Acta logistica - International Scientific Journal about Logistics
Volume: 12 2025 Issue: 1 Pages: 63-76 ISSN 1339-5629



*https://doi.org/10.22306/al.v12i1.585* *Received: 13 June 2024; Revised: 05 Aug. 2024; Accepted: 24 Oct. 2024*

# Ergonomics of the TMS system in the context of the efficiency of the freight forwarder work – the example of TMS AndSoft

**Dominik Gala**
University of Zielona Góra, Faculty of Economic and Management, Podgórna 50, 65-246 Zielona Góra, Poland, EU, dominik.gala23@gmail.com (corresponding author)
**Mateusz Kurowski**
University of Zielona Góra, Faculty of Economic and Management, Podgórna 50, 65-246 Zielona Góra, Poland, EU, m.kurowski@wez.uz.zgora.pl
**Paweł Szudra**
University of Zielona Góra, Faculty of Economic and Management, Podgórna 50, 65-246 Zielona Góra, Poland, EU, p.szudra@wez.uz.zgora.pl

***Keywords:*** TMS system, automation, ergonomics, transport, management.
***Abstract:*** The subject of consideration is to discuss key aspects related to the ergonomics and efficiency of IT systems, particularly in the context of Transport Management Systems (TMS). TMS supports the planning, control, analysis and optimization of flow processes, which translates into better technical resource management and cost reduction. Ergonomic design of IT systems aims to create intuitive and easy-to-use tools that minimize employee effort and reduce the number of mistakes made. This approach leads to increased work efficiency, which is crucial for companies, where process automation can significantly reduce the time needed to complete tasks and increase the efficiency of work. The article is based on the example of the TMS system from AndSoft and presents proposals for improvements of selected aspects of the system operation. The proposed improvements relate to the issue of planning and the creation of a unique feature allowing for cascading replenishment of resources, reducing the time needed to perform daily planning operations. In addition, it is proposed to synchronize two tabs "Orders" and "Availability resources" in order to find unplanned resources faster and assign them to specific transport ordersMoreover, an alert system was proposed to inform about errors made, which will allow for their quick detection and correction. In addition, a vehicle self-diagnosis system is proposed to monitor the technical condition of vehicles in real time. These innovative technological solutions contribute to increasing efficiency, reducing errors, and improving overall management of logistics elements.

## 1 Introduction

The development of information technologies and the constant pursuit of automation of both planning and operational processes creates predispositions for improvement and opens up opportunities for introducing improvements and innovative solutions. Today, logistics systems play a key role in the functioning of many companies, providing the basis for managing a wide range of business activities, including transport, warehousing, finance or human resources. The efficiency of the work performed is an extremely important element for companies in a constantly developing and competitive environment. Ergonomic process management translates into optimal use of time and better and more efficient performance of tasks, management, human flows, management of financial and work. Moreover, ergonomics of process management translates into optimal use of time and better and more effective performance of tasks and work. The focus on new information and telecommunication technologies contributes to the improvement of the quality of the services provided and the opportunity not only to attract new customers, business partners and markets, but also to the improvement of the results of the operations carried out [1]. The article presents an analysis of the ergonomics of AndSoft's TMS system, examining how its features and functionality affect the efficiency of shippers' work. The ergonomics of IT systems, although often underestimated, can effectively influence the productivity of people using the software. This paper presents an analysis of individual aspects of the TMS system from AndSoft, which, being the basic product, may not fully fit the needs of users. Despite the growing importance of TMS systems, much of the research conducted so far has focused mainly on technical aspects, often overlooking the influence of ergonomics on both operational efficiency and user satisfaction. Earlier studies frequently failed to address the specific needs of users, and the practical issues associated with using these systems.

The objective of the article is to present solutions that increase the efficiency of freight forwarders by improving the ergonomics of the TMS system. The study addresses the significant impact of ergonomic improvements on the productivity and well-being of dispatchers, underlining the relevance and necessity of investigating this research problem. The paper posed the following research questions: How does the automation of processes in the TMS system affect the time of execution of planning operations? What solutions can improve the ergonomics of the TMS system? What are the benefits of improved ergonomics in TMS systems? The above research questions have been formulated to focus attention on key aspects of the functioning of the TMS system and their impact on operational efficiency and user satisfaction. The answers to these questions will not only identify areas for improvement, but also propose concrete solutions that can bring tangible benefits to transport companies. The research is based on literature analysis and empirical methods. Literature analysis allows to identify existing solutions and best practices in the field of transport management and ergonomics of IT systems. Analysis of improvements will allow to check specific implementations in the TMS system, showing the effects of introducing different technological solutions.

Moreover, the article seeks to fill the existing research gap regarding TMS system functionality by offering an in-depth analysis of the ergonomics of AndSoft's TMS system. It examines how various features and functionalities of the system impact the efficiency of freight forwarders work and suggests targeted improvements to optimize ergonomics. The analysis covers several key areas, including process automation, its effect on planning operation times, and associated financial benefits, while also addressing potential implementation challenges. The article identifies essential areas that require enhancement and proposes innovative solutions that can provide significant advantages to transportation companies. Thanks to the analysis of the ergonomics it is possible to significantly improve shippers' daily operations, increase their efficiency and job satisfaction, and ultimately enhance service quality and transport process optimization. This comprehensive approach underscores the importance of ergonomics in maximizing the effectiveness of TMS systems and delivering practical benefits to the industry.

## 2 Literature review

### *2.1 Ergonomics of information systems*

Ergonomics is a scientific discipline that deals with the analysis and optimization of people’s working conditions, taking into account all factors affecting them [2]. Moreover, ergonomics is a multidisciplinary discipline dedicated to improving human physical and mental health to provide a safe, comfortable, and healthy environment, thereby enhancing efficiency. It involves the science of understanding and applying the interactions between humans and other elements of a system [3].

Researchers define ergonomics in various ways, according to W. B. Jastrzębowski "The name of Ergonomics, taken from the Greek words ergon (ergon) work and nomos (nomoz) law, principle, means the Science of Work, that is, about the use of forces and abilities given to man by the Creator" [4]. In the words of the author, ergonomics deals with research and optimization of working methods adapting them to the physical and mental capabilities of people. Ergonomics involves the study and optimization of working methods, adapting them to the physical and mental capabilities of individuals. It encompasses the application of principles from human biological sciences to optimize the fit between people and their work environment, leading to increased productivity and improved well-being [5].

Ergonomics in practical terms means adapting the various aspects of work to the capabilities of employees and improving the efficiency of the activities carried out. Although ergonomics is a humanistic field, placing the human being at the very centre of interest, the development of technology, research and other aspects of the field have broadened its scope of interest not only to the physical and biological aspects of adapting to changing working conditions, but also to the ergonomics of information systems, i.e. the time spent on tasks, the number of errors made and the adaptation of systems to user requirements [2].

Ergonomics is divided into two main approaches, namely corrective ergonomics and conceptual ergonomics. The first of these focuses on the analysis of prevailing working conditions in terms of matching their psychophysical predispositions to workers and users. Its main objective is to develop specific recommendations, improvements or modifications which will make an appropriate contribution to achieving harmonization of work and to reducing both physical and mental stress on man-machine systems, and to increasing the productivity and quality of work [6]. Conceptual ergonomics, on the other hand, begins with the planning or design of, for example, tools, machines, system software or workstations. Its aim is to establish in advance clearly defined interrelated functions between man and machine or system to reflect basic ergonomic requirements, with the least possible biological load on the person using the system or appliance, while maximising safety and productivity [6].

