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Danube Cycle Plans

Danube Cycle Plans

Extended CBA Methodology for Transport Infrastructure Projects

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Danube Cycle Plans | Policies, plans and promotion for more people cycling in the Danube region

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Contact

Coordinator:
KTI Institute for Transport Sciences
András Munkácsy PhD
Email Address: munkacsy.andras@kti.hu
Web: www.kti.hu

Authors:
Dániel Tordai
Tamás Andrejszki PhD
Georg Hauger PhD (external expert)

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and the project activities & results are available on:
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1. Introduction

Cycling policies have become more and more critical over the last decade. This mode of transportation can be part of the solution for many of humanity's challenges in the 21st century. Travelling by bike is a carbon-neutral way of transportation, so it is an effective tool in the fight against climate change. Commuting by using an active mode of transport has significant health benefits. It is cheaper to travel by bike than by car by a magnitude. Bicycles are more silent and use less space than cars, so they have a much better impact on the urban environment. Cycling also got attention for being an infection-safe transportation mode, a vital feature since the beginning of the COVID pandemic in the spring of 2020. These benefits make cycling an appealing alternative to more and more people in Europe. However, cycling is still only a minority in the transportation modal split in the vast majority of countries in Europe. Most commuters still find individual car usage a more attractive alternative, due to its flexibility and comfortability.

Several factors must come together to make people change their commuting behaviour and insert cycling into their daily routine. A cultural shift is necessary, meaning that individuals have to think more consciously about their travelling habits. They must be willing to reorganize their lives to accommodate cycling into it. This cultural shift includes the spread of knowledge about the benefits of cycling, the actual risk, and information on the adverse environmental and other effects of individual motorised transportation modes. But another critical element is infrastructure: the lack of proper bike lanes and paths can discourage travellers from trying this form of transportation. So the number one priority for advocates of cycling has been the creation of adequate infrastructure that provides safe and comfortable routes for bikers.

There are huge differences among the European countries regarding how developed their cycling route network is. In recent years, there has been a breakthrough in many cities and countries, with the political willingness to design roads and urban spaces with cyclers in mind becoming stronger and stronger; in others, this breakthrough is yet to come. Whatever the situation might be in a given area, estimating the economic benefits of cycling infrastructure projects is a vital part of the planning and evaluation processes. There are already well-established methods for transportation projects that can be used to appraise a project's net value to society, such as the Cost-Benefit Analysis (CBA) or the multi-criteria analysis (MCA). Although these are widely used in the industry to evaluate all kinds of projects, using them for cycling projects requires some extension. There are several well-documented and scientifically proven benefits of cycling that other, non-active transportation modes do not have, i.e. health benefits or carbon-free transportation. To approximate the net benefit of a cycling infrastructure project, one has to consider these benefits as well. Otherwise, cycling projects might seem less favourable compared to other projects.

This document, building on scientific evidence and best practices, provides a guideline that practitioners can use to estimate the net benefit of cycling projects to society, i.e. to better understand the impact of cycling infrastructure projects, showing a broad(er) panorama of the related societal impacts.

This work has been part of the Danube Cycling Plans project, which aims to promote cycling in the Danube region by diverse activities, including creation or update of national cycling plans, definition of a cross-border cycle route network on the basis of national plans, provision of common infrastructure standards, estimation of investment necessities, as well as a multitude of other ways (marketing, know-how exchange, mentoring, etc.).

2. The current practice of the economic evaluation of cycling projects in the EU

2.1. THE 2014-2020 PERIOD

For the programming period 2014-2020, the European Commission released a document titled Guide to Cost-Benefit Analysis of Investment Projects (*Guide to Cost-Benefit Analysis of Investment Projects*, 2014). This document describes how cost-benefit analysis must be conducted for major projects financed within the EU cohesion policy. EU regulation considers a project to be a significant task if the total eligible cost exceeds EUR 50 million (the part of the investment cost that is eligible for EU co-financing). For the EU financing of these projects, carrying out a CBA was a legal requirement. The general approach of this guideline is to include all direct employment or external environmental effects realised by the project, indirect or wider products are excluded. These latter effects are hard to quantify robustly and are usually transformed forms of direct effects, so by excluding the indirect effects, we can avoid double counting on certain benefits.

