IS THE AUTOMATION TO BE AN EXCLUSIVE SOLUTION TO TRAFFIC PROBLEMS?

Kristi Bombol, Daniela Koltovska Nečoska
Sv. Kliment Ohridski University, Faculty of Technical Sciences
Department for Traffic and Transport
POB 99, 7 000 Bitola, Republic of Macedonia

Summary

There is as many as necessary evidence that the application of modern technologies including computers, electronics and communications can improve traffic conditions, enhance the environment and economic productivity as well.

Known as Intelligent Transport Systems (ITS) as a whole, these technologies have been accepted throughout the world in a short time as an alternative to the traditional approach of building more roads for mitigation of traffic congestion.

After thirty years of development and implementation, one can conclude that automation is facing with difficulties such as the complexity and system's robustness, the high rate of detector failures, the lack of trained personnel, too much commercializing put etc. A question has out there arisen: Are the automation systems capable to do everything possible? Are they exclusive and unique in their power? Or, is it the automation that gives the solution for traffic problems only?

In this paper we aim to present another type of strategy that may keep staying in line with the "smart" solutions, but being friendlier and human needs oriented. Namely, the Traffic Study of the City of Bitola (2011) promotes the concept of "livability". It focuses mainly on the application of measures for making vibrant, healthful, aesthetically pleasing settings, and on preservation of historical, cultural, and natural aspects valued by the community. The objective of "livability" is to use transportation investments to improve the standard of living, the environment, and the quality of life for all communities, urban, suburban and rural.

In this paper "smart" solutions within the "livability" concept for treating traffic problems in the central area of the City of Bitola will be presented. A concept of environmental traffic management and sustainable transport system development is proposed. It implies implementation of non-radical, user friendly and cost-effective measures. In order to convince ourselves that the proposed concept is worth implementing, we simulated "before" and "after" the traffic flows on signalized and non-signalized intersections in the central urban area by using the simulators VISSIM and VISUM. Our goal was to show that it is not only the automaton to be the sole answer to traffic problems in the middle sized cities. Au contraire, another "smart" solutions but hardware or software do exist. We do hope that this approach will give an incentive for changing "the big picture of automation". Thus, a step forward towards more human and by nature traffic management in given contexts will be made.

1. INTRODUCTION

Intelligent Transport Systems (ITS) involve a wide range of various technologies, data processing, communications, control and electronics. The application of these technologies represents a pure revolution and an alternative to the approach of dealing with urban traffic problems.

The ITS incorporate a number of concepts, such as: Automated Highways, Automated Vehicle Navigation, Intelligent Public Services, Automatic Traffic Signal Control, etc. In this paper, we will be only dealing with the automatic systems of traffic management and control in the cities – the popular *adaptive signal control systems.*

The growing sophistication of software and hardware, the development and the application of information technology provided grounds for series of generations of adaptive systems to appear on the market, like: TRANSYT-7F, MAXBAND (first generation), SCOOT, SCATS, MOTION (second generation), OPAC, PRODYN, UTOPIA/SPOT (third generation). Due to their performance characteristics, they proved to provide travel time decrease, increase in traffic quality (mitigation of traffic congestion), improvement of safety etc.

After 30 years of development and practical application of automatic systems, today, we are facing certain difficulties in terms of complexity and robustness, high incidence of detector failures, lack of trained staff, over-commercialization and the like.

The question arises: *Are the automatic systems that powerful, unique and special? Or: is the automation the exclusive solution to traffic problems?*

This paper is about to give a distinctive, yet following in the line of "smart" systems, approach that is also human needs oriented. Namely, it is the Traffic Study of the City of Bitola (2011) which promotes the concept of "livability" in treating the traffic problems in the Central Urban Area (CUA). The main point refers to introducing measures for creating healthy and pleasant settings in line with preserving the cultural, historical as well as natural aspects. Beside this, a concept of environmental traffic management and sustainable transport system is proposed. In order to demonstrate the applicability and the potential of this approach, a simulation of signalized and geometrically redesigned intersections in the CUA is performed using SIDRA and SYNCHRO software tools and VISSIM and VISUM simulators. Both the "before" and "after" states have been analyzed.

The main objective was to show that it is not only the automation to be considered as a solution to the traffic problems in medium-sized cities since there are always other "smart" solutions, as well.

