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"FACILITATING TRANSPORTATION POLICY MAKING THROUGH AN ORGANIZED TRAFFIC DATA CONTENT"

1. INTRODUCTION

1.1 BACKGROUND

During the past decades, cities and metropolitan areas have been the receivers of a mass urban migration, with the mega city being the trend of the future. Indicatively, the world urban population has expanded from 1.35 bil. to 3.63 bil. between 1970-2011, while an increase of 72%, namely 2.6 bil., is expected until 2050 (United Nations, 2012). The phenomenon of growth in the urban population goes hand in hand with an ever increasing demand for transport, and the latter one leads to an ever increasing congestion, energy consumption, air and noise pollution, as well as to the need to increase the sustainability of the transport systems (Musso and Corazza, 2006).

On the other hand, even more than heavy infrastructure investment, strategic mobility management is becoming one of the important tools for meeting the previously mentioned demand. The term mobility management is used for strategies that result in more efficient use of transportation resources and give priority to public transit, ridesharing and non-motorized modes, particularly under congested urban conditions (Litman, 2003). In order to be able to deliver effective travel plans and implement them towards a sustainable mobility, large amounts of information about the transport network are essential. Equally important for a sustainable, long-term planning and short term proactive and reactive management of the transport network, is the sound processing of the data and the delivery of indicators that will allow the analysis of trends, the modelling of impacts and the measuring of progress towards the achievement of a certain objective (Sustainable Transportation Indicators Subcommittee, 2009).

Currently, traditional and new methods are used to provide traffic data. However, integration of such data is necessary. Furthermore, the actual quality of the information is highly variable and even the best data sets are often incompatible with those created in other jurisdictions and agencies due to differences in definition and collection methods (Sustainable Transportation Indicators Subcommittee, 2009; BTS, 2012; UK DfT, 2012; VTPI, 2012).

In an attempt to assess the transportation information needs as viewed by policy makers, the TRB committee has cited the importance of “ready access to data – archiving in usable and standard formats, providing easy, web-based data access, sharing of data across jurisdictions and agencies, and maintaining long-term trend data sets”, as an answer to non-properly documented data (TRB, 2006). The committee also discussed the importance of transport data

for planning, building and operating transportation systems, presenting, at the same time, examples of cases where data contributed to making a decision feasible or better (TRB, 2007).

When road safety is concerned, the DaCoTA EU Road Safety Project recognized that the lack of sufficient and reliable data on road traffic incidents and injuries is a major limitation of road safety analyses and may significantly affect the potential for evidence-based policy making in the European countries, regions and cities. Indicators and qualitative information to use for international comparisons, has also been highlighted as a baseline in order set up priorities for action (Muhlrad and Dupont, 2010).

Within the aforementioned context, the need for an effective data system, producing timely, standard-based, responsive and understandable data and analyses for decision support can be underlined.

1.2 AIM OF THE PAPER

Addressing the need for high quality, integrated data that will facilitate transport policy and decision making towards a sustainable mobility, the primary aim of this research is to present an approach for a traffic and transport data information chain, from traffic data collection to policy making. This approach has been implemented as a case study of the project VIAJEO in the city of Athens, through the development of an Observatory for Public Authorities and Transport Planners.

The Project VIAJEO "International Demonstrations of Platform for Transport Planning and Travel Information", funded under the 7th Framework Programme of the European Commission, brought together various stakeholders with the aim to design, implement, demonstrate and validate a technological open platform in order to enhance efficiency of overall urban mobility. This platform supports transport operations, plans a wide range of traveller information services, delivers dynamic information through integrated traffic data collection and management and provides standardized interfaces that connect a variety of entities related to mobility services.

Within the activities of the project, the pilot city of Athens (being the unique European pilot site among Sao Paolo, Beijing and Shanghai) has implemented the following services:

1. Service A, which deals with taxi fleet management and traffic information, providing a dynamic assignment and navigation to taxi drivers, as well as alerts concerning traffic incidents on route.

2. Service B, which provides an end-user multimodal trip planning and traffic information by delivering multimodal routes and presenting traffic information (i.e. travel times, traffic flows, road accidents) to end users via web and mobile phone applications.
3. Service C, which establishes an Observatory for public authorities and traffic planners. The specific objectives and components of this service are outlined in the next sections of the paper.

More specifically, chapter 2 of the present paper describes the current transport set up of the city of Athens, in terms of available transport modes, traffic management centres, missing data, etc. and outlines the particular needs of the local transport and traffic planners, as these investigated under the activities of the project VIAJEO.

Following, chapter 3 presents the information value chain, which is described as the basis for the Observatory's architecture formulation, and it presents the Observatory, in terms of its architecture, major components and use by traffic planners.

Finally, chapter 4, as a concluding chapter, assesses the benefits of the particular service and provides recommendation for potential exploitation.

2. THE CASE STUDY OF ATHENS

2.1 SET UP

In Athens, the Greek capital, and its greater urban area (Attica region), since the latest 1990's and especially due to the Olympic Games of 2004, many projects have been funded that have contributed to the development of a modern region-wide transport network (Michaelides et al., 2010) consisted of six transit modes, namely the Underground Railway (metro), the Electric Railway, the Urban Railway (tram), the fleets of thermal buses and trolley buses and the Suburban Railway.

