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Integration of driving performance efficiency metrics in heavy-truck companies: Joiditrans, Lda. in-company project

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Master in Management of Services and Technology

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Department of Marketing, Strategy and Operations

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Acknowledgments

This dissertation represents much more than an academic project. It represents the culmination of almost 18 years of learning and development. I had the possibility of contacting countless people who each in their way, shaped and helped become the man that I am today. During all these years, I faced several challenges, and with this project, I would like to leave a word of appreciation to all these people in a unique way, because they changed my life and deserve a special mention.

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To all of you, my sincere thank you.

Resumo

A fim de analisar e entender novos modelos e ideias de avaliação de eficiência, este projeto foi desenvolvido em parceria com uma empresa de transportes rodoviários de mercadorias denominada de Joiditrans, com a finalidade de definir quais as métricas e indicadores que permitem a uma empresa como esta sobreviver num setor de mercado competitivo como é o dos transportes rodoviários.

Com base numa pesquisa que reunisse informações valiosas e importantes para o desenvolvimento de uma revisão da literatura completa, definiram-se conceitos essenciais que tornaram possível entender um problema existente nas empresas de transportes e as diversas formas como é possível criar modelos de melhoramento da eficiência do negócio.

Este projeto-empresa permitiu identificar os diversos problemas que a empresa possui, pois, a Joiditrans ao não conseguir utilizar de forma eficaz e correta as informações dos sistemas de telemetria, acaba por provocar falhas e defeitos na análise de indicadores de performance. Assim com base na revisão da literatura e na realidade da empresa, foi possível observar e descrever como a empresa se organiza e como são aplicadas diferentes técnicas de condução de veículos pesados.

Desta forma, com todos estes dados obtidos e observados, identificou-se o que está a ser bem feito e o que pode ser melhorado através de uma proposta de um modelo de implementação de análise de performance de condução e como a empresa pode conseguir controlar futuramente estes indicadores de performance de forma a garantir sempre a mesma eficiência operacional.

Palavras-Chave: Sistemas de Telemetria; Condução Ecológica; KPI; Eficiência.

JEL: R4 – Transportation Economics; R41 – Transportation: Demand, Supply and Congestion.

Abstract

In order to analyze and understand new models and ideas for efficiency evaluation, this project was developed in partnership with a road cargo transportation company named Joiditrans, with the purpose of defining which metrics and indicators allow a company like this to survive in a competitive market sector such as the road transportation.

Based on research that gathered valuable and essential information for the development of a complete literature review, it was defined essential concepts that made it possible to understand an existing problem in transportation companies and the different ways in which it is possible to create models for improving the business efficiency.

This company-project made it possible to identify the various problems that the company has, because Joiditrans by failing to use effectively and correctly information from telematics systems, ends up causing flaws and defects in the analysis of performance indicators. This way, based on the literature review and the reality of the company, it was possible to observe and describe how the company is organized and how different techniques of heavy truck driving are applied.

In this way, with all this data obtained and observed, it was identified what is being well done and what can be improved through a proposal for an implementation model of driving performance analysis and how the company can manage to control these performance indicators in the future to guarantee always the same operational efficiency.

Keywords: Telemetry Systems; Eco-Driving; KPI; Efficiency.

JEL: R4 – Transportation Economics; R41 – Transportation: Demand, Supply and Congestion.

Index

| | |
|--|------|
| Acknowledgements | i |
| Resumo | iii |
| Abstract | v |
| Index | vii |
| Figures Index | ix |
| Tables Index | xi |
| Acronym List | xiii |
| 1. Introduction | 1 |
| 1.1. Problem Definition | 2 |
| 1.2. Research Objectives | 4 |
| 2. Literature Review | 5 |
| 2.1. Main Theoretical Concepts | 5 |
| 2.1.1. Telemetry Systems | 5 |
| 2.1.2. Eco-Driving | 6 |
| 2.1.3. Truck's Key Performance Indicators | 7 |
| 2.1.4. Efficiency | 9 |
| 2.2. Empirical Information | 10 |
| 3. Performance Efficiency Model based on Literature Review | 15 |
| 4. Methodology | 19 |
| 4.1. Research Context | 19 |
| 4.2. Research Design | 19 |
| 4.3. Data Collection | 22 |
| 4.4. Data Analysis | 22 |
| 5. Business Analysis | 25 |
| 5.1. External Analysis | 25 |
| 5.1.1. Macro Environment Analysis | 25 |
| 5.1.1.1. PESTEL Analysis | 25 |
| 5.1.2. Micro Environment Analysis | 30 |
| 5.1.2.1. Industry/Setor | 30 |
| 5.1.2.1.1. Porter's Five Competitive Forces | 32 |
| 5.1.2.2. Market | 37 |
| 5.1.2.2.1. SWOT Analysis | 37 |
| 5.1.2.2.2. GE McKinsey Matrix | 42 |
| 5.1.2.2.3. Road Transportation Portuguese Market | 45 |
| 5.2. Internal Analysis | 46 |
| 5.2.1. Competitive Advantages | 48 |

| | |
|--|----|
| 5.2.2. Value Chain | 49 |
| 5.3. Business Audition and Analysis | 51 |
| 5.4. Data Collection, Analysis and Treatment | 53 |
| 5.4.1. Interview to the Management | 53 |
| 5.4.2. Surveys to the Drivers | 55 |
| 6. Research Findings and Recommendations | 59 |
| 6.1. Definition of Results | 59 |
| 7. Research Summary and Improvements | 63 |
| 7.1. Efficiency Performance Model | 63 |
| 7.2. Implementation Plan | 69 |
| 7.2. Monitorization of KPI's | 71 |
| 8. Conclusions and Discussion | 75 |
| 8.1. Contributions to Management | 75 |
| 8.2. Contributions to Knowledge | 76 |
| 8.3. Limitations of the Project | 76 |
| 8.4. Future Studies and Projects | 77 |
| 9. References | 79 |
| 10. Attachments | 85 |

Figures Index

| | |
|--|----|
| Figure 1.1 – Road Transportation Fuel Prices in EU Member States | 2 |
| Figure 2.1 – Telematics System Communication | 5 |
| Figure 2.2. – Eco-Driving Techniques | 7 |
| Figure 2.3 – Road Transportation Efficiency Measures | 9 |
| Figure 2.4 – Driver’s Perception-action Process | 11 |
| Figure 2.5 – Telematics Indicators | 12 |
| Figure 2.6 – Model of Driver Behaviour | 13 |
| Figure 2.7 – Behaviour Process | 14 |
| Figure 3.1 – Road Transportation Business Context | 15 |
| Figure 3.2 – Diagram of the global approach for energy consumption and emissions | 16 |
| Figure 3.3 – Monitorization of Driver’s Behaviour | 16 |
| Figure 3.4 – Correlation of Efficiency | 17 |
| Figure 3.5 – Efficiency Formulas | 17 |
| Figure 5.1 – Joiditrans Value Chain | 50 |
| Figure 7.1 – Fuel Consumption Targets | 73 |

Tables Index

| | |
|--|----|
| Table 1.1 – Specific Objectives of the Enterprise Project | 4 |
| Table 2.1 – Examples of Truck KPI's | 8 |
| Table 5.1 – Macro Environment Analysis/PESTAL Analysis of Road Transportation Sector | 25 |
| Table 5.2 – Porter's Competitive Forces in the Road Transportation Industry | 32 |
| Table 5.3 - Joiditrans SWOT analysis | 37 |
| Table 5.4 – Analysis of the Attractiveness of the Industry and Business Unit | 42 |
| Table 5.5 – Joiditrans GE/McKinsey Matrix | 44 |
| Table 5.6 – Diesel Reference Values | 52 |
| Table 5.7 – Fleet Performance Indicators | 53 |
| Table 5.8 – Consumption and Travel Analysis | 53 |
| Table 5.9 – Drivers' Survey Results | 56 |
| Table 6.1 – Joiditrans' Operation Goals | 60 |
| Table 6.2 – Joiditrans' Current Driver Performance Factors | 61 |
| Table 6.3 – Driver Performance Factors | 62 |
| Table 7.1 - Driving Performance Classification Grid | 64 |
| Table 7.2 – Weightings of driving analysis categories | 65 |
| Table 7.3 - General Evaluation of Driving Performance | 66 |
| Table 7.4 - Average Grading for Fuel Consumption | 67 |
| Table 7.5 - Driving Performance Classification | 68 |
| Table 7.6 - Implementation Plan of Efficiency Model | 70 |
| Table 7.7 - Fuel Consumption Targets | 72 |

Acronym List

ANTRAM – Associação Nacional de Transportadores Públicos Rodoviários de Mercadorias

APCER – Associação Portuguesa de Certificação

CEO – Chief Executive Officer

ECMR – Energy Consumption Management Regulation

Fectrans – Federação dos Sindicatos de Transportes e Comunicações

GDP – Gross Domestic Product

GOE – Grams of Oil Equivalent

GPS – Global Positioning System

HP - Horsepower

IMT – Instituto da Mobilidade e dos Transportes

INE – Instituto Nacional de Estatísticas

KM - Kilometer

KPI – Key Performance Indicators

PESTEL – Political, Economic, Social, Technological, Environmental, Legal

SMEs – Small and Medium-Sized Enterprises

SNMMP – Sindicato Nacional de Motoristas de Matérias Perigosas

SWOT – Strengths, Weaknesses, Opportunities, Threats

TOE – Ton of Oil Equivalent

TPP - Taxation of Petroleum Products

VCLC – Vertical Collective Labor Contract

1. Introduction

The act of transportation provides an impetus for trade and generalized economic growth, which are fundamental to generate wealth and prosperity in society (Rodrigue, 2017). It is through the various means of transportation that massive logistical networks and mass circulation of goods have created and guarantee the physical connection between the most diverse national and international markets over the years. With the progressive advancement of technology and equipment that has been developed, the current efficient transportation systems guarantee the quality of transportation and optimization of all supply chains (Wang et al., 2016). But in the last few decades, fundamental factors have emerged to this type of activity that has also led to a change in the transportation paradigm and the need to ensure transport efficiency that was not previously considered (Schipper, 2019).

Globalization, technology and the increase in available information has made people start demanding their resources and materials in an increasingly faster and more efficient way, and through this, they continuously look for different ways to guarantee them (Cassidy, 2010). This led to a market squeeze as competitiveness increased substantially, prices decreased and as a result, the margins of the companies belonging to the logistics chains decreased (Matos et al., 2011). Furthermore, with the spread of the digital age and the introduction of technologically developed mechanisms, the major challenge for transportation companies and their respective fleet managers is no longer to know where the vehicle is and when it would deliver its cargo, and began to be the way the resource is used and how it is possible to transport the greatest amount of goods with the least possible use of resources (Schweitzer et al., 2008).

The optimization of fleets and the use of transportation vehicles has been something that transportation companies increasingly seek to adopt in an easy way, and that allows them to guarantee a reduction in operating costs but at the same time that increases the profitability of transport and companies (Journal et al., 2010), making it possible for companies not only to reduce excessive fuel consumption but also to find effective ways to reduce the ecological impact (Text, 2017) and increase road safety (García-Arca et al., 2018). It is for this reason that transportation companies have tried to find a way to invest in telemetry technology in heavy vehicles, in constant training and learning in eco-driving for their employees to develop essential metrics that guarantee control in the type of driving and the behaviour of its drivers behind the wheel (Owner & Mar, 2019).

The big problem for transportation companies is that this new dynamic and organizational culture are totally unknown, and these companies still do not fully integrate metrics and alternative analyzes that make the transportation sector follow this new reality (Newswire, 2019). The use of telemetry systems currently guarantees not only the location, the use of effective routes or other methods of location management but also allows the generation of trip reports that allow a fleet manager to know how the resource is used and how it can be improved in its respective use (Boodlal, 2014).

However, the fact that there are several behavioural variables and several mechanical components, this generates a high inefficiency of the resource, which becomes a difficult challenge for the transportation companies to operate and to obtain a high return on investment in technology and efficiency methods (Sanders et al., 2002).

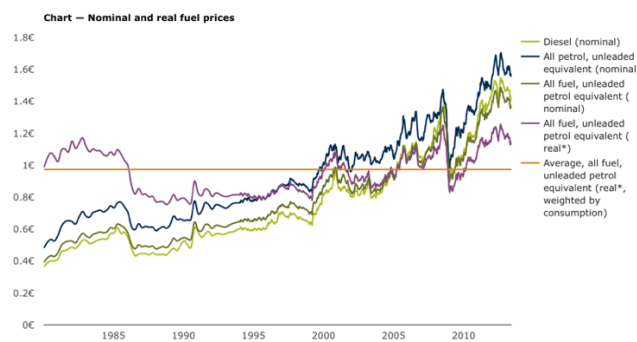
In this way, this study seeks to establish metrics that demonstrate and prove the way companies in this sector can analyze, evaluate and act on the components that generate the lack of efficiency in the use of transport resources and that consequently through intelligent telemetry systems leads to transport and logistics companies to incur expenses in the medium and long term that decrease the profitability of this sector, being subject to external variations of the companies (Journal et al., 2010).

In addition, it is essential to highlight that this theme is widely debated in several studies and researches where several components such as eco-driving, the impact of drivers' behaviour on driving, the efficiency of telemetry systems and intelligent technology are analyzed in order to understand what is the best efficiency method for a transportation company (Anderhofstadt & Spinler, 2019). It is in this context that this study seeks to contribute to the increase in knowledge and the approach that can be taken on these different themes.

1.1. Problem Definition

In the 1980s, some authors and institutions began to study the impact of driver behaviour on the truck's fuel consumption and performance (Wasielewski et al., 1980), but at that time the profit and margins of transportation companies were much higher because fuel was cheaper and competition in the market was much lower (Siero et al., 1989).

Figure 1.1 – Road Transport Fuel Prices (Including Taxes) in EU Member States



Source: European Environmental Agency, 2019

For this reason, transportation companies have not invested or improved driver training, which ultimately led to a lack of efficiency in an entire sector, especially in terms of performance behind the wheel (L. Verdonck et al., 2013). In addition to this, the demand for new transportation solutions have gradually increased over the years and like several large logistics operators, the population in general, began to consider other ways of being able to acquire their products, making it more demand in other transportation segments, thus decreasing profitability and demand for road transportation (Thies, 2009).

The fact that there are several sources of transport from air, sea and road transportation has meant that road transportation has started to be used more and more in terms of distribution, which reduce the distance travelled by them (Zhou, 2008). This caused that a company specialized in the road transportation sector to lose part of its commercial power and the way it positioned itself before the market (Abreu, 2018). In any case, this market segment remains indispensable for the various supply chains, being a fundamental part of the commercial and economic networks (Rodrigue, 2017).

Although road transportation has been heavily harassed over the years and nowadays has difficulties in maintaining the same profit margins than it had before, these companies are trying to find new ways to guarantee good financial results and operational improvements on the business. Many companies are looking for a viable solution that will allow them to improve the performance and safety of their employees, generate a better quality of service and reduce high operating costs (Leavitt, 2008).

Currently, competitiveness is higher than ever, and companies in all sectors are trying to become more efficient, productive and profitable in the whole process (Text, 2019). The efficiency of activities, the improvement of processes and the optimization of resources is a very current topic, and more and more experts and managers believe that efficiency is the most profitable mechanism in any business (Hedman, 2016). This means that in more competitive sectors such as the road transportation sector it is essential to approach this issue in a complete and integrated way in the process of the company's activity, seeking to solve the problem through internal business projects that develop this issue as deeply as possible.

When it comes to proving a theory or a model, the best way to do it is to use this internal business type of project, because to do so requires concrete evidence for a viable implementation and this can only be proven in the act of the company's own productive activity (Waiyaki, 2013). The way this study is approached also stems from the fact that it is necessary to understand the reality of the activity and what is the best perspective for analyzing this theme because the way the implementation of performance analysis metrics can influence the driver's daily activity, knowing that their actions and behaviours directly affect the results and effectiveness of this topic (Bassani, 2019).

The theme of this research is related to the total efficiency of resources and equipment and its consequent reduction of operating costs in road transportation companies. This topic can be approached in different ways because these types of companies have different operating costs dependent on different variables, so therefore it is necessary to find different strategies to reduce them (Newswire, 2019).

For these reasons, the best way to identify this problem and manage to develop a method of analysis and evaluation of driving variables is through the practical observation of variables and the business reality, which is something that can only be done in a real road transportation company such as the portuguese company named Joiditrans, Lda.

The fact that the author of this project has a leading position in the company and is responsible for the company's innovation department made it possible to identify this problem and understand that there are not enough studies on techniques analysis and tools that would improve the operational efficiency of a transportation company like this.

In the thought of efficiency and constant improvement, what makes this project curious is that, in the opinion of this author and many others, the best way to do it is through the definition of performance metrics intended for each sector (García-Arca et al., 2018), monitoring driver performance (Ha et al., 2019), improving driver behaviour (Kolman, 2010) and implementing eco-driving techniques in the company's culture (Zavalko, 2018). And this reveals the importance of a method like this, especially in a business area that many people are not involved and have a lot of difficulties in improving this kind of businesses in terms of operational efficiency.

1.2. Research Objectives

The main objective of this study is the identification of the main efficiency problems of road transportation companies and the integration of a new paradigm in them through a method to optimize resources and profit in this business. However, it will be necessary to use all the information from the literature review to jointly, with the current situation of the company, define new driving models for drivers of heavy vehicles as well as a proposal for an efficiency model that allows to reduce operating costs by improve the driving performance of heavy trucks and the consequent improvement in financial results. To achieve this objective and make it possible to implement the concept of operational efficiency, it will be necessary with this study to also achieve the following specific objectives that are shown on the following table.

Table 1.1 - Specific Objectives of the Enterprise Project

| 1 | 2 | 3 | 4 | 5 |
|---|---|--|--|---|
| Define a <i>performance analysis model</i> that allows the company to guarantee the efficiency of its resources | Create a new <i>culture of economic driving</i> in driver performance | Identify the <i>physical, mechanical and behavioral variables</i> that generate resources and financial losses | Develop a <i>rating system</i> that defines the quality of each driver's performance | Provide a <i>viable tool</i> that allows road transport companies to reduce their operating costs |

Source: Own elaboration

These objectives are fundamental for the development of the entire project, as they will be the guidelines that will allow developing the structure of the efficiency model, as well as the evaluation of the metrics applicable in the company and that will be analyzed and improved through an implementation proposal. They will also be essential for a coherent analysis of the company, how it is currently organized and how it can evolve in operational terms.

2. Literature Review

2.1. Main Theoretical Concepts

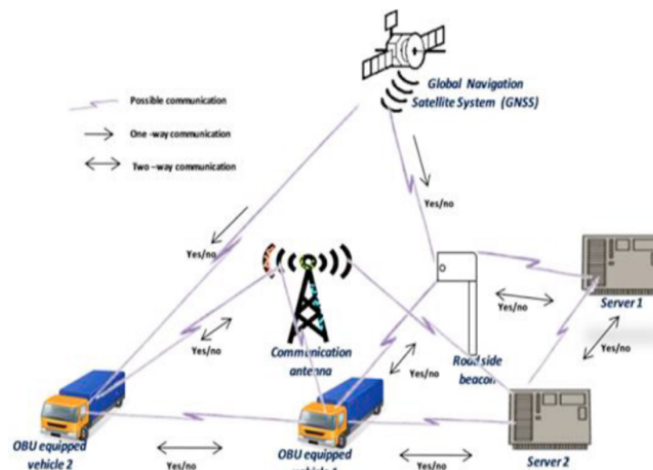
The best way to ensure the feasibility of this study is to approach the reality of the road transportation business model as closely as possible. For that, it is necessary to generate not only performance indicators but also concepts that allow companies to integrate this new paradigm into the company's culture. This study is based on a mentality of efficiency, performance, improvement of the heavy vehicles driving activities and the efficiency of the company itself. For this reason, the following concepts are the bases of this study, because everything that will be thought, analyzed and defined will have these four concepts in mind, being these the concepts the telemetry systems, eco-driving, truck key performance indicators and operational efficiency.

2.1.1. Telemetry Systems

Telematics is the convergence science that interconnects the telecommunications and the GPS information and the telemetry is the measurement and interconnection between all databases of trucks, GPS sensors and wireless communication with systems and satellites that measures and integrates various parameters of information on the activity and performance of a given vehicle (Waiyaki, 2013). It is the telemetry system technology that is a fundamental concept for this study because this real-time information about the truck's performance, allows transportation companies to reduce their costs by maintaining the efficiency and their KPI's of their resources at the highest level (Mika, 2014).

All telemetry systems have the same operating model as are shown in the figure 2.1, because using GPS technology, it is possible to obtain various informations such as location, distance travelled, or speed used on a given route. Fleet managers can use these measurements to optimize routes and improve the route's expected effectiveness (Trimble, 2012), because the good utilization of this data and information is the main purpose of all the communication and connectivity of the telemetry systems, as are shown in the figure below.

Figure 2.1 – Telematics System Communication



Source: Modelling and Sensitive Analysis of the Impact on Telematics System in Vehicles, Beqir Hamidi, 2016

On the other hand, this communication technology promotes connectivity between drivers and the logistic control centre through the various diagnostic sensors that can be used to define and monitor vehicle maintenance (Winlaw, et al., 2019). The search for an improved telemetry technology in a fleet of transportation vehicles is a strategy that more and more fleets seek to implement (Mika, 2014), but there is still great uncertainty on the part of them in justifying the return on investment (Colin, 2008). This reveals that there is a need for transportation companies to understand the reasons for using advanced telemetry technologies in addition to traditional data collection such as location or speed (Fleet Owner, 2012). Factors such as the behaviour of drivers and the handling of the resource allow guaranteeing an increase in productivity in the company as well as a reduction in costs and fuel savings (Fleet Owner, 2012). The use of telemetry systems in road transportation companies is still seen as a process without the necessary return, and several companies claim that the application of these systems is justified depending on the number of vehicles that a company has in the fleet, to justify the necessary investment in this type of systems. This reveals one of the main reasons why some companies in this sector do not adopt these telemetry measures, ignoring completely the advantages of this type of technological systems (Fleet Owner, 2012).

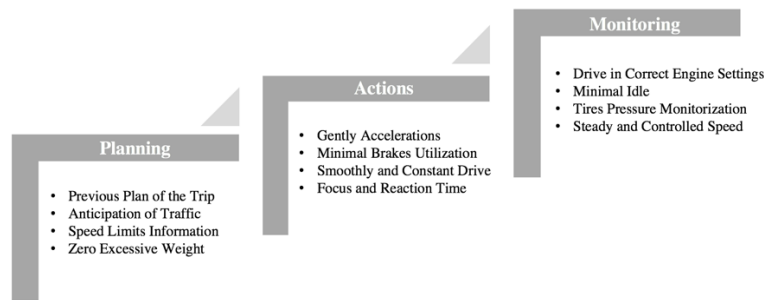
Despite this, there are also several companies that understand the importance of implementing telemetry systems (Post, 2014) and understand the full potential of this technology, which reveals distinct improvements in the behaviour of drivers, in the productivity of the journeys and created savings of fuel which are indexed to its performance (Fleet Owner, 2012).

2.1.2. Eco-driving

The concept of eco-driving is a set of behaviours, techniques and strategies adopted by drivers when driving a heavy vehicle that aims to minimize excessive energy consumption, minimize fuel consumption and reduce CO₂ emissions (Zavalko, 2018). The definition of this concept is based on several behavioural variables that, through training and continuous learning, allow driving strategies to be applied that guarantee the possibility of lower fuel consumption and emissions (Mele, 2008). The concept of environmentally friendly driving is a concept that is increasingly being discussed and implemented not only in road transportation companies but also in our daily driving practice (Ersan, 2020). The encouragement of prevention techniques and the intelligent use of movements and mechanical work mean that there is a massive reduction in fuel consumption, in emissions of polluting gases, in the car material durability and the increase in road safety (Kolman, 2009).

For many drivers of heavy transportation vehicles, the concept of eco-driving comes down to the concept of driving more slowly, with lower engine speeds in order to consecutively comply with speed limits and that translates into effective driving (Wright, 2007). But this is just another example of the lack of knowledge of the various drivers because like the following table shows, there are several efficient techniques which reveals an opportunity for transportation companies to change the mentality of their drivers and to achieve an improvement in their results (Andrieu, 2012).

Figure 2.2. – Eco-Driving Techniques



Source: Own Elaboration

Eco-driving has proven to be one of the most practical measures with tremendous potential for success in terms of fuel economy, reduction in the emission of polluting gases and an improvement in road safety for drivers (Stanton, 2010). This is due to the fact that the way the driving activity is carried out, from the more intensive use of the brake, the increase in average speed in search of a reduction in the travel time, or even the high peaks of engine speed, leads many drivers while driving to sometimes, create this kind of habits which generates an exhausting driving and an excess of material consumption that triggers a series of risks and problems for the driver and the truck (Young, 2012).

The driving task is continuously subject to external inputs to which it is necessary to continually react to speeds, distances or even predictions that will happen in front or behind the vehicle (Zavalko, 2018). Due to the number of inputs and unpredictable facts that a driver is subjected to, some believe that the task of road driving is even more challenging than, for example, the task of air piloting (Leavitt, 2008). The cognitive level that heavy vehicle drivers are subject to is relatively low, but the amount of those inputs makes this a too demanding task (Leavitt, 2008), which therefore it is necessary to train drivers so they are prepared to react in the best possible way to the most diverse inputs, improving their capacities, making it possible to carry out the most ecological driving possible (News Bites, 2015).

