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Integrating factor analysis and the Delphi method in scenario development: A case study of Dalmatia, Croatia

Petra Radeljak Kaufmann

University of Zagreb, Faculty of Science, Department of Geography, Marulićev trg 19, 10000 Zagreb, Croatia

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ABSTRACT

When developing scenarios, it is challenging to integrate quantitative and qualitative methods. This paper describes a new approach to scenario construction for spatial research and planning that was used to conduct a case study of constructing explorative development scenarios for Dalmatia, Croatia, until 2031. The methodology of scenario development consisted of: 1. factor analysis, which was used to reduce and classify a large set of data on different aspects of spatial development and to isolate underlying factors of development characteristics. These factors were used as variables to develop a regional typology; and 2. two rounds of the Delphi method, where an interdisciplinary panel of experts examined possible future developments in the light of aforementioned factors supplemented with other, nonquantifiable factors. Multivariate analysis was proven to provide a sound, but also complex, quantitative foundation for recognising the underlying driving forces of development characteristics, while the participation of experts in the Delphi panel significantly improved recognition and interpretation of the factors crucial to scenario development.

1. Introduction

The scenario method is used in different areas of planning to portray alternative futures by identifying key driving forces and uncertainties that influence a system over a given time period. In future studies scenarios are described as perhaps a keystone methodology (Slaughter, 2002) and the tool *par excellence* (Inayatullah, 2008). Since the mid 20th century scenario method has also become an important part of planning in business and public policy, technology foresight, and environmental studies, as well as spatial research and planning. Scenarios can serve as a basis for generating ideas and testing conditions, against which plans and strategies can be evaluated (Rikkonen & Tapio, 2009). They integrate thinking about various aspects of spatial development, and through it give strategic direction to spatial planning. Scenarios help in defining areas prone to risks (Price et al., 2015). They have also been used at various levels, from global to local (e.g. Alcamo, 2008; ET2050 Territorial Scenarios and Visions for Europe, 2014; Kok, Patel, Rothman, & Quaranta, 2006; de Nijs, De Niet, & Crommentuijn, 2004; Özkaynak, 2008; Promper, Puissant, Malet, & Glade, 2014).

Scenarios are constructed by scientists and experts from diverse backgrounds, often with stakeholders, resulting in the use of a great number of methods and techniques. These methods and techniques have been systematised in multiple ways, depending on the type of planning and the general purpose of the exercise (Amer, Daim, & Jetter, 2012; Bishop, Hines, & Collins, 2007; Bradfield, Wright, Burt, Cairns, & van der Heijden, 2005; Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006; Inayatullah, 2008). For example, Börjeson et al. (2006) discuss the applicability of various generating, integrating and consistency-checking techniques used in developing scenarios, e.g. surveys, workshops, the Delphi method, modelling, and cross-impact analysis, while Bishop et al. (2007) list eight general categories (types) of scenario techniques, such as judgmental techniques, baseline/expected, or elaboration of fixed scenarios.

The methodological openness and flexibility of scenarios presents certain issues. Approaches ranging from 'intuitive' ones based on the process of group work and learning, to 'formal' ones working from quantified knowledge and often using computer simulation techniques in scenario development (van Notten, Rotmans, van Asselt, & Rothman, 2003) indicate the importance of choosing a proper combination of methods and techniques for specific scenario studies. Research shows that different methods produce diverse scenarios, and that combining and layering different

E-mail address: radeljak@geog.pmf.hr.

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methods enriches the outcomes (Curry & Schultz, 2009). Challenges related to distinguishing and integrating qualitative and quantitative methods in scenario construction are also often discussed (e.g. Alcamo, 2008; Dammers, 2010; Kemp-Benedict, 2004). Scenarios built through a participatory approach to planning potentially encompass rich and complex knowledge. The modelling procedure, however, calls for reducing complexity in order for researchers to prepare a consistent set of input parameters for scenario simulation (Alcamo, 2008; Walz et al., 2007).

The objective of this research is to contribute to scenario development in spatial research and planning, by constructing explorative development scenarios through a new combination of factor analysis and the Delphi method. The specific approach is demonstrated using the example of the Croatian coastal region of Dalmatia. The main factors that have influenced recent development characteristics, based on the factor analysis, are shown at the level of local government units. These factors are examined and possible future developments considered by an interdisciplinary panel of academics and practitioners engaged in the broad field of spatial planning. The Delphi panel improved recognition and interpretation of the factors crucial to scenario development, by providing a 'direction' in the interpretation of the results of a complex factor analysis and by including other (non-quantifiable) factors important for the recent and future development of the region. The resulting scenarios can be used in policy formulation and implementation.