Although, currently, a significant percentage of the citizens' transportation in Attica is undertaken by the public transport modes (Figure 1), the predominant presence of the private car in the daily movements of the citizens has sharpened the problem of traffic congestion, air and noise pollution and energy consumption, especially in the city centre.

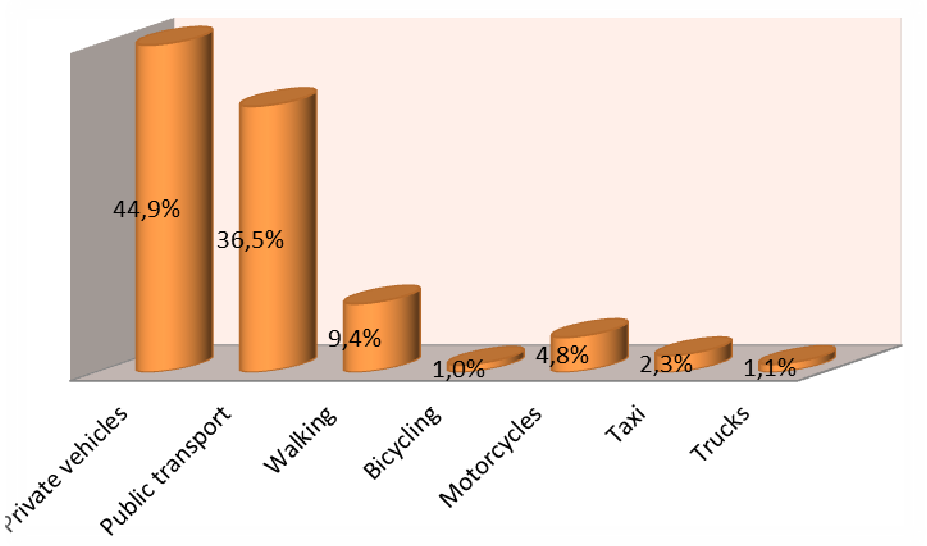


Figure 1: Allocation of the trips into the various transport modes within the prefecture of Athens (Source: Athens Urban Transport Organization, 2006)

As for the current situation of traffic data collection and provision, the following authorities/bodies are identified:

- The Athens Traffic Management Centre (ATMC), which deals with the monitoring of traffic conditions in main roads of Athens, the adoption of measures for dealing with emergency incidents (accidents, vehicles immobilizations, abstractions, works in progress, events, etc.) and the provision of real time traffic data to the drivers concerning the traffic conditions.
- The Traffic Management Centre of Attiki Odos S.A., which monitors the traffic conditions in the high-speed toll motorway of Attiki Odos.
- The Hellenic Statistical Authority (EL.STAT.), an independent authority under the control of the Hellenic Parliament that provides, among other statistics, the road accident related data, as well as census statistics on the vehicle ownership.
- The Athens Urban Transport Organization (OASA), the authority responsible for the Attica region mass transport, which offers up-to-date public transport data (schedules and network) for all transit means to be used for commercial applications.

2.2 THE NEEDS AND PRIORITIES OF THE LOCAL TRAFFIC PLANNERS AND OPERATORS

During a survey that was conducted within the activities of the VIAJEO project (Kortsari et al., 2010) the views of transport planners and operators regarding the provision of traffic

information in the city of Athens were examined. The survey approached representatives of the public transport sector, namely the Ministry of Transport and the Athens Urban Transport Organization and representatives of the road sector, namely the Traffic Management Centre, the General Directorate of Transport Works and the Directorate of Road Studies. The main objective of the survey was to gather information on the needs, requirements and challenges in data, methodologies and tools concerning local transport management and mobility. The investigation focused on issues such as:

- the major challenges of the city of Athens related to traffic and the extent to which these challenges can be addressed by the construction of new motorways, roads and public transport systems;
- The significance and utility of Intelligent Traffic Systems (ITS) in the traffic management, as these perceived by the interviewees;
- The current use of traffic information, in terms of responsible departments/authorities and type of traffic data currently collected and provided to the users;
- Plans for traffic information and expected effects.

Concerning the mobility challenges that the city faces, all traffic planners that were interviewed agreed that the solution cannot be found in the construction of new roads, but in the better planning of the public transport network (that will, among other measures, include the extension of the metro lines and the improvement of the quality of transportation services), the better surveillance of drivers in the city centre (e.g. trespassers of bus lanes), the higher use of Intelligent Transportation Systems (ITS) (i.e. High Occupancy Vehicles (HOV) priority measures, extensive use of traffic information through Variable Message Signs (VMSs), etc.) and the provision of high-quality traffic information.

Concerning the latter, the traffic planners mentioned the accuracy of the information that is currently provided by the two traffic control and management centres and, therefore, they highlighted the various VMSs installed in Athens as currently being the most successful mean of real-time traffic data provision in the Greek capital. Nonetheless, previous studies in Athens Metropolitan area (Tsirimpa and Polydoropoulou, 2009) indicated that although a very high percentage of the drivers (end users) are aware of the VMS in Attica, only a small number of them (30%) stated that the VMSs have somehow influenced their overall travel behaviour. To the contrary, end users seem more willing to use information from other sources like radio, either prior to their journey or en route.

