MEASUREMENTS WITH TRAFFIC COUNTER IN CITY LOGISTICS IN LJUBLJANA

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Abstract

City supply is one of the most highlighted topics in modern logistics. The main goal of research activities is consolidation and reduction of transport needs, lowering energy consumption, air and noise pollution, etc. The goal of our Tracy R&D Project is to invent an appropriate, flexible and low-cost traffic counter tool to support scientific research, decision making process and evaluation of actions made by city authorities. In our essay we present a possible application of Tracy tool in the Slovenian capital.

Keywords: City supply, traffic counting, measure

1. IMPORTANCE OF THE TRAFFIC VOLUME IN CITY LOGISTIC

There are many topics appearing in the scientific literature related to city logistics research like efficient supply chain, improved infrastructure and reduced logistics costs. Topic of economy and feasibility means growth in service, sector attract, investments and new jobs. Topic of urbanization covers efficient and reliable supply and sustainability. The topic of traffic means less trucks, lower congestion, intelligent routing and higher truck utilization and the final topic, environment, covers improvement of life quality, noise reduction and air quality improvement.

Taniguchi et al. defined City Logistics as “the process for totally optimising the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy.” (Taniguchi et al., 1999) (Taniguchi et al., 2001)

Reference (Benjelloun & Crainic, 2009) said that City Logistics aims to reduce the nuisances associated to freight transportation while supporting the sustainable development of urban areas. It proceeds generally through the coordination of shippers, carriers, and movements, and the consolidation of loads of different customers and carriers into the same environment-friendly vehicles.

Most authors describe city logistics in the frame of transportation or freight delivery. Reference (Dizan et al, 2012) stated that logistics is vital to the life of cities and their residents. It is a major provider of wealth and a source of employment. Large logistics facilities, serving increasingly national and international markets have become a crucial element of dynamic metropolitan economies.

The next definition that comes really close to what we are researching was stated by Reference (Awasthi & Chauhan, 2012). It says that “City logistics is that part of the supply chain process that plans, implements, and controls the flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customer’s requirements’’. The logistics associated with consolidation, transportation, and distribution of goods in cities is called city logistics. From a systems point of view, city logistics consists of many subsystems involving different stakeholders namely shippers, receivers, end consumers, transport operators and public administrators. The end-consumers are residents or the people who live and work in the metropolitan areas. Shippers (whole-salers) supply good to the receivers (retailers, shopkeepers) through transport operators (or carriers). Administrators represent the government or transport authorities whose objective is to resolve conflict between city logistics actors, while facilitating sustainable development of urban areas.

The existing studies on city logistics planning can be mainly classified into (a) survey based approaches, (b) simulation based approaches, (c) multicriteria decision making based approaches, (d) heuristics based approaches and (e) cost-benefit analysis based approaches (Awasthi & Chauhan, 2012).

In our paper, we are going to pay attention on traffic point of view and research. As Reference (Ehmke et al, 2012) stated, city logistics is about routing and scheduling logistics operations in urban areas. Concerning transportation, it seeks for approaches allowing for fast, accurate and reliable pickup and delivery operations as conducted by parcel services or waste disposal services. Nowadays, city logistics service providers have to consider dynamics within logistics processes, e.g., shorter delivery times, higher schedule reliability and delivery flexibility. Furthermore, service providers compete against other road users for the scarce traffic space of inner cities. In conurbanisations, traffic infrastructure is regularly used to capacity.

Realistic travel time estimations for the links of the traffic network are one of the most crucial factors for the quality of routing, since travel times in road networks heavily depend on network load, Network loads in urban areas are highly fluctuant with respect to different network links and times of the day, resulting in traffic jams. Hence, city logistics routing cannot rely on mere travel distances. For the most part, a single travel time value per link, as provided by today's digital roadmaps, only insufficiently represents the traffic situation.

City logistics routing requires time-dependent travel times capturing load fluctuations for each network link (Ehmke et al, 2012).

