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Revealing the cycling potential of starter cycling cities: Usefulness for planning practice

Cecília Silva*, João Teixeira, Ana Proença, Tamara Bicalho, Isabel Cunha, Ana Aguiar

Institution: Faculty of Engineering of the University of Porto, Rua Dr. Roberto Frias, 4200-465, Porto, Portugal

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ABSTRACT

The potential of cycling to bring about more sustainable travel behaviour has been largely recognised. Regardless of this potential, many cities worldwide still offer poor conditions for cycling and present residual cycling shares. These so called 'starter cycling cities' are those currently facing the hardest challenges in bringing about cycling. One such challenge is to develop a strategic starting point for the future cycling network. An emerging research field here has focussed on the concept of potential for cycling to provide planning support tools.

This paper assesses the experienced usefulness for planning practice of the 'Potential for Cycling Assessment Method' (Silva et al., 2019) in supporting the planning process of starter cycling cities. Following Planning Support Systems literature on the assessment of usefulness for the planning process, we tested the tool in several experiential workshops involving four Portuguese municipalities falling into the starter cycling category.

The Potential for Cycling Assessment Method revealed high usefulness in supporting the planning process regarding cycling policies, particularly with regard to *Enthusiasm* generated and the *Communication* value. Revealing the potential for cycling through the spatial visualization of several relevant indicators seems to have had a strong impact on the planning practitioners involved. All of them agree with the ability of the tool to provide support for real world planning decisions, for informing the debate, for identifying areas for cycling infrastructure and for selection of strategies. These findings must be viewed with some reserve considering, in particular, the limited national context.

1. Introduction

There has been an increasing recognition of the potential of cycling to bring about more sustainable travel behaviour in urban areas (Pucher et al., 2011; Handy et al., 2014). Many cities worldwide have strived to improve conditions for cycling, trying to follow the example of more experienced cities. According to the PRESTO (2010) project, starter cycling cities are the ones facing the hardest challenges here. These cities offer poor cycling conditions and present residual cycling shares (below 10%) and therefore have no cycling tradition or technical know-how (BYPAD, 2008). It is now recognized that cities, in different stages of development of cycling, face different problems, have different needs and require different solutions, limiting transferability of solutions between champion cities[1] or even climber cities[2] and starter cycling cities. The PRESTO project gives particular attention to the need for a neighbourhood level approach for starter cycling cities (in contrast to the city-level approach for champion cities) and to the higher need for infrastructure-based policies, particularly focused on improving safety and providing directness. While champion cities benefit from a well-established network of basic infrastructure for cycling, starter cycling cities are struggling to start building their basic network. Regardless of the many design guidelines for cycling infrastructure, they tend to focus more on the 'what' (such as, width, surface material and colour) then on the 'where' (Larsen et al., 2014; Lovelace et al., 2017), providing little to no support on where to start the structural network leading to the necessary shift in balance in favour of cycling.

* Corresponding author. Civil Engineering Department at the Faculty of Engineering of University of Oporto and Integrated Member of the Research Centre for Territory, Transports and Environment.

E-mail addresses: ccsilva@fe.up.pt (C. Silva), ega11021@fe.up.pt (J. Teixeira), anaclaudia@up.pt (A. Proença), tamarabicalho@fe.up.pt (T. Bicalho), isabelcunha@fe.up.pt (I. Cunha), anaa@fe.up.pt (A. Aguiar).

[1] Cities offering good conditions for cycling and holding cycling shares above 30% (BYPAD, 2008).

[2] Cities offering conditions in between starter and champion cities (BYPAD, 2008).

[3] Here we include formal cycling infrastructure and low speed areas (30 km/h Zones).

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Much of the research developed in cycling is focused on champion or climber cities (Pucher and Buehler, 2008; Heinen et al., 2010). More research is needed for starter cycling cities, in particular, research able to provide support for the development of the baseline cycling network (Larsen et al., 2014; Lovelace et al., 2017; Silva et al., 2019). The debate on 'where' to begin the development of the cycling infrastructure of a starter cycling city has lead authors the explore the concept of potential for cycling, i.e. where cities have higher or lower potential to accommodate and even encourage cycling. Tools such as the Bicycle Safety Index Rating (Davis, 1987) the Bicycle Level-of-Service (TRB, 2010), the Index of City Readiness for Cycling (Zayed, 2017), the Analysis of Cycling Potential (Transport for London, 2010), the Propensity to Cycle Tool (Lovelace et al., 2017) and the Potential for Cycling Assessment Method (Silva et al., 2019) are some of the planning support tools we can find in recent literature.

This paper assesses the usefulness for planning practice of one of these tools, the Potential for Cycling Assessment Method (Silva et al., 2019). The Method has been designed to reveal spatial disaggregation of the cycling potential and by doing so identify areas with higher and lower potential for cycling, regardless of the average cycling potential of the city. In doing so, the Method intends to reveal areas with high potential for cycling for the development of the structural cycling network and enable the assessment of the effect of possible future networks on the cycling potential (Silva et al., 2019).

Here we take a deeper look into how planners perceive the usefulness of such capabilities in supporting the planning process of starter cycling cities for the development of cycling policies. As such, the paper addresses the following research question: Is the Cycling Potential Assessment Method useful for supporting the planning process in starter cycling cities?

Following the multidimensional approach from te Brömmelstroet (2013), this research explores the potential of the Cycling Potential Assessment Method in supporting the planning process by generating positive reaction (*enthusiasm*), *insights* (into the problem and into participants' assumption) and enhanced *commitment* to the cycling potential, by having an influence on daily professional routines (*behaviour*), and by facilitating *communication* and *consensus* building among planning practitioners. In addition, we explore the planning task for which the tool is considered most useful by planning practitioners (following Silva et al., 2017). The research approach resorts to experiential workshops where planning practitioners from four Portuguese municipalities, falling into the starter cycling category, are involved in experiencing the tool in a planning process before the experienced usefulness is assessed (te Brömmelstroet et al., 2014).

The next section briefly presents the Potential for Cycling Assessment Method. The following section details the research approach including information on the analysis process, testbed selection and the workflow of the workshops. Finally, we discuss the main findings and conclusions of this research in the last two sections.