In this guideline, two conditions must be fulfilled for a project to be financed by the EU: the financial net present value has to be smaller than zero, so the project must require financial support, and the economic net present value has to be bigger than zero €, so the analysis has to prove that society is better off with the project than without it.

Regarding the benefits of the projects, the following methodology should be applied: impacts generated on project users due to the use of the good or service being developed or improved as part of the project should be counted as the direct benefit of the project. In most cases, it is advised to calculate the willingness to pay for users, and all direct effects should be included in that. Examples of positive non-market effects are savings in travel time, increased life expectancy or quality of life, prevention of fatalities, noise reduction, and resilience to climate change. Externalities are defined as benefits or costs that do not occur in the transaction between the producer and the direct effects of the project but fall on third parties. Noise, air pollution, and greenhouse gas emissions can be examples of such effects. Some of these externalities are internalised, meaning that individuals can harvest some of the benefits or mitigate some of the negative effects, if they modify their decisions with regard to transportation choices.

In this guideline, cycling projects are not explicitly mentioned, and they are also missing from its supplementary document, the Handbook on the External Cost of Transport (Arno Schroten & Sander de Bruyn, 2017). The reason can be multiple folds: cycling projects often do not reach the project value that requires a CBA, and they do not represent a large portion of infrastructure projects. Although the economic analysis of transportation projects chapter of the document (chapter 3.8) considers many aspects that apply to cycling projects as well, such as instruction on the evaluation of travel time, vehicle operating cost, accidents, noise, air pollution, and climate change, several cycling-related benefits do not appear in this document, such as e.g. health benefits. However, this guideline does not permit taking into account additional benefits if their application is justified. In theory, it is possible to include health benefits and the benefit of the perceived safety of bikers in the case of a cycling infrastructure project.

In accordance with this EU level document, national-level CBA guidelines also do not mention any cycling-specific benefits that should be taken into account. Neither the Bulgarian (Ministry of Transport Bulgaria, 2008), the Czech (Sudop Praha a.s., 2018), the Croatian (Deloitte, 2016), nor the Romanian (Ministerul Transporturilor Si Infrastructurii Directia Proicte Asistenta Technica, 2013) guidelines specifically mention cycling.

The Hungarian methodology (Trenecon Tanácsadó és Tervező Kft., 2016) contains guidelines about how to handle cycling specific issues, although the method applied is not always in line with international scientific literature. For example, it recommends using a lower value for value of travel time (VOT) for cycling than for a private car, which goes against the scientific consensus. Regarding cycling-specific benefits, the document considers health benefits, citing a feasibility study from Canada (Quay Communications Inc, 2008), mentioning both short-term and long-term benefits. The recommended economic value that should be used to monetise health benefits is 0.1$ per additionally travelled kilometre by bike at 2008 price levels. This guideline also recommends taking into account tourism-related benefits. However, the recommendations here are very vague. The methodology applied here goes against the general principles of the EU level document i.e. not including effects occuring in secondary markets, as it doesn't consider the potential decrease in tourism elsewhere and henceforth might double count some benefits.

A Hungarian cost-benefit analysis on the EuroVelo 6 route dealt with the benefits of cycling directly (Hegyen-völgyön konzorcium, 2014). This route was expected to increase occupational commuting and tourism traffic, as it goes through several towns and goes along the river Danube so that it can attract recreational users. It counted travel time savings, changes in risk of accident, transportation cost changes, and health effects as direct effects, and it also listed environmental impacts, touristic effects as externalities. It dealt with commuting and tourism traffic separately, listing travel time savings, environmental and transportation cost changes only with commuting traffic, and tourism effects only with tourists (health-related benefits and changes in risk of accident were listed at both places). Estimations for the size of the different user groups were also separated. This separation is a straightforward yet precise way of overcoming the other priorities for the two groups, i.e. recreational users usually do not evaluate travel time savings as much as commuters; on the contrary, they might appreciate a longer but more pleasing route.

