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Developing an app proposal for tuk tuk service management

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Abstract: In most tuk tuk companies, outdated methods are used in the daily management of the company, which makes the processes slow and time-consuming. So, it was found that it was necessary to use information technologies to make tuk tuk companies more effective in daily management. Therefore, the main objective of this project was the development of an application, that works like an information system, for tuk tuk companies. The requirement gathering carried out, allowed conclusions to be reached about the type of information that was to be relevant in the application as well as its functionalities. It was concluded that it is necessary to have two types of applications, a mobile and a desktop. The App brings advantages related to the reduction of errors in the database, overview and knowledge of the employees' work, and improvement in time management that can increase the productivity of the company's managers.

Keywords: Business Analytics; Cloud; Business Information Systems; Business Intelligence; Dashboard; Mobile Apps; Desktop Apps; Key Performance Indicators; Tuk tuk; Tourism.

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1 Introduction

Information technology and business are becoming inextricably interwoven. I don't think anybody can talk meaningfully about one without talking about the other.

Bill Gates

Bill Gates wrote this phrase in 1999, in his bestseller “Business at the Speed of Thought” (Gates, 1999), since then, it has come a long way in the technology sector. According to Gartner, Inc., spending on Information Technology (IT), in the world, in 2019, reached 3.7 billion dollars. These numbers do not stop here. Gartner Inc. also predicts that IT spending globally for 2020 will grow by 3.7%, with software spending by organizations being mainly responsible for this growth (Costello and Rimol, 2019). As Gates says, management and IT are inextricably linked, and in an era of exponential growth in the technological component, it is very difficult for a company to manage effectively and efficiently without resorting to technologies. Within the information technology sector, there are information systems, mobile computing, cloud services, among others, which, like the entire IT sector, are also seeing growth. According to the Gartner group, the crucial parts of IS are Cloud Computing and Business Intelligence (BI) technologies. BI cloud technologies are considered much more flexible than traditional ones, cloud computing intends to be global and promote services for all individuals.

This article, describes the development of an information system for a tuk tuk company. Information systems development not just as a technical activity, but as an integrated social and technical system of knowledge with multiple dimensions consisting of product-related (Performance dimension), process-related (Management dimension) and goal-related (Framework dimension) knowledge areas (Hassan and Mathiassen, 2018).

There are several apps for tuk tuks working in different countries, mainly in Asia, but they are mainly touring apps (Jack, 2020), but the main objective of this work is to propose an app that is a true business information system, to help the management of tuk tuk companies. While initial work in Business and Information Systems Engineering (BISE) was often rooted in artificial intelligence, database systems, or operations research, the community has adopted new approaches to address new types of problems, mainly with the advent of mobile communications (van der Aalst *et al.*, 2018).

Even in small organizations and businesses that can be considered familiar, these types of management tools are advantageous. In the tourism area there are several family businesses, such as Guided Tours, Local Accommodation networks, Traditional Souvenir Shops, bicycle or motorbike rental, among others that despite their size can benefit from SI. A concrete example of these businesses is the company under study in this project, a tuk tuk Guided Tour company, Citytuk. A tuk tuk is a motorized version of the pulled rickshaw or cycle rickshaw. Most have three wheels and do not tilt (Figure 1). In the city of Lisbon there are more than 500 tuk tuks (<https://www.portugalvisitor.com/portugal-travel/tuk-tuk>), most of them belonging to small companies. Lisbon is, with Barcelona, one of the European cities leading in overnight stays. In 2019, Lisbon received more than 5.9 million international tourists (<https://travelbi.turismodeportugal.pt/en-us/Pages/Home.aspx>).

Citytuk is a company located in the heart of Lisbon, which promotes guided tours as well as other tuk tuk experiences and activities. In terms of logistical functioning, it is a company that does not use entirely modern methods, however, it has become more technological over the years. The process is as follows: every day the drivers (tuk tuk

drivers) go to the garage where they choose a tuk tuk and start their day at work. At the end of the day they they complete a form regarding information about the tuk tuk they rode, how many services they did, with how many people, among other information. At the end of each day, the company's operations managers/directors pass this information into a database on the company's computer, although this process is already more automatic for managers, it is laborious. It is this traditional data transcription process that this study will focus on, it will make it technological and automatic, thus optimizing the management of the company and the work of both managers and drivers.

Figure 1 Tuk tuk from the City Tuk company



2 Research objectives

There is a problem today in most tuk tuk companies: the transcription of the data from the daily sheet (which contains the registration of the services performed by each driver on the day) is a slow and time-consuming process, as it is done through traditional methods. Therefore, the main objective of this study is the creation and development of an application (app) for fleet management of tuk tuk companies.

This application will serve as a substitute for the daily sheet used by the tuk tuks drivers, to fill in with the data of the services performed each day. From the application, data should automatically go to a database of the company's operations directors, so that they are automatically provided with all the information.

The app will bring a great advance in time management for tuk tuk companies, as well as other advantages: the reduction of errors in the database, since there will be no duplication of data transcription (first by the driver and then by the manager) that leads to more errors; it will also provide a clearer overview and knowledge of the work done by each driver. Furthermore, the creation of different statistics about each driver, which increases the reliability of the information provided by them. These last advantages

relating to the company's employees will also bring progress in terms of human resource management.

All of these mentioned benefits come from the app's three main goals:

- Automation of the registration of the driver services daily sheet;
- Offer varied statistical data for each driver;
- Control the data provided by each driver through the statistics.

Regarding the specific objectives of the present research, these are quite direct and simple:

- Understand which technologies for monitoring fleets or dedicated to transportation, namely tuk tuks, already exist;
- Determine the most relevant requirements to have in the app so that it is as accurate as possible;
- Understand how the application can increase the company's management success.