2. The Potential for Cycling Assessment Method

The Potential for Cycling Assessment Method aims to categorize and provide spatial visualization of the potential for cycling of starter cycling cities. Table 1 summarises its main characteristics. The Method uses a three-dimensional approach considering Target-Population, Target-Areas and Political Commitment to Cycling. Target Population assesses the cycling potential of the city's population to identify the population groups with more propensity for cycling and their location at a census tract level. Target Areas identifies the most suitable physical (such as, topography) and built environment conditions (such as, road hierarchy or locations of activities). Political Commitment for Cycling assesses existing cycling policies and the effect of general land use and transport policies on the potential to cycle. The method uses a number of socioeconomic indicators combined with coverage and accessibility-based measures, at the same time that it assesses complementary measures implemented to incentive cycling, resulting in the production of a map (showing special variability) and an average value for each indicator.

For each indicator a scoring system from 1 (lowest potential) to 5 (highest potential) is used. The individual maps are used to build an aggregate map for target-population and target-areas and a weighted aggregate score for the whole study area. For a more detailed overview of the Method see Silva et al. (2018) and Silva et al. (2019).

The Method assesses the city compatibility with cycling, in a similar way as the Index of City Readiness for Cycling (Zayed, 2017). However, this Method considers socio-economic and demographic characteristics in addition to the built and natural environment characteristics. Moreover, it offers a disaggregated analysis in addition to the aggregate analysis of the cities' compatibility. Due to the mix of disaggregate maps and average scores, the Method is able to provide a spatial analysis, allowing to identify the city areas that due to their population characteristics or their built or natural conditions have higher potential of showing latent demand for cycling. Despite of its disaggregated nature it is far less dependent of data, which can be hard to attain at this scale, such as, traffic conditions and travel behaviour required by methods such as the Bicycle Level-of-Service (TRB, 2010) and the Bicycle Safety Index Rating (Davis, 1987), or the Analysis of Cycling Potential (Transport for London, 2010) and the Propensity to Cycle Tool (Lovelace et al., 2017), respectively. Also due to the mix of aggregate and disaggregate assessments, this tool enables the identification of areas with cycling potential even within cities with general low potential, at the same time as it can be used to support the prioritization of investments (regarding the potential for cycling uptake). Finally, the tool can be used to assess the cycling potential gains from cycling policies (like the construction of new cycling infrastructure), by comparing the current state with expected scenarios.

3. Research approach

This research explores the usefulness of the Cycling Potential Assessment Method for the planning process in starter cycling cities. For this we follow the framework developed by te Brömmelstroet (2013) as applied by Silva et al. (2017). Focussed on the added value provided to the planning process (te Brömmelstroet, 2013) we explore the ability of the method in generating positive reaction (*enthusiasm*), *insights* into the problem and into participants' assumption, and enhanced *commitment* to the cycling potential. In addition, we explore its ability to influence daily professional routines (*behaviour*), and to facilitate *communication* and *consensus* building among planners. Finally, we also explore the planning task for which the tool is considered most useful by planning practitioners (*'useful for what'*), namely, informing the debate, generating and identifying problems, analysing problems, selecting strategy/options (Silva et al., 2017).

In summary, the assessment of the usefulness for the planning process follows the following dimensions (te Brömmelstroet, 2013; Silva et al., 2017):

- Reaction
- Insight
- Commitment
- Behaviour
- Communication
- Consensus
- Useful for what

Following the rationale that assessing usefulness requires hands-on experience (Straatemeier et al., 2010) we used a series of workshops (two for each local authority) to engage planning practitioners from local authorities with the Method (te Brömmelstroet et al., 2014). The workshops were designed to simulate a real planning exercise making use of the method in the design of cycling strategies. In this experiential

Table 1
Key characteristics of the Potential for Cycling Assessment Method.

Method	Aim/Output	Indicators/Parameters Assessed
The Potential for Cycling Assessment Method	Categorize and provide spatial visualization of the cities' cycling potential Numerical score, spatial representation & disaggregation, typology of cities	Target Population • Age • Car ownership • Educational level • Student presence • Population density Circulation Conditions • Road hierarchy • Road network speed • Accidents • Topography (Slopes) Target Areas • Accessibility to education facilities • Accessibility to main and secondary centres • Accessibility to PT stations • Occupation diversity • Cycling Infrastructure's coverage Political Commitment to Cycling • Population coverage by cycling Infrastructure • Schools coverage by cycling Infrastructure • Network coverage by cycling Infrastructure • Population coverage by bicycle parking • PT stations coverage by bicycle parking • Relative coverage by PT • Accessible student population to school by bicycle • Accessible population by bicycle • Accessible area by bicycle • Relative accessibility • Complementary measures

research design, the method was used to assess the current situation regarding cycling potential (first workshop), as well as to assess cycling strategies currently under development by the municipality and to support the development of new strategies (second workshop). The assessment of the experienced usefulness for the planning process was collected through a survey at the end of the second workshop. The survey presented a number of statements based on the dimensions referred to before. Participants were asked to rate these statements using a Likert-type scale ranging from 1 ‘strongly disagree’ to 4 ‘strongly agree’.

3.1. Workshop workflow

Four Portuguese municipalities were invited to take part of this research. A first meeting was set up with the municipal official on mobility or the mobility department director of each municipality. This meeting served to explain the aim of the research project and of the workshops. The invitation for the workshops was directed to all planning professionals directly involved in the cycling planning process of the municipality. The selection of participants was made internally by each municipality. Although some participants were absent in one of the two workshops, for personal or professional reasons, we were informed the group of participants represented the main professionals involved in the cycling planning process.

The first workshop aimed to familiarize participants with the concept of cycling potential and to explore the current status of the municipality regarding cycling potential. The workshop started with a brief presentation of the Method (concept, aims and main indicators). This was followed by the presentation of the main results of the method. The results included individual maps for each indicator and aggregate maps on target population and target areas, picturing areas of the municipality with higher and lower potential for cycling according to the dimension under analysis. In addition to maps, the results also included average values for each indicator. These results generated several discussions, ranging from simple questions to spontaneous discussions among participants on specific strategies under development by the municipality. The workshop concluded with the collection of suggestions for improvement to the method.

Once familiar with the method, the second workshop enabled a hands-on experience in developing cycling strategies with the support of the information provided by the method. The information provided included the current cycling potential, analysed during the first workshop, and future cycling potential scenarios. These scenarios resulted of the assessment of cycling strategies, currently under development by the municipality. The workshop started with a detailed presentation of the cycling potential for the tested scenarios and of the comparison with the current situation. Again, the results already fuelled several debates among participants during the presentation. Participants sometimes even seemed to ignore the research team, starting discussions with colleagues on particular solutions they were working on. The presentation was followed by a group activity (Fig. 1) aimed at the design of new cycling policies (or changes of the ones tested in the workshop). The research team did not take part of this activity, acting only as observers (only intervening when occasionally called to clarify some of the results being analysed). The workshop ended with the survey assessing the PSS’ perceived usefulness for the planning process.

