2300496 Thursday, May 18, 2023 Friday, May 19, 2023
AEOPO2300497 Thursday, May 18, 2023 Friday, May 19, 2023
HSEOPO2303859 Tuesday, May 16, 2023 Thursday, July 06, 2023
HSEOPO2303860 Tuesday, May 16, 2023 Thursday, July 06, 2023
AEOPO2300466 Friday, May 12, 2023 Tuesday, May 16, 2023
AEOPO2300468 Friday, May 12, 2023 Sunday, May 14, 2023
AEOPO2300484 Friday, May 12, 2023 Saturday, May 13, 2023
OPOSE2300868 Friday, May 12, 2023 Thursday, May 25, 2023
AEOPO2300463 Wednesday, May 10, 2023 Friday, May 12, 2023
OPOAE2300418 Tuesday, May 09, 2023 Sunday, May 14, 2023
OPOAE2300421 Tuesday, May 09, 2023 Saturday, May 13, 2023
AEOPO2300454 Monday, May 08, 2023 Wednesday, May 10, 2023
AEOPO2300455 Monday, May 08, 2023 Tuesday, May 09, 2023
OPOAE2300408 Monday, May 08, 2023 Friday, May 12, 2023
284
Total # of services
232
Export services
52
Import services
2580
Total # of containers
25M
soma_frete1
27.69M
Spendings with Ran...
Freight cost evolution
2M
1M
0M
Freight
Jul 2023
Sep 2023
Nov 2023
Jan 2024
Mar 2024
Date
jobno Quote Date Name Freight Business Type Origin Destination Incoterm
0147 Tuesday, November 07, 2023 Salvador TEXTIL, S.A. 125 AE Porto Abidjan CFR
0202 Monday, January 01, 2024 Salvador TEXTIL, S.A. 138 AE Porto Abidjan CFR
0111 Monday, October 02, 2023 Salvador TEXTIL, S.A. 150 AE Porto Abidjan CFR
0100 Thursday, September 21, 2023 Salvador TEXTIL, S.A. 150 AE Porto Kigali CFR
037 Thursday, July 20, 2023 Salvador TEXTIL, S.A. 162 AE Porto Abidjan CFR
092 Wednesday, September 13, 2023 Salvador TEXTIL, S.A. 162 AE Porto Abidjan CFR
06 Monday, June 19, 2023 Salvador TEXTIL, S.A. 162 AE Porto Abidjan CIF
022 Wednesday, July 05, 2023 Salvador TEXTIL, S.A. 162 AE Porto Abidjan CIF
065 Thursday, August 17, 2023 Salvador TEXTIL, S.A. 162 AE Porto Kigali CFR
091 Tuesday, September 12, 2023 Salvador TEXTIL, S.A. 162 AE Porto Lilongwe CFR
0157 Friday, November 17, 2023 Salvador TEXTIL, S.A. 169 AE Porto Entebbe CFR
0131 Sunday, October 22, 2023 Salvador TEXTIL, S.A. 169 AE Porto Kigali CFR
0232 Wednesday, January 31, 2024 Salvador TEXTIL, S.A. 169 AE Porto Lilongwe CFR
0102 Saturday, September 23, 2023 Salvador TEXTIL, S.A. 188 AE Porto Cabinda CFR
0193 Saturday, December 23, 2023 Salvador TEXTIL, S.A. 188 AE Porto Luanda CFR
0116 Saturday, October 07, 2023 Salvador TEXTIL, S.A. 192 SE Leixoes Luanda CIF
0191 Thursday, December 21, 2023 Salvador TEXTIL, S.A. 194 AE Porto Kigali CFR
0242 Saturday, February 10, 2024 Salvador TEXTIL, S.A. 194 AE Porto Lilongwe CFR
032 Saturday, July 15, 2023 Salvador TEXTIL, S.A. 200 AE Porto Cabinda


Export and Import
All
Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
Biztype
BizScope
284
Total # of Jobs
232
# of Exports
52
# of Imports
2580
Total # of containers
# of containers by Year and Quarter
Quarter Qtr 1 Qtr 2 Qtr 3 Qtr 4
# of containers
Year
# of Biztype
biztype AE SE AI SI
Costs by Business type
Freight by Destination by Business type
numero de jobs
destino
Luanda
Maputo
Abidjan
Kigali
Lilongwe
Durban
Dar es Salaam
Mombasa
Leixoes
Porto
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial


