

# MONITORING PROGRAM FOR NON-MOTORIZED TRANSPORT IN THE CITY OF SKOPJE

Assist. prof. dr. Angelevska B., Assoc. prof. dr. Atanasova V.  
Faculty of Technical Sciences – University “St. Kliment Ohridski” Bitola, Macedonia  
beti.angelevska@tfb.uklo.edu.mk; vaska.atanasova@tfb.uklo.edu.mk

**Abstract:** Information about non-motorized transport, i.e., cycling and walking, are needed for planning and management support of urban transport systems. However, in the city of Skopje, monitoring programs still aren't established by transport officials on regular basis. Hence, transport planners and researchers lack bicycle and pedestrian counts for managing traffic demand. Having in mind principles for comprehensive monitoring as a framework for assessment, this paper summarizes approaches and recommendations for initiating monitoring program in the city of Skopje. Also, describes steps in establishing monitoring program and identifies possible application of the analyzed monitored data for non-motorized transport.

**KEYWORDS:** CYCLING, WALKING, MONITORING

## 1. Introduction

The benefits of non-motorized transport (cycling and walking) as sustainable transport modes are widely recognized [1]. They're environmentally friendly, have health benefits associated with physical activity and take up less road space per user.

Creating communities that support cycling and walking is an important strategy for promoting health, reducing air pollution, and lessening our dependency on an auto-centric transport system. Yet the design of our cities, neighborhoods and transport systems often discourages people from walking or bicycling to places where they work, learn, play, or shop. Urban planners, transport engineers, and other public health professionals need accurate counts of bicyclists and pedestrians to help inform transport planning and investing that support these transport modes [2].

Therefore, there is a need to launch initiatives to count bicyclists and pedestrians in the city of Skopje. These initiatives are based on a growing body of research that documents practical approaches to counting and ways that counts can be used in modeling, as well as in other aspects of transport planning [2].

Traffic volumes are a basic input for transport planning and engineering; hence a modern and comprehensive monitoring program need to be established to produce estimates of non-motorized transport [3]. Not having this program in the city of Skopje and not having data for the trends in the levels of bicycle and pedestrian activity, transport planners and engineers lack basic information about bicycle and pedestrian volumes needed to plan for these modes. In addition, the lack of routine counts for bicycling and walking means these modes of travel have not been assessed adequately in long-range transport plans.

Therefore, emphasizing the need for counting and implementing monitoring program in the city of Skopje, this paper describes the steps needed to develop a consistent and comprehensive monitoring program. It also explores how counted data for bicycle and pedestrian transport can be analyzed and used in order to support transport planning and attain wide public promotion.

## 2. Non-motorized transport in the city of Skopje

### 2.1. The Basic plan for bicycle use

The Basic plan for bicycle use in the city of Skopje was completed in 2004, in the framework of the project “Capacity building of Ministry of environment and spatial planning”, coordinated by European agency for reconstruction [4]. The purpose of this plane was to improve the environmental quality and health condition of the citizens, through the use of bicycle.

This plan for bicycle use has been a starting point for activities aimed to popularize and promote bicycle as a transport mean. Its vision was a creation of a safe, comfortable and friendly

environment for bicycle use in the city of Skopje, which will encourage citizens of all ages to use bicycle for transport and recreation in everyday life [4].

The current state of the cycling network in the city is presented in fig. 1, in which current and planned cycling paths are marked in red and blue.



**Fig. 1:** Current and planned cycling network in the city of Skopje  
Source: [4]

Cycling surfaces in the city of Skopje are categorized in several categories (fig. 2 – a, b, c).



**Fig. 2:**  
a) cycling paths  
b) cycling lanes  
c) recreational cycling paths along Vardar river

Source: [4]

Compared with the situation a few decades ago, the improvements in the development of cycling infrastructure are obvious. Still, additional effort is required to create a well-connected and modern cycling network, in order to encourage the use of this sustainable mode of transport.

## 2.2. Further development of cycling

Development of cycling in the city of Skopje is a vital part of the sustainable urban transport plane for the city. Results of the so far made progress in the creation of safe, comfortable and friendly environment for the use of bicycle are optimistic and have justified all the efforts for its achievement [4].

Lately, many successful efforts for development of cycling in the city of Skopje have been done, in order to promote and popularize cycling and to attract more bicycle users on urban streets. For realization of this aim, changes in urban network for development of safe, modern and continuous cycling network in the city of Skopje have been made. Also, several years ago a system for bicycle renting was introduced, which is still in function, widely accepted between citizens.

