

# USER INTERFACE OF AN INNOVATIVE EXTERNAL BAGGAGE STORAGE SYSTEM FOR PUBLIC TRANSPORTATIONS

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**Abstract:** An innovative external baggage storage system for public transportation has been developed to ensure the ergonomic requirements. This paper proposes, for this system, a user interface that increases the level of comfort and security for train passengers. The interaction between the storage system and the final user it's based on a complex scenario which includes the analysis of train stops time frames, type of luggage, train station configuration and the user's age.

**Keywords:** PUBLIC TRANSPORTATION, STORAGE SYSTEM, ERGONOMIC, USER INTERFACE

## 1. Introduction

The purpose of this study is to analyze the current state of comfort and accessibility in public transport by rail and how they interfere with passenger transport options and their comfort when using these services. This study is based on surveys conducted in Europe by various companies specialized in this field and on statistical data recorded during simulations of passenger behavior and time tables on various train routes in Romania in the last 3 years by studying [1].

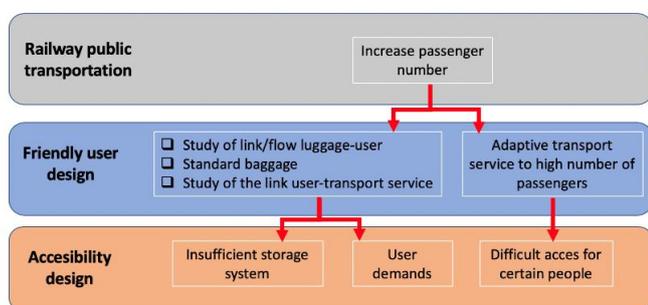
The study shows that there are various situations in Europe in terms of passenger comfort, accessibility and security, and areas requiring improvements in rail transport services.

These surveys concluded that the major difficulties are embarkation in train, finding the reserved place, access to storage spaces, reduced mobility inside trains, uncomfortable chairs and the lack of security system.

The research is focused on the study of elderly people, people with disabilities and tourists. The results of this work will be relevant to future development and design, in terms of ergonomics, accessibility and comfort, in the public transport area. This study is aiming to optimize the flow between the passenger and luggage module by using the same user interface.

A major concern in rail passenger services is to find and assess the level of customer satisfaction. This level of satisfaction is largely influenced by the following factors: comfort, accessibility and security. Although these factors have been improved over the past 20 years, there are still major problems that require resolution and situations requiring improvement (figure 1), according to the information presented in the following study.

The impact of passenger dissatisfaction with rail transport services can lead to operational and financial costs. Also, this can impact environment in terms of people preferring to use personal transportation (greater pollution and more congested roads) [2].



**Fig. 1** Global increasing of passenger using public transportation *Грешка! Източникът на препратката не е намерен.*

In this study, the time required for different types of passengers to embark and disembark from the train is measured. Passengers aged between 15 to 70 years with heavy or light luggage are considered. Data was also collected during several train journeys,

with a large baggage experimenting with the storage solutions offered inside the train [3].

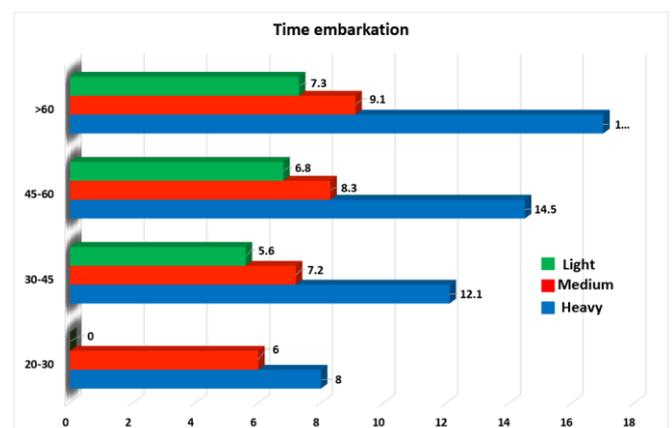
## 2. Ergonomic environment *Грешка! Източникът на препратката не е намерен.*

The comfort or discomfort of train passengers vary according to the purpose of the journey, the age of the passengers, the type of the wagon and the length of the journey. The influence of these factors increases when agglomeration exceeds a certain level, due to inadequate baggage storage or exceeding the normal journey capacity.

Human behavior has a special role in a properly constructed ergonomic environment. Psychological, behavioral and physical factors are needed to be analyzed in order to determine their influence on passenger comfort. Ethnographic methods can also be used to understand passengers behavior so that the user does not feel constrained in any way when traveling.

The constant changing technology can be used to inform, influence and direct passengers to make better use of the solutions offered for travel. Besides that, it is very important how the design impacts passenger behavior.

To determine the efficiency of accessibility and ergonomics offered by the train's characteristics in relation to human behavior, the time required for different passengers for boarding and disembarking from the train was measured [4]. The time measurement process was carried out during various hours of the day, including peak hours. By analyzing these times, adjustments can be made to the access routes and inside the train to achieve a better flow of passengers during the embarkation and disembarkation process.



**Fig. 2** Time analysis for embarkation *Грешка! Източникът на препратката не е намерен.*

A wide range of metal powders (from light alloys through steels to super-alloys and composites) is currently available for DMLS

process and other new materials are under development. Table 1 lists mechanical properties of selected powder materials.

