

## TRANSFORMING CONSTRUCTION WITH INNOVATION IN LOGISTICS: A STUDY CASE

## TRANSFORMANDO A CONSTRUÇÃO COM INOVAÇÃO NA LOGÍSTICA: UM ESTUDO DE CASO

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**Abstract:** Marked by rapid urbanization and intense competition, the construction industry faces crucial challenges in addressing urban sustainability. Despite the crucial role of innovations, the construction sector has historically grappled with significant limitations in terms of innovation and productivity, remaining less digitized compared to other industries. The urgent need to accelerate innovation and reduce costs is highlighted by the association between globalization and technological development, underscoring the importance of solutions like Construfrete. With a projected notable growth of 85% in the international construction market by 2030, driven by artificial intelligence and digitization, the urgency of technological adoption in the sector is evident. Construfrete, specifically designed to meet the needs of the Bahia market, aims to optimize the transportation of materials and equipment, enhancing connections between drivers and construction entities. This methodology ensures the app is competitive and responsive, facilitating more efficient and environmentally conscious logistics. Ultimately, Construfrete not only addresses the logistical demands of construction but also boosts efficiency, benefiting drivers, customers, and the local economy in Bahia.

**Keywords:** Urban Sustainability. Construction Innovation. Technological Adoption. Logistics Optimization. Construfrete.

**Resumo:** Marcada pela urbanização rápida e intensa competição, a indústria da construção enfrenta desafios cruciais na abordagem da sustentabilidade urbana. Apesar do papel crucial das inovações, o setor da construção historicamente lidou com limitações significativas em termos de inovação e produtividade, permanecendo menos digitalizado comparado a outras indústrias. A necessidade urgente de acelerar a inovação e reduzir custos é destacada pela associação entre globalização e desenvolvimento tecnológico, sublinhando a importância de soluções como o Construfrete. Com um crescimento projetado de 85% no mercado internacional de construção até 2030, impulsionado pela inteligência artificial e digitalização, a urgência da adoção tecnológica no setor é evidente. O Construfrete, especificamente projetado para atender às necessidades do mercado da Bahia, visa otimizar o transporte de materiais e equipamentos, aprimorando as conexões entre motoristas e entidades de construção. Esta metodologia garante que o aplicativo seja competitivo e responsivo, facilitando uma logística mais eficiente e consciente ambientalmente. Em última análise, o Construfrete não apenas atende às demandas logísticas da construção, mas também aumenta a eficiência, beneficiando motoristas, clientes e a economia local na Bahia.

**Palavras-chave:** Sustentabilidade Urbana. Inovação na Construção. Adoção Tecnológica. Otimização Logística. Construfrete.

## 1 INTRODUCTION

At the dawn of the 21st century, in a world characterized by rapid urbanization and a highly competitive landscape, innovations in the construction industry play a crucial role in addressing the challenges of urban sustainability (Regona, 2022). However, the construction sector has historically faced limitations in terms of innovation and productivity, resulting in a relatively low level of digitization compared to other industries. With an average productivity growth of only 1% per year over the last two decades, questions arise about the sector's efficiency, given its rules and fundamental characteristics. In this context, the association between globalization and technological development demands that companies accelerate their innovation processes and continually seek ways to reduce costs. According to Nawrocki (2022), the level of risk associated with innovation increases with the complexity and novelty of the technologies used in its development and implementation. Therefore, the effectiveness of efforts to strengthen innovation depends on the activities of many entities and their relationships. It is anticipated that the international construction market will grow by 85%, reaching the mark of 15.5 trillion dollars by 2030, with the potential for artificial intelligence (AI) and sector digitization to increase productivity from 0.8% to 1.4% annually (Ribeiro, 2022). Much of this growth is driven by technological advancements at every stage of the construction lifecycle, including planning, design, and construction. In correlation with logistics, Ferrell (2018) suggested a path to improve logistics systems, emphasizing on-demand logistics, freight consolidation, facility sharing, and incentives, as well as case studies and quantitative analyses as focal areas. In this challenging scenario, Construfrete emerges as an application with innovative solutions to logistical challenges in the construction industry, developed by Production Engineering students at the Federal University of Bahia. As the international construction market is poised for significant growth, largely driven by AI and increased digitization, the demands on the industry's logistical systems are becoming increasingly complex and critical. Efficient management of these systems is vital for harnessing the growth potential effectively. The need for more sophisticated logistical solutions is becoming a pivotal aspect of industry evolution, as traditional methods often fall short in addressing the dynamic requirements of modern construction projects. These advancements in technology not only facilitate better planning and execution but also ensure that the materials and

equipment essential for construction are managed more efficiently. Amidst this backdrop of rapid technological integration and market expansion, Construfrete's innovative approach to logistics represents a timely intervention, aimed at revolutionizing how resources are deployed within the industry.

