Sustainable traffic management in a central business district: The case of Almyros

Athanasios Galanis, Nikolaos Eliou

***Abstract*—** This paper presents the results of a research project that evaluates the ability to manage the transportation network in the central area of the city of Almyros, Greece. The proposed network will not only improve the road safety level of motorists and vulnerable road users but also will provide organized parking areas. The proposed traffic management actions are divided into short term and long term ones. The short term traffic management actions include the implementation of one way streets, change of traffic signs, the redesign of the sidewalks and the relocation of parking areas. The long term actions include the development of a complete motorist parking master plan.

***Keywords*—**Sustainability, Traffic, Management, Pedestrian, Safety, Parking

I. Introduction

THIS paper presents the results of a research project that evaluates the ability to manage the transportation network in the central area of the city of Almyros, Greece. Mixed traffic condition in traditional urban areas in Greece and promotion of motorists resulted in many transportation and environmental problems. The lack of proper pedestrians' or bicyclists' urban road infrastructure and the continuously raising demand for vehicle parking slots in the central business district resulted into a chaotic traffic situation which is difficult to be managed. Such problems are not faced only in major cities but also in middle and small sized ones in Greece. Citizens are not used to travel using sustainable or public transport modes and furthermore are strongly negative towards road pricing entering or parking in the central district of their city as they consider parking right as a public good.

In the city of Almyros the proposed network and the transportation management solutions will not only improve the road safety level of motorists and vulnerable road users but also provide organized on street parking areas. Short term transportation management actions include the implementation of one way streets, change of traffic signs, the redesign of the pedestrian network, the relocation of parking areas and adaptation based on sustainable demand. Long term actions in the city include the development of a complete motorist parking master plan, combining the on street and off street available parking areas.

Athanasios Galanis is with the University of Thessaly, Department of Civil Engineering, Pedion Areos 38334, Volos, GREECE (phone: +30-24210-74174; fax: +30-24210-74119; e-mail: atgalanis@uth.gr)

Nikolaos Eliou is with the University of Thessaly, Department of Civil Engineering, Pedion Areos 38334, Volos, GREECE (corresponding author to provide phone: +30-24210-74150; fax: +30-24210-74119; e-mail: neliou@uth.gr).

A. Sustainable transportation

Sustainable transport modes contribute into the environmental, social and economical sustainability of the modern societies. A transportation system serves the demand of personal contact. The benefits of mobility rising should balance the environmental, social and economic cost that a transport mode or system provides.

There is no commonly accepted definition of sustainable transportation. According to the Canadian "Center for Sustainable Transport" (CST) a sustainable transport system is the one that [1]:

- Serves the needs of accessibility and mobility in personal and society level with respect on human and environment, targeting to balance the needs of presence and future needs.
- Is sufficient and effective, offers alternative choices of transport modes supports a competitive economy and a balanced territorial development.
- Reduces the emissions, uses alternative power resources and minimizes the used space.

B. Pedestrian Safety

Pedestrians are vulnerable roads users as they are exposed to higher levels of risk during their interaction with heavy or fast motorized traffic. There is a lot of literature regarding pedestrian accident severity. The most common factors which influence pedestrian accidents are pedestrians' age and gender, alcohol usage and vehicle type. Sze and Wong applied logistic regression in order to investigate the influence of contributory factors on the probability of fatality and sever injury [2].

In pedestrian – vehicle crashes young (under 19 years) and older pedestrians (over 60 years) are more likely to be involved in fatal accidents than other age groups [3]. Parameters that significantly influence the severity of the pedestrian injuries are the: vehicle type; drivers' on pedestrian alcohol involvement and age (over 65 years) [4]. The elderly are more vulnerable, higher speed limits lead to higher injury severity, accidents at signalized intersections are less severe and darkness leads to higher injury severity [5]. There is also an influence of personal and environmental characteristics on pedestrian severity in pedestrian-vehicle crashes. The environmental conditions should be examined more

thoroughly and be an important consideration when planning urban areas [6].

In USA, 4.378 pedestrians were fatally injured and 69.000 were severely or lightly injured in 2008 [7]. The most fatalities took place in urban areas (72%), in sites outside intersections (76%), during good weather condition (89%) and during the night (70%). Men were the most vulnerable group as their contribution to the fatality rate was 70%. Examining the age split, 18% of the fatalities were pedestrians above 65 years old and 7% youth below 15 years old. The time of the day and the day of the week were also related to the pedestrian fatality rate. 38% of the pedestrian fatalities took place between 3pm and 7pm. About the half of the pedestrian fatalities took place during the weekend due to higher pedestrian traffic volumes, usually noticed in this time period of the week.