Geographical Data
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Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
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BizScope
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Origins
Cities
jobno
Quote date
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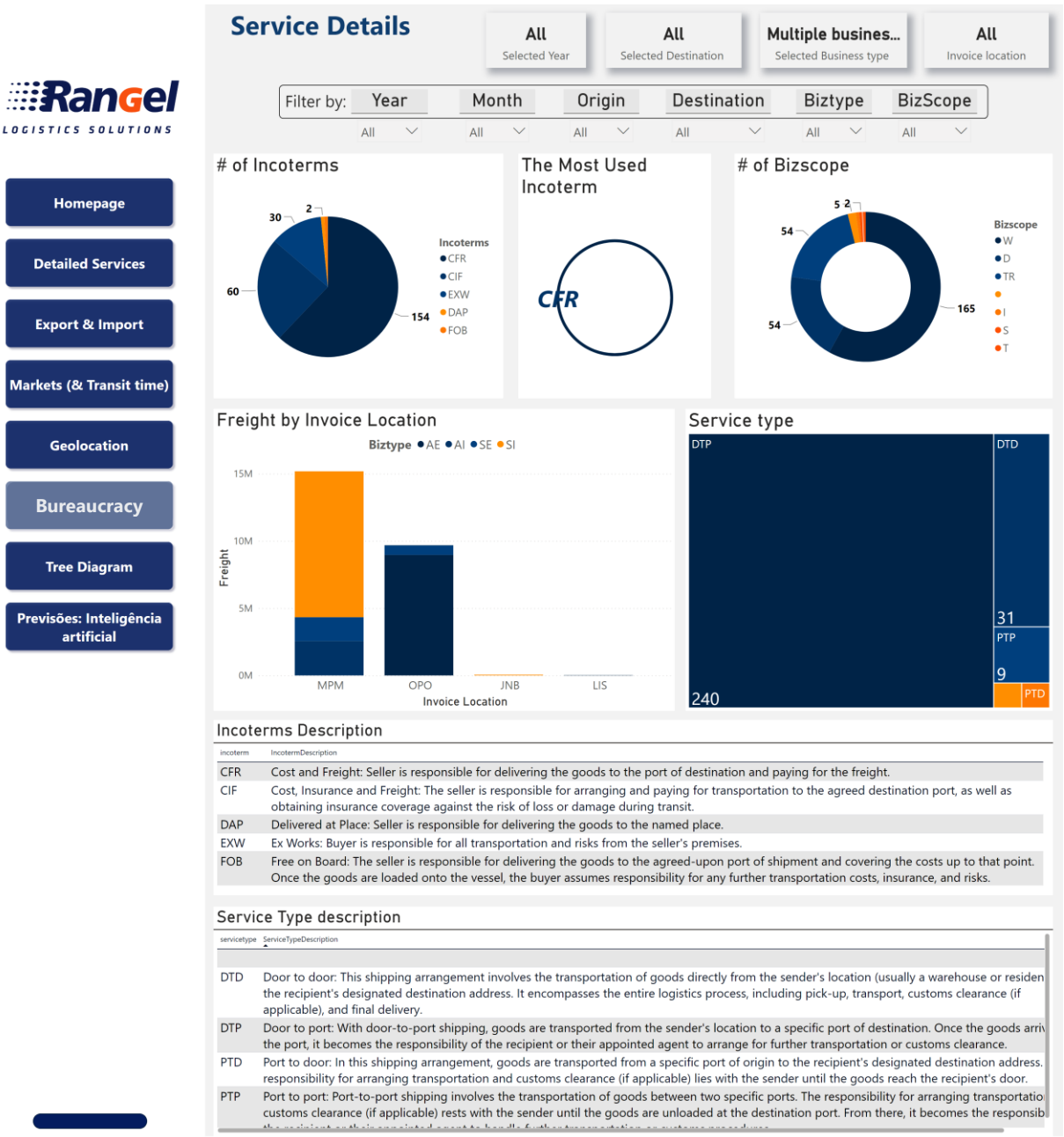
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial