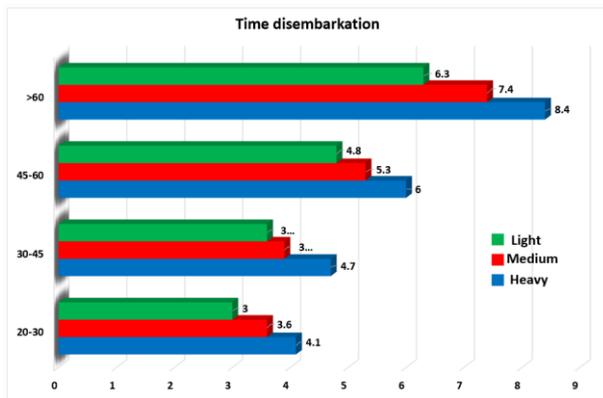


Fig. 3 Time analysis for disembarkation Грешка! Източникът на препратката не е намерен.

Thus, in case of medium and large luggage, the average disembarkation time for people aged from 20 to 35 was 4.54 seconds and for embarkation was 4.91 seconds. For the same type of luggage the average time at disembarkation for people between 35-70 years was 8, 4 seconds, and 8.8 seconds for embarkation. For younger people, boarding or disembarking time was about 2.5 seconds and for the elderly, between 7 and 15 seconds, depending on their luggage.,

Figure 2 and 3 shows disembarkation and boarding times in function of luggage volume for people of different ages was analysed considering stationary times at different stops. An increase in average time can be observed (highlighted in blue) for boarding and disembarking in case of people with large luggage and the elderly (respective of the size of their luggage).

### 3. User interface

The interaction between the user and the module is based on a complex scenario. The module is mounted on a train wagon and there is a live communication interface with the railway service provider. The scenario takes into account stationary times, the type of baggage and user age.

The user has access to a deposit space in the moment of buying the ticket. This will probably require an additional cost (figure 4).

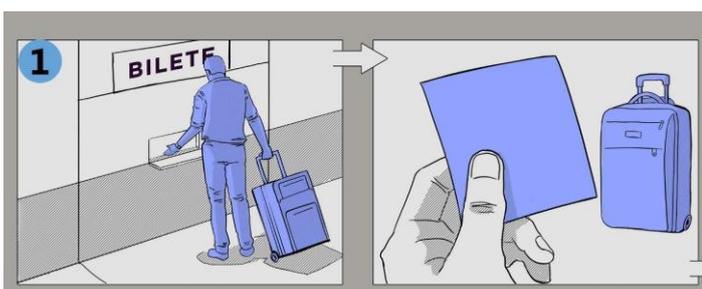


Fig. 4 Scenario: First step- Purchasing the ticket for deposit space Грешка! Източникът на препратката не е намерен.

The allocation of a deposit space it is done by a software. This software process the availability of spaces and destination stations. Boundaries are put in place, to avoid overloading a module, using methods to uniform the distributing of the seats for the entire train wagon.

Access to the deposit space is possible by scanning the barcode printed on the ticket at the time of purchase (figure 5). The ticket scan sends a command to the module to select the allocated deposit space [5], bringing it to the level of the user (figure 6).

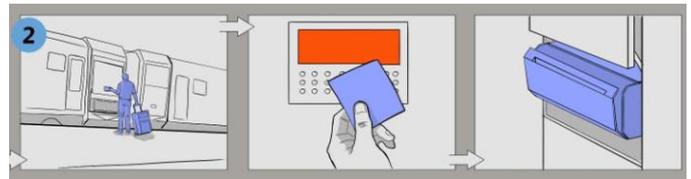


Fig. 5 Scenario: Second step- Automatically assignment of deposit space Грешка! Източникът на препратката не е намерен.

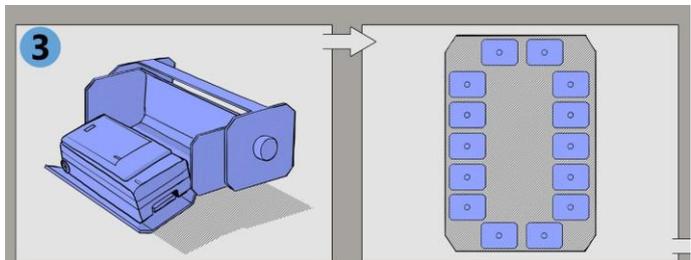


Fig. 6 Scenario: Third step- System pick up of the luggage.

The system takes the capsule with the luggage in, then prepares another capsule for the next user (figure 6).

To access the baggage at the destination station, the user has to scan the ticket on a device located inside the wagon in the immediate vicinity of the access door (figure 7). The location of the scanning device, is based on the intention of organizing and fluidizing access to the module. The time required for pick up the luggage from the deposit space is equivalent with the time needed for the passenger to scan the ticket, disembark the train and arrive in front of the module.

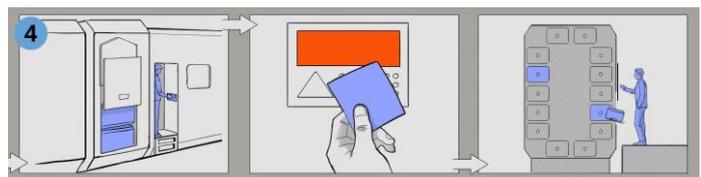


Fig. 7 Scenario: Fourth step- Pick up the luggage at destination.

### 4. Conclusions

The external baggage storage system presented in this paper brings an increase in comfort and security for railway transportation users. The system offers adequate storage for luggage and easy access.

The storage dimensions are in total concordance with the existing type of baggage. The module dimensions permit the internal design, to be modified in case of changing the international standards.

Implementation of this system doesn't require administrative staff and has a friendly user interface. Also, the system pick up mechanism it's easy to use, by elderly and people with disabilities.

From a security point of view, the system can be improved, by adding special scanning device in the moment of the pick up.

The proposed concept represent a viable solution which can partially resolve some of the current shortcomings in public transportation.

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