The main assumption of the ergonomics of information systems is therefore to create an environment in which there is compatibility between the system or software and the user. The system is a tool to be used by the user, so the person (the user) is the most important. According to M. Miłosz, “the ergonomics of the environment and computer tools (both software and hardware) determine the productivity of employees, as well as the costs of their activities” [2]. These aspects have a great impact on the functioning of the machine-man system. The first and most important goal when designing IT systems is to create an ergonomic interface. The physical and mental characteristics of users should be taken into account here. Properly designed interface is key to effective use of the software reducing stress and effort related to work, which consequently leads to a reduction in the number of potential errors, but also to improved work efficiency [6].

According to the aforementioned ergonomic aspects, it is crucial to adapt to the needs of the users. In the context of TMS (Transport Management System), it is important that it is designed with ease of use in mind. An aspect that greatly contributes to improving the ergonomics of IT systems is the interface. The user interface should first of all be clear, transparent and intuitive to use. Properly designed, it allows you to focus on important elements, making it easier to find them and perform individual tasks. In addition, it should clearly identify the main functions without the need for time-consuming search [2]. A home screen that is not designed as described often generates problems such as making mistakes and long-term searching for particular features, which consequently leads to user dissatisfaction and mental fatigue. Ensuring proper ergonomics of the IT system is able to increase operational efficiency, improve the well-being and efficiency of users. Important elements of the ergonomics of information systems include [2]:

- **Intuitive, easy to learn** (ease of use even for new users, minimization of training in operation and technical support),
- **memorability** (the system is easily memorized in operation, even after a long break),
- **legibility and transparency** (presents data in a structured, easy-to-find way),
- **adaptation to users' needs** (design taking into account users' expectations),
- **flexibility and personalization** (adaptability to individual preferences),
- **minimization of effort** (reduction of physical and mental loads),
- **maximization of automation** (reduction of repetitive, routine operations),
- **error rate** (minimization of error rate),
- **satisfaction** (maximization of work comfort).

The issue of ergonomics is linked to work efficiency, as well-designed IT systems can make a significant contribution to improving the efficiency and productivity of users. Work efficiency means that workers (users) achieve the best possible work outcomes as a result of their activities [8]. Work efficiency refers to the ability of employees to achieve specific goals with minimal expenditure of time, resources and energy. It can also be used to determine the efficiency and productivity of employees. In addition, this issue covers both the quality and quantity of the tasks performed. A high ratio means that the employee not only achieves satisfactory results, but also does so in a way that minimizes losses and maximizes benefits.

## 2.2 *Features and Functions of TMS Systems*

Today, in a highly competitive business environment, the efficient operation of a company's logistics system is a key aspect if a company wants to maintain profitability, minimize costs and meet the needs of its partners. Moreover, it can also be an indicator of the success of a company.

A logistics system encompasses a network of entities, individuals, operations, data, and resources that facilitate the movement of goods from suppliers to customers. It can be comprised of three primary networks or subsystems, such as procurement, production and distribution. More generally, a logistics system can be defined as a system comprising intentionally organized and integrated flows of materials and products, along with the corresponding information, within a given economic system [9]. The definition point out that these systems are created and implemented in companies for specific purposes, such as qualitative or financial. It is important that they operate smoothly, ensuring the free and fast flow of information, aiming at the optimal use of available resources, reducing costs and errors.

A TMS system, being a logistics system, can include key business issues and logistic processes, such as control strategies and tools used. Because these systems are ERP systems, they can fulfil a wide range of functions in enterprises [10]. Logistics researchers and specialists have a diverse approach to the concept of logistics systems, as they may depend on factors such as the sector of the economy, the nature of the activity and the functioning of the company.

The planning function, which is one of the most important, is responsible for the organisation of transport taking into account predefined transport conditions, such as volume, arrival and departure time, compatibility of the means of transport, trailers and so on. Ergonomic choice will depend on the amount of data and the transport plan by the dispatcher – locations of owned vehicles, transport tariffs, availability of drivers, loading methods, etc. [11].

Despite its name, the scope of activity of TMS systems is not limited only to transport management. The system can be expanded with specific modules, often depending on the software provider and user needs [12]. The following figure (Figure 1) shows examples of modules in TMS systems.

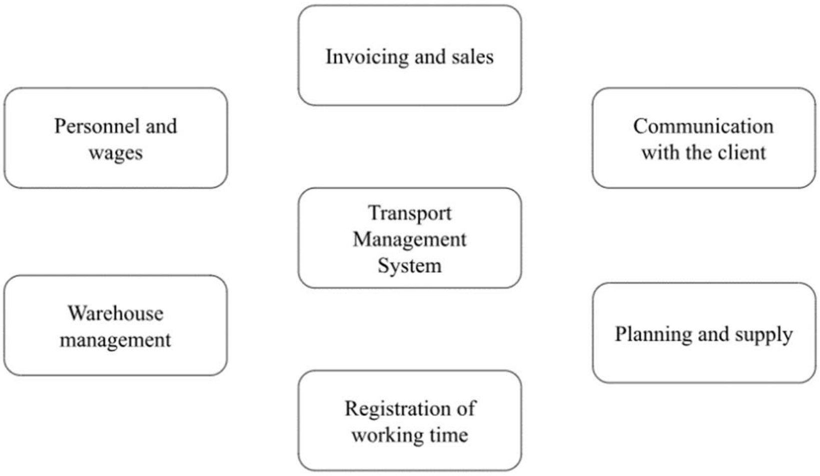


*Figure 1 TMS system modules*

The next stages of the analysis show the variety of functions that TMS systems perform. Particular attention should be paid to how technological solutions are able to affect the efficiency of shippers' work. Features such as fleet management, real-time route optimization, monitoring the status of vehicles, shipments, generating cyclic tasks for drivers significantly improve the efficiency of day-to-day operations and improve employee productivity. The functions of TMS systems in the literature are described in three main perspectives, namely in the functions of data processing, information functions and actual tasks assigned to the systems used. The first group includes [12]:

- **data recording -** storing information (integrated company data) and events in real time, limiting to a minimum manual data entry into the system,
- **data transformation -** actions performed on the collected information (calculation, sorting, indexing, combining and selecting data) - new information value,
- **storage, archiving -** storage of data in the system,
- **searching, filtering and presentation of data -** fluent information response to user queries and appropriate form of presentation.

Moving to information features that tell you what kind of information we may receive through the use of information technology and the levels of governance at which that information may be used. Stępniak C., Sobociński M. and Chluski A. distinguish six interrelated functions, which are presented in Table 1 [12].

