The TREX project

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Abstract

The article presents the results of the international research and development project EUREKA No. LF 14003 called TREX, which was dealt with by OLTIS Group in 2014-2017. It includes the definition of the issue and its presentation, followed by a technical and technological approach to the preparation, negotiation and implementation of transport of extraordinary consignments in the proposed information system. Individual modules and functionalities of the information system, including their use, are analysed.

KEY WORDS: *extraordinary consignment transport, TREX, EUREKA, information system, freight rail transport, transport path*

1. Introduction

The aim of the EUREKA project is market-oriented research and development, i.e. market application of project solutions results. Given the difficulty of obtaining existing descriptions of obstacle registers and information for the creation, processing and registration of requests for transporting extraordinary consignments and related documents, there is a significant assumption of successful use of the outcome of the solution in the rail freight and intermodal transport market.

There is high potential for implementation with all entities involved in the transport of extraordinary consignments, i.e. railway infrastructure managers, railway transport operators (carriers), railway forwarders or logistics operators/operators of logistics services, mainly because the system will help optimize the economic and operational costs of the user, increase efficiency of work related to the transport of extraordinary consignments and thus increasing the competitiveness of these entities in the field of international transport.

The aim of the EUREKA project no. LF14003 TREX "Research and development of a new information system to support the transport of extraordinary consignments by rail with a focus on broad gauge and implementation of European TSI standards", was research and development of an information system that addresses the issue of transportation of extraordinary consignments (MZ) on European railways with a special focus on multilingual environment (Czech, Slovak, Polish) English, German). The practical result of the project is a comprehensive software solution applicable on a European scale, which offers a clear display of the characteristics of the lines in terms of transportation of extraordinary consignments and which will contribute to the promotion of planning, optimisation, management and monitoring of extraordinary rail transport operations with normal and wide gauge.

2. Methods/Experiment

Definition of MZ

A consignment shall be considered extraordinary if, by virtue of its external dimensions, its weight or nature and the fixed equipment or the wagon, it causes particular difficulties to an entity involved in the transport of the consignment and therefore the consignment can be accepted for transport only if specific technical or operational conditions agreed upon in advance by all the RU railways involved in transport are met [1, 2, 3].

Provisions for the preparation and handling of extraordinary consignments

The following basic documents shall apply to the international transport of extraordinary consignments:

- General Contract on the use of freight wagons — AVV; [17]
- UIC loading guidelines — Volume 1, 2 and 3; [3, 10, 11]
- Arrangement on international transport by rail COTIF;
- Uniform Legislation for the International Carriage of Goods by Rail — CIM (Appendix B to COTIF);
- Uniform legislation on the contract for the use of infrastructure in international transport by rail — CUI (Appendix E to COTIF);
- Agreement on mutual exchange and use of passenger cars in international transport (RIC);
- Agreement on the International Transport of Goods by Rail (SMGS) [4].

UIC Decree 502-1 is binding for all UIC railway undertakings involved in the international transport of extraordinary consignments and defines the term 'extraordinary consignment'. It regulates the authorisation and authorisation procedure in international transport and lists the contact persons of various emergency consignments groups as well as national authorisation authorities [3, 4, 5].

The preparation and implementation of transport of a consignment requires coordinated action by involved railway undertakings (RU), infrastructure managers (IM) or railways (railway undertakings in which there was no division into RU and IM). At the time of this decree, all railways have not yet implemented a "railway reform", and therefore the responsibility for organizing extraordinary consignments lies either with the "railway" or the IM/RU. Railways are understood within this decree as railway undertakings in which there is no division between the RU and the IM. Individual RU and IM may also conclude agreements, which deviate from the provisions of this decree, with one another. This applies only to the extraordinary consignments referred to in this decree and only to the transport of consignments between contractors. [6, 7, 8, 9]

Specific measures are provided for in UIC Decree 502-2 for the coding of consignments with an exceptional gauging in accordance with the coded outline scheme. Provisions concerning the transport of extraordinary consignments on railways with a track gauge of 1520 mm are set out in UIC Decree 502-3 [3, 4, 8, 10, 11].

Research

One of the tasks set for the first sub-objective was to establish contact with railway companies, or to pick railway companies and establish contacts that led to the acquisition of relevant data relating to the transport of extraordinary consignments. Contacts for specific responsible persons were sought in teams of railway carriers and railway infrastructure managers. Based on experience, questionnaires were created for these experts who were subsequently contacted with a request to complete them. Detailed research and investigation into the existence of relevant standards, collection and processing of data relating to the transport of extraordinary consignments on normal (1435mm) and wide (1520mm) gauge lines is key for processing a review of methodologies and for describing processes for SW equipment supporting the transportation of extraordinary consignments.