Apart from the above, the traffic planners placed particular emphasis on the need for data so as to ensure structured decision making. More specifically, a representative from the Directorate of Road Studies of the Ministry of Infrastructure Transport and Networks mentioned that the types and requirements of data needed for strategic transport planning

mainly concentrate on hourly traffic loads and raw data regarding peak hours, daily and seasonal traffic flows, and other relevant information. The officers from the Athens Urban Transport Organization mentioned that it would be very useful if a system was available that would process the existing data and provide indicators more appropriate for decision making. Finally, the representatives from the Directorate of Road Studies also stressed the need to expand the road network equipment for collecting traffic flows and the existing software for data processing, as well as the network for data transmission so as to ensure the interoperability between the existing traffic centres.

3. AN OBSERVATORY FOR TRANSPORT AND TRAFFIC PLANNERS AND OPERATORS

3.1 THE PROPOSED VALUE CHAIN OF INFORMATION FLOW: FROM TRAFFIC DATA COLLECTION TO POLICY MAKING

In the process of creating a service or system that provides information (primary or secondary), several parties, procedures, systems and channels are involved. According to: Herrala, 2007; Keskinarkaus and Haapasalo, 2004; Mäkinen et al., 2005, the value chain of information flow contains the elements shown in Figure 2, namely:

- the raw data that are delivered from the data provider, processed/analysed/maintained by the content provider (and/or the information provider) and directed by the service provider;
- the services, namely the service supplier, who is responsible for the overall marketing and dissemination, and the information channels, through which the service is publicized;
- The beneficiaries, namely the users, the system supplier, who is responsible for the services equipment and the system vendor who is responsible for the selling of the service.

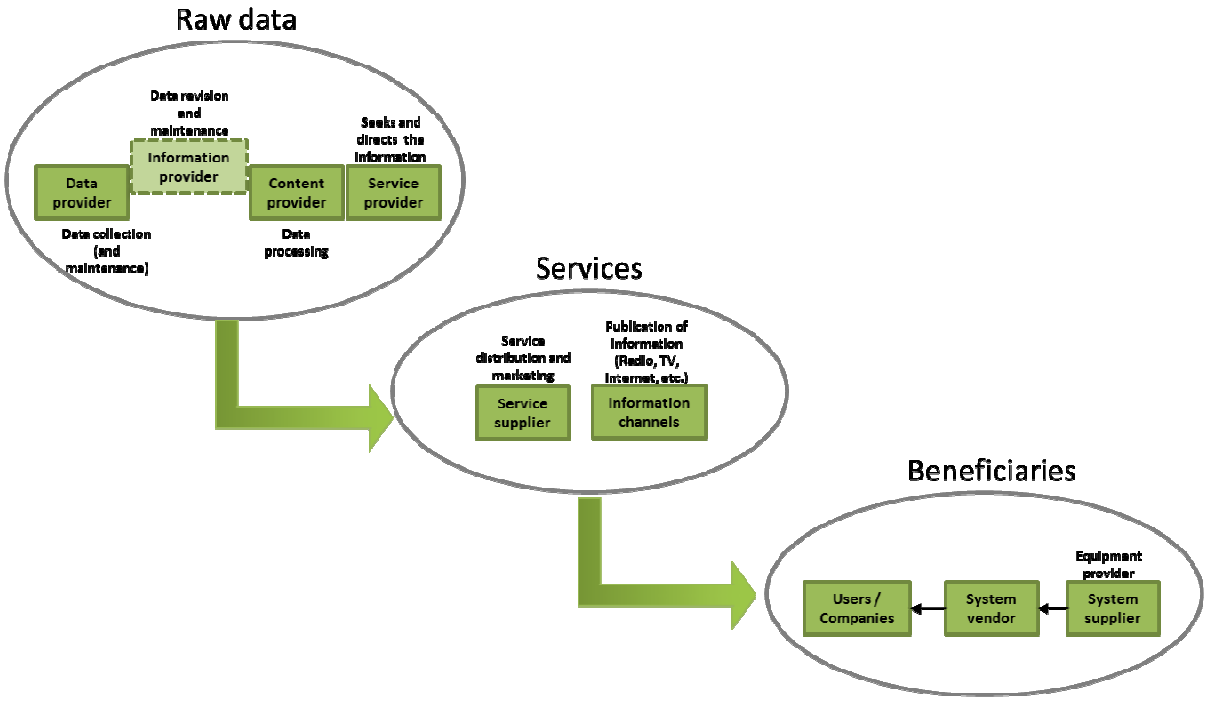


Figure 2: The value chain of information flow (source: Herrala, 2007; Keskinarkaus and Haapasalo, 2004; Mäkinen et al., 2005)

The aforementioned value chain of information services reveals the complexity of the entire process and the different parties that are involved in its various stages. Many efforts have been implemented in the past in an attempt to standardize and/or harmonize several aspects of the process and thus to create and interoperable, stable and robust chain of services, interfaces and processes. Any initiative to standardize and harmonize the entire process, starting from traffic data collection up to the contribution to policy making, needs to be based on the following three axes:

- **Data/indicators**: This axis mainly refers to the two ends of the value chain, i.e. from common data sets (raw data) that need to be collected up to the secondary information (indicators) that can be proposed to the users (e.g. traffic planners) in order to stimulate effective policy making. Within the past year various efforts to standardize and harmonize the data collection and processing methods have been made, either related to communication protocols (e.g. the Traffic Management Data Dictionary (TMDD), SIMONE for Floating Car Data) or software for transportation planning, travel demand modelling and network data management (e.g. VISUM, VISTA, etc.)
- **Communications**: This axis refers to the communication of the various data through standardized messages and interfaces between the various components of the value chain.