The application Construfrete aims to enhance efficiency in the transportation of materials and equipment, contributing to urban sustainability by optimizing resources and reducing environmental impact. According to Petrov (2021), transport mobility is influenced by people's general activities, making it crucial to understand the balance between demand and supply. Therefore, to effectively connect those in need of fast and secure deliveries with transportation experts, Construfrete transcends the traditional limitations of the industry. The platform is designed to meet the specific needs of a wide range of users, from individual engineers to small construction businesses. The agility in scheduling, real-time tracking, and precise delivery execution make Construfrete an essential tool for advancing the construction industry. Entrepreneurship, as solidified in the late 1980s as a legitimate field of academic research, represents a driving force for economic and social development. As entrepreneurs distinguish themselves from managers, not just by taking risks but through their ability to innovate and creatively reorganize resources, they become central to modern market dynamics. Drucker already emphasized in 1985 the importance of entrepreneurship for North American economic development, citing demographic growth and job creation as key indicators. This transformative role of entrepreneurship is even more crucial in contexts of rapid technological change and global integration, where new opportunities and challenges constantly arise. The interdisciplinary approach, as suggested by Alves in 2022, enriches the understanding of this phenomenon, combining economic insights with psychological perspectives for a more comprehensive analysis that highlights the relevance of entrepreneurship in promoting economic growth, improving productivity, creating jobs, and advancing socially.

The development and implementation of the application aim to address the needs of the Bahia market by providing an efficient and intuitive solution to connect drivers and engineers/construction companies. This methodology provides a structured approach to application development and implementation, ensuring that user needs are met and the final product is competitive in the Bahia market. The main objective of this article is to explore and promote the concept behind Construfrete,

highlighting its benefits and potential to contribute to transportation in the construction industry. The community is invited to consider the opportunities this innovation brings to the sector and envision a future in construction that fully embraces the digital revolution.

## **2 THEORETICAL FRAMEWORK**

### **2.1 Entrepreneurship**

Entrepreneurship solidified itself as a legitimate field of academic research only in the late 1980s (Carland et al., 1998). According to Santos and Pellin (2008), an entrepreneur, more than someone who simply takes risks or seeks to satisfy needs, has a broader role, someone with a desire to conquer through new combinations. This perspective distinguishes the entrepreneur from the manager, whose primary responsibility is to manage the company's resources as effectively as possible (Queiroz, 2019). Drucker (1985) mentions entrepreneurship as a crucial factor for North American economic development, citing quantitative data on demographic growth and job creation in the local labor market. The period analyzed by Drucker encompassed the "baby boom" years, from 1965 to 1985. Kirchhoff (1997) emphasized the phenomenon of entrepreneurship from an economic perspective, contrasting with classical static theory. According to Alves (2022), entrepreneurship is an activity aimed at creating economic growth, improving productivity, creating job opportunities, and generating social advances. The author also incorporates concepts from psychology into the study of this area, enriching the analysis as perspectives from other disciplines contribute to a more comprehensive understanding of the subject.

### **2.2 Logistics**

With economic growth, most companies must be prepared to have a complete logistics infrastructure to meet the needs of the transportation market; Sukessada (2017). Therefore, having good transportation logistics is essential for competitiveness, as there are costs involved in the process, and better management of these expenses puts the company ahead of others. Thus, Cavanha (2001) defines logistics as the part of the supply chain process that plans, implements, and controls

the efficient and effective flow and storage of goods, services, and related information from the point of origin to the point of consumption, aiming to meet consumer requirements. After the period of the great wars, with a portion of the world devastated, there arose the need to find ways to rebuild. Thus, logistics shifted from the military realm to the scenario where major powers needed to change their strategies for economic growth; Paoleschi (2017). According to Castiglioni (2017), through the constant changes the sector has undergone over the years, Business Logistics emerged, which analyzes available options for the flow of goods and how their values are constituted compared to the quantity of goods they can transport.

### **2.3 Digital services in Brazilian transport**

In Brazil, the advancement and widespread use of digital services are already a reality. For example, Uber has over 1 million drivers/delivery personnel and operates in over 500 cities in Brazilian territory. On the other hand, its competitor, "99," has around 600,000 drivers and operates in more than 1,000 cities. These pieces of information confirm that Brazilians are increasingly seeking practical solutions in the digital realm, whether for personal transportation or other products.