In Greece, 248 pedestrian were fatally injured in 2008 [8]. In EU-14, 3.683 pedestrians were fatally injured in road traffic accidents in 2005 [9]. In Greece, 81% of pedestrian fatalities took place in urban areas. On the contrary, less pedestrian fatalities in urban areas were reported in Netherlands (72%) and Sweden (63%). The greatest risk for pedestrians' road safety was located in intersections, where pedestrians are forced to conflict with other road users.

C. Built environment features related to walking

There are major benefits from the promotion of walking both in urban and regional revel. Pedestrians do not consume fuel to travel, pollute the air or create noise. In urban areas the choice to walk depends on many factors. Shay et al propose two groups of factors that influence walking: ability and motivation [10]. The "motivation" factors relate to personal or social characteristics. Only with the presence of the ability factors can be the motivation factors operational in order to promote walking among citizens.

The distance and the time that is necessary for a commuter to reach his destination are major factors in order to travel on foot [11]. Pedestrians travel slowly, resulting to a limited distance they can reach: 1-2 km. Issues more than road safety and mobility, like personal image the value of time are usually the critical factors for a citizen's choice to walk. Especially, highly paid workers cannot afford lose working time selecting to travel on foot or with public transport modes.

Personal safety is also a major factor for many citizens to walk [12]. Especially women avoid walking during night time selecting another transport mode or choosing not to travel. Many parents consider that their children face not only problems for their road but also personal safety when they walk [13].

The relationship between walking and built environment can be examined using specific audit tools [14]. Furthermore, the features of the pedestrian built environment can be graded, resulting to a walkability index [15]. Finally, the pedestrian urban infrastructure can be examined using walkability indicators [16]. This type of indicators can help engineers and stakeholders to find where the pedestrians face mobility problems across their desire route.

D. Transportation demand management

The continuously growing demands of the transportation system relates on the raising cost for providing additional infrastructure, protecting the environment and minimizing energy consumption. This demand has increased interest for improving management and operations of the existing transportation systems. Transportation Demand Management (TDM) or Mobility Management is a general term for strategies that result in more efficient use of transportation resources [17]. Transportation Demand Management (TDM) represents a valid approach by embracing strategies designed to influence changes in travel behaviour by affecting modal choice, frequency of trips, trip length, and route travelled without calling for additional transportation infrastructure investment [18]. There are many strategies to achieve transportation demand management which are divided into categories according to how they affect travel. The basic strategies are the following [17]:

- Improved transport options
- Incentives to use alternative modes and reduce driving
- Parking and land use management
- Policy and institutional reforms
- TDM programs and program support
- TDM planning and evaluation

Some of the "improved transport options" are the following [17]:

- Address security concerns: Strategies for improving personal security
- Alternative work schedules: Flextime, compresses work week and staggered shifts
- Bus rapid transit: High quality bus service on busy urban corridors
- Bike/ transit integration: Ways to integrate bicycling and public transit
- Nonmotorized planning: Planning for walking and cycling
- Nonmotorized facility management: Best practices for managing nonmotorized facilities such as walkways, sidewalks and paths
- Park and ride: Providing convenient parking at transit and rideshare stations
- Public bike systems: Automated bicycle rental systems designed
- Taxi service improvements: Strategies for improving taxi services
- Telework: Use of telecommuting as a substitute for physical travel
- Traffic calming: Roadway design that reduce vehicle traffic speeds and volumes
- Transit improvements: Strategies for improving public transit services
- Universal design (barrier free planning): Transport systems that accommodate all users, including people with disabilities and other special needs

E. Parking management

Parking in urban areas is an essential component of the transportation system. Motorists want to park at every destination. Building parking facilities represents a major cost to society, especially in the period of financial crisis. The availability of public space for parking is one of the most common problem facing designers and stakeholders worldwide. The balance between parking supply and management is not only an economic problem but also a social and environmental one.