*Table 1 Information functions of TMS systems [12]*

| Lp. | Function | Description of action |
|---|---|---|
| 1 | Records of data | Collection of various data related to internal factors (data on ongoing processes, resources, etc.) and external factors (legal regulations, tax, insurance, etc.) for the needs of the organization. |
| 2 | Reporting and information | Regular preparation of datasets (according to specific criteria) reflecting the state of the organization and the processes taking place. Reports created for the needs of the company, e.g.: balance sheet, inventory, resource utilization rate or reports for tax and statistical offices. |
| 3 | Automatic analysis | Supports the performance of analytical tasks according to accepted methods to assess the state of the organization and compare results with historical, planned or industry data. |
| 4 | Automatic control | "Early warning" system when information is entered incorrectly or when parameters fall outside predefined ranges. Automatic control becomes particularly important in the process approach, as it automatically monitors the implementation of individual processes. |
| 5 | Planning | Generating sustainable plans for future periods, developing different scenarios for which information on the type and quantity of material inputs necessary to perform tasks is presented - used later in automatic control. |
| 6 | Supporting decision-making processes | Optimization of available decision options and selection of the most advantageous one based on adopted criteria. |

Acta logistica - International Scientific Journal about Logistics
Volume: 12 2025 Issue: 1 Pages: 63-76 ISSN 1339-5629


The last area refers to the real tasks performed by the systems. They depend to a large extent on the activities undertaken in the company and the information needs generated on this basis. These relate to the scope of your business and may include activities such as fleet management, route planning, delivery scheduling, monitoring vehicle routes, creating workshop lists, inspections, servicing, selling services, creating invoices, orders, transport documentation, finance, human resources or customer communications. Depending on the needs of the transport company, the system will have to be flexible and adapted to the specifics of the transport industry, ensuring optimisation of logistics processes and efficient management of the fleet [12].

It is worth noting that nowadays, with such extensive functionality of systems and demand for information, it is advisable to use individual solutions that best meet the needs of a particular entity. You can buy ready-made products, but it is worth looking at them with a critical eye and consider implementing improvements. Adapting to the specific needs of the company will allow for a continuous process of improvement, change and acceleration of the work performed [13].

## 3 Characteristics of the TMS AndSoft system

TMS AndSoft is an ERP-class transport management system. It has many other functions, which depending on the demand (or department) can be used or not. It is necessary to pay attention to the functionality of its individual elements. The most important elements are those to which the user spends the most time in performing daily activities. First of all, it is worth paying attention to the initial interface of the program (Figure 2).


*Figure 2 TMS - AndSoft interface*

It is divided into several tabs, each of which is responsible for different areas of management. In addition, in each of them there are links to detailed tabs for performing daily work for the transport manager. As you can see, the initial screen is characterized by simplicity and minimalism, facilitating transparency even for new users. The aim of this action is to reduce unnecessary elements and facilitate navigation, which translates into the efficiency of using the system.

The first element of the system is the expansion of the “Master Files” tab (Figure 3). This tab is a database of all data about company resources, vehicles, trailers, drivers, customers, addresses, etc. It is a specific data source for all activities performed on other system tabs.

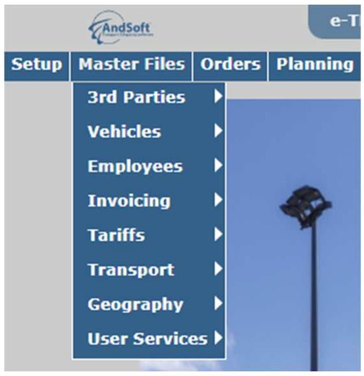


*Figure 3 Master File tab*

Another tab to pay attention to is the “Orders” tab (Figure 4). It allows you to check through various filters (1) generated orders in different time periods (2). To familiarize yourself with the order, simply enter it by pressing the button (3). This tab is used by shippers to find the orders they are handling during the given periods.

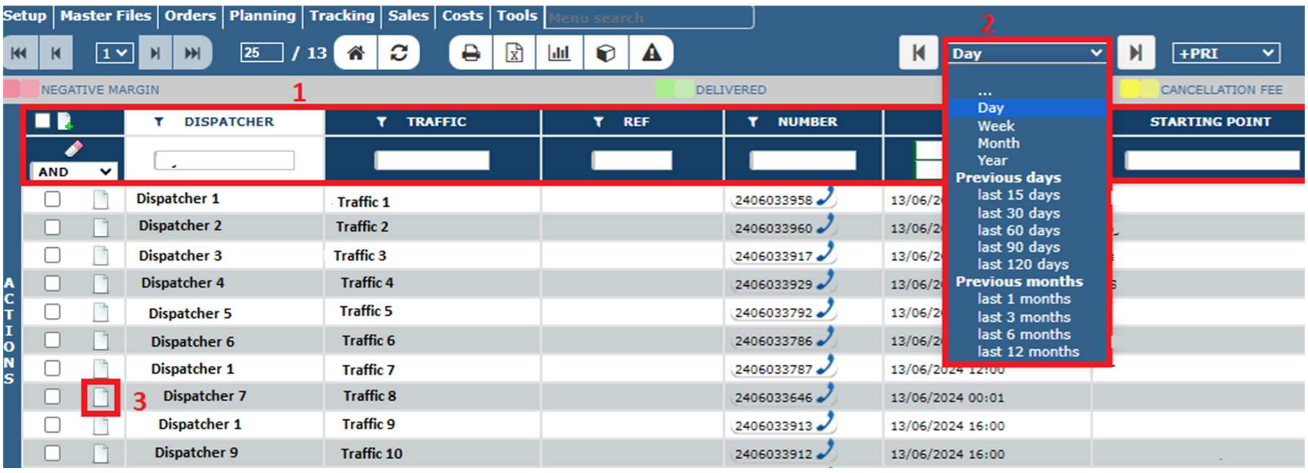


*Figure 4 Orders tab*

A transport order in the system is presented in the figure below (Figure 5). Entering the window contains a plan for the implementation of transport. It includes addresses, time frames and information about places of loading, unloading, and other stops (1). The "trash" and "scissors" icons allow you to remove or split waypoints, respectively. Another figure (Figure 6) shows how the system also allows to add references (2) and attachments from the drivers directly from their phones, which streamlines the documentation process (3). This ensures that all documents are securely stored in one place, eliminating the risk of losing them.

The figure (Figure 7) shows the process of planning a transport order. Orders are divided into segments, and their quantity depends on the specificity of the transport (number of points of loading, unloading, transhipment, driver change, etc.). Resource allocation is done by adding a corresponding resource to each segment (driver, vehicle, semi-trailer). In the present example, it is the vehicle 7057, the trailer t412 and the drivers BOES, BEOV and VEZA.