In Salvador-BA, there are more than 100,000 registered cargo vehicles (IBGE, 2022), and, on the other hand, more than 20,000 companies are connected to the construction sector (CBIC, 2023). Recognizing the lack of companies that bridge these two sectors in the Bahia market highlights the need for expansion. Additionally, the Bahian capital accounts for about 5% of the national civil construction GDP, making it the largest sector in the Northeast region and with ample growth potential, according to data from the Union of Construction Industry of the State of Bahia (Sinduscon/BA). It is also important to mention the current concepts of Lean Startup. Ries (2011) introduced the concept of Lean Startup by combining Lean Manufacturing concepts for emerging companies. The idea was for entrepreneurs to view the business model as an organization, not just as a product. Therefore, rapid interaction between teams was necessary to measure customer satisfaction levels and determine whether to maintain or discard an idea. According to Ries (2011), anything customers experience in their interaction with a company should be considered part of the product. Therefore, the success of the team or venture is determined by its ability to quickly conceptualize and build a Minimum Viable Product (MVP). The MVP is that version of the product

that allows a complete build-measure-learn cycle with minimal effort and the shortest development time. In all cases, the organization is dedicated to revealing a new source of value for customers and is concerned with the impact of its product on these customers.

### **3 METHODOLOGY: APP DEVELOPMENT AND IMPLEMENTATION**

#### **3.1 Target Audience Study**

Conducting market research and interviews with the target audience, including drivers and engineers/construction companies, to understand their needs, challenges, and expectations regarding the interaction and cargo transportation process. Identifying the main "pain points" of potential customers to better direct the application's development to address these specific issues.

#### **3.2 Market and Competition Analysis**

Identification and detailed analysis of existing competitors in the market offering similar or related solutions. Evaluation of the advantages and disadvantages of competitors to identify opportunities to develop an application that stands out through a unique proposition.

#### **3.3 Design and Platforms**

Creation of the application's design based on the information collected in the target audience study phase and best usability practices. Decision on launch platforms, considering the prevalence of iOS and Android operating systems in the Brazilian market. Analysis of the specific needs of each platform, taking into account user demographics and the technical advantages of each operating system.

#### **3.4 Monetization and Distribution Strategies**

Definition of monetization strategies, such as subscriptions and advertising, to ensure revenue generation and the continuous maintenance of the application.

Planning distribution strategies, including promoting the application on app stores (Google Play and App Store) and possible digital marketing campaigns on Google Ads and Facebook Ads to attract more users.

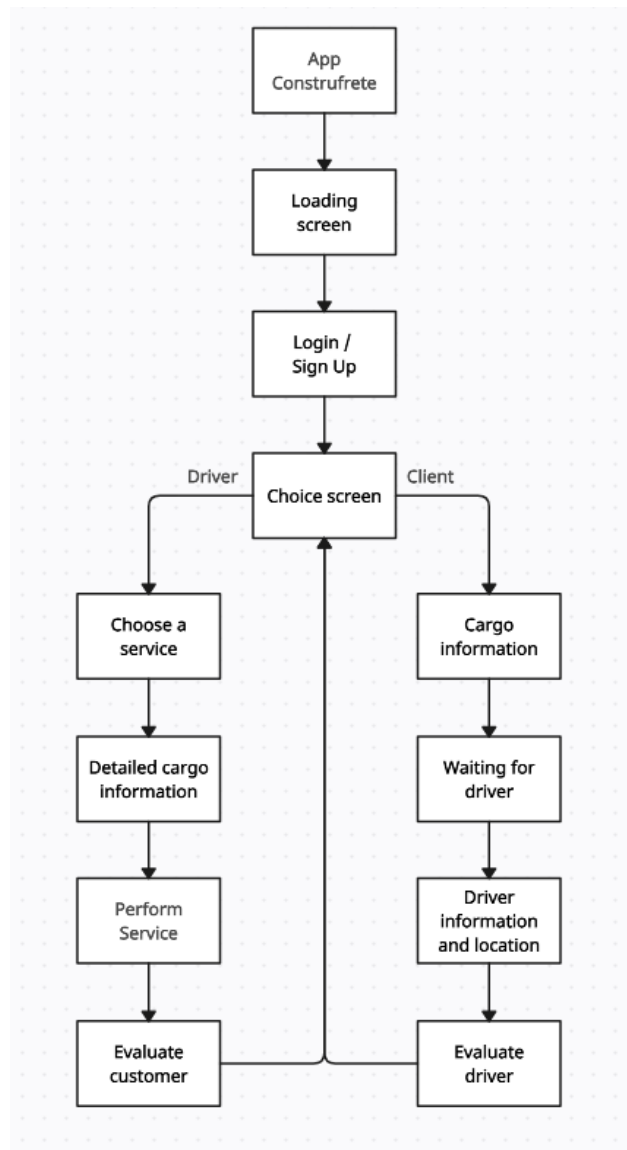
### **3.5 Testing and Improvement**

Extensive testing of the application, with continuous feedback from the target audience, to enhance usability, efficiency, and overall solution quality. Implementation of improvements based on user feedback, ensuring a final product that meets market expectations.

