Transportation Demand Management through Physical Improvements: The Case of Pristina

Beni Kizolli^{1,*}, Seda Hatipoğlu²

¹Department of Infrastructure and Traffic, Faculty of Civil Engineering, UBT - Higher Education Institution, 20000, Prishtinë, Kosovo

²Institution of Science, Faculty of Traffic Planning and Implementation, Gazi University, 06560, Ankara, Turkey

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Abstract In developing countries, the fact that public transportation services have not exceeded a certain level increases the use of the private vehicle as a type of transportation in urban transportation day by day. Insufficient road and parking problems are big obstacles in the solution of traffic problems for years. The institutions responsible for solving traffic problems have often made intractable urban traffic problems with the understanding of the necessity of high-cost investments. In this context, despite the traditional understanding, "Transportation Demand Management" strategies developed within the framework of new approaches, evaluated the problem through the outline of existing infrastructure facilities and offered alternatives to the use of private vehicles with less investment. Transportation Demand Management strategies are based on various policies and programs that result in more efficient use of traffic infrastructure. It examines situations related to urban traffic problems and argues that it can be solved through the understanding of TDM. Within the basis of urban traffic problems and solutions in Pristina, Physical improvements have been proposed within the urban central ring for the purpose of improving the public transportation system and the use of bicycles.

Keywords Pristina, Urban Traffic, Transportation Demand Management, Physical Improvement

1. Introduction

The demand for expansion of road network within a short period of time has always been realized as a result of industrial development within the population-oriented cities and with the process of expanding the city areas in developing countries. Understandings that cannot manage these processes in a healthy enough manner have prioritized supply-creating solutions; in other words, it was seen that there was an idea of "increasing demand by increasing supply" [5].

The search for a new approach was entered as it became clear that the problems were not solved within the traditional planning approach of "increasing demand by increasing supply", but on the contrary, a new and gradually increasing vicious circle was introduced [4]. This causes a low level of traffic flow due to frequent cross-section points, especially with the congestions caused by inefficient investments and inadequate solutions of problems due to the traditional understanding of urban center roads. A different proof that this perception remains in Pristina is the fact that about 4 million euros are envisaged for infrastructure investments from the municipal budget in 2020, leading as one of the highest items within the framework of other services in total for each year [14]. With this budget, it can be emphasized that more efficient solutions can be realized with a different understanding in a city with a population of 450 thousand, and policies that will ensure a sustainable traffic flow with minimal costs, despite the high budgets of developed countries, are being studied [18].

As a result of the investments exhibited by the current management approach, it is seen that different approaches are needed to produce new solutions. Developed countries aim to maximize urban traffic efficiency by managing and providing solutions instead of responding to demands. With the promotion of more effective, healthy and environmentally friendly solutions instead of unnecessary investments, public transportation is generally pioneered, while at the same time deterrent policies are carried out against private vehicles (Broadusnon, Litman, & Me, 2009, s. 5). By following the infrastructure with the understanding of transportation demand management, it will be possible to provide alternative options for urban transportation by providing continuity for the inner-city central network and traffic flow through physical improvements that will offer more passengers instead of vehicles with less investment.

In this context, by complying with the recommendations in the 2025 Pristina Development Plan, it can be ensured that these applications are used in all intensive centers by sticking to the TDM understanding with physical improvements in the central public itinerary, evaluating solutions and managing with the main problems [13].

2. Materials and Methods

2.1. Material

After the First World War, in 1947, Pristina became the administrative center of Kosovo. City planning has been carried out regularly since this period. The city of Pristina, the central location of the Balkan peninsula, is located in the northeastern part of Kosovo. The city of Pristina, which seems to be the central location of the Balkan peninsula, is located in the northeastern part of Kosovo. The altitude of Pristina, which is established on an area with plenty of hills, is 730 meters. In the north and east, the Germia forest reaches a height of 1,100 meters. Pristina is bordered by Arberia on the west, Pozderke hill on the north, the Germia forest on the east and in the south and southeast it is bordered by the settlements of Veternik and Mati [13].

The inability of public transportation to show the desired efficiency in the city of Pristina as a capital, affects the increase in the use of private vehicles. Parking shortages and traffic congestion are problems that cannot be solved when heading to the city center for different reasons. Road transportation is available among the alternatives of passenger transportation; and in this context, private vehicle, taxi and public transportation are among the preferences [13].