2.1.3. Truck KPI's

KPI's are indicators that allow the company to manage its operation in the most economic and efficient way possible, based on a set of parameters defined by the impact on costs, quality and services (Rushton, 2010). These indicators are often calculated by responsible managers, who in the heavy vehicle KPIs uses several information from communications systems to develop metrics and variables that are able to measure the driver's performance. These variables can be provided mostly by GPS and telemetry systems that provide real-time data (Myerson, 2012), and it is possible to monitor and guarantee good driving within the various defined parameters. For this to happen, it is necessary to understand what type of factors contribute to the development of driving as efficient as possible (Kaçan et al., 2019).

Driving performance indicators can be guaranteed through different categories that, based on the vehicle they drive, the load they carry, the route they take or the individual socio-cultural factors of each driver, assign an evaluation of driving performance capable of generating a rating system for the different driving profiles of the various drivers. (Bowersex, 2013).

Any of these variables is preponderant in the final result obtained in terms of driving efficiency and more specifically in fuel consumption and financial profitability, and it is necessary to understand each variable and how each one influences the efficiency of the resource (Murphy, 2015). The following table shows an example of several truck KPI's defined in the project and which demonstrate the different categories and the different variables that can be analysed in a driving performance.

Table 2.1. – Examples of Truck KPI's

| | | | | |
|---------|---|--|-------------|---|
| On-road | Total weight [t] Load [t] Distance [km] Total time [h] Driving time [h] Average speed [km/h] Max speed [km/h] | Average distance Driving time Average speed Maximum speed # of excessive speed events # of excessive RPM events # of abrupt acceleration events # of abrupt braking events # of excessive idle time events | Driv. Indep | Total weight |
| | | | Driv. Dep. | Utilization Distance Ascent route Average speed # of exc. RPM Exc. RPM max Abr. accel. max Abr. brak. max # of exc. speed # exc. idle time |

Source: Transportation Research Part D 56, Jenny Díaz-Ramirez, 2017

With regard to the type of vehicle that each driver can perform, there are several options on the market for transportation companies, since the different truck brands seek through their capacity to guarantee vehicles that allow carrying out most of the transportation work, only specifying according to the pre-established needs of its clients (Professional Engineering, 2009). Thus, despite the different brands that exists in the market for heavy goods vehicles, all of them work on the same business model, because they guarantee a similar set, specifying each vehicle only after sales (Barua, 2020).

This means that in a company that specializes in a specific sector of activity, it is possible to guarantee maximum operational efficiency available on the market without discrepancies between the various vehicles in the same sector as a transportation company, with different drivers reacting differently to inputs they get from the road, and this is central to reading the various KPIs that represent the driving profile (García-Arca, 2018). In this way, there are several categories that influence this same evaluation and that can be divided into categories such as the slopes and the shape of the course, the number of reactionary events such as braking, accelerations or sudden turns, the use of engine speeds and the use of the auxiliary brake based on the route (Myerson, 2012).

All of these parameters are performance indicators of a driver and, it is necessary to analyze each one individually through KPIs to understand how each one affects the performance and general efficiency of the vehicle (Bowersex, 2013).

2.1.4. Efficiency

The concept of efficiency is a known concept and it is often used by companies linked to industry and the mass production of products (PR Newswire, 2012). It is this type of companies that seeks maximum efficiency throughout its manufacturing process and uses this as an indicator, allows them to measure the level of efficiency of various equipments, in order to eliminate non-valuable activities to guarantee the most profitability (Nakajima, 1988). According to this idea, the maximum possible efficiency is the identification of general production failures and high operating costs in order to adopt innovative techniques that improve and optimize the entire production capacity (Shacklett, 2013).

Efficiency is generally considered a concept applicable to automatic or semi-automatic processes of production or manufacturing, and is usually defined through elements of evaluation, performance and quality of each equipment, as well as the integrated processes (Garza-Reyes, 2015).

In the case of a factory production where it is possible to determine how the equipment produces the products and how it is possible to improve their efficiency, in the case of road transportation these are machines subject to several unforeseen situations, and for this reason, it is much more complicated to apply this same concept. But in any case, it is possible to look at this concept as a way of incorporating a new methodology in the business models of transportation companies (García-Arca, 2018). The following figure shows an example of several dimensions in which efficiency can be applied to the road transportation business model and where it is possible to measure the performance and viability of the activity.

Figure 2.3. – Road Transportation Efficiency Measures



Source: How to Use Telematics to Reduce Expensive Costs and Improve Fleet Performance, Assetworks, 2014

This association of the efficiency to the road transportation sector presupposes a focus on the efficiency of its resources and the corresponding good performance of its drivers, which through the collection of telemetry data it is possible to determine fundamental factors in determining efficiency in a business model (Hedman, 2016).

In the business model of the road transportation sector, it is challenging to introduce a concept such as this one, since the machines that make up the company's productive part are outside of its infrastructures, making it more challenging to have control and rigour in their activities (Lai, 2017). This makes it necessary to adapt this whole concept to a different reality, which allows the analysis of all factors within this new reality (Hedman, 2016).

In any case, this concept is crucial for an industrialization mentality and seeks to optimize resources, reducing losses, downtimes and waste which automatically represent an improvement in the manufacturing process (Hedman, 2016). This does not mean that efficient companies are the ones with efficient processes, that allows to obtain positive results, reducing losses and hidden costs associated with the performance of their productive activity (Eck, 2002).

2.2. Empirical Information

When defining several key concepts that are part of this study, it is necessary to understand the studies and models that have already been studied and tested and how this project can contribute and improve knowledge about eco-driving techniques, analysis of performance indicators and the vision of much more efficient operational activity. It is necessary to analyze several articles that develop a conclusion and define a strategy for this project.

The basis of this entire project is the ability to collect data and indicators that are essential for the interpretation of driving performance, and that can be developed throughout an efficiency project in companies (Boodlal, 2014), which is why it is necessary to collect information from intelligent systems and integrated softwares that can ensure that this data is obtained in real-time, in order to trace a pattern of driving performance trends of the various heavy vehicle drivers (Mika, 2014).

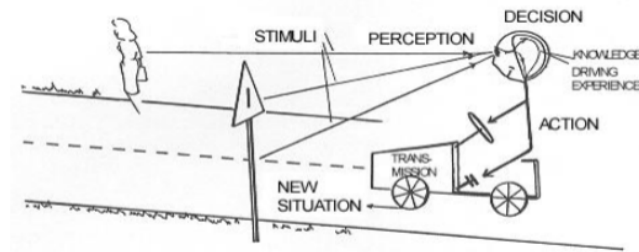
In 2014, Shelley Mika described how difficult a complete implementation could be in changing heavy vehicle drivers' daily activity. However, the author also suggests that an investment in a complete telemetry system and an integrated GPS provides fleet managers with tools to continually analyze the different drivers' performance and manage to change their habits and behaviours (Mika, 2014). The moment when the return on this investment is highest is when drivers incorporate eco-driving techniques and safe driving at work, ensuring the highest possible return in terms of equipment efficiency and operational improvements (Mika, 2014).

In 2018, Alexandr Zavalko published an article where he experimentally developed the concept of eco-driving (Zavalko, 2018). After identifying an environmental problem and an excessive fuel consumption problem, he tried through different experiences and different groups of drivers to prove the big difference between efficient and non-efficient eco-driving practices and the perception of the driver's in these different approaches. (Zavalko, 2018).

As a first approach, it was possible to conclude from this study that, in the short term, there was in fact, a reduction of about 13% in energy consumption, but in the long run, this reduction drops to 4%. The conclusion drawn from this experience is that it is not an easy task to apply long-term performance analysis concept because it requires constant monitoring of the company to maintain or even improve its long-term performance rates (Zavalko, 2018). The second approach of that study refers to identifying the various performance indicators that can be identified as the leading causes of excessive energy consumption. Some drivers tried only to improve their driving efficiency by improving the gearbox utilization and making better use of the truck's kinetic energy.

In constant, another set of drivers tried to improve their driving performance using a set of more comprehensive range of eco-driving techniques, such as following a medium speed, slight acceleration forces, high utilization of the auxiliary brake, increase of safety distance, among others (Zavalko, 2018). Of course, the best results were from the group of drivers who applied a much deeper set of eco-driving techniques and those who think the driving activity, analyzing inputs and perceptions from the outside. This set of driving skills resulted in improved KPIs and a consequent improvement in operational results (Zavalko, 2018).

Figure 2.4. – Driver's Perception-action Process



Source: Basic Driver Perception-action Process, Hakkinen & Luoma, 1991

However, one of the biggest challenges that were proven with this study was the difficulty of implementing the main KPIs to improve the efficiency of a transportation company, and it was with this issue that, in 2018, Jesús Garcia-Arca and other authors developed a practical study, focusing on that particular issue. Any company uses KPIs to maintain their business' efficiency and translate through these indicators, the results they obtain over time (Garcia-Arca, 2018). When we refer to KPIs, we are thinking directly about improving the costs, quality, and service provided, however in the road transportation market, to guarantee the efficiency of performance, it is necessary to use different analysis (Rushton, 2010). For this author, the fundamental question would be to fit different production indicators and adopt them in the reality of this business. He tried to apply efficiency concepts in order to be able to apply new concepts within the company, and with that line of thought couldn't proved to apply the same concepts to the transportation company (Garcia-Arca, 2018).

In the case of road transportation, it is not a simple process to determine the efficiency of the material, the cost of the process and the variations in the cost of the materials, because the transportation process is subject to several unpredictable situations and it is not possible to calculate precisely these indicators without technological tools and integrated softwares (Waiyaki, 2013).

Road transportation has always been seen as a form of guarantee from one point to another, and priority has always been given to transport effectiveness in the shortest possible time, leaving aside fundamental human components in efficiency and profitability during transportation (Kolman, 2010). This paradigm shift was only possible due to all the technological advances that have been developed in the electronic and monitoring components, and the various transportation industries are continually seeking to improve their efficiency and performance, applying training strategies and regular monitoring of their employees (Kolman, 2010).

One of the strategies companies should invest is monitoring through GPS and telemetry software that allows them to understand the performance of the various drivers, how to improve it and how it affects the road transportation business profitability (Kolman, 2010). As Díaz-Ramirez stated in 2017, GPS telemetry systems and telematics softwares provide a quick analysis that is fundamental to the driver performance and is the key to understanding the indicators that can create a much more complete analysis and what are the metrics and performance KPIs that best define the efficiency of a given resource depending on the driver's behaviour, driver profile, trip, conditions and vehicle attribute (Díaz-Ramirez et al., 2017). The figure 2.5 shows the variety of data that can be integrated on the analysis of the activity' efficiency.

Figure 2.5. – Telematics Indicators



Source: Telematics in the Canadian Trucking Industry, Sharpe, 2019

The study that was developed by Richard Hedman in 2016 allowed to understand that it is possible to apply a different concept of total efficiency in the transportation sector through different KPI's and telemetry data. This only happens because the availability of transport, the performance of that transport and the quality of goods are all variables in which a transportation companies can trust and measure (Hedman, 2016).

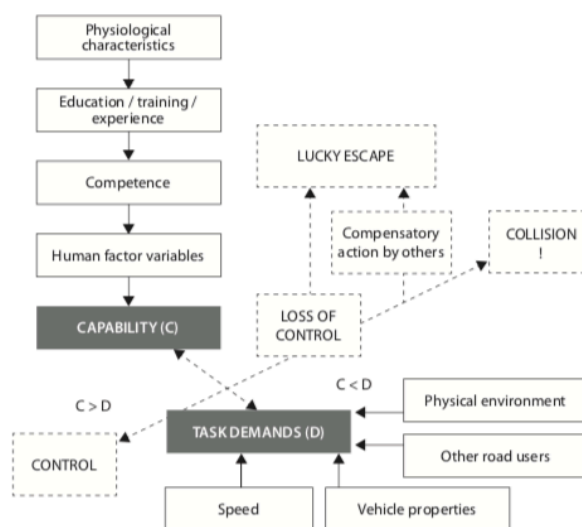
These concepts are mainly used on efficiency evaluation and although the availability and quality of products depend on other different analyzes and different industry requirements, the performance variable is a universal concept for the transportation sector, and it is at this point that the project tries to create a different perspective (Hedman, 2016). It is very fascinating to use a concept of efficiency differently from that used by other authors because by integrating this concept with an analysis of driving performance and an improvement in current driving practices, it will not only be possible to obtain improvements in terms of emissions of gas, fuel consumption and process efficiency, as well as the development of a new mentality and a new culture of efficiency in transportations companies, which can only be achieved through a profound improvement in the performance of resources, as already occurs in many other sectors (Hedman, 2016).

This type of businesses needs to guarantee an organizational culture and an implementation of effective strategies that guarantee a reduction in energy consumption and CO2 emissions, while guaranteeing the viability of their business (Díaz-Ramírez et al., 2017).

In 2004, Léonardi carried out a study showing that the reduction of fossil fuel consumption and CO2 emissions can be affected by investing in new vehicles or new gas filtration systems, investing in driving skills, and the best environment for the various drivers of heavy vehicles (Léonardi, 2004). In this study it was suggested that it would be possible to estimate the effect of telemetry on performance and energy efficiency to find efficiency indicators that would reduce the CO2 emissions by heavy vehicles (Léonardi, 2004). In 2014, Sainu Franco also defined that the policy and culture of eco-driving not only provide an improvement in fuel consumption, but the reduction in fuel consumption directly results in a reduction in gas emissions to the atmosphere. The emission of gases by the transportation sector depends on the type of vehicle used, the type of fuel used and the combustion process to be more or less efficient due to human utilization (Franco, 2014). This means that there is a correlation between these factors, and it is possible to define what the emissions of gases depend on and how it is possible to reduce their emissions (Franco, 2014).

For many environmental institutions, there is a joint view that the application of small measures, such as changing the driving styles of professional drivers and stabilizing new measures for the emission of polluting gases, are just as effective as the application of technology or innovative techniques in the mechanical efficiency of engines designed and built by heavy vehicle manufacturers (Wright, 2007). Through telemetry systems, companies in the transportation sector can guarantee the monitoring and control of the attitudes and behaviours practiced by their employees and thus achieve desirable performance KPIs in order to strengthen their business models with knowledge and innovative techniques that allow them to gain ground against their competitors, monitor their businesses and achieve high levels of operational efficiency (Zavalko, 2018).

Figure 2.6. – Model of Driver Behaviour

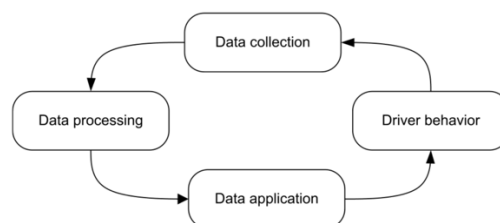


Source: The Task-Capability Interface Model, Fuller, 2008

Regardless of the business strategy that each company adopts and the organizational culture that each one has, it is indisputable that telemetry systems based on GPS data have a significant impact on the way they are monitored, and it is through precise details that can be guaranteed the performance of drivers heavy vehicles (Professional Engineering, 2009).

An example of this applicability was the project of a heavy vehicle construction company, MAN, which, in partnership with the Professional Engineering newspaper in 2009, sought to develop a pioneering telemetry project based on GPS technology in order to guarantee the emission of viable data performance of the vehicle in question making it simple to analyze fundamental data such as fuel consumption, sudden braking, among others. A classification system was added that classifies drivers on a scale from A to G depending on the efficiency with which each driver drives their respective vehicle. This, despite being established as a pilot project and a way of proving the advantages of the application of systems of this kind, was just one example of how these telemetry systems need to be more effective and more developed in order for there to be greater profitability of the transportation market and also a professionalization of transport and road driving practices (Professional Engineering, 2009). This professionalization of driving practices includes fundamental driving issues such as short-term memory, reaction time, efficient changes in attention, visual and motor coordination, planning, estimation time, focused attention, among others (Leavitt, 2008). All of these capabilities are purely psychological capabilities, which monitorized by telemetry, lead to the need for specialized training and development to a new improved skill set (Leavitt, 2008).

Figure 2.7. – Driver Behaviour Change Process



Source: Driver Behaviors on Different Presentation Styles of Traffic Information, Mustafa, 2010

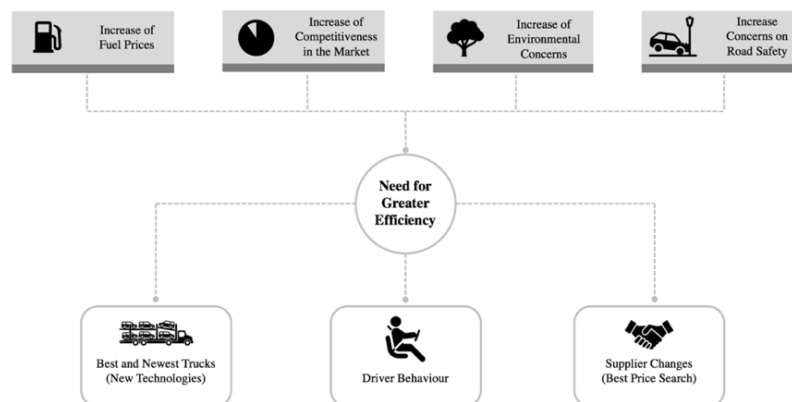
However, on the other hand, as stated by Michael Roeth in 2019, there are cognitive issues that can be learned and improved within the organization's culture and that allow drivers to acquire knowledge about advanced driving techniques such as the intelligent use of the auxiliary brake, positioning and the safety distance for the vehicles in front, the mechanical reductions in the gearbox, the efficient use of the idle times, the reduction of the occurrences of braking, accelerations and sudden turns or even the regular work in efficient consumption RPMs of fuel (Roeth, 2019). These are part of a set of intelligent driving techniques that together can reduce fuel consumption in an extraordinarily effective and efficient way, having a huge impact on fuel economy, which guarantees transportation companies to a cost reduction. Permanent operational efficiency generates a competitive advantage for companies that apply this type of strategy compared to their competitors (Kolmar, 2010).

3. Performance Efficiency Model based on Literature Review

The various articles and authors that make up the entire literature review allow the definition of basic concepts on the theme of efficiency, as they allow us to guarantee that this is a theme studied and analyzed by several authors, which represents the veracity of the existing problem.

That is why, based on the literature review, it was possible to define a complementary model based on the information in the existing articles and thereby understand the entire line of thought and the entire strategy envisaged in the application of this new organizational culture within a road transportation company (Walton, 1999). As you can see in the diagram below, the existence of external factors to the company, such as the increase in fuel prices (Anderhofstadt, 2019), the increase in market competitiveness (Plakandaras, 2019), the increase due to environmental concerns (Ha, 2019), and the increase due to road safety concerns (Douglas, 2019), lead to there being a need for companies in this type of sector to adapt in order to survive in the market. Thus, there is a need for greater efficiency throughout the business process, taking into account that measures have to be taken that meet this need (Plakandaras et al., 2019).

Figure 3.1 – Road Transportation Business Context



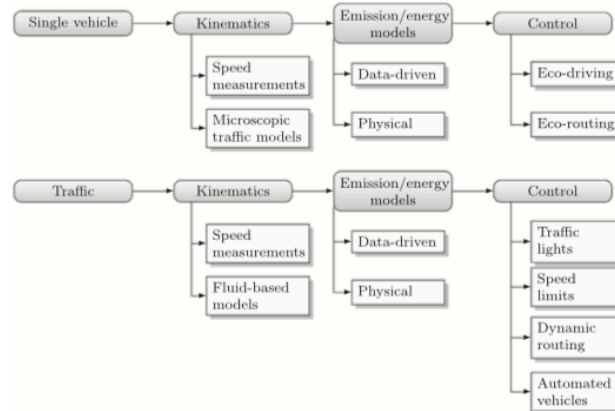
Source: Own Elaboration

These measures and strategies may change depending on the management decisions of these companies, as the figure 3.1 represents several options that can be taken in order to reduce waste and high operating costs, such as the acquisition of new vehicles and technologies (Díaz-Ramirez et al., 2017), acquiring new suppliers in the supply chain (Verdonck et al., 2013) or improving the specific training of vehicle drivers (Birrell, 2012). These are all possible investments and strategies that can significantly improve the performance of a company in this sector.

In this specific study, the emphasis is placed only on the whole strategy of improving and taking advantage of drivers' performance in driving practice and how they manage, by making small corrections along the way, to bring greater profitability in their work and to the company (Hermans, 2016). These minor corrections and improved performance are called eco-driving, and as are shown in figure 3.2, there are several factors that can influence this performance and which as a correlation between all the operating costs, energy consumption and emissions.

To control these factors of group of vehicles are used traffic lights or traffic speed limits and other strategies, which to control individually each vehicle, it depends only to the driver behaviour and his eco-driving practices (Oviedo-Trespalacios et al., 2019).

Figure 3.2 – Diagram of the global approach for energy consumption and emissions

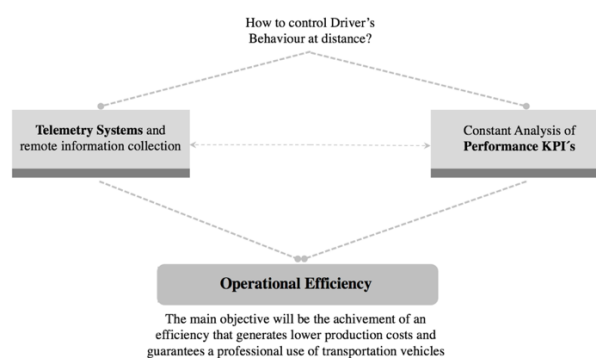


Source: A review of the modelling and control strategies for improving environmental of road transportation, Othman, 2019

As previously mentioned in this study, eco-driving is the set of behaviours adopted by drivers who can minimize excessive energy consumption using the lowest possible fuel consumption when driving the transportation vehicles (Wang, 2017). These sets of behaviours mean small changes that, through a training process, allow drivers to acquire a deeper knowledge of how the vehicle they drive works and how they can correct potential failures (Mann, 2010).

Only in this way it is possible to make a profitable business, which fundamentally depends on its employees' correct performance, which also raises an equally important question of how these companies can monitor and ensure that the desired results are achieved (Linkov, 2019). This is only possible through an efficient definition of performance metrics that, with intelligent GPS and telemetry systems, allow for real time fundamental data for efficient monitoring of resources. Currently, several GPS platforms offer, through connections to the vehicle control unit, real performance data for the most diverse vehicles (Cedillo-Campos, 2019). However, the big challenge for companies is based on the lack of parallelism between these telemetry data with the performance KPI's that are fundamental for the profitability of the trucks' routes (Chae, 2009).

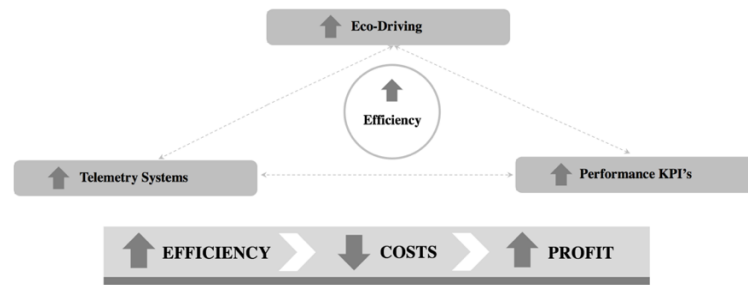
Figure 3.3 – Monitorization of Driver's Behaviour



Source: Own Elaboration

It is through the integration of these efficiency metrics in the fleets of heavy vehicles that a company in this sector will be able to achieve significant results and make them more profitable because through the professionalization of the activity, as well as efficiency throughout the entire process of provision of its services is that it will allow a reduction of operational costs, fundamental for the profitability of these companies (Kim, 2013). As shown in the figure 3.4, through a correlation between eco-driving, performance KPIs, telemetry systems and overall efficiency, it is possible to improve efficiency and guarantee greater business profitability.

Figure 3.4 – Correlation of Efficiency

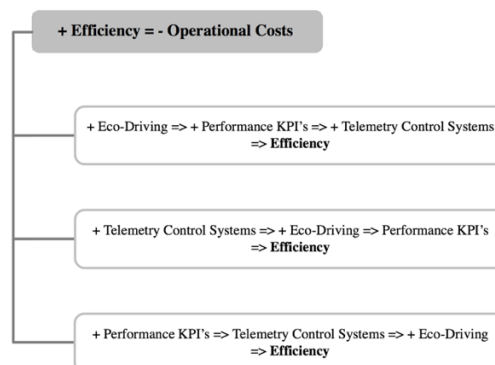


Source - Own elaboration

Several formulas demonstrate how each concept improved individually, leads to the improvement of another and, as are shown in figure 3.5, implementing efficient driving techniques in its drivers, the company automatically succeeds in improving performance KPIs, which, when constantly monitored through telemetry systems, it is possible to guarantee constant operational efficiency (Lewis-Evans, 2012). On the other hand, if the company invests in advanced telemetry systems, it makes it possible to understand whether the various drivers are effectively applying efficient driving techniques and that this may lead to an improvement in KPIs and in the overall efficiency of the activity (Tagesson, 2017).

Finally, by defining the main performance KPIs to be analyzed, and by integrating them into telemetry systems, it allows to realize again how much the type of driving performed, changes the operational results and thus, when applying new driving techniques, it improves the its efficiency (McCouch, 2019). In this way, all these concepts are interconnected and related to the efficiency of road transport activity.

Figure 3.5 – Efficiency Formulas



Source - Own elaboration

4. Methodology

4.1. Research Context

This study addresses a general and current issue in the transportation market because efficiency is essential for any company, but in this one, it is not possible to accurately measure the performance and efficiency of the driver's performance. Nevertheless, the fact that the fuel price is rising, CO2 emissions from trucks still a problem, and companies in this market are desperate to find new efficient solutions to make this project something current and vital.