2.2. THE 2021-2027 PERIOD

For the new budgeting period, the European Commission has published new guidelines for the economic appraisal of infrastructure projects (*Economic Appraisal 2021-2027*, 2021). The main novelty is that cost-benefit analysis is not going to be a requirement for a project to be funded by the EU for this budgeting period. Still, the application of some economic appraisal tools will also be appreciated. Although a CBA or simplified CBA for smaller projects is still suggested (with the definition of smaller projects missing in the document), multi-criteria analysis or cost-effectiveness analysis is also possible. The document refers to the 2014 CBA guideline as the primary source of methods for CBA methodology and adds only minor changes. There is no cycling-specific recommendation in this document either. Still, the allowance for using various economic appraisal tools might give project evaluation more flexibility. It can make it easier for projects to include the benefits of cycling into their assessment.

This new guideline was published in September of 2021; national guidelines and recommendations are still in the making.

2.3. MODELLING BICYCLE TRAFFIC

Modelling future cycling traffic is a challenging part of the economic appraisal of cycling projects. Local context varies a lot around the world in terms of geography, weather, current existing infrastructure, and the population's attitude towards cycling. All these factors have a significant impact on how cycling traffic will change in response to the developed infrastructure. That has far-reaching consequences, namely, since all individual benefits that we will list later are multiplied by the number of cyclists. Therefore, the prognosis of future traffic has a significant impact on the societal level gains of the project.

In many cases of smaller cycling projects containing only a few infrastructure elements, it might be enough to come up with rough estimates of the possible future traffic. If similar projects have been executed at a similar location, their data can be used to estimate the traffic. For larger projects, proper traffic modelling might be feasible. In this case, adequate input data for the models is crucial; it is recommended to invest in collecting data about the current (ex-ante) traffic, especially since a posterior (ex-post) analysis of the project is impossible in its absence.

There is growing literature on how to model cycling traffic for proposed facilities. Gehrke & Reardon (2020) showcase a state-of-the-practice methodology in Cambridge, Massachusetts. Hankey et al. (2017) developed a model applicable to smaller communities. Jacyna et al. (2017) use the VISUM software to model bicycle traffic in cities. In case sufficient data is not available, the methodology of Hankey et al. (2021) might provide an alternative: they use street-level images and POI data from Google to estimate walking and cycling traffic, and the accuracy of their model is comparable to the traditional model's accuracy based on census and street-level data.

In any case, full transparency concerning traffic forecasting is advised. The volume of projected traffic has a considerable impact on the estimated benefits of the project, so having an appropriate estimation is crucial for the precise analysis of the societal impact of the project. Having a clear view of forecasted future traffic can help improve public opinion towards cycling projects and introduce accountability. Sensitivity analysis can help reduce the uncertainty of the forecasts: calculating benefits with different scenarios (i.e. cycling traffic staying at current levels, changing at the same pace as before the development was executed and growing at faster speeds than before the development) show the return of the project for society with different levels of cycling traffic change and can prove that these projects can have a net positive outcome even in the case of moderate traffic increase. Working with confidence intervals for traffic from models can help show the level of uncertainty of the return of the project.

3. Benefits of cycling already taken into account in the current practice

3.1. TRAVEL TIME

The benefit of travel time reduction due to a new infrastructure has the largest share of uses in many transportation projects. There is vast literature on the value of travel time (VOT). It has a well-established method to be considered in a CBA analysis, i.e. Guide to Cost-Benefit Analysis of Investment Projects. In short, people appreciate it when their travel time is being reduced. With the help of specific statistical methods, we can estimate their willingness to pay for this travel time reduction. This value that we get, called the value of travel time savings (VTTS), can represent the financial value of travel time reduction for users of new infrastructure.

Studies show that unit VOTs are usually higher for cyclers than for other modes of transportation. Wardman et al. (2007) estimated VOT for cyclers to be 18.17 EUR/h for commuters. Börjesson & Eliasson (2012) received similar results in their study, between 10 EUR/h and 16 EUR/h in the case of work-related trips. Van Ginkel (2014) found these values to be between 9.8 EUR/h and 13.43 EUR/h, and for recreational travel, between 7.57 EUR/h and 10.26 EUR/h. Ramjerdi et al. (2010), in the Norwegian Value of Time study, found that the VOT for cycling is 130 NOK/h 2009 price levels for all trips (approx. 13 EUR/h).