An example of a platform that uses standardized interfaces, such as DATEX II (DATEX Technical Group, 2011), is the VIAJEO open platform (Burkert et al., 2010).

- **Assessment methods:** This axis refers to the application of standardized practices and analysis methods/techniques for using the knowledge gained through the indicators and for supporting the decision-making process. Such practices include e.g. cost-benefit analysis (CBA), multi-criteria analysis (MCA) and computable general equilibrium (CGE) models.

In an attempt to specify further the proposed approach, Figure 3 depicts a simplified form of the value chain of information services with appropriately selected standards and guidelines.

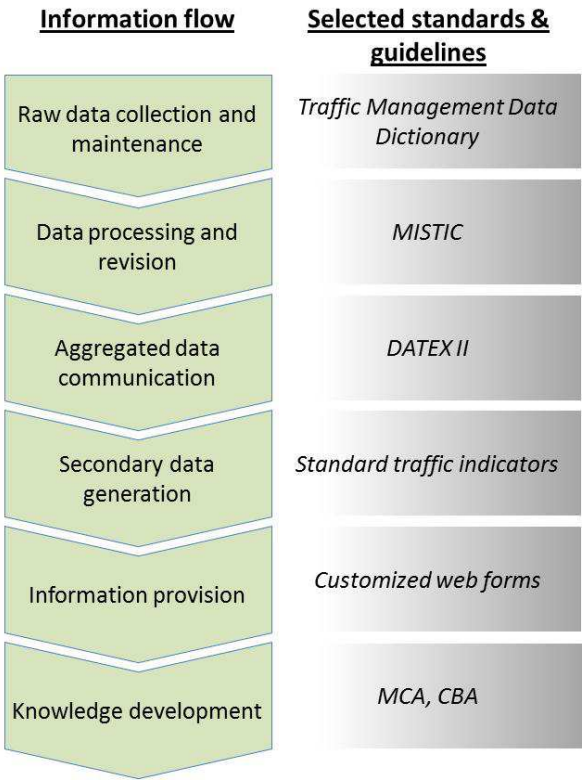


Figure 3: The proposed standardised approach from traffic data collection to policy making facilitation

3.2 Observatory System and service Architecture

The VIAJEO Observatory is a system for the management and processing of data and the provision of information to traffic and transport planners, public authorities and transport operators. The system collects data from various sources, archives them and combines them in order to produce traffic and accident related indicators that will help all interested stakeholders to estimate the status of the transportation system in the Attica region, to assess

the performance of various transport infrastructures and to support the transport policy making process.

The Observatory's architecture can be seen in Figure 4, where the system's internal and external components and entities are depicted. The information is collected in the form of raw data from the data providers (ATMC, EL.STAT.), processed/phrased into a usable format from the content providers (MISTIC, KOMVOS), further processed through the software routines that were developed for the calculation of the indicators and, finally, delivered to the users. MISTIC and KOMVOS represent the external entities of the system that feed the Observatory with processed data. MISTIC is a platform that integrates algorithms, applications, services and client engines in order to collect data from various sources, to process them and deliver information regarding the traffic conditions of the Attica region (Sarros et al., 2012). On the other hand, KOMVOS (PORTAL in English) is a web based application (currently possessed by the Hellenic Institute of Transport) aiming to provide data content and transportation services to all parties interested in the Greek transport system.

The Observatory's entities as well as the internal standardized processes for the data collection and analysis that were used are described in the following sections.

