Ekonomicko-manazerske spektrum
2024, Volume 18, Issue 2, pp. 111-121

INCREASING THE ECONOMIC EFFICIENCY OF TRANSPORT ENTERPRISES THROUGH TELEMATICS SYSTEMS

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Cite as: *Ujlacka, K., Konecny, V., Valaskova, K. (2024). Increasing the economic efficiency of transport enterprises through telematics systems, Ekonomicko-manazerske spektrum, 18(2), 111-121.*

Available at: *10.26552/ems.2024.2.111-121*

Received: 25 October2024; Received in revised form: 7 December 2024; Accepted: 19 December 2024; Available online: 31 December 2024

Abstract:
Research background: Cost optimization in transport is a key aspect of the competitiveness of transport companies, and modern telematics systems represent an innovative tool to improve economic performance. These systems allow detailed monitoring of vehicle parameters such as fuel consumption, driver driving style, and route efficiency, providing valuable data to reduce variable costs and improve overall operational efficiency.
Purpose of the article: The purpose of this article is to explore the importance of telematics systems in cost optimization for transport companies and to highlight their potential to improve efficiency and sustainability. The article provides an overview of the benefits of implementing these systems, their cost recovery, and the economic and environmental benefits of transport. The information is intended for practitioners, transport company managers, and policymakers concerned with improving efficiency of transport.
Methods: Data from real transport companies that have implemented telematics systems were used for the analysis. The methodology includes cost structure calculations with an emphasis on variable costs as well as a comparison of operational parameters before and after the implementation of telematics. Analytical and calculation approaches were used to determine savings and return on investment.
Findings & Value added: The implementation of telematics systems has enabled the transport company to have accurate and easy vehicle tracking capabilities, thus contributing to the possibility of adjusting the driving style of the driver and thus reducing consumption. This paper highlights the importance of these systems in achieving long-term economic and environmental efficiency in transport.

Keywords: telematics systems, transport company costs, cost optimization, transport

JEL Classification: F2; L8; O4; O5

1. Introduction

Freight transport plays an important role in logistics systems and supply chains, being an integral part of each country's economy (Gajsek and Rosi, 2015). Sixta and Macat (2005) point out the main function of transport, which is to ensure the physical movement of goods from the place of their production to the place of need or consumption. At the same time, transport serves to move products quickly and reliably, providing added value to customers if products are delivered on time, in the required quantity and quality, and without damage (Ujlacka, 2024).

Ensuring a balanced link between economic progress, social inclusion, and environmental protection is key to achieving sustainable development. Governments around the world are therefore placing emphasis on improving energy security, reducing the impacts of climate change, and improving air quality, particularly in urban areas where population concentrations are highest. One sector that has a significant impact on these priorities is transportation (McCollum at al., 2013; Erickson and Jennings, 2017).

Jeon and Amekudzi (2005) describe, that designing a sustainable transportation system requires solutions that are cost-effective, beneficial to the general public, and at the same time environmentally friendly. Such a system must promote economic stability, social progress, and natural resource conservation. Transport plays an essential role in socioeconomic development, reflecting the three fundamental dimensions of sustainability: economic growth, environmental protection, and social inclusion (Calderon-Rivera et al., 2024).

The dynamic environment of transport and logistics is increasing the pressure on transport companies, which are faced with continuously reducing operating costs while maintaining a high quality of service. Transport-related costs often form a significant part of the final price of products, thus directly affecting their competitiveness in the market (Wilmsmeier and Sanchez, 2009). To ensure long-term sustainability, companies need to focus either on maximizing performance, which allows for an efficient allocation of fixed costs, or on reducing variable costs through process optimization across all cost items (Poliak and Vrabel, 2010).

Transport costs are defined as the economic resources expended to carry out an activity that is expected to have an economic effect (Ferrari et al., 2023). These costs represent a financial expression of the consumption of production factors and are divided into fixed and variable costs (Konecny et al., 2010; Rodrigue, 2020). Fixed costs, such as vehicle depreciation or insurance, are independent of the volume of output, while variable costs, such as fuel or tolls, are directly related to the scale of operations.