The Pristina Sustainable Urban Mobility Plan has been designed based on the city's development plan. Generally, in-depth analysis of transportation systems and traffic

problems in Pristina was carried out to support the new urban mobility strategy. This research identified a number of key challenges outlined below regarding urban mobility throughout the city [15].

Pristina road network, especially the central ring road, needs to be redirected (Fig 1.). This initiative can be considered as the first step in improving traffic conditions. In addition, by dividing pedestrian and vehicle movements, it may be possible to increase service levels to all transportation systems. The road network that passes through the center of Pristina will be an important step in improving the situation, which is also an important point in improving continuity with the most reasonable interruptions of traffic flow [12].

Figure 1. One-way traffic itinerary projected in the inner-city central ring [13]

A number of different scenarios have been developed by consulting the city's stakeholders within the **Pristina Sustainable Urban Mobility Plan**. Each of these scenarios is intended to achieve visions and goals in different conducts.

The scenarios developed are as follows: **The First Proactive scenario** focuses on the development of public transportation across the city through the redirection of traffic flow. At this level, priority measures are envisaged to support the main corridors, while at the same time emphasizing that the integrated ticket system can be reached with new guidance on public transportation. The **Second scenario** envisages a more balanced approach to

achieving a sustainable traffic flow. It predicts arranging a new network hierarchy (main/secondary lines) to improve public transportation that is considered as a focal point. In general, this strategic option leads to the best flow for all road users. The **Third Maintenance scenario**: generally, it is considered as an approach that will improve the overall road performance and infrastructure. It prioritizes public transportation as a solution to traffic congestion. The main element of this strategy is to improve traffic flow, increase the performance of intersections and induce public transportation to the most preferred level [15].

Pristina Development Plan 2012-2022 - In the three scenarios, Development Plan does not explicitly recommend editing (Figure 2.) as predicted, however, it can evaluate an arrangement that can perform the objectives that scenarios advocate.

Figure 2. Physical itinerary section of the one-way traffic road network projected in the inner-city central ring [13]

Within the framework of all these developments, ideas and suggestions, data from different perspectives have also been used to support physical improvements, especially within the context of the inner-city central ring. The chronological framework leading to the presented studies is obtainable with the information given in the field of determining the following.

Infrastructure development - Pristina became Kosovo's administrative center in 1947. The construction of institutional and urban infrastructure in Pristina began after the Second World War. Since 1953, new settlements have been built, while the settlements and artifacts of cultural heritage have been destroyed [13].

Significant developments in the city of Pristina are perceived after 1999. With the urban transformation, a large part of the city has started to be restructured. In 1965, the "Plan for Traffic Directive" was completed and the deliberate work for 100,000 people was adopted in 1967. The purpose of the formalized directive is to prepare and expand the city planning infrastructure. With the introduction of this directive, urban planning prepared in 1953 was disrupted. Subsequently, in 1970, the Pristina Institute for Social and Economic Development designed the "City and suburban settlement program of Pristina". The Pristina General Plan was illustrated in 1988 and it was effective until 2000 [13].

Approved in 2004 and implemented until 2020, the Pristina Strategic Plan is envisaged for 4,334.52 km and 650,000 people. Leading to development. This study has been recognized as a guide until 2020 [13]. The demographic and general data in this plan will be able to be used as a source until the studies are renewed.

Demographics, noise and air pollution - As a capital, Pristina holds a total of 198,897 inhabitants, 49.8% of whom are men and 50.2% are women based on the last census, due to the release of new trends after the 1999 Kosovo war [1]. However, the data from this census do not match the data on energy consumption, water supply, vehicle registration and waste collection, which shows that the number of Pristina residents is about 450 thousand. While pursuing business life in Pristina, a large number of people are not registered, when comparing the 450,000 and 198,000 inhabitants. With an average annual growth of 1.5%, it is revealed that in 2022 Pristina will have a population of approximately 72,000 more with the natural increase of the population alone. Thus, in total, Pristina is expected to have a population of about 622,000 in 2022. An important phenomenon related to the population is migration from rural to urban areas within the borders of Pristina Municipality [13]. According to the assessment institutes, the dominant age group in Kosovo is 15-64 years (60%) and 0-14 years (33%) [16].

As reported by the Municipality of Pristina, air pollution is mainly available in urban areas and traffic is an important indicator of air pollution. The same assessment of this issue has been proven by the studies conducted through the Kosovo Statistical Agency [2]. Noise is another very common event in urban areas [9].