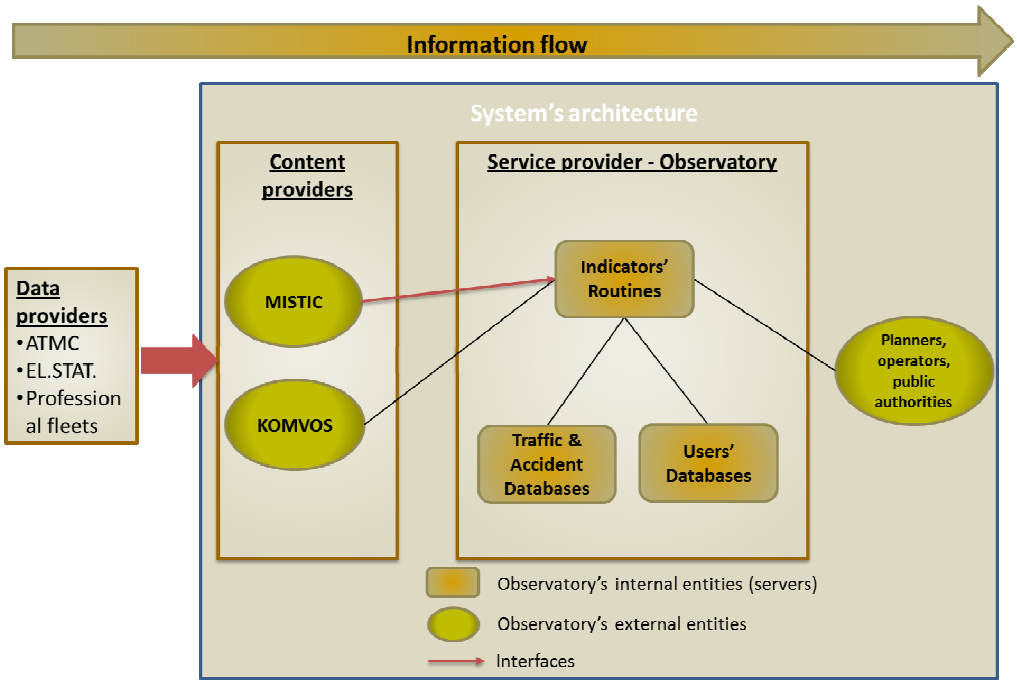


Figure 4: The VIAJEO Observatory's entities and information flow

3.2.1 Data providers

The raw data that feed the Observatory is provided by:

- The Athens Traffic Management Centre (ATMC), which provides traffic flow (veh/h), average speed (km/h) and road occupancy (%) per measurement point. The collection of the data and their archiving is done according to the standardized procedures, coding and databases that the ATMC has defined for that purpose. The databases from ATMC feed KOMVOS with historical traffic data and MISTIC with real time traffic data.
- The Hellenic Statistical Authority (EL.STAT.), which feeds KOMVOS with statistical data, namely: registered vehicles in Attica region; Attica's population data from the 2001 census; accident data (updated per year).
- Professional fleets. The VIAJEO Athens pilot site has implemented the collection of Floating Car Data (FCD) from telematics devices that were placed on taxi fleet vehicles. Since a standardized method to collect FCD does not exist, the VIAJEO partners decided on the adoption of the SIMONE protocol, as a widespread and well received (by the market) solution for the exchange of data (Burkert, et al., 2010). The FCD data sets are feeding the MISTIC module.

3.2.2 Content providers

The second level of the information flow regards the data processing that is done through the content providers of MISTIC and KOMVOS.

- MISTIC collects FCD and traffic data from ATMC through the communication protocols of SIMONE and DATEX II respectively, and it further processes this data, thus delivering a set of information to the Observatory, namely flow (veh/h), average speed (km/h), travel time (sec) and density (veh/km). These traffic characteristics are appointed to specific road segments (arcs) of the road network.
- Part of KOMVOS services is based on the traffic and accident related data provided by ATMC and EL.STAT. respectively. The data is retrieved by KOMVOS through web services. Dedicated databases have been created for that purpose, by using the ATMC coding and the EL.STAT. standards for the road accidents databases. A matching of the spatial reference of the accident data to the relevant polygons, lines and points of HIT's geographical reference system has also been implemented. In order to achieve the analysis of all data in a common georeference system, a similar matching was done between the arcs defined from the ATMC traffic counts and the GIS network of HIT.

3.2.3 Service provider – Observatory

The VIAJEO Observatory is a web-based application implemented under the URL: www.viajeo.imet.gr. The Observatory receives real time traffic data provided by MISTIC and historical data (i.e. traffic, accident and statistical data) from KOMVOS and process them through software routines in order to deliver aggregated data and a set of indicators for the traffic and accident conditions in the Attica region. Table 1 presents the transport, traffic and accident indicators that were defined and provided by the Observatory, clustered into four categories. The identification of the indicators was based on literature (Pajouh-Danech, 2001; Frantzeskakis & Giannopoulos, 1988), thus including basic traffic variables, such as the Peak Hourly Factor and the Average Annual Daily Traffic, but it was also based on indicators already provided by KOMVOS (i.e. road safety indicators). The routines for the calculation of the indicators were based on their definitions and their commonly accepted specifications.

Table 1: Transport, Traffic and Accident Indicators

No	Indicator	Description
Road safety indicators		
1	Number of reported accidents	Number of accidents including fatal, heavy and light injuries.
2	Region road safety indicator correlated to residents or vehicles	Total number of reported accidents of motor vehicles that include injuries (fatal, heavy, light) per 10,000 vehicles or per 100,000 residents.
3	Region road safety indicator correlated to accidents' conditions	Total number of reported accidents of motor vehicles per 10,000 vehicles (or 100,000 residents) and per road type (i.e. national road, rural road, municipal or community road, highway, speedway, other). Similar indicators refer to paving type, environmental conditions, paving conditions, paving state, night lighting, type of vehicles involved, accident type, manoeuvre type that caused the accident and type of traffic control.
4	Number of reported accidents per 1,000,000 vehicle km	Reported accidents (fatal, heavy and/or light) correlated to vehicle km.
5	Number of reported accidents categorized by the nature of accidents	Number of accidents categorized by the nature of accidents (vehicle-to-pedestrian, vehicles-to-vehicles, single vehicle, vehicles-to-pedestrian)
6	Death rate correlated to residents or vehicles	Ratio of reported deaths from motor vehicle accidents to number of vehicles or residents.
7	Pedestrian death rate correlated to residents or vehicles	Ratio of reported pedestrian deaths carried away from motor vehicles to number of vehicles or residents.
8	Region accident weight indicator correlated to residents or vehicles	Number of persons injured during motor vehicles accidents per 10,000 vehicles or per 100,000 residents (injuries categorized heavy and light).
9	Region accident weight indicator per 1,000,000 vehicle kilometers	Number of people injured in road accidents per 1 million vehicle kilometers. Injuries can be considered as fatal, heavy and light.