Effective management of these costs is essential for the long-term sustainability and competitiveness of transport companies in an increasingly challenging global environment (Gruzauskas et al., 2018).

Cost optimization of businesses is one of the key elements of doing business. There are various costs that operators have to bear in connection with the operation of means of transport. However, fixed costs are difficult to optimize due to their immutability to short-term changes, legislative conditions, capacity constraints, or limited capacity (Mostafa et al., 2023). Changing economic conditions, as well as the impact of competition, force transport companies to optimize, to a large extent their operating costs, which are variable costs. It is important to identify the main cost items and try to find ways and measures to reduce them to the lowest possible level (Lukasik et al., 2017). Optimized fleet management requires knowledge in several areas in order to effectively control the company's costs, pursue the goal of maximizing profits, and minimize financial losses (Nagy et al., 2024). One of the key areas is fleet management, which focuses on the efficient use of the fleet in ground transportation. Real-time management coupled with data collection for detailed analysis is an important tool for reducing operating costs (Topolska and Topolski, 2016). A proper selection of a telematics system can serve as an effective support tool (Pattanaik and Goswami, 2023). It provides up-to-date information on the location and status of a specific vehicle, which allows for optimizing route planning and reducing "idling". At the same time, it allows flexible responses to unexpected situations such as congestion or vehicle breakdowns. Tracking vehicle conditions helps prevent costly breakdowns and saves time, which is extremely important in the transport sector. In addition, the system monitors fuel consumption, which has a significant impact on the operating costs of the transport company (Pasierbski, 2020).

2. Methodology

In practice, there are several approaches to reducing costs in transport, each tailored to the specificities of particular businesses or sectors. The most commonly used methods include route optimisation, fleet management and the use of modern technologies for monitoring and analysing costs. These methods make it possible to effectively manage operating costs and improve the performance of transport companies.

Fixed costs - costs do not change with a change in output volume. The immutability of these costs is not entirely clear. A part of these costs depends on a certain range of the firm's capacity and remains the same regardless of the degree of its utilization; these are absolutely fixed costs. Part of the fixed costs is constant only within a certain range of capacity utilization (the range of output volume), but when the range is exceeded, there is a one-off increase in costs, 12 then it is a relatively fixed cost. They remain constant over the next time span (Gnap and Poliak, 2017).

Variable costs - the value of costs varies depending on the change in the quantity of the company's output. In road transport, in connection with the operation of transport means, variable costs are divided into variable costs dependent on the amount of performance (fuel costs, toll costs, and variable costs dependent on the time of vehicle operation; e.g., driver's time wage (Konecny et al., 2010).

2.1. Methods and data

Costing of own costs in a transport company is a key process that allows to accurately analyse the cost structure and to identify the main factors influencing the economic results. This method is important not only for the pricing of services, but also for improving the efficiency and competitiveness of the company.

Similar to evaluation methods, costing also uses mathematical formulas for averaging calculations. In the case of cost in a transport company, we can consider the following formula:

$$P_i = \frac{\sum_{j=1}^{n} C_{ij}}{V_i} \tag{1}$$

where P_i is the unit price for the i-th type of performance

C_{ij} represents the costs for the i-th type of performance in the j-th cost item

V_i is the total volume of performance

2.1.1. Ranking method

For the cost analysis in the transport company, the costing method was applied, which divides the costs into variable and fixed costs. This method is characterized by a dynamic approach and allows to produce economically accurate results even for preliminary calculations, e.g. for calculating the price for transport. Dynamic costing is particularly useful in transport environments where vehicle performance and operating conditions can exhibit considerable variability.

The calculation was made on the basis of data collected from a real transport company. Data for one vehicle over a period of one month was analysed, with an average monthly performance of 10 000 km and an average working time of 180 hours. The average speed of the vehicle was determined based on the telematics system and was 66.1 km/h. The telematics systems allowed the vehicle's movements and performance to be accurately tracked, which significantly increased the accuracy of the calculation.