The performance of driver efficiency is an issue that has long been analyzed by several heavy vehicle manufacturers and by significant transportation and logistics companies in Europe and the World. Nowadays, the way the market has positioned itself has generated enormous pressure on smaller and more fragile companies due to the current economic context, such as the portuguese transportation market.

This is a company project, so it must be done based on real analyzes of a transportation company to guarantee feasibility and consistency of the data obtained throughout the entire project. Although Joiditrans does not currently apply permanent performance monitoring or in-depth data analysis as proposed in this study, the company management has defined and applied other methods of analysis and control to guarantee its high-quality standards. To account for the differences between the various employees, the company currently applies a policy of investing annually in trainings on this topic and monitors it monthly through average fuel costs. The company also periodically reviews key performance KPIs such as idle times, average repair and maintenance expenses, and average fuel consumption, to make comparisons with the daily occurrence records that accounts for all drivers' attitudes, both in terms of performance and in terms of the behaviour of those same employees.

4.2. Research Design

Research design is an essential step in any scientific study, it provides a general connection between all theoretical concepts and the practical approach that a company's internal project has. For this reason, the research design was decided based first on the data obtained from the literature review, then on the reality of the transportation sector business and the inclusion of a new operational model in the company's daily activity. Research design can be based on three different approaches, and these can be exploratory research, descriptive research and causal research. These different approaches meet the objectives and applications of each study project, in which case the best approach to be applied to develop the research design is one that allows an analysis that describes the characteristics or functions of a given event. Unlike a more exploratory approach that seeks to ensure a more comprehensive and exploratory identification of ideas or thoughts or a more casual approach that focuses mainly on the correlations between causes and effects, the descriptive approach fits perfectly with the objectives established for this research.

Based on the literature review, this choice comes from the fact that a descriptive approach describes the evolution of a set of characteristics and variables in the model and, to prove the increase in efficiency through the improvement of driving performance, it is necessary to analyze the reality of the company and measure over some time the evolution of the particular variables under study.

These measurements of the various indicators can be obtained through secondary observation of the data and constant interaction with drivers through surveys, management reports and training programs that are mostly primary data. Also, this study must have a longitudinal design based on the fact that this study will apply to a sample of drivers several performance indicators that can be measured repeatedly over time with the same variables for other drivers as conclusions for the study.

In addition to this prior planning in terms of the general approach and the observation of those expected to be acquired throughout the study, it is also essential to define precisely the entire planning of the research. Since this research is based on the planning of descriptive research and through a longitudinal design, this means that in this in-company project it is necessary to follow fundamental steps that can prove and validate this study project. Since these steps are the initiation, planning, execution, monitoring, control and conclusion, there must be a definition of the various steps that will occur throughout the study, mainly in the way the efficiency model should be applied.

1. Initiation and Planning

- At an early stage of the project, it is essential to define the entire application of the project and the model that is sought to prove and for that reason in terms of study planning, it is essential to obtain data that can create an understanding of the concepts of efficiency in this sector, in which case it is essential to acquire the most various concepts from the most diverse articles so that there may be a viable source of literary information, in order to have a reliable database in the conclusions of this study.
- In order to meet the objectives established in this study project, it is essential to study, analyze and demonstrate which physical variables and performance analysis factors will be the basis of the study and define concepts understood by the literature review in order to establish the necessary conclusions on how the company should position itself on this topic. It is essential to realize that there are factors of greater importance than others concerning costs and waste they cause and the various performance factors.
- Even in the initial phase of this project study, it will be necessary to prepare the internal analysis of the company and the road transportation market, as well the interviews and surveys for the company's management and for the drivers under test, in order to understand their knowledge about this lack of efficiency in driving performance. This happens from the fact that it is necessary to conclude that the quality and performance depends on the company's willingness to invest and the change of behaviours from the driver's mentality and operational activity.

2. Execution, Monitoring and Control

- Based on all the concepts of the literature review and the current situation of the company, it will be essential to analyse and audit the company in all its aspects, because when auditing it, both in terms of company analysis, in terms of interviews and surveys, it will be fundamental for there to be a knowledge about what the company does correctly and what it does not do.
- During this period, and after conducting a study on the current situation of the company and the road transportation market, it will be necessary to obtain data to understand where it will be possible to obtain a better return with a creation and development of an applied model in driving performance efficiency. The best strategy that a transportation company can use to be able to raise awareness and modify the thinking of its employees is through obtaining valid data that represent their driving performance and the consequent profitability of the company.
- During the implementation of a study like this, it is necessary to continually evaluate the KPIs associated with the vehicles under study in order to trace the evolutionary plans, understanding how this changes according to the behavioural change that should exist on the part of the drivers under analysis.
- With an integrated analysis of the various KPIs associated with this study and analyzing how they relate to the definition of a driver profile, it will then be possible to guarantee a complete model of performance analysis that is based on its performance over some time, and that is fair to both the company and the driver at the time of performance analysis.
- Finally, from a quantitative perspective, it is essential to develop a capacity to monitor KPIs in the future so that the company can improve its performance margins and also ensure greater profitability in the market in which it operates.

3. Conclusions

- All this knowledge that will emerge from this study will be directly connected to the objectives of this project study because in guaranteeing the objectives of this study and consequently guaranteeing the viability of this model, it thus confirms the need for a different approach concerning the performance analysis of several drivers.
- With the implementation of a project with a huge impact, this will lead to the integration of a new organizational culture through a new line of thought among the company's drivers and a complete understanding of the ecological driving skills and efficient performance techniques that contributed not only to the knowledge in the company but also that it can contribute to the literature community on the efficiency in companies of road transportation.

4.3. Data Collection

In order to obtain all the data necessary to justify this project, it is necessary to adopt specific data source strategies that allow maintaining all the viable and fundamental information. There are different ways to obtain real data, and they can be obtained by primary data, which are collected for the first time and by secondary data, which are collected by data that have already been studied.

In this study, it is essential to obtain data and information in real-time close to the reality of the truck's performance and, for this reason, it is very important to work with the same GPS and telemetry systems and have the same indicators, with the same value limits to minimize errors and lack of information. On the other hand, it will also be necessary to obtain qualitative data, which will be obtained through surveys with the company's managers and with the company's drivers.

These procedures have as main objective to understand the knowledge and the dynamics that the members of the company have on efficiency and eco-driving skills, but also to obtain the knowledge on their perspectives regarding the changes that have emerged from this new monitoring method and that have affected the daily activities of the drivers and the daily results of the company.

In the case of interviews with managers, it is because it is necessary to understand the reality of the company from a more human perspective. After all, although it is essential to guarantee efficiency and an improvement in terms of financial results, it is crucial to ensure that the company's management is willing to apply a model like this, if you have tried it before or if you believe in the difference that studies and projects like this can make in a road transportation company.

In the case of surveys with drivers, these will be even more important because it is necessary to understand how they act in their daily activity if they recognize that there are unconscious flaws in the way they act, if they are available and motivated to modify their behaviours and how they can be trained so that they can apply knowledge of efficiency in the future and changing the paradigm and the requirement of their positions.

4.4. Data Analysis

The analysis of the data in this study is based on descriptive analysis, and for that methods and research of data observation will be used. In the case of observation methods, this will be done by observing data that is then analyzed by computer software such as Excel. In addition, these data and the respective performance observation will be described through a set of observation methods, which are better suited to the analysis and the objective of this study.

The fact that most indicators and performance factors are defined at an early stage of the project and that all of them are analyzed mutually throughout the project results in a structured observation approach. The entire observation methodology applied throughout the project will be divided between an observation disguised in an initial phase, and an analysis of observation not disguised in the last phase of the study. This is because, in the first stage of the research, it will be necessary to understand the driving parameters by which each driver is analyzed and only after obtaining this initial

performance data, behavioural analysis and the definition of a training plan will it be done an undisguised observation to the drivers, in order to improve the results obtained in comparison with the data obtained previously. Still, regarding the observation methods, the option of using a contracted observation happens because the observation will be made only through GPS and telemetry data, which will in future facilitate the company in monitoring the performance of drivers and their actions without having to invest in financial and human resources to carry out face-to-face monitoring.

On the other hand, the objective of conducting a set of surveys and interviews will be to understand the knowledge and culture that company managers and their employees have about the efficiency of resources and how they have some perception or knowledge about how a truck works in operational terms and how it can be used in favour of drivers and the company. That is why these interviews will be conducted depending on the application of this performance analysis model.

This study will be applied to a set of company drivers who will be randomly defined and who, through the analysis of this study, will be able to understand its true impact on the results of an organization and how companies depend on innovative efficiency strategies to exceed in a market like the road transportation.

5. Business Analysis

In order to understand the reality of a road transportation company and therefor develop models of effectiveness for its activities, it is necessary to have a complete analysis of the reality of the company so that the defined strategies are the most appropriate.

All the literature review that was carried out allows identifying fundamental concepts and ideas of efficiency. Still, it is necessary to be able to apply them in the best way in the company that is being implemented such methodology. For this reason, the business analysis consists not only of structural business analysis (such as external analysis and internal analysis) but also through interviews and surveys, making it that possible to audit the company and verify what it does best and where the efficiency performance model proposed may be more advantageous.

5.1. External Analysis

5.1.1. Macro-Environment Analysis

As individuals or as an organization, we all live surrounded by external factors that directly affect the strategies and define the decisions or plans that may exist. In the case of the business world, there are several factors that directly or indirectly affect companies, represented by an analysis that allows understanding the reality in which the company lives, how it communicates and relates to the external environment and how it is organized to obtain the highest possible profitability.

This analysis consists of a set of factors that are divided into different categories and makes it known by the acronym PESTEL (Political, Economic, Social, Technological, Environmental, Legal). In addition to the importance that these various factors have in the macro environment of companies, they also influence all other elements of the microenvironment of companies.

Table 5.1. – Macro Environment Analysis/PESTAL Analysis of Road Transportation Sector

| Political | Economic | Social | Technological | Ecological | Legal |
|--|---|--|-----------------------------|---|---------------------------------|
| Political Reality in the European Union | European Economy – GDP, Unemployment Rate, Inflation Rate | Portuguese Population, Aging in Portugal and Active Population | Alternative Combustion | Maximum Emission Limits for Polluting Gases | Industry Legal Regulation |
| Regulatory Agencies such as Transportation Community and IMT | Portugal Economy – GDP, Unemployment Rate, Inflation Rate | Portuguese Emigration | Driving Intelligent Systems | Environmental Certifications | Alvara and Community Licence |
| European Cabotage Policy, Unions and Associations | Economic Context of Road Transportation Market | Foreign Residents in Portugal | Proximity Sensors | Energetic Reduction Plan | Transportation Sheets and CMR's |
| VCLC – Vertical Collective Labor Contract | Taxes on Oil Products | Recruitment for Transportation Market | Digital Information Flow | Mandatory Periodic Inspection | Driving and Resting Times |

Source: Own elaboration

5.1.1.1. Political Factors

All companies in every sectors are directly affected by the political environment in which they operate and, in terms of road transportation companies, some rules and policies directly affect the activity of these companies and, for this reason, new legislation, for example, VCLC (Vertical Collective Labor Contract) undoubtedly has a huge impact on the operating margins and business models of these companies.

As are shown in Table 5.1, political factors are factors that represent the degree of intervention of a given government and can benefit or hinder the business context based on the policies that are defined. Since Joiditrans is a Portuguese company, policies of the Portuguese government and the European Commission are expressed in laws applicable to the sector, forcing the company to have to comply with national and community guidelines.

In recent years, extra-community policies for the road transportation sector have resulted in a wide range of possibilities for companies in this sector, both nationally and internationally. Procedures such as the free movement of goods and people, the standardization of laws and the standardization of the environmental status of vehicles have given all companies in the sector the possibility to represent themselves abroad with the same competitiveness as other foreign companies. The need for this harmonization and understanding of technical and administrative standards led to the creation of a Transportation Community that defined a set of identical rules for transporters from different countries, such as the rules for maximum dimensions and weights of vehicles and cargo, regulation of driving hours, the generalization of on-board documents, cabotage policies, among other procedures.

Cabotage is a policy that regulates the European transportation sector because it limits the number of services that a carrier can perform in a foreign country, making it possible to make better use of both European supply chains and the various pages that see their cross-border trade growth in a steadily way with lower competition.

The Portuguese State was able to professionalize and regulate the entire sector through a regulatory agency like IMT, which in turn applied policies and regulations that made parameters and rules mandatory that allows portuguese companies to operate in Portugal in the same way that they function in Europe. This economic stability and political stability in Portugal generated a period of specific increases, in terms of the wage bill of employees, to take advantage of the current economic context. The new collective labour agreement (VCLC) that was mentioned before ensured an increase in the purchasing power of road transportation drivers, guaranteeing salary increases of around 11.1% in terms of base salary and 4% in pecuniary clauses.

5.1.1.2. Economic Factors

Economic factors represent the explanatory factors of the financial system in which the company operates, mainly identifying its structure and behaviour, affecting the purchasing power of potential customers and the company's cost of capital. The economic environment in which a company is

inserted is fundamental for the profitability and survival of the business because it represents not only the ability of a company to finance itself but also to be able to sell more or fewer products because of the general economic power of consumers.

Most of the data and conclusions that are referenced in table 5.1 were acquired through official reports from the European Commission, Eurostat, Banco de Portugal and financial platforms that demonstrate a macroeconomic image of the European community and the Portuguese economy, and that play a fundamental role in any company that is part of them, such as Joiditrans.

The European Union presented a GDP growth rate of 1.4% in 2019, while the Eurozone's gross domestic product grew by 1.2%. On the other hand, GDP per capita in the Eurozone reached the highest value in history with an amount of 34,770€ which, despite this, represented an annual variation of 2.8%, a deal below the interpretation of the indicator in 2018 and 2017.

The unemployment rate followed a downward trend in the last quarter of 2019, which represented the creation of jobs that generated an increase of 0.3% of employed people. Throughout 2019, the unemployment rate in the Eurozone has been steadily and steadily decreasing from an unemployment rate of 7.8% to 7.3%, which has meant an increase in the country's purchasing power. European population and the Community economy.

In 2018, the inflation rate reached a value of 2.3%, and this decreased until the end of 2019, the rate reached 0.7%. Despite this, with the increase in the purchasing power of the population, there has been a progressive increase in the rate since the beginning of 2020, which may still change due to the general slowdown of the economy this year.

In the case of Portugal, the Gross Domestic Product (GDP) increased by 2.4% in 2018 compared to the previous year, and this growth contributed to the increase in domestic consumption compared to external consumption. These increases also made it possible to reach the highest value of GDP per capita in Portugal, getting an amount of around 23,000€, which represents historical value in this matter.

The unemployment rate has declined since the highs of 2013, and in the year 2019, it reached the value of 6.5% of unemployed, which represents well the country's employability, as well as the increase of its economic factors and purchasing capacity of the Portuguese. In addition to the increase in employability in the country, there have been wage increases in recent years that have stimulated the economy through consumption and investment.

The inflation rate in Portugal has followed the inflation trend in the Eurozone, as, as in most European countries, the inflation rate reached high levels in 2018, with a decrease over the past few quarters. In Portugal, the inflation rate reached a value of 1.6% in 2018, an amount that decreased and went negative discounts of -0.3% at the end of 2019.

In the case of the road transportation sector, developments were generally positive, as in terms of employment there was an increase of 4.7% in the industry, which contrasts with the slowdown in the growth rate of the industry in the last year. Through an analysis carried out by INE, the transport

sector experienced a slowdown in growth compared to the previous year, due to increased external competitiveness. The sector recorded not only a drop in its turnover but also a reduction in the volume of goods transported, which reverses the growth trend of previous years.

Portugal is the 5th country in the European Union that charges more tax for each litre of diesel fuel supplied. The tax rate associated with fuel prices is about 60% of the amount paid for the fuel, which represents the largest share of the amount paid by consumers. This governmental position stems from the search for more ecological ways of conducting road activities and the social demand for a reduction in the consumption of fossil fuels. According to official data from INE, 2018 was the fifth consecutive year with increases in the TPP rate, having registered an increase of 1,5% concerning the previous year.

5.1.1.3. Social Factors

The social factors correspond to the defining elements of society and the culture of the external environment, where they affect the needs of customers and the potential size of the market. As a Portuguese company, it is important to understand the entire social environment in which the company is inserted and through table 5.1, it is possible to know the impact that society and Portuguese culture guarantee on this company.

With a population of more than 10,1 million residents, Portugal is the 16th country in the Eurozone with the largest community within its national territory, the majority of whom are female, representing 52% of the population and the remaining 48% male.

With a negative population growth rate since 2011, the population's longevity index has increased, causing the ageing rate to increase also thanks to the country's health capacity to offer guarantees to the communities. Portugal has a child population rate of 16% aged up to 15 years and an elderly population rate over 67 years old of 20%.

According to studies revealed by INE, Portugal has an active population of more than 6 million, which is in line with the 2019 unemployment rate, which was 6,5% and showed a 0,5% drop compared to the previous year. This scenario is favourable in terms of employment. It follows the political incentive trends that have reduced the unemployment rate and, with this, increased the purchasing power of the Portuguese population.

Since 2011, about 800,000 Portuguese people of working age have left the country, being divided between permanent and temporary migrants. The preferable destination of the Portuguese to emigrate are the United Kingdom, Germany and Spain and today Portugal has a total of 2,3 million emigrants spread all over the world. In 2017, official statistics considered that Portugal was the country of the European Union with the highest number of emigrants in proportion to the resident population.

In 2019, Portugal registered a maximum number of foreigners residing in the country, with more than 480,000 people seeking Portugal as their country of residence. This represents a 13,9% increase in the immigrant population, and residence permits in the last year also increased significantly by

51,7%. Within this entire immigrant population, the majority are citizens of Brazilian, Cape Verdean and Romanian nationality. Nowadays, in the case of the road transportation sector, there is a huge difficulty in recruiting in terms of young Portuguese drivers who can replace older employees while maintaining a general staff of younger employees.

5.1.1.4. Technological Factors

Technological factors represent a set of elements that characterize the technical system, its capacity for influence, its speed, and the degree of evolution in people's and companies' daily lives. The changes that exist at the technological level can reduce the barriers to entry, reduce the minimum levels of productive efficiency, and influence the outsourcing decisions. In any case, table 5.1 demonstrates several technical factors that indicate how the evolution of technology has an essential role in terms of competition because a more evolved product may appear on the market, which in turn, can become cheaper, which becomes a competitive advantage for companies. So technology is the main bet for companies to stand out from competitors.

Currently, the most recent transport vehicles use efficient systems that guarantee a lower emission index of CO₂ gases into the atmosphere through the inclusion of a petroleum component called Adblue, which when injected together with the fuel absorbs large amounts of CO₂ particles, resulting in lower emission of these gases into the atmosphere. This system's inclusion ensures that transport vehicles can comply with quality and gas emission standards while also managing to reduce fuel consumption.

A technology that has been developed and improved over the years and the new models of transport vehicles is the innovative development of auxiliary driving systems such as the speed adapter, the brake anticipation and adaptation system, the ECO driving system or the tire pressure assessment system, are examples of the technological evolution that exists and how it can be used in the best possible way by the respective operators to achieve greater efficiency in the resource they use.

This type of technology guarantees a massive increase in road safety as it warns drivers of possible risks and distractions that may occur, managing to intervene on time, which increases in their security. This technology that is placed in transportation vehicles has proved to be extremely important for the control and safety of vehicles because even if the driver is unable to intervene in time, this technology has an automated capacity that works alone, avoiding collisions or detours on the road that may become fatal.

The new vehicles embedded with the latest technology can obtain extraordinarily viable and real data through optimized technology. Advanced information systems that record that same data on onboard computers and that send, without needing any GPS included, these same data, information and indicators to companies and vehicle manufacturers, who are thus able to monitor and evaluate each resource' performance in a more viable way.

5.1.1.5. Environmental Factors

Currently, the environmental factor is fundamental in the business world, as it can affect the entire strategy of a company, change processes in all departments, or even generate growth opportunities. The preservation of safety and quality, together with the desire for improvements in polluting emissions, has caused significant changes in the most diverse sectors and activities, as described in table 5.1. In the transportation sector, it is considered that it has participation and responsibility for the environment. For that reason, governments, institutions, and associations in the industry seek to reach an environmental agreement that ensures greater viability and creates less impact on the part of transport companies.

The EURO6 standard is the highest degree of classification assigned to a heavy vehicle that, due to its date of manufacture or technical specifications, complies with a set of requirements for reducing the emission of gases into the atmosphere. These requirements are, for example, the use of efficient fuel injection techniques and the application of gas treatment systems (such as particulate filters, specific catalysts, or SCR systems) that thereby significantly reduce CO₂ emissions.

The Council of the European Union defined standards and certifications that determined that “from 2025, new trucks and buses will emit an average of 15% less CO₂ and, from 2030, will emit 30% less CO₂” (European Council, 2018). Through these defined standards, the European Union believes that “between 2020 and 2030 we will emit 54 million tons less CO₂” (European Council, 2018), representing a less significant impact.

According to the regulations in Portugal, any company that has its fleet with fuel consumption exceeding 500 thousand liters of diesel per year is required to develop a plan to reduce energy consumption, which will be monitored by energy audits by the entities responsible. The objective is to ensure that there is a reduction in CO₂ emissions and that there is a better use of driver performance.

To be able to monitor and ensure that the various land vehicles have the correct characteristics within the defined standards and certifications, there are periodic inspections that are essential for the regulation of the multiple vehicles. According to Decree-Law No. 144/2012, all road vehicles are subject to a period of technical reviews, which seek to regularly confirm the maintenance of suitable operating conditions, the safety of all equipment, and compliance with all emission standards that are established.

5.1.1.6. Legal Factors

All sectors of activity in the market are regularized and have to comply with legislation that all companies in the industry must be aware of. As represented in table 5.1, companies need to be attentive to any legislation that may influence the normal functioning of their activities, whether they are legislation of the current activity, the legislation of the future movement, labor legislation, tax regulations, codes regulations, standards, and certifications or any other mandatory indications for the practice of the activity in the sector.

There is a set of regulations for the various companies in the different sectors within the entire automobile road transportation market in the road cargo transportation industry. To all countries belonging to the European Union, a Community directive is applied that prevails in the national legislation of each country, for example, in the case of Portugal, it is Decree-Law n° 257/2007 that uses and regulates road transportation of goods.

When we talk about national transportation, the licensing is called Alvará, and to carry out international transport, another licensing named Community License is necessary. Obtaining these authorizations is fundamental to the practice of the activity, and in order to get the license, it is required to comply with a set of requirements established in Decree-Law n°257/2007 and Regulation n°1071/2009 of the European Parliament.

Heavy vehicles transporting goods for others need, legally, to have onboard a document that proves and evidences all the materials transported from a specific place to another. In national terms, there are the so-called transport guides. In the case of international transport guides, also known as CMR, they are authorized for their use either in national or international terms as long as this also complies with all the fulfillment requirements established in the aforementioned regulation.

All heavy vehicle drivers are required by law to comply with an established number of maximum driving hours and minimum hours of rest, which ensures the driver's full awareness and attention to his driving duties' performance. Although this legislation is punishable to the driver and is responsible for complying with these driving times, transport companies must guarantee the training and compliance with these rules established nationally and internationally.

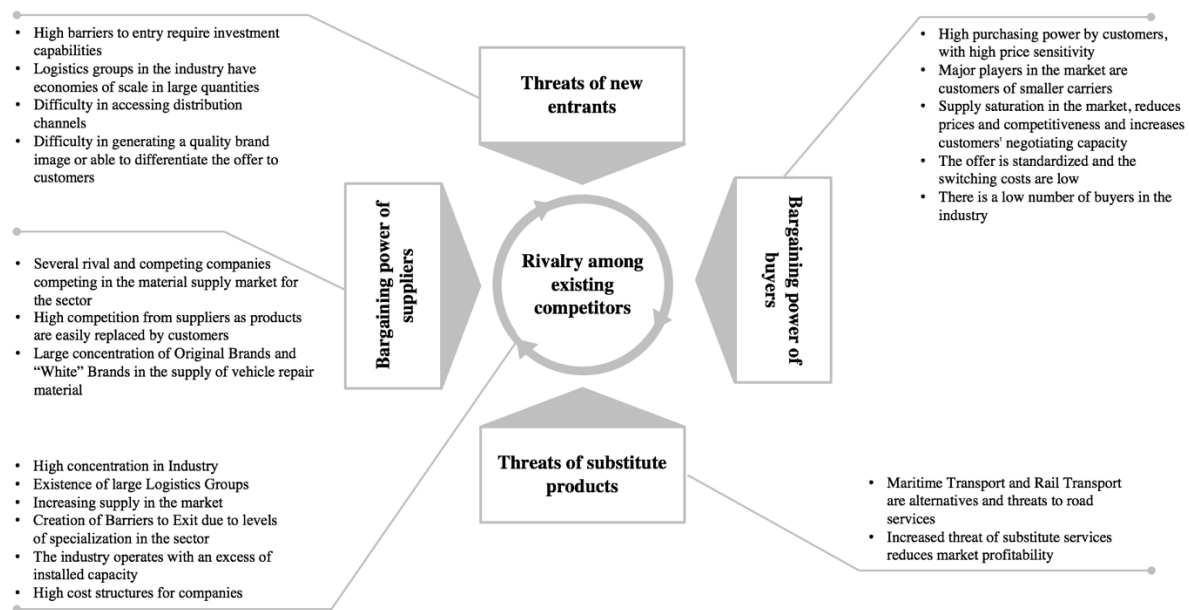
5.1.2. Analysis of the Micro-Environment

5.1.2.1. Industry/Sector

To analyze a sector or an industry is to observe a company's restricted way and the environment that influences it, including competitors, customers, suppliers, and all those involved in commercial and economic relations within the same industry. Thus, a sectorial analysis allows us to understand the sector's profitability and the risks to which a sector may be subject, and the advantages that arise from the different positions within it. Thus, the best way to understand the industry's viability is Porter's five competitive forces model.