3 Literature Review

3.1 Information Systems in Organizational Management

The concept of Information Systems (IS) has several definitions, since it is used in very different contexts (Boell and Cecez-Kecmanovic, 2015). The initial concept of IS was to acquire and process data from the organization and present it in the form of reports - something that was very objective. Data is the raw material of information, and when isolated it has no value. Information is the interpretation and treatment of data that, when analysed and organized, offer useful value (Alturas, 2013). The potential of IS is endless and could be exploited in order to find the balance between three dimensions, which are economy, society and environment (el Hilali and el Manouar, 2020).

Li (1997), identified in his study the five main critical success factors of IS in the eyes of managers (Li, 1997). consistency and precision of the output; safety and reliability of the output; relationship between the user and the individual developing the SI; user confidence in the SI; sense of timeliness of the output, that is, availability of the output at the most appropriate time for its use. Also, the quality of the system is essential to obtain systemic benefits. Easier, faster, and reliable access – as system quality elements – will lead to higher user satisfaction that at the end will bring to optimum system net benefit (Permana and Sutaryo, 2020).

A relevant set of critical success factors identified in an organization's information systems leads to the success of its information systems. Information system success (ISS) received considerable attention from researchers as it plays an important role in improving the efficiency and productivity of an organisation (Aboaoga *et al.*, 2020).

Investing in IS and other IT assets brings many benefits to companies. The benefits of investing in IT assets and their effects on the multidimensional measurement of a company's performance include financial and non-financial metrics, which must be able to capture all tangible and intangible benefits (Mohamad *et al.*, 2020).

3.2 Business Intelligence and Business Analytics

The term Business Intelligence (BI) dates back to 1958, when Hans Peter Luhn, used it in a scientific article, defining the term as: “The ability to apprehend interrelationships of facts presented, in order to create and guide actions towards desired objectives” (Lumpkin *et al.*, 2011). In 1989, Howard Dressner, coined and popularized the term Business Intelligence as “Methods and concepts that improve business decision making through the use of fact-based support systems.” Until then, many of its characteristics were encompassed in the definition of Information Systems (Negash and Gray, 2008).

Today, many companies are looking for dynamic infrastructures that adapt quickly to the needs of their applications (Muntean, 2015). The success of BI applications also depends on the hardware platform used. Existing hardware platform should allow the organisation to provide application communications via the internal network. There should be also suitable hardware to run existing applications such as data integration software in the organisation. In such cases, it could be expected to implement BI during a short period and with low costs, and the investment risk would be low (Jahantigh *et al.*, 2019).

Business Analytics (BA), on the other hand, was introduced in the early 2000s, it is about delivering the right decision-making support to the right people, and making the digital processes happen at the right time. This definition arises from the fact that BA is being increasingly applied and automated in technological processes, and this one has to promote not only the offer of decision support but also the offer of data in an intelligent manner (Laursen and Thorlund, 2016).

These two types of management are often confused due to their similarities: both exist to improve the performance of an organization by improving the management of decision making (Côte-Real *et al.*, 2014). However, they also have many differences. As Laursen and Thorlund (2016) claim, “BA allows businesses to go beyond traditional BI.” Thus, taking into account the definitions used, BA emerged as a topic within BI, as BA focuses on topics at a more detailed level than BI, which offers simpler solutions to users (Laursen and Thorlund, 2016).

The differences between one and the other are more evident when analysing the respective frameworks. BI is always adapted by organizations according to their requirements, culture and history so that informed decisions can be made, so the BI framework has as main approaches: the most traditional BI approach, which is related to data aggregation, business analytics and data visualization and an approach related to the integration of the organization's processes in the BI itself. According to this: “BI is a mechanism that bridges the gap between management processes and business strategy” (Zeller, 2008). BA's approaches that support business performance are always based on IS. Thus, these are more efficient when different areas of expertise come together, namely (Schláfke *et al.*, 2013):

- Management Accounting Applications - They focus on the identification and use of cause / effect relationships to optimize performance.
- Analytical Methods - Techniques that combine logical reasoning with complex mathematical, statistical or econometric models.
- IT - IT is the basis of all BA applications, so the performance of analytical management is enhanced when combining the three areas.

3.3 Mobile Applications

Nowadays the world is in an age of agility and data is constantly available, it is important for people to have permanent access to personal and private data. The development of mobile technologies and the growth of users with mobile devices created an opportunity to always be connected online, check e-mails, view documents from shared folders and access data directly in the cloud, smartphone or tablet (Pocatilu *et al.*, 2013).

It is convenient to be available for constant change and be alert to new ways of performing our daily tasks through these systems available in our technological devices, namely the computer, tablet or smartphone (Barreto and Alturas, 2018).

The field of mobile computing is becoming a fundamental part of the daily lives of individuals. Mobile applications (or apps) are a component that today is essential when talking about mobile devices. They are gaining an increasing share of the world market and have all the advantages of mobile cloud technology (Xu *et al.*, 2015). These are not only used for personal use, but the corporate market has also been incorporating apps on a daily basis to streamline work and processes. Apps that involve data management have proven to be a fertile area of work for organizations in that area. The mobile apps used in business management are distinguished from the different IS as they focus on some essential features: functionality and portability, as they combine the characteristics of traditional IS with the basic features of mobile devices (Gebauer and Shaw, 2004).

Every day new apps appear, and every day many apps disappear because they have no real use. In order to survive the digital Darwinism, new e-businesses should be based on providing contents, whose value is driven by their efficiency, lock-in, design, and ability in adding complementary monetisation mechanisms; this value should be captured through the ads value capture schema and In-App purchases if 'free' apps are offered, while it should be captured through mixed mechanisms for 'pay per download' apps (Cristofaro, 2020).

3.4 Desktop Applications

By definition, a desktop application is software that can be installed on a single computer (portable or fixed) and used to perform specific tasks. This type of applications contrasts with web applications, which require a web browser to run, or mobile applications that require a smartphone or tablet to run (Smith, 2018).

There are advantages and disadvantages to using these types of applications, some of the advantages they present are (Lee *et al.*, 1998):

- Security - Desktop applications are less prone to security risks. It is possible to have total control over stand-alone applications and thus protect them from possible vulnerabilities.
- Internet connection - They generally do not need an Internet connection, which makes them more independent.
- Feature-rich - Most desktop applications support many functions in addition to their main task.