Service Details
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Selected Year
All
Selected Destination
Multiple busines...
Selected Business type
All
Invoice location
Filter by:
Year
Month
Origin
Destination
Biztype
BizScope
All
Homepage
Detailed Services
Export & Import
Markets (& Transit time)
Geolocation
Bureaucracy
Tree Diagram
Previsões: Inteligência artificial
# of Incoterms
30
2
60
154
Incoterms
CFR
CIF
EXW
DAP
FOB
The Most Used Incoterm
CFR
# of Bizscope
5
2
54
54
165
Bizscope
W
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S
T
Freight by Invoice Location
Biztype AE AI SE SI
15M
10M
5M
0M
Freight
MPM
OPO
JNB
LIS
Invoice Location
Service type
DTP
240
DTD
31
PTP
9
PTD
Incoterms Description
incoterm
IncotermDescription
CFR
Cost and Freight: Seller is responsible for delivering the goods to the port of destination and paying for the freight.
CIF
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Service Type description
servicetype
ServiceTypeDescription
DTD
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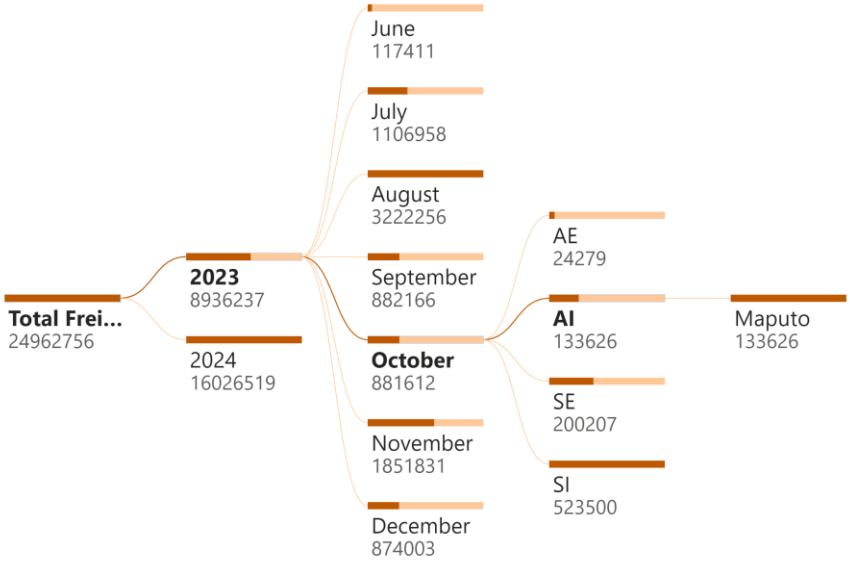
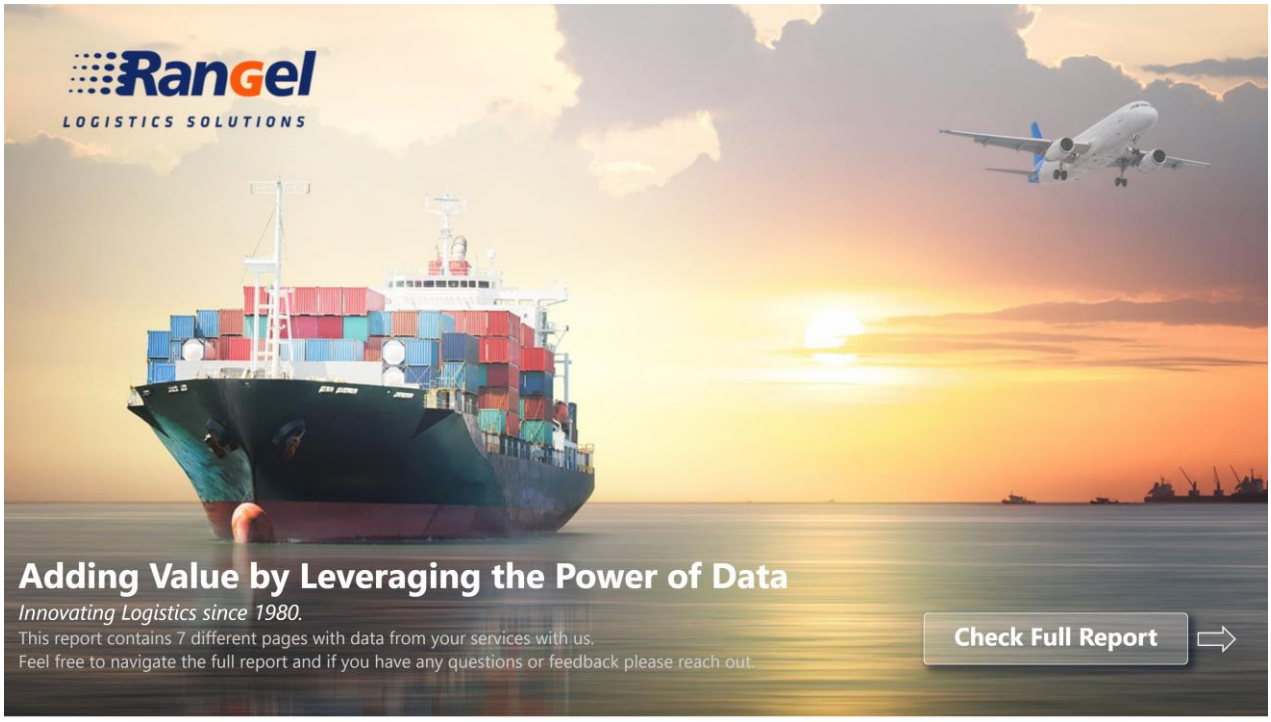
PTP
Port to port: Port-to-port shipping involves the transportation of goods between two specific ports. The responsibility for arranging transportatio customs clearance (if applicable) rests with the sender until the goods are unloaded at the destination port. From there, it becomes the responsib