### **3.6 The form of the application**

For the vision of the application to become a practical and effective reality, it is crucial that the Minimum Viable Product (MVP) be carefully designed to meet user needs and expectations. With that said, all development of the application's interfaces was done on a website called "FlutterFlow." Through it, it was possible to create a prototype of the application to facilitate its explanation of operation. Before presenting each developed interface, it is essential to observe the App's operating flowchart.

To better understand the functionality and design of the Construfrete app, it is crucial to view the operational flowchart that details the interaction process between drivers and clients from the start. This flowchart, presented next as Figure 01, describes each step of the app from the initial loading screen to specific functionalities for drivers and clients. Observing this flowchart will help comprehend how the app facilitates the logistics process in the construction industry, providing an intuitive and efficient interface to effectively connect users with the necessary services. Figure 01 - App Operation Flowchart essentially illustrates how the Construfrete app operates, ensuring a smooth and functional user experience.



**Figure 1 - App Operation Flowchart**

## 4.1 INTERFACE DESCRIPTION

### 4.1.1 User login / registration

Upon launching the application, the first step is to log in to the user's account for identification. If the user doesn't have an account, there is an option on the same screen to register. The application should allow users, whether individual engineers or small construction companies, to quickly and easily register, providing basic information such as name, phone number, email address, and password, ensuring a simple entry into the platform.



#### ***4.1.2 Access type selection - client or driver?***

After logging in, the user must choose whether to provide or request a service. This is essential for the initial operation of the application. Generally, transportation apps provide two separate apps (one for drivers and one for clients), but we have unified everything into a single app, aiming for convenience and cost reduction at the project's outset.

#### ***4.1.3 Service listing and freight information screen***

Choosing the driver option will display a clear and categorized list of available freight services for the construction industry. This includes options for transporting various materials, from bricks and cement to heavy equipment, allowing users to choose the service that best suits their specific needs. When selecting items from the list, the driver will be directed to another screen with more detailed service information (customer data, cargo weight, departure and destination locations, material type, budget, and service date). It's important to note that the service's cost is determined by the application itself, calculated based on the distance traveled and the cargo weight. This is crucial for finding values that are agreeable to both parties, ensuring satisfaction on both sides.

#### ***4.1.4 Search, scheduling, and delivery tracking***

When accessing the application as a client, users will provide information about the cargo they want to receive or send. They must provide details such as pick-up and delivery locations, preferred dates, and specific cargo information, simplifying the scheduling process. After submitting the information, the application will list the service for any driver to view and express interest in providing transportation. When the driver accepts the service, the client will be directed to a screen with a map showing the exact location of the driver for tracking the entire delivery.

#### ***4.1.4 Customer/driver evaluation***

After completing the delivery, both users - the driver and the client - will go to an evaluation screen, where they can praise or criticize each other without revealing

their identities. This is an extremely important tool to gather quality feedback from application users. Poorly rated users are likely to lose significance within the app, helping increase overall user satisfaction with ConstruFrete.

## **4.2. IMPORTANT INFORMATION**

### ***4.2.1 Delivery tracking***

To ensure transparency and convenience, including real-time tracking features is of utmost importance. Users can track the status of their deliveries, from collection to final destination, ensuring deadlines are met.

### ***4.2.2 Payment system***

The app will feature a secure payment system, allowing users to make payments quickly and conveniently directly through the program, ensuring a friction-free experience.

### ***4.2.3 Email and push notifications***

To keep users updated on the status of their deliveries and other essential information, the application will send email and push notifications, ensuring they are always informed and in control of their operations.

### ***4.2.4 Customer support***

A customer support line will be available to handle user questions, issues, and requests, ensuring they receive assistance when needed.

### ***4.2.5 Administration and control panel***

An admin control panel for administrators to manage drivers, delivery orders, reviews, and other essential operations, ensuring an efficient platform operation.