Some of the disadvantages that this type of applications can present are related to:

- Maintenance - Desktop applications must be installed separately on each computer that a certain user needs to work on, the same is true when it is necessary to update the application.

- Ease of use - This disadvantage is also due to the fact that the desktop application is confined to a single specific physical space. That is, it ends up causing a constraint in its use because it is not always accessible.

But to get the best out of information systems, users need to be trained well. User training and technical support could positively impact the success of information systems projects (Chevers and Grant, 2019).

3.5 *Fleet Management Apps and Dashboards*

The term Intelligent Transport Systems (ITS) appeared in the early 1930s in Europe, the USA and Japan, and is in constant development. The ITS' scope is to study and optimize all the structures involved in the transport of people and goods. The range of applications directed to ITSs is very wide, from information systems for users, traffic control, management of emergency services, payments for car parks, fleet management for cargo vehicles, public transport and tourism, among others (Meirelles, 1999).

In particular, the development of fleet management systems is a rapidly growing industry. This system helps businesses to control their fleets efficiently and effectively through a good allocation of resources (Thong *et al.*, 2007). There are many IS that have emerged, including mobile applications to help drivers and, above all, company managers. These systems can also contain a dashboard with the most relevant statistics for the company manager. Dashboards are not meant to give more information, but to give the right information to the right person at the right time, using the means indicated and in an economical way. Dashboards radically improve the decision-making process, by amplifying human cognition and capitalizing on human perception capabilities, they are designed to provide managers with quick and intuitive overviews of workers' performance and consequently in companies (Yigitbasioglu and Velcu, 2012).

In recent years, many systems for transport and route management have emerged, the most sophisticated being the Advanced Traveller Information Systems. In the field of road transport, Advanced Traveller Information Systems represent a relevant tool to manage road traffic, improve drivers' utility and make a more efficient use of transport infrastructure. Due to the growing sources of enroute information available nowadays, it is crucial to understand better its influence on drivers' behaviour, particularly regarding route choice (Romero *et al.*, 2020).

3.6 *Key Performance Indicators*

The term key performance indicators (KPIs) was introduced in Europe in the late 1970s, the concept emerged from the government's efforts to improve financial management based on performance reports, and so it was almost exclusively for issues related to political and funding responsibilities (Borden and Bottrill, 1994). Over the years, KPIs began to involve many areas, especially the management area of any organization. Eckerson defines KPI as a metric to measure how well an organization or individual performs the operational or strategic activities that are crucial to the organization's current and future success (Eckerson, 2009). The real-world systems usually have lots of predefined KPIs, which refer to different aspects of system performance (Wan *et al.*, 2021).

Atkin and Brooks (2000) refer that for good performance reports it is important to identify the factors that are necessary for the organization's success. These factors - KPI -

expose the efforts that are necessary to achieve the organizational objectives, help management to understand, evaluate and guide the progress made and also greatly facilitate the decision-making process. Understanding the organization's objectives is crucial for measuring performance indicators (Atkin and Brooks, 2000).

KPIs have seven main characteristics: they are non-financial; they are measured frequently (daily or weekly); the CEO (Chief Executive Officer) or senior manager gives importance to the indicators indicated; they are simple and clearly indicate the necessary action to be taken; they are based, that is, they hold a team of employees accountable; have a significant impact and ultimately encourage appropriate actions (Parmenter, 2015). Thus, through well-defined KPIs, these can be transformed into successful strategies for the company (Lavy *et al.*, 2010).

4 Methodology

Considering the characteristics of this project, including the objectives, the analysis of the appropriate methods for its realization, as well as the quantitative or qualitative approaches, the Design Science Research (DSR) research method was more appropriate for the proposed objective. At a time when the IS research community has stopped focusing on technical issues associated with IS and now tends to focus on more behavioural issues (Parker *et al.*, 1994), interest in applying qualitative methods in IS are increasing, and DSR is a qualitative method (Carstensen and Bernhard, 2019).

Considering that the present project aims at the design of an artifact, this seems to be one of the reasons why the DSR method is suitable for it (van der Merwe *et al.*, 2020) because DSR is also seen as a systematic method for design (Cross, 1993). DSR basically consists of two fundamental steps: build and evaluate. Building is the process of developing an artifact for a specific purpose and evaluating the action of measuring the performance of the artifact in the execution of what it proposes, in the environment for which it was planned to act (Hevner *et al.*, 2004).

5 Results presentation and analysis

5.1 Building Phase

5.1.1 Requirements Management

The requirements management (RM) is the process of obtaining, documenting, analysing and ordering the requirements and then controlling, measuring and supervising the changes and the possible risks of happening. The quality of the requirements affects the work carried out in the subsequent phases of a project (Oberg *et al.*, 2000).

The requirements of a project can be divided by type: functional and non-functional. The first are descriptive requirements: describe the features that the system offers and are easily perceived by the customer. The second consists of the way in which the functional requirements are to be implemented, they relate more to the project development team. In addition to the type, the requirements can be classified between high-level or low-level

requirements. There are several ways to obtain through different means, the careful selection of these means is important and must be done according to the complexity and type of project (Arif *et al.*, 2010). The means used to obtain requirements in the present project were: interviews, knowledge of the field, observation and introspection.

Through the requirements management phase, it was concluded that it is necessary to develop two different applications: a mobile and a desktop. The first will be a simple application for the company's drivers, and its main function is to replace the paper form that is currently used to collect information about the shift and the services performed. The second is an application for the company's operations managers/directors that mainly serves to replace the current Excel files. It aims to be a more modern way of presenting data in more detail, automating the transcription process and also having a data analysis area consisting of tables and a dashboard with values calculated based on the KPIs to help the manager in the decision-making process and to have a more comprehensive and clear vision of what is going on in the company. Dashboards have proven to be very useful tools for fleet management, having already been implemented, for example for management of a family-run taxi company (Freitas and Alturas, 2018).