The survey was focused on the future implementation of required characteristics in the transport of extraordinary consignments according to UIC (International Railway Union), TAF TSI (Telematics Applications in Freight Transport, Technical specifications of interoperability) and OSŽD (Organization for Cooperation of Railways). Close cooperation with international organisations and railway undertakings, leading to compliance of the proposed system with applicable regulations, was a prerequisite for these steps. The survey also included the finding of input data for the basic description of the spatial passability of the lines and the description of the railway network for the purposes of registration and outputs of the MZ.

The questionnaire enquiry contained two sets of questions. The first set was intended for carriers, the second for the railway operator/infrastructure manager. Part of the questions was for both types of entities and aimed at finding the following data:
- the entities that ensure the negotiation of the transport of extraordinary consignments (MZ) in the railway transport in the given country,
- compliance with regulations for transport of MZ (national and international),
- method of securing the MZ,
- the information systems used to secure the transport of MZ and the evaluation of the MZ transport path and their interfaces to other IS,
- documents and telegrams used for communicating with partners in negotiating and securing transport of MZ (national and international),
- method of transfer of issued telegrams between partners, dispatching apparatus and operating staff.

In addition, the set of questions for the railway operator/infrastructure manager included the following questions:
- is there a computer-kept obstacle register for MZ for individual lines and is it used,
- whether the dimensions and shape of obstacles are registered in the database,
- methods used for obstacle measurement and data processing prior to entry in the register,
- use of the eight-digit obstacle and consignment code as defined in UIC Regulation 502-2,
- the methodology used for determining surcharge for consignments and obstacles,
- the existence and availability of a digital description of the railway network (transport locations, transport sections, mileage positions of transport locations and list of tracks at individual locations and sections).

Both sets of questions in the questionnaire included the question whether the subject considered the current method of negotiating an MZ to be satisfactory and, if not, what should be changed.

Based on the results of the questionnaire investigation, personal meeting and subsequent analysis, it was possible to compile an overview of the current organisation of transport of MZ and the tools used for this purpose. The conclusion that the existing ways for the processing and evaluating the MZ agenda, including the tools used, are sufficient, but it is

necessary to address their improvement and streamlining, was drawn. One possibility is to deploy a compatible information system, which would allow users (SMZ) to reduce the time required for dealing with the requirements of the carrier, to increase the efficiency of the work related with transport of MZ and registration of obstacles, and which would provide reliable tracing for transport of MZ and subsequent improvement of the safety of this process and centralization of complex documentation formed during securing the transport of MZ, along with quick access to documentation and provision of timely and comprehensive information related to the transport of MZ in international transport.

The resulting solution is intended to contribute to the optimization of the economic and operational costs of the railway carrier, in particular:

- to reduce the time required to deal with the requirements of the carrier;
- to increase the efficiency of work related to transport of MZ and obstacle registers,
- to improve safety during MZ transport thanks to reliable tracing
- to provide timely and complete information related to the transport of MZ in international transport,
- to centralize comprehensive documentation resulting from the provision of transport of MZ and quick access to documentation,
- to make savings related to increased safety and lower operational hazards.

Testing of the proposed information system

Based on the analysis and requirements of individual SMZ, an information system described in the chapter Results was created. The developed software also had to be tested by SMZ personnel. As is clear from the nature of the SMP organization, there were two applications to be tested, one for the carrier — MIZA and the other for the infrastructure manager — PREKAZKA. Both applications are of WinForm type (so-called bold client) for the Windows operating system. .NET Framework 4.5 is used, data is stored in Oracle 12c database. Installation of both versions of the system is carried out by Click-Once technology.

The project application is designed for two different organizational units of railway infrastructure. MIZA is intended for employees of the URMIZA group, part of PREKAZKA is intended for employees of the infrastructure manager. For this reason, the applications were tested independently. In both applications, of course, knowledge of professional issues and an adequate level of knowledge of work with computers running Windows 10 is assumed.

In order to reach the successful testing goal, both workplaces prepared documents based on real situations, i.e. for MIZA application, the actual request for transport used in the past with appropriate documents, for PREKAZKY application, Excel files containing descriptions of obstacles, were used as supporting documents.

When testing the MIZA application, a new request for transport was created from the prepared documents. Subsequently, all necessary requirements were added, such as the selection of a suitable wagon and the proposal of alternative paths — variants of transport. Subsequently, the individual paths were checked. Then the documents necessary for the authorisation to transport and their subsequent distribution were created. In the course of these activities, the stability of the application and the correctness of the implementation of the performed activities were tested. While the described activities were running, a test record was created.