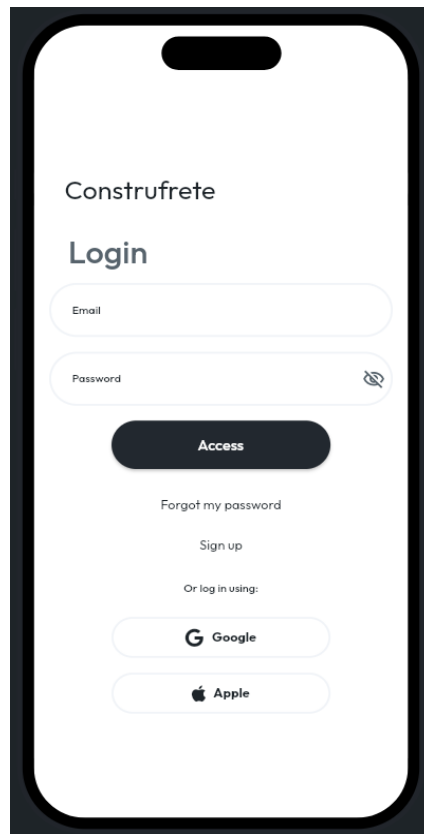
### 4.3 Interfaces

To define the app's colors, we researched what each color conveys to the public. The Color Theory, developed by the German Johann Wolfgang Von Goethe, explains what feelings each color generates in people. According to Johann Wolfgang, the color black is related to elegance, protection, intelligence, and sophistication, while the color white evokes purity, innocence, and honesty. Using this information, black and white were chosen to convey elegance, sophistication, honesty, and, above all, simplicity. The app aims to have an elegant and sophisticated look while seeking simplicity to attract customers, as it is very intuitive and easy to use. These are essential characteristics for the App's main audience, which includes drivers (looking for security and simplicity in using the service) and engineers (seeking something sophisticated yet efficient and practical). Next, images of the application interfaces will be presented. To illustrate the visual impact and strategic choice of colors in the Construfrete app, Figure 02 demonstrates the app's operation visualization during the loading screen. The choice of black and white reflects principles of elegance, protection, and sophistication, while conveying purity and honesty, aligning with the expectations of the app's target audience, which includes drivers and engineers. This initial screen is crucial for establishing the user's first impression, reinforcing Construfrete's brand as a reliable and aesthetically pleasing transportation solution in the construction industry. Figure 02 - App Operation Visualization during Loading Screen provides a clear example of the application of these design concepts.



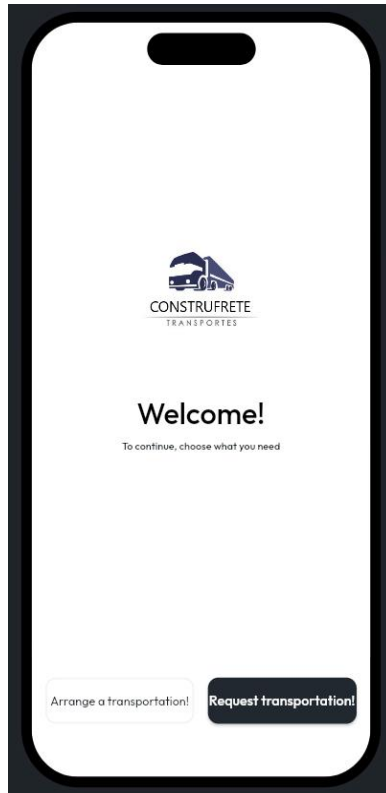
**Figure 2** - App Operation Visualization during Loading Screen

The app design is meticulously crafted to provide an accessible and intuitive experience for all users in the construction industry. The color palette, predominantly white with blue and black details, conveys confidence and professionalism. The choice of blue, featured in our logo, not only represents these values but is also universally recognized, facilitating the app's identification.



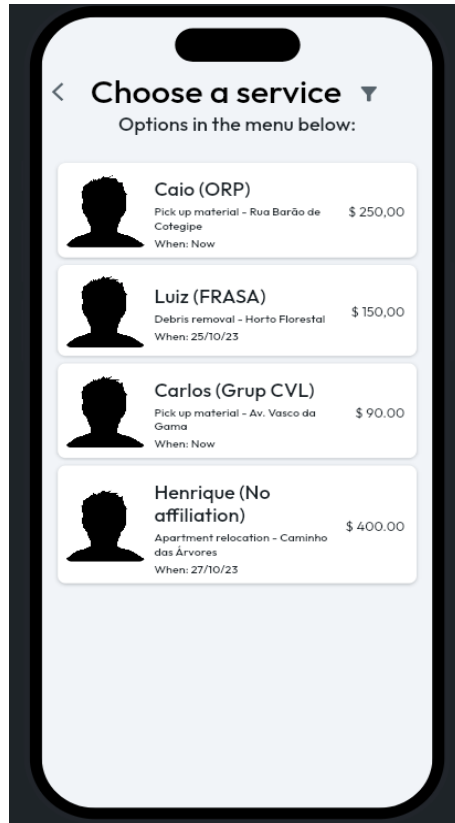
**Figure 3** - Screenshot of the Login/Registration Screen