Travel time determination is a long established field of research. Traditionally, travel times have primarily been of interest in the context of modelling traffic flows and quality. The process of travel time determination consists of two basic steps. First, traffic flow data is collected empirically. Then, the collected data samples are analyzed and extrapolated in terms of traffic flow models providing travel times. The collection of traffic flow data is usually carried out by stationary sensors or by manual short-time census. Traffic flows in urban road networks are highly fluctuant with respect to different network links, times of the day and day of the week. In order to derive travel times for city logistics, area-wide data collection is necessary (Ehmke et al, 2012).

Data analysis is usually carried out by parameterizing data flow models by collected data samples, resulting in sped-flow diagrams or daily curves of traffic flows. However, traffic flows on urban main streets are subject to a large variety of influences leading to modelling obstacles. A detailed reconstruction of travel times from traffic flow samples is complex. In sum, the provision of reliable travel times for city logistics routing is a challenging task and valid approaches are rare (Ehmke et al, 2012).

2. THE ANDROID BASED APPLICATION: TRACY

The measurement is an essential part of the modelling and simulation process, what makes us possible to realize problems and bottlenecks, to generate input parameters and to validate the designed simulation model.

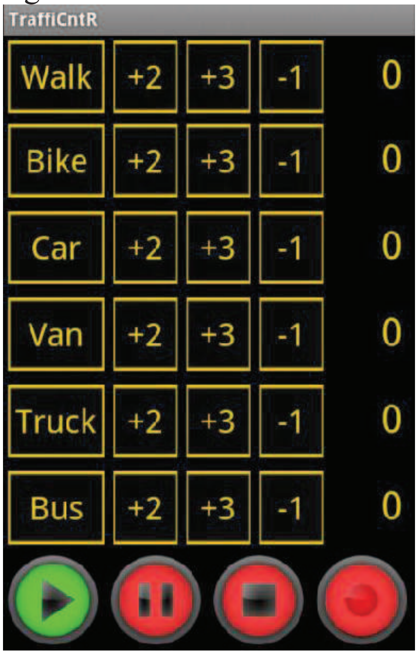
Although measurement and monitoring has a key role in the innovation process these activities usually got only little interest. Many possible solutions are available from in-built recognition systems and video-observation to the paper-based hand-writing applications. The widely used traffic counter systems and methods have many disadvantages, like time demand of the data digitalization or huge installation cost.

We developed the Tracy System in Szabó-Szoba R&D Laboratory, Győr under the Android platform, running on tablets or smart phones. The goal was to develop an innovative traffic counter system, which is able to replace the old paper based systems. The data collection is much more exact and processing of data is easier. There are no special logistics skills required by the observers, but on the other hand the application is powerful enough to have the capacity of gathering sufficient data in the real time window.

The application is flexible and modular, as a result we can measure different vehicles with different focus, different places, and special measures (like how many people are in the car, or the cyclist wear a helmet or not, etc). The system save all the data with time stamp, as a result we can analyze the time distribution of traffic, and listen the voice file recorder by the application. On this way it is possible to make audio-comments related to unpredictable events during the measurement. With this system we can see the time periods between the vehicles and we can follow the daily traffic distribution.

Data gathered with Tracy can be used for different purposes such as recognizing the traffic flow on different points, crossroad's load and maximum capacity of vehicles on a certain road.

Figure 1: TRACY screen



Source: (Hodosi et al., 2013)

3. CASE STUDY: CELJE, LJUBLJANA SLOVENIA

Case study of Celje was made for the purposes of the test one of the new invention of the laboratory. The idea or the main problem in the city of Celje is a number of delivery vehicles in the city centre, next to the mall, route between the highway and city centre.

The test environment was chosen by a local experience about a critical intersection. On this road our hypothesis was that we will able to show the traffic distribution from the data of the vehicles which leave the intersection, that is the reason why we measured from different directions.