It is assumed that the driver must use a smartphone with an Android or iOS system in his daily life and that he has access to mobile data or Wi-Fi. The requirements are of a functional nature and of medium-high level (Table 1).

Table 1 Functional Requirements

For the mobile application , the software must have the following features	For the desktop application , the software must have the following features
• No response limit. • Free (without additional investment). • Data entry via smartphone (browser or app). • Online data update. • Various options for fields and content. • Allow unlimited registrations. • Information on the income to be received from the driver. • Be available on Android and iOS.	• Free (without additional investment). • Allow unlimited registrations. • Update of information entered by the driver on the smartphone. • Output to a spreadsheet file that allows export / synchronization. • Various options for fields and content. • Organization of aggregated services (by date, driver, tuk tuk, etc.). • Provide statistical data (graphs, tables, etc.). • Be practical and user-friendly to install and start.

5.1.2 Solution architecture and adopted technologies

The system used to develop the project was Microsoft SQL Server. This decision had as main reason the fact that it is a database system whose installation and licensing are relatively simple and free, contains a user-friendly interface and the connection with Microsoft Azure, which will be used to place the project on cloud. Microsoft SQL Server processes information quickly, it is possible to expand to the cloud and offers powerful business insights; has integrated security (windows authentication, SQL Server authentication); easy integration with the most common spreadsheets (Microsoft Excel); good data recovery strategy and facilitates the transition from solutions to the cloud with support for hybrid environments (Mistry and Misner, 2014).

Regarding the cloud system to be used, as already mentioned, Microsoft Azure was chosen. This is the leader in cloud services and is constantly expanding. Through Azure the customer can customize their own cloud environment; it is geographically spread over several regions, which allows the customer to make the right choice of which data centre to access according to technical and legal requirements; and, according to official MS Azure documentation (Microsoft azure, Mar. 2015) “cloud services are grouped by proximity to each other in the Azure data centre to achieve the best possible performance.” (Persico *et al.*, 2015).

As for the development of the interface, there are some factors to take into account for a good decision of the programming language to be used, namely: if it is fit-for-purpose; the choice of the platform on which the program is developed; and the capabilities of the person who is programming (Spinellis, 2006). The language chosen for the development of the desktop and mobile application was C#. C# is an object-oriented language. According to a study by Kruglyk and Lvov (2012), C# is one of the most suitable programming languages for software development for both desktop and mobile, which is why it is considered fit-for-purpose (Kruglyk and Lvov, 2012). The IDE (Integrated Development Environment - platform) on which the desktop application was developed is VisualStudio 2019, which has good interface components. Third party components were also used, namely a set of DevExpress documents. Finally, like the SQL language, C# is a language familiar to the languages taught during the course, and thus it is the language that best fits with the programmer's capabilities (Figure 2).

Figure 2 Applicability of programming languages (Kruglyk and Lvov, 2012)

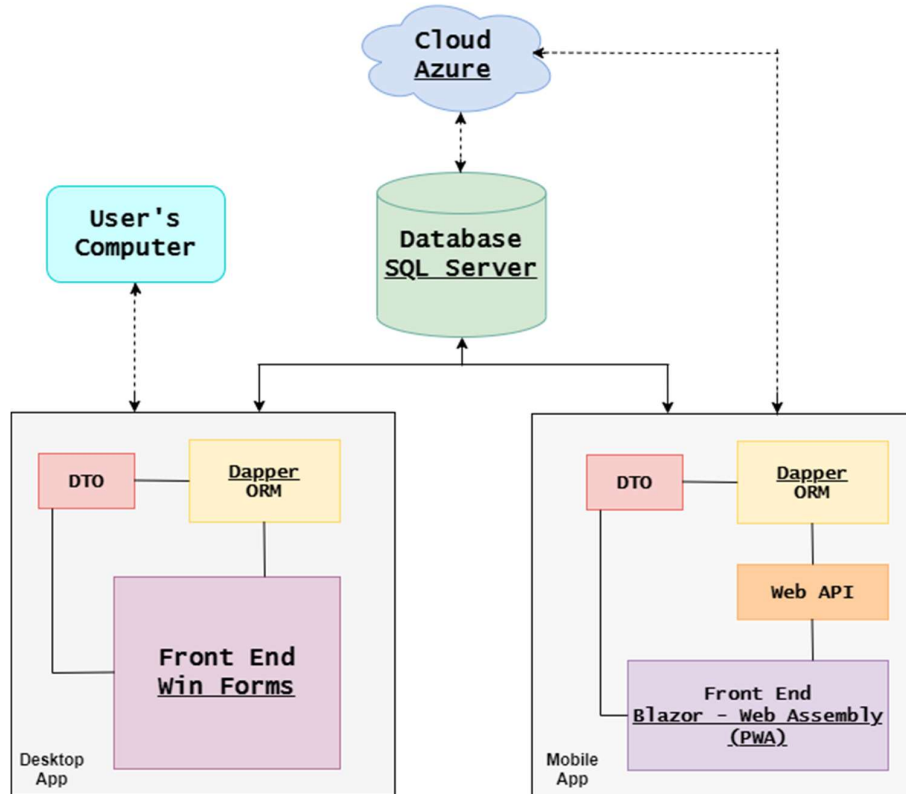
	Pascal	C#	Java	Python	C++	Object Pascal	PHP	Javascript
System programming	0	0	0	0	2	0	0	0
Web – programming	0	2	2	2	1	1	2	1
Desktop – programming	1	2	2	2	2	2	1	0
Mobile – programming	0	2	2	2	2	0	0	0
Web – client development	0	2	2	2	0	0	0	2

Legend:
0 – the language is impossible to use for such purposes
1 – the language can be used for these purposes but there are better solutions
2 – the language can be used for these purposes and is recommended to

The mobile application was developed using the Blazor platform, Blazor is an open-source web application from Microsoft, which allows programmers to develop web applications using the C# language. Initially, the use of Flutter, from Google, was considered, however Flutter had the disadvantage of not being able to develop web applications. The reason why it was necessary to be a web application is because the Appstore does not accept private applications, and the present project should not be available to everyone, only for company workers. Thus, it was necessary to find a platform that, as indicated in the requirements specification phase, could be available for both Android and iOS (iPhone Operating System). Blazor allows you to generate PWA's (Progressive Web Apps), which are different from native applications (the most common)

because they have the ability to run on various platforms regardless of the operating system, as they run on the web through the browser, and are therefore available on both Android and iOS. Figure 3 shows the architecture of the technological solution.