The main subject of this study is to provide an uninterrupted flow of traffic through physical improvements within the framework of the central ring, as well as to develop it as the most preferred alternative of the urban transportation.

Traffic infrastructure - In this respect, after the 2000s, intercity transportation was pioneered, while irregular and insufficient investments were made in urban traffic infrastructure due to budget and management understanding.

Signaling status - Professionally desired arrangements cannot be made due to the lack of pedestrian trails and the distance of the buildings between the roads. By 2008, 150 trails were marked vertically, while only 24 roads were marked horizontally. Only 15 light signaling were made in vertical and horizontal marking at a total of 34 priority intersections.

Intersections - Rotating intersections: Some intersections are arranged as a rotating intersection with the idea that it offers higher capacity to relieve the density of the inner-city center. With this type of solution, the flow of heavy traffic is strict. However, due to the lack of studies, rotating intersections cannot be arranged within the framework of the required standards. For instance, at some rotating intersections, the road lane and the intersection lanes do not match. In addition, insufficient signaling near some rotating intersections does not allow traffic to align before the intersection, which negatively affects the capacity of the rotating intersection.

Intersections are signaled by horizontal and vertical marking. Until recent years, classic intersections +, T and

Y were arranged with illuminated signaling and vertical/horizontal marking before the rotating intersection arrangement was used. Busiest intersections: "Fehmi Lladrovci", "Muharrem Fejza", "Ilir Konushevci", "Agim Ramadani", "Tirana", "Zagrebi", "Ahmet Krasniqi", "Tirana", "Xheladin Rekalju", "Eqrem Çabej", "Agim Ramadani", "UÇK", "Fehmi Agani", "Lidhja e Prizrenit", "Tirana", "Fehmi Agani", "Migjeni", "Luan Haradinaj", "Garibaldi", "Luan Haradinaj" and "Kosta Novaković".

Illuminated signaling: 17 intersections of the city are equipped with illuminated signaling. All of these signaling provide services. In the future, there is goal of coordinating communication with the control center through modern technology, since it has not offered the desired result in terms of maintenance and evaluation in recent years.

2.2. Method

The main subject of this study is to give an uninterrupted flow to traffic with physical arrangements to be made within the framework of the central ring, while leading and developing public transportation as the most preferred alternative to the urban transportation.

Transportation services that are carried out by public transportation vehicles offer a higher capacity compared to private vehicles. Therefore, perfecting the public transportation system and making an attractive usage of it especially for the urban central road network is quite important for the solution of the actual problems. Different solutions may also be preferred to reduce the density of the central road network in the city, for example, the movement of private vehicles towards the center may be restricted or blocked [19].

In this regard, we will introduce what kind of priorities we will provide in public transportation with the current situation within the context of the results obtained on different studies and surveys, as well as the results of these studies and our suggestions on the physical arrangements to be made within the framework of the central ring.

The inquired question within the framework of the Sustainable Urban Mobility Plan in Pristina was, "What is not working properly in Pristina?". To add meaning to this main question and to make it easier to understand, a few other issues have been highlighted: illegal taxis, lack of information and explanation, inadequate access for disabled people, lack of integrated tickets, lack of reliability and priority in public transportation. "What is right in Pristina?" has been asked in order to obtain the outline of the positive situation that should be followed, while the previous question has been asked to reveal the negativities. Again, a few more issues have been highlighted to add meaning to this main question and to make it easier to understand: increasing the number of modern buses, reasonable ticket prices, improvement in bus lines [15].

Between May and July 2017, about 1,600 surveys were filled out, providing comprehensive information on various travel issues. Most responses were received from people under the age of 45 (almost 85% of total responses). More than two-thirds of participants are men.

Online surveys and field count were carried out in order to find answers to the main questions and topics.

The most important reason for home surveys was to obtain a more detailed picture of urban transportation in Pristina. This survey was also used in some countries of the EU. A total of 3064 house surveys were conducted between 26 May and 27 July, and the survey, which was applied to citizens over the age of 15, was one-to-one interviews [15].

Subsequently, we have benefited from the survey results of 782 passengers using public transportation from a different study. The survey and its form with the public transportation passengers in Pristina are shown in Annex-1. Our survey consists of 8 questions and covers a total of 36 options.

3. Results

The fact that Pristina is the capital and the inability of public transportation to show the desired development affects the increase in the use of private vehicles. Parking shortages and traffic congestion are problems that arise from different reasons when heading to the center of the city.

