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Statistical Assessment of the Development of the Transportation System in Chosen Countries – an International Approach

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Abstract

The main aim of the paper is to attempt the assessment of the process of the transport development in chosen countries with implementation methods, which allow taking into account interactions between different areas of the transportation system. Hence, the order taxonomic methods with the implementation of multidimensional Weber median were introduced. The introduction of proper taxonomic methods in the assessment process of transportation system development can bring more opportunities in order to enhance the efficiency of the use of limited financial resources coming from the European Union as well as national budgets of particular countries.

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Keywords: logistic; interactions; transport area; taxonomic measure

1. Introduction

Improvement of the development level of particular regions of the European Union is one of the crucial goals of socio-economic policy. This kind of process is strictly connected with the area of transport because mobility has significant impact on the European Union market as well as on the quality of life. Moreover, transport stimulates economic growth what enables job creation [1]. The European Union has specified the most important objectives in the document called Europe 2020 Strategy [2]. Furthermore, the main areas of political activity and detailed goals in the European Union transportation system were shown in the document called White Paper. All these could not be possible without three basic financial instruments i.e. European Regional Development Fund, Cohesion Fund and

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European Social Fund. Thus, in the field of the transport and energy network policy, 59 billion euro has been allocated [3].

Hence, the most important thing is to make a proper assessment of the current state of the transportation system, what ought to have a positive impact on its use. In addition, achieving this purpose is very complicated. These difficulties are increased by the fact that transportation system is very sophisticated, the users are diversified, and the possibilities of interrelation of public authority are different as well as the senility of its recipients [4].

The aim of the paper is to determine the level of spatial development of transportation system taking into account the interrelationships and interactions in the set of diagnostic variables in the case of the European Union member states.

2. Methodology

Transport is considered as a complex phenomenon therefore the research in this field can be run using two approaches. The former one is called a one dimension analysis where the level of the transport development is assessed separately according to single variables. Hence, it causes many difficulties in clear-cut assessment process of the analyzed objects. However, the latter introduces taxonomic tools and creates possibilities to support logistic policy by the procedures of the ordering and classification of research objects which are described by many variables [5].

The empirical assessment of the development of the transportation system as well as its particular branches and law regulations was carried out in the literature [6–11]. The analyses with implementation of taxonomic methods are presented in the literature as well [12–15]. Moreover, transport is considered as a field of sustainable consumption [16] and plays important role in households' expenditures for example, purchase of new and second hand motor vehicles, motorcycles, bicycles and so on [17].

Making the review of the literature in the area of taxonomy, there are two basic types of synthetic measure construction. The first one, in its classical version, uses arithmetic mean and standard deviation [18]. The order version of synthetic measure construction implements median as well as *mad* (median absolute deviation) where standardization takes the following form [19]:

$$z_{ij} = \frac{x_{ij} - \theta_j}{1{,}4826 * mad(X_j)} \tag{1}$$

where *mad* (median absolute deviation) in the distribution of particular variables is estimated by the following formulas:

$$mad(X_j) = \underset{i=1,2,\ldots,n}{med} \left| x_{ij} - \theta_j \right| \tag{2}$$

Values of θ_j are considered as particular elements of multidimensional Weber vector, which is estimated by the following formulas [20]:

$$T(\Theta, R^m) = \arg\min_{\Theta \in R^m} \left\{ \sum_{i=1}^{n} \left[\sum_{j=1}^{m} \left(x_{ij} - \theta_j \right)^2 \right]^{1/2} \right\} \tag{3}$$

The history of Weber median and construction process of multidimensional vector is presented by Młodak [21]. Moreover, this kind of median is applicable into different research fields as well as other forms of variable normalization like unitization or ratio transformation are introduced [22, 23].

Implementation of multidimensional median construction is very important in the case of variables with strong skewness which has a significant impact on the result of linear ordering of research objects. Additionally, this kind of median allows for considering the interactions in the set of diagnostic variables used in research field.