Developing an Interactive System to Provide Management Support for Transportation Research Organizations

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Abstract: This paper covers the process of developing and populating the TransNEW international database designed to assist management from transport research organizations in providing the means for research to support decisions. The process ranges from database and tables creation to the setting up of relationships between database elements and web forms so that database fields may be populated and the information can be easily managed. The next phase involved inputting information gathered by TransNEW Partners. The described processes and procedures involved choosing the appropriate platform, and designing an information management system for this database.

Keywords: transport, database, MySQL, transport infrastructures, researcher database.

1. Introduction

In accordance with the objectives of the Framework Programme 7 - FP7, the transport domain has been very well represented through research sub domains financed by different calls.

In this respect, the FP7 Action Support has also been sustained by different projects which were developed by large consortia having partners all over Europe. This approach is not unusual, taking into consideration the development of the transport domain and its importance in the development of the economy.

Some figures illustrate this reality: in the EU, 44% of freight is carried by road, compared to 39% on short sea routes, 10% by rail and 3% by inland waterways. Regarding passengers, road transportation accounts for 81%, compared with 6% by rail and 8% for airways.

On the other hand, road safety is a major issue in EU policies. In 2009, over 35,000 people were killed on EU roads, and over 1.5 million people suffered injuries in traffic accidents. The estimated cost for road incidents accounted for about 130 billion Euros in 2009.

Starting from this reality, the research area has to play a very important role due to the innovation elements which can provide the necessary safety and security of road traffic.

Intelligent transport systems – the usage of ICT technologies in transport – appear as a normal approach in achieving the requirements presented above.

At the same time as Europe has to represent a single market for ICT innovation, it is quite normal that all the actors in the transport domain have to be well and consistently informed.

It is unanimously recognized that sometimes there is a lack of information between research and innovation and implementation outcomes into reality.

The project TransNEW aims to cover at least a part of this inconvenience.

TransNEW is a Coordinating and Support Action aimed at supporting transport research activities in New Member States. TransNEW stimulates and facilitates the participation of the New Member States and especially the involvement of Small and Medium-sized Enterprises - SMEs in transport research. TransNEW encourages the participation and the collaboration in transport research at a national, regional and European level. The projects' objectives are: to assess transport research capabilities, to foster cross-border integration, to create a database of expertise and capability per country and dedicate focus to SMEs'.

This article will focus on the creation and design of the TransNEW database accomplished by joint research.

The TransNEW Partners have gathered data from 26 participant countries. The data concern actors involved in transport research and projects concerning transport research. All the data will be used to facilitate the participation of the organizations from the New Member States, especially SMEs, to collaborate in transport research, encouraging them to become major actors at national or regional level, and to extend their activity area in the transport research.

The database will be divided into fields and activities and the data was acquired by using questionnaires, which contained specific questions addressing both organizations and researchers. The content of the questionnaires was decided by the TransNEW Consortium and the questions aimed to gather information that was relevant for the purposes of TransNEW. The standardized questionnaire was emailed to respondents who were encouraged to fill it in and email it back.

The responses to the questionnaires are put together for each country in Excel files. This means that for each of the 26 countries participating in TransNEW, there is an Excel spreadsheet containing all the data about the organizations, researchers and projects involved in transport research. After this step, all the information from the spreadsheets will be placed inside a single database, and will be available for public use.

The database will provide access to specific details about the organizations involved in transport research; moreover, it will facilitate the collaboration between organizations and will be the bridge that allows the potential partners for transport research projects to search at a national, regional or at European level.

After analyzing the questionnaires, several solutions for implementing the database have been considered.

The *main* criteria for narrowing the search for solutions were:

- the database must accept a large amount of record (tens or even hundreds of thousands);
- the database must have/accept a management system for handling the large amount of information contained in it;
- the tables must be flexible, since the data is not uniform; the organizations are of different type, statute, etc.;
- the database must handle relations between tables, since the information cannot be properly managed by using just one table;
- the database must provide support for filtering the information, using diverse searches/filters.

Since the TransNEW project is also focused on SMEs involved in transport research, special attention was paid to the structure of the "Organization" category. This structure includes all the details of a SME that are of interest for transport research and moreover the structure must provide support for other types of organizations.

Because one of the project's goals is to encourage the collaboration between SMEs and other national organizations involved in the transport research, the structure for the organization must be split into a higher number of tables, in order to make the search and the filtering more accessible, using fixed criteria such as transport themes or transport modes. The filtered results must reflect the areas of interest and the potential of each organization, in general, and SMEs, in particular, in order to establish potential partnership proposals for the benefit of transport research.

After carefully weighing in the advantages and disadvantages of each of those solutions, the software solution chosen to build the database was MySQL.