Fig. 1. Hands-on exercise Bicalho (2019).

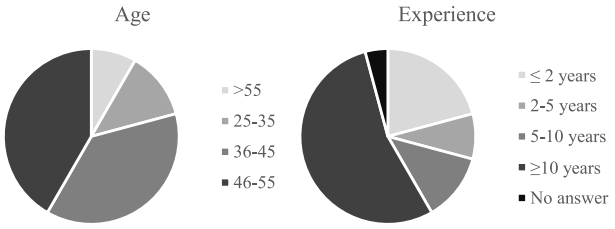

Fig. 2. Age and experience of participants (N = 24).

The workshops involved a total of 24 participants (6 in each municipality) with a balanced number of technicians from Urban Planning and from Mobility and Transport departments (13 participants from each, of which 3 participants where part of both departments). Of these, one was a municipal councillor while the remining had technical responsibilities, with roughly half also holding management responsibilities (as heads of department or division). It is fair to say that the sample had a strong representation of experienced planners. Approximately half participants were experienced planners with more than 10 years' experience in the field. In line with this, 80% of the participants were between 36 and 55 years old. At the same time, roughly 20% of participants held less than 2 year's professional experience (Fig. 2).

3.2. Testbed selection

The selected case-studies in this research are four Portuguese municipalities: Braga (Fig. 3), Guimarães (Fig. 4), Oporto (Fig. 5) and Matosinhos (Fig. 6), all located in the northern part of the country. Although all come from the same country these case-studies are paradigmatic examples of Starter Cycling Cities, with a residual cycling modal share (0.1–0.3% - Table 2) and heavily car-reliant (Table 2). Coming from a national context which, in itself, can also be considered starter cycling, sustained by a strong popular resistance and political scepticism, this testbed is particularly adverse. Although additional assessments in different national context are naturally required, this testbed provides an interesting starting point due to the high levels of resistance and total lack of planning tradition.

Moreover, the cities are small to medium-sized cities (in the European context). This makes them of particular interest considering that small and medium-sized cities (between 50 000 and 250 000 inhabitants) represent more than 80% of the European Union's cities (Nabielek et al., 2016). The sample holds a diversity of urban context. Braga (Fig. 3) and Guimarães (Fig. 4) are characterized as more sprawled municipalities with low-density developments spread-out across the municipality. Whereas the municipalities of Oporto (Fig. 5) and Matosinhos (Fig. 6) area coastal cities, part of a Metropolitan Area, and are mainly urban and compact.

Figs. 3–6 represent the population density of the four municipalities including the location of their main urban centres (the white areas represent areas without population). The figures provide a clear picture of the differences between the municipalities with Braga and Guimarães having significant parts of their territory sparsely populated, while Matosinhos and, in particular, Oporto showing mainly densely populated areas.

4. Testbed: potential for cycling revealed

Of the maps presented in the workshops we present only a few examples of those of strategic importance to the debate. Figs. 7–10 present the aggregated cycling potential regarding target-population and target-areas (aggregating all 10 indicators of both dimensions). For each municipality we can compare the current situation (on the left) and its future potential with the implementation of new cycling infrastructure and network improvements (on the right). For further detail on the results of the application of the Method to these municipalities, see Silva et al. (2018) and Silva et al. (2019).

We can see that there is a gain in the cycling potential with the implementation of new cycling infrastructure in all cases. However, there are significant differences between the municipalities according to the projects' "ambition", with Matosinhos showing the greatest

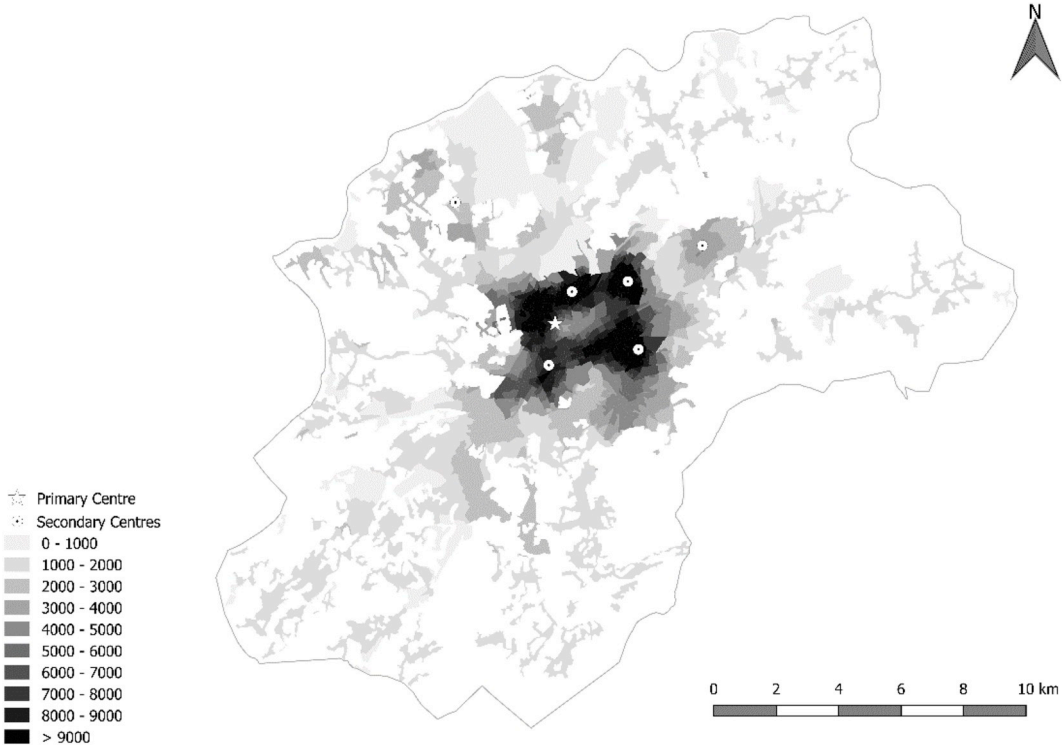

Fig. 3. Municipality of Braga: main centres and population density (inhabitants/km^2) Silva et al. (2018).