The costs had to be divided into three groups - variable costs dependent on distance travelled, variable costs dependent on time, and fixed costs that were recalculated:

$$c_{v\,km} = \frac{C_v\ (€/month)}{L\ (km/month)} \tag{2}$$

where $c_{v\,km}$ is variable costs dependent on distance travelled

C_v is variable costs

L is vehicle performance

$$n_{v\,hod} = \frac{C_v\ (€/month)}{H\ (h/month)} \tag{3}$$

where $c_{v\,hod}$ is time-dependent variable costs

H is number of hours of vehicle operation

Fixed costs are independent of the output realized and are given in absolute terms.

An important parameter in the cost analysis of transport companies, which allows calculating of the average cost per kilometer of vehicle travel, is the calculation of the unit price per kilometer. It is calculated according to the formula:

$$P_{km} = \frac{C_v\ (€/\ h)}{v_t (km/h)} \tag{4}$$

where P_{km} is unit price per kilometre

v_t is average vehicle speed

Another important parameter in the costing of own costs in transport companies is the calculation of the cost per hour of vehicle operation. It allows the annual fixed costs to be allocated to a specific time period of vehicle use and thus to determine their value per hour of operation.

$$P_h = \frac{C_F\ (€/month)}{H\ (h/month)} \tag{5}$$

where P_h is cost per hour of vehicle operation

C_F is fixed costs

2.1.2. Data

The prices of the individual items within the transport company's costs in €/month include a wide range of expenses, which are divided into fixed and variable. These expenses are calculated based on data from the real conditions of vehicle operation, and the specific values may depend on the type of vehicle, its use, and the region in which the company operates. Below is an expanded overview of typical items:

- Fixed costs (€/month): depreciation of vehicles, insurance, rent for premises, administrative costs.
- Variable costs (€/month): fuel, tolls, maintenance and repairs, tires, drivers' wages.
- Other costs include telematics systems and technologies and parking fees.

These items provide an outline, but the actual costs depend on the size of the company, the type of fleet, the nature of the transport services and market conditions. Properly understanding and managing these costs is key to the efficient operation and long-term sustainability of a transport company.

Table 1 provides a detailed breakdown of the costs per vehicle, the data being derived from an analysis carried out by the transport company. These costs include items related to the operation of the vehicle such as fuel expenses, maintenance costs, insurance, driver labour costs as well as other variables affecting the total operating costs of the vehicle. The data provided reflects actual operating conditions and serves as a basis for evaluating the economy of individual vehicles.

Table 1: Cost of individual items associated with the operation of the vehicle

Item	**[€/month]**
Fuel	3,828.00
Ad Blue	210.00
Other materials and services	23.00
Tires	345.00
Salary	1,354.40
Deductions	490.29
Reward	380.00
Maintenance/repair	299.00
Depreciation of semi-trailer combinations	1,934.24
Travel refunds SR	102.00
Collision insurance	83.19
Compulsory contractual insurance	134.42
Carrier insurance	22.70
Motor vehicle tax	45.38
Fees, GPS, phone	11.90
Parking	120.00
Directed by	780.00
Toll	1,400.00

Source: internal data of the transport company

The data collected from the transport company provides a detailed overview of the vehicles, routes and driving techniques of the drivers, serving as a basis for optimising operations and reducing costs. By implementing telematics systems, key parameters can be monitored in real time, which includes information on the length and efficiency of routes, drivers' driving styles and fuel consumption. The analysis of this data allows for improved route planning, leading to overall savings and, to a high degree, in particular, fuel savings.

Telematics also enables detailed monitoring of driver behaviour, such as acceleration, braking or cruise control use, identifying inefficient driving habits. Correcting these habits can make a significant contribution to reducing costs and improving safety. In addition, fuel consumption data enables companies to take action to optimise vehicle performance, which is particularly important when managing variable costs that directly affect economic efficiency (Kubas et al., 2021).

The overall impact of the use of telematics systems on reducing transport costs can vary. It depends on the degree of use and implementation of the systems.