Figure 3 Technological Solution Architecture



5.1.3 Brand Name and Image

Brands are fundamental components of the strategic options of a product, service or company (Crittenden, 2011). Selecting an appropriate brand name is one of the vital marketing decisions for the product and is often an arduous task (Keller, 1993).

The brand name is quite important. Bo, Shao, and Rivers (2008), empirically examined the effects of brand relevance, connotation, and pronunciation on consumers' preferences for new brand names. Results showed that the contribution of connotation will be attenuated if the brand name is difficult to pronounce (Bao *et al.*, 2008). The name chosen for the brand that represents this project was Tuksy, which is an easy name to pronounce in most languages.

In this paper, the term logo is used to refer to the graphic design that a brand uses to identify itself (Pittard *et al.*, 2007). The value that the logo offers to a brand is mainly related to the identification and differentiation of the brand in relation to competitors and

also with the relationship with consumers. Colours are essential elements, both in the daily lives of individuals and at the ancestral level, human beings appeared and evolved in an environment full of colours (Popa *et al.*, 2013). The Tuksy image is composed of two colours: light blue and dark grey the main colour being light blue, dark grey is presented as a neutral colour (Figure 4).

Figure 4 Tuksy logo



5.2 *Evaluating Phase*

5.2.1 *Competitors Analysis*

Since the beginning of the post-industrial period (1945 to 1970), competitiveness among companies in the goods and services sector has become increasingly accentuated. Thus, the analysis of competitors has become an essential tool for the effective development of a company's competitive strategic management. Kotler and Keller (2017) highlights two forms of competition, the direct one, which offers the same product line, with a similar price regime for the same target audience; and indirect competition, it sells substitute or complementary products to the same target audience (Kotler and Keller, 2017). Thus, it was necessary to analyse the competitors of the application to be developed. Since the application is personalized, it does not find direct competitors. However, some indirect competitors were found: CarTrack and Frotcom.

When analysing these two indirect competitors with the product to be developed, it is quickly realized that they do not present a major competitive threat. Firstly, and although the competitors are quite complete, they are not specialized in the tourist vehicle market, namely tuk tuks. When monitoring the fuel, both Frotcom and Cartrack allow the fleet manager to understand the strategy, he must adopt so that there is no waste, thus saving a high amount of money in the long run. However, the majority of tuk tuks are currently electric, so this great advantage that classic fleet management tools bring to the customer would not be noticeable in the case of Citytuk. Another major factor that makes Tuksy far above the competition, is the fact that it is personalized. Thus, it should be noted that despite the target audience being the same, the objectives of the various products are different, thus highlighting the uniqueness of the application under development.

5.2.2 *Tuksy Desktop Analysis*

For a correct use of the application, it is necessary to test it, and to understand if all fields are in operation and if the statistical formulas used to obtain averages and rates are correct. For this purpose, thousands of fictitious data had to be carefully entered (due to the data protection policy - applied in accordance with the General Data Protection Regulation -, the company was unable to provide the actual data of the drivers). The main

focus of the simulation phase is to see if there are bugs in the program and if it responds to the needs of the company. One of the priorities when elaborating the data was to keep it realistic, not inserting values that are too different from the real world, and not inserting the same values in all fields because a constant repetition of data, in the Data Analysis area, would translate into not very dynamic graphs and tables and it would not be possible to detect possible existing failures.

For the layout of the Tuksy Desktop content, tabs were defined, which were later separated by areas, so the menu is presented as follows:

- Data Analysis: Dashboard, Aggregated Data, Billing, Cross Information.
- Operations: Daily Operations, Payments, Shifts, Services, Master Services.
- Resources: Drivers, Tuk tuks.
- Definitions: Configure Commission, Others.

The Data Analysis area consists of a statistics area that presents the company's KPIs. The analysis of KPIs helps in decision making, project performance improvements, and identifying problems quickly. For this project, the most relevant KPIs for the daily activity of Citytuk were identified:

- Net amount of revenues (€).
- Total services.
- Average hours of work per driver.
- Average revenue (€) per driver.
- Average services per driver.

All of these metrics are calculated from the information provided by the form that the drivers fill out throughout the workday.

5.2.3 Tuksy Mobile Analysis

The testing phase of Tuksy Mobile is much simpler than that of Tuksy Desktop, since the database is the same. Therefore, it is only necessary to enter some data in the mobile app to certify its functioning.

Tuksy's mobile application is very intuitive, and has only four tabs:

- Home - this shows the name of the driver that is registered in the account in use and a Date field, which after entering it starts the shift, automatically opening that tab.
- Shifts - this one contains several fields with information about the shift that the driver must fill in at the beginning and end of the shift.
- Services - after starting the shift, each time the driver performs a service he/she should add the respective information in this tab.
- Dashboard - this summarizes all the driver and company revenues, as well as some other data that make up the KPIs.

5.2.4 User Qualitative Analysis

Throughout the development and writing of this project, there was permanent contact with Citytuk's Operations Director, Nuno Silva. This contact consisted of several meetings, the last of which consisted of a short interview. This interview aimed to understand what the company's perception of Tuksy is, in which it concluded:

- Tuksy Desktop would be very useful and welcome to the company, is easy and intuitive to use. It would bring advantages such as: the reduction of the error factor, the

improvement of time management, and brings a better knowledge about the patterns and behaviours of each driver.

