

# A Comparison of Two Software Packages for the Simulation of Pedestrian Flows

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*Abstract:* - Urban transport (traffic), for many reasons, is becoming a bigger and bigger problem in today's world. Although it is a type of problem that arises, transport solves many important social issues, such as economic problems, unemployment, and poverty, and it raises the general standard of modern living. It is in this paper that the pedestrian flows in the city of Bitola, at two of the busiest locations along the pedestrian street Shirok Sokak, will be considered. The behavior of pedestrians when crossing a pedestrian crossing, whether they cross legally or illegally, as well as a comparative analysis with two software packages, is the key objective of this paper. The use of software packages is of great importance for traffic engineers, as it allows for real-time simulation of traffic participants, perception of problems, and provision of suggested solutions.

*Key-Words:* - Analysis, Behavior, Pedestrians, Software, Simulation, Bitola.

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## 1 Introduction

Almost all trips between an origin and a destination require a walking section. Walking as a means of transport is commonly used for short trips or as a feeder for other modes of transport. People walk to shop or to reach a transport node, such as a bus stop, train station, car-sharing station, or bike-sharing docking station. Children walk to school, and senior citizens spend their free time going for walks. Therefore, in modern cities, the modal share of walking tends to be high, although it is often undercounted by statistics and travel surveys, [1].

When planning the traffic infrastructure, priority is given to the space for passenger cars, freight traffic, and public transport vehicles; then the space for walking and cycling is almost never planned separately for public transport vehicles in order to give priority, [2]. Planning for sustainable urban mobility implies prioritizing space for walking,

cycling, and public transport over space for passenger cars and freight traffic, [3].

Pedestrians, cyclists, and motorcyclists are particularly vulnerable in today's transport system, and their behavior should be adjusted accordingly, so that the consequences are smaller, [4].

One of the reasons why pedestrians and cyclists suffer so much in traffic, in addition to driver errors and inadequate traffic infrastructure, is certainly their failure to comply with traffic rules and regulations. Data collection was carried out on the territory of the city of Bitola on the behavior of pedestrians when crossing a pedestrian crossing, for which purpose 2 (two) main locations were selected, [5]. Among these locations was the pedestrian street Shirok Sokak, also known as "Bitolsko Korzo" - the busiest and most famous street in the center of Bitola, with numerous shops and bars, [6].

Today, it is strictly a pedestrian street, and once cars also moved along it. Now, it serves as a vibrant hub for local shops and cafes, bustling with people enjoying the atmosphere. The transformation has revitalized the area, making it a popular destination for both residents and tourists alike.

Shirok Sokak is home to the largest shops, restaurants, the opera house, galleries, and many cafes and clubs. Here you will find the oldest architectural works and buildings in the Balkans, which have adorned the city since Turkish times.

On this street, a count was carried out at two points, i.e., places where we have intersections with motorized traffic. Data collection was carried out on 17.05.2024 on Friday, a market day, within a three-hour count, i.e., from 11:00 to 14:00. A simulation of pedestrian movement was made using two software tools.

## 2 Defining the analysis area

### 2.1 Epinal

This location is situated near the Epinal Hotel. Due to the size of the pedestrian traffic, there are two pedestrian crossings placed next to each other. Here we have the intersection of "Shirok Sokak" street with "Pece Maticevski" street. Shirok Sokak is a pedestrian street where, along its length, there are a large number of restaurants, bars, shops, cafes, and hotels, and all of these facilities attract a large amount of traffic. Shirok Sokak is a tourist attraction for a large number of domestic and foreign visitors, [7].

Data collection was carried out, focusing on the two pedestrian crossings in both directions of movement. Figure 1 illustrates the first location where data was collected, which is near the hotel in Epinal.



Fig. 1. Location at the Epinal Hotel  
Source: Google Maps, [8].

### 2.2 Solunska

The location of location two, known as Solunska Street, is the pedestrian crossing that connects the named street and the pedestrian street Shirok Sokak. Nearby, we have individual housing, a large number of shops and restaurants, and a cafe. The counting of pedestrians was done in both directions of movement, [9].

This location was chosen as one of the most frequented because it intersects with the famous tourist attraction, Shirok Sokak. Figure 2 shows the location of 2 – Solunska.