Table 2 gives an overview of the data obtained by the transport company through the implemented telematics system. These data include key parameters that have a direct impact on fuel consumption and the overall efficiency of the vehicle operation.

Table 2: Costs of individual items associated with the operation of the vehicle

	Parameter	**Unit**	**Prior to the introduction of the telematics system**	**After the introduction of the telematics system**
Route	Distance travelled	km	9139	9,078
	Consumption	l/100 km	31.7	26.9
	Cargo weight	t	30.9	33.8
	Average gradient	%	0.51	0.42
	Number of	-	989	970
Driving technique	Average speed	km/h	64.7	66.1
	Driving time at speed > 85 km/h	%	24	0.2
	Engine running time without consumption + Ecoroll	% of total journey time	23.1	36.8
	Driving time with cruise control	% of total active engine time	28.2	64.15
	Exceeding the tensile speed	% of total active engine time	1.79	0.1

Source: author based on internal data of the transport company

In Table 3, we can see an overview of the costs associated with the implementation and use of the telepathic unit based on the offer provided by Webispečink. This offer includes the cost of the basic equipment, which includes the telematics E.V.A. unit, the cable for fixed installation, the installation of the unit including antennas, the connection to the CAN/OBD/FMS bus, as well as the connection to the tachograph card for driver identification and AETR compliance. System activation and monthly access to the Webdispečink web application with a global SIM card is an integral part of the system. These items are essential for the full functioning of the system. The total one-off cost of the basic equipment amounts to 133 €, while the monthly operating costs amount to 15.95 €. The offer also includes expansion accessories. These are optional extras that extend the system's functionality and improve its efficiency. The total cost of the extension is 555 €, with monthly fees for additional services amounting to 34 €.

The total cost of implementing the system, including basic equipment and extended services, amounts to 688 €. With full use of the extended services, the monthly operating costs amount to 49.95 €.

3. Results

Fuel consumption is a key parameter that has a significant impact not only on the economic efficiency of a transport company but also on the environmental aspects of its operations. This aspect is particularly important in the road transport sector, where the cost of fuel represents a significant item in the budget. In Figure 1 and Figure 2, we can see a comparison of the parameters before and after the introduction of the telematics system. The average fuel consumption after the introduction of the telematics system and the start of the monitoring of the driver's driving parameters decreased by 5.1 l/100 km with relatively the same, or even higher, average load weight and the same distance. Fuel consumption has fallen by 453 litres. At a diesel price (8.12.2024) of 1.216 € without VAT, the company can save up to 0.0584 € for every one kilometer of distance travelled, which at an average monthly driving performance of 10 000 km represents a saving of 584 € /vehicle.

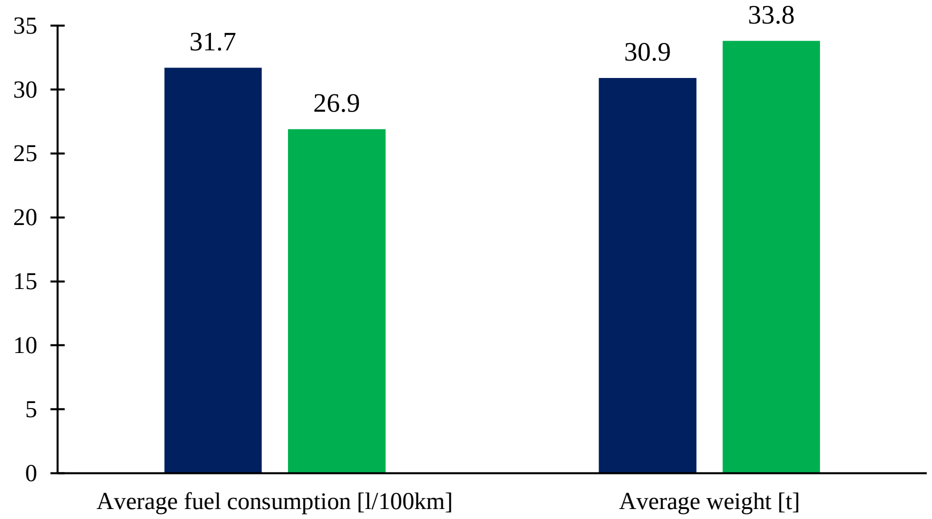
For a better idea and detailed display of individual cost items, a calculation sheet (Table 4) has been developed, which serves as a clear tool to analyse all important parameters and expenses related to the operation of the fleet.