The following diagram demonstrates the entire structure of the road cargo transportation industry, in this case, car transportation, using Porter's five competitive forces model to characterize best the sector in which Joiditrans is inserted.

Table 5.2 – Porter's Competitive Forces in the Road Transportation Industry



Source - Own elaboration

This model is a business model developed by Michael Porter that allows knowing the positioning of companies in a particular industry or sector, relating their customers, suppliers, and competitors, understanding the current and future reality of that same sector. These five competitive forces are the bargaining power of customers, the bargaining power of suppliers, the rivalry between existing companies, the threat of new entry, and the threat of substitute products.

5.1.2.1.1. Porter's Five Competitive Forces

5.1.2.1.1.1. Rivalry between Existing Companies

High Industry Concentration due to the presence of Large Logistics Groups - The European car transportation market is very compact due to the massive logistics groups, which are the leading forces in the sector and the main customers of the various smaller carriers. This causes many other companies to compete and seek to offer the best possible product at the lowest possible price, reducing market profitability and creating enormous pressure on these smaller carriers.

The increase in supply and rivalry in the market leads to a reduction in market prices - Within the transportation sector, depending on each company's specialization, some markets are much more saturated than others. For example, in the case of a general cargo transportation company, there is a massive rivalry because a large group of companies decreases the competitiveness of the companies and increases the rivalry between them. In the case of the automobile transportation market, saturation is not so marked. Still, in recent years (mainly after the 2008 crisis), there has been an increase in

companies' entry in this sector, causing the supply to grow exponentially, which meant a decrease in practice and consequently, a reduction in companies' profits inserted in the market.

Specialization of Transport Structures creates Barriers to Exit, which makes it difficult to leave the industry if it loses attractiveness - To be able to enter a specialized market such as road transportation of cars, which requires a specific type of structure for the transportation of automobiles and that prevents the transportation of other types of materials such as these structures, this means that if the industry loses attractiveness or that companies are unable to compete directly with larger carriers, prevent them from leaving this market. So when trying desperately to guarantee services and productivity, they use strategies such as practicing the service below the market price, which removes profitability and stability from the industry itself.

The industry has a mature growth rate and operates with an excess of installed capacity - The main engines of transport and automobile logistics made throughout Europe are the car manufacturers and their respective sales. If consumers buy cars at a controlled pace, this leads to increased vehicle production at the factories, triggering a supply chain for various carriers and logistics companies. Due to the economic growth observed in recent years, car sales were rising, generating attractiveness for the industry and developing existing companies in the automobile transport sector. This growth, coupled with new competing companies' entry, led to an excess of installed capacity in the industry, leading to its degradation.

The cost structures of companies in this industry are high, which requires a high volume of production - Carriers operating in this market need to guarantee continuous service continuity to support the activity and ensure growth. With a structure of high operating costs, these companies need to guarantee the quality and profitability for their business, which is hampered by the surplus of companies in the market and the limitation of logistical services that happen daily.

5.1.2.1.1.2. New Entry Threat

The high barriers to entry require investment capacity - The entry barriers in this type of market are quite considerable because the truck's purchase is an increased investment, and the investment in a specialized car transport structure, which raises even more the investment. Despite this, after guaranteeing all licenses and legal commitments with the responsible entities, it is possible to enter the market with a lower investment because the market itself is not very demanding about the age of the vehicle or its structure, which allows a semi-new or used truck that is attached to a semi-new or used structure already allows it to enter the market and the ability to compete with the companies already present in the market.

Logistics groups in the industry have a large financial capacity and therefore create economies of scale in large quantities - As currently large customers, being Europe's leading automobile logistics groups, are bombarded daily with the supply of new suppliers, the price is increasingly reduced, which reduces the profitability of the business. Although new carriers enter the industry, many of them cannot reach the desired quality levels and, therefore, often end up not surviving. Still, until that happens, they end up taking advantage of other companies' transportation, making it very difficult to monetize the transportation business.

Difficulty in accessing distribution channels - The small carriers present in the market, when trying to survive and trying to find new customers, are often stifled by the big players in the market and end up having no choice but to be part of these companies' logistics chain or end up unable to survive. This makes it very difficult for a company that enters the market to grow exponentially and to achieve a position of dominance like these market players.

Difficulty in generating a quality brand image or able to differentiate the offer to customers - When the market is on an upward slope, and there is a surplus of service, large logistics operators need to ensure a more elaborated way of transporting products to customers and thus allowing new carriers to enter into complying with car manufacturers' commitments. However, when the reverse process happens, there is enormous pressure on the levels of quality and the image that each company represents in the market, becoming a threat to small companies that enter the car transport market, but that does not have the reputation, the quality and brand image that guarantees them survival in times of service deficit.

5.1.2.1.1.3. Clients' Negotiating Power

In the industry, there is a high purchasing power on the part of customers, which increases their price sensitivity - In the case of the automobile transportation sector, large logistics groups in Europe are the main customers of the small carriers in the sector, and bargaining power is enormous because, due to their too dominant position in the market, they are significantly price sensitive. Also, these large logistical groups are the ones that define the levels and standards of quality and prices adopted in the market, which guarantees them enormous bargaining power against their smaller suppliers, such as Joiditrans.

Major players in the market are customers of smaller carriers - Because these customers are logistical groups that work with different brands in the automotive sector, this offers the possibility to integrate vertically upstream, entering the industry and becoming their suppliers. This dominance guarantees them a comfortable position against smaller competing companies, and they can use these same companies as their suppliers or invest in their trucks and transportation structures, which reduces

their expenses with external suppliers. All of this makes it extremely important to stand out for the quality of service and performance, as customer's bargaining power is one of the biggest obstacles to smaller operators' ability to generate wealth.

Supply saturation in the market, reduces prices and competitiveness and increases the negotiation capacity of customers - The increase in the offers of transport companies has dramatically reduced companies' bargaining power and, consequently, the increase in the bargaining power of buyers. Despite the presence of large operators on the market, they act as intermediaries and guarantee services to a considerable set of logistics carriers. Thus, with the gradual and constant growth of the market and the consequent entry of several carriers, this generates a saturation that gives big players the chance to further control these smaller companies' prices and profitability.

The offer is standardized, and the switching costs are low - The road transportation sector, particularly the car transportation sector, is a sector where the service is standardized and does not add any extra cost when moving from one carrier to another. The way cars are transported from production plants to logistics parks or from these parks to the various dealers across Europe are carried out using the same procedures. Although different quality standards may be required in different situations, the main trigger for transport choice is based on the price and image of the company. However nowadays, with the dominance of large customers in the market, the requirements have made many companies safer and with better quality indexes, making switching costs lower and lower since many companies have useful quality indexes at prices lower.

There is a low number of buyers in the industry - Due to the small number of buyers, the loss of a customer has an extremely significant impact on any market operator. Although there are several car brands in Europe, there are a small number of logistics companies that ensure the entire distribution of these brands. Many companies have to work directly with these logistics companies without being able to have direct contact with car brands.

5.1.2.1.1.4. Bargaining Power of Suppliers

In the industry there is a low bargaining power on the part of the suppliers, as there are several rival and competing companies competing in the market - In the transportation sector, in general, the bargaining power of the suppliers is shallow, which is due to the immense competition in the market. In terms of truck supply, several brands offer equally technological products at very similar prices. However, in terms of suppliers of maintenance and repair material for these vehicles, there is a large concentration of competitors in this sector, which leads to a decrease in negotiating power and differentiation by some quality, but essentially by price.

There is high competition from suppliers as the products they offer are easily replaced by customers - Transportation vehicle suppliers face very fierce competition in the market as the existence of several brands that sell a very similar product prevents exponential growth and is hugely dependent on the supplier-customer relationship. One of the strategies that heavy vehicle manufacturers use is to strengthen relationships in after-sales service or through contract agreements established over a long period.

High concentration of Original Brands and “White” brands in the supply of vehicle repair material - Several suppliers supply materials very identical to the originals, with very high quality and lower prices than the original brands, which means that there are several possibilities for carriers when it comes to their suppliers. Although heavy vehicle manufacturers use a service to sell individual parts in order to make the brand and product they sell profitable, there are a considerable number of companies that live by selling identical or original brand material, which gives companies a vast variety of purchase options, which ultimately reduces the bargaining power of suppliers.

5.1.2.1.1.5. Threat of New Products / New Services

Maritime Transport and Rail Transport are alternatives and threats to road services - The threat of new services to replace the road transportation of cars is relatively high. Different car brands are continually looking for ways to reduce the cost of transporting vehicle production to various dealers worldwide. Road transport in this sector will always be a vital part of the supply chain, as it is the only way to distribute vehicles in the countries and to be able to guarantee distribution through the remote points of sale of the automobile brands. Despite this, the threat that new substitute services may exist is since brands are looking for alternatives, such as rail or sea transport, to move vehicles over long distances from factories to the various logistical points and critical points. Thus, car manufacturers and large logistics players can move large quantities of products at more affordable prices, which, despite taking longer, guarantee a reduction in costs with suppliers of these companies.

Increased threat of substitute services reduces market profitability - Road transportation does not have the possibility of transporting large quantities of vehicles simultaneously or at such low prices, making the sector only the bridge between logistics centers and resale concessionaires, thus making a door-to-door distribution and not a long-haul service. Also, road transportation being subject to external factors with a much higher rate, transport guarantees are slightly lower than the other options mentioned above, and thus companies enter into agreements with other transport sectors, thus removing market space and product for road transportation to practice its activity.

5.1.2.2. Market

5.1.2.2.1. SWOT Analysis

To assess a company's position in the market in which it operates, it is necessary to carry out a joint and simultaneous analysis of its internal and external dimensions. It is for this purpose that the SWOT analysis exists. This analysis is a business analysis model that makes it possible to understand its real position concerning the external environment, taking into account its internal gains.

In this case, to assess and understand the company's position in the market about its competitors, it is necessary to understand and evaluate all the company's strengths, weaknesses, opportunities, and threats in the market, to define the best possible strategy. The following diagram demonstrates the identification of the various situations existing in the company Joiditrans, which allows us to understand how the company can put itself in the best way in the market.

Table 5.3 - Joiditrans SWOT analysis



Source - Own elaboration

5.1.2.2.1.1. Forces

A company's strengths are its resources and skills that can be used to develop a competitive advantage. In the case of Joiditrans, it is possible to understand the various advantages that the company has over the rest of the market, as, as shown in Table 5.3., The company has a strong relationship with customers and intrinsic control over its fleet.

Specialization in car transportation, customer loyalty and creation of a reputation brand - The fact that the company has been in the automobile transportation sector for more than 20 years made Joiditrans create a prestigious brand in Portugal and Europe, having customers and services across the continent. His specialization has proven to be an asset for the company because the know-how he has

acquired and which he applies in his activities, has generated a good position in the market and an appreciation for all its customers.

Good transport service to the customer, generating a good relationship and commercial loyalty -

Over the years, the company has invested in techniques and training of human resources to be able to guarantee high degrees of quality and performance. In the sector in which the company finds itself, it is essential to have a responsible, reliable service that meets the most demanding automobile brands' requirements.

Competitive prices - Diversity and a good relationship with different suppliers allow us to obtain the necessary materials at lower prices, with lower production costs, which guarantees a competitive advantage in customers' prices. One of the most excellent strategies that the company has applied in recent years is the use of cost leadership strategies in relation to its international competitors. Thus, it has allowed the company to survive with competitive prices in an industry extremely dominated by large business groups.

Internal inspections and vehicle quality control - The company operates under a pre-defined system of audits on its vehicles' quality and maintenance, which allows it to increase quality levels and standardize the entire fleet with the same quality record. By using a constant quality and inspection record in its transportation vehicles' minimum requirements, the company ensures viability and confidence in its transport, which translates into a good market position against its competitors.

Human Resources Preparation - The company submits all drivers to a set of initial training, to guarantee the quality of its service since the initial hiring, progressing in terms of quality, and loyalty to the company. Throughout recruiting a new employee, the company invests in the capacity to train and improve employees' work rates to represent this in profitability for the company. This initial preparation and constant training guarantee not the necessary lessons for the practice of the activity, but also the integration of these new employees in the new work group.

Internal Vehicle Repairs and Interventions - The fact that the company has a specialized workshop in its facilities saves and recovers capital in external repairs and ensures greater control over the costs and quality of interventions and maintenance. This strategy has always been applied in the company's history, and over the years, with the know-how acquired, the company has improved its intervention and repair techniques for its vehicles, which has proven to be an asset for the company. Since it allows for a more excellent approximation in the interventions that are made, to guarantee that they are carried out with the highest quality but and be able to control within the budgets all expenses with the maintenance of vehicles and transportation structures.

Evaluation of your team, proximity and management monitoring with all employees - Through strict control and supervision in the business's different phases, this allows maintaining a high level and optimizing the service performed to the maximum. The company uses a strategy of proximity between management and the company's various departments so that it is possible to understand how they operate and be quicker to correct any errors that may arise and that may generate waste. This control and the registration of the various employees' actions allow the management to understand each employee's reality, the most significant difficulty of which is to end up understanding the reality of each driver who is physically distant and impossible to guarantee the same proximity and control with same.

5.1.2.2.1.2. Weaknesses

A company's weaknesses are something the company does not have or something the company does not do well, so it is a potential competitive disadvantage. For this, it is necessary to identify them and ensure that competitors have the same weaknesses to not gain an advantage before the company.

In the case of Joiditrans, the main weakness is due to the lack of efficiency in their productive activity and others such as:

Deficiency of a system/model that monitors resources efficiently - The lack of technological development, the lack of R&D investments, and the lack of a reliable driver performance monitoring system prevent the company from having guarantees of its resources and how the various variable costs are controlled. Any road cargo transportation company, such as Joiditrans, faces a significant challenge in controlling and guaranteeing the way transport vehicles are handled and how some can offer the company much more profitable than others. In this general weakness of all companies in the industry, this study seeks to act and offer companies a chance to ensure greater efficiency of their resources.

Exclusivity in the provision of services to customers - The fact that the transport of goods is always carried out in the same way, hinders a company's ability to stand out and guarantee a new way of performing the service. In the case of Joiditrans, being a car transport company, it is not possible to offer another service to its customers without an acquisition or investment in this strategy and, therefore, it has a limited portfolio in terms of the solutions it can add to the market.

High operating costs - A company in the transport sector has high operating costs, from fuel consumption to vehicle maintenance, making it difficult to obtain large margins for progression and profit. With the progressive increases in fuel prices and the power of inflation, companies in this field are increasingly afflicted by high operating costs, making it challenging to maintain high competitiveness over a long period.

Lack of Marketing Skills - Due to the exclusivity of the service provided, Joiditrans does not invest in large amounts in marketing and the dynamization of its brand, and although the company has a great relationship with its current customers, the difficulty in propagating service and its existence leads to increased difficulty in acquiring potential new customers.

5.1.2.2.1.3. Opportunities

When carrying out an external analysis like this, it is possible to understand some growth and profit opportunities for a company, that is, there are indications of something in the market that the company can take advantage of in its favor and build a competitive advantage in its favor. In this transportation company, it was possible to identify some opportunities that should be explored, such as the growth of viable telemetry and performance control technologies.

Growth of new telemetry technologies - The fact that transportation companies are looking for new ways to gain competitive advantages with their customers has meant that truck manufacturers or even GPS and telemetry companies are seen as a business opportunity for your customers. A transportation company like Joiditrans, by defining its own driver performance monitoring model, will make the company at a good point compared to the rest of the market and in this perspective, with the progressive technological advance, the technologies that applied in the business models or the transport vehicles themselves will be more sophisticated and viable to their application.

Ease of dissemination on social networks and digital networks - Currently, there is an enormous facility to publicize a brand and reach immense customers that would have been extremely difficult to achieve in the past. Through the correct investment in advertising tools, a company can effectively demonstrate its services and skills effectively and establish relationships with customers via online, using options such as e-commerce. Social networks, web platforms, and online technology have remade marketing and how a company or its brand is advertised.

Entry into new markets - The fact that the company is too experienced in the automotive transportation sector has allowed Joiditrans to acquire the know-how to establish an effective and committed position in the automotive market. Despite this, other markets and other transport options such as road transportation and used or used car logistics can provide them with extra income without compromising the core of the business and without having to make large investments to enter in new markets diversify their businesses.

Possible changes in Fuel Prices - The COVID-19 pandemic, in 2020, caused great difficulties and unprecedented delays in the economy because, with the confinement of populations and the paralysis of the economy, this led to a huge decrease in global fuel consumption and its consequent decrease in

its price. These fluctuations in fuel prices may generate future opportunities for this type of company, as it will be necessary to dispose of all the products stored during this period of standstill.

5.1.2.2.1.4. Threats

Some changes in the external environment of a company can lead to the appearance of some threats to the stability of a company and that is why it is necessary to identify them and ensure that the company is prepared to deal with these types of external threats to the company that are coming from the market. Analyzing Joiditrans' current position in the market, it was possible to identify the exponential growth and vertical integration of many of its customers as its main threat.

Vertical integration of customers - Large European customers have started to invest in their fleets to integrate not only logistics but also to carry out the goods transport process. The financial capacity and size of these companies in the market allow this vertical integration throughout the entire storage, logistics and transport process, which means that the customers themselves, that is, these large European logistics groups also end up being competitors of smaller carriers, which automatically creates an added difficulty for them to survive in the market.

Political Context in the Transport Sector - With the entry into force of VCLC and the application of a new remuneration system for drivers of heavy vehicles, this generated an increase in the salary mass of national carriers, which requires an increase in the company's productive capacity or the availability of customers to adjust their prices to this new reality. With the demands of the market, the excess supply that reduces the sale price, and a considerable salary increase, this leads to a decrease in Portuguese companies' competitiveness concerning international companies.

Reduced human resources - Despite the increase in wages in terms of drivers, there is currently a shortage of labor and great difficulty finding enough drivers to cover the shortages that occur and allow a company to grow and become competitive. Driver work has been devalued over the years, and the number of people who enlist for this type of service is getting smaller and smaller, which makes it very difficult for companies that need staff who are willing to do this job and can become qualified to perform the service in the best possible way.

Price War with Competitors - With the economic growth of the last few years, the automobile road transportation industry has undergone several changes since the vertical integration of large companies in the market and the entry of new competitors, which removed attractiveness to the market. The surplus supply of transport companies in the automobile transport market led to a price reduction that jeopardized their profitability and created a price war between the various companies in the market, preventing them from growing steadily and above to ensure long-term profitability.

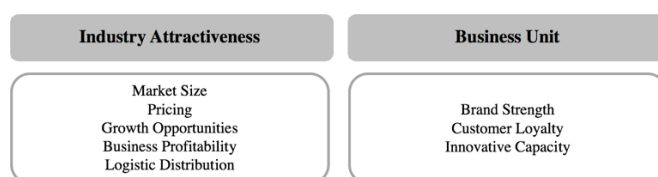
Epidemiological Pandemic COVID-19 - The greatest threat to public health in society emerged in 2020, with the appearance of an epidemiological coronavirus pandemic, also known as COVID-19. This pandemic forced the shutdown of activity in several industries and all non-essential services, which automatically generated considerable losses in all companies in all sectors. While it is still challenging to predict the future difficulties that this pandemic will bring in the future, regardless of the opportunities that may arise from this crisis, there is no doubt that this is a current and future threat to all companies and societies around the world.

5.1.2.2.2. GE/McKinsey Matrix

Although SWOT analysis ensures a good representation of a company's competitive position and how it can use opportunities and threats to shape its strengths and weaknesses, the position it occupies in the industry and what strategic decisions are not fully perceived can be taken so that, depending on the attractiveness of the industry or the strength of the company's position in the same industry, the best investment decisions can be made. In this way, the GE/McKinsey matrix is a great tool to bridge the SWOT analysis, as this business analysis matrix is a more efficient analysis matrix than the BCG analysis, which allows finding opportunities in the industry, thus having a more precise notion of the investments that can be made and a more simplistic way of making decisions.

In the automobile road transportation industry, several factors make it possible to understand its attractiveness, among which is the size of the market, the price charged, the growth opportunities, the profitability of the business, and the logistics distribution. In addition to analyzing the industry's attractiveness, to establish a viable and realistic relationship with the investment reality to be made, it is also essential to carry out an impartial analysis of the business unit within that particular industry. In the case of Joiditrans, where its business unit is the automobile road transportation service, it presents different factors such as the strength of the brand, customer loyalty, and innovative capacity.

Table 5.4 - Analysis of the Attractiveness of the Industry and Business Unit



Source - Own elaboration

Based on external evaluation factors of the industry and internal evaluation factors of the company's business unit, it is possible to understand what positioning this business unit and what type of investment can be made based on the industry's attractiveness. In the case of the automobile road transportation industry, several factors make it possible to understand its attractiveness, including the following:

Market Size - Despite the existence of large logistics companies in the industry, which provide a large part of the complete logistics service that is carried out in Europe, the existence of a large production ratio on the part of several car brands, makes room for the existence of many other smaller carriers, which means that there is room in the industry for the existence of a carrier that supports the largest companies in the industry.

Pricing - The price of the automobile road transportation industry varies depending on the product levels that need to be distributed and the supply of carriers, which leads leading to a constant verification of these same factors causing the price to suffer different changes. This demonstrates the excellent bargaining power of the prominent logistics players and how they can dictate the prices practiced in the industry.

Growth Opportunities - The acceleration or deceleration of the automotive industry generally follows the patterns of growth or slowdown in the world economy, as the confidence indexes of society, in general, to acquire new or used vehicles make this create different dynamics in the automotive industry and consequently in the automobile road transportation industry. Despite doubts about economic growth that emerged in early 2020, the automotive market has historically shown reasonable rates of recovery and long-term global growth.

Profitability of the Business - Within this type of industry, the profitability of any business unit is fundamentally dependent on the carriers' capacity to provide a quality service within the most excellent possible efficiency. However, the constant flow of automotive products that are produced and sold allows to guaranteeing continuity of service and profitability of the business, as long as it manages to maintain operating margins that guarantee constant profits.

Logistic Distribution - As previously mentioned, in this type of industry, logistical distribution is based on the entire production of the different car manufacturers, but the car logistics process is very competitive among large business groups that have the majority of the share of the market. Although this represents a risk for smaller carriers, they are a fundamental part of these logistics companies' commitments to brands, allowing new companies to enter the market that guarantees this distribution throughout the territory.

In addition to analyzing the industry's attractiveness, to establish a viable and realistic relationship with the investment reality to be made, it is also essential to carry out an impartial analysis of the business unit within that particular industry. In the case of Joiditrans, where its business unit is the automobile road transportation service, it presents the following factors:

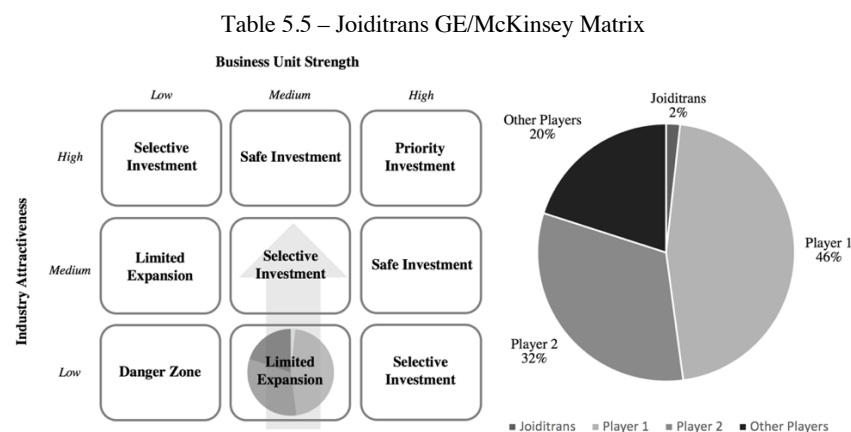
Brand Strength - For a carrier in this industry to achieve a level of regular service and have growth opportunities, it is essential to generate an image of quality and commitment for customers.

Furthermore, in the case of Joiditrans, the company presents the right image towards its customers, which is the result of regular service and high performance over several years, making this company well established in the industry.

Customer Loyalty - In the same way that Joiditrans seeks to carry out its transport in the best possible way and according to all the customers' requirements, they also return their appreciation through not only their income but also a good sense of loyalty towards this company. The big problem in this situation is that with the entry of several carriers in the industry and the consequent increase in the offer, it is difficult for customers to maintain the same loyalty when prices in other options can be advantageous.

Innovative Capacity - Within the automobile road transportation industry, Joiditrans is a company that has demonstrated, over time, an excellent innovative capacity both in terms of modern transport vehicles and in terms of operational procedures. However, with added difficulties in the industry, it is essential that the company can find new ways to innovate and remain competitive in the market.

In the GE/McKinsey matrix, several categories of investment help managers in decision-making and are crucial for focusing capital. These categories can be categories where investment is a priority and fundamental, where investment is safe and shows signs of growth, where investment needs to be selective and cautious, where investment needs to be as little as possible and where investment must be completely abandoned. The following diagram shows how these investment strategies are adapted according to the industry' attractiveness and the strength of a particular business, in which case the possible positioning of the business unit in Joiditrans in the industry in which it operates is represented.