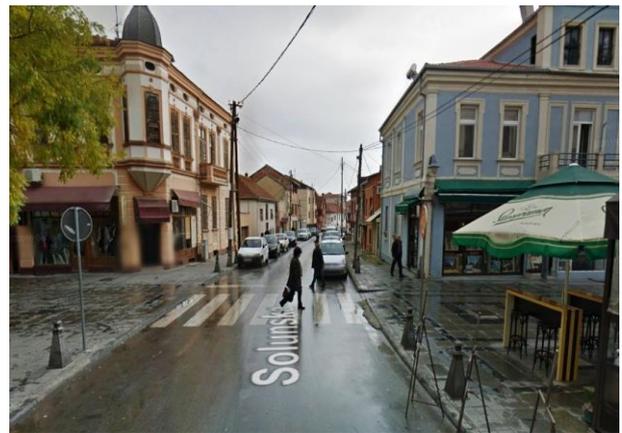


Fig. 2. Location at the Solunska  
Source: Google Maps, [8].

Figure 3 shows a map that shows where the Shirok Sokak pedestrian street extends, as well as the intersections where pedestrians are counted, one of which is Solunska Street, and the other is the intersection near Epinal Hotel, [10].

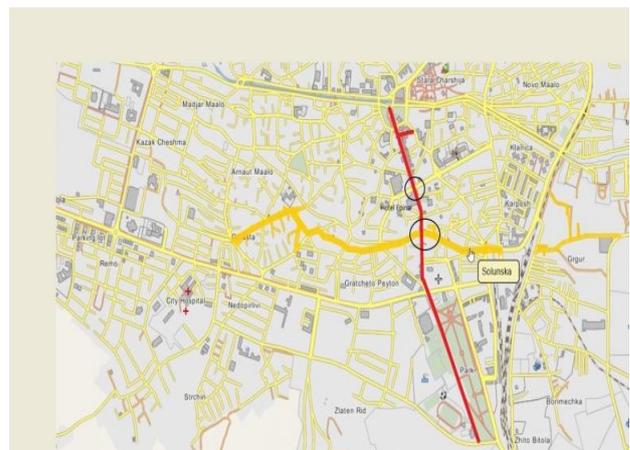


Fig. 3. View of the two intersections where data access was performed  
Source: Created by the authors.

### 3 Defining the method and technique of the research

The method that was used in this research is the counting sheet, [11]. The counting sheet was prepared in an Excel document. It consisted of two parts:

- The first part consists of general data, namely the name of the street/crossroads, day, date, time, direction in which it is counted, temperature, conditions/condition, observer, and index number, counting period, telephone number, and note.
- The second part consists of a table intended for recording the number of pedestrians; that is, the table is divided into two parts, namely legal pedestrian crossings and illegal crossings outside pedestrian crossings. Then the legal is divided into two more parts, adults and children, and each of these parts is divided into two more, that is, whether they looked left and right during the crossing or they did not look. The same applies to the illegal crossing of pedestrians.

### 4 Period of analysis and conducting the research

The counting of pedestrians took place on Friday, May 17, 2024, from 11:00 am to 2:00 pm. Friday was chosen because it is a market day in Bitola, and the flow of pedestrians is greatest on market days. The temperature during the period of analysis was 20° Celsius during sunny weather conditions.

The group of counters went out into the field in order to collect data on the behavior of pedestrians when crossing a pedestrian crossing, whether they do so on the pedestrian crossing or outside it, as well as whether they look left and right or whether they cross without looking.

A rule that should be practiced by pedestrians when crossing is the following: pedestrians make the crossing exclusively on a marked pedestrian crossing after first making sure that vehicles moving on the roadway can stop safely; this means that they should look left/right.

### 5 Processing of data with tabular display

#### 5.1 Results of the collection of data for pedestrian flows at the Epinal counter (Technical Faculty - Vero).

Figure 4 shows the pedestrian flows at the Epinal checkpoint, i.e., from the Technical Faculty towards Vero. From Figure 4, we can see that we have two marked pedestrian crossings.

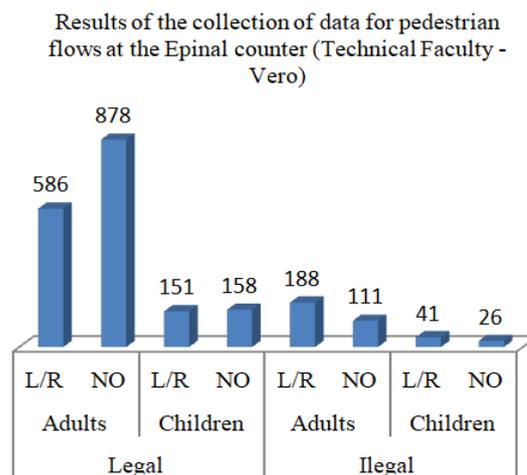


Fig. 4. Recorded pedestrian crossings at the first checkpoint, in twenty-minute intervals, hourly, and cumulatively (L/R look left and right, No – do not look )

Source: Created by the authors.