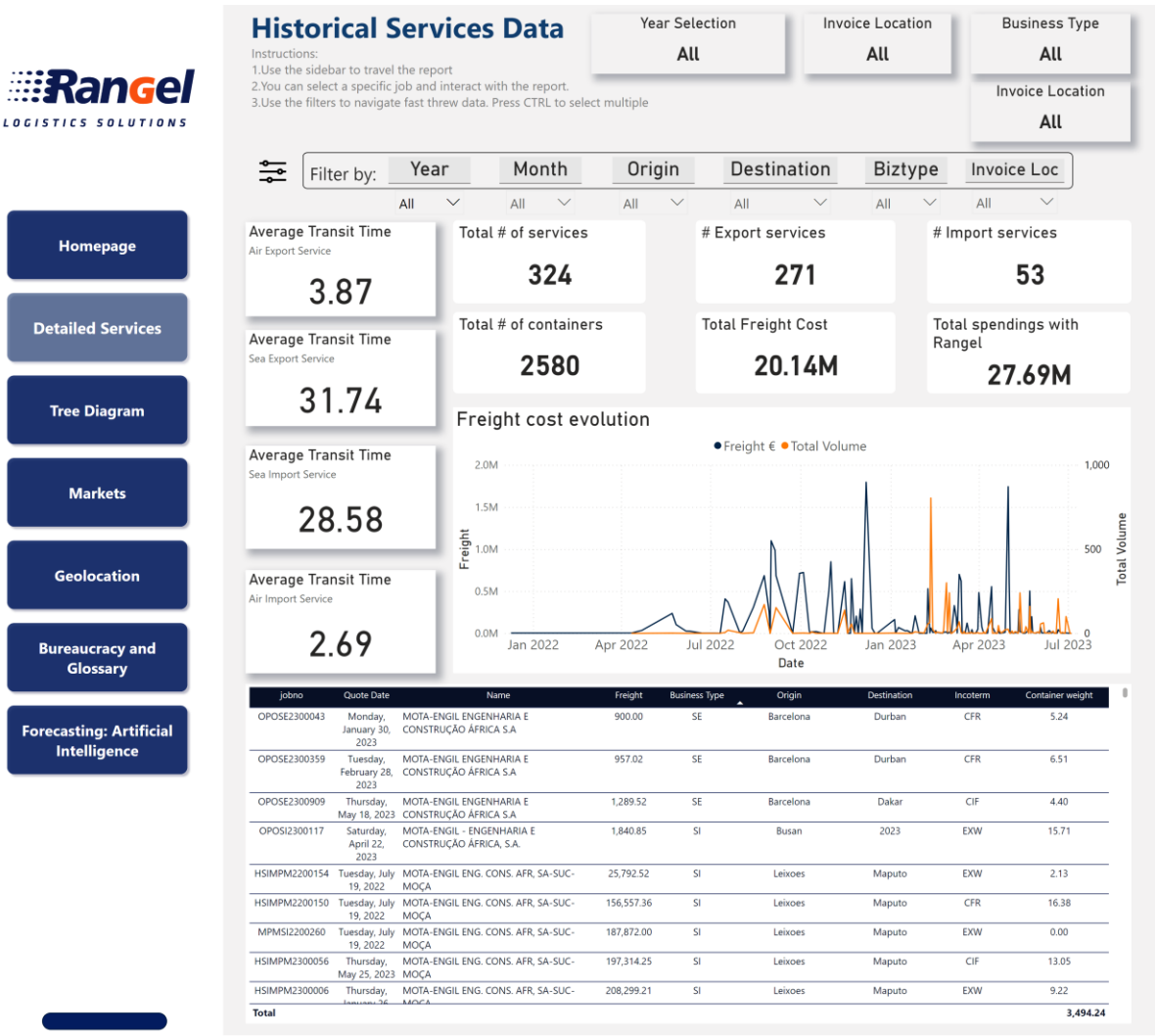
Rangel
LOGISTICS SOLUTIONS

- Homepage
- Detailed Services
- Export & Import
- Markets (& Transit time)
- Geolocation
- Bureaucracy
- Tree Diagram
- Previsões: Inteligência artificial