Parking management solutions present a higher sustainability index than raising supply of parking areas. Parking management can reduce urban sprawl and create a more complex and mixed used urban built environment. From the transport sustainability point of view, it reduces motor vehicle use and traffic congestion promoting safer and environmental friendlier transport modes. Furthermore, parking management reduces the environmental footprint of the city in terms of gas emissions and water pollution. The principles of parking management are the following [19]:

- Consumer choice: People should have viable parking and travel options
- User information: Motorists should have information on their parking and travel options
- Sharing: Parking facilities should serve multiple users and destinations
- Efficient utilization: Parking facilities should be sized and managed so spaces are frequently occupied
- Flexibility: Parking plans should accommodate uncertainty and change
- Prioritization: The most desirable spaces should be managed to favor higher-priority uses
- Pricing: As much as possible, users should pay directly for the parking facilities they use
- Peak management: Special efforts should be made to deal with peak-demand
- Quality vs. quantity: Parking facilities quality should be considered as important as quantity, including aesthetics, security, accessibility and user information
- Comprehensive analysis: All significant costs and benefits should be considered in parking planning

A major issue of the parking facilities is their cost to construct and operate. It is accepted that the major benefit of parking management is its ability to reduce facility costs. About 60% of total vehicle costs are either external or internal-fixed [20]. Land requirements per parking space vary depending on type and size. Off-street spaces require driveways and access lanes.

Many jurisdictions impose a special sales tax on commercial parking transactions, called an “ad valorem tax”. This tax tends to reduce the supply of priced parking. It may reduce total parking supply in areas where a significant portion of parking is provided by commercial operators. Implementation requires commercial parking operator to maintain reliable records of revenues or transactions. Some commercial parking operators may underreport their revenues to reduce their tax payments [21].

F. Traffic congestion

Traffic congestion is a condition on road networks that occurs as use increases and is characterized by slower speeds, longer trip times and vehicular queuing [22]. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, the result is congestion. As demand approaches the capacity of a road or its intersections, extreme traffic congestion is presented. When vehicles are fully stopped for a period of time, this is widely known as a traffic jam. The negative impacts of traffic congestion are the following [22]:

- Wasting time of motorists and passengers and delays
- Inability to forecast travel time accurately
- Wasted fuel increasing air pollution
- Wears and tear leading to more frequent repairs and replacements
- Stressed and frustrated motorists
- Block at emergency vehicles
- Spillover effect from congested main arterials to collector and local streets

Traffic congestion costs consist of incremental delay, vehicle operating costs (fuel and wear), pollution emissions and stress that result from interference among vehicles in the traffic stream, particularly as traffic volumes approach a road’s capacity [23]. Traffic congestion is a widely recognized transport cost as it is not only a significant factor in transport system performance evaluation but also affects transport planning decisions [24]. Congestion can be “recurrent” (regular: occurring on a daily, weekly or annual cycle) or “non-recurrent” (traffic incidents and disabled vehicles).

The medicine against traffic congestion is traffic management using “Intelligent Transportation Systems” (ITS) [25]. ITS are advanced applications which aim to provide innovative services relating to different modes of transport and traffic management, enabling road users to be better informed. Their goal is to make safer, more coordinated and smarter use of transport networks.

II. METHODOLOGY

A. Study area

City of Almyros has a population of 7566 citizens [26]. Almyros is a town and a municipality of the regional unit of Magnesia, region of Thessaly, Greece (Fig.1). Almyros is an important agricultural and commercial center of Magnesia and is also developing as a tourist center of the area.

The history of Almyros starts with the ancient city of Alos, a very important and populous town, famous for its port. After the Byzantine Empire, due to the pirate raids, the town was moved to its current position. After its liberation from the Turkish occupation in 1881, the city was developed and repopulated by Greeks. In 1980, a catastrophic magnitude 6.5 earthquake destroyed most of the town [26].

The municipality Almyros was formed at the 2011 reform by the merger of the following 4 former municipalities that became municipal units: Almyros, Anavra, Pteleos and Sourpi [26].

