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Evaluation and ranking of urban transportation projects

Content

0. Abstract

We present a Hungarian project portfolio planning case, in which special urban development projects have effects both on a whole town and its agglomeration. Working with the portfolio we had to solve two significant problems: How social benefits can be considered and calculated in hardly evaluable projects? How can we compare different types of projects?

Keywords: project portfolio management, strategy, cost-benefit analysis, multi-criteria analysis, traffic, public transport

The paper of conference

1. Introduction

As an introduction let's examine what project portfolio management actually means (Levine, 2005), and why it is significant. Simplifying the concept, project portfolio management means making strategic decisions about the projects the company should perform in order to achieve its goals. (Csendes, 2017a)

But why is decision-making so important when it comes to projects?

According to experience, in most of the organizations people come up with way more project ideas than their company could afford in terms of resources. Basically, it is a positive phenomenon, because we have a lot of ideas to choose from. However, it can cause difficulties as well.

2. Difficulties in evaluating transportation projects

Let's take a look on a specific case, which involves a town and its agglomeration. In an environment like this, we have to face with stakeholders of several kinds arousing different demands. Needs of local (town) and agglomeration population can be very different.

For example, local inhabitants prefer frequent stops of public transport, so that they do not have to take long walks home after getting off. While agglomeration populations prefer rare stops of the vehicles, so that it does not take long for them to reach the central parts. Besides, needs of owners of individual motor vehicles (cars) are also different from people's using public transport (bus lane or a plus lane for cars). Political players tend to be of different opinions as well (where should P+R parking be located, where should parking fees be made mandatory).

Financial resources can also have a determining role. Organizations usually know more projects than their resources available in the given period could cover. Moreover, human resources can limit certain projects as well.

In the transport system of a town, individual and public transport have to be synchronized, during which strategic goals, environmental aspects and the residents' needs should also be taken into account. Planning only individual, or only public transport projects is not reasonable either. We should keep in mind that we cannot begin only car- or only bicycle-related projects even within these categories.
It is important not to include merely strictly infrastructural projects - regulatory or customer satisfaction related ones are also significant. For example, creating customer service centers, harmonizing schedules, launching e-ticket and parking fee systems, setting zones, etc..

Examples mentioned above show how many different kinds of transportation projects could be performed, which makes decision-making and evaluating even more difficult. Furthermore, projects usually are in a different preparedness level. Projects on a conceptual level can often be more convincing than ones with detailed feasibility studies. That is why we should create the chance even for less prepared, still promising projects to be chosen.

An additional difficulty when it comes to planning the transportation of a town is the quickly changing environment that can have a huge impact on results of project evaluations, which makes results depend on time.
But what can change in the environment? Basically, anything.
The changes of cost items can be rather fast and unpredictable (materials, labor), and changes of certain infrastructural elements of the town (new blocks of flats, office buildings, shopping centers, even new bridges, railways etc.) can remake existing transportation habits making previously modeled traffic not relevant any more. Establishing a new block of flats or an office building suddenly brings high demands for public transport in that area, so a private investment can easily overwrite previous plans (on the condition, decision-makers would like to satisfy the residents' needs).

Social habits and different trends can have an impact on the projects as well. For example, using bicycles in the cities is getting popular in Hungary that is why many bicycle roads and lanes

have been built recently. Besides, nowadays the use of plug-in electronic cars is beginning to spread too, for which creating charging stations and parking places is highly needed.

3. Evaluating and ranking projects

It is important to make choosing from projects professional, that is why working out an unified system is in need. This system must take professional aspects into account, be as objective as possible, but supporting decision-makers and the society is also significant. However, there are certain elements that a project portfolio management system must include in every case. (Sebestyén, 2012) Checking the fit to the strategy and the strategic goals, and studying the feasibility always have to be carried out. (EC-SUMP, 2016) These elements can be used as a so-called first filter, making projects that do not support the strategy or are not feasible get out of the portfolio immediately. (KO) Moreover, resource requirements must also be measured, since the lack of special resources can be an obstacle of feasibility.

We present the difficulties of evaluating and ranking projects through a simplified example. This example is elaborated according to our experiences both working as experts and educators. “Csudapest” actually is a case-study used in project portfolio management courses of Corvinus University of Budapest. (Csendes, 2017b)

3.1. A fictive example: the portfolio management of Csudapest transportation investment projects

Csudapest is a fictive capital with a population of almost two million, and an agglomeration with one million. There are two strategic goals in Csudapest: 1. making it a livable town, 2. making its transportation system safe and predictable.

In the capital there are quite a few organizations focusing on transportation projects, including but not limited to bus and underground companies, road management, railway company, transport surveillance company etc. Decision-makers are planning the circle of projects to perform in the next ten years. They collected a hundred projects of different sizes and types from all of the developers. Investment cost of the projects is 2 000 monetary units. However, there are only 500 monetary units available for the ten-year period. Decision-makers have to choose from projects while staying beyond cost barrier and guaranteeing maximum satisfaction.

