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ScienceDirect

Tunnelling and Underground Space Technology 22 (2007) 414–432

Tunnelling and Underground Space Technology incorporating Trenchless Technology Research

www.elsevier.com/locate/tust

The role of surface characteristics in directing subsurface spatial planning processes: The case study of a high-speed railway in Slovenia

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Received 29 June 2006; received in revised form 25 September 2006; accepted 26 September 2006
Available online 13 November 2006

Abstract

An increased need for subsurface use has been recently noticed. At the same time, problems concerning planning procedures, licensing issues and environmental impact assessments of subsurface projects have been recognised. This paper considers the applicability and usefulness of spatial modelling within the scope of planning, assessing and evaluating subsurface projects. As a case study a high-speed railway in Slovenia (HSR) was examined. Special emphasis was given to the role of surface characteristics in directing subsurface spatial planning processes, since the characteristics of the subsurface are often uncertain and not sufficiently represented in existing data. A new planning method consisting of three consecutive phases was developed. The approach was based on spatial vulnerability, attractiveness and suitability models, supported by GIS. The results of HSR planning showed, that the method is particularly useful if applied in the early planning phases. The results were aimed to support the decision-making process in order to proceed towards optimal spatial solutions for the project.

Keywords: Subsurface; Spatial planning; GIS modelling; Impact assessment; Tunnelling

1. Introduction

Recently, the need to allocate new projects in the subsurface has grown for multiple reasons. Firstly, resistance to spatial damage has grown due to increasing public awareness, along with growth in population and increasing needs for space (Godard and Sterling, 1995). Secondly, decreasing tolerance to spatial damage has been the reason for growing compensation demands (Godard, 2002). Thirdly, construction costs and turnaround time of underground projects have decreased due to technical developments in construction methods and construction tools (Godard, 2002). Nevertheless, despite growing needs for subsurface use, the related spatial planning process is still undefined and inconsistent, despite increasing research efforts (Durmisevic, 1999; Edelenbos et al., 1998; Godard, 2002; Godard and Sterling, 1995; ITA, 2000; ITA, 2004a; Monnikhof et al., 1998; Roberts don, 1996). Some publications deal with methods of defining functions of subsurface space (Edelenbos et al., 1998; Monnikhof et al., 1998; Rönkä et al., 1998); others deal with comparative methods of assessing surface and subsurface siting alternatives for planned projects (ITA, 2004b; Panou and Sofianos, 2002). Most recently, an effort in assessing the environmental impact and safety issues of planned facilities has emerged (Colorni et al., 1999; Enserink, 2001; Godard, 2002; Roberts don, 1996). Technical and design development in the use of subsurface is an ongoing activity (Durmisevic, 1999; ITA, 1988; ITA, 2004a, Stille and Palmstrom, 2003). A remaining issue is the search for a methodology for consistent planning of projects in the

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doi:10.1016/j.tust.2006.09.003

subsurface. This paper describes how this was done in the case of planning a high-speed railway (HSR) in Slovenia.

1.1. Review of the past planning process for a HSR in Slovenia

The planned HSR through Slovenia is a part of the fifth European transport corridor, which connects Barcelona and Kiev (via Lyon, Turin, Milan, Venice – Trieste/Koper, Ljubljana and Budapest). Recently, the HSR has been planned as a double-track railway for mixed transport (mainly passenger), with the following basic technical parameters:

- Velocities: minimum passenger transport speed – 300 km/h, minimum freight speed – 100 km/h,
- Minimum horizontal radius: 5500 m, exceptionally: 5000 m,
- Maximum slope 12‰.

The HSR planning process in Slovenia has been divided into two phases: routing of the HSR in the western part of the country (from the Slovenian/Italian border to Ljubljana), and routing of the HSR in the eastern part. All studies up to now have concerned HSR routes in the western part of Slovenia, whereas alternative routes of the HSR in the eastern Slovenia have not yet been studied. Former studies have produced three alternative routes A, I and

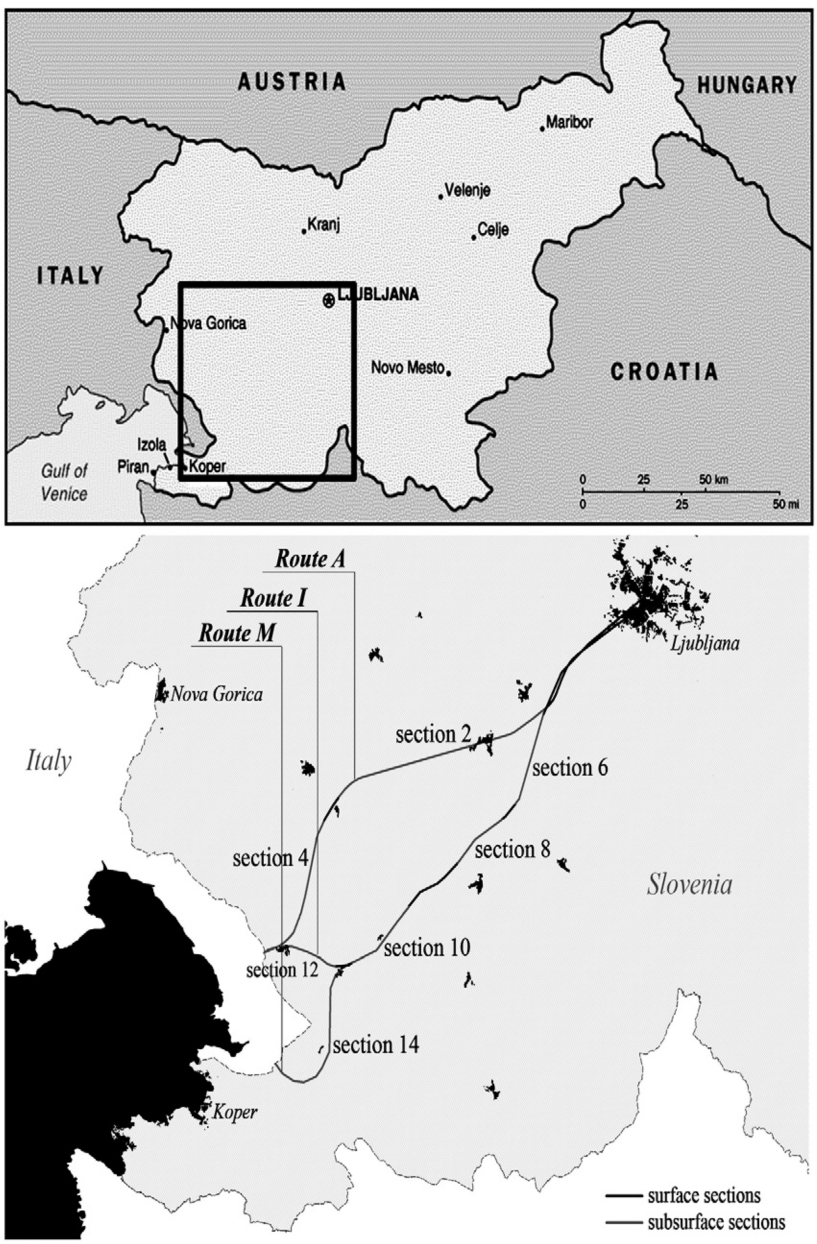

Fig. 1. Alternative HSR routes in the western Slovenia.