Table 3: One-off and monthly costs for the implementation of the telematics unit

Vehicle telematics unit		
Product name	**Price without VAT**	**Cost type**
Background		
E.V.A - telematics unit	3.95 €	monthly costs
EVA - cable for fixed installation	15.00 €	one-time costs
Installation of the vehicle unit into the truck incl. antennas	65.00 €	one-time costs
Connection to the CAN/OBD/FMS bus of the vehicle (only if supported by the vehicle)	22.50 €	one-time costs
Connection to DTCO - driver identification + AETR (card-only tachograph)	22.50 €	one-time costs
System activation (Always activated during installation and reinstallation)	8.00 €	one-time costs
Access to the WEBDISPEČINK web application incl. SIM GLOBAL	12.00 €	monthly costs
Summary of total one-off costs	**133.00 €**	**one-time costs**
Summary of total monthly costs	**15.95 €**	**monthly costs**
GPS monitoring expansion accessories (not a necessary part of the system)		
SW Package Forwarding - one-time fee for the whole company	320.00 €	one-time costs
SW Package Trailers - one-time fee for the whole company	40.00 €	one-time costs
Activate remote download of the tachograph and driver card	6.00 €	one-time costs
Business card reader for remote reading of the tachograph and driver card	104.00 €	one-time costs
Trailer ID - tool/carrier identification - without mounting	75.00 €	one-time costs
Trailer ID mounting	10.00 €	one-time costs
WEBDISPEČINK Extension Monthly Fees		
Tachograph and driver card archiving service - monthly fee for one vehicle	6.80 €	monthly costs
Perfectdrive for a detailed record of the vehicle's driving style from the FMS bus - monthly service	6.20 €	monthly costs
Package - Lenovo Tablet + WD FLEET 3D + Sygic Navigation + holder and charger + SIM card GLOBAL + Sygic traffic - monthly fee with 36 months commitment	21.00 €	monthly costs
Summary of total one-off costs	**555.00 €**	**one-time costs**
Summary of total monthly costs	**34.00 €**	**monthly costs**
Total one-off costs	**688.00 €**	
Total monthly costs	**49.95 €**	

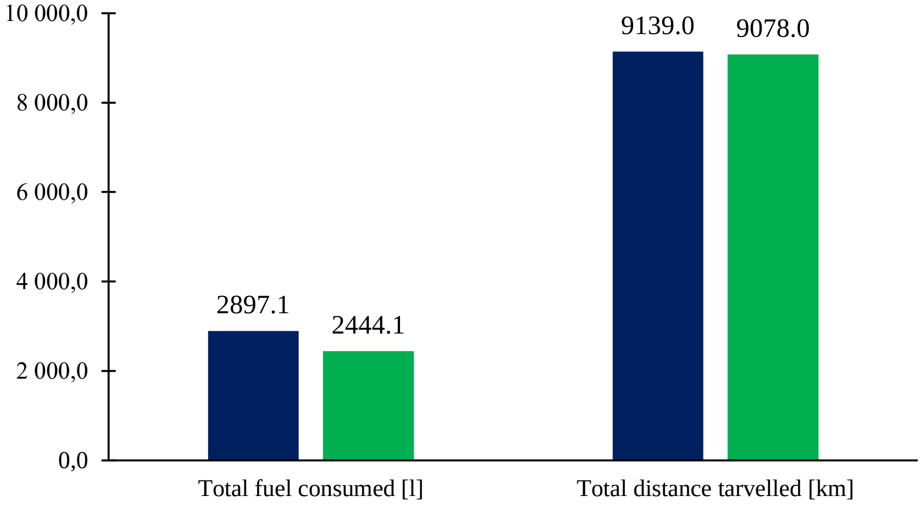
Source: author based on the quotation from Webdispečink

