Unified, Low-Cost Analysis Framework for the Cycling Situation in Cities

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Abstract—We propose a low-cost uniform analysis framework allowing comparison of the strengths and weaknesses of the bicycling experience within and between cities. A primary component is an expedient, one-page mobility survey from which mode share is calculated. The bicycle mode share of many cities remains unknown, creating a serious barrier for both scientists and policy makers aiming to understand and increase rates of bicycling. Because of its low cost and expedience, this framework could be replicated widely, uniformly filling the data gap. The framework has been applied to 13 Central European cities with success. Data is collected on multiple modes with specific questions regarding both behavior and quality of travel experience. Individual preferences are also collected, examining the conditions under which respondents would change behavior to adopt more sustainable modes (bicycling or public transportation). A broad analysis opportunity results, intended to inform policy choices.

Keywords—bicycling, modal splits, transport policy, surveys.

I. INTRODUCTION

An ambitious EU goal of 10% CO_2 reduction from the transport sector by 2020 has been put forth, with additional future targets [1]. Cycling can help to achieve this goal: "if levels of cycling in the EU-27 were equivalent to those found in Denmark, bicycle use would help achieve 12 to 26% of the 2050 target reduction set for the transport sector, depending on which transport mode the bicycle replaces"[2]. Investments in cycling can reduce carbon emissions [3].

Increased scientific understanding of cycling is paramount to ushering in a new era of increased cycling in all places, and for taking informed actions to reduce carbon emissions. The cycling transport literature is very new and a lack of standardized research on cycling makes comparison and policy-making more difficult. "The absence of reliable data on designated cycle paths at EU level puts a spoke in the wheels of measurement" [4].

Major studies on climate reduction present scenarios based on assumptions, and fail to model true trade-offs between modes [5]. This is particularly true given that the position has even been voiced that targeting behaviour and land use for reduction in vehicular travel are "blunt instruments" to be "less intrusive policy approaches such as improved fuel

efficiency and traffic signal optimization are more likely to directly reduce GHGs". [6] There is a clear need for better data from which to create validated models.

Fundamentally, there is a need to increase cycling which begets a need to understand cycling, yet standardized and easily replicable methods are needed. Mode shares are typically available for only certain years for a fraction of the world's cities, and the methods used vary widely, making the data inconsistent and difficult to reliably compare.

Efforts to standardize methods are newly formed [7]. Although a variety of surveys on bicycling have been conducted over time, these surveys are typically conducted locally and for specific short-term purposes or focused research inquiries, and are not openly developed for application and use across all cities. Authors have not found any other published work offering a method of surveying bicycle mode share, let alone a standardized method that includes data on the conditions individuals face, and their preferences. These additional data can be correlated to better understand bicycling, as well as to provide insight for policy makers as to the best actions to increase and improve cycling.

There are very different levels of cycling and very different speeds at which countries and cities are adopting cycling within the EU, from those with essentially zero cycling, to leadership cities such as Amsterdam and Copenhagen where a great deal of provision for cycling has been completed (resulting in cycling levels of 22% and 36% respectively, with systematic monitoring now practiced regularly by official bodies).

If monitoring of cycling levels were standardized, still, looking at only the modal split and provision of bikeways is too reductive. There are many issues which cyclists face, including theft, topography, weather, and respect by drivers; and many types of cyclists. Culture, age, gender, economics, land use, and more can all play a role.

There is a lack of resources in many municipalities to conduct comprehensive household surveys, and national surveys in Europe as well as the United States are highly problematic with regards to assessing bicycling, typically lacking the depth necessary for policy making insights. Perhaps the most unified effort in the world has been the BYPAD Audit, which has been conducted for numerous cities in Europe [8,9]. However, the BYPAD Audit does not include a detailed mobility survey, and does not calculate mode share. Moreover, the process is more expensive and time consuming than the simplified approach utilized here, and the internal process is typically held confidential, limiting public utility.

The BICY project is a comprehensive effort designed to

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increase cycling across Central Europe. The project includes a data collection and analysis phase intended to inform successful policy-making. Funded by the European Regional Development Fund (ERDF), and spanning seven of the eight countries in Central Europe (all but Poland), the BICY project has resulted in a complementary array of approaches and results which are extensible to additional places. Consistency and comparability of results is one great benefit.