Through the analysis of the previous scheme, it is possible to understand that the automobile road transportation industry has low attractiveness because although the market is considerably large, there is too much competitiveness due to the strength of players already in the market and the appearance of other competitors. Despite this, there are still opportunities for growth and capabilities to make a

transport business profitable because, in the case of Joiditrans, it has useful quality indexes, which has allowed it to create a quality image and a good relationship with customers.

With an innovative focus on efficiency, the company can obtain a competitive advantage that allows it to guarantee another status within the industry, and with the application of a useful model for the analysis of efficiency and performance of its drivers, the company will be able to optimize its resources in an innovative way, which in the long run will mean an improvement in its operating margins and profitability of the business. The increase in the company's innovative capacity can be a factor of great competitiveness within the market, making this business unit gain strength, and investment strategy can become a safe and growing investment, even with medium or low attractiveness for the automobile road transportation industry itself.

5.1.2.2.3. Road Transportation Portuguese Market

The Portuguese road transportation market is a market with a turnover of more than 6 billion euros, representing about 2.5% of Portuguese GDP, which reveals the enormous impact of this sector on national accounts. In the case of the Portuguese transportation market, unlike other transportation companies in other European countries, it has not concentrated much investment and research on the particular issue of performance efficiency, which has given European companies an advantage over time by presenting customers with prices of lower transportation costs, managing to maintain the same growth ratio and profit margins. This is a strategy that has failed Portuguese companies and where they should invest and analyze more deeply.

Joiditrans operates in a market with several competitors that make this market very competitive because, in addition to such European logistics groups that have a tremendous financial capacity and a remarkable expression in the market shares, there are still many other smaller carriers, of which this company is part of and complete all the logistics and automotive distribution that is done in Europe.

These small road transportation companies are the main competitors of Joiditrans because although the logistics companies apply a vertical integration strategy and have their fleet, they still need external carriers to support all the necessary distribution without ever compromising their commitments to car manufacturers. In doing so, these companies are the main customers of many European carriers, of which Joiditrans is a part and is essential to stand out. In order to be able to stand out in the competitive market, companies must use fundamental strategies that are crucial to their success, and in this case, a strategy that has failed in these companies is the fact that many do not pay so much attention to their operational efficiency, which leads to a lack of productivity and negative financial results.

To prove the impact that driver behaviour has on resource efficiency, this study is about a market that allows you to see the impact that small actions can have on wasting money. In other market segments, such as air transport, rail transport or even boat transport, asset controllers are much more covered by technological advances and engineering developments that allow them to make their

activities much more automatically than truck drivers' activity. In this last type of activity, drivers receive much help from intelligent systems like cruise control and others, but the fact that they are in the same space as thousands of other vehicles, this makes this particular sector much more subject to unpredictability, different variables, and exclusive dependence on their behaviour and other drivers.

The specification of this particular market creates a huge challenge to understand which companies in the market are open to this source of chances and looking for other solutions in the market. Another reason why this study applies only in the Portuguese context is that this study can be applied to the social and economic reality of that country in order to be able to understand the needs presented and evaluate in a more incisive way and practice the application of this method. Finally, in Portugal there is a more significant concern on the part of the Portuguese fleet operators being more concerned and focused on looking for new technological developments in the manufacture of trucks instead of analyzing other alternatives and new opportunities to generate operational improvements in their fleets.

5.2. Internal Analysis

Joiditrans, Lda. is a company based in Salvaterra de Magos and is a Portuguese car carrier, with more than 50 trucks and their respective transportation structures. In 2014, Exame magazine named the company one of the 100 Portuguese companies with the highest growth ranking between 2009 and 2012 (Exame, 2014).

According to official data from the INE and data provided by Joiditrans' managers, within the national road cargo transportation sector, Joiditrans occupies 140th place in turnover, rising to 124th place when it comes to gross added value. Bearing in mind that there are 7320 road cargo transportation companies in Portugal, this demonstrates this company's potential and positioning in the transportation market (INE, 2019). Since 2011, the company has been certified by APCER to a quality certification and has been distinguished with Top SME's status since then. Throughout this process, the company acquired an excellent service and an innovative capacity in the company's most diverse areas, such as administrative procedures, monitoring of metrics, and definition of medium and long-term objectives. This has made the company, over time, able to acquire scientific and technical knowledge about the importance and preponderance of all the performance of its vehicles.

Besides, the market segment in which it operates is a market with growth potential because, in Portugal, road transportation is the primary transportation sector in the country and, being specialized in the specific sector of car transportation, this provides an opportunity to grow and it is further consolidated in the market. However, like all other transportation companies, it is also subject to external factors that can alter its competitive position in the market, and that can, over time, become risk factors for the company.

Factors such as fuel prices, the wage burden on drivers, or the increase in inflation, are factors that cause the loss of competitiveness of Portuguese companies considered by their external suppliers,

causing the road transportation sector's margins to decrease considerably. In companies like Joiditrans, industrial cost goods are of exceptionally high importance today, causing these companies to use innovative ways to effectively reduce these operating costs.

Before this year of 2020, many experts and financial institutions already believed that the old economic growth would slow down, and with that, many challenges would arise. Banco de Portugal had a forecast for a decrease in Portugal's GDP growth rate (Banco de Portugal, 2019), which would automatically oblige companies to adapt and find new ways to continue to profit or increase their sales in foreign markets or even reducing their operating costs to find total operational effectiveness.

However, the year 2020 brought a different reality. The coronavirus pandemic, also known as COVID-19, made these specialists' predictions even worse because with the economy stopped during the health crisis, and with that companies and society were extremely aggravated. This whole situation is a critical issue for all companies, and as such, in the case of Joiditrans, it is also an enormous challenge. It is essential for Joiditrans to guarantee, that the company presents effective solutions to survive in the post-pandemic period and full economic hardship.

As it was possible to observe in the market analysis carried out on this research, the automobile road transportation industry has a better chance of guaranteeing higher margins than other transportation sectors. Joiditrans benefiting from a well-established position in this market and with a good reputation with customers, it is essential that the company rethink an equally effective strategy in terms of the performance and efficiency of its resources. It is also essential to find new solutions that can bring the company a competitive advantage against competitors and can bring optimization in terms of operational losses.

In the road transportation sector of automobile transport, there are several market segments such as the transportation of new vehicles, the transportation of used vehicles or even heavy vehicles' transportation. In the case of Joiditrans, it operates mainly in the transportation and distribution of new vehicles, transporting from production factories to logistics parks or even directly to the car dealers and sale points, which also has a vehicle transportation services used in Europe from specific points for collection to the final consumer. Despite this study being applied in any of the market segments in which this company is or plans to be present in the future, the transportation of new vehicles represents more than 90% of the company's productive capacity and for that reason, it is necessary to analyze this type of service in particular, to concentrate the market analysis.

The best way to understand the value that the company has internally and the competitive advantages that guarantee for the market is through an analysis of their value chain, which allows to obtain a more realistic image of the business' advantages and how the operational' efficiency may improve the creation of business value.

5.2.1. Competitive Advantages

The offer of a product or service to a customer is directly linked to its quality and the way it is produced to be sold at the best price. Automobile road transportation is a continuous service where efficient execution is essential, with quality procedures that allow the carrier to profit from its business and its customers to obtain fast and harmless transportation, that is, with high quality. Ensuring that the company applies the most correct and most efficient processes that guarantee advantages for both the company and the customer, makes the business more sustainable and more competitive.

For this reason, it is necessary for a company to define all its competitive advantages, as these are the advantages that enable the company to guarantee the best possible price for its customers while at the same time being able to reduce its costs and obtain the best operating margins. It is in this way that the competitive advantages help an organization to define what is most important to fulfill its mission, because although these factors vary according to the objectives and mission of the company so that it has a future, certain elements do not may fail, such as the main factors of the company's development and the main factors of customer satisfaction.

In the case of Joiditrans, throughout its experience in the market and its ability to innovate and apply differentiating strategies, there is a set of factors that the company considers essential for it to obtain good results in the market and to create a relationship of satisfaction service by the customer, being these competitive advantages the following ones:

Accumulated and Specialized Knowledge in the Sector (Know-How) - The specialization and total focus in the segment of road transportation of automobiles have allowed the company to acquire a profound knowledge of technical and organizational issues to add value to the market and the industry.

High Average of Environmental Index in Heavy Vehicles (Euro Index) - With a fleet of more than 50 heavy vehicles and more than 90% of vehicles with category of environmental index EURO5 and EURO6, this demonstrates the continuous investment in vehicles with lower emissions of CO2 and consequently with more remarkable efficiency modernity.

Reconditioning and Maintenance of Semi-New or Used Transport Structures - The company invests in the reconditioning and internal maintenance of all the transport structures it owns since by having a department fully designated for this task, Joiditrans can minimize large investments and obtain indexes equally satisfactory to such new structures.

Fleet Control and Management - One of the processes that most contributed to the growth of the company's quality of service was implementing organizational and evaluative processes that ensure better control over the fleet. These processes are divided between traffic management and regular audits of quality and compliance.

Training and Development of Human Resources - The activity and success of Joiditrans until today is fundamentally due to the entire set of human resources that make up the structure of the company and that through an investment in continuous training have contributed to the increase in the levels of quality of the company and the reputation of the brand.

The factors described above demonstrate the critical elements for the company's success and the creation of value for its customers, but it is through the inclusion of a new aspect, such as the analysis of performance indicators, that the company believes to adding value extra to your competitiveness and your performance as a road carrier.

It is in this perspective that it is necessary to evaluate the competitive advantages of Joiditrans in opposition to their specific competitors since all road car carriers in Europe work on a productivity strategy always trying to guarantee the maximum possible services, making the most significant possible number of km's having in order to obtain income based on those same km's traveled. With the considerable increase in supply in this specific market, there is currently decreased prices applied and a decrease in operating margins, which generates several ways to obtain competitive advantages in the market, and Joiditrans, taking into account the current market situation, seeks to obtain its competitive advantage based on a cost leadership strategy.

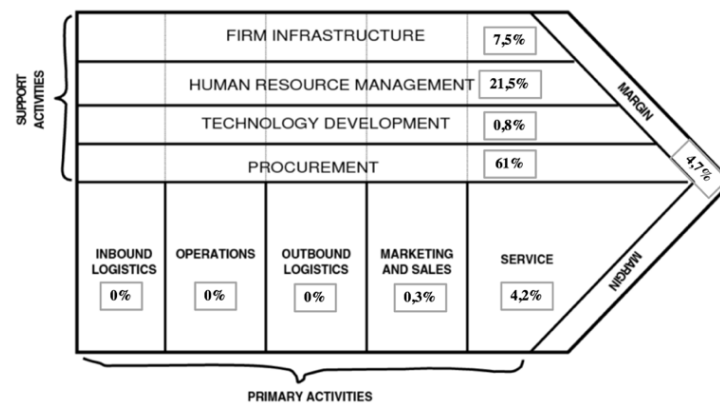
Being a competitive advantage, the ability of a company to neutralize or diminish the competition's action in the market segment, this can be obtained through the differentiation of the offer or the leadership by the costs. In the case of a road transportation company such as Joiditrans, it is a fundamental way of guaranteeing market share and resisting changes that may occur over time. A company that is a leader in lower costs does not automatically mean that it has to be the company that practices the lowest prices in the market because companies with lower costs can have higher operating margins and profits in particular when competing against non-differentiated services such as this type of road transportation, and to be a leader in costs it is necessary to be more efficient and innovate in products, services, and processes to reduce time and costs.

The application of this performance analysis model meets the fact that the company seeks to ensure this competitive advantage and thus manage to become even more competitive because despite the company already being able to be a company in the market with a good reputation, with excellent knowledge of the market and service adjusted to its right level of quality, the company seeks to offer a competitive service at a low cost, but which guarantees at the same time increased efficiency and an increase in its operating margins.

5.2.2. Value Chain

A value chain is the set of activities carried out by an organization to create value for its customers and how their activities in the chain are carried out, determining their costs and their profits. The following table represents how Joiditrans creates value and obtains its operating margins.

Figure 5.1 - Joiditrans Value Chain



Source - Michael Porter's Value-Chain Model of a Firm, Posadas, 2006

Through an analysis of the value chain, it is possible to understand how the company establishes itself and organizes it to obtain results and profit margins in its activity. The large share of costs that the company has is related to the procurement since these are the processes carried out to acquire the necessary resources to keep the company in operation, which means that all expenses inherent to the company's activity are accounted for in this portion.

Bearing in mind that the entire activity of the company is based on the provision of services and the activity of road transportation represents a dynamic activity, it is automatically necessary that the company dispenses much of its capital in the continuous flow of activities, especially when the company integrates a constant flow of a supply chain. Also, in support activities, the company has a percentage of 7,5% in support systems to maintain daily operations that include general administrative, legal, financial, and accounting management, represented by the company's infrastructure.

Something evident in the value chain structuring is the general expenditure on the company's human resources. In the case of Joiditrans, there is a set of activities associated with the recruitment, development, retention of talents, and compensation of employees and the company has a percentage of 21,5% of expenses in this portion. This demonstrates how vital human resources are for the company, as in this activity, the presence of qualified human resources that guarantee the best performance and profitability of the various resources is essential, and that is why the company must invest in the recruitment of specialized persons, in continuous training of its human resources and fair assessment of each performance, in order to make the best possible management of their most valuable employees.

Finally, in the company's support activities, it is still worth almost noting in technological development because the 0,8% represents the investments made in this portion only to guarantee a return on investment through new technologies and innovations such as process automation.

In Joiditrans, being an extremely exclusive services company, it does not have any production costs, represented by 0% in the inbound, production, and outbound logistics. Despite this, the

company still uses processes to convince customers to buy its services, spending about 0,3% on marketing and branding, and uses a very considerable share in after-sales services through activities that maintain and increase the value of services after purchase, such as the logistics work that the company does in the course of transportation and activities developed by the company.

This demonstration of the company's value chain represents a real approximation to what the company's strategy is, and although it is evident that the company spends a lot of its capital on the constant operation of its activities, it is also essential to highlight the existence of a strategy of future investments because when investing in human resources and the company's brand image, Joiditrans seeks to guarantee the viability of its position in the market, strengthening itself internally.

5.3. Business Audition and Analysis

All the analysis carried out on the road cargo transportation industry, and the analysis carried out internally at the company allowed us to understand the entire context existing in this market and how it is crucial to change habits in a company's entire operational activity. It would be essential to guarantee an approximate image of this reality so that it would be possible, based on the whole surrounding context, to understand what the company is doing correctly and what could be improved to optimize its activity to the maximum.

This car transportation company has shown itself to be the perfect example of a company that can become much more optimized by applying an operational efficiency model, as it has the knowledge, experience and status in the market to become an innovative company in this field. But before assessing the efficiency of the company's procedures in terms of efficiency, it is necessary to establish the most significant advantages to apply operational efficiency, which would reduce excessive energy consumption and consequent reduction of financial losses.

There must be a current notion of the Joiditrans fleet to understand how the application of an efficiency model can bring benefits in the short and long term for the company. For this purpose, an energy audit was carried out in partnership with the company's administration and with ANTRAM consultants, which describes a complete and in-depth overview of the company's fleet.

According to the Energy Consumption Management Regulation (ECMR), established in Decree-Law n°58/82 of 26 February, any road cargo transportation company with its fleet and with total annual fuel consumption equivalent of more than 500 tonnes of oil is required to have an energy report and a plan to rationalize fuel energy consumption, and this in-company project was the fundamental mainstream for the realization of the fleet fuel consumption analysis.

The performance of this energy audit and the plan to rationalize Joiditrans' vehicle fleet is an essential tool in reducing energy consumption, costs, and environmental impacts because with the conclusions of this joint work and the decisions taken by the company, this project had an fundamental role in terms to acquire a notion of the situation of the energy consumption of the fleet that is possible through the analysis of the fleet, made throughout this current project.

Although the company's fleet increased by 8% in 2020, the only data considered was the analysis of the previous year's fleet, that is, it focused on a set of 49 vehicles active in 2019, which already represents a good sample and a good picture of the general overview of fleet consumption.

Through the collection of descriptive elements and technical characteristics of the constituent vehicles, as well as the supply records and monthly distances traveled by the vehicles, it is possible to highlight the main factors that characterize and influence the management and operation of the fleet, and also establishing a comparison between the different vehicles. Data such as brand, model, power (hp), EURO index, total km traveled, and total liters supplied by each vehicle were used, and in relation to the primary energy indicators of the fleet, the reduction coefficients were considered as the ton of oil equivalent (toe) of the fuels, established in Art. 13 of the Regulation N°. 228/90 considering diesel 1,045 toe/t and considering that 1000 liters of diesel correspond to 0,835 tons.

It was considered according to the fleet's composition, that the specific energy consumption selected is the energy consumption in grams of oil equivalent per vehicle kilometer (goe/V-Km), also known and presented as liter/100km.

Table 5.6 - Diesel Reference Values

| |
|------------------------------|
| 1 toe = 1 000 000 goe |
| 1000L Diesel = 0,835 ton |
| 1 Ton Diesel = 1,045 toe/ton |

Source - Own elaboration

Joiditrans mainly presents 19ton truck-type vehicles, and when doing all the analysis and calculations associated with its consumption, it is possible to quantify three performance indicators, and these indicators generally allow a perception of the performance evolution both in terms of operational and energy terms.

Taking in consideration the conversion factors defined in the legislation established in Art. 13 of the Regulation N°. 228/90, it was used an average diesel density of 0,835 liters/ton and one ton of oil equivalent to 1,045 units of primary energy (toe). It was determined that the company during the year 2019 presented a very considerable utilization level of the vehicles (Km/Vehicle), that is on average, each vehicle throughout the year traveled 119,188 km and taking into account all the fuel supplies made by the vehicles of the company, it had a fuel consumption of 2,175,638 L, which reveals that the company's fleet has an average consumption of 37,3 L/100Km and represents 1,816,657 ton of oil.

These are very critical data to make a general analysis of the fleet's energy performance, in addition to which it was also determined that the company's fleet has an average power (HP) of 433,7hp, where 49% of the fleet represents vehicles with EURO6 environmental standards.

Table 5.7 - Fleet Performance Indicators

| Performance Indicators | |
|-------------------------------|---------|
| Level of Use (Km/Vehicle) | 119 188 |
| Average consumption (L/100Km) | 37,3 |
| Average Power (hp) | 433,7 |
| % of vehicles with Euro 6 | 49% |

Source - Own elaboration

The fleet uses diesel exclusively as fuel, and the table 5.8 shows for 2019 the systematic data of primary energy consumption (toe), the displacements per vehicle-kilometer (V-Km) of the vehicles that make up the fleet and the respective specific energy consumption (C). A consumption of 1,816,657 ton of oil represents 1898,41 toe, and V-Km represents the vehicle-kilometer made, that is, the sum of all kilometers traveled by all vehicles of a given category. The final value of the specific energy consumption (C) was obtained considering the energy consumed in goe, divided by the V-Km, which represents a variable easily measurable and describes the overall company' fuel consumption.

Table 5.8 - Consumption and Travel Analysis

| | |
|--------------|---------|
| Energy (toe) | 1898,41 |
| V-Km | 5840213 |
| C (goe/V-Km) | 325,06 |

Source - Own elaboration

5.4. Data Collection, Analysis and Treatment

5.4.1. Interview to the Management

To understand the company's organizational culture in the best possible way and how it applies its methods of analyzing and improving the performance of its drivers, it is necessary to collect as much information as possible, both quantitative and qualitative. In the case of Joiditrans, the company's management has always recognized the need to evolve internally all the employees, to offer its customers the best and most differentiated service proposal, which is one of the reasons for looking for a new performance analysis model to ensure the best possible profitability. To draw the correct and necessary conclusions from this study, it is necessary to understand how company management is positioned in this matter and how their respective drivers can apply correct and practical driving.

It was decided to interview the company's management so that it was possible to have the best approximation to the company's cultural reality, and the CEO of the company was interviewed to obtain the best and most qualified information possible.

The interview was built based on fundamental information for the analysis of the company's reality and the planning of the model to be applied to improve its efficiency. Thus, all the questions asked serve the purpose of covering different perspectives, from economical to operational, using a complete speech and a set of questions that help the CEO to answer the questions in a complete, concise, and objective way and with an appropriate language for the status and responsibility of the interviewee. All the answers given during this interview, were vital information for the whole process under development, as they not only demonstrate all the knowledge that the employer has about its employees but also how they monitor and guarantee their profitability and the consequent impact on the smooth operation of a road transportation company.

As shown in the Annex 2, Joiditrans management has invested in solving several efficiency issues to obtain competitive advantages for its activity. As defined in the efficiency model based on the literature review, the company also identifies several ways to achieve greater efficiency, such as purchasing of new vehicles, constant negotiation with suppliers and the change in driving behaviours by the drivers. Through this interview, it was also possible to understand how the company obtains their monitoring performance data, its policy and strategies concerning the acquisition of new vehicles and what impact this type of vehicles have on the driving and performance of the various drivers. For the company's management, it is necessary to find a change in the behaviour of drivers and also find adequate tools to make this change in their behaviour. The acquisition of new vehicles with the best technologies available on the market allows to ensure greater control over the driver's attitudes, which instinctively helps them improve their driving behaviours.

The CEO itself considers that drivers have some knowledge of acceptable eco-driving practices, but that it is not always easy to be able to apply in different models or even new cultures of this type of driving because many times due to the lack of drivers and overconfidence of themselves, it becomes challenging to be able to change driving behaviours and implement new standards in their daily activity. The best way for the company evaluate these behaviours it is through the analysis of performance KPI's, which the company apply two of them, the average fuel consumption and idle times and gets them with traditional tools in the average fuel consumption case, and with GPS technology support in the case of idle times.

In the case of GPS software, the company's CEO understands that the GPS data they obtain is quite viable because of the consistent and precise data transmitted to the operational managers, which has been verified as authentic throughout the daily activity experiences. Also, something that the interview also allowed us to understand very well was the position that the company's management has given in terms of technological innovations existing in the market, because for the company's CEO, it is inevitable to consider the potential that the new vehicles have. On the other hand, despite all

existing technology, in order to be possible to reduce the idle times for example, this type of factors is exclusively dependent on the driver's action. Although several brands in the heavy vehicle market offer different solutions, there are no perfect solutions to replace the drivers' specific actions. Despite the advantages that each brand may have, it is the company's strategy to have diversified investments by the different brands of heavy vehicles, in order to obtain the maximum advantages from each one and in a way that the company can always be competitive without being dependent on any supplier.

Also, the interview made it possible to acquire fundamental data for this study because it was possible to understand that 30% of the company's operating costs are derived from fuel consumption and that, from the perspective of the company's management, the way the driver uses his resource could have a significant impact on consumption in the order of 3%. In addition to this, all driving performance also impacts the premature wear of components, making it possible to impact 2% on company costs directly. With a direct impact of 5%, driving performance is seen at Joiditrans as something essential for the business' viability and profitability because to have an idea, if the company has revenues of around 10,000,000€, the impact of driving performance can cause losses of 500,000€.

It is also important to note that Joiditrans managers aim to optimize its fleet to the point that allows it to have an overall average fuel consumption of 32 L/100km, which represents a massive change in all driver behaviours and for that, the managers believe that evaluate the drivers into seven categories of performance would bring a clear picture of the difference of performance between drivers and result in an optimization of the business operation.

This entire interview was essential to understand the whole vision and strategy used by the company's management in terms of optimizing its activity and improving its operations. A road transportation company like Joiditrans, needs to have well-defined plans in relation to this topic and that is why it is essential that the plans outlined for business efficiency are aligned with the company's entire management strategy.

5.4.2. Surveys to the Drivers

In this study, it is essential to ensure that the drivers have the necessary knowledge to apply efficient and responsible driving. For this reason, it was also necessary to develop a survey that demonstrates all the knowledge of the majority of drivers, and that allows having a viable base of information on the concepts of eco-driving. Also, taking into account several categories of performance evaluation, the survey to the drivers was developed based on these same categories to understand how each category of performance evaluation is aligned with the theoretical and practical knowledge of the various drivers. The survey was applied to 80% of the drivers of the company because due to the ease of contact with them and the fact that it is a relatively small and accessible sample, it was essential to ensure that it would be possible to obtain the most viable and most real information possible.

To achieve the best viability of the information obtained in these surveys, it was necessary to test the questions so that they were easy to understand, with simple language and a short survey so that employees could correctly understand the message and the objective of each question, responding most simply and truthfully possible. For this reason, pre-tests were carried out previously with four company volunteers, who are not part of the sample and allowed defining the survey in the best possible way for the study's proper sample, that is, the company's drivers.

In the case of some questions of a more detailed and technical nature, it is sought to ensure what level of knowledge they have and how through a comparison between their answers and the telemetry data, it will be possible to find a better understanding of all the dynamics experienced in the company, as this leaves several wastes due to the lack of knowledge and monitoring and how it can improve its analytical metrics. All the surveys' results are represented in Annex C the tables below, in which the left-one represents the number of answers of each choice, and the right one represents the percentage of answers based on the total sample.