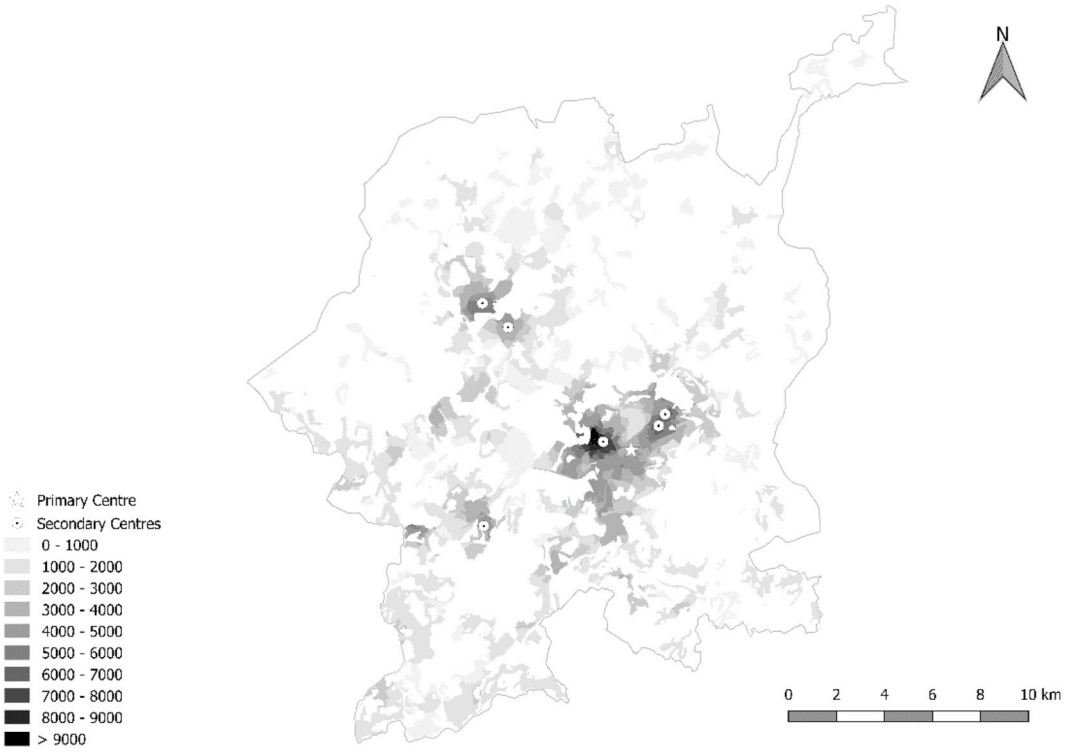

Fig. 4. Municipality of Guimarães: main centres and population density (inhabitants/km^2) Silva et al. (2018).

improvement.

Table 3 presents the length of the current and future cycling network for each municipality. All municipalities show residual networks in the current situation and significant expansion plans. Matosinhos shows the largest network extension, increasing it sevenfold.

Fig. 11 represents the percentage of population covered for each potential for cycling score (1–5) for each municipality in the current and future scenarios. In the current scenario, Oporto shows the highest potential with 87% of the population residing in areas with a potential for cycling scoring 4 or above, followed by Matosinhos (57%), Braga (50%) and Guimarães (26%). However, in the proposed scenario (Future), Matosinhos shows the most significant improvement, leading to almost all of its population residing in areas with a potential for cycling scoring 4 or above (92%) and more than 40% residing in areas with the highest cycling potential.

While both Braga and Guimarães have planned larger infrastructure improvements than Oporto, it will cover less population and urban area, resulting in less significant cycling potential gains. This can be explained by Braga and Guimarães being more sparsely populated than Oporto, leading to Oporto having its cycling infrastructure covering a

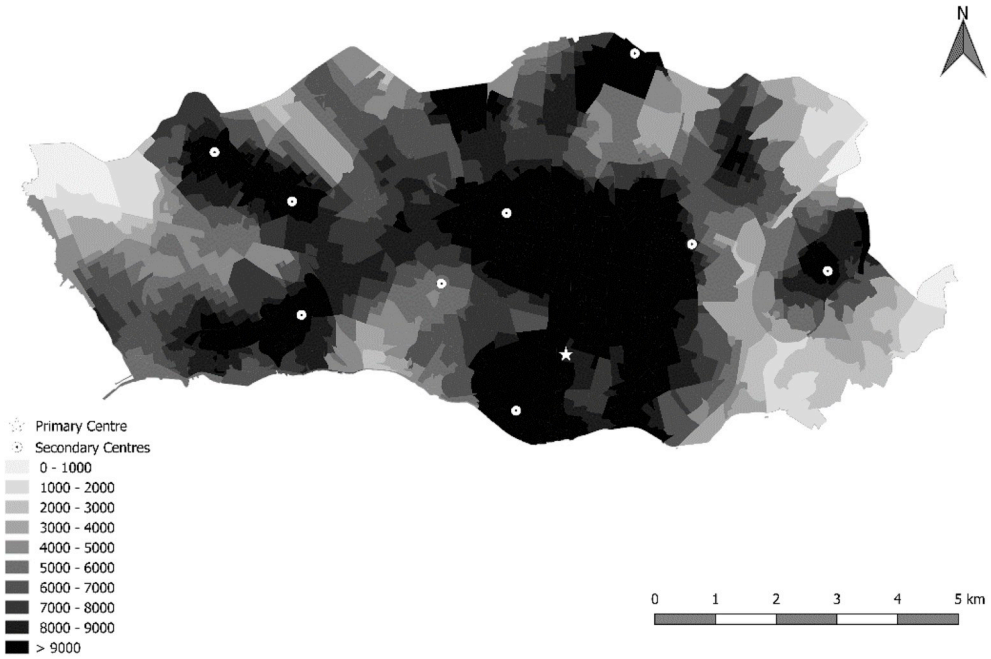

Fig. 5. Municipality of Oporto: main centres and population density (in inhabitants/km^2) Silva et al. (2019).