- Despite the fact that the selected KPIs do not contain any specific information, they provide a very important base of revenue, which, when complemented with other information, provides a very useful knowledge to the company about its status. The display of information through a dashboard was considered intuitive and practical, as it is possible to perceive trend lines. The operations director considers that this application is missing from Citytuk, it is more than just a “bonus”, it is a real necessity.

- Adapting drivers to Tuksy Mobile would be very quick and easy, it is simpler than the daily sheet currently used, workers like to feel they are in a modern environment. The Dashboard separator, existing on Tuksy mobile, also serves as a greater incentive for workers.

6 Conclusions

6.1 Discussion

This project came up with the need to modernize the daily operation of tuk tuk companies, namely, the Citytuk company, which worked as a partnership for this project. Thus, the project consists of a mobile application to replace the daily sheet (of paper) filled in by the drivers, and a desktop application, for managers, to which all the information submitted by the drivers in the mobile application goes, and which, not only replaces the existing Microsoft Excel files, as it offers a data analysis area, with statistics, a dashboard and other indicators. All of the functions described meet the specific objectives defined for the applications.

Regarding the first objective of the study, on the analysis of technologies that already exist in this business area, it was concluded that although there are fleet management applications and tuk tuk hitchhiking applications, none present as a direct competitor to the project introduced. Fleet management applications are not very personalized considering the needs of companies and are more specialized for non-tourist vehicles. Tuk tuks applications have a different purpose, as they consist of a lift service, for the customer, not for the company and for its management.

The second objective of the study considering which are the most important requirements to have in the application, was accomplished through the requirements survey. In this phase, it was found that there would be two applications, for different users, and with different requirements. The requirements were raised using mainly the means of interviews, knowledge of the field, observation and introspection. Functional and medium-high level requirements have been completed. An analysis of the available technologies was also carried out, in order to understand which are the most appropriate in order to be able to comply with all requirements. The requirements have all been met, and the application serves the needs of the company with virtually no limitations. It could be adaptable and improved as new ideas or developments emerge.

Finally, the last objective of this study: if it is possible to increase the success of the company's management, it was concluded through an interview with the Director of Operations, Nuno Silva. It was concluded that the use of the application drastically reduces the error factor, since there is no duplication of data copy (it was done by the driver and

then by the manager, and it is now done only by the driver). It also brings advantages in terms of time management, there is a huge saving of time not only because it is no longer necessary to transcribe the data from the daily sheet to Excel, but mainly due to the long time spent in the calculation of the statistics to analyse the performance of the workers and the company, that with the adoption of the solution, as everything is automatically calculated and the values presented in an intuitive way, this time is drastically reduced. Finally, the level of knowledge of the drivers' work both at a general and individual level is also improved, since Tuksy allows an overview of the performance of each one. In addition to these three factors for increasing the success of the company's management, Tuksy radically modernizes the company's management methods and offers performance indicators in a simple and intuitive way. Thus, it was concluded that Tuksy can effectively increase the success of the company's management by making it more assertive, fast, intuitive and modern, which can give rise to better sustained management decisions, and consequently increase the company's efficiency.

6.2 Contributions and limitations

This project represents a strong contribution to the business community, namely regarding tuk tuk companies. As mentioned in the Competitors Analysis subchapter, this technological solution has a great differentiating characteristic from the others, which is the fact that it is customizable and adapted to the reality of each company. The basis of the created solution can be replicated in any company in the same sector. Thus, if other companies show interest, an information collection will be carried out next to it so that an update can be made and adapted to its needs. With the acquisition of Tuksy it is possible to: facilitate the work of managers, offer more technological resources to workers, and possibly improve the productivity and profitability of companies.

One of the limitations that this project had was the fact that it was not put into action with the company. In addition, as already mentioned, it was not possible for the company to provide the real data of the drivers and the shifts and services they carried out in the last year due to the data protection policy (applied in accordance with the General Data Protection Regulation (GDPR)). However, it was developed taking into account the needs of the company and the manager itself, and was tested with numerous data close to reality, so the tests are as accurate as possible and therefore the integration of the application in Citytuk is not expected to be complicated. Another issue that may limit its use is that to use Tuksy mobile, the drivers must have access to the internet via Wi-fi or access to a mobile data network, if this is not verified the data is not submitted. However, since the company's activity takes place in the centre of Lisbon, there is network coverage in virtually all locations for access to mobile data or access to public Wi-Fi networks available.

6.3 Future Projects Proposals

For the future, this project has a lot of growth potential at both micro and macro level, that is, it not only has the possibility of development within the company currently under study, Citytuk, but it has a high potential for expansion to other companies.

At the micro level, the Tuksy project must be implemented in the company and all users must become accustomed to using it so that the best possible advantage can be taken.

From then on, the project will be constantly updated according to needs, both to satisfy the essential issues that require resolution and to implement new features that arise in the middle of information systems. The goal is to be as complete and at the same time as simple as possible. One of the proposals for new functionality is to incorporate in the Tuksy Mobile a GPS that, from the moment they start the shift, is active and saves the places where this driver is with the tuk tuk. This feature has the main function of the company's managers to have a perception about whether the track calculated by the GPS makes sense with the locations that the drivers said were in the form - in the fields of Pick-Up Spot and Drop-Off Spot.

After a few months and depending on the company's feedback, namely if it becomes an essential tool for the job, the possibility of becoming a paid software is open. The payment model would be similar to that of the vehicle fleet management software companies, that is, paid monthly and not dependent on the number of vehicles or drivers. As for the value, it will only be established in the future, comparing it with the values of the most similar competitors (but considering that this software is 100% customized for this specific company). The value also depends on the work involved: number of hours and complexity of the work.

In the long-term future, if the project is solid and progressing well, the possibility of extending to other tuk tuk companies is on the table. Here, a market study would first be carried out to understand the openness of other companies to this information system and the need for it. Once understood and if there is such a need in the market, it is necessary to understand which points in the current Tuksy do not meet the needs of new companies and therefore must be improved - there are base points that are known from the start which differ from company to company like the drivers 'commission, the names of the tuk tuks' models, among others. Depending on the company's need for the application and the type of modifications and work involved that will be necessary to make the model suitable for each of the new companies, the price is set.