When testing the PREKAZKY application, new obstacles were created. Files of the Excel type, where data about obstacles was stored, were used as the data source. Then, the saved data was edited. Obstacle registration sheets were continuously created and the application responses to the requirements were investigated. While the described activities were running, a test record was created.

3. Results

Definition of an information system

The solution was expected to introduce a unified liaison source of information, accessible on the Internet, including simplification of planning transport of MZ, reducing the planning time for transport of MZ, use of available national and international sources of professional information, rationalization of work of users in the professions of transport of MZ, ensuring the availability of up-to-date information, i.e. finding required data in application modules, additional modular extensibility of the application platform and the possibility of using electronic information in other systems.

The conducted analysis showed that the system can function on its own and independently from the surrounding systems in normal operation. If it will be filled with the necessary data, then there is no need for its functionality and availability to bind with the reliability of other information systems. This showed that the content of this sub-objective should be to meet the needs of communication within the system, i.e. communication between its parts or rather its layers.

Technical description of the MZ transport system

The architecture of the information system consists of the application layer, which is the application server where the application files are deployed, and of the data layer, which is the database server with Oracle database. The last layer is the presentation layer consisting of end-user monitors running the application client. The information system also has a web layer represented by the websites of the forms "Request for authorisation to transport MZ" and "Document Viewer". The Web Part of the application runs on a Web server in the Internet Information Services of the current version of the

Windows Server. The site uses ASP.NET version 2.0. The application is built on the Microsoft.NET version 2.0 application interface. The structure of the information system is displayed on Fig. 1.
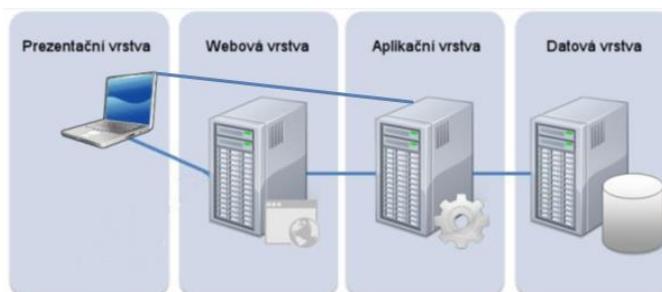

Fig. 1: Basic structure of the information system

The resulting information system is a ClickOnce type, a deployment technology that allows you to create self-updateable Windows applications that can be installed and run with minimum user interaction. Self-updateable means that they can search for a newer version that is available and automatically replace all updated files. Updates can be returned to a previous version by the end user. Because installations are isolated, installation or application startup cannot interrupt an existing application. The application layer passively communicates with the web layer (i.e. communicates with the web on the port and address where the application server is running) and actively with the database (i.e. queries the database). Both communications are one-way.

Basic functionalities of the system:
- processing the Sender's request (web form/e-mail/Mail),
- complex registers of MZ — also in German (editing, viewing, copying of records),
- selection of suitable wagon for transport of MZ and automatic calculation of its parameters,
- specification of MZ outline points and calculation of surcharges for verification of spatial passability;
- automatic calculation of surcharge for the specified radius of the arc.
- display of MZ outline, load profile and obstacles,
- uploading the desired transport path — Loading, exporting and importing the transport path in the Map module,
- advice — Internal within the company and External towards the partner organization,
- verification of the spatial passability of consignments along the specified path,
- determination of delivery, transport and track conditions for the transport of MZ,
- determination of the price for delivery,
- creation of output TLG (requests, authorisations, permits, instradations, etc.) and management of related documents,
- distribution of telegrams and documents to designated addressees;
- archiving individual versions of consignments, telegrams and Advances.

Technological procedure for preparing the transport of an extraordinary consignment

The technological process of working with an extraordinary consignment can be expressed in the time sequence of individual activities, which correspond to the individual modules of the system:
- Registration module — processing of "Request for authorisation for transport of MZ", registration of extraordinary consignment,
- Map module — verification of passability of the proposed transport path,
- Obstacle Editor module — editing data about obstacles on the network,
- Outputs of MZ module — processing the output TLG, management and administration of documents, distribution of outputs to addressees.
Individual modules and their functionalities are listed in the following sections of the article.

MZ registration module

The MZ register represents the basic module of the whole system. Its functions are to ensure the processing of all necessary data for the security of the transport of the extraordinary consignment. These data are subsequently used and processed in other modules.

Security of all activities related to registration and transport of MZ is very demanding. Therefore, it is appropriate to have available to the participants a comprehensive software tool, which creates information support for the transport of extraordinary consignments and ensures efficient processing of the agenda related to the provision of transport of MZ at all stages.