From Figure 4, we can notice that we have a large number of legal crossings of pedestrians without looking left/right, namely 878 adults and 158 children, while 585 adults and 151 children looked left/right. Since it is a large flow of pedestrians, we also have a large number of illegal crossings by adults, namely 188 who looked left/right and 111 who did not.

#### 5.2 Results of the collection of data on pedestrian flows at the Epinal counter (Vero-Technical Faculty).

Similarly, from Figure 5 below, we can notice that legally, with a view to the left/right when crossing a pedestrian crossing, we have 916 adults (35%) and 258 (10%) children, while without looking, 594 (22%) adults and 236 (9%) children. While illegally looking left/right, 214 (8%) adults and 58 (2%) children, while without looking, we have 257 (10%) adults and 113 (4%) children who crossed the pedestrian crossing.

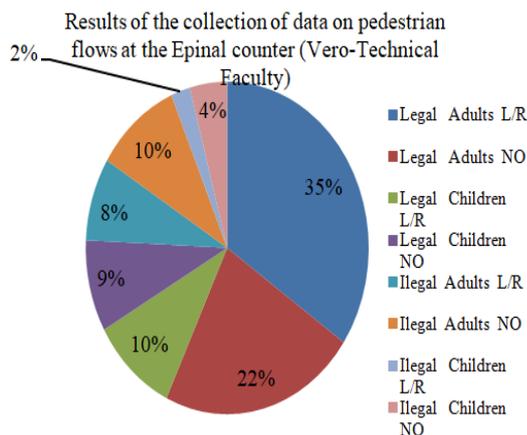


Fig. 5. Recorded pedestrian crossings at the first checkpoint, in twenty-minute intervals, hourly, and cumulatively (L/R look left and right, No – do not look)

Source: Created by the authors.

### 5.3 Results of the collection of data on pedestrian flows at the counter on Solunska Street (Technical Faculty – Vero).

Similarly, from the Figure 6, we can see that 405 (25%) adults and 25 (2%) children who looked left/right while crossing legally crossed a marked pedestrian crossing, while 531 (33%) adults and 168 (11%) children crossed legally, but did not look left/right. 163 (10%) adults and 55 (3%) children crossed illegally, but they looked left/right while crossing, 199 (12%) adults and 59 (4%) children who did not look left/right while crossing.

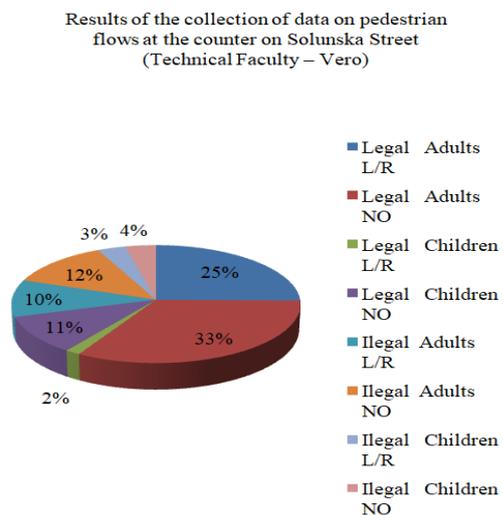


Fig. 6. Recorded pedestrian crossings at the second checkpoint, in twenty-minute intervals, hourly, and cumulatively (L/R look left and right, No – do not look)

Source: Created by the authors.

### 5.4 Results of the collection of pedestrian data at the Solunska street counter (Vero - Technical Faculty).

Similarly, from the Figure 7, we can see that 527 adults and 90 children crossed legally with a view to the left/right, 134 adults and 30 children passed illegally. 580 adults and 376 children crossed legally without looking to the left/right, while 103 adults and 23 children crossed illegally.

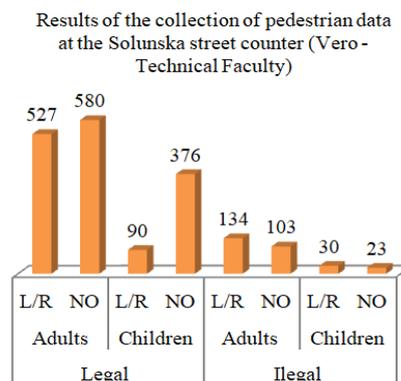


Fig. 7. Recorded pedestrian crossings at the second checkpoint, in twenty-minute intervals, hourly, and cumulatively (L/R look left and right, No – do not look) Source: Created by the authors.