Figure 1: Comparison of average fuel consumption and average weight before and after the telematics system



Source: author

Figure 2: Comparison of total fuel consumed and total distance travelled before and after the telematics system



Source: author

Table 4: Costing sheet before the introduction of the telematic unit

Item	**Value [€/month]**	**$c_{v\,km}$ [€/km]**	**$c_{v\,h}$ [€/h]**	**C_F [€/year]**	**P_{km} [€/km]**	**P_h [€/h]**
Fuel	3,828.00	0.3828	-	-	0.3828	-
AdBlue	210.00	0.0210	-	-	0.0210	-
Other materials and services	23.00	0.0023	-	-	0.0023	-
Tires	345.00	0.0345	-	-	0.0345	-
Salary	1,354.40	-	7.5244	-	0.1138	7.5244
Deductions	490.29	-	2.7238	-	0.0412	2.7238
Reward	380.00	-	-	380.00	0.0319	2.1111
Maintenance/repair	299.00	0.0299	-	-	0.0299	-
Depreciation of semi-trailer combinations	1,934.24	-	-	1934.00	0.1625	10.7444
Travel refunds SR	102.00	-	0.5667	-	0.0086	0.5667
Collision insurance	83.19	-	-	83.19	0.0070	0.4622
Compulsory contractual insurance	134.42	-	-	134.42	0.0113	0.7468
Carrier insurance	22.70	-	-	22.70	0.0019	0.1261
Tax on motor vehicles	45.38	-	-	45.38	0.0038	0.2521
Fees, GPS, phone	11.90	-	-	11.90	0.0010	0.0661
Parking	120.00	-	0.6667	-	0.0101	0.6667
Directed by	780.00	-	-	780.00	0.0656	4.3333
Toll	1,400.00	0.1400	-	-	0.1400	-
-	-	-	-		**1.0693**	**30.3238**

Source: author

The reduction in fuel consumption has a direct and positive impact on the overall operating costs of the transport company, specifically the costs associated with fuel and additives such as AdBlue. These costs are classified as variable, which means that they are directly dependent on the amount of kilometers driven and the consumption of the vehicle.

A specific calculation shows that a reduction in fuel consumption of 5.1 litres per 100 kilometres can reduce the cost of operating the vehicle by 0.0586 € per kilometer. This value is based on the assumption of a constant price for fuel and AdBlue.

In Table 5, we can see that the cost per kilometre of travel is reduced by 0.0586 €.

Table 5: Costing sheet for the introduction of the telematic unit

Item	Value [€/month]	$c_{v\,km}$ [€/km]	$c_{v\,h}$ [€/h]	C_F [€/year]	P_{km} [€/km]	P_h [€/h]
Fuel	3,244.00	0.3244	-	-	0.3244	-
AdBlue	208.00	0.0208	-	-	0.0208	-
Other materials and services	23.00	0.0023	-	-	0.0023	-
Tires	345.00	0.0345	-	-	0.0345	-
Salary	1 354.40	-	7.5244	-	0.1138	7.5244
Deductions	490.29	-	2.7238	-	0.0412	2.7238
Reward	380.00	-	-	380.00	0.0319	2.1111
Maintenance/repair	299.00	0.0299	-	-	0.0299	-
Depreciation of semi-trailer combinations	1,934.24	-	-	1934.00	0.1625	10.7444
Travel refunds SR	102.00	-	0.5667	-	0.0086	0.5667
Collision insurance	83.19	-	-	83.19	0.0070	0.4622
Compulsory contractual insurance	134.42	-	-	134.42	0.0113	0.7468
Carrier insurance	22.70	-	-	22.70	0.0019	0.1261
Tax on motor vehicles	45.38	-	-	45.38	0.0038	0.2521
Fees, GPS, phone	11.90	-	-	11.90	0.0010	0.0661
Parking	120.00	-	0.6667	-	0.0101	0.6667
Directed by	780.00	-	-	780.00	0.0656	4.3333
Toll	1,400.00	0.1400	-	-	0.1400	-
-	-	-	-		**1.0107**	**30.3238**

Source: author

The cost saving opportunities are not limited to savings per kilometre and savings per month, but have also been quantified for standard annual driving performance of 80 000-120 000 kilometres in Table 6. This view offers an even more detailed overview of the potential savings, especially for vehicles with higher annual driving performance.