Infrastructure - Different capacities are observed in various parts of the urban road network. In recent years, road maintenance and arrangements have been carried out regularly, along with the road segments built in the city. These initiatives are reflected in the development of traffic flow and safety. Overall arrangements in the combination of urban main roads are made with illuminated signaling and rotating intersections. Signaling on newly built roads contributes sufficiently to the flow and safety of traffic. However, both the flow and the security of traffic are insufficient due to the lack of signaling and coordination in old road networks. Pedestrian crossings are set only near the intersection, and are also planned between the intersections according to the need. Another problem is the lack of general signaling affecting the capacity of the road network in settlements outside the city center.

Public Transportation - In order to make public transportation attractive, special lanes, comfortable and safe stations, sufficient information opportunities, reduced travel time, one-stop point-to-destination access during ticket transfer, ticket alternatives and quality service conditions within the bus transportation should be offered. Despite the lack of fast or private bus lanes, according to the "2012-2022 Pristina Urban Development Plan", recommendations were made for the new arrangement with a total of two-way four-lane road network available within the urban central road ring. Until 2022, one-way

traffic mobility was foreseen to take place over three lanes in the urban central road ring, along with a single lane for private or high-speed bus station that was envisaged under this ring.

Survey Results – A table of leading options was reached out as a result of a comprehensive survey to provide an overview of various aspects of traffic and transportation for Pristina residents, businesses and visitors [15].

As shown in Figure 3, among the highest response is the private vehicle preference, which accounts for almost 35%. Public transportation and pedestrian preferences can be considered as a positive indicator in terms of total

demand for sustainable urban transportation, with a rate of 23.5%.

As shown in Figure 4, more than 50% of the respondents stated that this transportation system will be more encouraged among the preferences as a result of the implementation of advanced cycling infrastructure. Only 16% of the respondents assume that nothing can encourage them to use this transportation system. Therefore, as a result of improving the conditions and safety of cycling infrastructure, this transportation system may also be considered as more stimulus among preferences.

Figure 3. Online survey result: Transportation Preferences [15].

Figure 4. Online survey result: Reasons to increase bicycle preferences [15].

Figure 5. Online survey result: Reason for Transportation (11579 stakeholders) [15].

As shown in Figure 5, according to surveys, 62% of the users have indicated that they prefer the public transportation system more than 5 years ago. The reasons for preferences over 30% are attributed to increased quality in public transportation services. 12% of the public transportation is being preferred due to the lack and inability of parking.

Table 1 shows the results of the survey, which was conducted with 782 passengers on public transportation.

Table 1. Survey results with 782 passengers in public transport

Number	Questions	Sort by highest frequency	Frequency	Percentage
1	Age	19-35	435	55,6
		0-18	287	36,7
		36-65	45	5,8
		66-100	15	1,9
2	Family monthly income	0-250	443	56,6
		251-500	220	28,1
		501-800	79	10,1
		801-1.500	40	5,1
3	Purpose of transportation	Education	353	45,1
		Business	247	31,6
		Education & Business	94	12
		None	49	6,3
		Social and health needs	19	2,4
		Education & Social and health needs	7	0,9
		Education & Business & Social and health needs	6	0,8
		Business & Social and health needs	4	0,5
4	Why did you choose this type of transportation?	Social and health needs and none	3	0,4
		More economical	465	59,5
		Fast	140	17,9
		Lack of parking	46	5,9
		More economical & Fast & Parking fees	30	2,4
		More economical & Fast	26	3,3
		More economical & Lack of parking	25	3,2
		Parking fees	19	1,8
		More economical & Parking fees	14	0,1
		Lack of parking & Parking fees	13	1,7
		More economical & Fast & Lack of parking	2	0,3
5	What type of model would you prefer to pay?	Fast & Parking fees	1	0,1
		More economical & Fast & Parking fees	1	3,8
		Monthly ticket	354	45,3
		Electronic card	172	22
		Ticket	126	16,1
		Classic payment	81	10,4
		Monthly ticket & Electronic card	25	3,2
		Monthly ticket & Ticket	13	1,7
		Monthly ticket & Classic payment	6	0,8
6	What are your preferences instead of public transport?	Electronic card & Classic payment	3	0,4
		Ticket & Classic payment	2	0,3
		Vehicle	426	54,5
		Business service	160	20,5
	How often do you use public transportation?	None	190	24,3
		Vehicle & Business service	6	0,8
		Every day	423	54,1
		4-5 times a week	204	26,1
		2-3 times a week	115	14,7
		Once a week	23	2,9
		Less	17	2,2