A.3 Reports final version




Historical Services Data
Instructions:
1.Use the sidebar to travel the report
2.You can select a specific job and interact with the report.
3.Use the filters to navigate fast threw data. Press CTRL to select multiple
Year Selection
All
Invoice Location
All
Business Type
All
Invoice Location
All
Filter by:
Year
Month
Origin
Destination
Biztype
Invoice Loc
All
Homepage
Detailed Services
Tree Diagram
Markets
Geolocation
Bureaucracy and Glossary
Forecasting: Artificial Intelligence
Average Transit Time
Air Export Service
3.87
Average Transit Time
Sea Export Service
31.74
Average Transit Time
Sea Import Service
28.58
Average Transit Time
Air Import Service
2.69
Total # of services
324
Export services
271
Import services
53
Total # of containers
2580
Total Freight Cost
20.14M
Total spendings with Rangel
27.69M
Freight cost evolution
Freight €
Total Volume
2.0M
1.5M
1.0M
0.5M
0.0M
Freight
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Total Volume
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Jul 2022
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Jan 2023
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Quote Date
Name
Freight
Business Type
Origin
Destination
Incoterm
Container weight
OPOSE2300043
Monday, January 30, 2023
MOTA-ENGIL ENGENHARIA E CONSTRUÇÃO ÁFRICA S.A
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SE
Barcelona
Durban
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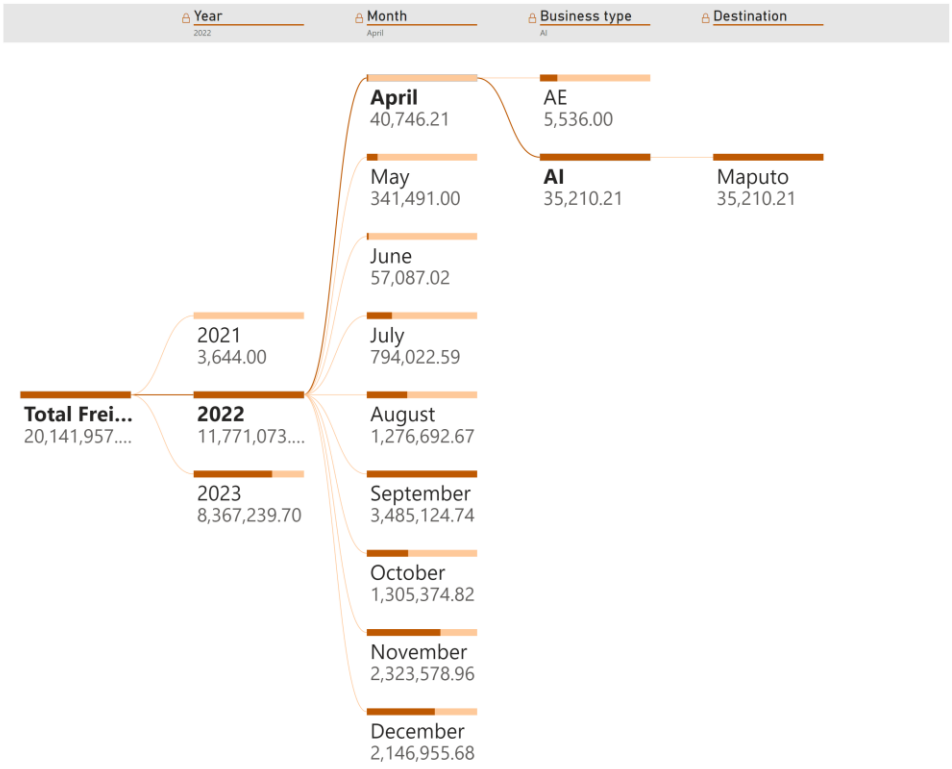
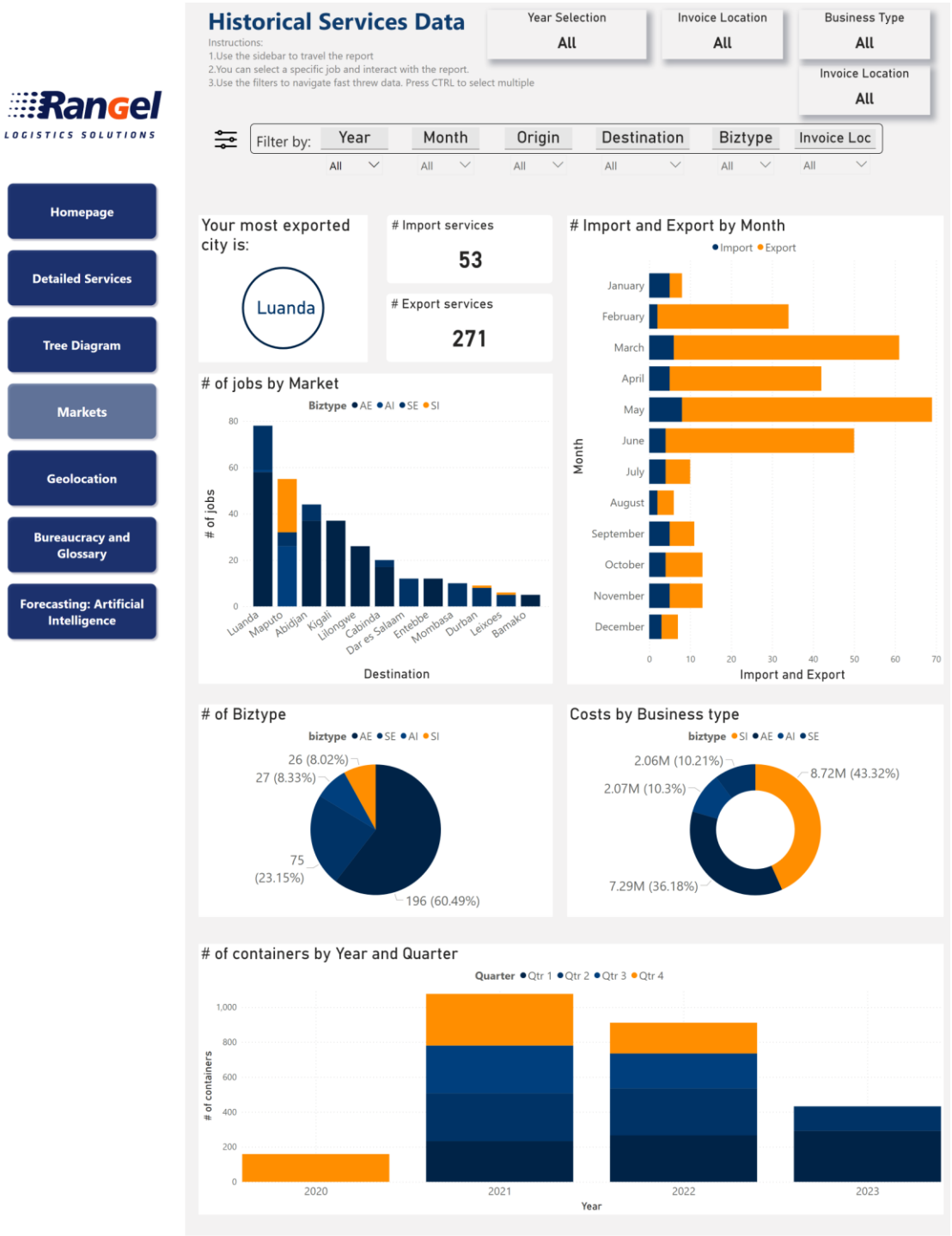
5.24
OPOSE2300359
Tuesday, February 28, 2023
MOTA-ENGIL ENGENHARIA E CONSTRUÇÃO ÁFRICA S.A
957.02
SE
Barcelona
Durban
CFR
6.51
OPOSE2300909
Thursday, May 18, 2023
MOTA-ENGIL ENGENHARIA E CONSTRUÇÃO ÁFRICA S.A
1,289.52
SE
Barcelona
Dakar
CIF
4.40
OPOSI2300117
Saturday, April 22, 2023
MOTA-ENGIL - ENGENHARIA E CONSTRUÇÃO ÁFRICA, S.A.
1,840.85
SI
Busan
2023
EXW
15.71
HSIMPM2200154
Tuesday, July 19, 2022
MOTA-ENGIL ENG. CONS. AFR, SA-SUC-MOÇA
25,792.52
SI
Leixoes
Maputo
EXW
2.13
HSIMPM2200150
Tuesday, July 19, 2022
MOTA-ENGIL ENG. CONS. AFR, SA-SUC-MOÇA
156,557.36
SI
Leixoes
Maputo
CFR
16.38
MPMSI2200260
Tuesday, July 19, 2022
MOTA-ENGIL ENG. CONS. AFR, SA-SUC-MOÇA
187,872.00
SI
Leixoes
Maputo
EXW
0.00
HSIMPM2300056
Thursday, May 25, 2023
MOTA-ENGIL ENG. CONS. AFR, SA-SUC-MOÇA
197,314.25
SI
Leixoes
Maputo
CIF
13.05
HSIMPM2300006
Thursday,
MOTA-ENGIL ENG. CONS. AFR, SA-SUC-
208,299.21
SI
Leixoes
Maputo
EXW
9.22
Total
3,494.24