Table 6: Overview of cost savings for annual driving performance

Savings at 80 000 km (€)	Savings at 90 000 km (€)	Savings at 100 000 km (€)	Savings at 110 000 km (€)	Savings at 120 000 km (€)
4,669.44	5,253.12	5,836.8	6,420.48	7,004.16

Source: author

In addition to the savings the company can make on fuel, the introduction of a telematics system and the monitoring of driver driving style will also add to lower brake and tyre costs, which can contribute significantly to the company's overall savings and improve its financial situation. At the same time, they can increase vehicle safety and reliability, which is key to the efficient operation of a transport company.

4. Discussion and Conclusions

In order for a transport company to remain competitive, it is crucial for carriers to analyse cost items carefully and strive to optimise them. One effective way to do this is to use telematics systems that provide the detailed data needed to improve management and reduce operating costs.

The return on investment in a telematics system is extremely fast in the optimistic scenario, making it an effective tool for improving the economic performance of a transport company. At a saving of 584 € per month per vehicle, the initial investment in the system, including basic equipment and enhanced services, which represents a one-off cost of 688 € and a monthly operating cost of 49.95 €, can be repaid in just 38 days. This fast return on investment underlines the high efficiency of the system in real operating conditions.

 ISSN 1337-0839 (print) / 2585-7258 (online)

While the overall cost of deploying and operating the system will increase when the system is expanded to more vehicles in the fleet, the cumulative cost savings increase significantly. In the case of a multi-vehicle fleet, the savings can amount to several thousand euros per year, which has a major impact on the overall economic performance of the company. These savings allow the transport company to invest in innovation, fleet modernisation or improving the quality of services provided, thus increasing its competitiveness in the market.

In addition to the financial benefits, telematics also provides non-financial benefits such as better traffic management, improved driver and vehicle safety, reduced administrative burden and better monitoring of compliance (Elander et al., 1993; Truby et al., 2024). In the context of large fleets, the introduction of telematics is a strategic step that not only brings direct economic savings, but also promotes sustainability and long-term business development. In this way, telematics systems are becoming an integral part of modern transport company management (Hamidi et al., 2016).

Based on these findings, carriers can take concrete steps to optimize the use of their resources and minimize negative impacts on operations. Overall, this example and the related recommendations show that a telematics system can be an important tool for a transport company to achieve the goals of efficient management and cost optimization.

Research in the field of telematics systems can make a significant contribution to monitoring and reducing negative externalities associated with transport, which include environmental, social and economic impacts. From an environmental perspective, telematics systems can help to minimise emissions of greenhouse gases and other pollutants.

From a social point of view, telematics systems promote road safety. Continuous monitoring of driver behaviour and the technical condition of vehicles can reveal potential risks such as driver fatigue, speeding or wear and tear on important vehicle components. Reducing the number of road accidents not only saves financial costs, but above all protects human life and health.

The economic aspect of negative externalities is equally important. Traffic congestion causes not only lost time but also increased fuel consumption and higher emissions. Telematics systems allow dynamic route planning based on the current traffic situation, leading to smoother operation and lower economic burden.

Author contributions: All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

Funding: This research received no external funding.

Acknowledgments: This paper was supported by the project no. 20205 Sustainable Mobility Plan of the City of Martin.

Data Availability Statement: Data available in a publicly accessible repository that does not issue a DOI. Publicly available data were used in this study. You can find this data here: [https://www.webdispecink.sk/sk/]. Internal data of a specific transport organization were also used.

Conflicts of interest: The authors declare no conflicts of interest.

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