This work presents the low-cost analysis framework developed for the BICY project, a framework that allows a deeper understanding of the cycling situation within and between cities, enabling researchers and policy-makers to reveal important findings and make further progress on increasing cycling.

The analysis consists of three primary components:
- SWOT analysis (Strengths, Weaknesses, Opportunities and Threats);
- Detailed Mobility Street Survey
- Indicators, consisting of official data and their relationships, correlated with observed cycling levels

Outputs include:
- Key findings include modal share and cycling index
- Cyclists' and Public Transport users' experiences
- Future modal change by scenarios

II. METHODOLOGY

As part of the Central Europe project BICY, analyses have been conducted in 13 cities, located in seven central European countries: Ferrara (FE), Comacchio (CO), Ravenna (RA) and Cervia (CE) in Italy; Graz (GR) in Austria; Erfurt (ER) in Germany; Košice (K), Michalovce (MI) and Spišská Nová Ves (SNV) in Slovakia; Prague (P) in the Czech Republic; Budaörs (BU) in Hungary; and both Koper (KO) and Velenje (VE) in Slovenia. In some cases analyses focused on the province or regional level: Provinces of Ferrara and Ravenna in Italy (PFE, PRA); and the Košice Self-governing Region (KSR) in Slovakia.

The methodology handbooks for each piece of this methodological approach are available in English. The survey itself is already available in six languages (Czech, English, German, Hungarian, Italian, Polish, Slovakian, and Slovenian). All will be available for public use as a result of the BICY project.

A. SWOT Analysis

SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or plan. The advantage is its speed and cost effectiveness, coupled with the generation of dialogue and face to face meetings among a diversity of stakeholders.

While the SWOT analysis is not essential to the data collection of the survey effort, it is important for the policy-making framework, both to generate understanding and

qualitative data, and in creating dialogue where often none existed. Results can be quantified and compared as both a tool for understanding and as a validation measure.

This type of analysis involves specifying the objective of the project or plan and identifying the internal and external factors that are favorable and unfavorable to achieve that objective. A SWOT analysis must first start with defining a desired end state or objective. A SWOT analysis may be incorporated into the strategic planning model. The four SWOT elements are defined as:
- Strengths: attributes of an institutional and/or territorial context helpful to achieving the objective(s).
- Weaknesses: attributes of an institutional and/or territorial context harmful to achieving the objective(s).
- Opportunities: *external* conditions helpful to achieving the objective(s).
- Threats: *external* conditions which could do damage to the objective(s).

To ensure balanced composition of the local/regional SWOT analysis group for bicycle mobility in the respective region, representatives of the following groups were included:
- Politicians – in charge of cycling policies
- Administrators – such as bicycle representatives of towns and cities
- Cycle lobby groups if available, or else selected citizen that are cyclists
- And one moderator

The methodology utilized 18 varied starter questions based on the BYPAD system, which were intended to evoke deeper and more comprehensive consideration of all factors influencing cycling. The moderated groups will then collectively generate top level summaries of the four categories. These can later be qualitatively compared with other cities' SWOT results.

Note that the Italian SWOTs focused on the provinces (PFE, PRA), and the SWOT from Slovakia focused on the region as a whole (KSR) including the three cities studied here. Italian cities CO and CE are contained within the Italian provinces, respectively, with CE completing one; CO did not.

B. Official Indicator Data

Official data was collected regarding population demographics and transportation infrastructure. Key values included the total length of bikeways. Indicator data can be combined with survey data, to detect patterns and relationships, and then to model the results of actions and investments aimed at changing transportation behaviour, particularly to increase cycling and public transport use, and to reduce carbon emissions.

C. Street Survey

The survey collected data about the present use of transport modes, the quality of users' experience when using those modes, and under what conditions interviewees would change

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from car and motorcycle use, to PT and/or bicycle use.

The street surveys can never be perfectly representative, even though representative groups such as supermarkets and schools have been targeted for the interviews. Thus statistical corrections are performed by applying relative weights to interviewees belonging to different groups (males, females, minors, adults, elderly, and car owners). The goal has been to bias all results in favour of lower cycling, in order to always present the most conservative estimates.

