LoadFix is an information system which enhances security of the loading processes in railway transport

INTRODUCTION

Transportation management is one of the most important logistic processes, since transport costs may amount to 60% of the total logistics costs [10]. The scope and the role of logistics have undergone significant changes in recent years [7, 5]. This change is largely due to the emergence of new technologies that have profoundly affected the practice and significance of logistics management [20, 9, 4]. In addition, with the change in business operations from national to transnational, logistics information systems (LIS) are being recognized as an essential driving force of business success in today’s global marketplace [1]. Nowadays, logistics information systems support all of the logistics processes concerned with acquiring, storing, creating and distributing materials [12]. At the same time the need for real time information will become crucial, putting emphasis on flexible IT-systems that can deal with large amounts of data and are easy to interconnect [19]. The literature of the subject provides many examples for the application of the logistics information systems [14÷17, 22÷24].

Using appropriate methods of loading and securing goods on transport means guarantees traffic safety and prevents damage to the cargo and railway cars [11, 18, 21]. Inappropriate methods of securing goods may also cause serious risks for other rail users, for example an unsecured cargo may hit other vehicles, damage the overhead lines and cause a serious accident [8]. Transport managers are responsible for the decisions, whether to use own or external transport. In particular, they are responsible for the choice of a particular carrier and the specific route of transporting cargo [6, 3]. The loading method depends on many factors, primarily: cargo type, packaging, transport means and type [13]. Depending on them, an appropriate means of transport, method of loading and securing goods are to the selected [2].

1. LOADFIX SYSTEM

The LoadFix system is an application developed in cooperation with the largest Polish railway carrier – PKP Cargo S.A. It helps to select the best method of loading and securing for specific types of goods transported by rail. The user enters the cargo parameters and properties into the system, provides the starting point and destination of the cargo. The system advises the user by presenting the viable methods of securing the cargo, showing the regulations applicable for the route and operator and listing the available fleet for every operator on the route. Railway carriers may use the system in two ways: by searching for information or by entering them into the database. Searching for information is understood as looking through the legal regulations photographic and written documentation, wagon specifications provided by the manufacturer, etc. When it comes to the data entering functionality, the systems allows the operators to input information on their regulations applicable to clients, specifications of modified wagons, photographs showing cargo securing methods, etc.

The presented system will allow, among others:

1 POLITECHNIKA KRAKOWSKA IM. TADEUSZA KOŚCIUSZKI W KRAKOWIE, Wydział Mechaniczny; 31-864 Kraków; al. Jana Pawła II 37. Tel. +48 374 33 25, Fax: +48 374 33 11, augustyn@m8.mech.pk.edu.pl
2 POLITECHNIKA KRAKOWSKA IM. TADEUSZA KOŚCIUSZKI W KRAKOWIE, Wydział Mechaniczny; 31-864 Kraków; al. Jana Pawła II 37. Tel. +48 374 35 22, Fax: +48 374 33 11, michnej@m8.mech.pk.edu.pl
3 POLITECHNIKA KRAKOWSKA IM. TADEUSZA KOŚCIUSZKI W KRAKOWIE, Wydział Mechaniczny; 31-864 Kraków; al. Jana Pawła II 37. Tel. +48 374 35 12, Fax: +48 374 33 11, maciek@m8.mech.pk.edu.pl
The rationalisation of the work of loading and transport organisation specialists as well as other personnel encountering the issues of loading and securing goods,

The introduction of a unified system for a source of information about the loading and securing of goods,

The automation of the process of working with expert data and updates,

The improvement of access to the information about the loading process so that it can be used by a wide group of users,

Providing the user with good orientation in the structure of the system as well as segmentation of data on loading and securing goods,

The guarantee of finding information on shipment loading and securing.

Through a modern application based on Internet technology, the user of the system will gain access to a database of loads and means of transport. By the filtering options, the user will be provided with the method of loading and securing a particular, user-selected group of loads. One of application screens are presented in figure 1.