The carrier, transporter, or freight forwarder must be able to ask the infrastructure manager for authorisation to transport the extraordinary consignment. When registering an extraordinary consignment, the data from the Request for authorisation to Transport MZ are used. This request can be delivered in the form of a prescribed form by mail or e-mail (or fax) — in which case the user will process the data from it in the process of registration. Electronic applications are available in the "List of Requests through the Web Form". The Web Form should be available in electronic form to all customers on the Infrastructure Manager's (IM) web portal. Data uploaded by the applicant are automatically taken from the application into the "Registers" module. Functionality of this module ensures registration of all necessary data for creating output telegrams and negotiating about MZ with partners.

The content of the form "Request for authorisation to Transport an Extraordinary Consignment" according to [3] includes:
- Request parameters — role of the applicant, character of the MZ,
- identification and contact details of the applicant,
- specification of the type of consignment and wagon line,
- the outline dimensions of the consignment;
- proposal of the transport path,
- information about the consignor, the consignee, the carrier of the consignment,
- other required information on MZ,
- attachments — sketch, file with additional information

After filling out the items in the form and sending it, the data from the form is written into the database. IM staff can see all the requests displayed in the "authorisation Request List" in the application. In the next step, in the "Register" module the data from the application is collected and processed in the process of registration an extraordinary consignment record. Decree UIC 502-1 [3] defines the procedures for the processing of basic documents and their content.

The basic database tables and the relations between them, as well as the definition of the main code lists — tables for storing basic data are defined in the Register data model. One of the results of the analysis of regulations regulating transport of MZ is a set of basic processes connected with securing the transport of MZ.

While maintaining the time sequence of each step, these are the following processes:
- Notification of intent to transport an extraordinary consignment — Request for shipment,
- Registration of the extraordinary consignment,
- Verification and definition of the path for transporting the extraordinary consignment,
- Processing of documentation related to the transport of an extraordinary consignment.

Announcement of intent to transport an extraordinary consignment — Request for shipment and its registration

The customer can announce the intention to transport an extraordinary consignment (MZ) at the URMIZA workplace in several ways — by sending the Request for an authorisation to Transport. Registration of an extraordinary consignment (MZ) is designed in such a way that IS users have at their disposal tools, with which they can, at any time, arrange activities related to registering the record about MZ.

The basic functionality of registration consists of the following functions:
- registration new MZ from the Request for authorisation to transport an MZ (Web form Request),
- registration of a new MZ directly by editing items without receiving data from the Request,
- Continuous registration of an established MZ,
- registration of records of the item also in the German language mutation using a dictionary,
- creation of a new MZ record by copying an existing record,
- creation of an inverse transport path record against another existing MZ,
- deletion of the MZ record with release of the MZ number used,
- archiving individual registered versions of MZ records,
- sorting and filtering of MZ records in the register lists,

The IS is designed in such a way that at the initial stage of the registration process, when creating a new record on MZ, the user defines the MZ number (the authorisation character number), while the application ensures unambiguous identification of the established MZ record. All related records and data in the database are assigned to this unique identifier. The application can record, in addition to standard extraordinary consignments, specific cases of authorization for transportation of Extraordinary consignments — Transport Type Sheet (PTL). This is an authorisation for the transport of certain goods for carriers (one or even more) on specified transport paths. The transport of large containers (High Cube) can serve as an example. In this case, the carriers do not need to ask for permission to authorise the transport, because the conditions of transport of this type of goods are set out in the PTL. For the purposes of statistics, the application provides various statistical summaries about the number of processed records on MZ, the number of telegrams issued and uploaded documents for the selected time period. Description of outputs with drawing up a template for input data.

Verification and definition of the path for transporting the extraordinary consignment

SMZ RU/Railroad, in whose area of responsibility the transport begins (responsible for negotiation), verifies all documents and processes the "Request for Authorisation for Transport of Extraordinary Consignment".