The Tree Diagram

This page is the most interactive in the whole report.
Please click the bars to find out more about your company activity with **RanGel**.




Rangel
LOGISTICS SOLUTIONS
Homepage
Detailed Services
Tree Diagram
Markets
Geolocation
Bureaucracy and Glossary
Forecasting: Artificial Intelligence
Historical Services Data
Instructions:
1.Use the sidebar to travel the report
2.You can select a specific job and interact with the report.
3.Use the filters to navigate fast threw data. Press CTRL to select multiple
Year Selection
All
Invoice Location
All
Business Type
All
Invoice Location
All
Filter by:
Year
Month
Origin
Destination
Biztype
Invoice Loc
All
Your most exported city is:
Luanda
Import services
53
Export services
271
Import and Export by Month
Import
Export
January
February
March
April
May
June
July
August
September
October
November
December
Month
Import and Export
# of jobs by Market
Biztype AE AI SE SI
# of jobs
Luanda
Maputo
Abidjan
Kigali
Lilongwe
Cabinda
Dar es Salaam
Entebbe
Mombasa
Durban
Leixoes
Bamako
Destination
# of Biztype
biztype AE SE AI SI
26 (8.02%)
27 (8.33%)
75 (23.15%)
196 (60.49%)
Costs by Business type
biztype SI AE AI SE
2.06M (10.21%)
2.07M (10.3%)
8.72M (43.32%)
7.29M (36.18%)
# of containers by Year and Quarter
Quarter Qtr 1 Qtr 2 Qtr 3 Qtr 4
# of containers
2020
2021
2022
2023
Year

Rangel LOGISTICS SOLUTIONS

- Homepage
- Detailed Services
- Tree Diagram
- Markets
- Geolocation
- Bureaucracy and Glossary
- Forecasting: Artificial Intelligence

Geographical Data

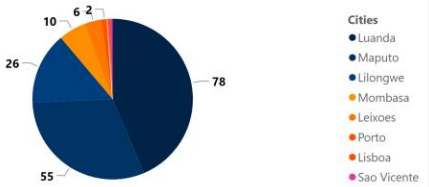
Instructions:
This is a **special** page and a very interactive one.
Please SELECT a specific job from the table bellow and check what happens with the maps.

Filter by: Year (All) | Month (All) | Biztype (All) | BizScope (All)

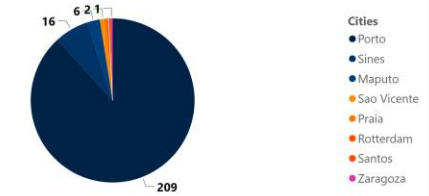
Origin: All
Destination: All

jobno	Quote date	Origin city	Destination city
OPOSE2300909	Thursday, May 18, 2023	Barcelona	Dakar
OPOSE2300043	Monday, January 30, 2023	Barcelona	Durban
OPOSE2300359	Tuesday, February 28, 2023	Barcelona	Durban
MPMSI2200483	Thursday, December 01, 2022	Beijiao	Maputo
OPOSI2300117	Saturday, April 22, 2023	Busan	2023
OPOSE2300896	Sunday, May 07, 2023	Genova	Dar es Salaam
OPOAI2300040	Tuesday, February 07, 2023	Heathrow Apt/London	Luanda
OPOSE2300672	Wednesday, March 29, 2023	Leixoes	
HSEOPO2303899	Friday, May 19, 2023	Leixoes	Abidjan
HSEOPO2303902	Friday, May 19, 2023	Leixoes	Abidjan
HSEOPO2303903	Friday, May 19, 2023	Leixoes	Abidjan
HSEOPO2303906	Friday, May 19, 2023	Leixoes	Abidjan
OPOSE2300525	Friday, March 17, 2023	Leixoes	Abidjan
OPOSE2301013	Wednesday, June 21, 2023	Leixoes	Abidjan
OPOSE2301114	Sunday, June 04,	Leixoes	Abidjan