Fig.1: Almyros regional location (Background picture retrieved from Bing Maps, processed by the authors) [27]

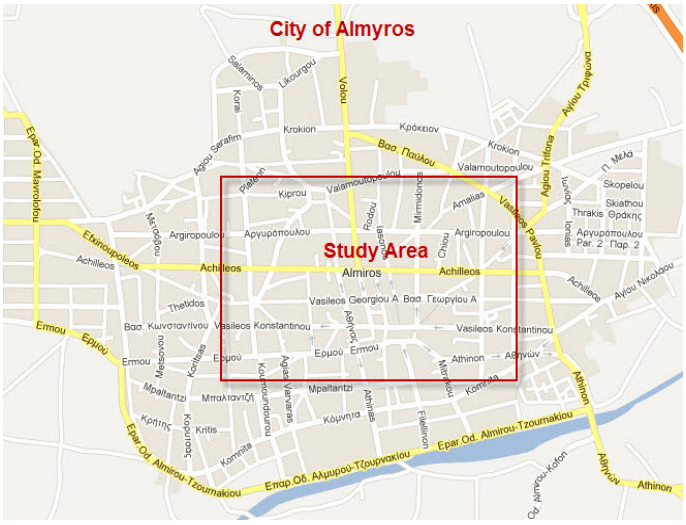

Fig.2: Study Area (Background picture retrieved from Google Maps, processed by the authors) [28]

B. Research targets and steps

This study was funded from a research project aiming to present solution for the transportation network of the city of Almyros, Greece (Fig.2). The necessity for this study was obtained from the current traffic and safety problems for motorists and pedestrians and the parking demand in the central business district of the city. The targets of the study were the following:

- Evaluate the current access problems in the study area in compliance with the land use features
- Present short-term traffic management solutions: one way streets, traffic signs, pedestrian streets and sidewalks
- Prepare of an on-street and off-street parking plan in order to comply with the motorists' parking demand
- Promote and improve sustainable mobility, accessibility, convenience, road and personal safety in the study area

The steps of the study were the following:

- Collection of the transportation flow and motorists parking demand data
- Collection of the urban road network infrastructure and traffic signs – signals data
- Presentation of the current road urban network in CAD software
- Preparation of the proposed traffic and parking management actions in CAD software

The synopsis of the proposed actions is the following:

- Urban road network traffic management
- Motorists parking demand management
- Sustainable mobility management

C. Current traffic situation

This city is formed with regional streets which are able to channel the traffic flow around the center of the city (Fig.2). The major traffic problem was located in Baltazi St, in the sector Filellinon St - Mitakou St. where a bottle neck was acknowledged.

The main urban network is composed from horizontal and vertical streets with adequate width. The streets in the central business district around the central square are mainly one way (Fig.3). Illegally parked vehicles were located all over the study area and mainly around the square. The enforcement of the law from the local police should be a proposed action.

Fig.3: Current urban road network

The central square is the heart and the vital point of the city. Around the square there are pedestrian streets (Thermopylon, Iasonos St) and traffic calming streets (Ermou, Agoras, Grigoriadou and part of Athinas St) where recreational and private sector services are presented (Fig.4).

The streets that surround the central square (Konstantinou, Othryos, Athinon and Myrmidonon St) are one way streets and their average width is 8-10m. Due to that width many illegally parked vehicles were noticed. Parking restriction and traffic calming measures should be implemented in these streets.

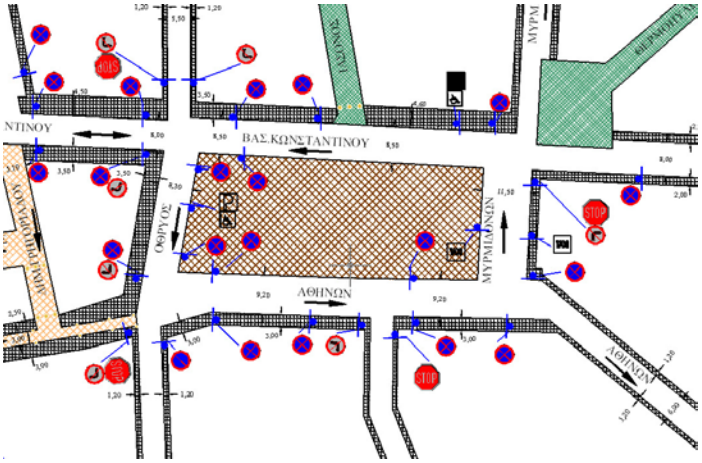

Fig.4: Current urban road network (central area)

The existing pedestrian streets operate as they are planned but they present access problems to emergency vehicles which should be faced and solved.

In the central square area there is only one traffic signal which is not operational. Due to that fact, the traffic management is accomplished only with traffic signs.

In the central business district area there is a public parking place with capacity of 60 vehicles, located in Iasonos St. This off-street parking place is unorganized, not designated with many litter presented.