References

- van der Aalst, W.M.P., Becker, J., Bichler, M., Buhl, H.U., Dibbern, J., Frank, U., Hasenkamp, U., *et al.* (2018), "Views on the Past, Present, and Future of Business and Information Systems Engineering", *Business and Information Systems Engineering*, Vol. 60 No. 6, pp. 443–477.
- Aboaoga, M., Aziz, M.J.A. and Mohamed, I. (2020), "A conceptual model of institutional information culture and interpersonal conflict which influence the information system success: User's perception", *International Journal of Business Information Systems*, Vol. 33 No. 1, pp. 1–22.
- Alturas, B. (2013), *Introdução Aos Sistemas de Informação Organizacionais [Introduction to Organizational Information Systems]*, Edições Sílabo, Lisboa.
- Arif, S.U., Khan, Q. and Gahyyur, S.A.K. (2010), "Requirements Engineering Processes, Tools/Technologies, & Methodologies", *International Journal of Reviews in Computing*, Vol. 2, pp. 41–56.
- Atkin, B. and Brooks, A. (2000), *Total Facility Management*, John Wiley & Sons.

- Bao, Y., Shao, A.T. and Rivers, D. (2008), "Creating new brand names: Effects of relevance, connotation, and pronunciation", *Journal of Advertising Research*, Vol. 48 No. 1, pp. 148–162.
- Barreto, D.S. and Alturas, B. (2018), "Quality-in-use App Evaluation : Case of a Recruitment App for Portuguese SMEs", *Journal of Information Systems Engineering & Management*, Vol. 3 No. 1, pp. 1–9.
- Boell, S.K. and Cecez-Kecmanovic, D. (2015), "What is an information system?", *Proceedings of the Annual Hawaii International Conference on System Sciences*, Vol. 2015-March, pp. 4959–4968.
- Borden, V.M.H. and Bottrill, K. v. (1994), "Performance indicators: History, definitions, and methods", *New Directions for Institutional Research*, Vol. 1994, pp. 5–21.
- Carstensen, A.K. and Bernhard, J. (2019), "Design science research—a powerful tool for improving methods in engineering education research", *European Journal of Engineering Education*, Taylor & Francis, Vol. 44 No. 1–2, pp. 85–102.
- Chevers, D.A. and Grant, G.G. (2019), "Developers' views on the adoption and benefits of software process improvement programs in Canadian software development firms", *International Journal of Business Information Systems*, Vol. 32 No. 2, pp. 238–252.
- Côrte-Real, N., Ruivo, P. and Oliveira, T. (2014), "The Diffusion Stages of Business Intelligence & Analytics (BI&A): A Systematic Mapping Study", *Procedia Technology*, Elsevier B.V., Vol. 16, pp. 172–179.
- Costello, K. and Rimol, M. (2019), "Gartner Says Global IT Spending to Grow 3.7% in 2020", Orlando, Florida, USA, available at: <https://www.gartner.com/en/newsroom/press-releases/2019-10-23-gartner-says-global-it-spending-to-grow-3point7-percent-in-2020>.
- Cristofaro, M. (2020), "E-business evolution: an analysis of mobile applications' business models", *Technology Analysis & Strategic Management*, Vol. 32 No. 1, pp. 88–103.
- Crittenden, V.L. (2011), "Brand Growth Strategy", *Wiley International Encyclopedia of Marketing*, John Wiley & Sons.
- Cross, N. (1993), "Science and design methodology: A review", *Research in Engineering Design*, Vol. 5 No. 2, pp. 63–69.
- Eckerson, W.W. (2009), *Performance Management Strategies: How to Create and Deploy Effective Metrics*, TDWI Best Practices Report.
- Freitas, F. and Alturas, B. (2018), "Implementação de Dashboard Operacional para Empresa de Táxis Familiar [Operational dashboard implementation for a family taxi business company]", *13th Iberian Conference on Information Systems and Technologies, CISTI 2018*, AISTI, Vol. 2018-June, pp. 1–6.
- Gates, B. (1999), *Business at the Speed of Thought: Using a Digital Nervous System*, Time Warner, New York, NY, USA.

- Gebauer, J. and Shaw, M.J. (2004), "Success factors and impacts of mobile business applications: Results from a mobile e-procurement study", *International Journal of Electronic Commerce*, Vol. 8 No. 3, pp. 19–41.
- Hassan, N.R. and Mathiassen, L. (2018), "Distilling a body of knowledge for information systems development", *Information Systems Journal*, Vol. 28 No. 1, pp. 175–226.
- Hevner, A.R., March, S.T., Park, J. and Ram, S. (2004), "Design science in information systems research", *MIS Quarterly: Management Information Systems*, Management Information Systems Research Center, Vol. 28 No. 1, pp. 75–105.
- el Hilali, W. and el Manouar, A. (2020), "Sustainability through information systems: how can information systems lead to sustainable business models?", *International Journal of Business Information Systems*, Vol. 33 No. 2, pp. 225–249.
- Jack, M. (2020), "The socio-spatial installed base: Ride-hailing applications, parking associations, and precarity in tuk tuk driving in Phnom Penh, Cambodia", *Information Society*, Routledge, Vol. 36 No. 5, pp. 252–265.
- Jahantigh, F.F., Habibi, A. and Sarafrazi, A. (2019), "A conceptual framework for business intelligence critical success factors", *International Journal of Business Information Systems*, Vol. 30 No. 1, pp. 109–123.
- Keller, K.L. (1993), "Conceptualizing, Measuring, and Managing Customer-Based Brand Equity", Vol. 57 No. 1, pp. 1–22.
- Kotler, P. and Keller, K.L. (2017), *Marketing Management*, 15th ed., Pearson Education.
- Kruglyk, V. and Lvov, M. (2012), "Choosing the first educational programming language", *CEUR Workshop Proceedings*, Vol. 848, pp. 188–198.
- Laursen, G.H.N. and Thorlund, J. (2016), *Business Analytics for Managers: Taking Business Intelligence Beyond Reporting*, 2nd ed., John Wiley & Sons.
- Lavy, S., Garcia, J.A. and Dixit, M.K. (2010), "Establishment of KPIs for facility performance measurement: Review of literature", *Facilities*, Vol. 28 No. 9, pp. 440–464.
- Lee, D.C., Crowley, P.J., Baer, J.L., Anderson, T.E. and Bershad, B.N. (1998), "Execution characteristics of desktop applications on windows NT", *Conference Proceedings - 25th Annual International Symposium on Computer Architecture, ISCA*, pp. 27–38.
- Li, E.Y. (1997), "Perceived importance of information system success factors: A meta analysis of group differences", *Information and Management*, Vol. 32 No. 1, pp. 15–28.
- Lumpkin, G.T., Steier, L. and Wright, M. (2011), "Strategic Entrepreneurship in Family Business", *Strategic Entrepreneurship Journal*, Vol. 5 No. 4, pp. 285–306.
- Meirelles, A.A. de C. (1999), "Sistemas de Transportes Inteligentes: aplicação da telemática na gestão do trânsito urbano [Intelligent Transport Systems: application of telematics in urban traffic management]", *Revista de Informática Pública*, Vol. 1 No. 1, pp. 1–16.