2. The Analysis of the Factors Relevant for the Database

In order to develop a consistent and reliable database for TransNEW an analysis of all the factors that can contribute or interfere in the development process were considered.

The main phases in the TransNEW methodology were:

- The Consortium established the Terms of Reference that determined the overall parameters of data collection.
- The parameters were defined to identify key researchers, country specific organization's in Universities and Industry and transport-related projects and SMEs.
- Desk-based research is being carried out for each country to begin to build up an idea of who is currently active in the area of transport research. This will form the foundation of the TransNEW Database fields in addition to the fields identified in the Terms of Reference.
- A questionnaire has been created based on fields already defined for the database, which is being used to assess the current situation in transport research
- The questionnaire has been tested for validity, reliability and ambiguity of the questions

- The questionnaire is currently being emailed to respondents. Eventually, the respondent will be directed to a web address to complete the information where the information will be entered directly into an SQL database
- Data responses will be analyzed to determine patterns of transport research collaboration on a local, Regional and European level
- This same process will be used with SMEs in each country to assess their level of participation in EU projects

Information will be entered into the database in two main ways:

1. by Partners during their initial searches;
2. by individual registration or by the registration of the organization they belong to, when the database goes public.

The first parameters that must be analyzed when building this sort of system are the input parameters. For the TransNEW database, these are represented by the data gathered within the questionnaires; therefore the analysis of the questionnaires represents the starting point of the database construction.

After this analysis, it is important to consider country specific issues; these issues are raised primarily by the special characters present in most languages.

The next phase consisted in the test of the available software solutions for the implementation. The advantages and disadvantages of each solution were analyzed and the most suited software platforms for the construction of the TransNEW database were determined.

The last phase of the analysis consisted in the analysis of the output for our database, the output is partly similar to the input, since the database reflects and stores the data gathered through the questionnaires.

2.1 The analysis of the questionnaires

The questionnaire is formulated using the following criteria:

- determining the overall parameters of data collection, creating the questionnaire, to be used to assess the current situation in transport research,
- in each country and for each transport mode, analyze data responses, including

SMEs in each country to assess their level of participation in transport projects.

From the point of view of the database planning, the questionnaires have been analyzed according to the following:

- the main categories that are stored within the system;
- identification of the fields that belong to each category;
- the types of fields that are comprised in the Excel Spreadsheet;
- the dimension of each field in the Spreadsheet;
- the limitations (if any) that are set on some specific fields in the Spreadsheet.

After all of the above had been performed, we established the 3 main categories that had to represent the core of the database: Researcher, Organization, and Project.

The SME module enabling users in New Member States to browse and contact appropriate SMEs was part of the Database itself. The reason for that decision was made in the Designing part of developing the prototype. It is easier to collect, maintain and support all the data in one place, having one joint Database, instead of two separate databases, one for organizations and researchers and another for SMEs.

2.2 The web system for managing the database

In order to test the functionality of the database, and to further manage the information that will be contained in it, it was decided to create forms for handling the data. The best way to do this is by using web forms. In this way, the data can be inserted, modified or updated from anywhere in the world by a plain internet connection.

The software solution chosen to create the web forms was PHP. The term PHP: Hypertext Pre-processor is a widely used, general-purpose scripting language designed for web development to produce dynamic web pages. The PHP code is embedded into the HTML source document and interpreted by a web server with a PHP processor module, which generates the webpage document. This solution has proved to be fast, stable, secure, easy to use and is also an open source language.

PHP interfaces very well with MySQL, making it easy to manage the information stored in a MySQL database. Besides PHP, JavaScript and Ajax are also used in order to build the client-side code that allows us to add various features to the TransNEW web application.

2.3 Authentication

The first phase in constructing the web forms was to create the authentication procedure. This is to ensure that only registered members can have access to the database.

The users have access only to specific forms, or just to several entities of the forms. By this, we make sure that the users will only have the privileges to modify their own information.

no unauthorized alterations performed to the data, and the information in the database is the official, correct information, gathered by the Consortium members.

2.4 Forms for inserting data

In the next phase our team created web forms for inserting data. The forms follow the structure of the database. There were restrictions imposed on the fields that required this procedure – for example, an Organisation name cannot be longer than 200 characters.

We present in Figure 1 a web-form used for registering, adding and updating information related to a transport organisation.

Figure 1. Web form of the organisation

The authentication procedure is mandatory for TransNEW; using it makes sure that there are

For the descriptive fields an "office-like" style was set up that allows the use of the most

common things needed for a long text – bold, italic, underline, paragraph or bullets. The web forms contain text inputs (name, address, phone etc), radio buttons (to select the range of researchers employed in the organisation etc), checkboxes (to select the transport modes in which the Organisation is involved, to select the Organisation statute etc), submit buttons (to send the information to the database).