Table 5.9 – Drivers' Survey Results

| | A | B | C | D | | A | B | C | D |
|----|----|----|----|----|----|-----|-----|-----|-----|
| 1 | 27 | 11 | 2 | 0 | 1 | 67% | 28% | 5% | 0% |
| 2 | 21 | 12 | 6 | 1 | 2 | 52% | 30% | 15% | 3% |
| 3 | 0 | 35 | 0 | 5 | 3 | 0% | 87% | 0% | 13% |
| 4 | 3 | 37 | 0 | 0 | 4 | 8% | 92% | 0% | 0% |
| 5 | 21 | 5 | 8 | 6 | 5 | 52% | 13% | 20% | 15% |
| 6 | 0 | 0 | 29 | 11 | 6 | 0% | 0% | 72% | 28% |
| 7 | 31 | 6 | 0 | 3 | 7 | 77% | 15% | 0% | 8% |
| 8 | 3 | 11 | 26 | 0 | 8 | 8% | 28% | 64% | 0% |
| 9 | 26 | 2 | 0 | 12 | 9 | 65% | 5% | 0% | 30% |
| 10 | 3 | 37 | 0 | 0 | 10 | 8% | 92% | 0% | 0% |
| 11 | 2 | 19 | 4 | 15 | 11 | 5% | 47% | 10% | 38% |
| 12 | 35 | 0 | 5 | 0 | 12 | 87% | 0% | 13% | 0% |
| 13 | 13 | 5 | 11 | 11 | 13 | 32% | 13% | 28% | 27% |
| 14 | 2 | 5 | 6 | 27 | 14 | 5% | 13% | 15% | 67% |

Source - Own elaboration

In the tables above, the situations in which more than half of the sample answered in the same way in each particular question are represented in gray, which will be assumed to be more likely to be the general knowledge and culture that each driver has about a particular issue. Examples of this general culture in the knowledge of the drivers it is the question number 1, where 27 of the drivers, which represents 67% of the total sample, believes that eco-driving it is the most efficient driving possible according to the route to be performed, which is correct.

Looking at the answers to question number 2, and understanding that a given driver answers any of the wrong answers and that through telemetry we understand that he has an abnormal amount of sudden braking, then we can determine that the driver travels very close to the vehicles in front, which forces him to sudden brakes, wasted resources and an alarming decrease in road safety. However, in the case of question number 3, there is an enormous knowledge of the drivers for the correct use of the engine speed, since 35 drivers who represent 87% of the sample, affirmed that the green zone of the

speeds represents the lowest possible consumption which ends up bringing more significant benefits to the resource's profitability.

In most of the questions presented to the drivers during the survey, there was always an issue in which more than half of the sample covered, and in the case of question 4, it was also no exception. With this question, it was possible to understand that all the majority of drivers have a general knowledge of what the correct procedure is like when being exceeded because 92% of the sample correctly stated that the correct attitude to be taken in this situation is to maintain the safety distance reducing speed if necessary.

In the case of question 5, the answers have already shown to have a more dispersed profile because, 52% correctly stated the pressure indicated for the tires of heavy vehicles, but the rest of the sample, they dispersed his answers among the other options, which demonstrates a significant lack of knowledge of several drivers. The answers that were given to question number 6 were divided into only two options, which allowed automatically to know that all drivers who answered the survey are aware that a vehicle that is in neutral continues to consume fuel. In this question, the answers are divided between two similar options, where most drivers responded to a more technical and intuitive option. During a trip made by a heavy vehicle, drivers go through several situations along the entire route, such as steep climbs and descents.

With the answers to question number 7, it was possible to observe that 77% of the sample considers that the correct procedure to be taken when a heavy vehicle approaches a steep descent is to take your foot off the accelerator so that the vehicle takes advantage of the inertia without creating any accentuated wear on the tires and braking systems. A curious fact obtained in the answers to this question was that 15% of the sample stated that in this situation, the correct attitude is to maintain a constant speed to take advantage of the balance of that same descent. In terms of the actions to be taken by a driver when taking a route with a high rate of loads and discharges, the answers obtained by question number 8 in annex 3 demonstrate that drivers have a general knowledge of the actions they must take to reduce the fuel consumption in these situations. 64% of the sample confirmed that the best strategy to reduce consumption on these routes is to reduce the maximum of the idle times. The remaining drivers considered maintaining the correct tire pressure and driving at the speed limits are more correct strategies.

Question number 9, is a complete question exclusive to drivers' general knowledge on the best possible use of the gearbox. Although today, trucks with automatic gearbox technology already manage the engine speed optimally, it is always up to the driver to control that management or be the one to change the changes the correct way possible. With the data obtained in the answers to this question, it was possible to understand that only 5% of the sample answered this question correctly because although on the climbs it is logical to change changes in the maximum rotations of the green zone, in the case of the descents, the correct procedure is to guarantee that inertia alone increases the engine speed just by changing it upwards when they reach about 80% of the green zone. It is a

widespread thought that, you can change gears with low revs on descents, but this only causes little vehicle safety, but it also ends up eventually causing kick-downs.

The answers obtained to question number 10 demonstrated that drivers have a general and correct knowledge about the overtaking procedure, and this is because 92% of the sample correctly considered that the correct way to overtake is through good visibility and a reasonable distance from the vehicle in front, so that the truck can gain balance and make overtaking as quickly as possible.

Although question number 10 had very similar answers, the same does not happen in question number 11 because when asked about the relationship between the use of the retarder and inertia, this generated several different responses. Although almost 47% of the sample considered that fair use of the retarder does not mean that the driver does not have to take advantage of the vehicle's inertia, for 38% of the sample they consider that the use of the retarder should only be done in times of greatest need, always taking advantage of the strength of inertia. Although the thought of this 38% of the sample is not entirely wrong, it does not mean that the retarder can only be used in times of greatest need. The use of this mechanism to be carried out regularly and overcome the use of the vehicle's inertia. This general knowledge of the retarder's functionality is supported by the answers given in question number 12, where 87% of drivers considered that the retarder guarantees better braking safety without excessive fuel waste or the premature wear of the braking systems.

The last two questions in the survey, question number 13 and number 14, were questions where in the options there several situations in an orderly manner were so that it was possible to understand what the drivers' thoughts were on specific subjects. In the case of question number 13, when asked about the most efficient driving factors, the answers were quite dispersed, where 32% of the sample considered a particular order, 28% considered another, and 27% considered another, which demonstrates the general lack of knowledge about which the most important and least crucial efficient driving factors. On the other hand, in question number 14 of annex 3, there was already a greater coherence of answers about which are the most dangerous factors for road accidents, where 67% of the sample considered these same factors in the same order.

As shown in Annex C, the survey was applied to a sample of 40 drivers, who were the total drivers who were active, and the annex shows all the responses given by the drivers to the questions. Analyzing the survey, in the total of 14 questions asked to employees, 12 questions had more than 50% of answers in one of the options, which demonstrates a general understanding of certain notions of driving, such as the safe way to overtake where 91% of respondents answered correctly about this driving action. On the other hand, there were two questions, where the answers were dispersed, and this shows that the different drivers have different understandings on the respective topics, and in which the company needs to apply strategies to train their drivers into the right mindset, as well as correcting the drivers' thoughts that not correspond to optimization and efficiency of the operational performance.

6. Research Findings and Recommendations

6.1. Definition of Results

All the analysis carried out throughout this study, from the literature review to the company's intrinsic analysis, allowed to obtain different knowledge and conclusions, but without a doubt, the need for greater efficiency of driving by truck drivers.

The analysis of data that was made to Joiditrans allowed to realize that the company can manage to improve its results enormously if a monitoring and classification model is applied that allows to understand at the exact moment how the impact of each driver's performance implies a high expense cost and a consequent decrease in business profitability. It is necessary to define the frequency, magnitude, and weight that drivers' actions imply for the company.

With the company's external and internal analysis, it was possible to understand the reality of a business that, for many, is unknown and to what extent it is possible to change the efficiency of a business, where that is totally in the hands of drivers. With the current situation in the road cargo transportation sector, it is possible to understand that many companies seek to obtain different competitive advantages, which is fundamental for their survival.

By carrying out market analysis and internal analysis of the company's reality, we can conclude that the company has made correct decisions in the market because the study that was carried out revealed that the road transportation industry is extremely competitive and that constant establishing of new competitors creates a decrease in the profit margins of companies already established in this type of business. However, in the case of Joiditrans, this company has been competing in this market for more than 20 years, managing to establish its reputation and its marketshare, becoming a player in the European road transportation sector.

This demonstrates the company's current position in the market, but this does not mean that the market does not adjust, and the company could lose the competitiveness that it has today. Therefore, it is necessary to ensure constant improvement to be more efficient than its competitors and have more competitive advantages than them. One of the ways of measuring the road transportation company wastes, is finding ways to measure the most important resource for this type of business which and this case it is the fuel consumption and by assessing the energy consumption of its resources, it is something that company has to continually analyze and find ways to reduce it. Since this is a factor that can represents 30% of the total operating costs, this study carried out on the company's general consumption also made it possible to understand, based on these results, which objectives the company seeks to achieve and how important it is to have prior knowledge of all variables inherent in driving performance. When assessing its energy reality, the company's strategy ensures that the company has a real image of its activities and allows the establishment of energy reduction objectives through different strategies. In this case, new practices for driving and monitoring telemetry data will continually reduce its energy consumption.

Despite this energy analysis, it was necessary to have a closer approach to the business's reality, which ended up justifying the interview with the company's management and the survey to the various drivers of the company. The results of this interview and the survey were very enlightening, as there was explained in the previous chapter. It was clear that it is a significant need on the part of management to be able to optimize their business. There is still a considerable lack of knowledge among drivers about the correct way to drive and proceed in the most diverse situations.

The interview with the company's management played a crucial role in describing the vision and strategy of the company's leaders regarding the need to optimize the fleet through performance efficiency. It was through this interview that it was possible to understand that the company has several positive points regarding the topic of driving efficiency. For example, the company's management strongly supports and believes in improving business results, through a change in the behaviour of its employees, as with a 5% impact on operating costs, and it is clear that there is a need for improvement. The company's management has real data that represent the immediate needs of the company, as defining the goal of reducing average fuel consumption to 32 L/100km, or understanding that there are 5% of operating costs that can be reduced by its drivers, so this demonstrates how well-defined goals exist within the company.

Table 6.1 – Joiditrans' Operations Goals

| |
|--|
| Reduce Average Fuel Consumption to 32 L/100Km |
| Reduce Driver impact on Fuel Consumption by up to 3% |
| Reduce Premature Wear of Components Costs by up to 2% |
| Reduce Total Excessive Operating Costs by up to 5% |

Source - Own elaboration

On the other hand, the surveys carried out on 80% of the company's drivers demonstrate well the general knowledge that these employees have of the correct practices of eco-driving, and through these, it is possible to reach conclusions on which are the correct measures to be taken. Although there are some more confusing topics for drivers, where in a group of employees, the answers were quite dispersed, there are other questions where practically everyone has the same general knowledge of a given topic. Questions related to the correct tire pressure, the correct use of the gearbox, the correct use of the idle times, primarily factors of driving efficiency or other topics that require more technical knowledge, are issues that have shown to have more dispersed answers and the company must invest in training and measures that to guarantee this knowledge to drivers. On the other hand, topics such as procedures when overtaken, procedures to be overcome, ways of using the retarder and other topics related to the daily driving activity, guaranteed responses that were closer to each other.

Currently, Joiditrans does not apply a long range of monitoring driving performance of its drivers, allowing it to rely on the quality and training of its employees and investing in eco-driving training, but the big problem that arises here is the fact that the company's management uses very few ways to monitor its drivers, evaluating only fuel consumption and idle times, and this automatically proves to be short for the needs of the company as there are many more factors that need to be evaluated and that need to be implemented in the analysis and general assessment made to the various drivers.

In this way, it was possible to reach several conclusions because, despite the evident need for efficiency in the road cargo transportation companies, there is still an enormous need for financial results but also the safety of drivers as this is always a crucial consideration for fleets and is a central aspect of your primary duty to look after employees while they are at work, so it is essential to closely monitor the driver's behaviour. It is also an important indicator concerning general road safety standards that telemetry provides managers with information about the driving profile. This information provides a useful tool for discussing performance with drivers and facilitates the development of personalized training programs.

With all this analysis, it was possible to understand that fuel is one of the three most significant expenses for transportation companies and improving fuel economy is a matter of cost reduction and environmental impact. Metrics such as litres at 100km, engine run times and unauthorized or unplanned mileage are essential for monitoring fuel consumption and efficiency, but its end up become short based only on these metrics. It is likely that the fleets are in a much stronger position to be more efficient, and that their vehicle immobilization implies constraints for the operation and must be measured and monitored. A road transportation company needs to know how productive it is, and for the current market, it is not enough to do several services and several routes without thinking about the way each one is executed. In the case of Joiditrans and all other companies in the same sector, fleet productivity can be measured using a series of metrics, such as litres/100km, average fuel consumption and idle times, but these metrics can only make it easier for traffic managers to identify patterns, which not necessarily represents a total driving performance analysis.

Table 6.2 – Joiditrans' Current Driver Performance Factors

| | |
|--|--------------------------|
| <i>Current Driving Performance Factors</i> | Litres/100Km |
| | Average Fuel Consumption |
| | Relanti Times |

Source - Own elaboration

It is indispensable to reduce the risk of downtime, which is a significant threat to fleets and can cause severe disruptions and delays, with all that this implies for customer service. Fleets must monitor preventive maintenance compliance, monitoring the number of unplanned maintenance events, to ensure that essential fleet preventive maintenance tasks are performed when they should.

Besides, it is necessary that this company apply a complete model of performance analysis that allows sustainably reducing its waste and for that it is necessary to have a set of variables that, are measurable and that describe the entire driving profile of each driver and that this represents the differences between the profitability of the various drivers.

The following table shows a summary of several fundamental factors for the analysis of driving, and that through the literature review, the analysis of the company and the existing culture in the management and drivers of the company, it will undoubtedly be able to represent the various desirable profiles.

In the act of driving, there are several variables and different situations that do not allow easy measurement, but it is through telemetry technology that companies can obtain this information. For example, the technology that currently exists in terms of telemetry, allows you to acquire data regarding the time of the journey, the distances in the journey, the types of journey, the practised speeds, the engine speeds used, the accelerations, braking and the vehicle consumption for specific routes. These can be considered categories where in each of them it is possible to integrate several variables and as such it is only necessary to identify which physical, technical or behavioural variables are possible to acquire through GPS and telemetry technology and the variables that are of interest to the management of the company to make a complete assessment of the driver profile.

The following table shows a set of driving factors, which are simple to acquire using telemetry technology and which can represent any driving behaviour and profile. These factors do not mean that others of greater interest to the company cannot be added or others that a specific telemetry platform manages to acquire viably.

Table 6.3 – Driver Performance Factors

| | |
|------------------------|---|
| <i>Travel Time</i> | Time w/ Engine On Driving Time Relanti Time PTO Time |
| <i>Route Distances</i> | Distance on Cruise Control (Km) Distance on Eco-roll Distance on ECO Mode |
| <i>Route Type</i> | Climbing Distance (%) Descending Distance (%) Average Slope of the Route Transported Weight on Route |
| <i>Speed</i> | Average Speed Speed Levels |
| <i>RPM</i> | Green Band Kickdown |
| <i>Acceleration</i> | Sudden Accelerations Coast Accelerations Accelerator Pedal Position |
| <i>Braking</i> | Sudden Brakes Brake Pedal Position Braking Total Distance Retarder Average Utilization |
| <i>Fuel</i> | Driving Consumption Relanti Consumption PTO Consumption |

Source - Own elaboration

7. Research Summary and Improvements

7.1. Efficiency Performance Model

In order for results to be consistent and for there to be greater control over the discrepancies that arise throughout the performance analysis process, it is necessary to make several assumptions.

For example, as this proposed model seeks to prove the impact that the driver has on the performance of a vehicle along its route, it is essential to assume that all drivers have identical transportation vehicles and that the metrics that are defined in this study are based only on their performance, and that different brands do not have different results. Another assumption that needs to be understood when analyzing driver's performance, is the lack of mechanical defects in the vehicles presented, so that the results obtained are as close to reality as possible and where there is no data analysis error associated with it. It is also necessary to assume that the model that will be presented is based on the collection of potential data on the same route and where both have the same transportation load so that there is a greater comparative capacity among the drivers that were analyzed.

Finally, it is necessary to assume that Joiditrans has a GPS where it offers a geolocation capability that allows the company to know where its vehicles are positioned but also that it offers the possibility and the ability to provide Joiditrans with exact telemetry data, where the information error is as little as possible and where it ensures that there is a stable data flow that allows parameterization and in-depth analysis of the acquired data. The efficiency and performance of a resource such as a transportation vehicle are directly related to its technology, but also how its operator uses this resource.

Eco-driving or preventive driving is essential to ensure a high level of service quality, good material preservation and exceptionally high safety for the driver himself. Many drivers have no technical knowledge of driving, knowledge of the technology present in the vehicles or even knowledge of the operation of the engines, which often leads them to follow myths and assumptions that generate errors, dangers and waste. High training and constant training in this knowledge mean that drivers can understand their performance deficiencies, allowing them to improve and guarantee better results for the company. However, the big question that arises here concerns the fact that how road transportation companies manage to monitor and ensure that drivers have effectively acquired the knowledge necessary to improve their driving and will continue to be maintained over time this efficient driving, generating results and competitive advantages for the company.

Although the market for heavy vehicles and road cargo transportation has several technologies inherent to this type of service, the only viable and capable way to guarantee performance control is through telemetry technology. As already mentioned throughout this study, telemetry is the way companies collect, store and analyze fleet data from GPS platforms and allows them to make informed and informed decisions that can effectively improve productivity while reducing their costs. Currently,

the most critical aspect of telemetry is obtaining practical information on how drivers operate their vehicles.

A significant challenge that many companies face is the ability to obtain this information is related to the fact that several platforms on the market guarantee geolocation, which can triangulate the vehicle’s position, tracking its routes and its current position, but today it is insufficient to meet the challenges that exist in the road cargo transportation sector. In order to be able to respond to the need for greater control over drivers’ behaviour and performance, more advanced systems are needed, that is, telemetry systems that can guarantee companies not only the location of their vehicles but also manage to acquire vital information about the routes and the way they were carried out. The investment in a useful GPS and telemetry platform is essential to ensure and maintain positive results. Also, when the fleets of a road transportation company are mono-branded and have a telemetry system, their analysis and monitoring become much more straightforward, however, the level of customization is shallow, and when the fleets are multibrand, and each has its telemetry system, analysis and monitoring is virtually impossible and requires advanced middleware.

Furthermore, it is necessary to have a definition of the number of classification categories and how each one is divided and covers because in the case of Joiditrans it was defined, based on the interview with the company’s management, that the classification system would be defined in 7 levels so that it was a better understanding and greater scrutiny in data analysis is possible and also so that this classification method would be in agreement with other classification systems already applied in the company’s organizational culture. It is in these decisions and these details that each transportation company needs to define its internal standards.

Driver ratings should be made according to levels of performance and quality and according to the perspectives of the company’s management and in this case, the drivers’ assessment will be carried out according to a 7-level scale, which causes a more significant discrepancy in terms the amplitude of each level and where each level will correspond to a classification letter as shown in the following table:

Table 7.1 - Driving Performance Classification Grid

| | | | | | | |
|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|

Source - Own elaboration

When the objective is to introduce a concept of efficiency and a panorama of performance within the daily activity of a company, it is necessary to have technical knowledge of the various factors that influence the analysis of the paths taken by the vehicles, and that can serve to apply improvement measures and training in order to find the most outstanding efficiency possible. But before it is possible to create variations and interconnections between factors that describe the profile of each driver, it is necessary to have a prior analysis of the different factors that constitute this analysis, as

shown in table 6.3, so that all adjacent variables when driving a heavy vehicle, they are organized into categories, such as Travel Time, Travel Distances, Type of Travel, Speed, RPMs, Accelerations, Braking and Fuel Consumed.

During this study, it has already been mentioned some of the difficulties and unpredictability to which the driving of heavy vehicles is subjected and therefore it is necessary to have a categorization of the factors in order to make the analysis and evaluation of each one more manageable.

When analyzing and monitoring individually and methodically the data of each performance factor that constitutes each of the categories mentioned in table 6.3, it is necessary to have a weighting for each one in the sense that it is necessary to understand which factors and which categories most important for the best use of the resource. So it will be possible to calculate and define the classification of each category based on the different factors that constitute these categories and which will be fundamental to distinguish the individual performances of each driver.

After making an average of the ratings that assign a rating per route, an average of the ratings made based on the previously decided weights and which will be averaged with the individual rating of each driver concerning energy consumption is then generated. The following diagram shows an example of how each performance category will be weighted and analyzed in order to obtain a global rating for each driver.

Table 7.2 - Weightings of driving analysis categories

| Travel Time | Route Distances | Route Type | Speed | RPM | Acceleration | Braking |
|-------------|-----------------|------------|-------|-----|--------------|---------|
| 20% | 15% | 15% | 10% | 20% | 10% | 10% |


Source - Own elaboration

Unlike many other traditional businesses, a road cargo transportation business allows access, through GPS and telemetry systems, to produce data that, under strategies and models like this, allows you to understand the productivity and profitability of each employee, in order to be able to manage human resources throughout the company better. Managing driver behaviour is essential to reduce costs and have a positive impact on results, as it is possible to add tangible value by improving driver safety, reducing costs and minimizing risk exposure. Driver safety should be the top priority, regardless of the size or type of fleet, and it is through driver classification that can help with productivity, safety, efficiency and compliance. Fleet/traffic and safety managers can and should use driver ratings to identify risky behaviours and determine which drivers need special monitoring or additional training, as this driver rating should also be used to identify the best drivers of the fleet so that they can also be rewarded by making a driver with high safety parameters an efficient driver.

Driver classification generally uses a complex algorithm, taking into account many factors and data flows, transforming these results into a real-time score, assigned to each driver that includes the driver's behaviour to provide a clearer picture of the profile risk. With a unique driver rating, fleet and

transport managers can quickly identify each person's risk level. Also, individual classifications are combined to assign an overall fleet risk rating in real-time, giving the ability to effectively measure and monitor driver risk as a KPI, since as "risk" can be entirely subjective, the scoring can and should be adapted to each organization to best suit its risk perception. Throughout the entire analysis of the study, there must be a classification as are shown in table 7.3, that encompasses the most diverse factors and that allows this classification to be a deciding factor for the management and the human resources department of a company like Joiditrans.

Table 7.3 – Driving Performance Classification

| Driving Performance Classification | | | |
|------------------------------------|--|---------------|--|
| Performance Category | Driving Assessment Factors | Preponderance | General Driver Performance Rating |
| <i>Travel Time</i> | Engine Time Driving Time Relanti Time PTO Time | 20% |  |
| <i>Route Distances</i> | Distance in Cruise Control (Km) Distance in Eco-roll Distance in Eco mode | 15% | |
| <i>Course Type</i> | Uphill Distance (%) Downhill Distance (%) Average Slope of Course Weight Carried on the Route | 15% | |
| <i>Speed</i> | Average Speed Speed Levels | 10% | |
| <i>RPM</i> | Green Band Kickdown | 20% | |
| <i>Acceleration</i> | Abrupt accelerations Coast acceleration Position of the accelerator pedal | 10% | |
| <i>Braking</i> | Hard Braking Brake Pedal Position Total Braking Distance. Average Retarder Utilization | 10% | |

Source - Own elaboration

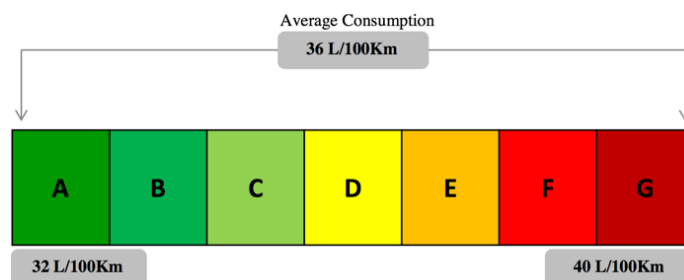
In recent years, telemetry technology and advanced data analysis have changed the way companies approach to fleet and traffic management. With the increased transparency that telemetry provides, there is a complete need for real-time knowledge of fleet performance. The potential for managing a connected fleet is essential.

Every day, a fleet generates millions of data points, and with all the information it is easy to understand how even veteran professionals can feel overwhelmed when trying to process this volume of data at the speed at which it is generated. The big challenge arises when merely processing the data is not enough, as technical knowledge and wisdom are also needed. That is why it is essential that the configuration of the relevant information for each of the hierarchical levels in the organization and it is also essential that the people who deal with these systems daily have to generate relevant information for continuous improvement, to achieve objectives and efficiency.

It is also through control and monitoring in terms of the performance of all drivers that it is possible over time to design performance patterns, habits and panoramas where it enables the company to identify them and ensure that it makes the best decisions so that there is continuous training of its employees because there is a set of panoramas detected through the analysis and monitoring of telemetry data that defines a driver profile and where possible classifications that determine the performance of a given driver are represented.

How this model is conceived, covers a whole set of situations that occur daily in the activity of drivers and that makes it possible, through data analysis, to better understand the driving process of each employee, allowing the company to make decisions regarding training, in order to constantly improve all company resources. In doing so, the company can define a fundamental strategic plan that combines not only the weight that each driver's action has on the company's results but also combines the frequency with which each employee takes these behaviours and with what magnitude or impact they have in all the system inherent in driving. It is in this line of thought that companies have been able to achieve most significant competitive advantages over their competitors. Speaking now of competitive advantages, it is important to define for the implementation of the study the averages that correspond to each level of evaluation and that are considered fundamental for the systematic analysis of the data and the performance of each driver. The following table demonstrates a simple example, where through the definition of an acceptable average/key, it will be possible to correlate the various levels of evaluation to acceptable consumption within a defined standard deviation.