No	Indicator	Description
10	Network segment accidents weight indicator	Number of people injured (fatally, heavily or lightly) for a specific time period in a specific road segment.
11	Severity of accident	Number of accident including deaths in relation to the total number of accidents.
12	Road safety indicator based on the average speed	Number of total accidents reported in a specific road segment for a specific time period, categorized by the average speed.
13	Road safety indicator based on the road density	Number of total accidents reported in a specific road segment for a specific time period, categorized by the density of the road segment.
14	Road safety indicator based on the traffic flow	Number of total accidents reported in a specific road segment for a specific time period, categorized by the traffic flow.
Infrastructure and vehicle ownership indicators		
15	Road network open length indicator per 100.000 residents or 10.000 vehicles	Length of the network referring to a specific unit of reference of the region such as the population or the number of vehicles
16	Vehicle ownership per 100.000 residents	Number of vehicles per 100.000 residents in a specific region
Road traffic indicators		
17	Average traffic flow on a specific journey	The average traffic flow on a specific journey
18	Total time spent on a specific journey	The time taken to travel between 2 specified points, by a specified route, including any time taken by involuntary stops and delays. Calculated as the sum of the journey times of the sections (arcs) of the journey.
19	Average journey speed	The average speed on a specific journey
20	Average journey time	The average journey time on a specific journey. Calculated by the average journey speed and the total length of the journey.
Other traffic indicators		
21	Peak hourly factor indicator	The hourly volume during the maximum-volume hour of the day divided by the peak 15-minute flow rate within the peak hour.
22	30th maximum value of the hourly volume	The 30th maximum value of the hourly volume in a specific road segment during the period of one year.
23	Yearly variation of the volume	Percentage of increase or decrease of the Medium Daily Hourly Volume of a road segment for the same day between 2 successive years.
24	Average Annual Daily Traffic	Fraction of the total number of vehicles going through a specific spot or segment of the road during a year to the total number of days of the year.
25	Annual Daily Traffic	Fraction of the total number of vehicles going through a specific spot or segment of the road during a specific time period to the total number of days of the period.
26	Monthly variation of traffic	Comparison of the traffic flow in a particular road segment in various months in the same year or in the same month during different years.

The data exchange between KOMVOS and the VIAJEO Observatory is achieved through the replication of the data of the KOMVOS databases to the relevant databases of the VIAJEO Observatory that have been created for that purpose. This permits the automatic update of the VIAJEO Observatory data when an update on KOMVOS data occurs.

The data exchange among MISTIC and the Observatory is implemented through a standardized interface that uses the European DATEX II communication protocol for traffic data exchange.

Further to the above, the Observatory contains the users' databases, where the information provided by each user during his/her registration procedure is stored and maintained. These databases have been created and maintained based on HIT's standards and procedures.

The communication between the user and the Observatory is done through web forms defined by HIT, namely: user's preferences for raw data request; user's login; user's preferences for indicators; results.

3.3 USE OF THE OBSERVATORY

In order to be able to access the service, first the user has to register to the system and acquire his personal user name and password by providing (through web forms) a minimum set of personal data (name, organization, contact information, etc.).

Once logged in to the system and in order to acquire the provided information (indicators), the user has to select calculation criteria, which are mainly provided through drop-down lists. For the accident indicators, for example, nine areas of selection are included in the calculation form, from which the user can choose the indicator itself, the geographical and time-period criteria of his preference, the type of accident (fatal, heavy, etc.), the accidents' nature (vehicle & vehicle, vehicle & pedestrian, etc.), the report unit (100,000 residents, 10,000 vehicles, etc.), the accidents' conditions, the injured people conditions and whether or not the indicator will be based on the number of accidents or the people involved in the accidents (Figure 5).

Once all the necessary calculation criteria have been inserted, the Observatory returns the requested information in a table, while a map is used in order to visualize the selected area or road segment. The option of displaying the outcome in form of charts is also provided, along with the display of the yearly and monthly variations of selected indicators.