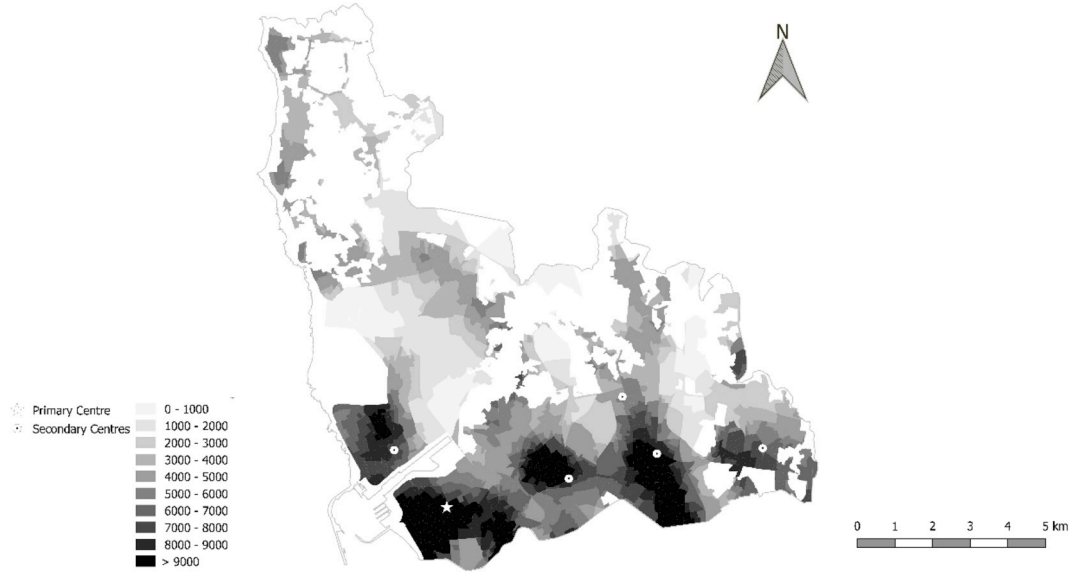

Fig. 6. Municipality of Matosinhos: main centres and population density (in inhabitants/km^2) Silva et al. (2018).

Table 2
Case-studies main characteristics and their modal share (INE, 2011).

Characteristics		Braga	Guimarães	Oporto	Matosinhos
Population		181 494	158 124	237 591	175 478
Total Area (km^2)		183.4	241.0	41.4	62.4
Area within the urban boundary (km^2)		71.7	61.8	39.8	39.3
Population Density (inhab/km^2)		2530	2560	5970	4468
Modal Share	Walking	18.2%	18.2%	21.6%	16.1%
	Cycling	0.2%	0.1%	0.2%	0.4%
	Public Transport	15.4%	18.2%	26.1%	21.4%
	Private Motor Vehicle	66.1%	63.3%	51.9%	61.9%
	Others	0.1%	0.2%	0.2%	0.3%

higher percentage of the population and urban area. Matosinhos presents a more comprehensive cycling policy than the other three municipalities, leading to high levels of coverage by the cycling network, which translates in significant gains for its Cycling Potential, whereas in the remaining municipalities the improvements are less extensive.

Finally, we take a look at the aggregate scores for the three dimensions of analysis (Table 4), including the current and future scenarios.[4]

As observable, Braga and Guimarães experienced a very small change with the implementation of their projects, ranging from a 3% increase in Braga's Target-Areas to 12% in their Political Commitment to Cycling. Even though Guimarães had a larger infrastructure (existing and planned), it wasn't as effective in covering its population and urban area as Braga, resulting in a poorer Target-Areas score. Regardless of the general score, both municipalities show significant gains of their cycling potential in the city centre (Figs. 7 and 8). Oporto and Matosinhos, on the other hand, had a visible evolution from the current to the future scenarios. Due to Oporto's compactness and being densely populated, its proposed cycling infrastructure, even though not as extensive as other municipalities, covered a higher percentage of its population. Finally, Matosinhos had such a complete and integrated strategy that the Political Commitment to Cycling suffered a 97% increase. The proposed infrastructure would reach virtually all its population.

5. Usefulness of the potential for Cycling Assessment Method

Most of the dimensions analysed regarding the perceived usefulness of the Cycling Potential Assessment Method (Fig. 12) have shown a considerable positive response in all case-studies, mostly regarding Reaction/Enthusiasm (all participants agreed that the workshops produced useful results) and Communication (all but one participant agreed that the method and the concept of cycling potential helped in communicating and understanding each other's ideas about cycling as a mode of transport). The Method was also recognised by the participants as allowing them to have a better understanding of the other participants' opinions (Insight into participant's assumptions) with 13 strongly agreeing, 10 agreeing and only 1 disagreeing. It is reasonable to say that all the participants believe that the Method is relevant for their planning practice and that it brought out satisfactory results and an interesting perspective regarding the cycling potential of the municipality (Insight into the problem). The participants considered that the presentation of the Method resulted in the commitment to share its outputs outside the session (Commitment) and to be used during daily planning practices (Behaviour). The positive perception is also present in its usability to help the decision-making process, to support the debate, to identify where to act and define strategies. In fact, in Braga, the participants reported that the Method helped them validate the new cycling strategy they have been working on. The planners from Braga even considered using some of the Method's results during the public consultation of their cycling strategy with, for instance, one of the planners stating: *"the map showing the car's attractiveness versus the bike could be useful in the future" Participant #1 Braga (free translation from Portuguese)*. In Matosinhos, the results from the Method provided support for the implementation of the Mobility Plan, with participants stating it would have been interesting for them to have those maps during the Plan's conception. In fact, their enthusiasm led to an invitation for a pubic presentation of the results together with the first public presentation of the Mobility Plan.

Although the assessment of usefulness reveals to be quite positive overall, it shows to be a little less efficient in generating consensus regarding the problem, goals and possible solutions. In fact, the difficulty in reaching an agreement was also noticed during the workshop

[4] Regarding the Target Population, we did not extrapolate population data for the future, as such, we consider scores to be unaltered. Considering the assessment of future cycling policies, the remaining dimensions were considered most relevant.