The street survey administration requires:

- carefully chosen and recorded locations of each survey
- time of year (more than one season, such as summer and winter, is best)
- trained staff who ensure that respondents fully understand and properly answer each question

The survey respondent is asked:

- frequency and purpose by mode
- time spent per day on regular modes
- experience made on regular used modes
- willingness to change (to bike or public transport) if certain requirements were met

The first questions determine whether the respondent lives in the target city, and in any event, how far from the center. This is useful for verifying representativeness as well as spatial analysis (including the relationship of density to travel behaviour). There are no further questions regarding the location of destinations, however. See Fig. 1.

Fig. 1: The residence block. (Name is provided for the survey city.)

Next we determine the types of modes used on a typical travel day. This includes trips to school as well as to work. The survey is administered by trained representatives. If a respondent is neither a student nor employed (including retirees), they are still asked for a typical travel day (Fig. 2).

Fig. 2: Travel-type block: to ask for transport mode and trip purpose

After ascertaining modes used, we ask detailed information about how those modes are used. In this way we already know the frequency and type of travel, before asking details regarding travel times and characteristics of the travel experience. (See the General Mobility Block, Fig. 3).

Fig. 3: The general mobility block.

The final section is the "Future transport block" shown below in Fig. 4. Respondents are asked: "What are the *minimum requirements* that would convince you to use *public transport for your daily trips*?" and, "What are the *minimum requirements* that would convince you to *use a bicycle for your daily trips?*" (Emphasis provided as found in survey.)

Fig. 4: The future transport block.

From the stated preferences, policy analyses can be conducted. Actions aimed at increasing cycling can be evaluated on a scenario basis, calculating new modal splits. Cost-benefit analysis, carbon emissions implications, and more can then be estimated.

At the end of the survey, the administrator records brief demographic information: sex of the respondent, and age category. "Minor" refers to those 12-17. "Adult" refers to respondents aged 18-59. "Seniors" are those aged 60 and up (see Fig. 5). This is essential for survey correction.

Fig. 5: The personal demographics block.

D. Cost and logistics of survey

Target survey response was 1500. Approximately 1000

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surveys would be necessary to ensure a ±2% precision even for low shares (like the modal split for example). Survey errors and corrections can reduce the total number of comparisons, thus 1500 is a more reliable target.

A pilot survey was conducted and a cost calculator generated. It was determined that each survey collected would cost less than 2 euros. Approximately 35% of the cost was for gifts (shirts and gadgets) to reward respondents for participating. Personnel cost was assumed to be 13 euro/hr. Surveys were administered by staff, to ensure consistency of results. The average time to compile a survey was approximately 4.5 minutes each.

Additional time is required to analyse the surveys. Raw surveys were processed by scanning and computer processing using SurveyMaster open source software. The templates used can be made available to the public for replicating the method. This approach afforded a high level of ability to error-check hand-written responses.

Survey results were then further processed by original software written in Python in a Unix environment. Algorithms for survey correction and data extraction could thus be specially tailored.

E. Survey bias and correction

Bias in a survey can take many forms, but at the root it is any error that shifts answers, often – but not always – away from their true values. Bias takes many forms and to eliminate all bias is essentially impossible, it can only be minimized. Despite efforts to ensure balanced survey responses, all surveys introduce bias. It can only be minimized, and then an effort made to correct it.

Bias is but one type of potential error that any survey effort faces. Despite the detailed methodology guide, survey administration was not entirely consistent, and even if it were, a design can never be perfect; the public introduces further error as well.

Likely types of errors in this survey include the following.

➤ *Coverage Errors*

Coverage errors occur when some portion(s) of the target population is/are excluded from the survey. In this survey, that would certainly include those who travel infrequently or who do not travel at all. Coverage error probably helps account for the relatively low proportion of older respondents, and could increase or decrease representation of other groups, such as workers, depending also on time of day and location of the survey. Important to cycling, which can be quite seasonal, time of year and simply the weather on the survey day can greatly influence survey response. Taking surveys on different types of days can be used as a method of correction.

➤ *Nonresponse errors*

Even for those who are present, there are always those who refuse to participate in a survey, so their potentially unique views are not able to be included.

➤ *Measurement errors*

These could also be called errors of perception and representation.

The can include question wording, question ordering, interviewer effect, and more.