"Skopje - cycling city 2017" is new capital project for advancement of cycling infrastructure in Skopje and for improvement of safety in cycling. In the frame of the project, four main cycling routes will be defined, along city's boulevards; also, 51 km long cycling paths will be reconstructed. The goal is to alleviate the movement of cyclist, to increase safety and to achieve an effective cycling network. This will be accompanied with public campaigns and strengthening of the public responsibility. These activities are aimed towards building the perception that cycling and walking are attractive modes of transport and towards increasing their usage by providing appropriate environments and infrastructure.

Presented achievements have contributed for successful development of cycling in the city of Skopje, and for building of sustainability of urban transport. The future progress in cycling will depend of the efforts directed to the development of continuous, safe and modern cycling network.

## 2.3. Walking

Having in mind that the city of Skopje is approaching to 600.000 inhabitants, it's clear that walking is not a first option for everyday urban journeys (work, school, shopping, recreation...). Compared with other transport modes in the city, so far walking has got the least attention. That is the reason why aren't prepared any plans and programs schemes for development and progress of walking infrastructure, and why aren't available data or statistics of any kind.

## 3. Development of monitoring program

### 3.1. Need for counting

Traffic counts are one of the basic building blocks of transport planning and engineering [3]. Transport planners and engineers need information about volumes of bicyclists and pedestrians on streets, sidewalks, multiuse paths, and other facilities to design safe and efficient urban transport systems.



Fig. 3: Urban cycling and walking; Source: [5]

For example, if transport managers do not know traffic volumes and do not observe seasonal variations, they cannot determine exposure and accident rates, and they cannot assess the effectiveness of programs to reduce bicyclist and pedestrian fatalities. Similarly, if transport managers do not know volumes of bicyclists and pedestrians on particular facilities, they cannot determine efficient maintenance programs that maximize benefits of resources devoted to system operations [3].

Counting initiatives will show whether the levels of bicycle and pedestrian activity are increasing and also their variations due to differences in infrastructure or season, neighborhood socio-demographics, urban design, land use, and other characteristics of the built environment [2].

Monitoring data are key requirement for transport plans, providing accurate figures such as scheme assessment and evaluation. Hence, cycle and pedestrian monitoring provides valuable information for decision-making [5].

By monitoring pathways and cycle ways, local authorities gain the data they require to evaluate the access to safe and convenient walking and cycling facilities, to justify the investments and to adapt the layout to real needs and demands [5].

### 3.2. Counting non-motorized traffic for transport planning

Data of bicycling and walking patterns, such as peak hour traffic and average daily bicycle traffic, are commonly used in transport planning and management to estimate daily or annual traffic, compare mode share, or design facilities [2].

Counts of bicyclists and pedestrians can be used to estimate demand for facilities, the potential benefits of investments, and the need for traffic control modifications. Planners can use counts and models to estimate traffic on proposed new cycling and walking facilities, to quantify their attraction and to understand visitor circulation. Counts can also be used to encourage state and local officials to institutionalize commitments to counting and planning for infrastructure that supports bicycling and walking [2]. As monitoring programs are initiated, public health professionals and policy-makers will be more empowered to make stronger arguments for investments in bicycling and walking facilities, as well as other interventions to increase active travel [2].

The lack of pedestrian and bicycle volume data is a barrier to transport officials efforts to plan more effective facilities and to improve safety for pedestrians and bicyclists. The lack of system-wide pedestrian and bicycle volume data limits the ability of transport officials to provide or improve pedestrian and bicycle facilities where the need is greatest and is an impediment to developing better predictive methods for pedestrian and bicycle crashes [6].

The most common ways for use of pedestrian and bicycle count data are [6]:

- tracking changes in pedestrian and bicycle activity over time;
- measuring the usage of a bicycle or pedestrian facility;
- evaluating before-and-after volumes after a new facility is opened/improved;
- identifying high-priority locations for pedestrian and bicycle facility improvements;
- prioritizing pedestrian and bicycle projects;
- conducting risk or exposure analyses;
- quantifying exposure and develop crash rates and identifying the before-and-after safety effects of upgrading a facility;
- monitoring travel patterns at automated count sites, for use in developing factors to expand short-term bicycle and pedestrian counts at other locations;
- modeling transport networks and estimating annual volumes;
- developing and calibrating multimodal travel demand models.

Once started, non-motorized count data will likely continue to grow in importance as cities integrate non-motorized performance measures into their performance management programs [6].