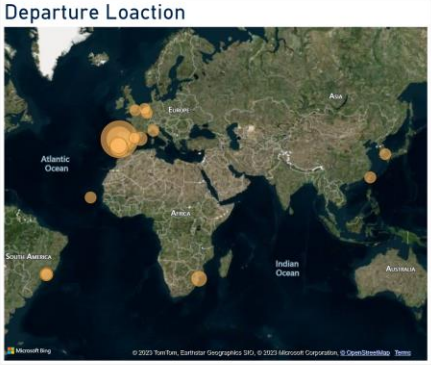
Destinations



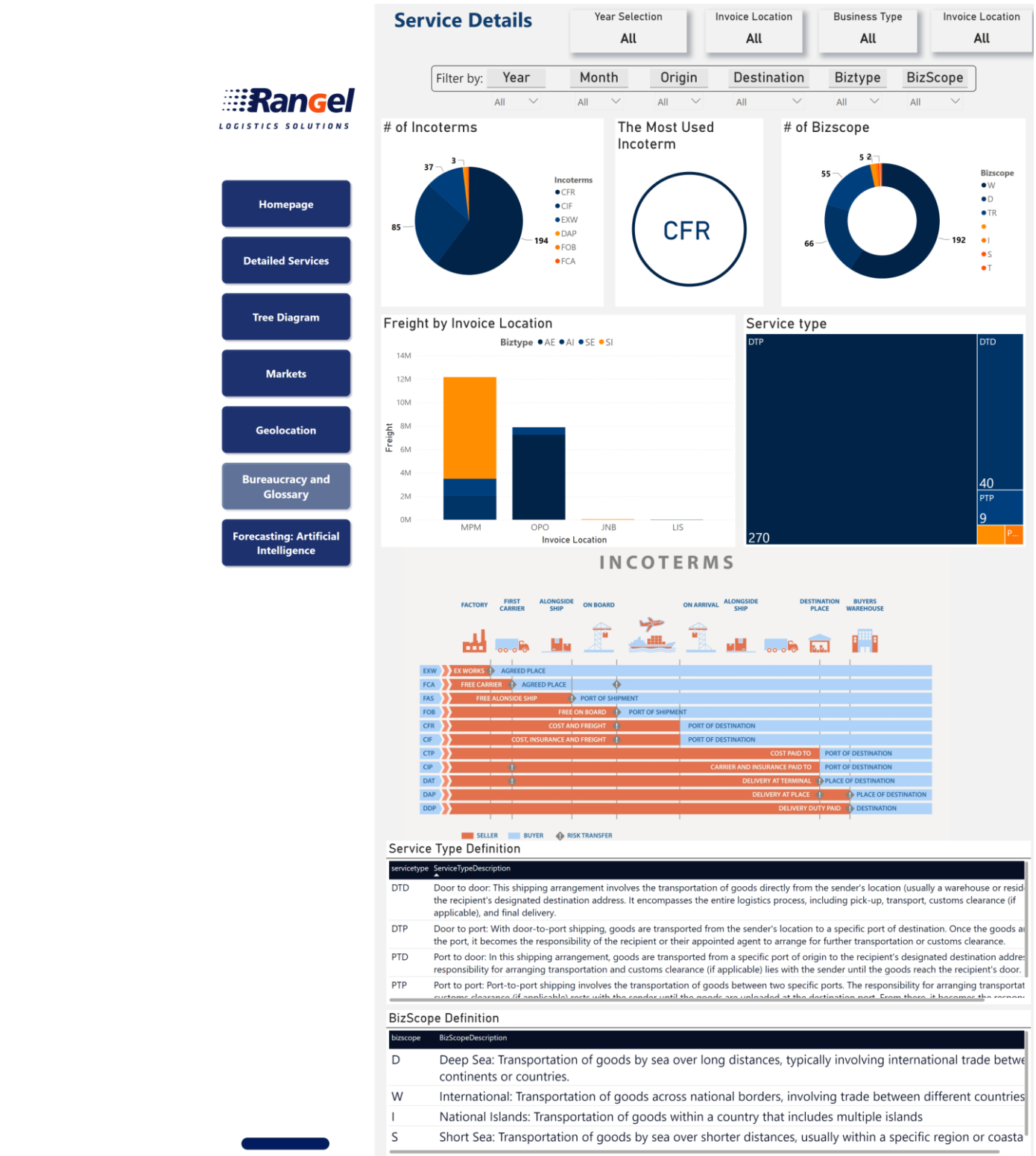
Origins



Departure Loaction



Destination Location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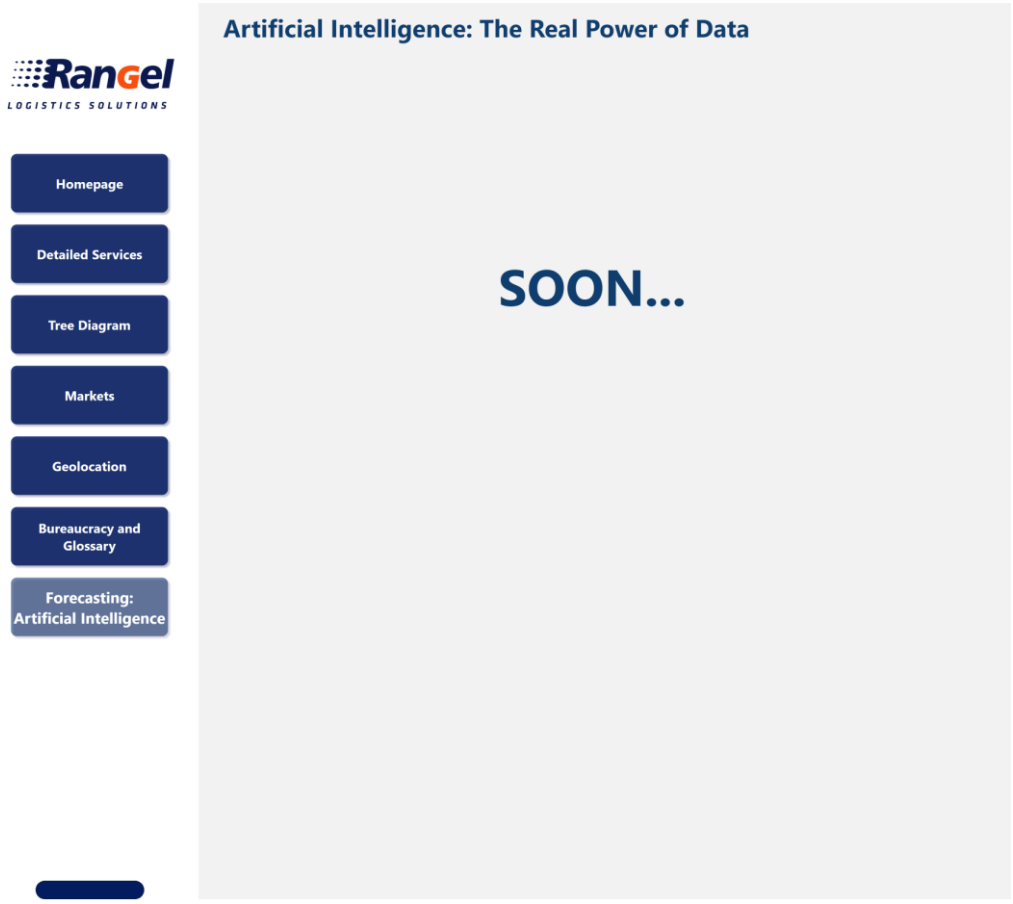
Service Details
Year Selection
All
Invoice Location
All
Business Type
All
Invoice Location
All
Filter by:
Year
Month
Origin
Destination
Biztype
BizScope
# of Incoterms
Incoterms
CFR
CIF
EXW
DAP
FOB
FCA
37
3
85
194
The Most Used Incoterm
CFR
# of Bizscope
Bizscope
W
D
TR
I
S
T
55
5
2
66
192
Freight by Invoice Location
Biztype AE AI SE SI
Freight
14M
12M
10M
8M
6M
4M
2M
0M
MPM
OPO
JNB
LIS
Invoice Location
Service type
DTP
270
DTD
40
PTP
9
INCOTERMS
FACTORY
FIRST CARRIER
ALONGSIDE SHIP
ON BOARD
ON ARRIVAL
ALONGSIDE SHIP
DESTINATION PLACE
BUYERS WAREHOUSE
EXW
EX WORKS
AGREED PLACE
FCA
FREE CARRIER
AGREED PLACE
FAS
FREE ALONSIDE SHIP
PORT OF SHIPMENT
FOB
FREE ON BOARD
PORT OF SHIPMENT
CFR
COST AND FREIGHT
PORT OF DESTINATION
CIF
COST, INSURANCE AND FREIGHT
PORT OF DESTINATION
CTP
COST PAID TO
PORT OF DESTINATION
CIP
CARRIER AND INSURANCE PAID TO
PORT OF DESTINATION
DAT
DELIVERY AT TERMINAL
PLACE OF DESTINATION
DAP
DELIVERY AT PLACE
PLACE OF DESTINATION
DDP
DELIVERY DUTY PAID
DESTINATION
SELLER
BUYER
RISK TRANSFER
Service Type Definition
servicetype
ServiceTypeDescription
DTD
Door to door: This shipping arrangement involves the transportation of goods directly from the sender's location (usually a warehouse or resid
the recipient's designated destination address. It encompasses the entire logistics process, including pick-up, transport, customs clearance (if
applicable), and final delivery.
DTP
Door to port: With door-to-port shipping, goods are transported from the sender's location to a specific port of destination. Once the goods a
the port, it becomes the responsibility of the recipient or their appointed agent to arrange for further transportation or customs clearance.
PTD
Port to door: In this shipping arrangement, goods are transported from a specific port of origin to the recipient's designated destination addre
responsibility for arranging transportation and customs clearance (if applicable) lies with the sender until the goods reach the recipient's door.
PTP
Port to port: Port-to-port shipping involves the transportation of goods between two specific ports. The responsibility for arranging transportat
BizScope Definition
bizscope
BizScopeDescription
D
Deep Sea: Transportation of goods by sea over long distances, typically involving international trade betwe
continents or countries.
W
International: Transportation of goods across national borders, involving trade between different countries
I
National Islands: Transportation of goods within a country that includes multiple islands
S
Short Sea: Transportation of goods by sea over shorter distances, usually within a specific region or coasta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Artificial Intelligence: The Real Power of Data
SOON...