The category between the ages of 19-35 and 36-65 constitutes over 60%, as the first question shows. As the second question shows, 0-250 and 251-500 euros constitute over 80% of the monthly income categories. There is a category of around 76% addressed to the educational and business transportation purposes, as the third question shows. There are over 80% of the respondents who stated that they preferred public transportation due to being more economical, faster and lack of parking, as the fourth question shows. Monthly ticket and electronic card are preferred among the highest ticket models, constituting almost 70%, as the fifth question shows. 54% declared their choice of private vehicle preferences instead of public transportation, while 24% would not prefer neither private vehicle nor business service except public transportation, as the sixth question shows. 54% appear to be using public transportation every day, as the seventh question shows (Table 1).

4. Discussion and Proposal

The focal aspects of traditional approaches to the transportation problem can be gathered in three main groups: a distorted understanding of productivity, lack of social content and indifference to environmental problems [11].

As a result of the inability to manage the demands on the central ring of the inner-city, which we consider as the subject, the density of the road, which is the main corridor in the central ring, happens to be a different indicator. Within the "Bill Clinton" itinerary, the most intense traffic flow in both directions is recorded in approximately 48,000 vehicles / 12 hours, close to this situation, on the "Fehmi Lladroveci" itinerary, the same traffic flow is recorded approximately 33,000 vehicles / 12 hours [15]. The current state of the main corridor or collector roads in this subject indicates that 8000 vehicles pass through the day; as a result, the roads need to be improved [11]. These examples require additional capacity in the future due to the inability to manage the current situation properly, nevertheless it is known that such a solution cannot be physically available any longer.

Initially, these approaches to traffic supply have generally improved traffic conditions; however, this stimulates widespread vehicle use and consequently creates new blockages. The temporary relief brought by new roads and intersections to overcome these new blockages generates new additional demands, by creating additional capacity needs that consume urban area [11].

Instead of short-term and supply-creating solutions within the central ring, as well as the central ring itself, there is a need for long-term and sustainable uninterrupted traffic flow and solutions that will lead public transportation, instead of private vehicles. In Figure 3, 4 and 5, applications have been proposed to ensure the

development of sustainable traffic disruption and public transportation, including survey results and comments from stakeholders.

Other important features that should not be ignored are the provision of a safe and economical traffic flow [17].

The demographic characteristics of the city should be seen among the pioneers, especially in Pristina, for the development of transportation alternatives in terms of young population and income average. Given that this type of transportation is not used efficiently in places with area restrictions in the city center during the day, we may notice the extent to which this type of transportation has an impact on the city and society [7].

Apart from the private vehicle, more attractive and more preferred improvements should be made on public transportation and bicycle alternatives. Through physical arrangements, it is possible to carry out applications that will emphasize both public transportation and bicycle transportation.

In addition, time saving / transportation speed is shown as the main reason in the selection of transportation systems, as a result of the answers given by the respondents with an average of 33 %. The other one / third stated that they do not have the opportunity to change their preferred systems due to lack of preferences among the transportation systems [15].

As seen in Figure 3, despite 35% vehicle preference, the public transportation preference is over 23.5%, and the other 24% are pedestrian. The advantage given to public transportation, compared to private vehicles and the improvement of the services in this transportation system, can be a pioneer in making public transportation among the most preferred.

We will evaluate the importance of these improvements in comparison with the survey results. As is shown in Figure 5, 62% of preferences from 5 years ago have been searched as a result of previous improvements, and we can predict that more comprehensive improvements will be provided.

Subsequently, there will be less intersections, shorter travels, easier information and applicability of integrated tickets, which will provide new traffic jams that will be solved by physical improvements.

We will compare and evaluate the survey results with 782 passengers, which are shown in Table 1, as a different reference point. As shown in Question 1, the groups with the highest transportation need between the ages of 19-35 and 36-65 make up 60% of the passengers. As shown in Question 2, monthly income holders between 0-250 and 251-500 euros make up 80% of the passengers. As shown in Question 3, those who prefer the public transportation with the business and education purposes make up 76 % of passengers. Question 4 accounts for over 65% of passengers who prefer public transportation due to "more economical and faster" reasons. As shown in Question 5, "long travel time, wage policies and security at stations"

are the key problems of public transportation by over 40% of the passengers. As shown in Question 6, 70% of the passengers stated the effects of “monthly ticket and electronic card” model preference. As stated in Question 7, the 24 % of the passengers indicated that they do not have any preferences other than public transportation. Finally, as shown in Question 8, 54% of the passengers emphasized that they use public transportation every day.