### 3.3. Approaching to counting

Monitoring and evaluation program should be developed for any intervention and the costs of this should be factored in when evaluating the cost of the proposed infrastructure. The program would typically be some variant on a logic map or logic framework – a systematic and visual presentation of the key steps required to develop a monitoring program based on the scheme objectives [7]. This requires the identification of aims, objectives, inputs, outputs, outcomes and impacts. A simple example is given in fig 4.

Objective	Input	Output	Outcome	Impact
Improve cycling safety	Infrastructure improvement resources	Physical route, signage etc	Increased usage, improved perceptions of safety etc	Reduction in incidence of accidents, congestion reduction etc

Fig. 4: Data gathering; Source: [7]

The approach to counting must consider the characteristics of the route or network. There are no quick fix ‘counts required per kilometre’ or ‘survey this many users’. Rather, the data to be collected should directly address the intended outcomes and impacts, and should relate to what is on the ground [7]. Is there a suitable location for an automatic counter on the route/network? Are there schools/workplaces that are served by the route/network where data can be gathered? Are there ‘braids’ in the route/network that dictate cyclist and pedestrian flows?

The other key constraint is cost. The investment in monitoring programs needs to be proportionate and address the outcomes and impacts cost-effectively. Scaling of costs is not a simple matter [7]. If a more detailed data set is required, costs are inevitably higher. A low cost scheme may not necessarily correspond to a scheme with a minimal data requirement.

### 3.4. Planning the monitoring program

The following steps are involved when starting to plan a non-motorized count program [6]:

- **Specification of the data collection purpose.** It is important to define at the start *why* data will be collected and *how* the data will be used, as this information drives subsequent decisions about where, when, and how to collect data. Both current and potential future uses of data should be considered.
- **Identification of data collection resources.** Available resources will help define the initial scale of the program. Many successful programs have started with a small number of count sites and later expanded after the value of performing counts had been demonstrated.
- **Selection of general count locations and determination of the count timeframe.** Pedestrian and bicycle data collection programs can benefit from combining two approaches (table 1): (1) gathering short-duration counts (typically less than one day to several days, but potentially up to several months) at many locations; and (2) gathering continuous counts over multiple years at a small sample of locations. Count sites can be selected in a number of ways, but the data collection purpose should always be a consideration when selecting sites. In addition to identifying the geographic scope of count program, previously should be thought about *how long* and *how often* counts will occur.

Table 1: Key steps in institutionalizing non-motorized transport monitoring; Source: [8]

Permanent Data Management Program	Short-term Data Program
1. Review the existing permanent count program	1. Select count locations (random and/or non-random)
2. Develop an inventory of available permanent count locations and equipment	2. Select type of count (segment and/or intersection)
3. Determine the traffic patterns to be monitored	3. Determine duration of counts
4. Establish seasonal pattern groups	4. Determine method of counting (automated and/or manual)
5. Determine the appropriate number of permanent automated traffic recorder (ATR) locations	5. Determine number of short-term counts
6. Select specific count locations	6. Evaluate counts (accuracy characteristics, variability)
7. Compute monthly factors	7. Apply factors (occlusion, time of day, day of week, monthly, seasonal)
8. Develop seasonal factors	

- **Consideration of available counting methods and technologies.** There are a number of available technologies for counting pedestrians and bicycles, and many count programs use several of these.

Implementation of the monitoring program should be performed after planning, and here different set of steps are involved (table 2).

Table 2: Planning and implementing the monitoring program

Source: [6]

Planning the monitoring program	Implementing the monitoring program
<ul style="list-style-type: none"> <li>- specify the data collection purpose</li> <li>- identify data collection resources</li> <li>- select count locations and determine the count timeframe</li> <li>- consider available counting methods and technologies</li> </ul>	<ul style="list-style-type: none"> <li>- obtain necessary permissions</li> <li>- procure counting devices</li> <li>- inventory and prepare devices</li> <li>- train staff</li> <li>- install and validate devices</li> <li>- calibrate devices</li> <li>- maintain devices</li> <li>- manage count data</li> <li>- clean and correct count data</li> <li>- apply count data</li> </ul>

### 3.5. Analysing the monitoring data

The analysis should be planned at the stage of designing the data collection approach and should respond directly to the requirements of the monitoring program [7]. For instance, there would be no requirement to report on trips to school if the primary outcome measure is tourism-derived revenue.

The complexity of assembling an expression of impact depends on the reporting needs and the data sources used. It is relatively easy to report on the usage of a short stretch of route if a counter is available and user intercept survey data available [7].