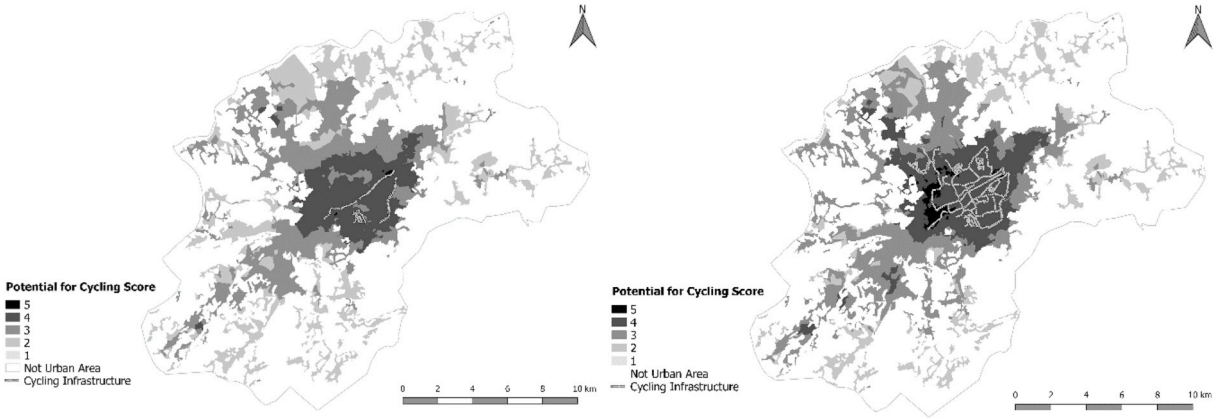

Fig. 7. Aggregated Cycling Potential of the Target-Population and Target-Areas in the current scenario (left) and in the future scenario (right) in Braga Silva et al. (2018).

discussion. When participants were asked to define goals and come up with strategies, divergences were found. This was especially clear regarding strategies focused on limiting car accessibility, with reluctance from planners in acknowledging the need of restricting car use in order to induce modal shift to cycling. For instance, a planner from the municipality of Guimarães stated: *"we want to solve for both modes … we want more car parking, better streets and more bicycles" Participant #1 Guimarães (free translation from Portuguese)*, which indicates potentially incompatible goals as providing easily available car parking will hinder efforts to induce modal shift from car to cycling. However, in Braga's and Matosinhos' sessions the discussions appeared to be more unanimous than in Oporto and Guimarães. This can be supported by the fact

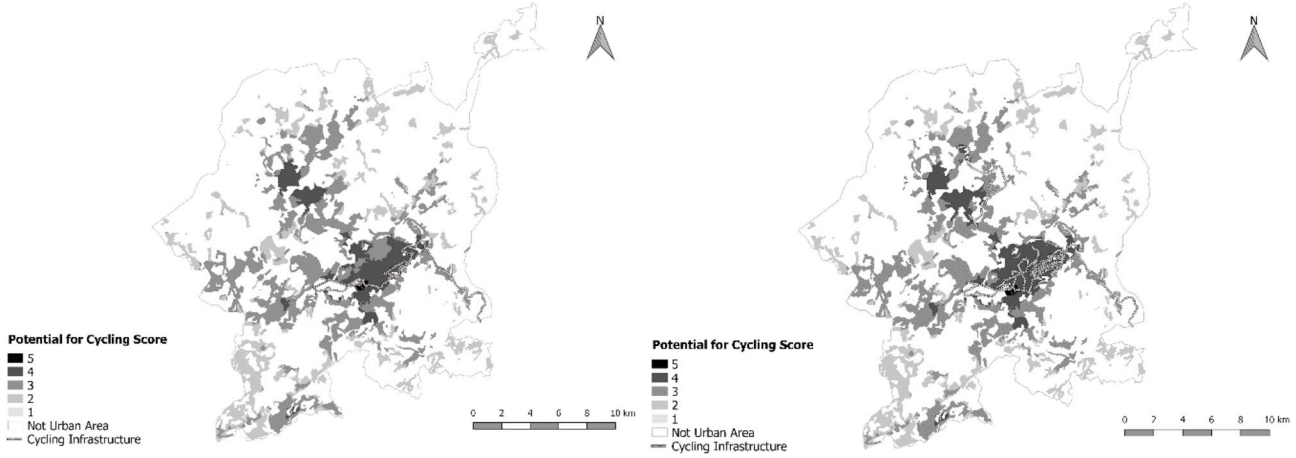

Fig. 8. Aggregated Cycling Potential of the Target-Population and Target-Areas in the current scenario (left) and in the future scenario (right) in Guimarães Silva et al. (2018).

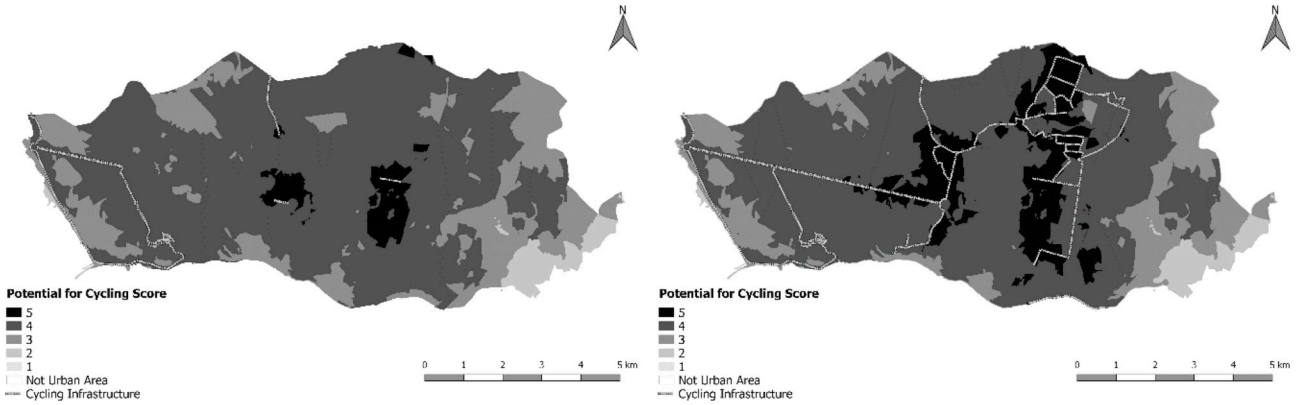

Fig. 9. Aggregated Cycling Potential of the Target-Population and Target-Areas in the current scenario (left) and in the future scenario (right) in Oporto Silva et al. (2018).