When uploading the request for transport of MZ, the customer usually defines the required transport path, on which they want to transport the MZ from the dispatch station to the destination station. The application allows users to process (using the "Map" module) the proposal of the actual transport path in the process of registration of MZ. In some cases, it is necessary to process several variants of the transport path. At the same time, the application will enable the verification of individual variants of the transport path using the "Verification of the traffic path" module. The result of the verification is recorded in the register in the Path screen, as well as in the Track Conditions screen. What is important is the fact that in the further work with the extraordinary consignment, in the creation of telegrams and documents, the priority is to work with the passable variants of the transport path. Only these can be selected in the output telegrams and only after that it is possible to safely transport the shipment from the dispatch station to the destination station. On Fig. 2 you can see the display of the shipment and gauging.
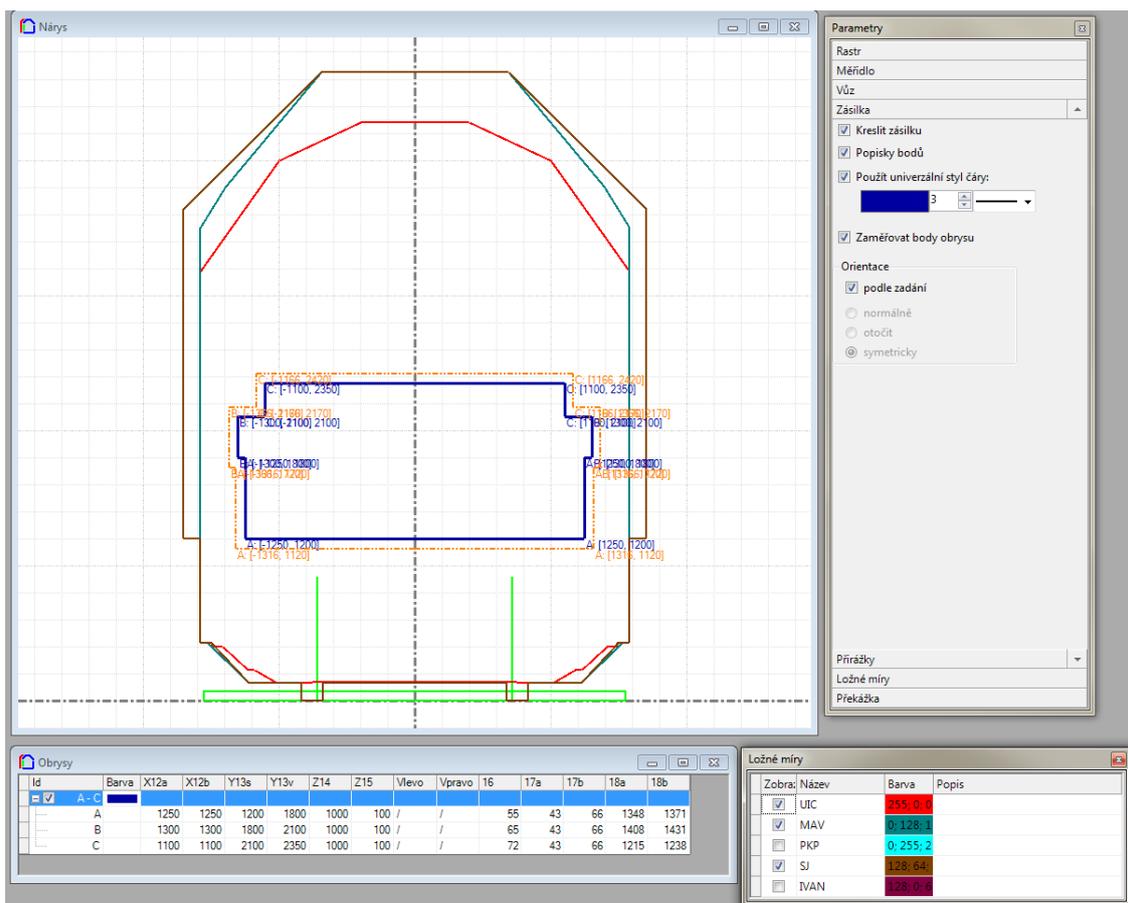

Fig. 2 Graphic display of the shipment

Negotiating about the shipment

If necessary, the SMZ RU sends a request for authorisation to transport with the scheme of good attached. SMZ IM will assign a transport number to the consignment if it has not already been assigned to the consignment by the RU. This transport number shall be provided throughout the correspondence between all parties involved in the transport (SMZ RU, SMZ IM, Rail SMZ). The RU or the railway SMZ concluding the transport contract (responsible for negotiation) will send "Request for authorisation to Transport an Extraordinary Consignment" to all RU SMZ or railways involved in the transport after obtaining the transport number.

The SMZ of the RU, IM or railway which has accepted the request for authorisation to transport an emergency consignment will check or, with regard to the specified parameters of the consignment, can check it within the area in which it carries responsibility for transportation.

Negotiations between RU and IM SMZ or railway SMZ

Each SMZ of the RU involved in the transport sends a request for authorisation to transport to the IM SMZ group, according to the network on which the consignment will be transported. For IM or railway SMZ on which the transport of coded consignments with exceptional gauging is established according to the provisions of UIC Decree 502-2 [10], this request for authorisation shall apply as pre-declaration of transport.