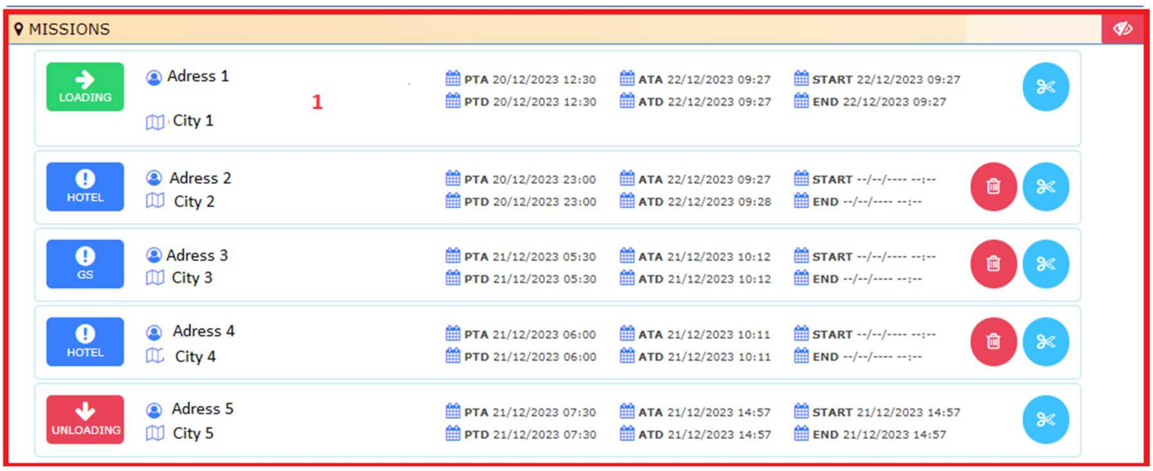

*Figure 5 Transport order*

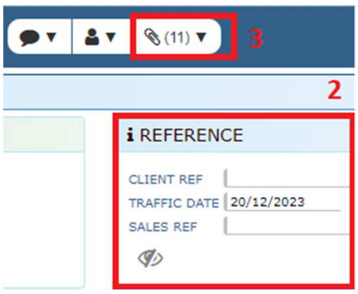

*Figure 6 Logistic elements*


SEGMENTS

| G.DIRECT | ASSIGN | LEG | ACTIONS | TRIP | SUBCO | TRUCK | DRIVER | DRIVER 2 | HELPER | TRAILER | TRAILER 2 | DATE LO | DATE UN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 433064 | | GR2300286767 | | 7057 | BOES | | | T412 | | 20/12/2023 12:30 | 20/12/2023 23:00 |
| | | 433065 | | GR2300287530 | | 7057 | BEOV | | | T412 | | 20/12/2023 23:00 | 21/12/2023 01:53 |
| | | 433066 | | GR2300273995 | SCAND DK | 7057 | BEOV | | | T412 | | 21/12/2023 01:53 | 21/12/2023 02:53 |
| | | 433067 | | GR2300287531 | | 7057 | BEOV | | | T412 | | 21/12/2023 02:53 | 21/12/2023 06:00 |
| | | 433068 | | GR2300288258 | | 7057 | VEZA | | | T412 | | 21/12/2023 06:00 | 21/12/2023 07:00 |
| | | 433069 | | GR2300273996 | ORE | 7057 | VEZA | | | T412 | | 21/12/2023 07:00 | 21/12/2023 07:21 |
| | | 433070 | | GR2300288259 | | 7057 | VEZA | | | T412 | | 21/12/2023 07:21 | 21/12/2023 07:30 |

*Figure 7 Planning a transport order*

An important element of the system is the “Planning - availability resources” tab (Figure 8), which is used to search for free, unplanned resources. It enables efficient management of company resources located in different locations without assigned tasks. By using this tab, it is possible to determine exactly where and when the vehicle, semi-trailer or driver will be available. However, the search for resources is still very time-consuming, due to the number of filters available and forcing the user to describe the needs in detail and then search and select the information received, resulting in complications and lengthy process. Additionally, manual data entry also carries the risk of frequent errors, which can affect the efficiency and accuracy of transport planning. Despite advanced tools and filtering options, inefficiency in finding the resources you need quickly is a challenge that affects overall performance.

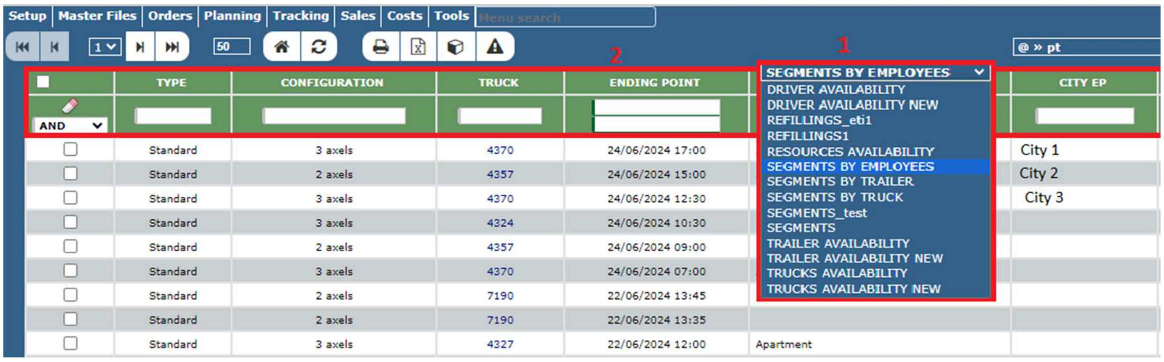

*Figure 8 Planning - availability resources tab*

Although, thanks to its extensive functionality, the TMS AndSoft system facilitates the work of shippers, it is possible to identify several problems and areas of potential improvement. Firstly, a noticeable problem here is the time-consuming and repeated replenishment of the same resources. Routes are divided into segments, due to ferry crossings, bridge crossings, loading, transhipment points, which generates additional segments that must be filled with the same information. This task is performed daily - drivers essentially perform the same tasks, however, they need to be sent instructions to carry out each day. The preparation of tasks falls under the responsibilities of dispatchers. Moreover, this requires spending time daily to manually enter and update information concerning the same resources, such as drivers, vehicles, and trailers. This repetitive and time-consuming activity not only burdens the employees but also increases the risk of making mistakes during data entry.

Secondly, the system lacks automatic control, which could lead to the possibility of duplication of resources. Lack of system alerts for potential resource duplication, can lead to planning, for example, one vehicle for two loads, causing confusion and unnecessary complications in work organization.

Another challenge is the time-consuming search for unplanned company resources, such as drivers, vehicles, and trailers, which can lead to a significant slowdown in logistical processes. Manual data entry also carries the risk of frequent errors, which can affect the efficiency and accuracy of transport planning.

The fourth problem is no control over the equipment of vehicles and trailers. The lack of effective control over the equipment of vehicles and trailers presents an additional obstacle, making it difficult to ensure the full technical readiness of the means of transport for order execution.

All these factors together impact the overall operational efficiency, increasing costs and the risk of delays in deliveries. An advantage of the TMS and ERP system is the ability to be flexible and fact that can adapt to mostly every need of the company. Using the system should be smooth and mistakes should be limited to minimum. In order to improve the transport management system, it is crucial to implement an alternative implementation that automates and optimizes these repetitive tasks, reducing work time and minimizing the risk of errors. Even minor modifications can significantly enhance efficiency and streamline workflows, making tasks both simpler and swifter to do. The right flow of information can help both to optimize the use of resources and to improve the coordination of flows in the supply chain, which can lead to improved ergonomics and reduced costs [14].

## 4 Methodology

The research methodology concerning the ergonomics of the TMS system is based on data and information sourced from a company currently using the TMS AndSoft system. These statistics provide comprehensive insights into various operational metrics and performance indicators relevant to the research, such as downtime of vehicle. By leveraging these data, we ensure that the analysis is grounded in the actual experiences of the organization. This approach allows for a examination of the impact of system enhancements on operational efficiency based on data collected from company's operational framework. Operational information, such as the times for completing specific tasks by dispatchers, was obtained from the company's internal reports. The time spent by dispatchers on performing selected tasks was measured, with the research sample consisting of 30 dispatchers at a similar level of proficiency in using the system, allowing for the acquisition of averaged results. The collected data enabled the determination of the average time required to complete transportation execution instructions. Times were measured twice, before and after the implementation of system changes. Based on the collected data, average times needed to complete transportation execution instructions were calculated. The measured times were compared with previous results to assess the improvement in ergonomics. Additionally, the research methodology included a literature review, which provided theoretical foundations on TMS systems, ergonomics, and process optimization in logistics. The financial data included average salaries for the position of international transport dispatcher in Poland, as well as average repair rates charged by truck service centers in the event of road breakdowns. This data was obtained from the company's documentation and market analyses.

