Construction Maeconomics Conference 2020

Possible criteria for prioritization of road construction projects

Pavel Krupík\*1

1CTU Prague, Faculty of Civil Engineering, Department of Construction Management and Economics, Thákurova 2077/7, 166 29 Praha 6, pavel.krupik@fsv.cvut.cz

Abstract

The article deals with strategic planning of transport infrastructure projects with elements of Construction 4.0. It presents the current method of evaluating these projects and presents the possible use of multi-criteria analysis, which is also compared with cost-benefit analysis. Furthermore, a search is made of all possible criteria that could be used in the evaluation of projects of new transport structures (highways and first class roads) by multi-criteria analysis.

Keywords

Road constructions, multi-criteria analysis, cost-benefit analysis, strategic planning, Construction 4.0

Introduction

During the strategic planning of the development of the road construction network, the economic evaluation of the project in accordance with Directive No. V-2/2012 Amendment No. 4 "Směrnice upravující postupy Ministerstva dopravy, investorských organizací a Státního fondu dopravní infrastruktury v průběhu přípravy investičních a neinvestičních akcí dopravní infrastruktury, financovaných bez účasti státního rozpočtu" [1]. For the process of evaluating the economic efficiency of transport infrastructure projects, it refers to the “Rezortní metodika pro hodnocení ekonomické efektivnosti projektů dopravních staveb” [2] and “Prováděcí pokyny pro hodnocení efektivnosti projektů dopravní infrastruktury” [3].

Fulfillment of criteria 3E, ie. their economy, efficiency and effectiveness, is particularly important for publicly funded projects, which must clearly demonstrate financial efficiency [10]. The evaluation of the efficiency of road and motorway constructions in the Czech Republic is performed on the basis of Cost-Benefit Analysis (CBA). The CBA method is based on the analysis of differential cost and revenue cash flows at the time of project evaluation. The method compares the benefits that the investment brings, with negative investment effects. All impacts of the investment (whether positive or negative) are converted into cash flows and included in the calculation of key indicators [3].

The choice of classification algorithm is an important issue in many fields. Because it usually involves more than one criterion, the task of selecting an algorithm can be modeled as problems with deciding on multiple criteria [6].

A possible solution is Multi-criteria analysis (MCA), which evaluates individual solutions exactly according to the set criteria and their weight. The project gets points if it meets the given criterion. These are then multiplied by the weight of the criterion [7].

Multi-criteria assessment can be algorithmized and therefore IT tools can be used. Here is a possible connection of this tool to Construction 4.0 [8].

Multi-criteria Analysis vs the Cost-Benefit Analysis

The CBA approach does not capture all intangible aspects, so the problem occurs when these impacts dominate. Then it is better to use the MCA approach [4].

|  |  |  |
| --- | --- | --- |
|  | CBA | MCA |
| When | Primarily *ex ante* and possibly *ex-post* | *Ex post; ex ante* |
| Where | Primarily large scale | Micro-scale |
| What | Quantifiable and measurable effects (“hard”) | Perception of the effect, including “soft” ones |
| Why | Efficiency | Effectiveness |
| How many | Single criterion and result | Multi(ple) criteria and indicators |
| Priority/Ranking | Output (support to decision makers) | Input (indications from decision makers) |

Figure 1: MCA vs CBA [4]

CBA is a widely used approach for quantifying the different types of project impacts across space and time by translating all impacts into discounted monetary conditions. The CBA prioritizes easily measurable economic goals at the expense of more complex and longer-term social and environmental goals [5].

In contrast, the MCA compares projects across several criteria. This makes it possible to assess impacts that cannot be monetized or that it is impractical and too complex [5].

Methodology

Possible criteria that could be used in the evaluation of projects of new transport structures (highways and first class roads) by multi-criteria analysis are based on a search of available literature and professional articles. Also are based on the consultation with experts from the Faculty of Civil Engineering of the Czech Technical University in Prague and the Ministry of Transport of the Czech Republic, which deal with the issue.

Results

After a detailed examination, criteria were identified that may have an impact on decision-making in strategic investment planning for the development of the network of motorways and first-class roads. These were divided into four categories according to content. The division of criteria is inspired by the PESTEL analysis [9]. Following a discussion with experts, no legislative and technological criteria were included.

Political

* compliance with the priorities of transport and territorial policies
  + part of the TEN-T network, connection to a major transport center
  + regional transport priority
  + development axis, area (ZÚR, PÚR)
  + support of European territorial cohesion
* connection to the current road network
  + dependencies of other investments on implementation of the plan
  + threats and conditionality of the plan
* state of preparation
* planned date of realization / completion

Economical

* project costs
* operating costs of infrastructure
* revenue (from tolls and other services)
* travel time costs
* external transport costs (accident, emissions, noise, greenhouse gases)
* saving time during transport
* financing options (PPP project, subsidies from the EU ...)

