AN INFORMATION SYSTEM AIDING THE PROCESSES OF CARGO LOADING AND SECURING IN RAILWAY TRANSPORT

Augustyn LORENC
Cracow University of Technology, Institute of Rail Vehicles, Jana Pawla II Str. 37, 31-864 Krakow, augustyn@m8.mech.pk.edu.pl
Maciej MICHEJ
Cracow University of Technology, Institute of Rail Vehicles, Jana Pawla II Str. 37, 31-864 Krakow, michnej@m8.mech.pk.edu.pl
Maciej SZKODA
Cracow University of Technology, Institute of Rail Vehicles, Jana Pawla II Str. 37, 31-864 Krakow, maciek@m8.mech.pk.edu.pl

Abstract
The analysis of the actual state showed that at the moment there is no information system which would allow railway transport operators in Europe to obtain the information about a safe, proper, and effective way of loading and securing loads in the means of transport. Therefore, it was acknowledged purposeful to make an attempt to design and then build an information system which would aid the process of choosing adequate loading and securing methods in railway transport. The analysis of the methods of loading and securing various groups of freight with taking into consideration the legally binding regulations and standards allowed the engineers to prepare a set of the initial data of the designed system called LOADFIX. The system reflects current market needs. Preliminary assumptions and the structure of the database of the designed system are discussed in this article.

Keywords:
Information system, railway transport, loading process

1. INTRODUCTION

Loading operations constitute an inherent element of the transportation process. The safety of cargo, loading machines which are used in operations, the railway rolling stock used for transport as well as the safety of running of trains and loading depend on the way in which loading operations are performed. Thus the knowledge of the technique and technology of loading operations is required. Insufficient securing of freight during its transportation results in the risk of damaging both the load or the means of transport as well as injuring the people who are involved in the transportation process. Improper cargo securing causes danger to other transport users. For example, unsecured cargo can hit another vehicle or damage the electric traction which may result in a serious accident. During unloading operations, when the doors or sliding walls are being opened, improperly secured cargo can hurt the workers performing unloading tasks [3].

Proper loading methods and the adequate securing of cargo in railway freight carriages guarantee the safety of running of trains and prevent cargo and carriages damage [4, 7, 9, 10]. The obligatory rules which are applied during cargo loading and cargo securing are included, e.g. in the internal regulations of rail transport operators, the documents of the UIC (International Union of Railways) [2, 5, 6], and trade loading instructions. It is the loader's responsibility to apply the proper methods of cargo loading and securing.

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2. REGULATIONS AND STANDARDS REFERRING TO CARGO LOADING AND CARGO SECURING IN RAILWAY TRANSPORT

The information about issues connected with loading operations and cargo securing during transportation is included in various regulations, instructions, and legal documents, e.g. [9]:
- instructions about loading, company official instructions, instructions on loading machine operations (the technical-operational documentation DTR),
- regulations referring to stations, workstations, loading stands/ramps,
- railway loading regulations: PKP, RIV, SMGS,
- regulations concerning hazardous cargo: RID (in rail transport), ADR (in road transport), IMO (in sea transport) [1], [2], IATA (in air transport),
- national and international standards: PN, ISO, EN, IMO, PRS, of other countries [8],
- legal documents: the law acts relating to railway, the road traffic laws, international contracts (AGC, AGTC), customs regulations, etc.

In rail transport, the UIC guidelines are regarded as the superior instructions:
- Loading guidelines, Section 1: Principles, UIC International Union of Railways [5],
- Loading guidelines, Section 2: Goods, UIC International Union of Railways [6].

3. THE CONCEPT OF THE SYSTEM WHICH AIDS THE LOADING PROCESS AND CONSIGNMENT SECURING

The analysis of the current methods of loading and securing various groups of cargo with taking into consideration the legally binding regulations and standards in load securing allowed the engineers to prepare a set of the in-put data of the designed information system which aids the loading processes and load securing in railway transport. A preliminary block scheme of the application of the system called the LOADFIX has been designed (Fig.1). It was assumed that the system includes several modules, e.g.
- management module,
- database module,
- data transmission module,
- security/protection module,
- access rights structure module,
- module of division of consignment into categories,
- loading method module,
- UIC loading guidelines module,
- language version module,
- consignment damage module,
- photographic and written documentation module,
- transport means parameters module.

The analysis of the predicted functions of the loading process aiding system allows for the determination of the basic set information necessary for the system. The set should be divided logically into component relations that would characterize the following items:
- transport operators
- transport routes,
- transport means,
- loading units,
- merchandise goods,
- loading means,
- regulations and rules (referring to the source documentation),
- loading and load distribution rules,
- methods and means of load securing,
- tables of occurrence identification for statistics,
3. The preparation of the database module – the issue characteristic

The basic condition for fulfilling properly the predicted tasks by the LOADFIX system is the appropriately designed database. The database should contain necessary data referring to the transported goods, transport and loading means, transport routes, requirements concerning the loading process, and other auxiliary data. Taking a type into consideration, the data can be divided into the following types:

- character data,
- numeric data,
- date and time data,
- logical values,
- long texts,
- graphics,
- multimedia data.