It is important to emphasize that the research concerning the ergonomics of the TMS system originated from a bottom-up initiative proposed by employees using the system. Employees, based on their daily experiences and challenges related to system operation, identified specific areas requiring improvements. Their suggestions formed the basis for implementing changes aimed at increasing the efficiency and convenience of using the TMS system. This approach allowed for the direct consideration of practical aspects and the actual needs of users.

Additionally, the idea of introducing self-diagnosing vehicles was derived from the literature and existing practices in the transport field. Such solutions are already being used in various transport sectors, confirming their effectiveness in monitoring the technical condition of the fleet in real-time. Self-diagnosing vehicles enable the early detection of potential failures and the execution of necessary repairs before they affect the execution of orders. This allows companies to enhance the reliability of their transport operations and ensure a higher level of safety. Integrating this solution with the TMS system represents another step towards more advanced and automated logistics.

## 5 Increasing the efficiency of the forwarder by improving the ergonomics of the TMS system

This article mainly introduces a novelty study that explores a practical approach to the ergonomics of a TMS system, with analyses aimed at measuring the time and financial benefits resulting from better adapting the system to the specific nature of a dispatcher's work.

One of the main novelty is the introduction of automation during replenishment of resources. In the below figure (Figure 9.) we see a generated empty order that must be supplemented with resources and then sent to drivers. Proposition of time saving improvement is the ability to adjust the generated order with an earlier division, tasks and elements that will be performed permanently by one driver. For this purpose, an additional column with name: "instruction number" has been added, which shows the division of work created when completing instructions.

So far, resources are assigned individually to each segment and the dispatcher is forced to assign it to all of them manually. The use of automation processes during the execution of key planning processes and system operation can contribute to increased efficiency, ergonomic and improved security and quality of performed activities. The completion of the first segment would automatically complete the vehicle and the semi-trailer to the very end of the instructions and the driver to the point where his plan ends. Then, entering the next segment, it could be filled only by adding the initials of the next segment, which would automatically add information in every segment marked with the digit 2.


SEGMENTS

| G.DIRECT | ASSIGN | LEG | ACTIONS | TRIP | SUBCO | TRUCK | DRIVER | TRAILER | DATE LO | DATE UN | MISSIONS | TP ID | INSTR. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 579807 | | GR2500395154 | | | | | 22/03/2025 22:00 | 22/03/2025 23:50 | 2 | | 1 |
| | | 579808 | | GR2500395156 | | | | | 22/03/2025 23:50 | 23/03/2025 02:17 | 2 | 16 | 2 |
| | | 579811 | | GR2500395153 | SCAND DK | | | | 23/03/2025 02:17 | 23/03/2025 03:17 | 2 | 16 | 2 |
| | | 579812 | | GR2500395157 | | | | | 23/03/2025 03:17 | 23/03/2025 05:00 | 2 | 16 | 2 |
| | | 579809 | | GR2500395158 | | | | | 23/03/2025 05:00 | 23/03/2025 06:00 | 3 | | 3 |
| | | 579810 | | GR2500395159 | | | | | 23/03/2025 06:00 | 23/03/2025 11:00 | 3 | | 3 |

*Figure 9 Empty order*

Filling out each segment on the list takes 5 seconds, and the entire instruction consists of 8 segments. We need a total of 40 seconds to prepare everything completely. However, when automation comes into play along with assigning fixed tasks to a single driver, the whole process is reduced to three quick actions, each taking 5 seconds. In total, this takes only 15 seconds. As a result, we save 25 seconds on each such operation, which, in percentage terms, gives us as much as 62.5% less time spent on this task. Assuming that a dispatcher completes about 15 such instructions per day and the company employs over 30 dispatchers, we can estimate the specific benefits of automation.

**Time benefits**

1. Time saved per dispatcher per day:

$$15\ instructions \times 25\ seconds = 375\ seconds\ (or\ 6\ minutes\ and\ 15\ seconds)$$

2. Time saved by all dispatchers per day:

$$30\ dispatchers \times 6\ min\ and\ 15\ sec = 187\ min\ and\ 30\ sec\ (or\ 3\ hours, 7\ min\ and\ 30\ \text{sec})$$

3. Time saved by all dispatchers per month (assuming 20 working days):

$$3\ hours, 7\ minutes, and\ 30\ seconds \times 20\ days = 62\ hours\ and\ 30\ minutes$$

4. Time saved by all dispatchers per year (assuming 240 working days):

$$62\ hours\ and\ 30\ minutes \times 12\ months = 750\ hours$$

**Financial benefits**

Assuming an average hourly wage for a dispatcher is 30 PLN (example rate):

1. Monthly savings:
$$62.5\ hours \times 30\ PLN = 1875\ PLN$$

2. Annual savings:
$$750\ hours \times 30\ PLN = 22{,}500\ PLN$$

In summary, automation and assigning fixed tasks to a single driver not only reduce the time required to prepare instructions but also provide financial benefits in terms of saved dispatcher work hours. Over the course of a year, the company can save up to 750 working hours, translating to 22,500 PLN.

For the second novelty improvement proposal is the implementation of an alert and notification system (Figure 10) in the event of a collision or duplication of assigned resources on the same transport days or an incorrect resource. This would inform users of a typing error. The system indicates an error by generating an alert in the form of an exclamation mark and changing the color of the corresponding fields to red, which would immediately draw attention to a potential problem. Visualization of errors is one of the elements of Lean Management and can contribute to minimizing errors and effectively highlighting errors causing an increase in the effectiveness of the management of operational processes.

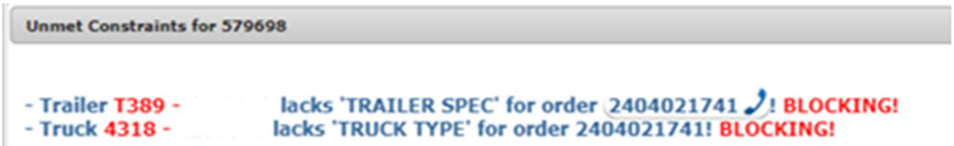


*Figure 10 Alert system*

Applying this tool can bring the following benefits:

- prevention of mistakes - alert system can minimize human errors by providing notifications and reminders, enhancing accuracy and reliability in tasks,
- clear sign that resources should be checked - An alert system acts as an automated prompt for resource checks, ensuring that nothing is overlooked, and that all equipment is on correct place,
- improving the quality of offered services - By integrating alerts that prevent oversight and mistakes, the overall quality of services improves, leading to increased customer satisfaction and a stronger reputation for reliability,
- reducing the cost of potential errors caused on loading places.

Another proposal for the third novelty is to introduce a system of automatic assignment of resources to orders based on synchronization of the “Availability Resources” tab with the “Orders” tab. This operation would require the user to enter into the system the requirements for a specific order once (type of trailer and vehicle, load capacity and the level of utilization of the cargo space - choosing the most suitable type of semi-trailer). It would be the same information required for the previous proposition for the alerts. So, there will be two advantages in one. Due to this information, the system, using the available filters and data, could introduce proposals for automatic replenishment of free resources. This would only require the user to accept the system proposal or reject it and enter resources manually. Proposals would be available from the point of entering resources into the order and reduce the time of manually searching in the system for not used resources. Additionally, the system could also propose at first the trailer which his load capacity and the level of utilization of the cargo space will be the most suitable for the loading (Figure 11). As a result of use of this tool, the system would also take into account the fact of long-term vehicle downtime - the first priority would be vehicles or trailers that have not been used for a long time to make them active and used for work again. The same will be for the drivers - As for the indicator of work performed by drivers, this would also translate into the visualization of the number of hours worked - including kilometers traveled.

