Establishment of Road Assessment Management System at Public Enterprise for State Roads - N. Macedonia
What is RAMS

- The RAMS is a planning tool that has a database, which stores and presents road data information, planning short and long-term road maintenance. The system is also used to create budgets and maximizes economic returns of the investments made for the road network.

- Road Asset Management provides decision makers with the necessary tools for efficient and sustainable management of roads. The process goes through the following steps:
  - Establish a complete inventory of all road network with all its elements
  - Provide a clear picture of the current condition/performance of the road network
  - Estimate the value of the asset
  - Predict future demand of traffic and service needs
  - Estimate maintenance needs and costs
  - Priorities objectives related to the desired quality and performance of the road network
  - Set up funding scenarios for the regular and timely maintenance and upgrade of the road asset
  - Define a strategy (RAM Plan)
  - Implement the RAM Plan

Road Asset Management is a permanent process!

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RAMS Software Overview

The RAMS software covers the next basic components:

- Road Data Bank (RDB) database,
- RDB application for data management,
- integrated GIS for data management and data presentation,
- integrated HDM-4 as data analyzing tool,
- use of HDM-4 for programming purposes.
RAMS Software components

- RDB database

  store all the roads data in standardized relational database according to road reference system (road section and chainage) and geometry (coordinates) simultaneously and care for data history,
RAMS Software components

- **Data maintenance tools**
  - RDB application for maintenance of the road data (import, input, edit, delete) is the core of the system; the RDB application is integrated with GIS and enables automatic transformation of data between the road reference system and geometry and must include utilities for data transformation when road reference system is changed;
  - data preparation for HDM-4 is supported as part of RDB application; based on the collected and processed data different homogenous sections (links) for different HDM-4 analyses; appropriate software for defining a homogenous sections and importing to HDM4 software In addition, the average characteristics of a matrix of road classes should be computed and exported to HDM-4 to be able to perform an HDM-4 network strategic analysis
  - The RDB is able to export the road network data per km, per homogenous road sections or for a matrix of road classes to Excel for further analysis.
  - GIS Desktop tool for road reference system and other GIS data management
RAMS Software components

- **Data analyzing and presentation tools;**
  - HDM-4 is used as basic analyzing tool for preparation of plans for road construction, reconstruction, rehabilitation and maintenance.
  - The GIS Desktop application is used for spatial analyses and data preparation for further analyses in HDM-4 and preparation of specific reports on road maintenance plans calculated by HDM-4.
  - The system produces standard reports and maps for monitoring the network and presenting the results of the HDM-4 evaluation.
  - WEB GIS system is the core system for all RDB data presentation to all PESR users.
RAMS SOFTWARE

- RAMS software:
  - RAMS Portal
  - RDB database and application
  - WEB GIS
  - HDM-4 Data handling model

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RAMS SW - PORTAL

RAMS Portal served as single entry point:

- with all information for users
- links to all RAMS SW components

- Integrated with PESR Active Directory single sign on system
- user rights are managed by PESR IT team

In 2018 RAMS Portal is regular use

news regarding the RAMS - new and updated road data, new functionality, etc. - are regularly published,

user documentation and FAQ are published, forum for user questions is open

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RAMS SW - ROAD DATA BANK

- Goal: to enable storing and management of all road asset data in standard database
- RDB includes database and application for road data management
- RDB database is designed as integrated relational and GIS database that store all the roads data in standardized relational database MS SQL Server according to road reference system (road section and chainage) and geometry (coordinates) simultaneously
- RDB application for maintenance of the road data (import, input, edit, delete) is the core of the system and is implemented as WEB solution to enable use of the RDB as many users as possible but also as client/server solution with more advanced functionality for advanced users (RAMS team).
- Important functionality of RDB is customized Data handling module that is used for road data analyses and preparation, defining homogenous sections and exporting prepared data to HDM-4 software.
RAMS SW - ROAD DATA BANK
Client/server version (full)

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RAMS SW - ROAD DATA BANK

- Database data structure/data model consists of
  - reference system data tables,
  - road geometric/design elements data tables,
  - road cross-section profile data tables,
  - pavement structure data tables,
  - road condition data tables,
  - traffic data tables,
  - traffic accidents data tables,
  - HDM Data handling support data tables,
  - road works management data tables (road works, road data collection works),
  - WIM (weight in motion) data tables,
  - iRAP data tables
- Data tables are organized and grouped into data groups of same topics, to ease access and to have data organized in the user application for better data access.