As an example, we present the evaluation of two projects of Csudapest:
One of them is building a new metro line, while the other one is building a hundred new charging stations and parking places for plug-in electronic cars. It is clear that the scale of the two projects are very different. Besides, project developers and the methods of evaluating the applicable utility also differ. The table below contains the fictive data and evaluation of the projects.

	New metro line	**100 charging stations**
Cost of investment	250 monetary unit	0,1 monetary unit
Cost of operation	5 monetary unit /year	0,5 monetary unit /year
Time of performing	5 years	1 year
Support of strategic goals (0-100)	90 scores	65 scores
Feasibility (0-100)	70 scores	75 scores
Method of utility evaluating	CBA	MCA
Cost-benefit ratio	1-1,1	Not known
Relative utility, MCA (max 100)	Not known	60 scores
Utility (0-100)	40 scores	60 scores
Weighted (4-2-4) total score (0-100)	**66 scores**	**65 scores**

In case of the new metro line project, the cost of investment is 2 500, and the annual cost of operation is 10 times as much, as it would be in case of the new charging stations project. The new metro line provides much more support for achieving strategic goals. (It makes the town more livable, and allows faster, safer and more predictable transportation. Charging stations also make the town livable, because the level of exhaust fumes can decrease in an indirect way etc.)

Feasibility score of the metro line is a bit less than that of the charging stations, but both projects got relatively high scores. Metro lines have been being built for more than a hundred years worldwide, many lines have been built in Csudapest as well, so there is neither technological nor legal obstacles for this activity. The project did not get 100 scores for the reason it can face with social resistance, land acquisition problems and other problems even during drilling, when unexpected circumstances can easily emerge. Although the charging stations do involve new technology, but many have already been managed to build. Though land acquisition related

questions can cause problems here too, but the chance of facing with unexpected circumstances is much less.

Utility of the metro line can be quantified by a widely accepted method, the cost-benefit analysis (CBA). The cost-benefit ratio is approximately 1 in the example, meaning that the cost of investment and operation (predicted for 30 years) and the benefits (including both economic and social) realized in this period are approximately equal. (Boardman et al., 2017.) The score of converted utility is 40. We will explain this concept later.

Utility of charging stations cannot be quantified by CBA, because demonstrating the project's effect on the traffic, and modeling the indirect social benefits are not possible. That is why we need a different way of estimating utility. This time it is the method of multi-criteria analysis (MCA) (Barbosa et at., 2017). MCA means scoring with the use of criteria determined in advance. Projects that can be evaluated with only MCA are evaluated on mixed (transportation, economic and social behaviour experts), expert workshops. It is important for all of the participants to be as informed about the projects as possible. (Trenecom – BKK, 2016)
The project in the example got 60 scores for converted utility.

Calibrating cost-benefit evaluations calculated with different methods means great difficulty. Normalizing the mass of projects evaluated with the two methods, and after that calibrating the results is often accepted as a good solution. Normalizing means that projects between the worst (0 score) and the best (100 scores) projects above the KO level[1] get scores according to their ratio of evaluation results.
Generally speaking, results we get in this way need to be checked with rank correlation in every case. We will not explain it in detail, but it is important to know that as a requisite we need a suitable number of projects which are possible to be evaluated with both methods. In case the correlation coefficient is appropriate, we do not have to intervene in the evaluation methodology. Let's suppose that in the presented example the coefficient is alright, and utility scores were converted in this way.

Weighting the scores, metro line project gets a total score of 66, while charging stations project gets 65. (Weighting: strategy 40%, feasibility 20%, utility 40%.) Thus, there is only little

[1] KO level: the determined minimum value, under which projects get out of the portfolio

difference. Depending on these, sequence of the two projects: 1. building a new metro line, 2. building a hundred charging stations. Results though make quite a few questions emerge: Is it good to perform a project that costs half of the planned budget? Maybe it would be reasonable to rank backwards and choose many smaller projects instead. Is it good to bring projects with less utility to the fore?
We will not present the rest of the elements of the project portfolio of Csudapest. These could have an impact on the answers given to above questions. The example illustrates that ranking and choosing do not come to an end even after quantifying projects.

Based on the total scores we get a raw project rank, which we have to fine-tune further. We have to check what the resources available can cover. In case of more strategic goals, we have to strive to create a healthy balance of support of them. After this, it is important to examine if there are projects (among ones within the cost barrier) which parallel performance is not recommended. (For example, connecting two points in a town: project one recommends a bus line, while project two recommends a tram line. Only one of the two possible projects should be performed to reach the goal, of course.) Furthermore, it is worth it to consider synergies among projects, and possible scheduling as well. The implementation of chosen projects must be scheduled in detail. It is not reasonable to break a road more than once or block a certain area again and again because of different projects etc.

It is also useful to integrate socialization into the whole process, which is intended to provide that the methodology and chosen projects contain opinion and acceptance of the widest circle of society. We have to keep in mind that it is the locals and people using public transport who are primary beneficiaries (or victims) of the transportation system of a town.

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