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An Integrated Solution for Pavement Management and Monitoring Systems

Lucia Rusu^a, Dan Andrei Sitar Taut^a, Sergiu Jecan^{a,*}

^aFaculty of Economics and Business Administration, Business Information Systems Department, "Babes Bolyai" University, Cluj-Napoca, 400591, Romania

Abstract

The aim of this paper is to present a holistic platform for pavement monitoring and maintenance management (PMMP). Our solution tries to exploit new technologies in order to design, integrate and implement an automated and portable visual road inspection system for traffic-speed pavement distress monitoring and analysis that can be installed on non-specialized vehicles. PAV3M developed based on solution based on PMMS requirements and recommendation made in EU programs as a modular decomposition based on business process analysis. For road monitoring and maintenance we opted for LCCA methods. Our solution includes Risk management module.

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1. Introduction

Evolution of pavement management system was marked by the domain specific technologies and new materials which appeared in recent years. Pavement process has developed in three major directions: pavement construction, pavement management, and pavement research. While pavement construction can manage new pavements and pavement rehabilitation including specification development and quality assurance, pavement management has monitoring post-construction roads, preventive maintenance and rehabilitation treatments for deterioration, and economic analysis of alternatives, based on life cycle cost analysis (Life Cycle Cost Analysis -LCCA). Pavement

* Corresponding author. Tel.: +4-026-441-8654; fax: +4-026-441-8570.

E-mail address: sergiu.jecan@econ.ubbcluj.ro (S. Jecan), dan.sitar@econ.ubbcluj.ro (D. A. Sitar-Taut), lucia.rusu@econ.ubbcluj.ro (L. Rusu)

research act in both circumstances, by offering new alternatives, modern solution, treatments and materials for pavement construction, maintenance, and rehabilitation.

Pavement management has many definition but most simply is “the process of maintaining the pavement infrastructure cost-effectively” (Wolters et al, 2011). Since 1993 American Public Works Association (APWA) defines pavement management as “a systematic method for routinely collecting, storing, and retrieving the kind of decision-making information needed to make maximum use of limited maintenance (and construction) dollars”. Another pavement management approach is “a program for improving the quality and performance of pavements and the quality and performance of pavements and minimizing costs through good management practices”.

A Pavement Management System (PMS) role is “to provide objective information and useful data for analysis to that road managers can make more consistent, cost-effective, and defensible decisions related to the preservation of a pavement network”. From another point of view PMS is a “set of defined procedures for collecting, analyzing, maintaining, and reporting pavement data to assist the decision reporting pavement data, to assist the decision makers in finding optimum strategies for maintaining pavements in serviceable condition over a given period of time for the least cost” (Vitulo, 2013).

According to Oguara approach, nowadays we can have several systems and procedures: Pavement Management System (PMS), Priority Rating System (PRS), Pavement Maintenance Management System (PMMS), Roadway Evaluation and Maintenance Programming (REMP), Pavement Serviceability System (PSS). Each procedure’s aim is to provide a consistent, reasonably objective and systematic procedure for establishing priorities, scheduling, and budgeting highway maintenance and rehabilitation requirements (Oguara, 2007).

Many communities opt for the strategy of purchasing COTS systems in pavement management. A Commercial off-the-shelf system (COTS) is defined as “an application or system software that is marketed widely as a pre-packaged product under an established commercial licensing or leasing agreement to the general public” (McPherson and Bennett, 2005). COTS systems, can be classified in three categories: Pavement Management Systems (PMS), Bridge Management Systems (BMS), and Integrated Management Systems (IMS), which can manage multiple road infrastructure elements or integrate PMS and BMS (Mizusawa, 2009).

EU programs such as RIMES (Road Infrastructure Maintenance Evaluation Study) and PAV-ECO (Pavement and Structure Management System - Economic Evaluation of Pavement Maintenance) have shown that EU member states spend billions of Euros annually on the maintenance and rehabilitation of their road infrastructure. Only 25% of EU countries (plus Norway and Switzerland) utilize automated data collection systems and the data analysis procedures for road maintenance. Our country has not yet implemented such a program for pavement maintenance and monitoring. Last year our Ministry of Transport presented the long time transport strategy and its vision about General Transport Master Plan (MT 2014).

Our paper tries to offer an original approach of an integrated PMMS based on several innovative camera system and a full set of additional sensors for positioning, orientation, and communication. After an introduction, section 2 presents several international programs for PMMS and related work. Section 3 offers PAV3M architecture, started with objectives, business process, actors and roles, structure, and functionalities.

2. Related works

In recent years pavement management systems have experienced a significant evolution, on the increasing role of modules increased cost analysis and forecasting as well as the evolution of GIS systems have proved their usefulness and PMS. We present some representative solutions for this area.

MS2’s Pavement Management System (PMS) offers the essential tools for cost-effective road improvement decisions, analyzing and managing. For efficiently management modules has several usefully facilities: road segment location and description, road condition survey dates, detailed road condition data, road segment and network ratings, graphs, and reporting, history of road treatments. Maintenance components are assured by an application of appropriate roadway deterioration and type and cost of recommended road treatments (MS2, 2014).

The SMEC Pavement Management System (PMS) is used by the Australian and international government authorities in order to improve performance of road networks and road inventory assets. SMEC is an Advanced Asset Management. Technical development solution is based on SQL Server and Oracle technology, Geographical Information Systems (GIS) integration, thematic mapping capabilities, and Highway Design and Maintenance (HDM)

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