The predominant white color contributes to the minimalist approach of the design. Evoking simplicity and clarity, this color creates a clean and neutral environment, allowing the blue details to stand out. This choice is not just aesthetic but also functional, simplifying user interaction and making the app accessible to a diverse audience.



**Figure 4** - Selection Screen for Access: Choose between Driver or Customer Profiles

The inclusion of large buttons is an integral part of our design, aiming to enhance usability and accessibility. These buttons are not just a visual element but a practical strategy to facilitate interaction, especially in challenging working conditions. The inclusive approach with large buttons benefits users with various needs, ensuring that the platform is efficient and user-friendly for everyone.



**Figure 5** - Overview of Available Services for Drivers

For the driver, available services, customer details, and freight information will be displayed, including names, addresses, amounts, dates, among other details. In Image 05, these points can be observed in more detail, such as the type of service and the weight of the cargo.

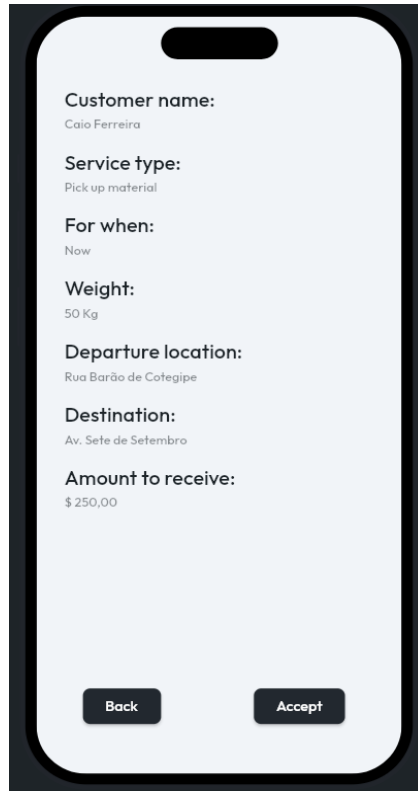


Figure 6 - Detailed Service Information Provided to the Driver

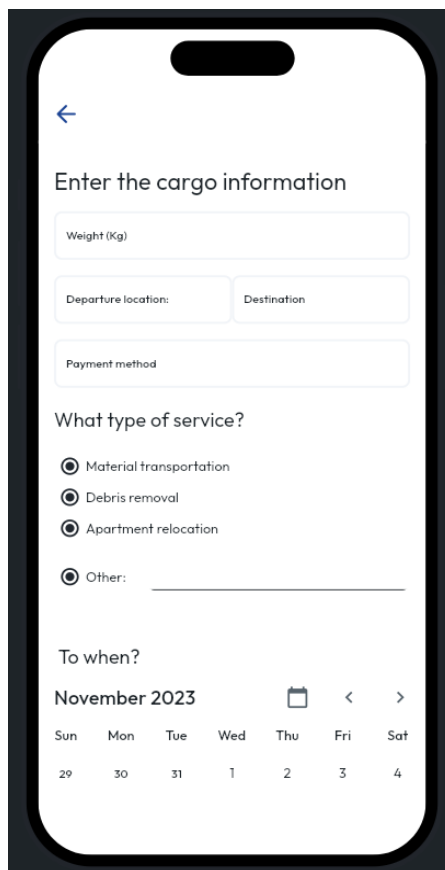


Figure 7 - Customer-Provided Cargo Information

For the customer, it is possible to input the requested service, type of material, departure and destination locations, as well as the expected date. The customer must also select the payment method.