Another major traffic issue is the location of the suburban bus station close to the central square. Located in Achilleos St which is a wide and one way street, limits its ability to raise motorists' parking area or operate as a two way street.

D. Traffic flow data

For the purpose of this study, traffic flow data collection in the following three intersections was conducted (Appendix):

- Achilleos – Michopoulou
- Konstantinou – Othryos
- Othryos - Ermou

The traffic flow data collection was conducted in two days: Saturday and Monday, from 8-10am and 13-15pm. For every time period and traffic direction the "Peak Busy Hour" and the "Passenger Car Equivalent" (PCE) were calculated.

E. Parking demand data

For the purpose of this study, motorists' parking demand data collection in the same days with the traffic flow data collection was conducted (Appendix). The exact location of the traffic parking demand collection data was the following:

- The area surrounding the central square with a range of one road segment
- The area described from the following streets: Achilleos, Filonos, Ermou, Giannopoulou, Komita and Panagopoulou

The main characteristic of the data collection was that 37% of the vehicles were illegally parked and only 63% legally. Due to that fact the smoothness of motorists' traffic in the study area was limited. In Monday, 84% of motorcycles were illegally parked and in Saturday 79%. This extremely high parking status created a difficultly controlled situation in the central of the city.

Another index that we calculated was the "Parking Demand" (PD) in the study area. It indicated the number of parked vehicles that are able to park around an urban block in compliance with the "block area" (BA) and the "building index" (BI). The building index in the municipality of Almyros is: BI=1.6. The parking demand was calculated in the according to the following equation (1). The result was: PD=2010 vehicles.

$$PD = [(BA)*(BI)]/80 \quad (1)$$

III. PROPOSED SOLUTION

The proposed traffic and parking management solution or "Master Plan" is presented in CAD format (Fig.5). A better and more detailed aspect of the proposed urban road network is also presented in CAD format (Fig.6). The drawing is escorted with a technical appendix (Fig.7). The proposed actions are focused on the following built environment aspects:

- Traffic Calming Streets
- Pedestrian Streets and Sidewalks
- Central Square
- Legal Parking Area

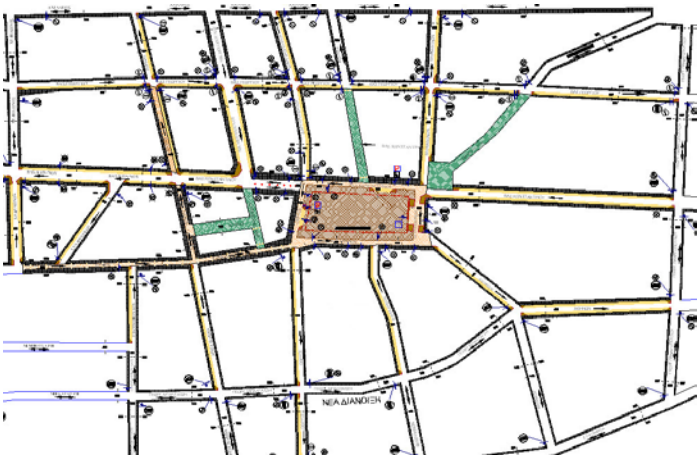
Fig.5: Proposed urban road network

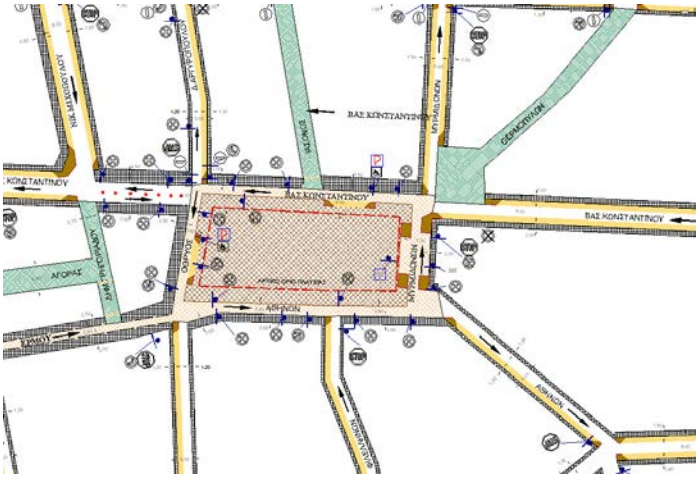
Fig.6: Proposed urban road network (central area)