According to the table presented in the surveys, it emphasizes the need and importance of physical improvements that will lead public transportation, which can be achieved through cheaper and more affordable ticket policies between public transportation, less time loss and safer stations.

Scientifically, public transportation is the general name of the systems used in urban passenger transportation, which is a specific and fixed itinerary, known for its price and time table, and anyone can benefit from it. The main purpose of public transportation systems, as a public service, is to ensure that people move from one point to another in the city in the most economical way [8].

Applications that are considered to offer alternative options in urban transportation will be proposed in the study by complying with the infrastructure along the central ring through the understanding of transportation demand management, via releasing the density of the city center network on one hand, and providing continuity on the other, through the physical improvements that will provide transportation of more passengers instead of more vehicles with less investment.

The central ring belongs to the existing itinerary in Pristina, with a length of approximately 6 km. Figure 2 demonstrates the physical cross-section width of the inner central ring consisting of 22m, which is available in many sections for 6 km. Most of the central ring itinerary is surrounded by pedestrian trail, while there are no physical barriers for pedestrian road construction in sections without a pedestrian trail. The width of the roads is different along the central ring itinerary. The strips are generally between 2.5 m–3 m and the road section have a total width of 19 m–22 meters.

Figure 6. Road section of the current central ring itinerary [12]

A large part of the central ring strips is separated by green area (Figure 6). The center ring itinerary intersects by in-center and out-of-center roads. There is a total of 46 intersections. 31 intersections consist 'T' connections, 8 intersections are '+' and 7 intersections consist of rotating intersections. There is a total of 26 stops in both directions along the central ring itinerary. All urban public

transportation lines depart from the central ring itinerary. Traffic density occurs during the current arrangement. Generally, the traffic paralyzes and complicates the public transportation services during the peak traffic hours. Since public transportation does not have a special lane application, there is a lot of time loss and low service level during public transportation. Within the basis of the mentioned conditions, public transportation services are not preferred in private vehicle encounters. Therefore, the private vehicle remains the preferred type of transportation for the people of Pristina in urban transportation. The problem evaluated by the survey results also appears to be related to the current road arrangement. The reorganization of the central ring can be considered as a solution in the understanding that the TDM strategy represents.

In the large sections of the central ring itinerary, where there is a possibility of physical intervention, three lanes for general vehicle routes and one special bus lane are recommended for public transportation and private public transportation organizations (Figure 7).

Figure 7. Road section as a result of reorganization of the central ring itinerary

Along the central ring with applications that will solve problems with physical regulation such as: pedestrian and bike trails, seven transfer stations and ten intermediate stations are recommended. After the physical change of the central ring, the recommended situation is summarized section by section in the Tables between 2-26, as well as, the proposed improvements are shown with drawings between Annex-2 and Annex-26.

Table 2. Description / section as a result of the regulation (1): ANNEX-1

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		= 21,25 total
Intermediate stations	0		

In the first section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 3. Description / section as a result of the regulation (2): ANNEX-2

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	1	To the university dormitory	=21,25m total
Intermediate stations	0		

In the second section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 4. Description / section as a result of the regulation (3): ANNEX-3

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	1	University of Pristina Campus	=21,25 m total
Intermediate stations	0		

In the third section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 5. Description / section as a result of the regulation (4): ANNEX-4

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	0		

In the fourth section of the arrangement, 3.5 m wide one private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 6. Description / section as a result of the regulation (6): ANNEX-5

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	1		

In the fifth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 7. Description / section as a result of the regulation (7): ANNEX-6

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	0		

In the sixth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 9. Description / section as a result of the regulation (8): ANNEX-7

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	1		=21.25m total
Intermediate stations	0		

In the seventh section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 9. Description / section as a result of the regulation (9): ANNEX-8

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	0		

In the eighth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 10. Description / section as a result of the regulation (10): ANNEX-8

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	2	Both sides of the road	2
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	1		

In the ninth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 11. Description / section as a result of the regulation (11): ANNEX- 10

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	0		0
Pedestrian trail	2	Both sides of the road	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stops	1	At Llapi Mosque	=19,25 m total
Intermediate stops	0		

In the tenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 12. Description / section as a result of the regulation (12): ANNEX- 11

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	0		0
Pedestrian trail	1	Both sides of the road	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	1		=16,25 m total
Intermediate stations	0		