The results above confirm classic theories' conclusion that travel purpose has a significant effect on VOT: work-related travel's VOT is significantly higher than leisure trips'1. Other factors that might influence VOT for cyclists, such as trip duration and trip frequency, have not yet been examined in detail. The findings above also underscore the need for separate estimation of VOT for cyclists, at least on the national level. In the absence of such data, it is advised that values from neighbouring countries with similar cycling infrastructure and cycling modal share should be used, adjusting for the difference in wages and price levels. What should not be done is the use of travel time estimates for other modes, as it has been shown in multiple studies (Börjesson & Eliasson, 2012, 2014) that those values are way smaller than the values of cyclists.

Application in appraisal

Ideally, research should investigate the VOT for cyclists in the given country. In this research on VOT of cyclists, and then later on in the application of the estimated VOT values, the proprieties of the given cycling infrastructure should be taken into account because as we have seen e.g. in Börjesson & Eliasson (2012)*, cyclists have different VOTs for different levels of security and comfort in cycling roads. If this research is not yet available, but the VOT for cars has been estimated in the country, the multiplication of that value should be applied by 1.4 to get a rough estimate of a VOT for cyclists on a segregated cycle tracks*[2]*. In case of that number is also inapplicable, then 13*

[1] This has been confirmed for other modes, not just for cycling, for example, in the study of Börjesson & Eliasson (2014).

[2] The EU guideline states that VOT for commuter cars is 9 EUR, and we see in the literature that the VOT for commuter bikers is close to 13 EUR.

EUR/h should be applied. Calculating the societal level benefits of travel time savings should be done with the same methodology as in the case of other modes, based on input numbers from traffic forecasting.

3.2. CHANGE IN THE NUMBER OF ACCIDENTS

The construction of new infrastructure in general in the transportation sector and cycling creates a safer environment explicitly for travel and reduces the probability of accidents. However, due to the growing number of cyclists, the absolute number of casualties might rise after introducing a new cycling infrastructure, as they attract new users. The product of the lower probability of accidents and the higher number of cyclists can still result in higher absolute number of accidents.

There is already a well-established approach for other (road and public transportation) modes that measure and monetise the benefit of creating safer travelling conditions. However, it is crucial to handle the contradicting effect of being more exposed to injuries while travelling due to less protection from the vehicle after changing the travelling mode from car to bike. Studies have found that this growing risk of injury is outweighed by the health benefits of regular cycling by one order of magnitude, so the health benefits of cycling are positive. In a subsequent section, we will analyse the health effects of cycling. We will deal with this question later, as several studies and methodologies examine the various health effects of cycling altogether.

Application in appraisal

Change in number of accidents should be taken into account as part of the health effects of cycling, as described in more detail later.

3.3. CO_2 & GHG EMISSIONS, LOCAL AIR POLLUTION, NOISE REDUCTION AND CONGESTION

If following the construction of cycling infrastructure, travellers will change from car to travelling by bike; then the project can result in several benefits external to the individual. These benefits can be calculated analogously to a project where public transportation infrastructure is developed. It is expected that thanks to the better connection, travellers will change their behaviour, travel less by car, and more by the mode with newly developed infrastructure. Thanks to reducing car traffic in both cases, CO_2 emissions can be smaller than in the absence of the project, local air pollution, and traffic congestion can decrease. The magnitude of these effects significantly depends on the result of traffic modelling. The number of trips taken by bike instead of the car has to be calculated with high precision. Once the number of individuals who change their mode of transport is calculated in the traffic model, the conventional method can be used to calculate the economic value of these factors.

The volume of avoided air pollutants has to be estimated. Then the economic value of that air pollution reduction has to be calculated based on the unit cost of that pollutant. The willingness to pay for noise reduction can be calculated via multiple methodologies, as detailed in Breidert et al. (2006). These values are already estimated on the national level and can be applied for cycling projects. Reduced congestion due to fewer cars on the road results in shorter travel times for those continuing to travel by car; their benefit in monetary terms can be calculated by using the exact value of travel time savings for drivers that are usually applied nationally or locally in car-related projects. A detailed list of these externalities and methods to calculate their financial values can be found in Schroten & de Bruyn (2017).