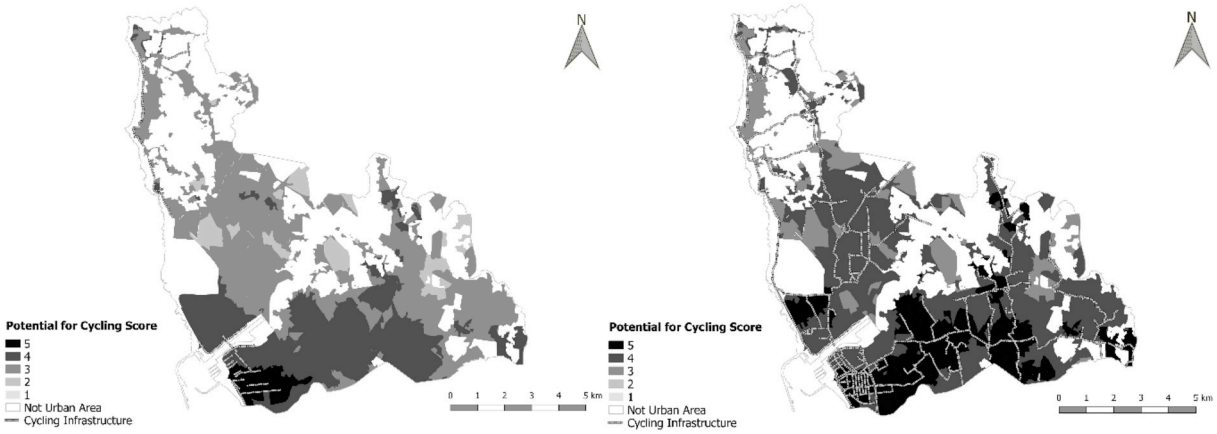

Fig. 10. Aggregated Cycling Potential of the Target-Population and Target-Areas in the current scenario (left) and in the future scenario (right) in Matosinhos Silva et al. (2018).

Table 3
Length of the current Cycling Infrastructure[3] and its extension by the proposed projects.

	Current Extension (km)	Proposed Extension (km)
Braga	11.6 km	58.6 km (+47 km)
Guimarães	23 km	64 km (+41 km)
Oporto	16 km	48.6 km (+32 km)
Matosinhos	20 km	143 km (+123 km)

that in Braga and Matosinhos, urban planning and mobility planning are merged whereas in Oporto and Guimarães they are two almost non-connected branches. In Oporto they even sit in a segregated manner, according to their work area, which would interfere even further with communication. In fact, Oporto was the only municipality where the workshops were carried out in an amphitheatre, while the rest were conducted in meeting rooms, with a common table where discussion and map analysis was more efficient. Nevertheless, Oporto's planners all agreed at the end that the maps with the coverage rate were very interesting. One of them further explained that *"they are very saleable, from a political standpoint. When we know that with this cycling infrastructure X more people get covered, it calls a lot of attention. Those maps and tables sell" Participant #1 Oporto (free translation from Portuguese)*.

Results on the dimension 'useful for what', presented in Fig. 13, reveal that the Potential for Cycling Assessment Method performed positively in all the analysed features.

The Method was found to be most useful for analysing areas and identifying potential areas for cycling use, as well as helping to make real world planning decisions (with 83% of participants strongly agreeing). All the participants also agreed on the usefulness of informing the debate and selecting strategies and options regarding cycling use (with 71% strongly agreeing). However, the participants' opinions regarding the Method's usefulness during the implementation of solutions were less positive, with one participant disagreeing.

It is also important to point out that in the municipalities where the Method's results showed less promising levels of cycling potential, particularly in Braga and Guimarães, the answers to the usefulness were not as positive as in Oporto and Matosinhos. Expected effects on cycling potential were probably below the expectations of participants, generating less enthusiasm around the usefulness of the method.

Nevertheless, the overall opinion on the usefulness of the Method was positive and the planning practitioners were convinced that the Cycling Potential was useful for their practice. As one planner from Guimarães stated: *"I think this type of information is above all essential for decision-making and the defence of that decision" Participant #2 Guimarães (free translation from Portuguese)*. As such, these optimistic results provide an interesting response to the capacity of the Method to represent the potential of the city to use cycling as a transport alternative, and even further, as a political tool to justify the efficiency of cycling infrastructure projects, according to Oporto's planners.

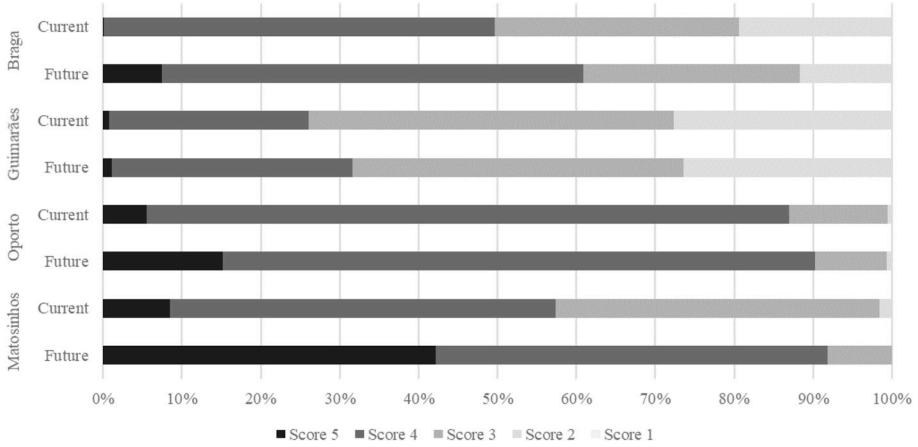

Fig. 11. Percentage of population covered by each potential for cycling score.

Table 4
Aggregated Cycling Potential scores of Target-Population, Target-Areas and Political Commitment to Cycling.

Potential Score	Braga		Guimarães		Oporto		Matosinhos	
	Current	Future	Current	Future	Current	Future	Current	Future
Target-Population	3.5		3.3		3.7		3.5	
Target-Areas	2.3	2.4 (+3%)	2.0	2.2 (+9%)	3.5	3.8 (+10%)	2.9	4.4 (+49%)
Political Commitment to Cycling	2.8	3.1 (+12%)	2.3	2.6 (+10%)	2.8	3.2 (+16%)	2.1	4.2 (+97%)

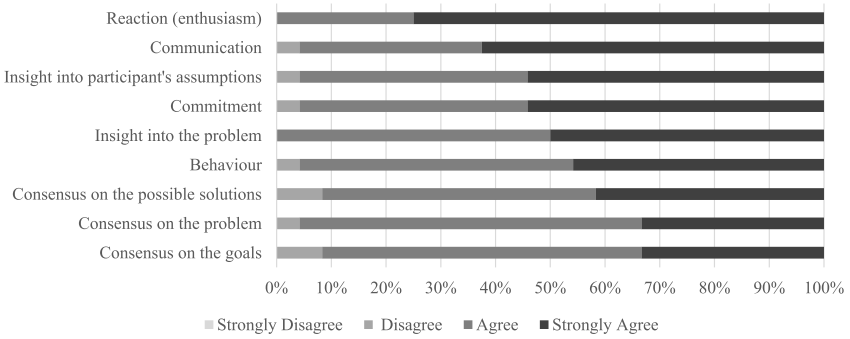

Fig. 12. Perceived usefulness of the assessment method in the 4 case-studies (N = 24).