Societal (people)

* the number of owners of the land concerned
* proximity to populated areas
* transport load (traffic intensity)

Environmental / ecological

* proximity to ecologically important sites
* land use
* flood risk

Conclusion and discussion

The article presents a search of possible criteria that could be used in the evaluation of projects of new transport structures (highways and first class roads) by multi-criteria analysis. He also dealt with the strategic planning of investments in the development of the road network in the Czech Republic.

The next logical step within the MCA is to select the most important, most suitable and most telling ones for strategic planning of public funds investments and assign them weight.

He also dealt with the strategic planning of investments in the development of the road network from the perspective of the relevant authorities in the Czech Republic.

Acknowledgement

This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS20/100/OHK1/2T/11.

References

1. CZECH REPUBLIC. Ministry of Transport of the Czech Republic. Guideline no. V-2/2012 Change No. 4, Směrnice upravující postupy Ministerstva dopravy, investorských organizací a Státního fondu dopravní infrastruktury v průběhu přípravy investičních a neinvestičních akcí dopravní infrastruktury, financovaných bez účasti státního rozpočtu Available online at: https://www.mdcr.cz/getattachment/Dokumenty/Ministerstvo/Vnitrorezortni-predpisy-(1)/Vnitrorezortni-predpisy/Smernice-V-2-2012,-zmena-c-4-dopravni-infrastruktura.pdf.aspx
2. CZECH REPUBLIC. Ministry of Transport of the Czech Republic. Departmental Guideline for the evaluation of economic effectiveness of transport construction projects Available online at: https://www.sfdi.cz/soubory/obrazky-clanky/metodiky/2017\_03\_departmental-methodology-full.pdf
3. CZECH REPUBLIC. Ministry of Transport of the Czech Republic. Prováděcí pokyny pro hodnocení efektivnosti projektů dopravní infrastruktury Available online at: https://www.sfdi.cz/soubory/obrazky-clanky/metodiky/2017\_provadeci\_pokyny\_efektivnost.pdf
4. BERIA, Paolo, Ila MALTESE a Ilaria MARIOTTI. Multicriteria versus Cost Benefit Analysis: a comparative perspective in the assessment of sustainable mobility. *European Transport Research Review* [online]. 2012, **4**(3), 137-152. ISSN 1867-0717. Available online at:: doi:10.1007/s12544-012-0074-9
5. CORNET, Yannick, Merrill Jones BARRADALE, Henrik GUDMUNDSSON a Michael Bruhn BARFOD. Engaging Multiple Actors in Large-Scale Transport Infrastructure Project Appraisal: An Application of MAMCA to the Case of HS2 High-Speed Rail. *Journal of Advanced Transportation* [online]. 2018, **2018**, 1-22. ISSN 0197-6729. Available online at: doi:10.1155/2018/9267306
6. KOU, GANG, YANQUN LU, YI PENG a YONG SHI. EVALUATION OF CLASSIFICATION ALGORITHMS USING MCDM AND RANK CORRELATION. *International Journal of Information Technology & Decision Making* [online]. 2012, **11**(01), 197-225. ISSN 0219-6220. Available online at: doi:10.1142/S0219622012500095
7. PILAŘOVÁ, Irena. *Leadership & management development: role, úlohy a kompetence managerů a lídrů*. Prague: Grada, 2016. ISBN 978-80-247-5721-6.
8. KSIĄŹEK, Mariola Violeta, Paweł Olaf NOWAK, Serkan KIVRAK, Jerzy Hubert ROSŁON a Leonas USTINOVICHIUS. COMPUTER-AIDED DECISION-MAKING IN CONSTRUCTION PROJECT DEVELOPMENT. *Journal of Civil Engineering and Management* [online]. 2015, **21**(2), 248-259. ISSN 1392-3730. Available online at: doi:10.3846/13923730.2014.996250
9. KAUŠKALE, Linda a Ineta GEIPELE. Integrated Approach of Real Estate Market Analysis in Sustainable Development Context for Decision Making. *Procedia Engineering* [online]. 2017, **172**, 505-512. ISSN 18777058. Available online at: doi:10.1016/j.proeng.2017.02.059
10. SCHNEIDEROVÁ HERALOVÁ, R. ***Kalkulace nákladů životního cyklu jako inovativní rozhodovací nástroj ve fázi navrhování staveb,.*** Business & IT. 2011, 2011(1), 46-62. ISSN 1805-3777.