Table 7.4 - Average Grading for Fuel Consumption



Source - Own elaboration

This is the part of the classification of the consumption of each employee that will later be related and weighted with the classification already defined through the analysis of his performance, and that will thus trace not only the driver's driving profile but also the profitability that it entails for the company. The best way for a company to understand in reality which employees bring more value to it and those who do not is through a classification method because, in order that a company can reward those who contribute most to the value or to punish those who bring losses to the company, there must be a fair classification system that effectively demonstrates the strengths of each one and how it is possible to guarantee a better overall result. The fact that the energy consumption component is addressed individually, and its weighting is added after the analysis of all other categories is because

this component is the component that has the most impact on the results and profitability of the company fleet.

The importance of energy consumption data led to its analysis being made later and added to the driver's profile also a posteriori, because despite all the control that a company seeks to acquire in the other categories it is essential to understand that energy consumption is directly related with the driver's performance and this leads to a more straightforward and more effective analysis to assess and monitor the individual performances of each driver with each truck. The other reason why this component is essential to be analyzed and added to the general classification of the driver is that energy consumption is also directly related to pollutant gas emissions, and when doing a performance analysis in which it can understand what behaviours lead to specific consumption, then it is simple to understand how these consumption influence the polluting capacity of a given vehicle.

The impact that each driver has on the estimated costs of each vehicle is quite significant because studies suggest that a large portion of the total costs of the vehicles derive exclusively from the behaviour and driving mode of each one, which may influence consumption, premature wear, claims and fines management, vehicle immobilization, reconditioning and depreciation. Also, companies must find fundamental ways to define their travel costs, driver profiles and the identification of errors, malfunctions and warnings in their process, which together will be fundamental for the creation of a new model of efficiency within road transportation companies.

Based on the defined weights that suit the reality of the company, it is possible to structure a logic of thought concerning each category underlying the performance of each driver, and after the weightings defined in the performance of each driver, these served to guarantee a proper classification in terms of the performance that is made by each driver, which will then be evaluated together with another critical component of the performance analysis which is fuel consumption. In the case of consumption, this category will have an impact of 60% on the final classification, thus joining the 40% that make up the set of all other categories defined above. The table 7.5 briefly demonstrates how the classification method applies in these cases and how the seven defined classification levels are established.

Table 7.5 - General Evaluation of Driving Performance

| Driving Performance Classification | | | | | | |
|------------------------------------|---|---|------------------------|---|---|---|
| General Driver Performance Rating | | | Truck Fuel Consumption | | | |
| 40% | | | 60% | | | |
| A | B | C | D | E | F | G |

Source - Own elaboration

Driving is an activity that requires extreme attention and perspicacity in the control and handling of a heavy vehicle that carries equally bulky and valuable goods that requires the driver to be primarily responsible for them, but also their safety. In addition to all the economic issues that concern the company, it is responsible for training and raising awareness of road safety for all its employees. The driving of heavy vehicles, when demanding a cognitive capacity and great attention, requires that there is a safety posture on the part of the drivers because the road risk decreases in proportion to the increase in attention, performance and control that the driver has in his car. Reducing driver risk has more benefits than just saving money, it helps to protect other colleagues and to protect the public. Prioritizing and mitigating driver risk reinforces the organization's commitment to a safety culture.

The secret to the successful application of a performance evaluation model for drivers of a road cargo transportation company is the continuous improvement of their drivers' activity through the control of their actions and behaviours. However, a company that can control and monitor the performance of its employees and the efficiency of its resources needs to ensure that all employees have the proper training and learning concerning acceptable driving practices and ecological performance. For this, it is necessary to have specific training plans for all types of employees that the company has, from those with a worse performance or a better performance.

In training activities designed for this type of concept, it is necessary to identify the level of performance of each driver because for drivers who have a knowledge and a profound application of eco-driving concepts, they may only need a slight training action, where others they may need face-to-face monitoring in order to improve their performance. This is how a company must position itself to be able to balance the performance of its employees, improving its offer of value to the market.

7.2. Implementation Plan

In order for the company to implement this new model and these new concepts of efficiency in the daily procedures and activities of the company, there must be an implementation plan on this new model so that the company knows what steps to take along of this new implementation. This efficiency model is based on the assumption that the company will continuously monitor the activity of drivers and control the performance KPIs of the various vehicles.

Despite this, it is necessary to be able to define objectives for reducing operational costs and consequently increasing operational efficiency, which means that this implementation plan has a definition of only a period, which does not mean that there is no continuity in the application of this efficiency model.

The table 7.6, represents an organizational plan for three years in order to understand what tasks will have to be performed during the period of implementation of this new performance paradigm in the company. Grey marks represent the actions during the respective quarter of the respective year.

Table 7.6 – Implementation Plan of Efficiency Model

| Tasks | 1Q/20 | 2Q/20 | 3Q/20 | 4Q/20 | 1Q/21 | 2Q/21 | 3Q/21 | 4Q/21 | 1Q/22 | 2Q/22 | 3Q/22 | 4Q/22 | 1Q/23 | 2Q/23 | 3Q/23 | 4Q/23 |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Implementation Planning | | | | | | | | | | | | | | | | |
| Organization Diagnostic | | | | | | | | | | | | | | | | |
| Meetings with Managers | | | | | | | | | | | | | | | | |
| Driving Factors Preponderances | | | | | | | | | | | | | | | | |
| Goals Establishments | | | | | | | | | | | | | | | | |
| Performance Tracking (Phase I) | | | | | | | | | | | | | | | | |
| Drivers Training | | | | | | | | | | | | | | | | |
| Performance Tracking (Phase II) | | | | | | | | | | | | | | | | |
| Results | | | | | | | | | | | | | | | | |
| Performance Data Evaluation | | | | | | | | | | | | | | | | |
| Conclusions | | | | | | | | | | | | | | | | |

Source: Own elaboration

Although this implementation plan is planning that will not be included in this project, this does not mean that there is no planning for the entire implementation of this model and how the company can change its procedures according to the reality of it and in a way that there may be a definite objective for a future period.

This implementation plan represents only the need that the company has to implement this type of project and part of the assumption that controls someone outside the company to apply this project or appoint someone internally as responsible for the implementation of this model. Thus, the responsible person must continuously carry out a diagnosis of the organization, so that the application of this project makes perfect sense within the company and that it is something innovative throughout the time.

Likewise, it will be necessary to hold regular meetings with management so that they know the results obtained throughout the respective year and so that there may be, together with management, the decision to maintain or change the preponderance of factors driving performance classification and setting new goals for the following year. In the implementation planning can be defined the GPS and telemetry software to use, the driving performance indicators to be analyzed and the drivers that will be parametrized during this implementation period. After that, it will be necessary to start tracking the performance of these drivers, and this sector can be separated into two phases.

The first phase can be the one which will take about a month and is where we can get the first data from the truck sensors and will be able to understand which are the most dramatic parameters and the ones that the company can improve and invest in training of the drivers.

Between these two phases of performance data collected by the telemetry software, the company must train its drivers in eco-driving and behaviour change behind the wheel and the second phase can start when the drivers become more self-conscious about their performance and start to invest in eco-driving techniques which will provide us different results from the first investigation approach.

This constant monitoring of indicators and the performance assessment of the various drivers will generate a new economic culture in daily operations, which will ultimately guarantee results in the medium and long term.

Thus, after collecting new efficiency data, it will be necessary to evaluate the performance of each driver, and as such, it influences the improvement of the overall results of the business. It can be this data that will have to be presented to the company's management so that decisions can be made regarding the following years and the feasibility of an efficiency project like this.

7.3. Monitorization of KPI's

The best way to achieve a high return on investment in telemetry is through continuous monitoring and constant control overall KPIs. Just collecting and analyzing data is not enough, it is about determining the baselines, starting points, defining objectives, choosing the tools and acting based on the results. Before starting to evaluate the financial results, it is necessary to identify the company's objectives by establishing what is expected to be achieved and thereby defining how the company has to organize itself so that it can maintain high results through telemetry.

Modern telemetry solutions provide details on fleet performance, a large amount of data you can gain from insights to optimize everything from driver safety to routes to customer service. Furthermore, the same data that facilitates fleet management can be used to justify the investment and obtain positive returns, year after year, in a sustainable manner.

When it comes to guaranteeing continuity in KPIs, it is necessary to define levels of results, for example, in 2019, Joiditrans covered about 5,850,000 km and consumed about 2,100,000 litres of fuel. When defining goals that must be established over time, it is necessary to define according to consumption in the years following the application of an efficiency model like the one presented in the project. The year of 2019 is the year on which the final calculation of the goals for reducing energy consumption will fall. To this end, the degradation of the fleet into categories and the establishment of global and partial goals can be based on the following formula:

$$M = \frac{(C - K) \times \left(\frac{N}{3}\right)}{2} \quad (1)$$

In this previous formula, M represents the reduction in consumption to be obtained by the end of year N of application, C is consumption in the last year, and K is a reference consumption, a value to be determined by the stakeholders, with a lower limit of 90% of the C value at the table 5.8 for the energy equivalences of the Joiditrans fleet in 2019 are summarized.

Based on energy consumptions and the data of kilometres travelled by each set of vehicles (V-Km), it is possible to calculate consumption for the totality in the reference year. Applying a value of

K=0,90, the goals defined in the table 7.7 are obtained, regarding the base year of 2019, projected for the years 2021, 2022 and 2023.

Joiditrans has an awareness and improvement policy for energy efficiency in the transportation fleet. Among the measures that the company regularly carries out for energy efficiency is eco-driving and periodic fleet renewal. Following the effort that the company has been making to improve the energy performance of its fleet and despite the factors mentioned above, opportunities for improving consumption were identified for the next three years.

Table 7.7 - Fuel Consumption Targets

| Goals | goe/V-Km | toe |
|------------------|----------|---------|
| C (goe/V-Km) | 325,06 | 1898,41 |
| C (goe/V-Km)2021 | 319,64 | 1865,29 |
| C (goe/V-Km)2022 | 314,22 | 1832,18 |
| C (goe/V-Km)2023 | 308,80 | 1799,06 |

Source - Own elaboration

As can be seen in table 7.7, over a 3-year horizon, an overall reduction in specific energy consumption of 16,25 goe/V-Km may be expected an equivalent reduction in average consumption of 1.9L/100km in all vehicles in the Joiditrans fleet.

In 2019, the company recorded consumption of about 2,100,000L of diesel, which in terms of primary material is equivalent to 1898.41 toe, and the specific consumption registered as goe/V-Km, can be expected to reduce consumption by around 5% over the next three years. Within the consumption reduction measures to be included in the energy consumption rationalization plan, they were defined jointly with those responsible for Joiditrans in order to ensure that they are feasible and included in the management plans.

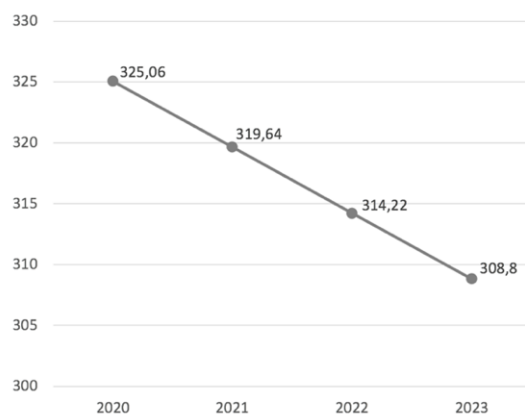
Over the next three years, the company expects to apply three new efficiency measures such as continuous specific training in efficient and eco-driving, greater control of tire pressure in vehicles and a technological update of 19ton trucks for EURO 2 and 3 to EURO 6, reducing the company's ecological footprint, and monitoring driver's performance behind the wheel.

These reference values that will be analyzed for three years and as such in this period it will also be necessary to apply in the strategy that improves the company's overall effectiveness, and for that it is necessary to use new techniques and strategies to improve results such as increased safety drivers, increasing productivity, reducing operating costs, reducing maintenance costs, reducing insurance costs, improving asset management and improving customer service.

All of these strategies will only be possible to achieve the reduction results that are represented in the figure 7.1, if the company can make the telemetry system's operation transparent, involve drivers

in these processes, internally disseminate the results in a systematic and straightforward way, create healthy internal competition, reward drivers with better performance, help and support continuous improvement and establish collective and individual training plans to maintain behaviours.

Figure 7.1 - Fuel Consumption Targets



Source - Own elaboration

8. Conclusions and Discussion

The development of this entire project has made it possible to achieve the objectives to which they had been proposed at the beginning of the project because with this project it was possible to identify the main problems and difficulties regarding road transportation companies in the market and how they need to position themselves in operational terms in order to guarantee the highest possible profitability.

This entire project aimed at the integration of a new efficiency paradigm adjusted to the business reality through a method of evaluation and optimization of resources and that would allow the business to guarantee new ways to reduce its operational losses. The analysis made to the company's current energy consumption allowed the establishment of future goals for the company so that it was possible to understand the impact of a new approach on the part of resource efficiency and paradigm shift in the behaviour of the company's drivers. Also, all the analysis and auditing that was done to the company through questionnaires and interviews established the company's internal reality and how it could apply a new concept of efficiency. The proposal for a performance efficiency model and the establishment of measures that allow the company to control the various KPIs over time will guarantee not only an improvement in business processes and activity, but will also bring guarantees of profitability through, for example, a decrease in energy consumption over time.

This entire project-company was also able to achieve the specific objectives that had been initially proposed because it was possible to define a complete model of performance analysis and a measure of future control of KPI's, it was possible to develop a new culture of concepts of eco-driving in the company, several driving variables and technical prominences were identified that allowed to identify the variables of evaluation of driving performance, it was possible to develop a driver performance classification system so that it was possible for the company to have a viable tool of analysis that would allow evaluating the performance of its collaborators not only through the consumptions but also of the attitudes and behaviours that they have throughout the whole driving.

8.1. Contributions to Management

Although technologies such as the GPS or diagnostic software are already widely used and essential for the daily activity of drivers, the simple act of driving a heavy vehicle continues to be performed in the same way that it was performed about 10 or 15 years ago. The driving teaching procedures have been developed and improved through a set of accumulated lessons that make the management of companies increasingly evolved and with a much more defined sense in the optimization of the activity. Despite the growing level of experience that accumulates in the knowledge of the company, expenses are also increasing, which forces a new perspective to develop the activity.

With the increase in operating costs, the increase in market competitiveness and the growing environmental concern, it is essential that companies in this sector find different types of solutions,

such as those that was addressed and studied in this project. Increases in efficiency improved driving performance, reduced waste and reduced operating costs are critical business issues and, for this reason, projects like this contribute a lot to the knowledge of anyone responsible for a transportation company like Joiditrans. Although currently there are companies that invest and seek to guarantee new ways of carrying out their transport activity, there is still a gap in the strategy to be adopted by these companies, making it possible to carry out an in-depth study on this matter in order to define better possible the strategies that can be adopted by these companies and which mechanisms of analysis, evaluation and monitoring will have to be implemented in the management of the company and consequently in the operational layers of the company.

8.2. Contributions to Knowledge

Throughout this research, it was possible to understand that even the studies that focused on the social issue in the performance and efficiency of a transport vehicle were focused outside Portugal, which means that outside the social, cultural and economic context of this country. For this reason, this project contributes to general knowledge because, by conducting a study on the performance of drivers based on this national context, it will allow the various transportation companies operating in Portugal to adopt more innovative monitoring techniques and optimize their business.

Also, this study may contribute to the literature and general knowledge, giving an interim perspective of a transport company linked to the reality that is experienced every day by drivers on the road and that leads them to reduce their performance. The link between ecological and safe driving with constant and effective monitoring that allows pre-defined performance KPIs to be reached is one of the many ways to achieve and maintain regular control over the efficiency of the most diverse resources, and this is what this study aims to contribute to companies but also to general knowledge in areas such as psychology, performance or the total efficiency of mobile resources.

8.3. Limitations of the Project

The realization of this project was based on general knowledge about the need for efficient activities and how a road transportation company could adopt this new operational reality with all the difficulties existing in a market like this. Despite this, the realization of this project also had its limitations.

The first limitation that this project had is the epidemiological pandemic of COVID-19, which coincided with the realization of this project, making it impossible to have a constant presence in the company, which forced the exchange of information online and consequent delay in obtaining fundamental data. All the information that was obtained for this project, like energy data, telemetry data, the interview with management and surveys with drivers needed to be obtained in a much more contained way than it would have been had this pandemic not occurred. Also, the second limitation that this project had was the sample size of the surveys and the interview with the company's

management because it was only possible to obtain a sample of about 80% of the total of the company's drivers, this represents only 40 drivers where there are hundreds of drivers across the country. In the case of the interview, it was only possible to make the CEO of the company, which, despite being the person with greater prominence and preponderance in the company, it was not possible to carry out the same interview with other company leaders, such as the head of operations and the person in charge to analyze of fleet performance data.

Finally, the third limitation that this project had was the lack of proximity to the GPS platform that the company uses, since all the data established in the proposed efficiency model to be implemented in the company, were obtained by data resulting from the review of the literature, data resulting from the metrics defined by the company and data resulting from the metrics that the GPS platform provides to Joiditrans. Despite this, for the realization of this project, it was not possible to understand whether the GPS platform would have the possibility to obtain other telemetry data than those previously established by Joiditrans.

8.4. Future Studies and Projects

This entire project-company presents a vast and complete vision of the reality of road transportation companies and allows us to understand how driving behaviours directly affect performance KPIs and the efficiency of each resource. Thus, in order to maintain this efficiency control, it is essential to apply models that establish an efficiency performance as proposed in this project. Despite all this, there are still many questions that need to be answered and analyzed concerning the efficiency of a resource such as the heavy vehicle, and this is where this study opens the opportunity for future investigations. Like any project, there are always questions that can be improved and evaluated differently, so that each project can contribute to a better knowledge of a specific subject. This specific project is no exception and opens doors to other new projects. It will always be necessary to evaluate the effectiveness of the model presented by this project because although it was developed to be as close as possible to the reality of the business, there is still a need for a complete assessment of the effectiveness of this model.

There is also the possibility that in the future there will be a need to re-evaluate the existing improvements in the company after the implementation of this performance analysis model and thus ensure that the company has a new position in the market and has competitive advantages in terms of efficiency, which may also be applied to other road transport companies. Finally, this project also opens up new possibilities so that the variables evaluated in this presented efficiency model can be initially integrated into new heavy vehicles and how the existence of all these data could shape the behaviour of drivers within the truck itself, how it would be better to collect this data, whether locally or through connections to GPS software as presented in this project, among others. Knowledge is something that must always be improved, and based on this project-company, there is still much knowledge that can be discovered and acquired.

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10. Attachments

| | |
|---|----|
| Annex A. The Company | 82 |
| Figure 10.1. Joiditrans Logo | 82 |
| Figure 10.2. Transportation Trucks | 82 |
| Figure 10.3. Joiditrans Website | 82 |
| Annex B. Interview to the Management & Answers | 83 |
| Annex C. Survey and the Answers of the Drivers | 86 |
| Figure 10.4. Eco-Driving Concept | 86 |
| Figure 10.5. Safety Distances | 86 |
| Figure 10.6. Relation between Green Zone RPM's & Fuel Consumption | 87 |
| Figure 10.7. Procedure when Overtaken | 87 |
| Figure 10.8. Tires Pressures | 88 |
| Figure 10.9. Relation between Gear Position & Fuel Consumption | 88 |
| Figure 10.10. Procedure when approaching a Downhill | 89 |
| Figure 10.11. Fuel Consumption Savings | 89 |
| Figure 10.12. Gear Change on Green Zone of RPM | 90 |
| Figure 10.13. Procedure to Overtake | 90 |
| Figure 10.14. Relation between Auxiliary Brake & Inercia Force | 91 |
| Figure 10.15. Best Utilization of Auxiliary Brake | 91 |
| Figure 10.16. Main Eco-Driving Factors | 92 |
| Figure 10.17. Main Road Accidents Causes | 92 |

Annex A. The Company



Figure 10.1 – Joiditrans Logo

Source: Company Courtesy



Figure 10.2 – Transportation Trucks

Source: Company Courtesy

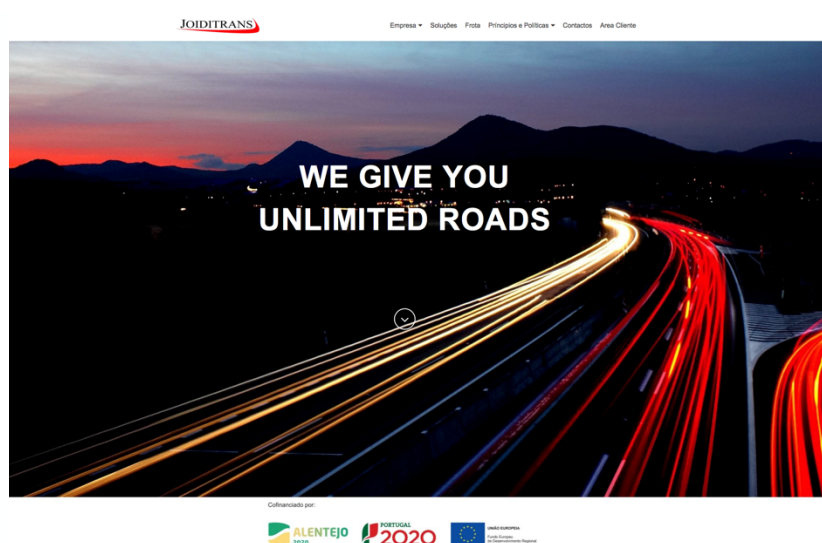


Figure 10.3 – Joiditrans Website

Source: www.joiditrans.pt

Annex B. Interview to the Management

1) What do you consider to be the company's biggest efficiency problem? Need to buy new trucks, reduce costs with suppliers or the need for drivers to change their behaviour?

Answer: It is strategic decisions that make all the difference in any company, but I believe that the secret lies in the balance between all of them because constant negotiation with suppliers is something almost daily and is much more linked to an operational part, but in this case the acquisition of new vehicles and the behaviour of drivers, these are linked together. The purchase of new trucks helps to change behaviours because there is technology on board that goes in this direction, but it is evident that despite this, all behaviours of drivers, whether on board new vehicles or not, are fundamental, as they can cause waste due to such erratic behaviour.

2) What is the economic driving culture that exists in drivers? Do you believe that they have knowledge of good economic driving practices? How does the company invest in this theme?

Answer: The company trains several drivers every year for operational efficiency and I believe that there is a general knowledge of the correct way to drive, which does not automatically mean that they apply this knowledge. There are phases in which the power of persuasion so that there is a complete change in the behaviour of drivers and there are other phases, such as the one we are living in now, in which the lack of new drivers leads to overconfidence on the part of existing ones, making it difficult to change these behaviours and implement new standards.

3) What are the metrics, KPIs or other driving performance indicators that the company uses to monitor vehicles? How do you get that data?

Answer: Essentially Joiditrans constantly and elaborately analyzes 2 KPI's, the average fuel consumption and the idle times. We obtain the average consumption through the kilometers we travel, and the liters filled and obtain the idle times through specialized reports of the GPS platform we use.

4) How reliable and viable are telemetry data transmitted from GPS and the respective telemetry systems?

Answer: The values are quite feasible because they show in real time, both the exact location and also provide data that with experience we have verified that correspond a lot to reality.

5) Do you consider that an entirely new fleet equipped with the best technology automatically guarantees positive and immediate results for the company?

Answer: No, it does not guarantee. What it does is that due to the technology they bring, it helps to gradually modify the behaviour of drivers. Nowadays, the technology that exists in heavy vehicles has a great impact because the most recent vehicles already have automatic gearboxes, which provides a better gearbox management, makes passages at correct speeds and rotations and limits speeds that not only ensures better efficiency as well as greater safety for the driver. What the newer vehicles are still unable to effectively guarantee are the idle times, the braking systems, the sudden accelerations and the sudden braking, which are entirely dependent on the drivers' actions.

6) Why does the company bet on a multi-brand fleet and not just on a single type of supplier of heavy vehicles and their behaviour?

Answer: Each supplier has different types of advantages, each of which has strengths and weaknesses. In addition, not all brands invest in the same type of technology, which is why there is no brand on the market that brings together all the technological conditions and advantages available on the market. The last reason why the bet is placed on a multi-brand is also derived from the fact that we do not want to be dependent on a single supplier, a single type of truck, a single type of parts, etc. It is essential to remain competitive, regardless of the supplier we use.

7) Since energy consumption is essential for the operational results of a transport company, what analysis does this evaluation parameter make and what percentage preponderance does it have in the profitability of each resource?

Answer: It is evident that energy consumption is fundamental to the profitability of this type of business because to have an idea of its impact, fuel weighs about 30% in the company's operating costs so it is evident the need to reduce it effectively. When we talk about the profitability of each resource and the impact that a driver has directly on the operational results of the same, we can be talking about a direct impact of 3% on the performance of the consumption of each resource.

8) What would be the ideal consumption averages in vehicles so that these expenses could be reduced considerably?

Answer: The objective we have established in terms of consumption averages in order to reduce operating costs, we are talking about an average of 32 L/100km.

9) *In addition to the energy consumption of each vehicle, there are also other factors for analysis of driving performance such as journey times, the type of route taken, the speeds performed, the engine speed/use of the gearbox, accelerations and brakes. What percentage preponderance do you consider that each of these categories has in a complete driving analysis?*

Answer: It is difficult to give a specific percentage to each of these categories, it would be necessary to make an individual analysis of each category to understand what impact each one may have. In any case, it is clear that the way in which the gearbox is used, how it brakes and how it accelerates, makes all the difference between the various drivers. In addition, the paths taken also influence performance a lot but in this specific case, there are different variables that have to be taken into account. It is evident that consumption and wear are different on secondary roads, and sometimes that use leads to higher consumption and wear, but in any case, due to the high costs of motorway tolls, it is necessary to make a balance so that there is the highest possible profitability.