Acta logistica - International Scientific Journal about Logistics
Volume: 12 2025 Issue: 1 Pages: 63-76 ISSN 1339-5629


| TRAILER | ENDING POINT | CITY EP | TYPE | SPEC | LOADING CAPACITY |
|---|---|---|---|---|---|
| T668 | 10.04.2024 16:30 | GREVE | Standard | Box | 66 EUR |
| T616 | 10.04.2024 15:00 | GREVE | Standard | Box | 66 EUR |
| T724 | 09.04.2024 23:00 | GREVE | Standard | Box | 66 EUR |
| T627 | 09.04.2024 16:30 | GREVE | Standard | Box | 66 EUR |
| T615 | 09.04.2024 16:15 | GREVE | Standard | Box | 66 EUR |
| T776 | 09.04.2024 16:00 | GREVE | Standard | Box | 66 EUR |
| T831 | 09.04.2024 13:00 | GREVE | Standard | Box | 66 EUR |
| T906 | 09.04.2024 09:00 | GREVE | Standard | BOX | 66 EUR |
| T899 | 09.04.2024 03:15 | GREVE | Standard | BOX | 66 EUR |
| T895 | 08.04.2024 16:15 | GREVE | Standard | BOX TAPA | 66 EUR |
| T775 | 08.04.2024 15:00 | GREVE | Standard | Box | 66 EUR |

*Figure 11 Example of proposition for trailer to use*

Last proposition of novelty is development of a vehicle condition monitoring system. The on-board computer of the vehicle in real time would supervise and control the operation and condition of the vehicle - reading parameters (oil state, liquids, air leaks, tire pressure, air pressure, brake system or others). In the event of a breakdown (of course, one that is not required to be repaired immediately - necessary for safe continuation of the journey), the on-board computer would send a notification to the operator at the company with the relevant information along with a description of the fault and a preliminary scope of work required and a proposal for the repair [15].

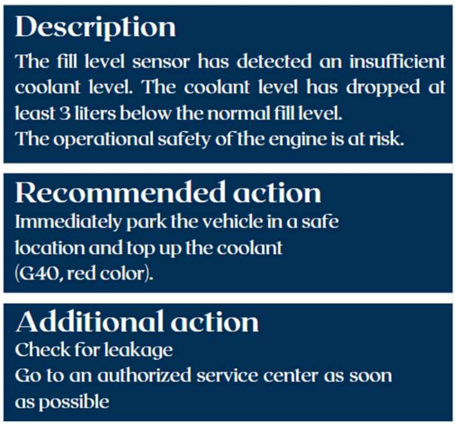


*Figure 12 Example of notification*

It can be an email or just a notification in the system (Figure 12). In addition, based on market prices and price lists available from servicing companies (ASO services) of individual repairs, the system would also show an approximate cost of repairs. Implementing such a system can contribute to:

- Avoidance of breakdowns and the ability to quickly repair the vehicle and execute the transport order on time,
- The time spent in the workshop and the associated downtime of the car are reduced to a minimum,
- Avoiding unnecessary workshop visits and repair costs,
- Information on the current state of wear of parts and fluids,
- Forecast of necessary maintenance activities.

In terms of numbers, the introduction of this system can bring the following benefits:

Reduce vehicle downtime
- Current Downtime: 10 days per vehicle per year
- Assuming a 50% reduction in downtime
- Downtime saved per vehicle: 5 days per year
- Fleet: 100 vehicles
- Total time saved: 500 days

Reduction of repair costs
- Cost of emergency repair in the field: 5000 PLN per vehicle
- Cost of planned repair: 3000 PLN per vehicle
- Annual breakdown rate: 10% (10 vehicles per year)
- Savings on repairs: 2000 PLN per vehicle
- Total savings: 2000 PLN x 100 vehicles = 200,000 PLN per year

Fuel optimization
- Average annual fuel consumption per vehicle: 50,000 liters
- Fuel savings: 5%
- Fuel savings per vehicle: 2,500 liters
- Fuel price: 5 PLN per liter
- Fuel savings per vehicle: PLN 12,500 per year
- Fleet: 100 vehicles
- Total fuel savings: PLN 12,500 x 100 vehicles = PLN 1,250,000 per year

Summary
- Downtime saved: 500 days per year
- Repair savings: 200,000 PLN per year

- Fuel savings: 1,250,000 PLN per year
- Total savings: 1,450,000 PLN per year

The implementation of these improvements will allow for better management of resources, significant improvements in ergonomics, greater user satisfaction, faster response to technical and operational problems and optimization of logistics processes, which in the long run will bring significant savings and improve the quality of services provided by companies.

The first three improvements – the alert system, synchronization of "orders" and "availability resources" tabs, and cascading instructions – are unlikely to involve additional costs, depending on the software vendor. These costs can already be covered by current operating fees and software vendor support. However, the implementation of these features will require implementation and programming of fixes, and then updating the system. The whole can last from 1 to 3 months.

On the other hand, implementing a self-diagnosis system, which monitors the technical condition of the fleet in real time, will be more demanding in terms of both cost and time. The estimated costs of implementing this solution may vary depending on the size of the fleet and the complexity of the system, but they can be assumed to be significant because all vehicles will have to be equipped with the appropriate equipment installed in the engines and programmed with the system. The time needed to fully implement such a system is usually several months, due to the need to integrate with existing infrastructure and train staff.

TMS systems are an excellent ready-made solution for transport and forwarding companies. In addition, much better results can be obtained by relatively low financial outlays on adapting the system to the individual needs of the company.

However, implementing the discussed system improvements also presents certain challenges that must be addressed. Understanding, identifying, and discussing these challenges is crucial for fully comprehending the process. The first potential issue is employee resistance to change. Users accustomed to existing procedures and systems may be skeptical about new solutions. These concerns may stem from fear of the unknown, a lack of understanding of the benefits, and a perceived threat to their work routines. This resistance can impact the success or failure of the changes. Researchers have long studied the causes of resistance and methods to manage it, many of them highlight that employee perceptions of fairness and reciprocity play crucial roles in the success of organizational changes [16]. Insights from these studies are particularly relevant in today's era of constant change, where managing employee resistance is crucial for organizational success. Effective communication of the purpose and benefits of new solutions is essential. It is important that employees have the opportunity to express their opinions and concerns about the proposed changes. This can be achieved by creating working groups responsible for testing and evaluating new system functionalities. A participatory approach allows for the early identification of potential issues and the implementation of necessary adjustments before the system is fully deployed [17].

Another challenge involves the costs associated with implementing system changes. Depending on the system provider, reprogramming and introducing new features may incur additional costs. If a company is already subscribing to a system, the introduction of new features might only be a one-time cost. Nevertheless, it is essential to conduct a detailed cost-benefit analysis to ensure that the investment yields the expected returns. Additionally, there are technical challenges related to integrating new functionalities with the existing system. Ensuring compatibility between new solutions and current systems is crucial to prevent issues with the flow or management of information and operational functionality. Furthermore, it is important to consider data security aspects. New systems must be protected against potential cybersecurity threats to safeguard sensitive information from unauthorized access [18].