Negotiations between RU or railways SMZ

"Consent of the RU SMZ to accept an extraordinary consignment for transport" is an announcement by which the RU/Railways involved in the transport confirms their participation in the transport contract for their transport section to the responsible entity.

Authorisation to transport

After obtaining authorisation for acceptance from all SMZs involved in the transport (RU/Railways), the sender receives an "authorisation to transport".

Processing of documentation related to the transport of an extraordinary consignment

The information system is designed so that users can process the required documentation for each registered record (there is an MZ number). Basically, it involves processing two kinds of documents — creating output telegrams and uploading various documents related to transport of MZ.

Furthermore, users can keep all the complete documentation related to transport of MZ in the application. The MZ Outputs module is used to ensure the circulation of processed documentation. Its function is to distribute processed telegrams or uploaded documents to specified addressees.

Additional requirements for the Registration module result from UIC 502-1. [3] It clearly defines the numeric codes of all individual items that must be recorded in the Registration process. These items form a basic set of data which are subsequently used in the process of producing output telegrams. Fundamental data stored in code lists (code books) are also needed for registration. However, these data need to be regularly updated. For this purpose, users have access to the "Code lists" module in the application.

Map module

Schematic interactive map with description of technical and operational characteristics of railway lines is designed as a separate internet application with several levels of access.

The basic structure consists of transport locations (DP) and transport sections (DS), which form the link between two transport locations. A single transport location can be located on multiple transport sections. Traffic locations and traffic sections are linked to their properties. The properties contain the characteristics of transport locations and transport sections, which are necessary for the calculation of the transportation path of an extraordinary consignment (MZ). The map can display different sets of data. Therefore, different maps can be displayed.

The obstacle registry, which contains a description of restrictions in transport of consignments over the network: Structures around the railway line, Limitation of the load capacity of the line, limitation of transport speed, are used along with the map.

In addition to the description of the infrastructure, the Map module is used to determine the variant paths of transport (variants) and also in the register of obstacles for determining the transport location or transport section for other work. The obstacle registry, which contains a description of restrictions in transport of consignments over the network such as structures around the railway line, limitation of the load capacity of the line, limitation of transport speed, are used along with the map.

The map has the following features:
- it defines objects of traffic locations and traffic sections.
- it establishes points of the national border;
- it assigns properties to traffic locations and traffic sections.
- it searches and filters traffic locations and traffic sections according to selection criteria above their properties,
- it highlights traffic locations and traffic sections in colour according to property values
- it provides information about Map module objects.
- it works with map layers,
- it creates different paths — variants when start and end transport locations with optional entry of transit locations are specified.
- it provides further information on the parameters of the chosen transport path; for availability of data on closures, these may also be displayed.

Description of railway network elements

The transport network consists of Transport Locations and Transport Sections. The transport section is located between two transport locations. One transport location can be located on multiple sections. The railway network must be interpreted as a network graph that contains points (represented by stations — transport locations) and edges (represented by links between stations). The description of the tracks is given in two tables. The Tracks table contains a list of tracks. TracksPointsSections table contains a list of Transport locations and Transport sections through which individual tracks lead. One Traffic Location can have multiple records — multiple tracks can run through it.

Network description levels — for RINF purposes, the railway network is presented as a series of transport locations

connected by sections of lines. The line can be described using different levels of detail. Fig. 1 below shows several ways of illustration, from detailed to simple. The national registration body may choose what level it complements, from simple to detailed.

Description of the spatial passability of lines

Obstacles on the path are registered according to UIC 502-2 and their influence on the clearance profile is evaluated by an 8-digit code according to this Directive [10]. Similarly, a consignment on a particular wagon is evaluated by an 8-digit code, and the condition "Obstacle code > Consignment code" must apply to assess the passability of the shipment around the obstacle.

After processing the obstacle register, critical obstacles between individual sections of the line are evaluated and the line section between two traffic locations is assigned a critical 8-digit code. In order to evaluate an appropriate transport path, the condition "Line outline code > Consignment outline code on the wagon + kinematic surcharge" must apply. Note: kinematic surcharge depends on the passage speed and arc of the track.

The path section number, km position, railway station number according to the international code list ENEE (UIC) is used to locate the obstacle — if there is an obstacle in the station, track number. To record the outline of the obstruction, the marking of characteristic points directed in the X, Y coordinate system from the track axis, or by length and angle (the system converts these measurements to X, Y points) is used. The obstacle description includes a header with data needed to locate the obstacle on the track (line, km_position, track, right/left), line characteristics at the obstacle location (speed, arc) and a list of points with coordinates that describe the shape of the obstacle. As input data it is possible to use existing records from pasports, manually recorded measurement results from various inputs from documents by their import or input into the system, output from laser measuring devices. Additional data include: position to the line (right/left), arc, superelevation, standard line speed, date of measurement.