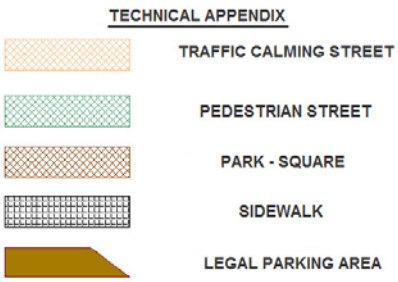

Fig.7: Technical Appendix (Legend)

A. *Proposed Action No1*

The first proposed action focuses on the expanse of the central square and the alteration of the surrounding streets to traffic calming ones (Fig.6). The remaining width of the streets will be 3.5m, completely satisfying for the motorists and emergency vehicles. Parking will be restricted around the central square except for 4 parking slots for mobility impaired citizens (2 in Othryos St and 2 in Konstantinou St). In Myrmidonon St, a special configuration will designate the taxi place where they can be unobstructed parked.

B. *Proposed Action No2*

The second proposed action focuses on the streets surrounding the central business district area. An expanse of the sidewalks' width for 2m is proposed. The most streets are one way so this action is able to be implemented (Fig.5). Furthermore, the on-street parking is organized. In two way streets no action is proposed. Generally, the more the distance from the center of the city the less traffic management actions are necessary.

C. *Proposed Action No3*

The third proposed action focuses on the full convert of the Agora St and Grigoriadou St to pedestrian streets. The only necessity is the unobstructed access of emergency vehicles across the streets.

D. *Detailed Actions in the Study Area*

The detailed actions for traffic and parking management in the study area are the following:

- Konstantinou St (Filonos St to Athinas St): Removal of the prohibit parking signs and convert to legal parking for both sides of the street
- Konstantinou St (Michopoulou St to Argyropoulou St): Sidewalk expanse until the pavement width of 6m which two vehicles movie conveniently (traffic calming street)
- Konstantinou St (Athinas St to Michopoulou St): Sidewalk expanse until the pavement width of 3.6m which one vehicle can movie conveniently (traffic calming street)
- Fragkou St: Placement of the sign prohibiting parking for both sides of the street due to the fact that is a two way street with a width of 6m
- Michopoulou St (Konstantinou St to Georgiou St): Change of the motorists heading from two ways to one way street and implementation of legal parking from one side of the street. On the other side the sidewalk will be expanded 1.4m in order the remaining pavement width will be 3.6m
- Athinas St (Georgiou St to Konstantinou St): Legal parking from one side of the street and parking prohibition in the other one putting the optimum signs
- Myrmidonon St (Konstantinou St to Georgiou St): Legal parking for both sides of the street. Contraction of the sidewalk width 0.6m in order to implement designated parking area. This practice will be expanded in all the surrounding streets of the central area
- Konstantinou St (Panagopoulou St to Myrmidonon St): Legal parking to the other side of the street. Removal of the parking prohibition signs. The remaining pavement width for motorists will be 4m
- Pappa St (Baltazi St to Ermou St): Legal parking only in one side of the street. Parking prohibition and sign placement only in the road segment (Baltazi St to Komita St). In this segment the street is two way and the pavement width is 5.5m
- Baltazi St: Along this street no action is necessary. The pavement width is 5.5m and the motorists' heading is two way.
- Othryos St (Athinon St to Komita St): Legal parking only in the one side of the street. This action is obliged due to the width of the street
- Filellinon St (Athinon St to Baltazi St): Legal parking only in the one side of the street. Placement of parking prohibition sign in the other side of the street
- Argyropoulou St (Achilleos St to Konstantinou St): Legal parking only in the one side of the street. The target of this action is the contraction of the illegal parking
- Konstantinou, Othryos, Myrmidonon and Athinon St (surrounding the central square): Alteration to traffic calming streets with a pavement width 3.5m and motorists parking prohibition

IV. Conclusion

Mixed traffic condition in traditional urban areas in Greece and promotion of motorists resulted in many transportation and environmental problems. The lack of proper sustainable mobility infrastructure and raising demand for vehicle parking areas in the central business district resulted into a chaotic traffic situation which is difficult to be managed. Such problems are not faced only in major cities but also in middle and small sized ones like Almyros.

The proposed actions and solution to the transport problem of the city should be implemented under strictly enforcement of the law by local authorities and police.

Appendix

In the Appendix a photo collection of the study area and a part of the traffic flow and parking demand data collection is presented (Fig.8 – Fig.12), (Table 1 – Table 3).