![Safe loading guidelines module screen view](image)

**Fig. 1.** Safe loading guidelines module screen view

The system will support a coherent approach to the complicated loading and transport safety operations. It will provide access to up-to-date information for a wide group of managers, technical employees and other participants of railway transport operations. The tool is designed especially for railway carriers, for whom the issues of safe and profitable cargo securing and transport are a daily affair. The information will also be useful for every person working with designing the methods for
loads storage and securing in railway transport. In particular, it applies to specialists and transport industry institutions, such as forwarders, employees of companies working with transportation methods and transport safety advisors. Furthermore, the data from the system may be used by technical service personnel (warehouse employees, loading equipment operators, controllers, etc.) directly responsible for receiving the goods, supervising the storage and securing goods during loading, controlling the means of transport and monitoring the goods in transit.

2. SYSTEM ARCHITECTURE

The LoadFix system is an online application. It was designed based on the technologies of: HTML 5.0, CSS 3.0, jQuery 2.1.0, PHP 5.5.14 and databases. The system allows the use of one of several relational databases, depending on the user preferences or capabilities of hosting services providers. The primary databases are:
- Microsoft SQL Server
- Oracle
- MySQL
- PostgreSQL

Providing for the cooperation with other existing systems is one of the key aspects of the LoadFix system. This may be implemented by sharing documents of data packages in a provided format, easy to be transferred and used by other systems. This solution provides increased system functionality by the possibility to use the functions of other specialist applications which are not implemented in LoadFix. The data exchange process may also apply to the IT systems with copies working independently for a period of time, without contacting the database (offline). Syncing the contents of the local databases with the main database of the system is required after a period of offline work. The architecture of the discussed system is presented in figure 2.

Fig. 2. LoadFix system architecture

3. MODULAR DESIGN OF THE SYSTEM

The LoadFix system has a modular design, allowing the separation of different modules, such as wagon specifications, regulations and cargo securing methods. This allows the system to be more clear both in the front-end and back-end, making future updates and expansions easier. The separation of individual modules allows easy specification of user access rights. The relations between the modules are presented in figure 3.

Some of the modules may work independently, despite their integration with other modules. This can be combined with access rights to provide a software which is tailored to special user groups. An
example may be the group of carriers who do not need access to searching transport guidelines and securing loads for specific cargo types and dispatching/destination locations.

**Fig. 3. Modular application structure diagram**

The modules included in the LoadFix system:

- **administration module**, is responsible for the integration of multiple modules (for example: database, access rights structure, goods categories, language versions and other modules for data input). The administration module is the one of the most important modules, as it controls the entire system; without it data input, editing and updating is not possible,

- **database module**, is responsible for entering, collecting and processing number and text data. The module also allows making backup copies of the database and related files on the server,

- **data transfer module**, allows integration with other applications. The module is connected to the security module and access rights structure module. Furthermore, the module uses Microsoft Active Directory to share the data from the LoadFix system with external users (systems),

- **security module**, works in the back-end. It is responsible for the encryption of sensitive data, such as users’ addresses, regulations, etc. saved in the database and their decryption to be displayed by the system,

- **access rights structure module**, allows to manage individual users as well as user groups by administer them rights to access specific portions of information, e.g. viewing/editing wagon specifications, documents, cargo securing methods, etc. The module functions almost entirely in the back-end,

- **shipment division into goods categories module**, is responsible for displaying cargo categories as a results tree. Good were categorised in accordance with UIC guidelines into the following ten basic cargo types: other, metal, agriculture, paper, stone and construction materials, vehicles and machinery, combined transport cargo units, barrels, palletized cargo units, cable drums. Selecting one of the above types will display cargo sub-types – the second category level,

- **loading methods module**, is closely connected with the shipment division into goods categories module. After selecting one of the primary categories from the main page, the system displays a detailed list of cargo subcategories. The division complies with the loads division proposed by UIC,

