# Definition of passenger user groups with Ward's method for the evaluation of journey planners

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Abstract:

A quantitative analysis was performed to evaluate multimodal journey planners, and for this purpose a framework of aspects was developed and user groups were created, so that all the different needs and expectations could be represented. In order to gain realistic answers from the user groups a survey – based on the aspects – was composed. Using the answers and the aggregated data, the evaluation can be validated. Based on the results it can be stated that the original user groups are not significantly different from each other. Therefore new user groups were defined using Ward's method. The answers were analyzed and the features of these new user groups were defined. Using this new assignment, the journey planners were re-evaluated and the ranking was compared to the original results. Furthermore the correlation between certain answers was explored, which results can help in the understanding of common needs of passengers.

## 1. Introduction

The European Union recognized the importance of trip planning issues, which was handled in the Easyway project that has a pillar concerning the development of travel information services, specially emphasizing the need of creating a comprehensive and fully multimodal journey planner. The "smart multimodal journey planner" competition was announced already in 2011, where many applications were evaluated and some of them were awarded. However a detailed quantitative evaluation was not performed. This investigation is based on a quantitative analysis of journey planners, where a framework of aspects was created in order to realize the most important features of these journey planners.

## 2. Evaluation of journey planners

Concerning the aspects a classification of aspects of journey planners was realized, which was divided into 5 main features, as route-planning services, booking and payment, handled data and operational features, comfort service information, supplementary information.

Creating user groups may help understanding basic user needs, thus all passengers were differentiated into 5 groups: student, worker, tourist, businessman and pensioner. The definition of the user groups was based on their age (younger, middle aged, older), their motivation of travel (school based, work based, leisure based), and their possible difficulty of travel (handicapped, without problem). We assumed that these groups have different preferences as the students are more interested in dynamic data, tourist would like

to know more about route-planning and payment and for the pensioners are supplementary information quite important.

The evaluation was performed using a compensational multi-criteria method. To each journey planner and each aspect a value between 0 and 10 was given. By summing up these values the general evaluation number was calculated. In order to take the specific needs and expectations of the user groups, normalization and weighting was performed. The normalization is based on the difference between the maximal possible and the maximal given value for each aspect. The weighting is based on the preferences of the user groups. Finally the weights of the user groups were taken into account by their transportation share, which results in the average qualifier number.

3. The survey

The key of collecting reliable data was the elaboration of a survey based on the aspects, which is necessary to get realistic weighting coefficients for the user groups. Therefore a survey was created, which contained questions about user demographic data, and the rest of the survey was divided into question groups, each part focusing on a category of journey planning features: route-planning, booking and payment, information about the journey, services information, other information.

Having the results of the survey a statistical analysis was performed. For all questions the mean values and variances were calculated concerning each user group. Then the Bartlett test was performed, which examines, whether the samples (user groups) have the standard deviation or not. For the whole set the ANOVA (ANalyis Of VAriance) was used, which defined, whether the user groups have the same mean values or not.

Using the results of the survey weights were assigned to the main aspects, and the evaluation of journey planners was performed. Analyzing the evaluation results the user groups did not show real differences regarding the main aspects, namely they behaved similar and preferred the same features. Therefore the redefinition of the user groups has to be conducted. Using the Ward method the users can be automatically classified into groups.

4. Ward's method and results

The used method for creating new user groups was the Ward method. This is a hierarchical clustering method, where the data are partitioned into a dedicated number of clusters in many steps. Ward method is an agglomerative clustering method, thus it first consists of all elements, and then step by step more elements will be ordered to a cluster. At each step the method includes those elements, which are the "closest" (according to a metric) to the cluster. Once a cluster is created as a result of a step, the elements of the new cluster cannot be separated again. The algorithm tries to find the optimal number of clustering steps. Ward method is conservative, monoton and creates about same big groups.

Having the original and new user groups the evaluation of the journey planners was performed and the

results were compared. In the case of new user groups some significant differences were discovered, which resulted in some changes of the journey planners' ranking.