Fig.8: Central Square

Fig.9: Ermou St (left) and Athinas St (right): Traffic calming streets

Fig.10: Iasonos St (left) and KTEL (suburban bus) desert area (right): Off street designated (left) and not designated (right) parking spots

Fig.11: Argyropoulou St (left) and Agoras St (right): Illegal parking

Fig.12: Intersection (Othryos St and Ermou St) Parking management

Table 1: Traffic Data (Intersection Othryos-Athinon St)

Intersection: Othryos St and Athinon St					
Heading: Towards Othryos St					
Day: Saturday	Time: 8am-10am				
Hour	1st	2nd	3rd	4th	Index
Car	22	32	36	33	1
Bus	0	0	0	0	2.25
Motorcycle	1	0	0	1	0.75
Total traffic flow	23	32	36	34	
Peak hour traffic flow	36				
Day: Saturday	Time: 13pm-15pm				
Hour	1st	2nd	3rd	4th	Index
Car	34	30	38	33	1
Bus	0	0	0	0	2.25
Motorcycle	0	1	2	2	0.75
Total traffic flow	34	31	40	35	
Peak hour traffic flow	40				

Table 2: Traffic Data (Intersection Othryos-Konstantinou St)

Intersection: Othryos St and Konstantinou St					
Heading: Left turn to Othryos St					
Day: Saturday	Time: 8am-10am				
Hour	1st	2nd	3rd	4th	Index
Car	37	44	50	42	1
Bus	0	0	0	0	2.25
Motorcycle	0	0	0	0	0.75
Total traffic flow	37	44	50	42	
Peak hour traffic flow	50				
Heading: Towards Konstantinou St					
Day: Saturday	Time: 13pm-15pm				
Hour	1st	2nd	3rd	4th	Index
Car	288	261	256	214	1
Bus	3	0	0	0	2.25
Motorcycle	21	20	20	10	0.75
Total traffic flow	312	281	276	224	
Peak hour traffic flow	312				

Table 3: Parking Data

Parking Data	
Legal parking (cars)	549
Illegal parking (cars)	313
Total parking (cars)	862
Legal/Illegal parking (cars)	0,64
Illegal/Legal parking (cars)	0,36
Legal parking (motorcycle)	8
Illegal parking (motorcycle)	41
Total parking (motorcycle)	49
Legal/Illegal parking (motorcycle)	0,16
Illegal/Legal parking (motorcycle)	0,84

ACKNOWLEDGMENT

Authors are grateful to the University of Thessaly, Department of Civil Engineering, undergraduate students: "Skoulas Emmanuel" and "Xintaris Dimos" for their contribution in the data collection of this research.