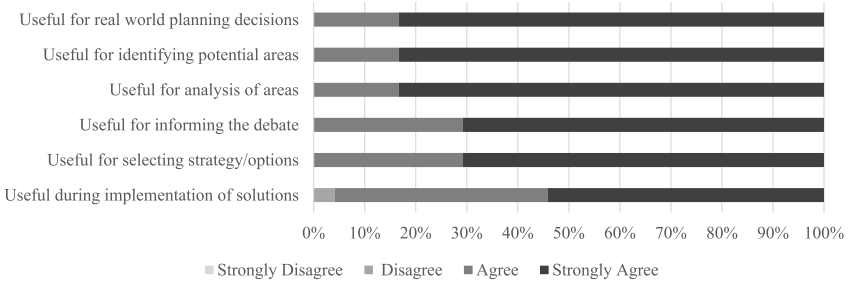

Fig. 13. Additional detail into the Perceived Usefulness of the Assessment Method in the 4 Case-Studies (N = 24).

6. Conclusions

The results of these first four experiential assessments of the Potential for Cycling Assessment Method suggest that it offers significant usefulness for the planning process. Particularly regarding its ability to generate enthusiasm, to support communication among participants, to generate insight into participant's assumptions and to generate commitment to cycling. The majority of participants of the workshops strongly agree with the usefulness of the tool with regard to these dimensions. In fact, the vast majority of respondents recognize the tool as useful for all the dimensions of usefulness under evaluation. Participants of the workshops were particularly convinced of the usefulness of the tool to support the identification of potential areas for cycling (over 80% of participants strongly agree with this). In addition, all planning practitioners involved in the workshop were convinced of the usefulness of the tool to support planning decisions and to inform the debate on cycling.

Although these findings are promising, they should be considered with moderation regarding the small sample of analysis, the limited national context and the absence of a control assessment. Regardless, the general enthusiasm towards all dimensions analysed revealed by this first assessment supports its potential in providing added value to the planning process and justifies new assessments, including control experiments, comparisons with other tools, and applications to other local and national contexts, among others.

The results also suggest that municipalities with limited cycling potential (for instance, resulting from steep topographies, urban sprawl or limited cycling policies) tend to be less enthusiastic about the usefulness of the method. The exact limitations need to be further explored. Although it is reasonable to expect less perceived usefulness in these cases it would be relevant to explore which dimensions suffer the most and which are still able to uphold its usefulness (if any).

Finally, it is important to note that the involvement of this assessment process in the development of the Potential for Cycling Assessment Method has brought to light several ideas for improvement, which are still being incorporated into the method. As an ongoing process, additional research is needed into improving the method. Comparisons studies with other similar methods are of importance here, as is the continued involvement of planning practitioners planned in future stages.[5]

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[5] One example of such future stages in the adaption of the method to the concept of Gross Potential for Cycling, excluding cycling infrastructure in the analysis, under the research project BooST Boosting Starter Cycling Cities (https://boost.up.pt/en/).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tranpol.2019.05.011.

References

Bicalho, T., 2019. Planners' Attitudes towards the Cycling Potential of their cities - an attitude change approach. (Master). University of Porto, Porto.

BYPAD, 2008. Cycling, the European Approach: Total Quality Management in Cycling Policy. Results and Lessons of the BYPAD-Project. s.l., s.n.

Davis, J., 1987. *Bicycle Safety Evaluation,* City of Chattanooga. Auburn University.

Handy, S., Wee, B. v., Kroesen, M., 2014. Promoting cycling for transport: research needs and challenges. Transport Rev. 34, 4–24.

Heinen, E., Wee, B. v., Maat, K., 2010. Commuting by bicycle: an overview of the literature. Transport Rev. 59–96.

INE, 2011. Censos 2011. [Online] Available at: http://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=censos_subseccao, Accessed date: 13 April 2018.

Larsen, J., Patterson, Z., El-Geneidy, A.M., 2014. Build it. But where? The use of geographic information systems in identifying locations for new cycling infrastructure. Int. J. Sustain. Transport. 7 (4), 299-317.

Lovelace, R., et al., 2017. The Propensity to Cycle Tool: an open source online system for sustainable transport planning. J. Transp. Land Use 505–528.

Nabielek, K., Hamers, D., Evers, D., 2016. Cities in Europe. PBL Netherlands, The Hague.

PRESTO, 2010. *Promoting Cycling for Everyone as a daily transport mode: lessons Learnt in five very different cities,* s.l.: intelligent energy europe.

Pucher, J., Buehler, R., 2008. Making cycling irresistible: lessons from The Netherlands, Denmark and Germany. Transport Rev. 28, 495–528.

Pucher, J., Buehler, R., Seinen, M., 2011. Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. Transport. Res. Part A 45, 451–475.

Silva, C., Patatas, T., Amante, A., 2017. Evaluating the usefulness of the structural accessibility layer for planning practice – planning practitioners' perception. Transport. Res. Part A 137–149.

Silva, C., et al., 2018. *The Potential for cycling assessment method - final report,* Oporto: Generation.Mobi project. report available at: https://citta.fe.up.pt/projects/1-46-generation-mobi-2013-social-network-of-interactive-devices-for-a-new-generation-of-urban-mobility.

Silva, C., et al., 2019. Revealing the Cycling Potential of Starter Cycling Cities. Transportation Research Procedia, Munich.

Straatemeier, T., Bertolini, L., Brömmelstroet, M. t., 2010. An experiential approach to research in planning. Environ. Plan. Plan. Des. 37 (4), 578–591.

te Brömmelstroet, M., 2013. Performance of Planning Support Systems: what is it, and how do we report on it? Comput. Environ. Urban Syst. 41, 299–308.

te Brömmelstroet, M., Silva, C., Bertolin, L., 2014. Assessing Usability of Accessibility Instruments, first ed. Off Page, Amsterdam.

Transport for London, 2010. Analysis of Cycling Potential: Policy Analysis Research Report. Mayor of London, London.

TRB, 2010. Highway Capacity Manual. Transportation Research Board, Washington DC.

Zayed, M.A., 2017. Towards an index of city readiness for cycling. Int. J. Transport. Sci. Technol. 210–225.