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RDB is designed for road data management, data collection, data analysis

RDB application (client-server version or web version) enables user to:
- access data,
- view, enter, search, filter, group data,
- conditional search record/advanced filter of data,
- edit (enter, change, delete data),
- view and change code-tables,
- design reports,
- view related documentation (images, documents, files).
RAMS SW - ROAD DATA BANK

Data handling module:

- Customized module that is used for road data analyses and defining homogenous sections and importing prepared data to HDM-4 software
- Based on the collected and processed data different homogenous sections (links) for different HDM-4 analyses can be provided
- The average characteristics of a matrix of road classes can be computed and exported to HDM-4 to be able to perform an HDM-4 network strategic analysis
- Data can be exported the road network data per km, per homogenous road sections or for a matrix of road classes to Excel for further analysis

TrueView Data Handling Module:

- Export sections defaults
- Homogenisation defaults
- Traffic Growth defaults
- Budget scenarios
- Alternatives
- Default scenario target IRI
- Super section classes
- Imported data
- Imported - Annual Data
- Imported - Annual Works
- Imported - Budget Scenarios
- Imported - Budget Scenarios Options
- Imported - Options
- Imported - Sections
- Imported - Work Programme
- Imported - Investments

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Conclusions:

➢ A comprehensive system was designed, which, with appropriate usage of trained professional users, enables PESR to have efficient data management of public roads under PESR jurisdiction.

➢ System requires regular data update, both in regard to reference system changes, road maintenance works and in regard to regular (scheduled annually, bi-annually or other interval) or on-request (after road works, requested by inspectorate, Police, PESR, ...) field measurements.

➢ Appropriate system of data flow and organizational procedures must be established in order to have road asset management system up-date regularly

➢ Open system to add other road inventory/road asset elements
RAMS SW - WEB GIS

GOALS

- Main goal was to deliver WEB GIS system that is the central point and basic tool for each PESR employee, where she/he can find all data about road, not only data regarding RAMS.
- Huge amount of road data collected in RDB can be effectively presented only through the visualization of this data on road network.
- Presentation of results of data analyses made by RDB data handling module and with HDM-4 prepared programs of road maintenance works.
- GIS is also entering point for access to other road documentation, pictures, etc.
RAMS SW - WEB GIS

- PESR gets efficient WEB GIS solution tailored to PESR needs
- modern 3 level WEB architecture
- data are stored in MS SQL Server Spatial Database
- application server implemented on open GIS standard GeoServer environment with WMS and WFS services, developed in compliance with OpenGIS® and OGC standards
- light user interface supported by any standard WEB browsers

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Presented RDB data:
- New RRS
- Existing road data
- GPR and WIM measurement data
- IRAP data
- Data handling module and HDM analysis

Other integrated data:
- Some data from AREC as WMS
- Open source data - Google Maps, Open Street Map
- HUB Sentinel Satellite data
- Old map of state roads

Functionalities:
- Layer groups and layers setting
- Media integration
- Searching and filtering
- Measuring
- Printing
- Simple analyzing and exporting data

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CONCLUSIONS

➢ WEB GIS is independent but integrated with other RAMS software and can be used as PESR central GIS system not limited only to RAMS content and users
➢ In future in WEB GIS can be added new data when available and new functionalities and processes can be supported
# HDM-4 ROAD NETWORK EVALUATION

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Distribution of Functional Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motorways</strong></td>
<td><img src="chart1" alt="Motorway Distribution" /></td>
</tr>
<tr>
<td><strong>Expressways</strong></td>
<td><img src="chart2" alt="Expressway Distribution" /></td>
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<tr>
<td><strong>Main roads</strong></td>
<td><img src="chart3" alt="Main Road Distribution" /></td>
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<tr>
<td><strong>R1 roads</strong></td>
<td><img src="chart4" alt="R1 Road Distribution" /></td>
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<td><strong>R2 roads</strong></td>
<td><img src="chart5" alt="R2 Road Distribution" /></td>
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<tr>
<td><strong>R29 roads</strong></td>
<td><img src="chart6" alt="R29 Road Distribution" /></td>
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</tbody>
</table>

## Distribution of road network functional classes and IRI categories

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DATA COLLECTION

Data was collected by roads survey with special vehicle to determine pavement structures (material type and thickness of pavement structure layers) of state roads in Macedonia for planning and programming of maintenance treatments in RAMS.
CONCLUSIONS

RAMS establishment is successful project and give expected results for all segments:

- RRS
- GPR and WIM measurements
- RAMS SW including RDB, WEB GIS and Portal
- Populating system with existing data
- Road network evaluation with the HDM-4

Difficulties:

- RAMS system is on place but is not used on daily base while PESR RAMS team are not established completely
- PESR posses special vehicles for road survey and for time-to-time PESR RAMS TEAM is preforming roads survey and prepare reports.
THANK YOU FOR YOUR ATTENTION