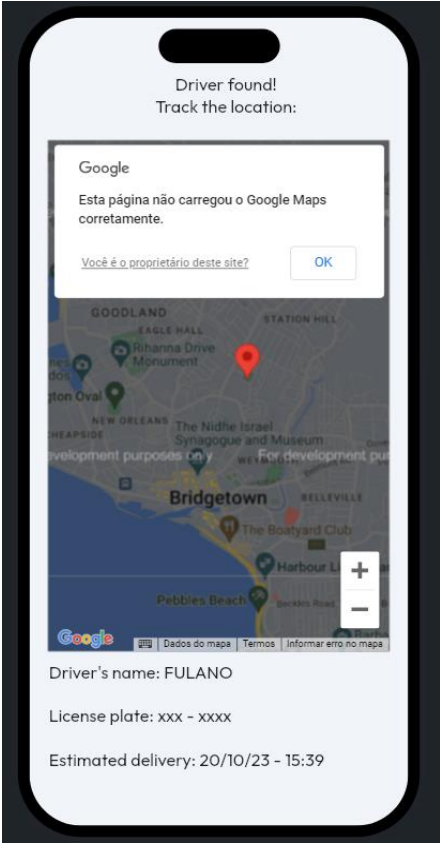


Figure 8 - Cargo Tracking (Customer)

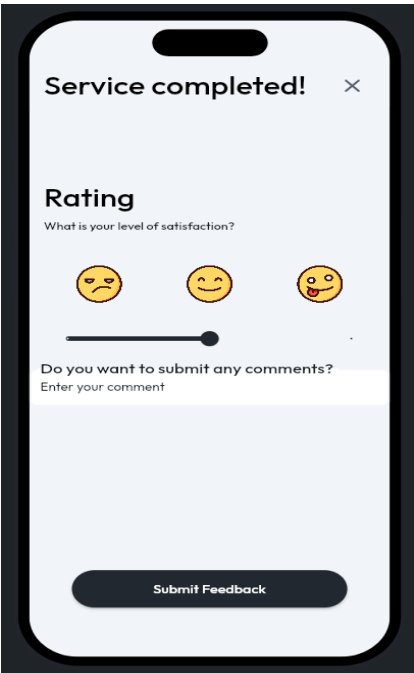


Figure 9 - Rating (Driver and Customer)



Finally, it is possible to evaluate both drivers and customers. This functionality enables the identification of good and poor users of the service, allowing the administration to take appropriate measures in case of misuse and ensuring that well-rated individuals are highlighted in the tabs shown earlier.

