Decision Support to Identification of Road Infrastructure Segments With Poor Conditions

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1 Introduction

Planning process of maintenance activities is highly complex and ill structured problem, in almost every civil engineering activity, and so is in the field of urban road infrastructure system. Lots of stakeholders with different opinions, huge amount of information quantities, multidisciplinary character of the problem, conflicts among goals and criteria, budget restrictions, are some of the factors that are affecting this problem complexity. In order to manage such complexity, a decision support approach is proposed to improve decision making to planning of maintain activates at the road infrastructure system. Firstly, relevant stakeholders are identified, gathered together and then divided in three groups: local government, experts and users. Road infrastructure segments that need to be improved because of their poor condition are defined. Segments conditions are express by Condition Assessment Value (CAV), using few the most relevant criteria: level of service, safety, time period passed form the last renovation, and stability. Expert assessment of segments conditions according to defined criteria are given and to achieve the most precise assessment methodology of Artificial Neural Networks (ANN) and Simple Additive Weighting (SAW) method is used. Petty and Mahoney (2008), He, Song and Chaudhry (2013), Dunkel et al. (2011), Bielli (1992), Jajac, Knezić and Marović (2009) etc. dealt with possibilities of generating decision support tools for maintaining road infrastructure. The approach is validated on the urban road infrastructure of the city centre of Split, Croatia, and proved to be useful for determining a set of road infrastructure segments where maintenance activities should be undertaken. The main characteristics of each segment of road infrastructure are collected and stored in database. These main characteristics of segments are important for defining criteria and their weights. Relevant criteria are defined by local government and experts, while criteria weights are determined by all stakeholder groups. Using the Analytical Hierarchy Process (AHP) weights are easily determined through a group decision-making process. Three scenarios are created, each one for each stakeholders’ groups. The fourth scenario is determined as the compromise opinion of all groups. Values of the compromise opinion are introduced as weights for the SAW method, which is used to set priority of selected road segments according to their improvement requirements. There were 236 defined infrastructure segments, divided into 10 types: street, street section, crossroad, garage, parking, bus station, bus terminal, petrol station, overpass and tunnel. All segments are analysed, and those with conditions that needed to be improved are identified using ANN. Only those segments with the condition assessed as poor, unsuitable and worn-out are selected for further analysis and priority-setting. The segments are then ranked according to defined criteria. Table 1 shows the ranking of the infrastructure segments. The segment evaluation with higher score value means that the segment is considered as prior to improvement. In this case segment Sg10 (76.87) has the highest value, while the Sg8 (25.88) has the lowest.
Table 1. Ranking of segments.

| Segment label | Score | Rank position |
|---------------|-------|---------------|
| Sg1           | 70.32 | 7.            |
| Sg2           | 72.75 | 4.            |
| Sg3           | 71.58 | 6.            |
| Sg4           | 44.35 | 15.           |
| Sg5           | 73.28 | 3.            |
| Sg6           | 58.21 | 10.           |
| Sg7           | 40.13 | 16.           |
| Sg8           | 25.88 | 18.           |
| Sg9           | 73.31 | 2.            |
| Sg10          | 76.87 | 1.            |
| Sg11          | 54.12 | 11.           |
| Sg12          | 49.16 | 14.           |
| Sg13          | 38.67 | 17.           |
| Sg14          | 66.57 | 8.            |
| Sg15          | 53.41 | 12.           |
| Sg16          | 63.18 | 9.            |
| Sg17          | 72.45 | 5.            |
| Sg18          | 49.82 | 13.           |

With the aid of proposed approach of decision support, ranking list for the priority of improvement of infrastructure segments is obtained. Finally, eight top-ranked segments are included in the maintenance plan, in the next investment period, as is decided by the final decision maker – the local government of the city of Split.

In this paper an approach of decision support for the road infrastructure segments maintenance planning is proposed. This way, support to final decision maker is very useful, practical and can be easily to applied, especially in making decisions for the compound and socially sensitive problem such is the maintenance planning of the road infrastructure segments. Main characteristics of the given approach are analysis of required data and selection of appropriate methods. The presented approach of decision support is an adequate tool for decision makers in the field of the improvement of maintenance planning of road-infrastructure segments.

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