The description of the spatial passability of the lines shall contain a registry of individual obstacles on the line. Obstacle measurement usually falls within the scope of infrastructure. It's associated to DU and Tracks. The values are stored in the Cartesian (normal) X, Z system. The X axis is a straight line laid on the link of rail level. The Z axis is perpendicular to it and passes through the axis of the tracks. Positive values on the X axis are to the right of the Z axis, face in the station direction, and on the Z axis above the X axis. The obstacle is displayed as one or more broken lines. The points of the broken lines copy the shape of the obstacle. The minimum number of points on the broken line is two, and the minimum number of broken lines is one.

Obstacle Editor Module

The module is of WinForm type (so-called bold client) for the Windows operating system. .NET Framework 4.5 is used, data is stored in Oracle 12c database. The program has two language versions, Czech and Polish. A special database schema was created for the application. Tables in which data about obstacles are stored — data needed for operation of Obstacles modules, data on access rights of individual users and data needed for operation the Map module were created in it.

MZ Outputs Module

The "MZ outputs" module allows to process output documents for securing the transportation of extraordinary consignments. Output documents are processed in the application to registered records of extraordinary consignments.

The required functionality of the "MZ outputs" module ensures:
- Creation of output TLG (requests, agreements, authorisations, etc.),
- Managing related documents (input, deletion),
- Distribution of telegrams and documents to designated addressees;
- Archiving individual versions of telegrams,
- Accessibility of selected telegrams for operation personnel.

Telegrams are used for communication between partners involved and participating in the process of negotiation and securing the transportation of extraordinary consignments.

Archiving documents functionality related to the transportation of an extraordinary consignment of the "MZ outputs" module ensures that all produced output telegrams and uploaded external documents are stored in database in such a way that they are available for displaying telegrams to a specific MZ Number — in the "List of documents for MZ", but also in a comprehensive list of all documents — "List of all documents". Even if the user creates several versions of the telegram type for one MZ Number, all created versions of telegrams are stored and archived in the database.

In masks for displaying "List of documents", all basic data about telegrams are visible — except MZ Number, these are items created when creating a telegram or uploading a Document: Telegram/document type, Date of entry into the database, and Name of the person processing the telegram, or Sender, Document description, File name, Document number, the date of entry of the document and the name of the person uploading the document. Another functionality is "Displaying the created telegram", or "Displaying the uploaded document" — the action ensures that the content of the created telegram or entered document is displayed. The user can continue to work with the displayed document as possible

within the format in which the document is processed.

Discussion

To ensure transport of MZ, individual railway administrations have established specialized working groups that keep the register of transport of MZ, coordinate the negotiation about MZ, communicate with partners on other railways (in writing in specified formats according to UIC 502-1), issue an authorising document for transport of MZ to the applicant (consignor), and issue telegrams for securing transport of MZ on a specified transport path. Communication between SMZ usually takes place in writing. In emergency cases, it may exceptionally take place in advance by telephone. All announcements must be made in one of the working languages of the UIC (German, French, or English). In such communication, numeric codes shall be used in accordance with paragraph A.1 (UIC 520-1) [3]. Authorisation or refusal of transport must be granted as quickly as possible (no later than 14 calendar days).

Each railway/IM/RU has one or more independent groups responsible for technical, operational, and commercial management, and for the authorisation of extraordinary consignments. The group shall keep records and coordinate the management of extraordinary consignments. The relevant national extraordinary consignment groups (SMZ) are responsible for extraordinary consignment, whether they belong to RU (SMZ RU), IM (SMZ IM) or rail (SMZ railway). If the rail/IM/RU designates several independent groups, the responsibility of each of them must be clearly defined.

The rules determining the relationship between SME RU and SMI are the subject of the 'Contract on the use of infrastructure in international transport by rail' — COTIF, Appendix E (CUI) [14]. The following bullet points include SMZ activities according to [9, 12, 13, 14, 15, 16, 17].

Activities of the Extraordinary Consignment Group of the Railway Undertaking:
- receiving requests from customers for the transport of extraordinary consignments;
- establishing transport conditions (selection of suitable wagon, appropriate loading method, and system of securing cargo, etc.) and delivery times,
- proposal of a transport path, including intermediate stations, of succeeding RUs;
- submitting a request for authorisation to transport to
- all RUs involved in the transport of consignment,
- the infrastructure manager on whose network his own RU has a safety certificate authorising it to operate according to a contract for the use of railway infrastructure, and for which this RU acts as the head of transport,
- giving authorisation to transport to all participating RU;
- informing customers and own employees about the conditions for the implementation of the transport contract by means of authorisation to transport.