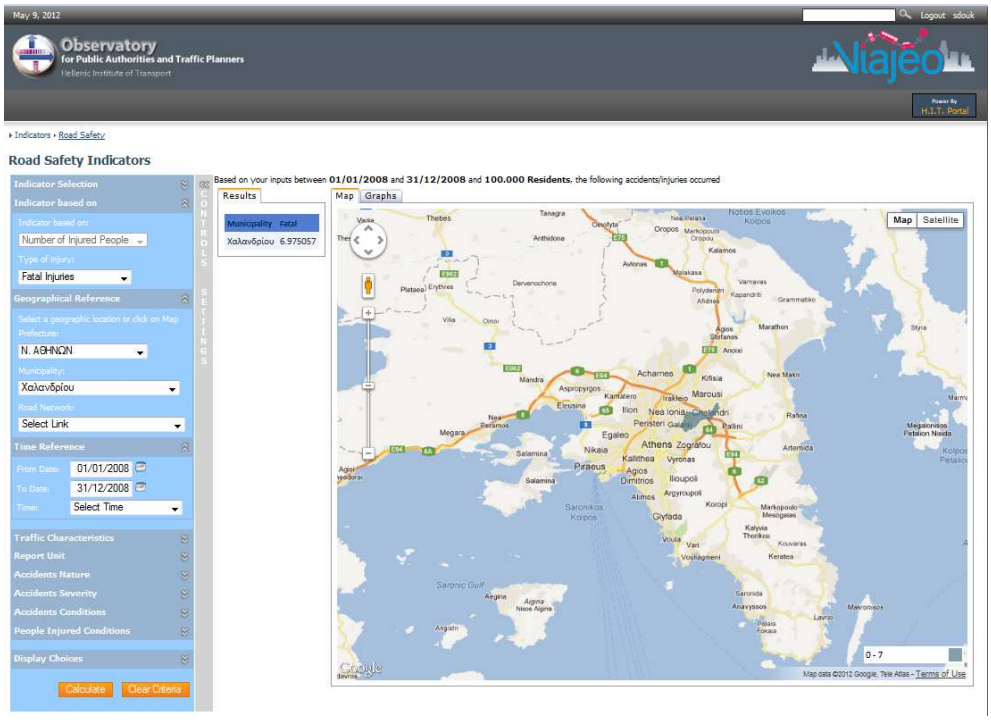


Figure 5: An example of an accident indicator provided by the VIAJEO Observatory

4. CONCLUSIONS

The need for the provision of high-quality traffic information has been widely recognized by the international scientific and business communities. High-quality traffic information is a strong prerequisite for knowledge development that would effectively stimulate the policy making process undertaken by traffic planners and decision makers. However, this is the anticipated end result of a long and complex process that starts from the traffic data collection and contains a series of parties, procedures, systems and channels. All these different and divers elements constitute the value chain of information services.

Many attempts have been made to standardize, harmonize or homogenize parts of this chain. The attempts have been focused, among others, on the communication between several components on the traffic data collection. To the Greek content, the traffic planners and transport operators that were interviewed for the VIAJEO purposes clearly stressed the need for data that would facilitate a robust transport decision making. Apart from the data collection, the transport and traffic planners also placed emphasis on the need for structured processes, as well as for the expansion of existing software and data transmission methods for the data among the traffic management centres.

The proposed approach covers three major data oriented elements of the information and decision making chain of policy makers: the data origin, the data communication and the data analysis and it is based on three axes: data/indicators, communications and assessment methods. Each of these axes includes and suggests specific standards and guidelines that are either proposed by the scientific community or by the industry and standardization bodies. The major advantage of this approach is that it follows a structured methodology for the entire chain of traffic information flow.

The VIAJEO Observatory is an example on how the proposed approach can be implemented in practice. The Observatory proposes a procedure for the collection of traffic and accident related data, their processing and the production of indicators for the monitoring of the traffic and accident conditions in the Attica region. This service adopts national standards for the raw data collection by the responsible authorities, European standards (DATEX II) for the exchange of data and indicators' specifications based on commonly agreed definitions. The set of indicators that were identified and integrated within the Observatory consists a proposal for the establishment of a standard set of information suitable for analysis by any (national) authority, organization or jurisdiction that has a twofold target: a) to exploit the information (indicators) itself, and b) to adopt standardized procedures for the production of transportation indicators and the related data collection and analysis practices.

On a policy making level, the transport and traffic related indicators and statistics, provided by the Observatory, could enable the clear definition of the problems/issues that the policy making should address, thus justifying the necessity of interventions and investments. They also provide those valuable data input in order for the policy/strategy options to be formulated (i.e. input for multi-criteria analyses), assessed and finally, successfully implemented, always in accordance to the performance information that is provided for the transport network in question.

Furthermore, defined transport and traffic indicators could measure the 'before' and 'after' situation, thus forming a valuable tool for the monitoring and evaluation of the policy measures that have been applied. They can also be used for scenarios building and assessment that will guide future investments on major transportation infrastructures.

The international and European transport community displays a variety of information tools that could support transport policy making through the provision of integrated data contents. Indicatively, the following are mentioned:

- OTIS the Online Transportation System of the Department of Transportation of Colorado (http://dtdapps.coloradodot.info/otis), which is an access point to information used for transportation planning and project development (it provides traffic counts and statistics, highway data, etc.).

- The ETIS and ETIS plus database (ETIS-BASE, http://www.etisplus.eu/default.aspx), which is a single online interface for accessing data (socio-economic, freight transport demand, passenger transport demand, cost, external effects).
- The UNECE database for road safety, concerning the pan-European region (http://www.unece.org/trans/main/wp6/transstatpub.html), which provides data on road accidents.
- At a national level, the NTUA Road Safety Observatory (http://www.nrso.ntua.gr/index.php/about-nrso.html) provides road safety knowledge (i.e. published scientific papers, research results, technical reports, etc.) and data (table and figures on road accidents, risk exposure and performance indicators).

