

Contents lists available at [ScienceDirect](#)

Journal of Rail Transport Planning & Management

journal homepage: www.elsevier.com/locate/jrtpm

Road accessibility model to the rail network in emergency conditions

Fabio Borghetti ^{a,*}, Gabriele Malavasi ^b^a Politecnico di Milano, Milan, Italy^b Sapienza Università di Roma, Rome, Italy

ARTICLE INFO

Article history:

Received 25 July 2016

Received in revised form 19 October 2016

Accepted 21 October 2016

Available online xxx

Keywords:

Railway accessibility

Railway emergency

Emergency management

Network resilience

Rail transport safety

ABSTRACT

This research project considers a quantitative model for analysing the accessibility of open-air stretches of a railway line in emergency conditions using the road system (Borghetti, 2014). The project derives from a previous study (Borghetti and Malavasi, 2016) which illustrated the problems regarding the vulnerability of a railway stretch with particular reference to accessibility in emergency conditions; a method for evaluating accessibility was proposed, with reference to a specific territorial situation. This work will examine in detail the analytic structure of the individual indicators that make up the model.

An Accessibility Index was determined for each railway link i of homogeneous length, starting from an evaluation of the territorial and contextual characteristics in which the line is positioned. The analysis procedure consists firstly of identifying those parameters that compete in implementation of the Accessibility Index, and secondly in aggregating the Indicator parameters which, through the use of relatively important weights, are part of Index determination.

The model is based on a comparative approach that places the Accessibility Index in relation to the links that make up a railway stretch, therefore identifying the priorities and a hierarchy of the management and/or infrastructural interventions carried out to improve accessibility should important events occur.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Following an important event involving the railway system, first aid, characterised by the immediate use of the resources available in the territory in the place where the event occurred, can present criticalities tied to the scarce rationalisation of interventions and a delay in guaranteeing assistance to those who are directly involved. The main accidental events that occurred have confirmed how access to a railway line can at times be complex in some contexts, therefore causing an increase in the intervention time by rescue workers.

In the majority of cases, in fact, the reply system to an important event, being for example infrastructure management, the fire brigade and medical service, uses road vehicles that are normally used for other types of intervention.

* Corresponding author.

E-mail address: fabio.borghetti@polimi.it (F. Borghetti).

The technical analysis of some accidents has confirmed that the territorial context in which the railway line is present in some cases made rescue operations difficult as far as the approach of vehicles, people and equipment suitable for handling the emergency are concerned.

Often, in fact, the railway is in areas that are not very anthropised, where the use type of the land can influence the accessibility of rescue services that use the road network.

As an example, the arrival/intervention time of the rescue teams and means that can reach the event (efficiency) also depend on the possibility or not of approaching the railway. Both factors can be estimated quantitatively according to how accessible the railway is.

The matter of railway accessibility is also contemplated in European Directive (2004)/09/EC, which disciplines the safety conditions for access to the railway services market. The main objective of the Directive is to improve the safety of the railway system, considering development of the directive itself, together with technical and scientific progress. The directive also introduces and defines the concept of safety management systems (Comunità Europea, 2004), intended as being the organisation and provisions applied by Infrastructure Management or by a Railway Company to ensure safe operation management. The safety management system documents and describes, in all its parts, the division of responsibilities within the Infrastructure Management or Railway Company. Among the essential elements that make up the safety management system are intervention, alarm and information plans should an emergency occur, agreed upon with the pertinent Authorities.

It is evident that implementing the plan presumes awareness of the surrounding territory and the entry roads to the railway system by the Rescue Teams, should a serious event occur.

Regarding safety in railway tunnels, Commission regulation (EU) No 1303/2014 of 18 November 2014 gives information on the technical specification of interoperability relating to “safety in railway tunnels” of the European Union rail system. The Regulation indicates, for example (Official Journal of the European Union, 2014), that *Member States should arrange rescue access in coordination with the rescue services.*

In the previous work (Borghetti and Malavasi, 2016), a method for evaluating accessibility by identifying the most important indicators was developed and applied. In this work, the model structure is expanded, with the aim of analytically describing the different indicators, with particular reference to criteria and parameters that contribute to accessibility estimation.

The result of model application foresees the implementation of thematic maps that can represent the accessibility value associated with the generic railway line element (link), making it possible to identify and plan interventions of a management and/or infrastructural nature aimed at improving accessibility to the rail network. By observing and evaluating these maps, it is also possible to establish a hierarchy of the interventions to be carried out, and if necessary to define the priorities.

The proposed method estimates the level of connection, and as such the accessibility between the rail network and the road network, highlighting the *contact points* – between the two transport systems – where it is possible to access the rail system from the road.

The structure of the calculation model is characterised by a comparative approach, because the determined nondimensional value of the Accessibility Index does not present an important absolute significance, but must be suitably compared in order to determine the links or stretches of network on which to carry out more detailed analyses and concentrate resources to improve accessibility.

The instrument areas of use involve a *pre-event* and a *post-event* phase: in the first, the interventions can be planned and programmed, while the second deals with the joint management of the emergency, which requires the arrival of rescue teams as quickly as possible.

2. Background

In scientific literature, various authors have faced the theme of support instruments in decisions aimed at evaluating accessibility in its most general meaning.

In some studies (Gutiérrez et al., 2011) (Miller and Wu, 2000) (Vandenbulcke et al., 2009) GIS - *Geographic Information System* technologies were applied to urban planning models the residential and business environments in order to verify the road accessibility of some areas (zones). The result demonstrated how the daily life of people, and also the relative choices, are influenced not only by the distance between the place where they live (home) and that where they go (e.g. work, school, shopping, free time, etc.), but also by the characteristics of the existing road system, which can improve (or decrease) accessibility also of the important emergency services (Fire Brigade, Ambulances, Police, Civil Protection) (Miller, 1999).

Another important aspects is the planning of transport, on which various authors have supplied some definitions of accessibility. As an example, for transport and planning engineering, Niemeier (1997) defines accessibility as *the easiness with which the required destinations can be reached*. Others have defined accessibility as *the easiness of reaching various services, destinations and/or activities from a particular point of origin* (Kwan and Weber, 2008) (Litman, 2015) (Vandenbulcke et al., 2009).

Furthermore, the accessibility of transport systems is widely studied by considering the user's point of view. In relation to the effectiveness of the transport system and the territory/context in which it is inserted, the concept of integrated mobility is introduced. For example, in the vast literature reported in the work of Geurs and van Wee (Geurs and van Wee, 2004), a review of accessibility measures is presented for assessing the usability of these measures in evaluations of land-use and transport strategies and developments.

Download English Version:

<https://daneshyari.com/en/article/4923653>

Download Persian Version:

<https://daneshyari.com/article/4923653>

[Daneshyari.com](https://daneshyari.com)