However, this approach can risk significantly underestimating usage on a more complex network due to the failure to account for sections of the route not covered by data collection activity [7].

The output from the analysis is required to communicate the usage and input and should be clearly expressed in the monitoring program. Options might reasonably be expected to include [7]:

- measures of levels of walking and cycling
- measures of/change in:
  - levels of walking and cycling
  - levels of walking and cycling among particular user groups
  - levels of walking and cycling by particular trip type category
- perceptions of safety
- perceptions of other facets of a route
- revenue generation performance of a route
- health benefits associated with a route
- economic benefits associated with a route
- benefit to cost ratio of a route.

Presentation of these results must have regard to the target audiences and be accessible to them [7]. Whilst a detailed analysis may be appropriate for a more technically minded audience, a strong emphasis on more visual representation of key results will be more suited to others.

Today's technology provides a range of solutions for monitoring and analysis of the data. No matter of the level of sophistication, the flow of data should be similar (fig. 5)



Fig. 5: Processes in monitoring program;

Source: [5]

Meeting government cycling targets and showing that count collecting data is important is one thing, but sharing the data with the public is a great way to share the success of cycling policy.

Example is a creation of the public web page, as an easy way to share the data with the public and other stakeholders. The counted data can be published on a dedicated web page for easy access by website users.



Fig 6: Example of public web page;

Source: [5]

Today's technology can offer a range of technology based solutions that can promote cycling and walking infrastructure and highlight active routes to both pedestrians and cyclists, encouraging increased usage. Based on counted data, technology can give support from custom design and product supply, through to delivery and on-going support [5].

#### 4. Conclusion

Strengthening the share of non-motorized transport, i.e., cycling and walking, and increasing the number of journeys made by bicycle or on foot represent a real objective in the building of a less congested, less polluted, and less noisy city that makes better use of space and energy.

Information about use of streets, bike lanes and sidewalks by bicyclists and pedestrians is needed to support planning and improve management of transport systems. For a variety of reasons, including the absence of regulations and because most bicycle and pedestrian transport occurs on local streets, so far aren't established monitoring programs in the city of Skopje.

Monitoring data are important for the support of transport planning - therefore, it's vital that authorities establish a monitoring program of non-motorized transport, which will set a baseline and changes will be measured from that. This will indicate priorities in cycling and walking, help make the case for continued investment, show where further investment is needed and provide data for the planning and design of continuous and safe cycling and pedestrian networks and facilities [7]. Data relating to a given route or network can be used to examine the efficacy of the development, to report

back to funders, to generate public support, or to make the case for continued improvement. If monitoring program is established and counted data are used for these purposes, their contribution for the effectiveness in the realization of the project "Skopje – cycling city 2017" without any deny, will be indispensable.

Once developed and implemented in the city of Skopje, as suggested in the paper, the possibilities of monitoring program will be limitless. Policy-makers, transport system managers and researchers can use monitored data for non-motorized transport in a wide variety of applications, including facility and system planning, allocation of resources for infrastructure investment, evaluation of project and program alternatives, and assessment of transport safety and management interventions [2].

#### References

- [1]. MCC Transport Strategy to 2016, Chapter 7: walking and cycling, pp 94-103.
- [2]. A national program of the Robert Wood Johnson Foundation, University of California, San Diego, Counting bicyclists and pedestrians to inform transportation planning, Active Living Research, Research brief, february 2013.
- [3]. Lindsey, G., Humphrey, H., The Minnesota bicycle and pedestrian counting initiative: methodologies for non-motorized traffic monitoring, Final Report 2013-14, Minnesota Department of Transportation, Research services, Office of policy analysis, research and innovation, University of Minnesota, October 2013.
- [4]. Krstanoski, N., Atanasova, V., Angelevska, B., Toward sustainability in urban transport through development of cycling in the city of Skopje, Third International Conference Towards a humane city, Novi Sad, October 27-28, 2011, proceeding pp. 179-184.
- [5]. <http://www.becounted.co.nz/services/data-monitoring-solutions/>
- [6]. Guidebook on pedestrian and bicycle volume data collection, Transportation Research Board, National Cooperative Highway Research Program, Report 797, Washington, US, 2014.
- [7]. Sustrans Design Manual, Chapter 16: Monitoring and evaluation of walking and cycling (draft), november 2014.
- [8]. Lindsey, G., Nordback, K., Figliozzi, M.A., Institutionalizing bicycle and pedestrian monitoring programs in three states: progress and challenges, TRB Annual meeting, 2014.