In the eleventh section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 13. Description / section as a result of the regulation (13): ANNEX- 12

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	0		0
Pedestrian trail	1	Both sides of the road	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=16,25 m total
Intermediate stations	0		

In the twelfth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 14. Description / section as a result of the regulation (14): ANNEX- 13

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Counterclockwise movement	9
Bicycle lane	0		0
Pedestrian trail	1	Both sides of the road	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		= 16,25 m total
Intermediate stations	0		

In the thirteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 15. Description / section as a result of the regulation (15): ANNEX- 14

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Two lanes moving counterclockwise and one lane moving clockwise	9
Bicycle lane	0		0
Pedestrian trail	1	Next to the bicycle lane	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		= 16,25 m total
Intermediate stations	0		

In the fourteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 16. Description / section as a result of the regulation (16): ANNEX- 15

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Two lanes moving counterclockwise and one lane moving clockwise	9
Bicycle lane	0		0
Pedestrian trail	1	Next to the bicycle lane	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	1		=16,25 m total
Intermediate stations	0		

In the fifteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 17. Description / section as a result of the regulation (17): ANNEX- 16

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement / Recommended lane needs to be built	3,5
Lane for overall vehicle mobility	2	Counterclockwise movement	6
Bicycle lane	0		0
Pedestrian trail	1	On the opposite side of the private bus lane	3
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		= 16,25 m total
Intermediate stations	0		

In the sixteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, one 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 18. Description / section as a result of the regulation (18): ANNEX- 17

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement / Recommended lane needs to be built	3,5
Lane for overall vehicle mobility	1	Counterclockwise movement / Recommended lane needs to be built	3
Bicycle lane	0		0
Pedestrian trail	0		0
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=7,25 m total
Intermediate stations	0		

In the seventeenth section of the arrangement, one 3.5 m wide private bus lane, one 3 m wide lanes for general vehicle mobility and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 19. Description / section as a result of the regulation (19): ANNEX- 18

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Two lanes moving counterclockwise and one lane moving clockwise	9
Bicycle lane	2	Next to the special bus lane	2
Pedestrian trail	2	Next to the bicycle lane	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	1		

In the eighteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 20. Description / section as a result of the regulation (20): ANNEX- 19

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	3	Two lanes moving counterclockwise and one lane moving clockwise	9
Bicycle lane	2	Next to the special bus lane	2
Pedestrian trail	2	Next to the bicycle lane	6
Physical separation	1	Physical distinction between SBL and general vehicle lanes: fence	0,75
Transfer stations	0		=21,25 m total
Intermediate stations	1		

In the nineteenth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 21. Description / section as a result of the regulation (21): ANNEX- 20

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement / Recommended lane needs to be built	3,5
Lane for overall vehicle mobility	0		0
Bicycle lane	1	Next to the special bus lane	1
Pedestrian trail	0		0
Physical separation	0		0
Transfer stations	1		= 4,5 m total
Intermediate stations	0		

In the twentieth section of the arrangement, one 3.5 m wide private bus lane, three 3 m wide lanes for general vehicle mobility, two 2 m wide bicycle lanes, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 22. Description / section as a result of the regulation (22): ANNEX- 21

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Common use of intercity bus lane	3,5
Lane for overall vehicle mobility	2+2	Two opposite directions	12
Bicycle lane	1	Two-direction	1,5
Pedestrian trail	1	Next to the bicycle lane	2,5
Physical separation	1	Physical distinction between SBL and general vehicle lanes: concrete	0,75
Transfer stations	0		=20,25 m total
Intermediate stations	0		

In the twenty first section of the arrangement, one 3.5 m wide private bus lane, four 3 m wide lanes for general vehicle mobility, one 1,5 m wide bicycle lanes, one 2,5 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 23. Description / section as a result of the regulation (23): ANNEX- 22

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Common use of intercity bus lane	3,5
Lane for overall vehicle mobility	2+2	Two-direction mobility	12
Bicycle lane	0		0
Pedestrian trail	2	Available from the pedestrian underpass to the rotating intersection. Due to the lack of space in the following area, pedestrians will benefit from the pedestrian trail of a sub-road.	6
Physical separation	2	Physical distinction between SBL and general vehicle lanes: fence	1,5
Transfer stations	0		=23 m total
Intermediate stations	1		

In the twenty second section of the arrangement, one 3.5 m wide private bus lane, four 3 m wide lanes for general vehicle mobility, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 24. Description / section as a result of the regulation (24): ANNEX- 23