These tools offer an organized structure of information, which can be used for decision making by transport policy makers. However, compared to the VIAJEO Observatory, they offer both a different content (data and indexes) and structure. For example, the NTUA Road Safety Observatory provides similar road accidents indicators (also based on the accident data provided by EL.STAT.), nonetheless structured in a different manner in terms of user interfaces and web forms. Since each information tool is tailor-made to suit the specific needs of its target group and to adjust its content to the available data, it is difficult to provide a comparative analysis between these tools and the VIAJEO Observatory. Nonetheless, it is worth mentioning that the VIAJEO Observatory is a new information service at a regional level that offers an important expansion of an existing system – KOMNOS - to the country's capital, providing, at the same time, one comprehensive access point both for traffic and accident data. Furthermore, it proposes standard procedures and interfaces for the collection and analysis of these data and provides traffic and road safety indicators based on commonly agreed definitions and specifications. The proposed standardized approach could be used as a reference model for both national and international similar approaches.

The Observatory was demonstrated to traffic planners and policy makers of the Athens transportation system, who had the opportunity to express their comments and opinions. The most important finding of this evaluation process was that the service itself provides a reference point for accessing aggregated and secondary data that will be useful for further analysis. The indicators and the way their results are shown were highly appreciated. They also suggested more and specific indicators that would be very useful to stimulate policy making. These will be integrated in a next version of the service. Finally, a strong characteristic of the Observatory is that many parts of it are based on standards and well known guidelines. According to the stakeholders, this can be proved the most important feature towards its future exploitation.

Concluding, the Observatory supports the provision of single-source, aggregated, accurate, comprehensive and up-to-date data in various forms (chart, maps, tables), thus addressing the

demand of modern transport planning in data availability and provision (an easy-to-access tool). Especially in the era of economic recession, where major infrastructures are difficult to be implemented, the need for smart and cost effective solutions is ever greater than before. The effective exploitation of traffic information and the generation of value added knowledge through standards and guidelines, which are publicly available, presents itself as a valuable tool for promoting common procedures and mechanisms for the production of homogeneous transport information.

5. LIST OF REFERENCES

[1] BTS - Bureau of Transportation Statistics (2012). *Annual reports*, Research and Innovative Technology Administration - Bureau of Transportation Statistics.

[2] Burkert, A., M. Milli and D. Yannick (2010). *Deliverable D3.1: Detailed design of the integrated open platform*, EU Project VIAJEO.

[3] DATEX Technical Group (2011). *DATEX II v2.0 Modelling Methodology*, European Commission - Directorate General for Mobility and Transport.

[4] Frantzeskakis, J. & Giannopoulos, G., 1988. *Transportation Planning and Traffic Engineering, Volume 1: Basic Principles.* 3rd ed. Athens: Paratiritis.

[5] Herrala, M. (2007). *The value of transport information*, Finland: VTT Technical Research Centre of Finland.

[6] Keskinarkaus, J. and H. Haapasalo (2004). *Transport telematics business model description*, Oulu: University of Oulu-Department of Industrial Engineering.

[7] Kortsari, A., Y. Tyrinopoulos, V. Mizaras, G. Sarros, M. Milli and F. Psomadelis (2010). *D6.1.1 Investigation.* EU Projet VIAJEO.

[8] Litman, T. (2003). *Sustainable Transport: A Sourcebook for policy makers in developing cities, Module 2b: Mobility Management*, Germany: GTZ Transport and Mobility Group.

[9] Mäkinen, J., P. Mol and J. Leinonen (2005). *Market study of dynamic traffic information*, Finland : ITS Finland.

[10] Michaelides, P., A. Belegri-Roboli and M. Theocharis (2010). Evaluating the technical efficiency of trolley buses in Athens, Greece. *Journal of Public Transportation,* Vol. 14, pp. 93-123.

[11] Muhlrad, N., Dupont, E. (Eds.) (2010). *Consultation of a panel of experts on the needs for data and technical tools in road safety policy-making*. Deliverable 1.1/4.1 of the EC FP7 project DaCoTA.

[12] Musso, A. and M. Corazza (2006). Improving Urban Mobility Management: Case Study of Rome. *Transportation Research Record: Journal of the Transportation Research Board,* Vol. 1, pp. 52-59.

[13] Pajouh-Danech, M., 2001. Road traffic indicators as a performance guide. *Traffic Engineering & Control,* 42(9).

[14] Sarros, G., M. Chatziathanasiou, M. Milli, Y. Tyrinopoulos, V. Mizaras and L. Locuratolo (2012). *Deliverable D6.1.3 Athens demo site design and implementation,* EU Project VIAJEO.

[15] Sustainable Transportation Indicators Subcommittee of the Transportation Research Board (2009). *Sustainable Transportation Indicators: A recommended research program for developing sustainable transportation indicators and data.* Washington D.C.

[16] TRB, 2006. *Transportation Information Assets and Impacts - An Assessment of Needs,* Washington DC: Transportation Research Board.

[17] TRB, 2007. *Information Assets to Support Transportation Decision Making,* Washington DC: Transportation Research Board.

[18] Tsirimpa, A. and A. Polydoropoulou (2009). *Travelers response to VMS in the Athens area.* Istanbul: Dogus University, pp. 179-187.

[19] UK Department of Transport (2012). *National Statistics Quality Review Programme,* UK Department of Transport.

[20] United Nations (2012). *World Urbanization Prospects, the 2011 Revision,* New York: United Nations, Department of Economic and Social Affairs, Population Division.

[21] VTPI - Victoria Transport Policy Institute (2012). *Transportation Statistics,* Victoria Transport Policy Institute.