➤ *Question wording errors:*

Given the language and cultural diversity of Central Europe, this is a probable source of some errors. The survey was provided in English by non-native speakers, and then translated into six partner languages. Each translation differed in subtle or even not-so-subtle fashion, despite an effort to provide clear instructions for strict quality control. Partners conducting translations were instructed to "pay attention to the exact meaning of the questions. Ask yourself whether people would give the same answer hearing the question in their native language than you would reading the English question."

Because the survey was administered in an active fashion by BICY staff, with specific directions to minimize error and ensure standardization of response, the technical wording of the survey questions may be less important than the success of the BICY staff in carrying out the survey goal. For example, although the travel data could be confusing to respondents, they were not intended to fill in the boxes themselves; a key directive to staff was: "Attention: Fill in only the modes that the interviewee uses almost every day. This can be seen in the previous, general mobility block. If the interviewee has not identified a mode that he uses every day then he should be asked to identify the most typical day and compile the question in this block for this day. It is not allowed to mix the trips of different days!"

➤ *Question ordering errors:*

The order in which a survey's questions are introduced can always introduce bias. However, there is no alternative but to have an order to questions, although bias can be minimized or at least, a direction chosen. To minimize bias, the survey flow opens with a broad question to determine all the modes a person ever uses, and then in the central block of questions, specifics about each mode are asked. In both cases, the car and motorbike subsections were always offered first, which would presumably tend to bias toward motorized answers, if anything. Only the very last question asked what a person needs to begin bicycling, and then after the question was asked for public transport. In this sense, if the survey was not neutral, at least it de-emphasized bicycling, and may thus have biased responses away from bicycling. Bias cannot be avoided, so steering bias away from cycling helps strengthen the validity of the findings, making them more cautious and conservative findings.

➤ *Interviewer effect errors:*

Although interviewers were instructed to be unbiased, it is always possible that bias can creep in, even unconsciously. For example, an interviewer might approach people who appear to be cyclists, since the study motivation is cycling. This could artificially inflate the representation of cyclists. Another case would be handing out the survey to a particular group, such as a cycling organization, or a group of workers from a certain employer, who might tend to be more uniform. The fact that interviewers administered the questions person-

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to-person can also introduce subtle bias, for any number of reasons such as if some were shy to report everything, or other influences.

It is important to note that surveys were filled out by trained staff, to minimize errors. The upside of interviewers' effect on error in this case is to help reduce errors of perception, and help ensure completeness of the data, as incomplete surveys would surely be higher without that help. In the cases where respondents wanted to fill the survey themselves, administrators were instructed to "make a control-question, for example: "Do you really use the bus every day?" in case the respondent answered the bus section." They were also instructed, that older folks "may need more attention when compiling the form."

Another form of interviewer error would be estimation error. For example, survey administrators were required to guess at the age of the respondent (minor, adult, and senior).

➢ *Incentivization bias:*

Although gadgets were provided as an incentive to participate, partners were instructed "the gadget should not be biased in promoting bikes, otherwise the survey will be biased".

➢ *Duplicate survey errors:*

In fact a large group of copies of the same survey were detected in one response group. The care with which surveys were processed, as well as the computerization of results, helps to detect errors. Handwriting was recognized, for example. If the motivation is simply to complete the survey faster, the error may be different than if the goal is to, for example, artificially inflate the number of cyclists in a given place. Unfortunately, a sophisticated effort of counterfeit surveys would be difficult to detect.

➢ *Failed to report location:*

A number of survey groups could not be matched to place, and in these cases their utility was reduced, or even had to be removed; for example, when surveys from two different cities were mixed. The bias here stems also from not being able to identify the diversity of locations. With good location data, additional interesting analyses would be possible.

➢ *Assumptions and Algorithmic Errors:*

Assumptions were made regarding the interpretation of survey responses. This included the assumption of average travel times in order to find distances traveled (discussed with modal split). Another example was the calculation of the share of car owners. Because car ownership was not explicitly identified by survey question, it was arrived at by combining survey data. Someone who used a car for everyday travel, as the driver; was not a minor; and possessed a driver's license; was presumed to be the owner. These place-based survey respondent shares were compared to national per-capita data regarding ownership of cars, to further generate survey correction weighting. Here again an assumption is made: that survey respondents own cars at the rate of the country as a whole. This may not be true; generally urban car ownership is expected to be lower than rural ownership. However, the bias will be toward increasing the share of car owners, so it remains conservative regarding bicycle behavior.