REFERENCES

[1] "Defining Sustainable Transport", Center for Sustainable Transport (CST), 2005, Available: www.cst.uwinnipeg.ca.documents
[2] N.N. Sze, S.C. Wong, "Diagnostic analysis of the logistic model for pedestrian injury severity in traffic crashes", *Accident Analysis and Prevention*, vol.39, no.6, pp. 1267-1278, 2007
[3] A.S. Al-Ghamdi, "Pedestrian-vehicle crashes and analytical techniques for stratified contingency tables", *Accident Analysis and Prevention*, vol.34, no.2, pp. 205-214, 2002
[4] S.S. Zajac, J.N. Ivan, "Factors influencing injury severity of motor vehicle – crossing pedestrian crashes in rural Connecticut", *Accident Analysis and Prevention*, vol.35, no.3, pp. 369-379, 2003
[5] N. Eluru, C.R. Bhat and D.A. Hensher, "A mixed generalized ordered response model for examining pedestrian and bicyclist injury severity level in traffic crashes", *Accident Analysis and Prevention*, vol.40, no.3, pp. 1033-1054, 2008
[6] K.J. Clifton, C.V. Burnier, and G. Akar, "Severity of injury resulting from pedestrian-vehicle crashes: What can we learn from examining the built environment?", *Transportation Research Part D*, vol.14, no.6, pp. 425-436, 2009
[7] "Traffic Safety Facts 2008 Data: Pedestrians", NHTSA National Center for Statistics and Analysis
[8] "Road Fatalities in EU: 2008", CARE (EU Road Accident Database)
[9] "Traffic Safety Basic Facts 2007: Pedestrians", European Road Safety Observatory
[10] E. Shay, S. Spoon, and A. Khattak, "Walkable environments and walking activity", Final Report for Seed Grant Submitted to Southern Transportation Center, University of Tennessee
[11] R.L. Mackett, "Policies to attract drivers out of their cars for short trips", *Transport Policy*, vol.8, no.4, pp. 295-306, 2001
[12] H. Easton, F. Smith, "Getting there: Reducing crime on public transport", Report for Nacro, 2003
[13] R. Bradshaw, P. Jones, "The family and the school run: what would make a difference?" Scoping Report June 2000 for the AA Foundation
[14] A. Galanis, N. Eliou, "Development and implementation of an audit tool for the pedestrian built environment", *Procedia-Social and Behavioral Sciences*, vol.48, pp.3143-3152, 2012
[15] A. Galanis, N. Eliou, "Grading methodology of the pedestrian urban road environment", *WSEAS Transactions on Environment and Development*, vol.7, no.6, pp. 157-166, 2011
[16] A. Galanis, N. Eliou, "Evaluation of the pedestrian infrastructure using walkability indicators", *WSEAS Transactions on Environment and Development*, vol.7, no.12, pp. 385-394, 2011
[17] Online TDM Encyclopedia, Victoria Transport Policy Institute, Updated January 2011, Available: http://www.vtpi.org/tdm/index.php
[18] C. Sisinnio, P.L. Winters, "Estimating Societal Benefits and Costs of transportation Demand Management (TDM)", 2008 Transportation Research Board 87th Annual Meeting, Washington D.C., 2008
[19] T. Litman, "Parking Management, Strategies, Evaluation and Planning", Victoria Transport Policy Institute, 2012
[20] T. Litman, "Parking Costs: Transportation Cost and Benefit Analysis", Victoria Transport Policy Institute, 2011
[21] T. Litman, "Parking Taxes: Evaluating Options and Impacts", Victoria Transport Policy Institute, 2011
[22] "Traffic Congestion", Wikipedia the Free Encyclopedia, Available: http://en.wikipedia.org/wiki/Traffic_congestion
[23] S. Grant-Muller, and J. Laird, "International Literature Review of the Costs of Road Traffic Congestion", Scottish Executive, 2007, Available: http://www.scotland.gov.uk/Publications/2006/11/01103351/0
[24] T. Litman, "Transportation Cost and Benefit Analysis II: Congestion Costs", Victoria Transport Policy Institute, 2012, Available: http://www.vtpi.org/tca/tca0505.pdf
[25] "Intelligent Transportation System", Wikipedia the Free Encyclopedia, Available: http://en.wikipedia.org/wiki/Intelligent_transportation_system
[26] "Almyros", Wikipedia the Free Encyclopedia, Available: http://en.wikipedia.org/wiki/Almyros
[27] Bing Maps, Available: http://www.bing.com/maps/
[28] Google Maps, Available: http://maps.google.gr/maps

Athanasios Galanis was born in Greece in 1983. He is an Adjunct Lecturer and Researcher in the Department of Civil Engineering, University of Thessaly, Greece. He obtained his Bachelor in Civil Engineering in University of Thessaly (2006) and his Master of Science in Transportation Engineering in Aristotle University of Thessaloniki (2007). He obtained his Ph.D. in Sustainable Transportation in University of Thessaly (2011). He is a member of the Technical Chamber of Greece, Union of Civil Engineers of Greece, and Union of Transportation Engineers of Greece. His research focuses at road safety and sustainable mobility. He presented his research at many national and international conferences and scientific journals. His professional profile relates in highway design, road safety audit, traffic management and architecture design.

Nikolaos Eliou was born in Greece in 1961. He is a Professor of Transportation Systems Simulation: Infrastructure, in the Department of Civil Engineering, University of Thessaly, Greece. He obtained his Ph.D. in Highway Infrastructure in Aristotle University of Thessaloniki (1990). He is a member of the Technical Chamber of Greece, Union of Civil Engineers of Greece and World Road Association. He is a member of many technical committees including the Committee of Infrastruction Projects, the Committee for the Local Administration and the Committee of Enquiry of the Technical Chamber of Greece. He is the President of the University of Thessaly, Department of Civil Engineering, Senate in University of Thessaly and Chairman of the Technical Board. He presented his research at many national and international conferences and scientific journals. His professional profile relates in highway design, road safety audit and traffic management.