- **UIC loading guidelines module**, is based on multiple regulations, manuals and legal documents. The safe loading guidelines module is a major module of key importance to the system. It frequently integrates multiple documents. Besides the simple viewing of loading manuals, the module also allows downloading them to a local drive for further offline use,
- **Language versions module**, comprises data stored in multiple tables of the database and text files kept on the FTP server. The module allows to enter translated texts and text files to the database (back-end) and show the selected language version (front-end),

- **Shipment damage module**, allows retrieving up-to-date forms for filing shipment damage claims. These forms are different for various carriers who have their own form layouts based on CIT and AVV,

- **Written and photographic documentation module**, is an additional module for storing data entered by users. The module allows to manage photographs of damaged loads, correctly secured loads for different wagon types and shipment damage reports,

- **Means of transport specifications module**, is responsible for entering, viewing and processing technical data of wagons. It is based on a wagon catalogue and additional specifications for loading, independent of the fleet of the carrier, e.g. stanchion spacing, wagon floor type, etc. The data on the specifications of the means of transport will be further supplemented by end users.

The language versions module and related method of data storage and processing are an important part of the system. Translations into foreign languages include the following scope of materials:
- contents of the text columns in database tables,
- descriptions of the contents of the non-text columns in database tables,
- other texts in applications forms,
- texts on printed reports,
- texts from source materials,
- context hints and clarifications,
- error and confirmation messages.

A multi-lingual application works based on a single database. All database tables are shared and text values are not duplicated for each language version – they are stored in a separate table containing text variable values for all languages (figure 4).

![Fig. 4. Text values storage for multiple language versions – diagram](image)

The text values stored in each of the tables were replaced by a number referring to the ID of the translation. The translation of each of the text values was included in a separated “Translation” table containing text values, language marking and translation ID – primary key. Such a solution allows to avoid the problem of duplicating values and errors related to changing the date of the database (omission of value modification due to connection error, for example).

Part of the data for translation is not contained in the database. These are mostly legal regulations, manuals and technical documentation, which are stored in separate PDF files for each language. The database contains only the file name and the system provides the appropriate files from the FTP server based on the language selected by the user. Files in different languages have a suffix determining their language, e.g. doc_20140611_54919_en.pdf, doc_20140611_54919_de.pdf. Such a solution allows the reduction of the amount of data kept in the database, i.e. file names separately for each language, which contributes to faster system response to the user’s query.
CONCLUSIONS

One of the most important areas for the implementation of the information system described above is the transportation of dangerous goods (flammable, explosive, hazardous, etc.) and prevention of danger by clear information on how to load and secure the goods. The main objective is to provide a European-valid intelligent information system in the form of a semantic web application that contains specific professional information systematically describing and articulating the structure of the transported goods according to international categories and standards. Among its other benefits are:

- Modern technology introduction,
- Use in data networks,
- Integration of international and domestic information,
- Mapping the relations, links and inter-connections in the field of loading,
- Avoiding differences in information interpretation,
- Option to use electronic information in other systems,
- High level of innovation in the IT sector of rail freight transport.

Loadfix information system shall lead to improved quality and simplification of work with information in the area of loading and securing of goods in the railway transport.

Abstract

Loading of cargo onto railway freight wagons and its fixing is a very important issue, which is directly related to protection of the transported goods, saving lives endangered by accidents, safety of operations and also the economic and commercial interests of the carriers. At present there is no place or solution, where various users from the railway carriers in Europe could find complex information about safe and correct loading and fixing of goods in means of transport. This article presents development of the innovative multilingual web application focused on cargo loading into railway wagons as an extensive database system with European regulations, instructions and examples, to guarantee the trouble-free fixing of the cargo during the transportation and to prevent accidents on railways. This solution shall allow a clear and structured approach to the “loading and fixing” of data according to the category of the transported goods, which will be based on the international classification of goods in line with the loading directives of the International Union of Railways - UIC.

The research results presented in the article have been implemented in the framework of the EUREKA E!6726 LOADFIX project which was financed by the National Centre for Research and Development
REFERENCES