Activities of the Extraordinary Consignment Group of the Infrastructure Manager:
- coordinating activities to determine and refine operational transport conditions within the competence of the infrastructure manager;
- checking the completeness and correctness of the shipment data obtained from the SME of the RU and assigning a transport number to the consignment.
- verifying the allocated transport path;
- establishing operational and technical conditions based on the information provided by the RU and makes them known;
- negotiating operational and technical conditions with neighbouring SMZ MI for the border zone;
- preparing documents to inform operational staff involved in the transport of the extraordinary consignment about its path and conditions of transport;
- setting prices for railway infrastructure services.

For national transport, it involves communication of representatives of the railway operator (in the environment of the Czech Republic it is SŽDC-URMIZA) with carriers asking for authorisation to transport an extraordinary consignment. Telegrams for communication with national partners (carriers) are processed in accordance with D31 Extraordinary shipments. Regulation. It clearly defines the numeric codes of all individual items that need to be used in the creation of output telegrams. [1]

For international transport, it involves mutual communication of representatives of individual railway operators involved in the transport of extraordinary consignment. Telegrams for communication with foreign partners are processed in German according to UIC 502-1 [3, 4]. It clearly defines the numeric codes of all individual items that need to be used in the creation of output telegrams.

The proposed information system enables registration of companies involved in transport of MZ (all entities such as shipper, recipient, payer, carrier), wagons and consignments (weight, dimensions — outline points of MZ and calculation of surcharge according to UIC 502-2 and other regulations for verification of spatial passability). Shipments can be displayed graphically including surcharges (elevation, side view, floor plan, load profile, etc.). Considering records, the system can manage transport paths (dispatch and destination stations, determination of transport path variants) and display them in the map. All this based on defined technical, transport, shipping, and line conditions for the transport

of MZ. It also provides the management of data from Authorisations to transport MZ from foreign railway administrations participating in the transport (transport path, authorisation character of the partner administration, date of validity of the authorisation, carrier, transport conditions, import, delivery time, other information). Archive of individual versions of MZ records is an integral part of the system.

A comprehensive information system dealing with the issue of transportation of extraordinary consignments on the European railway was implemented, for example, by ČD Cargo and SŽDC infrastructure manager. The introduction of a new system on the agenda of the transport of extraordinary consignments creates a prerequisite for the transition of oversized or heavier consignments from road transport back to rail and thus increasing the number of transported MZ. It provides the possibility of significantly reducing the time needed to negotiate such transport and reduce the time of stay of the consignment at border crossing stations between different gauges [18, 19, 20].

3. Conclusions

The system consists of software modules for fast and secure decision support about the possibilities of transportation of extraordinary consignments, for recording the requirement for transportation of extraordinary consignments and processing outputs for the transport of extraordinary consignments, and the obstacle editor module. The development of the application took place in OLTIS Group and OLTIS Slovakia. Individual modules of the system provide quick and safe decision on the possibilities of transport of MZ, registration and processing of requests for transport, definition of outline points of MZ, selection of suitable wagons for transport of MZ, editing of obstacles on lines, and processing of output documents necessary to ensure transport.

The presented information system is a unique and completely new innovative solution in the area of support of transport of MZ on rail. The project contributes to strengthening rail and intermodal transport as an ecological and supported mode of transport and to strengthening the position of railways in freight transport. The system thus contributes to reduction of costs, brings associated savings, and leads to optimization of planning and management of transport of these consignments, i.e. optimization of passability and transiency of lines, transport in specified trains, transport in real delivery time, etc.

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Abbreviations

MZ — Extraordinary consignment
SW — software, software equipment
UIC — International Railway Union
OSŽD (Organization for Cooperation of Railways)
TAF TSI — Technical Specifications of Interoperability, Telematics Applications for Freight
IS — Information System
SMZ — Extraordinary consignment Group
.NET - a set of technologies in software products that make up an entire platform
MIZA — application for carriers
PREKAZKY — application for infrastructure managers
TLG — Telegram
Instradation — consignments with priority load transitions between trains
IM - Infrastructure Manager
PTL - Shipping Type Sheet
ŽP = RU — railway undertaking
SMZ IM — Infrastructure Manager's Extraordinary consignments Group
DB — transport points/locations
DÚ — transport sections
RINF — Railway Infrastructure Register
ENEE - European Railway Location Database
COTIF 99 - Convention concerning International Transport by Rail
CUI - Uniform legislation on the contract for the use of infrastructure in international transport by rail (Appendix E to COTIF);
URMIZA — Central Register of Extraordinary consignments, SMZ IM at SŽDC