It might happen that cycling infrastructure projects might themselves generate traffic, i.e. if they serve as a tourist attraction, or if cycling infrastructure replaces car lanes, and henceforth increases traffic jams. In such cases, externalities of induced traffic must be taken into account.

Application in appraisal

The usual methodology should be applied to calculate these effects according to the Guide to Cost-Benefit Analysis of Investment Projects (2014), based on traffic modelling and forecasting.

3.4. INFRASTRUCTURE COSTS

One of the significant advantages of cycling is that the infrastructure costs are relatively small compared to infrastructure for other modes of transportation, and maintenance is also cheaper than rail or road for cars. The best solution for estimating infrastructure cost is collecting information on similar projects executed in a similar environment in the same area or country. It is important to work with lifecycle costs of infrastructure, meaning including all maintenance costs into the calculation, and not just upfront construction costs.

Application in appraisal

Use data of infrastructure costs already available from other projects, or if none have been executed, estimate it based on public road infrastructure costs. Construction and maintenance costs must be included as well.

4. Additional benefits to consider

4.1. HEALTH EFFECTS OF CYCLING - LONG TERM HEALTH EFFECTS (MORTALITY)

Multiple long-term health effects are related to regular cycling: e.g. lower stress levels, lower chance of cardiovascular diseases, and better general fitness.

The most commonly used methodology for monetising the health benefits of cycling is the HEAT methodology (Kahlmeier et al., 2017). It was developed by the World Health Organization (WHO) with inputs from several experts back in 2007, and it has been revised and appended several times since then. It has a user-friendly online interface that calculates health benefits of cycling for a given project and uses the value of a statistical life framework. The HEAT methodology only deals with the probability of mortality from any cause and excludes morbidity from its calculations. The relative risk ratio (RR) for cycling for physical activity is 0.9. The HEAT methodology also calculates the adverse effects of cycling: it estimates traffic incidents by multiplying generic road crush estimates by the measure of exposure, and it also looks at exposure to air pollution, using $PM_{2.5}$ as an indicator, and applying the relative risk ratio of 1.07.

Other studies apply different approaches to calculate the health benefits of cycling. Mueller et al. (2018) use preventable death from physical activity as the key indicator. They use the so-called metabolic equivalents of tasks to measure physical activity and calculate marginal gains for those who substitute car and public transportation for cycling. The relative risk ratio is lower than in the HEAT methodology, 0.81. They also consider exposure to air pollution, using the same PM2.5 indicator, and using the same RR as in the HEAT methodology. De Hartog et al. (2010) have estimated the risks and benefits of cycling and found that the RR for mortality changes between 0.5 and 0.9 thanks to cycling. They find that the RR for exposure to air pollution is relatively small, between 1.005 and 1.01, and that the risk of traffic incidents varies a lot with age.

Application in appraisal

The best way to estimate the economic value of the cycling project's health benefits is to use the online interface of the HEAT methodology since it is the most robust one, which considers both the positive and the negative health impacts of cycling, while being easy to use. In case that methodology is not applicable, the relative risk ratios applied in the HEAT methodology and detailed above should be used with roughly estimated as input data and apply the value of statistical life that is in practice in the given country.

4.2. GROWING PERCEIVED SAFETY

Cyclists appreciate when they ride in a safe environment. It is less stressful and more comfortable to ride on a separate cycle track than riding in dense and fast car traffic. This effect goes beyond the actual risk of suffering an accident. Although perceived and real risks can have common roots, they should be handled as separate effects, according to a working paper by the City of Copenhagen (COWI, 2009). Comfort or perceived safety can significantly influence the value of travel time: as it can be seen from the summary in the next paragraph, cyclists'

VOT is significantly higher if they have to share the road with cars than if they have a segregated path. This higher VOT means that they would pay more to decrease the time spent on that road section. So when more comfortable infrastructure is designed, and lower values of VOT are measured, that's because there has been an increase in the wellbeing of cyclists using that path. So if we design a bike path and apply a given VOT in the calculation of the benefits, we should include an additional value on it for the infrastructure being safe.