The user, after authenticating on the system, fills in the data in the web forms, and then presses the *Insert* button. At that moment, the information is sent to the database, and it is inserted in the corresponding table.

3. Populating the Database

The TransNEW database was populated using the Excel Spreadsheets, presented in Figure 2, that contain the information gathered by the TransNEW members for each country participant in the project. All the data in the spreadsheets was transferred to the MySQL database.

Information about organisations, researchers and projects are added and written inside the table lines.

3.1 The creation of the form for uploading the Excel Spreadsheet

The web system has the capacity to import the completed Spreadsheet template and transfer the data stored in its fields into the database so that database may contain real data. In order to read, parse and transfer the data within the spreadsheet, this must be uploaded to the web server where the TransNEW system (consisting of MySQL database and web forms) is located.

For this reason, we developed a web form for uploading an Excel file. The file is copied to the web server, where it is analyzed and the data is inserted in the database. These procedures are described in the next section.

Figure 2. Excel Template File, containing data from Norway

3.2 Read, parse and transfer the data from the Excel Spreadsheet

The uploaded file is analyzed inside the web system. This means that the information in the Excel cells are parsed and modified to suit the MySQL database. The procedure involves replacing the special characters (diacritics) with their corresponding HTML code, splitting text cells for inserting the data in different records in the tables' entities, arranging the *Start date* and the *End Date* to match the format of the MySQL date (mm-dd-yyyy).

Each cell in the spreadsheet is placed in a different cell in the MySQL database. This involves the Excel file being covered line by line, and column by column. This is the correct order for reading the Spreadsheet, for inserting an entire record in the database then to compare it with the next records, in order to avoid duplicates.

The first cells of the line that are transferred to the MySQL database are the ones including the details of the Organisation. The reason for this is that the Organisation is the primary element of the TransNEW project, including the database. The next cells that are transferred are the cells containing the data about the Researcher; this information is connected to the Organisation; finally the cells regarding the Projects are inserted; this information has the highest degree of independency.

Before inserting the data, a quick comparison is performed, in order to prevent the insertion of duplicate records. The comparison is made upon specific fields, established with the project leaders, such as organisation name, country, researcher name, researcher surname, project name etc

The system performs all these operations in the background; they are not seen by the user, everything is realised automatically. This fact also has the major advantage of reducing the chance of a human error; the user just uploads the Excel spreadsheet and all the information is analysed and moved to the database.

After all the information is transferred into the MySQL database, the user will only need to use the web forms to insert new data or update the existing one.

3.3 The search

The Simple Search has been set to have the following criteria:

- − Country;
- − Entity - Researchers, Organizations, Projects;
- − Search textbox – a box for the user to write the desired keyword or keywords for searching through the database.

The Simple search section is displayed in the top-right part of the site, and is available in all the pages of the site. The user can access it in any moment.

The Advanced Search is divided into four divisions, according to the main categories of the database: Researchers, Organizations, Projects, SMEs.

The search keywords from the user are compared with the information contained in the database, and the comparison results are narrowed according to the other criteria that was/were selected by the user

3.4 The search results

For the Simple search, the results are displayed in one or more lists, depending on how the information was found in the database. The possible lists are sorted by researcher, by organization and by project.

For the Advanced search, the results are displayed in a single list, corresponding to the subdivision selected by the user. The results are arranged in the most relevant order according to the user's search terms.

4. Conclusions

The TransNEW system is a quality program for inserting, updating and managing data concerning transport research capabilities and organisations from 26 European States. The system aims to support the participation and the collaboration of these organisations in the National and European transport research.

By using web forms to manage the information, the users have instant access to their account from anywhere in the world by means of a common internet connection. This provides a high degree of flexibility for the database management, since the information is only "a click away".

The database stores real, quality and verified data. The information contained in the database is gathered and verified by TransNEW Partners using Excel spreadsheets, in the first phase, and later inserted by registered users, after the initial phase is completed, by using the web forms created by ICI. This ensures that the database is protected against erroneous data, and is a reliable source of information for all the actors involved in the transport research.

The information is optimally positioned and interconnected, as web pages meet the

The software solution implemented is optimal, because the online platforms are growing each day. The Internet is the fastest and probably the best way to update the information in the TransNEW database; by being an online presence, it will be indexed by the Internet search engines and the public awareness of the TransNEW will be higher in the future.

The operation and maintenance of the database will continue after project completion. This ensures that countries can still access potential partners for projects at a regional, national or European level.

The real value of the system consists in the very large volume of information that will be recorded in the database, especially the facilities of data input, retrieval and search Web interface design.

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