## 6 Simulation of pedestrian flows with software tools

### 6.1 Software tool AnyLogic

Simulation modeling solves real-world problems safely and effectively. It provides an important analysis method that is easy to verify, transfer, and understand. Across industries and disciplines, simulation modeling is providing valuable solutions by providing clear insights into complex systems, [12].

Simulation allows experimentation with a valid digital representation of a system. In contrast to physical modeling, simulation modeling is computer-based and uses algorithms and equations. Simulation software provides a dynamic environment for analyzing computer models while they are running, including the ability to view them in 2D or 3D.

AnyLogic simulation software is designed and developed by The AnyLogic Company, a multinational software company operating out of the US and Europe with a global network of partners, including Engineering Group and Engineering Industries excellence.

AnyLogic was the first tool to introduce multi-method simulation modeling and remains the only software that has that capability on the market today.

The software has a large number of libraries for modeling multiple processes, such as:

- Library for railway transport, terminals;
- Pedestrian library for pedestrian flows at airports, stadiums, stations, or shopping centers;
- Library for road traffic for the movement of cars, trucks, and buses on roads, parking lots, and factories;
- Material handling library for production and warehouse processes.

To have a ready simulation of pedestrian flows with this software tool, a large number of steps and preparations are required, namely:

- setting the background,
- setting the scale of the background,
- delineation of the traffic network (traffic lanes, pedestrian crossings, parking lanes, stop lines),
- installation of road traffic blocks (from where their movement starts, where they move to, 3D vehicles, which lane they move on),
- installation of blocks for pedestrian traffic (start, course, and end of their movement,
- running the simulation.

Figure 8 shows the simulation of pedestrian flows with the AnyLogic software tool.

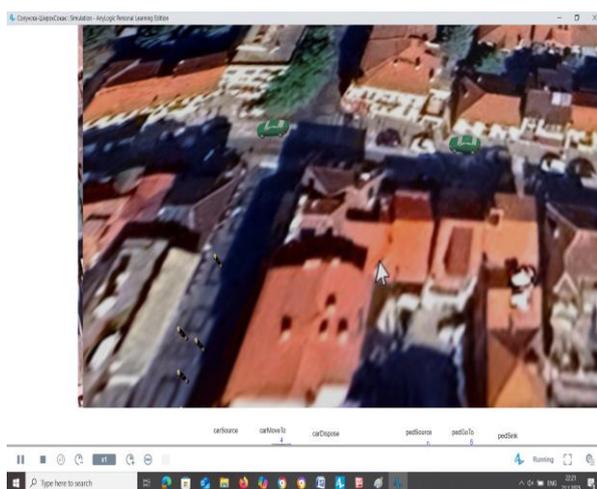


Fig. 8 Shows the simulation of pedestrian flows with the AnyLogic software tool.

Source: Created by the authors.

## 6.2 Software tool PTV Vision Vissim

The PTV Vissim is one of the most widely used software programs for microscopic modeling, due to its great level of microscopic detail, which allows the user to execute a realistic model quite effectively. This program can model urban and rural traffic and pedestrian flows, as well as the modeling of public road transport, [13], and private rail and transport, [14].

PTV Vissim is a microscopic multi-modal traffic flow simulation software package developed by PTV Planning Transport Verger AG in Karlsruhe, Germany. It was first developed in 1992. The name is derived from "Verkehr In Städten - SIMulationsmodell" (German for "Traffic in cities - simulation model").

The scope of application ranges from various issues of traffic engineering (transport engineering, transportation planning, signal timing), public transport, urban planning, and fire protection (evacuation simulation) to 3d visualization (computer animation, architectural animation) for illustrative purposes and communication to the general public.

PTV Vissim is part of the PTV Vision Traffic Suite, which also includes PTV Visum (traffic analysis and forecasting) and PTV Vistro (signal optimization and traffic impact).

In Vissim, the following types of traffic can be simulated and mutually interact:

- Vehicles (cars, buses, and trucks),
- Public transport (trams, buses),
- Cycles (bicycles, motorcycles),
- Pedestrians,
- Rickshaws, [15].