➢ *Correction of Bias*

Bias was corrected for by obtaining official data for population-level proportions of:

- Males
- Females
- Minors (ages 12-17)
- Adults (ages 18-59)
- Seniors (ages 60 and up)
- Car owners

Given the above data, it becomes possible to create weights for each group, for each city or region.

The census data for each city was utilized to find male/female ratios and age groups. Extrapolations to fit available data were made for each of the three age groups as necessary (some countries give age categories). Car ownership in the EU was found thanks to the European Environmental Agency. [10]

At the same time, to weight based on shares in the overall population will miss important differences. What if one group is more likely to travel? Certainly this is true for many groups. By focusing on times when most people travel, the attempt was made to minimize this source of bias error.

III. RESULTS

A. Main results from SWOT analysis

The process of summarizing each of the four categories involved creating summary categories under each area of the SWOT in an iterative process. The following types of Internal Strengths were identified for various cities (Fig. 6).

	PFE	PRA	CE	GR	ER	KSR	P	KO	VE	BU	NUMBER
CULTURAL SUPPORT											7
POLITICAL SUPPORT											6
EXISTING INFRASTRUCTURE											6
SUPPORTIVE LAND USE/PROXIMITY											5
TDM EFFORTS/TRAFFIC CALMING											5
NOTORIETY/WELL-KNOWN REPUTATION											5
PLAN/POLICY SUPPORT											4
ASSIGNED STAFF											4
TOURISM EFFORTS/EFFECTS											4
ACTIVE IMPLEMENTATION											3
FUNDING DEDICATED											2
CLIMATE GOOD											2
GEOGRAPHY GOOD											2
GROWING POPULARITY											2
PUBLIC TRANSPORT ACCESS											2
DEMOGRAPHICS/AGE											2
PUBLIC OUTREACH/PROMOTION											1
TOTAL ISSUES MENTIONED	9	7	6	8	7	3	4	7	6	5	

Fig. 6. SWOT Strengths: Summary Categories by Project Partner.

After completing the above for each of the four categories, the SWOT process has revealed clear patterns of importance across all places:

- The top strengths were existing support (cultural, political, assigned staff, and existing infrastructure/land use); TDM support and a cycling identity. Places hoping to build their strengths can look to those as goals and metrics.
- The top weaknesses are lack of a bicycling environment (routes, facilities, harshness of road

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traffic, and land use) and lack of funding to build one.
- Top opportunities: health and economic benefits, including tourism; and featuring opportunities for higher level policy support.
- Top threats: lack of funding, sociopolitical barriers and hostile environments.

The total number of types of concerns raised for each summary category in each place is depicted in Fig. 7, below.
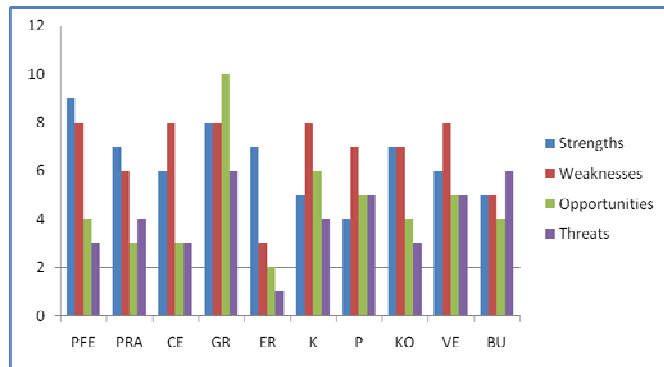

Fig. 7. Graph comparing total SWOT Summary Categories between municipalities

The SWOT thus uncovers specifics for each place, and a means of comparing trends across places.

B. Survey results

The detailed mobility survey has provided for a variety of results:
- Modal split
- Daily experience when driving, cycling or using public transport
- Stated requirements for changing behaviour (to cycling or public transport)

These can be analysed in terms of additional survey data, and other data regarding the city in question such as total length of bikeways, urban density, climate, topography, socio-economic characteristics, etc.

For some study areas, these modal splits were the first ever conducted, additionally unique in providing the first unified and consistent picture of bicycle mode share across all the study areas.