10) *In percentage terms, how impactful are the drivers' driving behaviours on the company's operating costs?*

Answer: The behaviour of drivers is fundamental to their performance and this can be clearly seen in the differentiation of performance of the various employees. In percentage terms, I believe that different behaviours influence vehicle consumption by 3% and premature equipment wear by 2%. Drivers' different behaviours influence the company's total operating costs by 5%.

11) *What should be the criteria for the classification of drivers? In how many categories do you consider your classification fair?*

Answer: I believe that a classification in for example 7 categories, already represented in a concrete way the performance of each driver, managing to make a fair and effective distinction on the different behaviours of the different drivers.

Annex C. Survey and Answers of the Drivers

1) What is eco-driving?

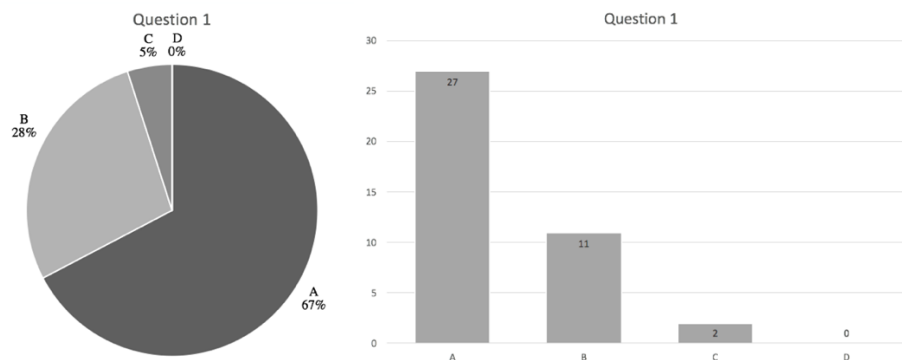
A) It is the most efficient driving possible according to the route to be performed.

B) Driving is the main objective of avoiding a road accident at all costs.

C) It is driving that aims to minimize damage and protect passengers in the event of a road accident.

D) It is the driving used through reactions and inputs from the road, influenced by the drivers' states of mind.

Figure 10.4 – Eco-Driving Concept



Source: Own elaboration

2) How do we know during the trip if we are sufficiently safe from the vehicle in front?

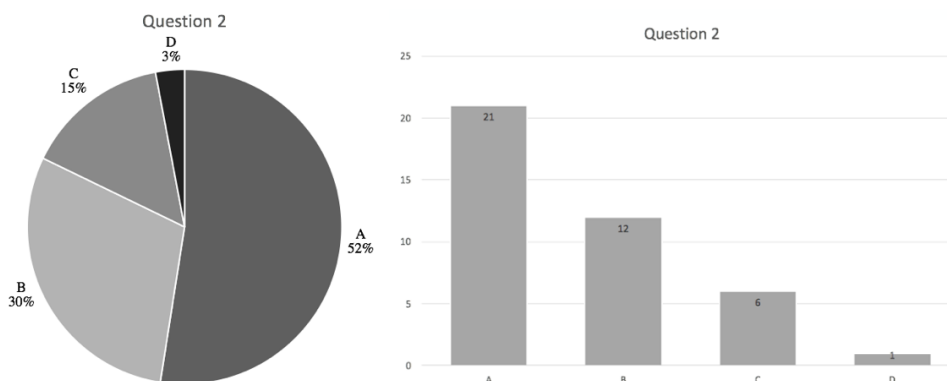
A) Through the brake test that represents the necessary braking for the vehicle to be able to stop in the available space, depending on the conditions of the track, condition of the tires and the speed at which it is traveling.

B) Imagining the space of a vehicle between our vehicle and the vehicle in front.

C) When driving at road speed and there is still enough space between vehicles.

D) Do not know, but we are constantly checking that there is no situation that could cause a dangerous braking of the vehicle that is driving right in front of the truck.

Figure 10.5 – Safety Distances



Source: Own elaboration

3) Do driving constantly with the engine speed in the “green zone” and the use of preventive braking influence the consumption of a truck?

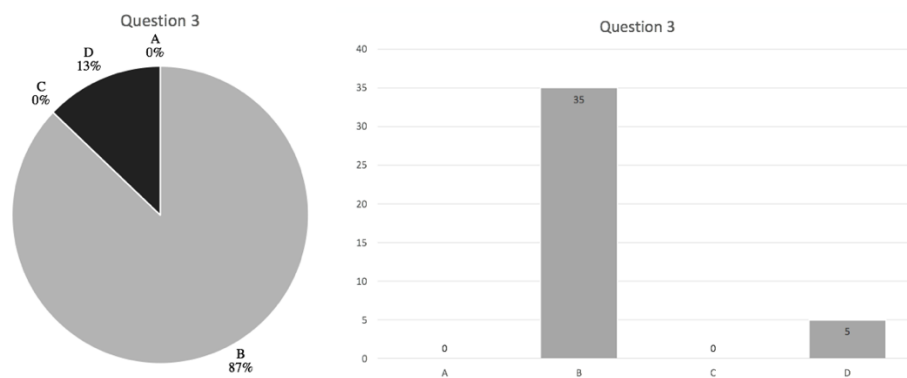
A) No, because in the green zone the engine power is not maximum, so the consumption is higher.

B) Yes, because the green zone represents the maximum torque, so consumption is as low as possible and preventive braking allows more time to circulate within this zone.

C) No, because for there to be a significant reduction in consumption it is necessary to drive with the rotations below the green zone.

D) Yes, because preventive braking ensures that it is possible to ride at lower speeds and consequently it is easier to reach this area.

Figure 10.6 – Relation between Green Zone RPM's & Fuel Consumption



Source: Own elaboration

4) What do you think is the right attitude to take when we are overtaken by another vehicle?

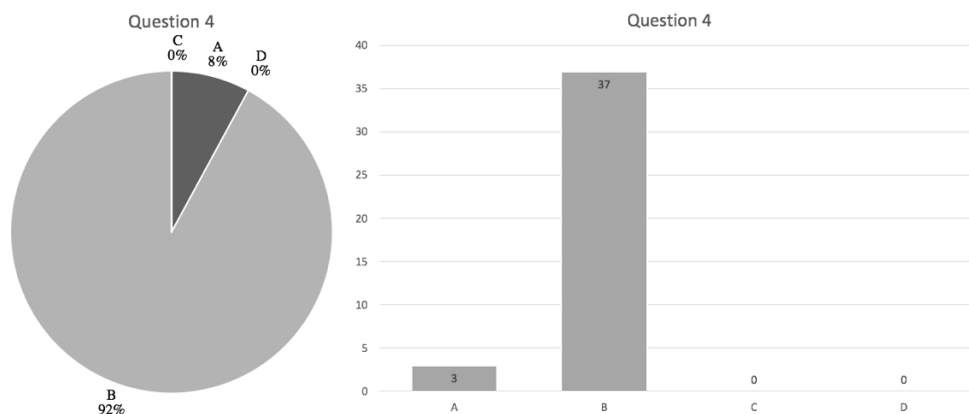
A) Maintain the speed of the moment.

B) Ensure the safety distance, reducing the speed if necessary.

C) Increase the speed, thus reducing the safety distance.

D) Braking abruptly.

Figure 10.7 – Procedure when Overtaken

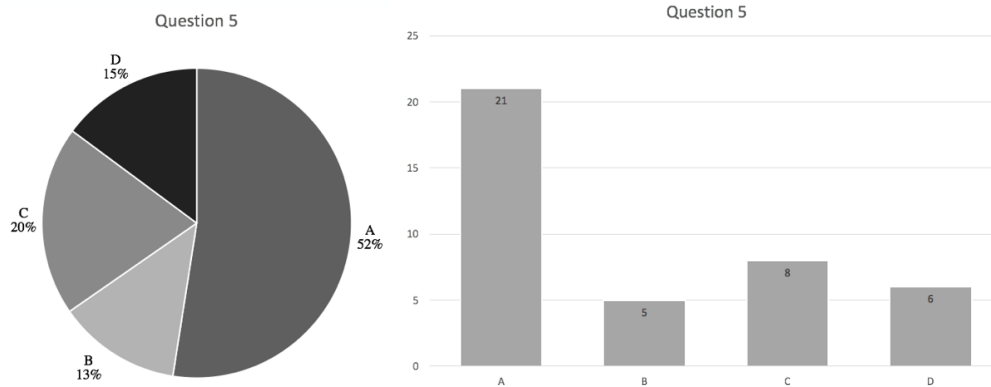


Source: Own elaboration

5) What is the recommended tire pressure for the truck and trailer of a heavy vehicle?

- A) Tires that circulate alone - 9.2 bar; Tires that run alongside - 8.5 bar.
- B) Tires that circulate alone - 9.6 bar; Tires that run alongside - 8.7 bar.
- C) Tires that circulate alone - 9.2 bar; Tires that run alongside - 8.7 bar.
- D) Tires that circulate alone - 9.2 bar; Tires that run alongside - 8.3 bar.

Figure 10.8 – Tires Pressures

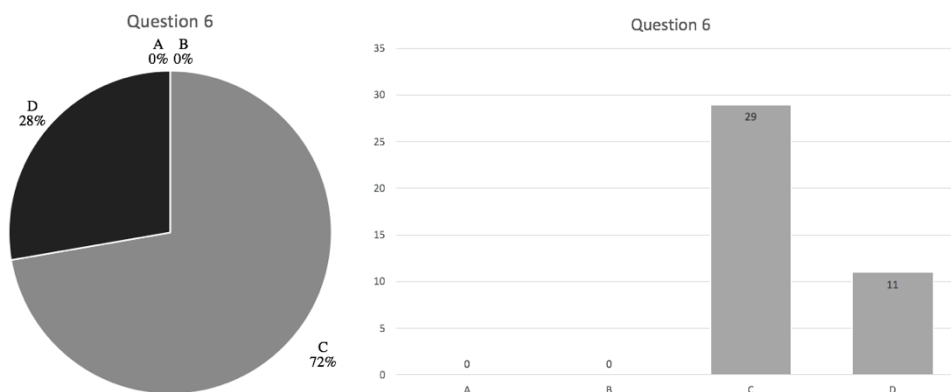


Source: Own elaboration

6) If a vehicle is in neutral while in motion, is it not consuming fuel?

- A) It is true because the vehicle takes advantage of inertia, ensuring that it does not consume any fuel or cause any other waste in other parts of the vehicle.
- B) It is true because the only expense that can happen is the expense of the brakes due to potentially more aggressive braking.
- C) It is false because although a vehicle with electronic injection is not accelerating, the fuel system does not completely cut the fuel injection to zero.
- D) No, because today with the electronic control of fuel supply, the savings are greater with gear changes, moderate speeds and a gear ratio as high as possible, which also ends up preventing further wear of the gearbox.

Figure 10.9 – Relation between Gear Position & Fuel Consumption



Source: Own elaboration

7) What do you think is the correct attitude when approaching a downhill during the trip?

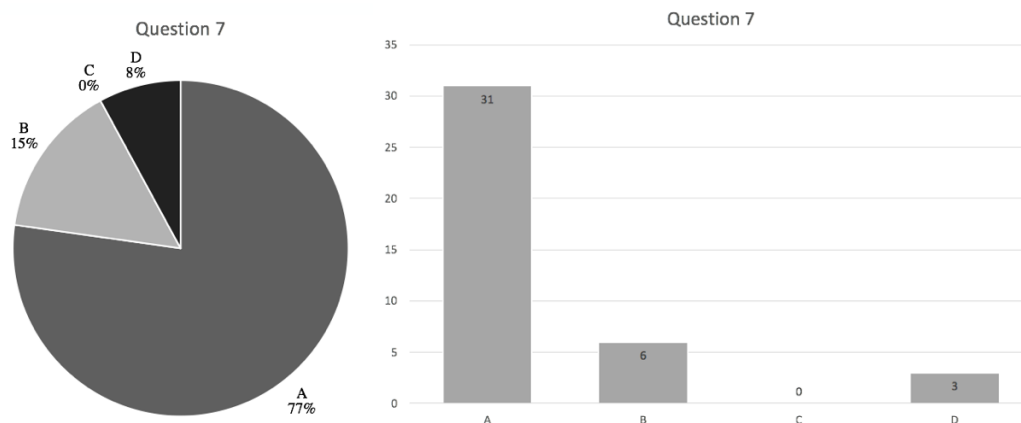
A) Take your foot off the accelerator in order to ensure that the vehicle takes advantage of the inertia achieved through the force of gravity, thus reducing the wear of tires and braking systems.

B) Keep the speed constant in order to guarantee a better balance for future climbs or overtaking.

C) Accelerate in order to ensure that we take advantage of all the movement of the truck in order to ensure greater speed and shorter driving time.

D) Check on the on-board computer, whether the various parameters are suitable, such as whether the tire pressure is still adequate.

Figure 10.10 – Procedure when approaching a Downhill



Source: Own elaboration

8) All measures described below reduce fuel consumption. Which one can save fuel by more than 15% on a route that has a high rate of loading and unloading procedures?

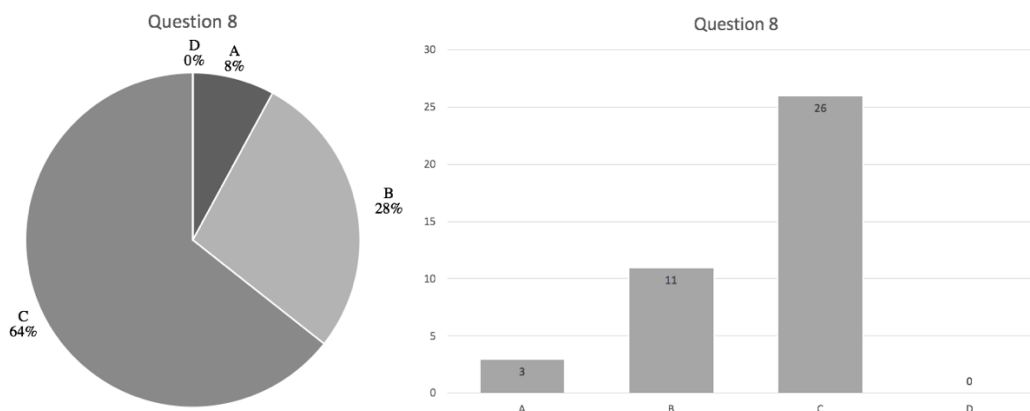
A) Keep the tires at the appropriate and recommended pressures.

B) Comply with speed limits on roadways.

C) Stop the engine, avoiding excessive idle times when the vehicle is stopped in parks or parking lots.

D) Plan the trip in advance.

Figure 10.11 – Fuel Consumption Savings

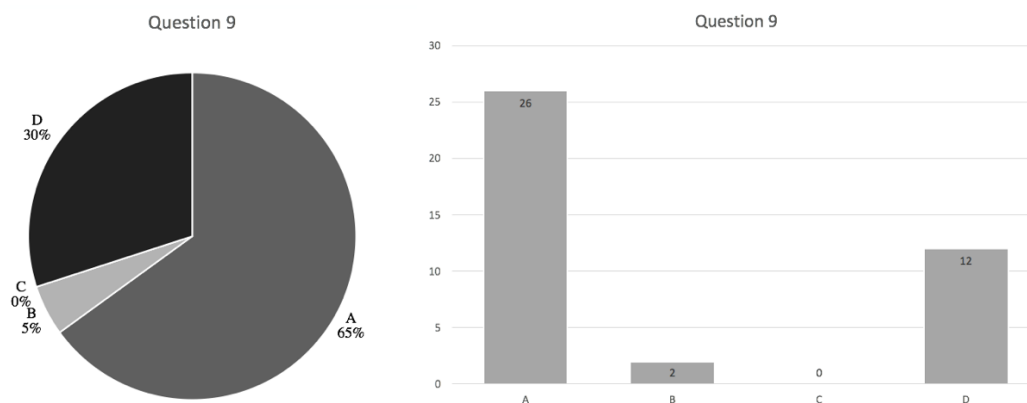


Source: Own elaboration

9) What are the Green Zone of RPM indicated to increase a change in uphill, downhill and flat terrain?
(G.Z. - Green Zone)

- A) Uphill - 80% G.Z.; Downhill - 20% G.Z.; Flat Terrain - 50% G.Z.
- B) Uphill - Max. G.Z.; Downhill - 80% G.Z.; Flat Terrain - Up to 70% G.Z.
- C) Uphill - Max. G.Z.; Downhill - 60% G.Z.; Flat Terrain - Min. G.Z.
- D) Uphill - Max. G.Z.; Downhill - Min. G.Z. rotation; Flat Terrain - Up to 70% G.Z.

Figure 10.12 – Gear Change on Green Zone of RPM

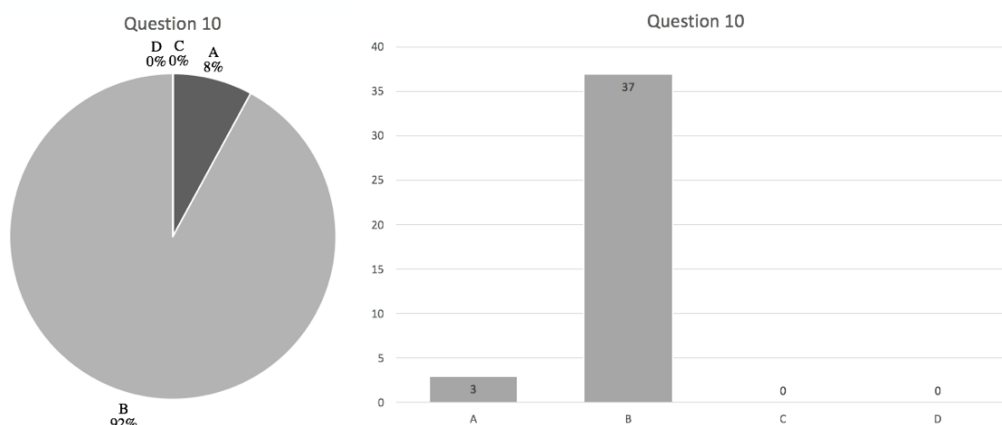


Source: Own elaboration

10) What is the safest way to overtake?

- A) Start overtaking near the vehicle in front in order to shorten the overtaking time.
- B) Ensure good visibility and a swing distance behind the vehicle in front in order to overtake quickly and with the longest possible reaction time.
- C) Always overtake at a speed above 70km/h.
- D) Always use the turn indicators during the entire overtaking process.

Figure 10.13 – Procedure to Overtake

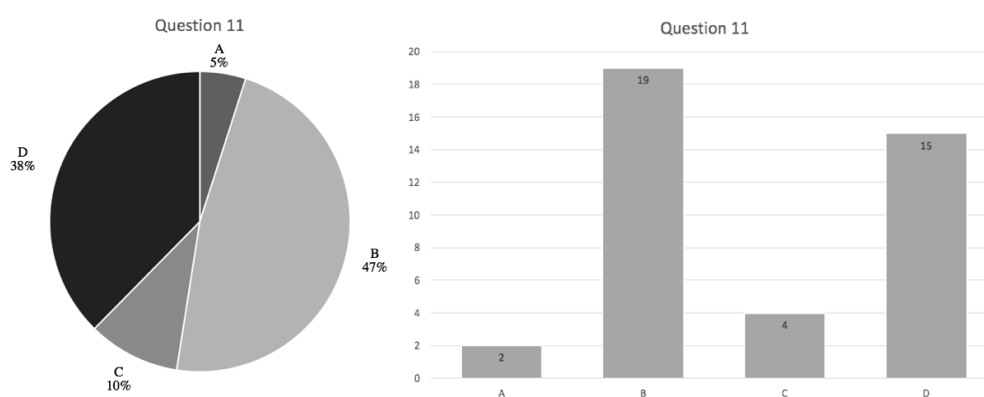


Source: Own elaboration

11) Does the use of the auxiliary brake replace the use of the force of inertia?

- A) Yes, because the use of the auxiliary brake is more efficient and safer than the force of inertia.
- B) No, because with greater use of the vehicle's inertia and movement, it is possible to reduce the use of the auxiliary brake with the same efficiency and safety.
- C) Yes, because the performance of auxiliary brake is designed to replace the use of the inertia force.
- D) No, because the auxiliary brake should only be used at times when the greatest need for braking and preventive braking is based on the force of inertia.

Figure 10.14 – Relation between Auxiliary Brake & Inertia Force

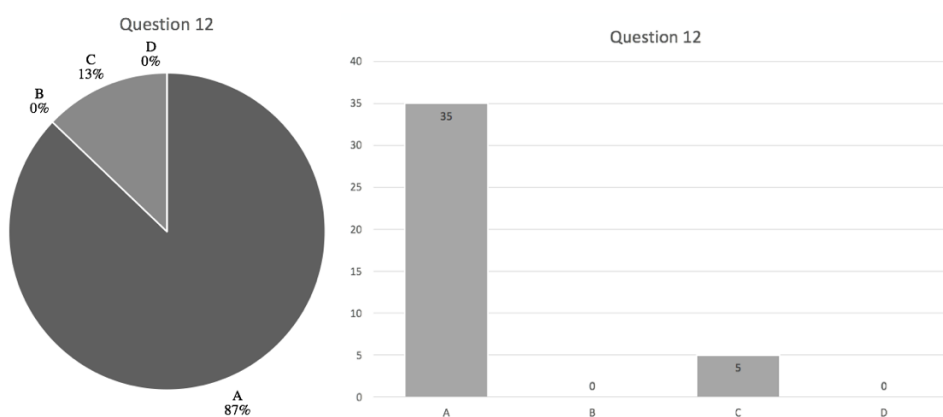


Source: Own elaboration

12) Which of the following statements represents the best use of the auxiliary brake (Retarder)?

- A) Ensures better braking safety, wasting less fuel and less wear on the braking systems.
- B) Their use is simple, which allows the driver to use them as often as he wants without harming his driving.
- C) With the use of the auxiliary brake, it is possible to make a better use of the trips with the use of more moderate brakes.
- D) It is a braking system that requires little maintenance which makes it possible to keep this equipment safe and functional for long periods of time.

Figure 10.15 – Best Utilization of Auxiliary Brake



Source: Own elaboration

13) Order the most efficient to the least efficient, the main factors of eco-driving and the consequent reduction in energy consumption.

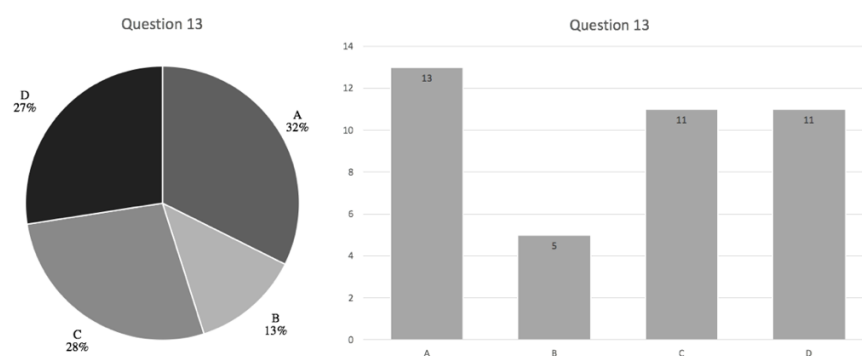
A) Driving in the Z.V., Use of Inertia, Adequate Tire Pressure, Reduced Idle Times, Compliance with Speed Limits, Prior Travel Planning, Less Load Weight.

B) Adequate Tire Pressure, Reduced Idle Times, Driving on the Z.V., Prior Travel Planning, Compliance with Speed Limits, Less Load Weight.

C) Compliance with Speed Limits, Advance Travel Planning, Less Load Weight, Use of Inertia, Driving in Z.V., Adequate Tire Pressure, Reduced Idle Times.

D) Reduced Idle Times, Use of Inertia, Driving in the Z.V., Prior Travel Planning, Less Load Weight, Adequate Tire Pressure, Compliance with Speed Limits.

Figure 10.16 – Main Eco-Driving Factors



Source: Own elaboration

14) Order the main causes of road accidents from the most dangerous to the least dangerous.

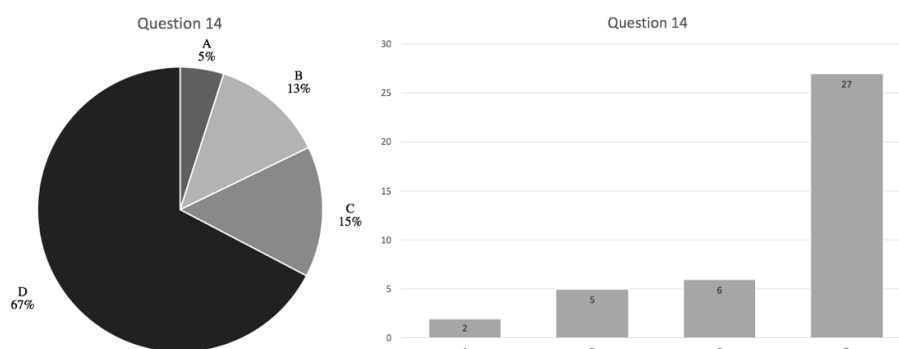
A) Distractions, Visibility, Speed, Lack of Experience, Disregard for Safety Distance, Disregard for Road Rules.

B) Speed, Disregard for Road Rules, Distractions, Disregard for Safety Distance, Visibility, Lack of Experience.

C) Disregard for Road Rules, Lack of Experience, Disregard for Safety Distance, Speed, Visibility, Distractions.

D) Distractions, Speed, Disregard for Safety Distance, Visibility, Lack of Experience, Disregard for Road Rules.

Figure 10.17 – Main Road Accidents Causes



Source: Own elaboration