The procedure for creating a simulation with the PTV VISION VISSIM software tool is as follows:

- wallpaper setting,
- scale setting,
- drawing links and connectors,
- drawing a footpath,
- entry of vehicles and pedestrians,
- connecting links and connectors,
- start the simulation.

Figure 9 shows the simulation of pedestrian flows at the first location near Epinal with the software tool PTV Vision Vissim.

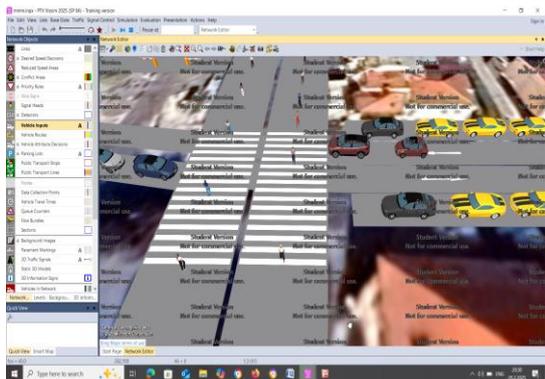


Fig. 9. Shows the simulation of predestined flows at the first location near Epinal with the software tool PTV Vision Vissim.

Source: Created by the authors.

### 6.3 Comparative analysis of the advantages and disadvantages of the software tools

Table 1 will show the advantages and disadvantages of the use of the software tools that were applied in this paper, [16], [17].

The simulation from the use of these two software can be said to fully correspond to the real world. Since the data that is needed to feed the software is collected beforehand from the monitored location and is entered as input data, when the software processes it, it shows us the final output goal, i.e., the simulation of movements.

## 7 Conclusion

Bitola is one of those cities that, due to its size, favorable topographical location, and annual weather conditions, has an excellent basis for building a bicycle and pedestrian network. This would enable the citizens of this city to benefit from the numerous advantages offered by these alternative solutions for reaching their desired destination.

The pedestrian paths have dimensions that do not comply with the design regulations. Especially in the central city area, these paths are of inadequate width (a few tenths of a centimeter) or do not exist at all, and are often faded.

On the territory of the city of Bitola, that is, at two pre-selected frequent locations, a pedestrian count was carried out. The count was conducted at marked pedestrian crossings.

Table 1. Comparative analysis of the advantages and disadvantages of the software tools

Advantages		Disadvantages	
AnyLogic	PTV Vissim	AnyLogic	PTV Vissim
Easy to use and Verify Safe	Micro-simulation Capabilities	Complexity and Learning Curve	Limited Macro-Simulation
Comprehensive Libraries and Tools	User-Friendly Interface	User interface features	Resource Intensive
Efficient	Comprehensive Modeling Options	Java Limitations	Cost
Insight into the work using algorithms	Strong Visualization	Cost	Demo version with limitations in functions
Video tutorial on using the software	Sophisticated Motion Model	Model Export Restrictions in Some Versions	Limited working hours
Visual display	Flexible and Customizable	Demo version with limitations in functions	Calibration Requirements
Various modeling	3D Visualization	Knowledge of programming languages	Data Requirements
Java Integration	Scenario Analysis	Data Requirements	Computational Demands

Source: Created by the authors.

The counting was done on both sides of the pedestrian crossing, with the task of the counters being to record whether pedestrians cross legally or illegally at the pedestrian crossing and whether they look left/right or not.

Everyday examples show that pedestrians cross the street at a red pedestrian traffic light, outside a pedestrian crossing, without looking left and right, move between the two road lanes, cut the flow of traffic when it suits them and where it suits them, stay unnecessarily on the roadway, use mobile phones, listen to music and do not follow the traffic and its happenings, etc.

For these reasons, pedestrians are victims in traffic accidents precisely because of disobeying the rules and regulations in traffic, because of low traffic culture, and because of bad habits of behavior in traffic. From the results, we can conclude that:

- Legal crossings at marked pedestrian crossings dominate.
- The crossing is done by looking left/right.
- When we have a large group of pedestrians, most often only a few people in the crowd look left/right, while the others pass without looking.
- When we have only one marked pedestrian crossing and a large flow of pedestrians, a larger number of them cross illegally;
- Which is not the case with two marked pedestrian crossings next to each other, when we have a larger width, pedestrians cross with greater confidence and do not look left/right.

Software tools and packages are of great importance to traffic engineers for the planning and simulation of traffic flows. Although there is a wide range of tools, the demo versions limit the opportunity to learn these tools.

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### **Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)**

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

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### **Conflict of Interest**

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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