Modal split is defined here as the share of regular trips performed by each mode, based on the mode used for the greatest distance by each individual. The modal split has been calculated in the following way: the questionnaire contained a table aimed at gathering information about modes, frequency of usage and trip purpose (see Fig. 3). The currently used mode has been the mode used every day and for the purpose of work/study. In cases where two or more modes have been indicated for typical travel day usage then the mode associated with the longest daily distance has been selected. For this

reason, there has been an additional table where the interviewee has indicated how much time she/he spends for each mode on a regular workday. From the time information the daily distance per mode has been estimated, assuming average urban speeds for each mode.

The survey focused on trip time because it is the most universal measure of travel for such diverse modes. In addition human recall and estimation is presumed more accurate when estimating time, rather than distance. Trip times were converted to distance before standard modal split was generated, but time-based modal splits are also possible. The calculation of distance required an assumption of average travel speeds:
- Auto: 25 km/hr
- Motorbike: 20 km/hr
- Public Transport: 10 km/hr
- Bicycling: 12 km/hr
- Walking: 3.5 km/hr

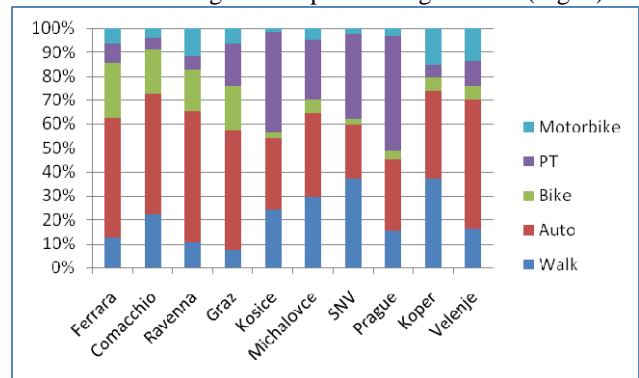Thus the following modal splits were generated (Fig. 8).

Fig. 8. Modal split for 10 cities across Central Europe, as found by BICY survey.

To give a small sample of the type of insights possible, results for just three questions are shown below. Those who commute by bicycle were asked if they fear having an accident on their regular route (Figure 9).
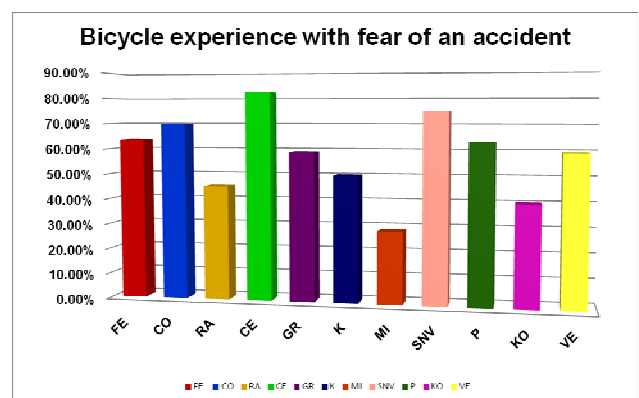

Fig. 9. Commuter cyclists reporting fear of accidents on their regular route.

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Commuter cyclists were also asked if they feel respected by car drivers on their regular route. (Figure 10). It is interesting that the Italian cities, including those with high cycling rates (the four on the left) have the lowest feelings of respect, corroborating the anecdotal reports that the culture of driving is unusually aggressive in Italy.
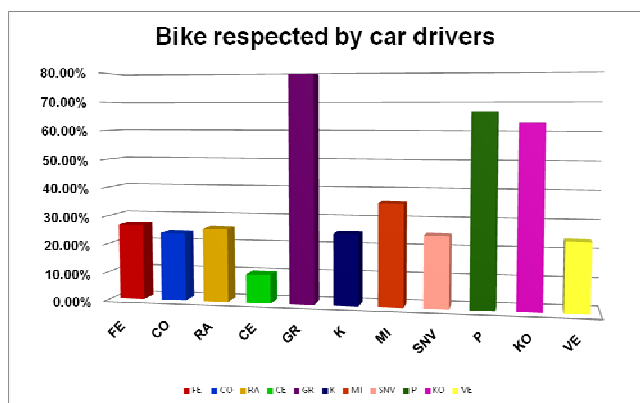

Fig 10. Commuter cyclists reporting feeling respected by car drivers.