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	2+3	Two-direction	15
Bicycle lane	0		0
Pedestrian trail	2	Two-direction	6
Physical separation	2	Physical distinction between SBL and general vehicle lanes: fence	1,5
Transfer stations	1		= 26 m total
Intermediate stations	0		

In the twenty third section of the arrangement, one 3.5 m wide private bus lane, five 3 m wide lanes for general vehicle mobility, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 25. Description / section as a result of the regulation (25): ANNEX- 24

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	4	Two-direction	12
Bicycle lane	0		0
Pedestrian trail	2	Two-direction	6
Physical separation	2	Physical distinction between SBL and general vehicle lanes: fence	1,5
Transfer stations	1		=23 m total
Intermediate stations	1		

In the twenty fourth section of the arrangement, one 3.5 m wide private bus lane, four 3 m wide lanes for general vehicle mobility, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

Table 26. Description / section as a result of the regulation (26): ANNEX- 25

Road section width (m)	Quantity	Traffic flow direction / Description	Width (m)
Special bus lane	1	Clockwise movement	3,5
Lane for overall vehicle mobility	4	Two-direction	12
Bicycle lane	0		0
Pedestrian trail	2	Two-direction	6
Physical separation	2	Physical distinction between SBL and general vehicle lanes: fence	1,5
Transfer stations	1		=23 m total
Intermediate stations	1		

In the twenty fifth section of the arrangement, one 3.5 m wide private bus lane, four 3 m wide lanes for general vehicle mobility, two 3 m wide pedestrian paths and 0.75 m wide physical distinction have been proposed for the physical separation between SBL and general vehicle lanes.

5. Result

For the past 50 years, every municipality in many countries has carried out some projects in its own way and based on its facilities, however traffic problems are still unresolved, and each passing year has become more complex. Different elements affect this situation indirectly. The main source of the problem can be accepted as a

result of the understanding of management; whereas understanding the essence of the problem by making healthy diagnoses and producing the right policies, may be effective in overcoming the problems in the city.

Inclusive solutions have been evaluated for the development and sustainability plan in Pristina, particularly in line with the objectives of the three scenarios. In this context, physical improvements have been proposed to the central ring, taking into account such goals: the redirection of traffic flow, the implementation of the integrated ticket system, the regulation of a new network hierarchy (main/secondary lines) to improve public transportation, leading the best flow of all road users according to this strategic option, improving the overall performance of the road network, prioritizing public transportation as a permanent solution, improving traffic flow and the performance of intersections as well as leading public transportation among the most preferred options.

These proposals have been evaluated with TDM strategies, which are considered as a new understanding to solve urban traffic difficulties. In addition, proposals were made by prioritizing public transportation and bicycle improvements within the frame of existing infrastructure and facilities through the Pristina example.

The itinerary was divided into 25 sections and analyzed section by section within the outline of the physical arrangement proposals of the current Pristina central ring itinerary. In each section within the basis of the central ring, TDM was adhered to the appropriate understanding during physical regulation. Proposals have been given in accordance with the infrastructure of the itinerary and the newly proposed regulations have been shown by drawings. In the proposal, the current 6 km long center reached a

total length of 7 km by expansion. This arrangement will take place on the 16 m wide road between the two pedestrian trails (platforms). In this context, three lanes with a width of 3 m have been proposed for private vehicles, whereas two-way bicycle lanes with a width of 1 m and a total of 4 km have been also proposed. Physical separation with a width of 0.75 m has been anticipated to separate the 5 km long and 3.5 m wide private bus lane and the special vehicle lanes from the special bus lane. As a result of the new arrangement, there are a total of 17 public transportation stations within the framework of the central ring, 7 of which are designed as transfer stations. Other stations are called intermediate stations, which offer a possibility of transfer to additional stations.

As a result, flexible but easy-to-perform projects from irreversible high-budget investments, as well as lightweight physical corrections from investments that force infrastructure opportunities-operating understanding-solutions using legal mechanisms have been preferred in accordance with TDM understanding. Intersections along the central ring have been reduced, special lanes for public transportation has provided the opportunity to create new itinerary, integrated passenger / ticket stops have been envisaged to facilitate the objectives, bicycle lanes and central ring, as well as the inner city and bicycle-accessible areas have been offered the opportunity to apply a large bicycle network.

Appendix

Recommendations made as a result of physical improvements along the central public itinerary.

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