2. INTELLIGENT URBAN TRAFFIC MANAGEMENT AND CONTROL SYSTEMS - PROS AND CONS

Each of the concepts of Intelligent Urban Traffic Management and Control Systems has its advantages and disadvantages. However, what is considered as common feature they are all sharing, is the predomination of *automation and intelligence.* The "pros" and "cons" that we are presenting here, fall within the technical and technological aspect and are in function of the system users.

The various generations of adaptive systems are, evolutionarily, classified in three generations. The first one (TRANSYT-7F, MAXBAND) generates the signal plans based upon historically averaged traffic volume data. Depending on the time of the day (TOD), pre-timed control plans are being selected and implemented. The updating frequency of control plans is generally 15 minutes. The second generation, (SCOOT, SCATS, MOTION) optimizes the signal plans based upon traffic flow anticipations rather than historically averaged traffic volume data. The frequency of updating the control plans is limited to not going beyond 10 minutes, with confidence that the issue of transition disturbances will be successfully avoided. The third generation (OPAC, PRODYN, UTOPIA/SPOT) is similar to the second, except for the updating of signal plans which occurs in shorter intervals, between 3 and 5 minutes. It is evident that every new generation involves application of ever more sophisticated algorithms to diminish the traffic delays and the number of stopping. For this purpose the system indispensably requires broad surveillance – pavement loop detectors and communication infrastructure. This is by no means a simple process. The complexity of their logic, the need for detectors, the permanent improvement of hardware, as well as the growing costs of operation and maintenance, are the problems that the practitioners face in this sense.

Here we give an example of the experience of SCOOT and SCATS and the challenges faced when installed in the USA. Neither the hardware nor the software were compatible to the American NEMA controllers.

And while the researchers argue over which generation is *actually adaptive*, which one is better, there is truly a large number of practitioners who

believe the second and the third generations not to be better than the TOD systems, according to research carried out in the USA [2]. The staff seeks the systems to be more common, more user friendly and compatible to the existing infrastructure (detectors and hardware), as well as less expensive to operate and maintain.

Certain systems and studies have become a marketing tool for the product/system. The best system in Australia is SCATS (Luc, 1989). The best system in Turin is considered to be SPOT/UTOPIA (Mizar, 2001). The TRL report states SCOOT as the best system, although Wood (1996) recommends analyzing the decentralization effects of his technique [2].

The latest developments in communications and information and computer technology lay the ground for emergence of numerous creative solutions on the market. These solutions are mainly designed to minimize traffic congestions. The adaptive systems have increased the user efficiency, safety and reliability. Today we speak about applying artificial intelligence in developing further *new* generations of adaptive systems. We would like to teach the systems to think as we, the humans do. Yet, the research activities are still on theory level so that we could not be quite confident about the way they would behave in real-life situations, in practice. We can only speak about them as being promising in terms of algorithm complexity – they are quite simplified. These conclusions are exclusively based on micro simulation research. It is worth waiting a while in order to realize their true values and advantages.

Yet another question has arisen: Are the automation systems capable of doing everything possible? Are they exclusive and unique in their power? Or, is it the automation that gives the solution for traffic problems only? The system is a comprehensive, dynamic entirety that exists and functions independently and purposefully in a given environment. As a system, the ITS is created to serve the humans as part of that environment. [3]. **Hence, the ITS should be "human needs oriented".** But, when have the humans started to communicate "more seriously" with the "computerized" environment? The humanity needs to perceive the world for the purpose of protection and feeling comfortable. The perceivable dependence on ITS happens at the beginning of one's career (after 25 years of age). *How does an ITS user behave?* The answer is in accordance with the skills developed under the influence of the social surroundings, activities and interests; in accordance with the motives, the character, the temperament, financial opportunities, service prices, estimated efficiency of the chosen option, the behavior pattern and the knowledge of option utilization [3].

Nevertheless, there is a disharmony between the ITS and the physical and mental characteristics of a human in terms of the quantity of services offered and mental capabilities, ITS service locations in the view of application efficiency [3]. Thus, it is very manlike to provide answers to the following questions:

- Have we managed to harmonize the ITS services to the physical characteristics of humans?
- Have we managed to harmonize the ITS services to the mental capacities of humans?
- Have we placed the ITS services within time and space to fulfill the ITS mission?

We considered the above questions as an introduction to a use a different approach – promotion of the concept of "livability" as a step forward towards a more humane and nature-like manner of traffic management.