The next figure shows the response from those who do not cycle regularly but say they would commute by bicycle if given a continuous and good bicycle route to do so (Fig. 11).
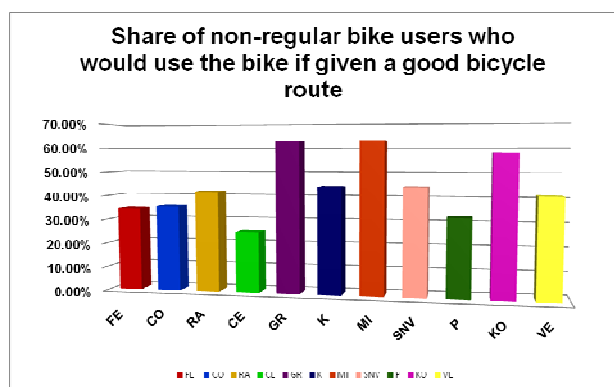

Fig. 11. Non-Regular Bike Users reporting they would bike regularly if given a continuous good bicycle route for their regular daily travel.

C. Survey Validity

A comparison of the survey results with official data, where available, suggests that the survey method is reasonably accurate (Fig. 12).

Given the variety of methods and the ever-changing transportation mix, this level of closeness is surprising. An additional source of validity is the fact that the survey results are collected in a uniform way, so even if there are errors, they are more likely to be consistent, allowing for more reliable comparison between cities.
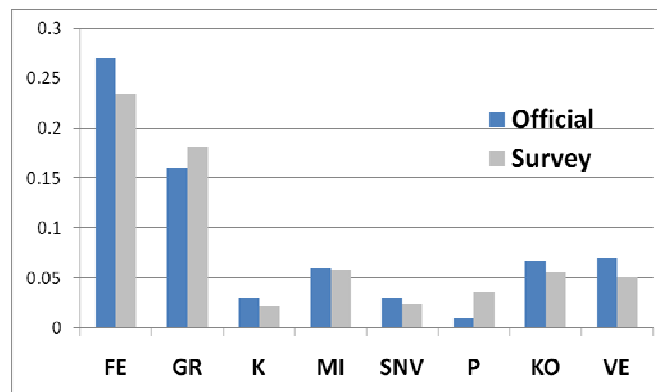

Fig. 12. Comparison of survey modal split with official data.

As discussed above, an effort was made to correct all known sources of bias wherever possible, and to bias for under-representation of cycling where a choice was possible.

There were problems of representation in some cities' surveys. No survey had equal numbers of male and female respondents. Most dramatically, BU had no male cyclists. Considering that a typical population has close to equal number of males and females, even small differences can be important.

In another city, RA, cycling modal split was 30% when taking all surveys into account, and only 17% when taking only those interviewed in nearby CE (who had residence in RA). Further investigation found the methodology was not followed, so sampling was non-representative.

In another case, the bicycle share found for ER was much higher than those found by other studies.

Thus, several cities were eliminated from further survey analysis due to representation problems or unrealistic results. There are clear indications that failure to follow the proscribed methodology was the cause, so the method itself does not appear to be the reason for the errors. In addition, a number of survey efforts fell short of the target surveys, resulting in a large range of uncertainty, shown below (Fig. 13).
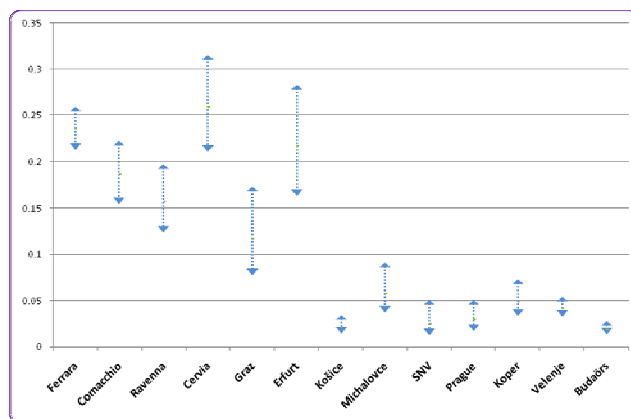

Fig. 13. Confidence intervals for bicycle mode share for each city, based on the number of surveys collected.