The final aspect is change management. It is vital to involve all users, maintain transparent communication, and monitor progress to ensure that the implementation proceeds according to plan and achieves the intended goals. Incorporating these elements into the deployment strategy will minimize risk and maximize the benefits derived from ergonomic improvements in the TMS system, thus optimizing logistics and the flow or management of material, financial, and human flows [19].

Moreover, a huge advantage of the TMS and ERP system is the ability to be flexible and fact that can adapt to mostly every need of the company. Working on the system should be smooth and mistakes should be kept to a minimum. However, as it is known not everything is perfect, but according to the ethos of Kaizen, which inspires to constantly improve, it still can be a step closer to reach it.

Modern technologies such as robotics, advanced GPS systems and artificial intelligence enable transport companies to reduce costs, optimize processes and, most importantly, improve financial results. Over time, more and more companies are willing to implement innovative solutions to improve and streamline transport and delivery operations [20]. Flexibility, development and training of employees, and above all simplicity and ergonomics of systems, will be the key to improving decision-making and work processes in companies [21].

The flexibility of TMS systems and their ability to adapt to specific needs and changes enable continuous development, improvement, and progression toward perfection. Enhancements to logistics systems largely result in better ergonomics for day-to-day operations, higher service quality, and minimized errors. The ergonomics of the system, or its adaptation to the users' needs, plays a crucial role here [2]. The proposed improvements are only a part of the potential developments that can be integrated into the system, tailored to the specific requirements of all company departments. Enhancing the ergonomics of logistics systems not only improves daily operations but also enhances the quality of services offered and increases competitiveness. Innovative solutions facilitate better responses to market changes, more accurate data analysis, and more efficient resource management. The potential adoption of these technologies highlights the company's commitment to utilizing advanced logistics solutions to optimize operations. The ongoing evaluation of these proposals focuses on ensuring that any new implementation provides a tangible return on investment, both in terms of financial savings and operational improvements. By carefully considering the integration of these systems, the company aims to strengthen the technical elements of logistics, thereby supporting its strategic goals of enhanced efficiency, reduced costs, and improved service quality. This strategic approach underscores the importance of leveraging cutting-edge logistics solutions to maintain a competitive edge and drive continuous organizational growth.

## 6 Conclusion

TMS systems are of great importance, and ergonomics plays a crucial role in their functionality. Significant changes are possible thanks to continuous improvement and ongoing monitoring of technological innovations, such as the on-the-job sensors that provide valuable real-time vehicle status data. It is worth noting that two of the four proposed improvements have already been implemented in practice in the company.

Although the TMS system has been effectively utilized in various organizations for many years, it faces certain challenges, such as employee resistance to change, costs associated with implementing system changes, and change management issues.

In response to the identified issues, an initiative from employees has emerged to introduce several key modifications aimed at improving the functionality and ergonomics of the TMS system.

Empirical research conducted after implementing the proposed modifications revealed that these improvements significantly enhanced operational efficiency, increased planning accuracy, reduced order fulfillment time, and contributed to cost reductions.

The first implemented feature is the additional column for automatic replenishment of resources, which has significantly improved the flow of information and management processes. This column allows for the automatic entry of resources into orders, reducing the number of errors associated with manual data entry and saving a considerable amount of time. It automates the process of resource replenishment, enabling dispatchers to manage their tasks more efficiently. This automation not only enhances the efficiency of logistics operations but also increases the ergonomics of the TMS, making it more user-friendly and tailored to the needs of its users. Statistics and conducted studies indicate that a person responsible for completing orders and preparing instructions handles around 15 instructions daily, and there are approximately 30 such individuals in the company. The time needed to complete these tasks, after the introduction of the mentioned column, has been reduced from forty seconds to fifteen seconds, saving twenty-five seconds on each planning operation. A dispatcher completing 15 such instructions can save 6 minutes and 15 seconds per day, which translates to 62.5 hours per year per person. Considering all dispatchers, this amounts to a saving of 750 hours annually in completing instructions. This feature not only optimizes the flow of information and material management within the system but also significantly enhances the overall efficiency and effectiveness of the company's logistics operations.

The implementation of an alert and notification system is designed to address issues such as resource collisions, duplications on the same transport days, or the assignment of incorrect resources. This system immediately notifies users of potential errors by generating alerts, represented by an exclamation mark, and changing the color of the affected fields to red. By clearly and promptly highlighting errors, the system reduces the likelihood of mistakes and enhances the effectiveness of managing operational processes. This feature contributes to more efficient logistics management by ensuring that all resources are accurately and appropriately allocated, thereby improving the overall reliability and performance of the company's transport operations. In addition to minimizing planning errors, the alert system enhances the accuracy of logistics operations by providing real-time alerts to users and highlighting potential mistakes or discrepancies in the planning process. For instance, if an inconsistency is detected between the scheduled resources and the actual availability, the system immediately notifies the relevant personnel. This functionality ensures that errors are promptly addressed, thereby improving the overall quality and reliability of logistics processes. Moreover, the alert system enhances the flow of information within the organization, enabling swift decision-making and proactive management of logistics operations. This integrated approach to error management and real-time notifications helps streamline the allocation of resources and ensures a smooth flow of operations, ultimately contributing to the efficiency and effectiveness of the company's logistics management.

Two of the proposed enhancements remain under consideration and are subject to a cost-benefit analysis for potential implementation. These include the synchronization of the "orders" and "availability resources" tabs and the self-diagnosing vehicle system. The synchronization feature would allow for more efficient identification of unplanned resources, thereby optimizing resource utilization and streamlining the planning process.

This capability would enable a smoother integration of various logistics elements, improving the flow or management of available resources and information within the system. Although not yet implemented, this proposal is seen as a valuable addition that could further enhance the operational efficiency of the company.

IT systems are considered responsible for the efficient organization of data processing and information exchange within the system and with other external entities [22]. The company's TMS collects real-time data, which is then analyzed to provide valuable insights into fleet performance and operations. Measurability in the TMS plays a crucial role, as planning and operational aspects such as on-time delivery ratios and trailer and driver utilization can be accurately calculated and measured [23]. All these aspects contribute to improving the ergonomics of the entire logistics process [24]. The synchronization of the "orders" and "availability resources" tabs enables more efficient identification of free, unplanned company resources, significantly speeding up the planning process and, consequently, the fulfillment of orders. This also allows for more optimal use of resources that have been inactive for an extended period. Additionally, the proposed implementation of an alert system will minimize planning errors by clearly highlighting them, thus increasing the system's ergonomics.

Last one is the self-diagnosing vehicle system is one of the proposed innovative solution. This system would provide real-time diagnostic information about vehicles, significantly reducing downtime and maintenance costs by enabling preventive maintenance. Such technology is already in use in various fields, with some vehicle manufacturers, like Mercedes-Benz, offering similar solutions. For example, Mercedes-Benz's advanced diagnostics systems can monitor the health of vehicle components, predict maintenance needs, and alert drivers and fleet managers to potential issues before they result in costly breakdowns. This proactive approach not only improves the flow of information and material management within transport logistics but also enhances the overall reliability and efficiency of the fleet. Based on the conducted research, implementation of the system of a self-diagnosis system could reduce downtime by 50%, which in a company with 100 vehicles will save as much as 500 days of vehicle downtime. Moreover, the cost of scheduled repairs in the service compared to repairs of breakdowns on the road is able to save 2000 PLN per vehicle, which on a yearly scale and with 100 vehicles will amount to as much as 200 000 PLN savings. In addition, five percent optimisation of fuel consumption at assumed prices and average fuel consumption through ongoing servicing of fluids and components in vehicles can bring savings of 1,250,000 PLN per year for 100 vehicles. In the context of transport management, this could be one of the next breakthroughs. The implementation of these cutting-edge solutions allows efficient management of fleet servicing, minimising downtime, breakdowns and reducing repair costs [21].