2. Study area

Croatia is one of the European countries that have (re)emerged on the political map of the continent after the fall of the 'Iron Curtain'. A part of the former Yugoslavia before the 1990s, Croatia has since been struggling through a difficult transition from socialism and a centrally planned economy, to capitalism and a free market economy. The 1991–1995 Croatian War of Independence, and post-war difficulties, have contributed to a transition process that has lasted longer than in some other post-socialist countries. On July 1st, 2013 Croatia achieved European Union membership following a series of recent advances.

Dalmatia is the southern littoral region of Croatia along the Adriatic Sea. Within its surface area[1] of 12,075 km^2, it consists of three parallel strips: islands, coastline, and the hinterland. Dalmatia is a historical/geographical region, which in the contemporary administrative organisation of Croatia can be defined as consisting of 131 local government units (LGUs) – towns and municipalities, pertaining principally to four counties: Zadar, Šibenik-Knin, Split-Dalmatia, and Dubrovnik-Neretva County[2] (Fig. 1). In 2011 the total population of Dalmatia was 855,731, one-fifth of the population of Croatia.

By the mid-20th century the landscape of Dalmatia was predominantly rural, and the economy of the area two-fold: maritime and agricultural (Friganović, 1974). In the past half-century, this region has been functionally and physiognomically transformed. Littoralisation, urban based industrialisation, and tourism development have effected changes differently throughout Dalmatia. Physiognomical changes were evident in the general urbanisation of the area – the growth of urban centres and the urbanisation of rural settlements, especially those surrounding larger cities, and in infrastructural development. Increasing concentration of people and economic activities has characterised coastal centres as carriers of the secondary and tertiary sectors of the economy. Changes were evident also in several waves of second-home construction on the coastal and island strips (Opačić, 2009). On the other hand, depopulation and socio-economic underdevelopment have marked the smaller Dalmatian islands, the interiors of the larger islands, and the Dalmatian hinterland (Faričić, Graovac, & Čuka, 2010; Lukić, 2012; Nejašmić, 1991; Pejnović, 2004). The landscape of underdeveloped parts of the hinterland and small, remote islands has often turned into a 'depopulation landscape' (Nejašmić, 1991, p. 236). This is why data on the steady increase of total population in Dalmatia in the decades following World War II 'mask' regional and local disparities, due to emigration and to the interregional restructuring of population.

The maximum population of 959,610 was reached in 1991, followed by a decrease related to the effects of war and to problems with the transition to a free-market economy. Given this history and the sharp turns in its historical trajectory, the future of the region is more uncertain than would be the case in a region with a more linear historical trajectory. That is why any study or plan for future development must take into account both qualitative and quantitative regional and local data, and the specific combination of methods used in this research is particularly appropriate.

3. Methods

3.1. The quantitative step of scenario development

The quantitative phase of this research study, which uses factor analysis, is partially based on the reasoning behind generating alternative future scenarios for rural England reported on by Lowe and Ward (2009). In their study, a set of variables was selected to serve as proxies for processes taken to constitute the inherent dynamics of rural futures, and subjected to factor analysis to identify a subset of critical uncorrelated variables from which to develop a typology of rural areas.

For the purpose of spatially detailed analysis, a comprehensive set of statistical indicators for LGUs in Dalmatia was collected. The choice of variables to represent recent development characteristics was made after a selection process based on extensive literature review and correlation analysis, as well as on prior knowledge of the region in question. The final set consisted of 49 manifest variables to be used in the factor analysis to look for the underlying latent variables, or main factors of recent development characteristics. There were eight groups of variables: 1. population number and structure; 2. demographic dynamics; 3. population activity and employment; 4. socio-economic structure of the population; 5. characteristics of town and municipality budgets; 6. characteristics of tourism development; 7. central services array; 8. housing structure and change, and level of construction land development (Table 1).

An analysis was conducted using the *SPSS Statistics* software package. The initial factor loadings were calculated using the principal component method. The rotation method selected was Oblimin with Kaiser Normalisation, where the resulting factors were correlated. Due to the fact that two LGUs[4] had missing values

[1] Calculated based on the State Geodetic Administration's Registry of spatial units, 2011.

[2] The town of Novalja, situated in the northern part of the island of Pag, is the only LGU that is part of Lika-Senj County and still included in this research. Namely, in spite of its administrative division between two counties, Pag is as a whole included in Dalmatia, which corresponds to other recent research (Faričić, 2012; Nejašmić, 2013; Lajić & Mišetić, 2013).

[3] Registry of spatial units, 2011, SGA was the source for digital layers containing administrative borders used for thematic mapping with ArcGIS 10.0. A Topographic Basemap from ArcGIS 10.0 was also used for Fig. 1.

[4] Local government units with missing values were Civljane and Škabrnja.