The number of surveys collected and correction factors are provided in Table 1. The relative weights have been obtained

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by dividing the share of the group obtained from official statistics, by the share obtained from the survey. Number of evaluated questionnaires, and relative weight for different groups are given for each city. The groups have been males, females, minors (12-17), adults (18-59), and seniors (60+). A relative weight of 1.0 means correct representation, less than 1.0 means overrepresentation and greater than one means under representation.

TABLE I
SURVEY CORRECTION FACTORS

	FE	CO	RA	GR	K	MI	SNV	P	KO	VE
#	1326	490	1396	185	920	301	281	446	485	1535
Males	0.82	0.83	0.93	0.89	0.93	0.93	0.98	0.9	1.05	0.94
Females	1.25	1.2	1.35	0.86	1.11	1.09	1.03	1.13	0.97	1.11
Minors	0.19	0.29	0.22	1.29	0.42	0.34	0.47	0.52	0.52	0.09
Adults	0.88	1	0.79	0.58	0.87	0.78	0.93	0.83	0.85	1.65
Elderly	1.69	1.03	6.18	3.06	1.63	17.74	1.02	1.46	1.2	1.4
Car owner	1.89	2.26	1.26	1.14	1.13	1.42	1.77	1.81	1.02	1.37

IV. CONCLUSION

A standardized survey method has been developed and tested, providing an expedient and low-cost means of obtaining transport data and a policy perspective for cities. Focused on bicycling, the survey is also useful for understanding user experience and behavior for other modes as well. Conducting two surveys in sequence (before and after) could be used for longitudinal analysis, for example, to test the effects of policy actions, new infrastructure, new services, and other changes such as changing cultural or economic factors. Although the survey could even be conducted by volunteers, it is critically important that the methodology is carefully followed to ensure accurate results.

When analysed in combination with official data describing each city, additional insights can be generated and predictive modeling is possible.

A third component of the framework results in qualitative analysis by stakeholders, affording an opportunity for dialogue that can be essential to the political process, as well as informative for scientific inquiry.

Together, these three framework elements provide a rapid and low-cost, standardized method for assessing the conditions and factors affecting urban bicycling as well as other modes of transport in any given city, and for comparing between cities, with special utility for making informed policy actions aimed at increasing sustainable transport and reducing carbon emissions in exchange for a plethora of expected co-benefits.

REFERENCES

[1] European Commission. 2011. White paper, Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. http://ec.europa.eu/transport/strategies/2011_white_paper_en.htm
[2] European Cyclists' Federation. December 2011. CyCle more often 2 Cool down the planet! Quantifying Co2 savings of cycling. http://www.ecf.com/wp-content/uploads/ECF_BROCHURE_EN_planche.pdf
[3] Wittink, Roelof. December 2010. Cycling and the climate agenda. http://www.ecf.com/wp-content/uploads/2011/10/Cycling-and-the-climate-agenda.pdf
[4] Eurostat. 2009. Panorama of Transport. Accessed January 5, 2012. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-DA-09-001/EN/KS-DA-09-001-EN.PDF
[5] J. Woodcock, P. Edwards, C. Tonne, B.G. Armstrong, O. Ashiru, D. Banister, et. al. Health and Climate Change 2: Public health benefits of strategies to reduce greenhouse-gas emissions. *Urban Land Transport, Lancet.* 374: 1930–43, 2009.
[6] A.T. Moore, S.R. Staley, R.W. Poole, Jr.. The role of VMT reduction in meeting climate change policy goals. *Transportation Research Part A.* 44, 565–574, 2010.
[7] J. Schweizer, J. Meggs, S. Bertoni, A. Pashkevich. 2011. Round table: rapid, quantitative assessment methods in support for cycling policy formulation. *Velo-City Global 2011* (conference).
[8] BYPAD Project website, accessed Jan. 25, 2011. http://www.bypad.org/
[9] BYPAD. Cycling: The European Approach. Available for download: http://bypad.org/docs/BYPAD_Cycling_The_European_approach.pdf
[10] European Environmental Agency. 2007. Car Ownership in Europe: Cars per 1000 People. Accessed December 2011. http://www.eea.europa.eu/data-and-maps/Fig.s/car-ownership-in-europe-cars-1000-people