The modified system is now operational in the company in a form that provides better integration with other tools, reduces the number of errors, positively impacts user well-being and work, and allows for more efficient management of resources and information.

In future research, we plan to conduct a comparative analysis of TMS systems with a focus on ergonomics. Additionally, we aim to undertake an in-depth modification of the TMS AndSoft system, accompanied by a comprehensive qualitative analysis of improvements in work efficiency.

## References

[1] HENSEL J.S.: Service quality improvement and control: A customer-based approach, *Journal of Business Research*, Vol. 20, No. 1, pp. 43-54, 1990. https://doi.org/10.1016/0148-2963(90)90041-B

[2] MAREK, M.: *Ergonomics of information systems*, Lublin University of Technology, Lublin, 2014. (Original in Polish)

[3] ZHANG, M., LI, H., TIAN, S.: Visual analysis of machine learning methods in the field of ergonomics — Based on Cite Space V, *International Journal of Industrial Ergonomics*, Vol. 93, Vol. January, 103395, pp. 1-10, 2023. https://doi.org/10.1016/j.ergon.2022.103395

[4] KARWOWSKI, W.: *The Discipline of Ergonomics and Human Factors*, In: Salvendy, G.*: Handbook of Human Factors and Ergonomics*, 3rd ed., John Wiley & Sons, Inc., 2006. https://doi.org/10.1002/0470048204.ch1

[5] KIRAN, D.R.: *Work Organization and Methods Engineering for Productivity*, Butterworth-Heinemann, pp. 219-232, 2020. https://doi.org/10.1016/B978-0-12-819956-5.00016-9

[6] ŻUKOWSKI, P., KOTUŁA, A.: Ergonomics as an Applied Scientific Discipline: (Methodological Issues), *Problems of Profesiology*, Vol. 2006, No. 1, pp. 13-27, 2006. (Original in Polish)

[7] PAAP, K.R.: *User Interface Design*, In: Smelser, N.J., Baltes, P.B. (ed.), International Encyclopedia of the Social & Behavioral Sciences, Pergamon, pp. 16104-16107, 2001. https://doi.org/10.1016/B0-08-043076-7/01622-3

[8] HASANAIN, B.: The Role of Ergonomic and Human Factors in Sustainable Manufacturing: A Review, *Machines*, Vol. 12, No. 3, pp. 1-27, 2024. https://doi.org/10.3390/machines12030159

[9] FAHIMNIA, B., MOLAEI, R., EBRAHIMI, M.H.: *18 - Integration in Logistics Planning and Optimization*, In: Farahani, R.Z., Rezapor, S., Kardar, l. (ed.), Logistics Operations and Management, Elsevier, pp. 371-391, 2011. https://doi.org/10.1016/B978-0-12-385202-1.00018-9

[10] SOLANO, M.C., CRUZ, J.C.: Integrating Analytics in Enterprise Systems: A Systematic Literature

Review of Impacts and Innovations, *Administrative Sciences*, Vol. 14, No, 7, pp. 1-26, 2024. https://doi.org/10.3390/admsci14070138

[11] AROBA, O.J., ABAYOMI, A.: An implementation of SAP enterprise resource planning – A case study of the South African revenue services and taxation sectors, *Cogent Social Sciences*, Vol. 9, No. 1, pp. 1-11, 2023. https://doi.org/10.1080/23311886.2023.2228060

[12] STĘPNIAK, C., SOBOCIŃSKI, M., CHLUSKI, A.: *ERP systems in logistics processes*, Wydawnictwo Politechniki Częstochowskiej, Częstochowa, 2020. (Original in Polish)

[13] HAO, Z., QI, GONG, T, CHEN, L., SHEN, Z.M.: Innovation uncertainty, new product press timing and strategic consumers, *Omega*, Vol. 89, pp. 122-135, 2019. https://doi.org/10.1016/j.omega.2018.09.011

[14] CHOPRA, S., MEINDL, P.: *Supply Chain Management: Strategy, Planning, and Operation*, 6th ed., Pearson, 2014.

[15] MERCEDES-BENZ, *Mercedes-Benz Trucks Uptime*, [Online], Available: https://www.uptime-demo.mercedes-benz.com/#/ [27 May 2024], 2024.

[16] KRUGEL, J.P., TRAUB, S.: Reciprocity and resistance to change: An experimental study, *Journal of Economic Behavior & Organization*, Vol. 147, pp. 95-114, 2018. https://doi.org/10.1016/j.jebo.2017.12.017

[17] HUSSAIN, S.T., LEI, S., AKRAM, T., HAIDER, M.J., HUSSAINH, S.H., ALI, M.: Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change, *Journal of Innovation & Knowledge*, Vol. 3, No. 3, pp. 123-127, 2018. https://doi.org/10.1016/j.jik.2016.07.002

[18] CHEUNG, K.-M., BELL, M.G.H., BHATTACHARJYA, J.: Cybersecurity in logistics and supply chain management: An overview and future research directions, *Transportation Research Part E: Logistics and Transportation Review*, Vol. 146, pp. 1-18, 2021. https://doi.org/10.1016/j.tre.2020.102217

[19] CARPENTER, J.: *5 - Managing human resources within a project*, In: Chandos Information Professional Series, Project Management in Libraries, Archives and Museums, Chandos Publishing, pp. 85-105, 2011. https://doi.org/10.1016/B978-1-84334-566-4.50005-9

[20] CASCETTA, E., HENKE, I.: The seventh transport revolution and the new challenges for sustainable mobility, *Journal of Urban Mobility*, Vol. 4, pp. 1-20, 2023. https://doi.org/10.1016/j.urbmob.2023.100059

[21] COLOVIC, G.: *4 - Ergonomic workplace*, In: Management of Technology Systems in Garment Industry, Woodhead Publishing India, pp. 80-105, 2011. https://doi.org/10.1533/9780857094049.80

[22] DOUCET, M.S., DOUCET, T.A.: *Control and Auditing*, In: Bidgoli, H. (ed.) Encyclopedia of Information Systems, Elsevier, pp. 287-305, 2003. https://doi.org/10.1016/B0-12-227240-4/00019-8

[23] KARIM, A., SAMARANAYAKE, P., SMITH, A.J.R., HALGAMUGE, S.: An on-time delivery improvement model for manufacturing organisations, *International Journal of Production Research*, Vol. 48, No. 8, pp. 2373-2394, 2010. http://doi.org/10.1080/00207540802642245

[24] HORVATHOVA, B., DULINA, L., ČECHOVA, I., GASO, M., BIGOSOVA, E.: Data collection for ergonomic evaluation at logistics workplaces using sensor system, *Transportation Research Procedia*, Vol. 40, pp. 1067-1072, 2019. https://doi.org/10.1016/j.trpro.2019.07.149

**Review process**
Single-blind peer review process.