Van Ginkel (2014) found that comfort value can be as high as 3.63 EUR per hour. Wardman et al. (2007) also found that time spent cycling on on-road non-segregated bike lanes is valued at 37% of the value case of cycling on roads with no cycling infrastructure. This value is even lower on segregated cycleways, 14%. Börjesson & Eliasson (2012) found VOT 16 EUR/h for cycling on the street and 10 EUR/h for separate bike lanes. Gössling et al. (2019) found that in Germany and Austria, cyclers choose 6.4% longer routes than optimal to avoid noise and poor air quality. As an average of these values, we recommend using 30% of VOT for calculating the value of growing perceived safety in the economic appraisal of new cycling infrastructure.

Application in appraisal:

This benefit is closely related to the value of travel time savings, and the calculation of this benefit should be closely related. Studies have shown that the magnitude of this benefit is approximately 30% of VOT, and the users internalise that: they will report lower VOTs if they can ride on safe infrastructure; however, the benefit of being able to use a comfortable, segregated cycle track is still present, and should be taken into account in economic appraisals.

4.3. PARKING COSTS

In dense, urban environments, where the price of real estate is relatively high, and there is fierce competition for land usage, significant benefit can be realised if the area used for parking cars can be decreased due to the growing share of cycling in the modal split. This benefit originates from the fact that in a place suitable for parking one car, up to 8 bicycles can be stored, and this smaller required space can free up valuable area.

Taking this benefit into account is possible in multiple ways. Lind (2005) estimated the cost-saving that companies can achieve if employees do not travel by car but rather by bike, and henceforth companies have to pay less for renting those parking spaces. We might also look at how much it costs for a private individual to rent a parking space in a private garage or a carpark. In case we would like to estimate the benefit originating from the freed-up public areas from parking, one possibility is to calculate the income that can be generated by the alternative usage of that space, for example, by renting it to local businesses.

The elimination of parking spaces might mean that the overall mobility cost for some might increase, if they have to walk further to their cars or store it in a costly way. This extra cost has to be taken into account.

Application in appraisal

This benefit is likely to be present in large-scale projects, and only in medium and long run. Travellers have to give up individual car ownership and sell their cars for this benefit to be present, and this is only likely to happen in case all major obstacles from everyday cycling have been cleared. Traffic modelling has to answer how many individuals would be willing to let their car go. In estimating this number, a key factor is the availability of other alternative *modes, like public transportation or shared cars. The more attractive they are, the more likely that individuals might be willing to sell their cars.*

The estimated freed-up space value can be calculated with the described methods above once the expected size of freed-up space has been evaluated. The local context must be taken into account.

5. Benefits of cycling that cannot be taken into account

There are some additional benefits of cycling that have been listed in the literature. Still, even though they exist, for some reason, they should not be included in the economic appraisal of cycling infrastructure projects.

5.1. SHORT TERM HEALTH EFFECTS – MORBIDITY

There is scientific consensus on the long term health effect of cycling, but short term health effects are much more contested in the scientific community. The methodology and many other methods do not consider them, as these effects are usually minimal, often statistically not significant, and their magnitude is relatively minor. Buekers et al. (2015) estimate reduced morbidity due to increased physical activity based on data from the US Department of Health and Human Services and others (2008) and Dutch and Belgian data. Due to the weak scientific consensus, we do not advise calculating with this benefit: i.e. de Hartog et al. (2010) states doesn't include morbidity due to weaker evidence, and the HEAT methodology excludes it as well, citing limited evidence (Kahlmeier et al., 2017).

5.2. DEVELOPMENT OF LOCAL ECONOMY ALONG CYCLE ROUTES

There is some evidence that cycling infrastructure can boost businesses alongside cycling routes. For example, Volker & Handy (2021) found in their literature review that most cycling infrastructure improved the economic performance of the local business in the US. However, even if that finding is accurate, we should not consider this effect, as this growing economic activity might be evened out by decreasing economic impact elsewhere. For example, if there is a shop next to the newly created cycle lane, its traffic might increase; however, shops further away from the cycle lane will lose customers if we assume that individuals spend the same amount on goods and services as before at the social level. So on the whole, this benefit is net-zero, some benefit being created in the proximity of the infrastructure, but adverse effects can appear further away. (See Economic Appraisal 2021-2027 (2021)). We do not recommend taking this effect into account in a cost-benefit analysis. Using other economic appraisal tools, such as multi-criteria analysis might be better suited to take policy goals into account, like supporting the local economy.