The character data refer to all kinds of the strings of alphanumeric characters. They may consist of a determined combinations of letters, digits, and other special signs. This type of data includes also strings built solely from digits providing that the digits do not appear in mathematical expressions or are not created on the basis of a certain mathematical formula. Examples of character data are various names of transported goods; the names, types and identifiers of transport and loading means; and the names and identifiers of initial and terminal stations.
The numeric data may be integers or real numbers. Integers can determine, for example, the number of bogies and axles of the transport means, the number of doors, or the number of separators and secure struts used in load securing. Real numbers can determine the dimensions of the transport means, e.g. the cargo surface and cargo capacity, door dimensions, the floor height, the weight and size of transported load, or transport tariffs/rates.

The date and time data refer to situating specified events on the time axis. They may be calendar dates, e.g. the deadlines of the specific documents which concern loading and unloading processes, the production date of transport means, and also the data which is added in time, e.g. a predicted time of load transport.

Logical values express in a binary way the occurrence of a specific event or a specific characteristic connected with the load, the transport means equipment, transport routes, the load resistance to shocks, and the temperature or humidity influence.

Long texts constitute this type of data which quickly describe a particular issue included in certain documents referring to, e.g. the requirements for securing the load, the load characteristic, or the characteristic of transport means and transport routes.

Graphics data contain different types of calculation schemes, load distribution and securing schemes, and the photographs of transport and loading means. In the database, they are stored as a file address.

Multimedia data are all types of pictures or sounds (e.g. films) which illustrate the properties of transport means, and the loading and transport processes. In the database, they are stored as a file address.

The data listed above may refer to distinguished objects called the entities. They may be places, things, persons, concepts, or events. The quality that describes a certain aspect of an object is its attribute. A certain descriptive identifier can be admitted for an attribute. Its value can be expressed with the use of one of the mentioned data types. The permitted values which can occur for a certain attribute determine the attribute's domain.

Between the entities which can be represented by particular tuples, in the determined relations of the database there are the following relationships:

- mutually unique "one to one" (1:);
- “one to many” (1:*),
- “many to many”(*:*).

The existence of the identical values of chosen attributes in two specified relations is a basis for the establishing of these relationships. It requires a detailed distinguishing of relations and their schemes with the application of the principles of database normalization.

### 3.2 Database schemes

The structure of the database was designed in the SQL Server 2008 in such a way that it fully allows for a module construction of the application. A multi-lingual application works on the basis of one database. All database tables are common; moreover – the number variables are not copied for the subsequent language versions, and the character variables are stored in separate columns for each language version. The language version columns have additional suffixes responsible for translating the original text into a foreign language, e.g. LoadName_EN, LoadName_DE), etc. The scheme of the database is shown in Figure 2.
As a result of pressing the language change button, the value of the $lang variable is changed. It is then stored and remembered for ever in a form of a session on the server (the PHP code).

$_SESSION['lang'])

For such a solution, the question for the database takes the following form:

"SELECT cargo_name$lang, cargo_type, ID_cargo FROM cargos ORDER BY lp"

Whereas, the $lang variable refers to the language suffix, e.g. "_PL" if the Polish language has been selected by the system user, which correspond to the "cargo_name_PL" column. If the standard language has not been changed then the variable is empty ($lang=""). Thus the system chooses the name of the "cargo_name" column from the database by guessing.

The system elements which are permanently in the program, e.g. the elements of the forms such as a “send” button, a “design by” foot, “all rights reserved”, stable elements of the module structure which are not the data ("wagons type", “security”), etc. are stored in a separate table in the database of a similar structure.

For such a solution, the system stable elements are displayed as an enquiry for the database:

“SELECT value$lang FROM translations WHERE ID_translate='1'"

It results in the obtaining of the “send” value if a standard language has not been changed, or the “Wyślij” if the language has been changed to Polish (variable $lang="_PL").
Thanks to this solution the copying of the same data (which could cause errors) is avoided. There is also no need to switch between the bases. Due to the application of the $lang variable in the program code, the system should work relatively quickly since it is unnecessary to create additional questions for choosing language translators.

4. CONCLUSIONS

Further stages of work will include the research and creation of the basic technical and functional modules of applications (i.e. the system architecture). They will be, among others: working on the project of the software of professional modules referring to regulations, changes and conditions of loading, consignment damage, photographic and written documentation, chosen parameters of transport means, and preparation of the modules for communication. Thanks to the presented system it will be possible to, e.g.

– rationalize the work of specialists in loading and transport logistics and of the operators who deal with the loading and securing of goods,
– introduce a unified system as a source of information about cargo loading and securing,
– automate the work process with specialists’ data,
– improve the access to the information regarding the loading process in such a way that the information can be used by a wide range of users,
– provide the user with an adequate orientation in the system’s structure as well as the segmentation of the data of cargo loading and securing,
– guarantee finding useful information on cargo loading and securing.

Completing the works on the system is planned in December, 2015.

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