3. WHAT IS THE CONCEPT OF *LIVABILITY*?

This is an important concept to define. While some would suggest livability means a life without cars, this definition really does not work for the millions of people who have chosen the lifestyle that an automobile affords. [4]. A public policy that addresses true livability must include urban communities, the environment and the economy, the public transport passengers and cyclists [4]. A *livable* future requires a balance of three key societal goals: vibrant communities, vital economy, and sustainable environment - all goals for the achievement of which good transport is essential [4].

In providing good traffic networks for the citizens, traffic professionals strive to create the incubator of such *livable* policies as community-sensitive design, historic preservation, asphalt recycling, and practical engineering. They support the expansion of choices for transport users which include public transport, walking, and cycling. Daily, they are working with communities and demonstrating that livability can be accomplished through road-related improvements.

Equating livability only to public transport, walking, and cycling, limits its relevance and excludes a wide range of improvements and community needs. Livability means choices and every transport project is an opportunity to improve the quality of life in a community. While much of the focus on livability has been about expanding

the opportunities to use public transport, or on making it easier to walk or cycle, for many people in our country these options are simply not practical in meeting their everyday needs for transport.

It is said that livability can be achieved through smart transport. In our case study we tried to propose to the Local Government of Bitola Municipality several techniques in order to produce community-responsive approaches. Our focus was on integrated planning solutions, on designing facilities sensitive to the passing citizens, and on developing safe neighborhoods, and vibrant and aesthetically pleasing settings. On the other hand, bearing in mind that the city of Bitola is a historic city, we wanted to preserve the historical, cultural, and natural aspects by introducing the concept of *livability*. The main *livability* objective was to use transport investments to improve the standard of living, the environment, and the quality of life for the citizens. To achieve this objective, we paid respect to how much the citizens travel to obtain various services (work, health, recreation, and shopping). We aimed at providing better transport choice for the family needs as well (walking, cycling, driving a car).

3. 1 How we started – the case study scope

On the demand of the Local Government of the Municipality of Bitola, we were assigned to conduct a Traffic Study of the City of Bitola. Within the traffic study several pilot projects had to be accomplished. One of the priority projects was the project of traffic management and control in the very centre of the city.

The area we covered with this study is a highly sensitive area due to position and function. The range of its traffic infrastructure connects the core of the city with its other parts, with the suburb and with the entering and exiting arterials. Furthermore, a great number of other various activities, either leisure or working, take place in this area. This means that it is exactly here, on this traffic network where all modes of traffic mix – motorized and non-motorized, i.e. vehicles, pedestrians, and cyclists.

Before designing the draft traffic solutions, a detailed analysis was made and data collected on field were processed, which met the objective of accurate identification of the problem. With the new approach philosophy applied – how to streetscape downtown and make it “livable to its residents and visitors”, we suggested and conducted a pilot study.

The main focus is on application of measures for creating the feeling of pleasure and comfort, and safety for all traffic users – drivers, pedestrians, and cyclists. These measures are as listed below:

- Introduction of roundabouts
- Introduction of one-way streets
- Prohibitted acces to pedestrian zone for all motor vehicles
- On-street parking control
- Widening the side-walks (narrowing the streets)
- Building bike paths
- Providing pedestrian access to the pedestrian zone (prohibition of motorized traffic)
- Landscaping (grass, flowers, trees)

3.2. Traffic Simulations – Current State

The approach to design of rational traffic solutions for all traffic users (motorized and nonmotorized), and the objective to achieve safe and efficient mobility in accordance with the principle of equality, equity and environmental acceptability impose eliciting input data on the studied urban network area. Data on the traffic flows were being collected in the period of two hours (14.00 – 16.00). Data was analyzed and processed in details and afterwards used as basis for developing traffic charts of the peak hour at all intersections of the studied area.

For a better presentation and clearer picture of the functioning of the overall traffic, simulations were conducted by means of software SIDRA (for analysis of intersection performance) and PTV VISSIM (for dynamic simulation). The analysis has shown partial loss of traffic activities, inappropriate motorized and nonmotorized traffic, congestion, flow mixing, indiscipline of drivers, illegal parking, vehicle queues at some intersections.

4. THE PROPOSED WAY TO *LIVABILITY*

In order to preserve the traffic, functional, and aesthetic role as well as the significance of the streets in the urban network in the studied area, we suggested several techniques:

a) Revitalization of the main street in the centre of the city

- The specific features of the centre of Bitola enhances the need of the residents for mobility
- If the design of the main streets satisfies the needs of a smaller community, then the goals, the features, and the nature would make the

community a public realm with active commercial and leisure life.