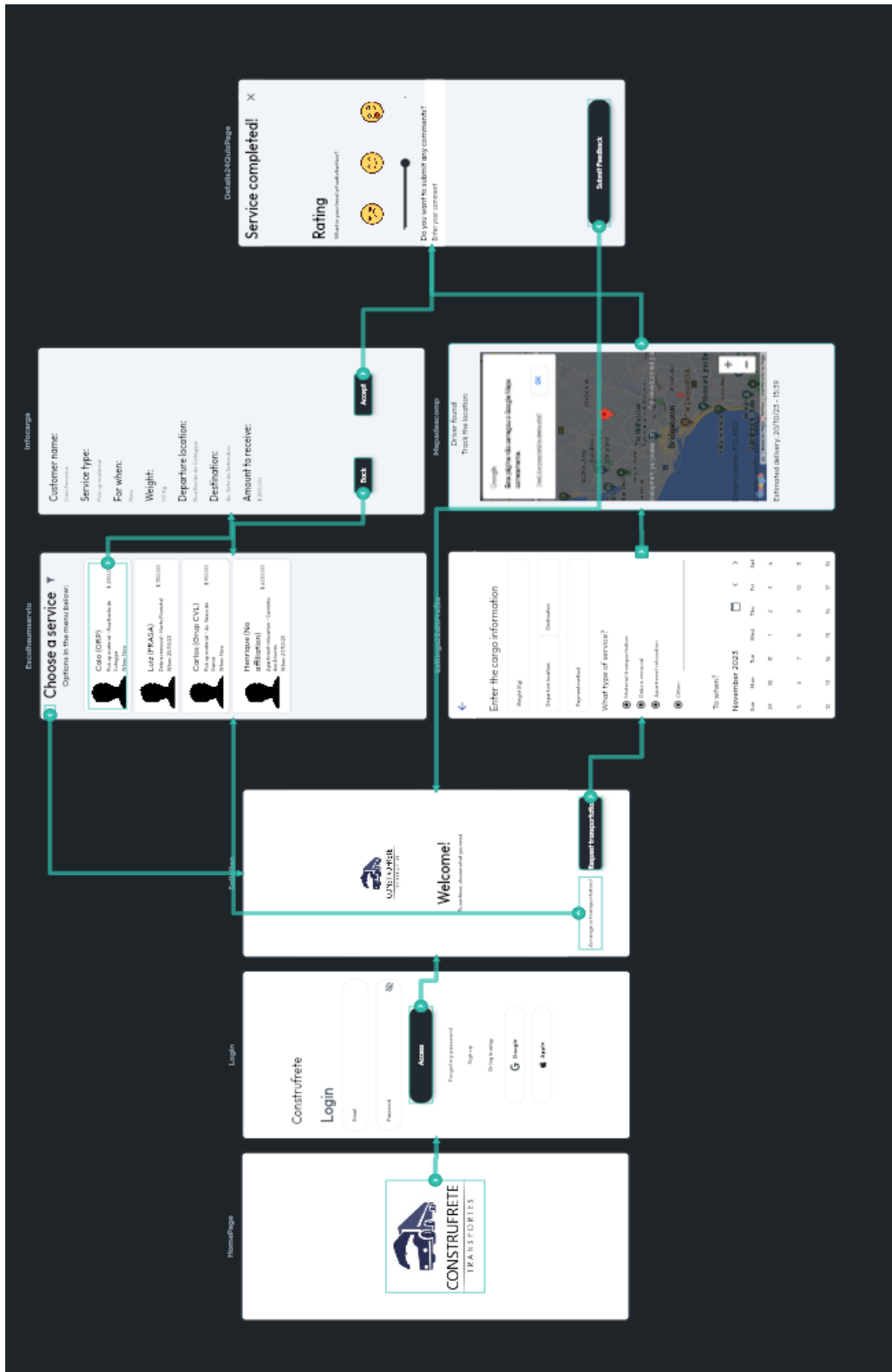


Figure 10 - Flowchart of Interfaces

In summary, the design of Construfrete seamlessly combines aesthetics and functionality. The color choices and minimalist approach aim to convey confidence and simplicity, while large buttons promote usability and accessibility. Our commitment is to provide a comprehensive experience in the construction industry, where operational effectiveness is coupled with ease of use for all professionals involved.

## **5 ANALYSIS AND DISCUSSIONS**

Given the presented panorama, it is crucial to deepen the discussion on how construction companies can effectively embrace the digital revolution, integrating technological innovations comprehensively. A promising strategy would be to establish collaborative partnerships between construction sector companies and technology-focused firms. This synergy could boost research and development of customized solutions, such as specific apps, aligned with varied needs, from individual engineers to small businesses. Despite all the advancements and benefits brought by the Construfrete app, there are some limitations that could be addressed to further improve the service over the long term. Firstly, the dependency on internet connectivity can be a challenge, especially in rural or less urbanized areas where network coverage is limited. This can hinder the efficient use of the app by drivers and clients in these locations. Additionally, resistance to change from some traditional users who prefer conventional logistics methods may limit the adoption of the app.

To overcome these limitations, continuous improvements could include the development of offline functionalities that allow users to access certain features of the app without needing an internet connection. This would ensure that drivers and clients can operate the app even under poor connectivity conditions. Furthermore, educational campaigns and training could be implemented to familiarize all users with the benefits and operation of the app, encouraging a smoother transition to new technologies. These initiatives would help to increase the app's penetration across all market segments and improve the overall effectiveness of the service offered by Construfrete. Furthermore, it is pertinent to explore how the implementation of emerging technologies, such as the Internet of Things (IoT), can revolutionize logistics in the construction industry. By connecting devices and equipment, IoT offers unprecedented visibility into the status and location of materials and equipment, optimizing processes and reducing waste. Moreover, data analysis from these devices

can provide valuable insights to enhance not only logistics but the entire construction lifecycle, from planning to execution (Succar, 2019).

In summary, by deepening the integration of technological innovations in construction, companies have the opportunity not only to overcome existing challenges but to shape a more efficient, sustainable, and adaptable sector to constantly evolving demands. These suggestions aim to guide digital transformation concretely, paving the way for a more promising future in the construction landscape.

## 6 CONCLUSION

This study shed light on the fundamental importance of dedicated software for interaction between drivers and clients in the cargo transportation sector in the Bahia market. It became evident that the implementation of this digital feature not only alleviates a significant gap in the market but also brings numerous advantages to both parties involved. For drivers, the software opens up a range of opportunities by offering a list of options to choose from in transporting loads. This not only increases job opportunities but also provides greater flexibility and control over their professional activities. Furthermore, the reduction of waiting time for clients seeking cargo transportation is one of the main contributions of this system, making the process more efficient and agile.

Consequently, the successful implementation of this application is likely to motivate both drivers and clients to adopt it as an essential tool in their daily operations. The smoother interaction between parties and the improvement in the process of hiring cargo transportation services could be the key to driving the sector in the Bahia market, providing tangible benefits to the local economy.

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