5.3. TOURISM EFFECTS

Unless the immediate goal of a project is to develop tourism in a given area, the EU guidelines prohibit the inclusion of external tourism effects in the calculation of benefits. It has to be assumed, that in the absence of the cycling project, tourists would have visited other touristic attractions, spending their time and money there. By building a new cycling track, individuals will not have more time nor money available to spend, so it is very likely that they are going to relocate their spending from other locations to the new cycling infrastructure. Therefore, taking this benefit into account would result in double counting, as the growth at the new location comes from a decrease at other locations, and in a CBA the goal is to estimate the benefits of the project for the entire society, not just for a region (see page 64 of (*Guide to Cost-Benefit Analysis of Investment Projects*, 2014). Some benefits that originate from spending free time cycling instead of doing some other leisure activities can be presented at other benefits, detailed earlier in this document, i.e. health benefits. Our suggestion is not to include this effect in the economics appraisal, unless the goal of a project is to develop tourism. In that case, precautionary measures should be taken to avoid benefit double-counting.

In case local tourism development is in the focus of a project, the growth of revenue in the following sectors should be considered: hospitality, accommodation, bicycle rental and repair services, and local touristic attractions. The workplaces created in these sectors could help keeping locals in remote areas, which can be an important policy goal that can be presented in a multi-criteria analysis. Reduced CO2 emissions originating from the fact that cycling is an activity without any CO2 emission can be also considered, especially if the project is not going to generate significant additional car traffic. If the effects of the project on tourism are included, the operating cost in the analysis should include the extra cost of providing an attractive touristic destination, such as waste collection or sanitation.

6. Conclusions

In this document, we have looked at the different benefits of cycling that should be included in the economic appraisal of cycling infrastructure projects, and proposed ways to include them in such an analysis. All the listed benefits are scientifically proven to exist, and their magnitude is large enough to be included in an economic appraisal. There is a policy consensus in Europe among city planners, transportation engineers and environmentalists, that cycling is the best solution to many of our problems related to transportation. In the main decision making framework for transport infrastructure financing, cost-benefit analysis, some of the benefits of cycling are already being taken into account: if we know how many new cyclists are going to use the proposed cycling infrastructure instead of driving a car, we can estimate the CO_2 and GHG emissions, local air pollution and noise reduction, as well as congestion relief originating from this modal shift using the traditional methodology. Including additional benefits of cycling into a CBA requires some adjustments of the traditional methods: cyclists have higher values of travel time than users of other modes, and the calculation of the risk of accidents according to our suggestion should be included in the overall long term health effects. There are benefits of cycling which are entirely missing from the current CBA practice, but are major advantages of cycling for society: cycling is healthy, and uses less space than other modes. To take into account long-term health effects, we recommend the HEAT methodology of WHO, and we suggest estimating the benefit originating from freed up space from parking cars. To include the fact that cyclists prioritise feeling safe along their routes, we recommend the monetisation of growing perceived safety, by adjusting VOT of cycling. All in all, with these modifications the societal benefit of a cycling project can be estimated more precisely compared to the traditional methodology, resulting in higher returns for cycling projects than for projects of other transport modes.

Other economic appraisal tools that are available according to the new EU regulation allow more flexibility, like the least-cost analysis or the multi-criteria analysis. These options might also accommodate the advantages of cycling listed above with the proposed methodology, as they can be easily adjusted to the project type. Their advantage is that they are easier to execute, require less data input, so they might be better choices for smaller cycling projects. They might also accommodate policy goals as well, which make them an attractive choice for appraisal.

We hope that the proposed methodology is going to be applied to many projects, especially in the Danube region, supporting stakeholders when they make decisions about investing into cycling, and therefore can help the promotion of cycling. As part of the Danube Cycling Plans project, we are conducting the appraisal of a EuroVelo 6 section with the traditional and with the updated methodology to show the difference our proposal makes.

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