How to achieve these goals?

- With sidewalks widening
- By widening side walk edges that would shorten pedestrian crossings
- By designing of bus "pull outs"
- With ornamented lamp posts
- With textured pavements and landscaping to visually distinguish the residential and commercial zones

b) Transformation of the main streets into neighbourhoods' centres

Urban streets should serve businesses and residents' needs. This means the application of the following techniques:

- Adaptation of traffic and keeping up with pedestrians' safety and comfort
- Providing adequate parking facilities
- Providing amenities that would help people feel like home

c) Improving neighborhoods with improvement programmes

The techniques include:

- Pedestrian and bike paths
- Preservation of historical buildings (The Besisten, bridges on the river of Dragor)
- Landscaping

d) Projects responsive to the community needs

This involves:

- Solutions with "the feeling for the context" in which transport projects are planned, designed, and implemented
- Projects should meet the requirements of the community and environment

e) Integrating transport and land use

- Coordination of transport and land use necessity, residence, energy, climate changes and policies for environment protection
- Development of joint plans – transport and land use, which would enable "smart" development schemes

f) Promotion of walking and cycling

In regards with this, we believe that the Local Government has a vital role to play in providing lanes/paths for cyclists and pedestrians.

g) Support of travel and tourism

We here have in mind:

- Providing parking facilities with accommodation, restaurants, and commercial activities
- Harmonisation of natural environment and connecting the city and the national park/countryside
- Approach to the pedestrian zone (currently with prohibition for motorized traffic).

The philosophy of *livability* that we have applied is a result of:

- The basic postulates of the link between the livability and mobility
- Optimal, friendly, and efficient functioning of the mobility of the residents and visitors by:
- Reducing conflict points
- Sharing the space for motorized and non-motorized traffic
- Improved Level of Service (LOS), reducing time loss
- Aesthetic looks improved with surroundings

In order to achieve the set goal we have taken the following measures:

- Introduction of roundabouts
- Introduction of one-way system
- Prohibition of motor vehicles at the access to the pedestrian zone
- Controlled on-street parking
- Widening the sidewalks (narrowing the streets)
- Bike lanes/paths
- Providing pedestrian access to the City park
- Landscaping (plants, grass, flowers)

The new friendly look of the area of the study is presented in Fig. 1. Micro-simulations were conducted in VISSIM.

Fig. 1. The new "friendly" area look (from micro-simulation in VISSIM).

5. CONCLUSIONS

With this case study we have shown how to achieve higher level of safety of traffic participants without making large investments, how to control both dynamic and stationary traffic and how to enable residents to live, work, and recreate in a friendly and aesthetically arranged milieu. Furthermore, we have decisively wanted to familiarize and promote the concept of *livable* streets or streets full of life and to recommend that:

- Streets are community life core where local people go shopping, meet and enjoy their leisure time
- The city streets should serve the businesses and the residents by adapting the traffic and providing comfort and safety for the pedestrians and cyclists
- Amenities should be provided to make people feel at home

All solutions suggested here are smart, sound and requiring minimum investments in the infrastructure (three redesigns of intersections into roundabouts, narrowing of streets and widening of sidewalks, adequate and renewed traffic signs and markings, design of bike paths/lanes on certain streets, grass and flowers planting.

For better presentation and clearer picture of the functioning of the overall traffic, simulations were conducted by use of software SIDRA (for analysis of intersection performance) and PTV Vision (for dynamic simulation).

The case study has shown that:

- Traffic function is preserved with manifold effects – providing access to constructions and frontal buildings, sustainable mobility for motorized and non-motorized traffic users
- Clearly marked cyclist and pedestrian zones, motorized traffic zones and the crossings in between
- Reduced number of conflicting points
- On-street parking control
- Left turns mostly prohibited
- Hedges and curbs give aesthetical looks, and while making the street scenario pleasant they provide safety for pedestrians and cyclists
- Historical and aesthetical features are preserved (churches, mosques, the Bezisten, bridges)

The success of the implementation of the concept of *livability* in the centre of Bitola will help to keep the economy viable, and enable more opportunities and better future.Our goal was to show that it is not only the automaton to be the sole answer to traffic problems in the middle sized cities.

However, for a successful implementation of the suggested concept a strong volition and powerful vision should be expressed by those who create the traffic policies and the common feedback, with a high sense for the needs and requirements of the local community – a path to true *livability*.

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