- van der Merwe, A., Gerber, A. and Smuts, H. (2020), "Guidelines for conducting design science research in information systems", *Communications in Computer and Information Science*, Vol. 1136 CCIS, pp. 163–178.
- Mistry, R. and Misner, S. (2014), *Introducing Microsoft SQL Server 2014*, Microsoft Press.
- Mohamad, A., Li, P., Alam, N. and Zainuddin, Y. (2020), "Portfolio of IT investment and organisational performance . Moderating role of decentralised decision making", *International Journal of Business Information Systems*, Vol. 33 No. 1, pp. 48–79.
- Muntean, M. (2015), "Considerations Regarding Business Intelligence in Cloud Context", *Informatica Economica*, Vol. 19 No. 4/2015, pp. 55–67.
- Negash, S. and Gray, P. (2008), "Business Intelligence", *Handbook on Decision Support Systems 2*, Springer, Berlin, Heidelberg, pp. 175–193.
- Oberg, R., Probasco, L. and Ericsson, M. (2000), "Applying Requirements Management with Use Cases", *Rational Software White Paper*, Vol. 5.
- Parker, C., Wafula, E., Swatman, P. and Swatman, P. (1994), "Information systems research methods: the technology transfer problem", *Proceedings of the 5th Australian Conference on Information System*, pp. 197–208.
- Parmenter, D. (2015), *Key Performance Indicators: Developing, Implementing, and Using Winning KPIs*, 3rd ed., John Wiley & Sons.
- Permana, D.S. and Sutaryo, S. (2020), "Does information system technology succeed in helping manage debt?", *International Journal of Business Information Systems*, Vol. 33 No. 1, pp. 23–47.
- Persico, V., Marchetta, P., Botta, A. and Pescapé, A. (2015), "On network throughput variability in microsoft azure cloud", *2015 IEEE Global Communications Conference, GLOBECOM 2015*, IEEE, No. ii, available at: <https://doi.org/10.1109/GLOCOM.2014.7416997>.
- Pittard, N., Ewing, M. and Jevons, C. (2007), "Aesthetic theory and logo design: Examining consumer response to proportion across cultures", *International Marketing Review*, Vol. 24 No. 4, pp. 457–473.
- Pocatu, P., Boja, C. and Ciurea, C. (2013), "Syncing Mobile Applications with Cloud Storage Services", *Informatica Economica*, Vol. 17 No. 2/2013, pp. 96–108.
- Popa, C.N., Popescu, S., Tamba-Berehoiu, R.M. and Tamba-Berehoiu, S.-M. (2013), "Considerations Regarding Use and Role of Colour in Marketing", *Scientific Papers Series : Management, Economic Engineering in Agriculture and Rural Development*, Vol. 13 No. 1, pp. 269–274.
- Romero, F., Gomez, J., Rangel, T., Jurado-Piña, R. and Vassallo, J.M. (2020), "The influence of variable message signs on en-route diversion between a toll highway and a free competing alternative", *Transportation*, Vol. 47, pp. 1665–1687.
- Schläpke, M., Silvi, R. and Möller, K. (2013), "A framework for business analytics in performance management", *International Journal of Productivity and Performance Management*, Vol. 62 No. 1, pp. 110–122.

- Smith, J. (2018), "Desktop Applications Vs. Web Applications", *Editorialtoday.Com*, available at:
https://www.streetdirectory.com/travel_guide/114448/programming/desktop_applications_vs_web_applications.html.
- Spinellis, D. (2006), "Choosing a programming language", *IEEE Software*, Vol. 23 No. 4, pp. 62–63.
- Thong, S.T.S., Chua, T.H. and Rahman, T.A. (2007), "Intelligent fleet management system with concurrent GPS & GSM real-time positioning technology", *ITST 2007 - 7th International Conference on Intelligent Transport Systems Telecommunications, Proceedings*, pp. 136–141.
- Wan, C., Li, W., Ding, W., Zhang, Z., Lu, Q., Qian, L., Xu, J., *et al.* (2021), "Multi-task sequence learning for performance prediction and KPI mining in database management system", *Information Sciences*, Vol. 568, pp. 1–12.
- Xu, G., Wu, Q., Daneshmand, M., Liu, Y. and Wang, M. (2015), "A data privacy protective mechanism for WBAN", *Wireless Communications and Mobile Computing*, No. February 2015, pp. 421–430.
- Yigitbasioglu, O.M. and Velcu, O. (2012), "A review of dashboards in performance management: Implications for design and research", *International Journal of Accounting Information Systems*, Elsevier Inc., Vol. 13 No. 1, pp. 41–59.
- Zeller, J. (2008), "Business Intelligence: The Road Trip", *Information Management Special Reports*.