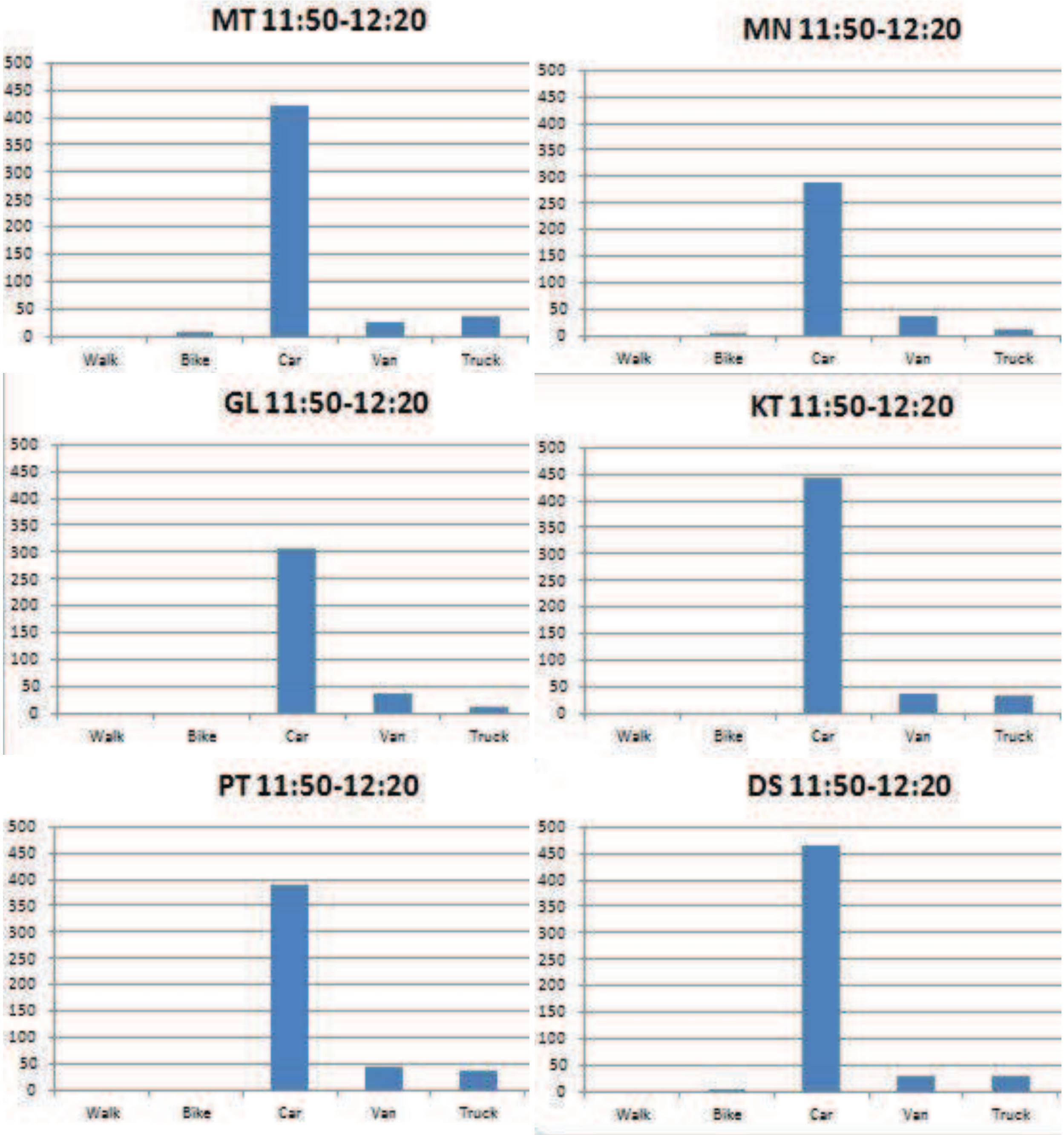
Figure 2: Observers on the road

Source: Google Maps, [available at: http://maps.google.com acess: 15.09.2013], own editing

The test started with observation and then measure on the road and in the intersection. The test measurement was held through 30 minutes, started from 11:50 and finished at 12:20. The weather conditions were sunny and clear, and the date was 22nd of may, 2013. Every point were measured only one direction not one lane, as it has shown on Fig 2.

The data what we got, shows that we can count the traffic distribution for an intersection from the data of the vehicles which leave the crossroad.

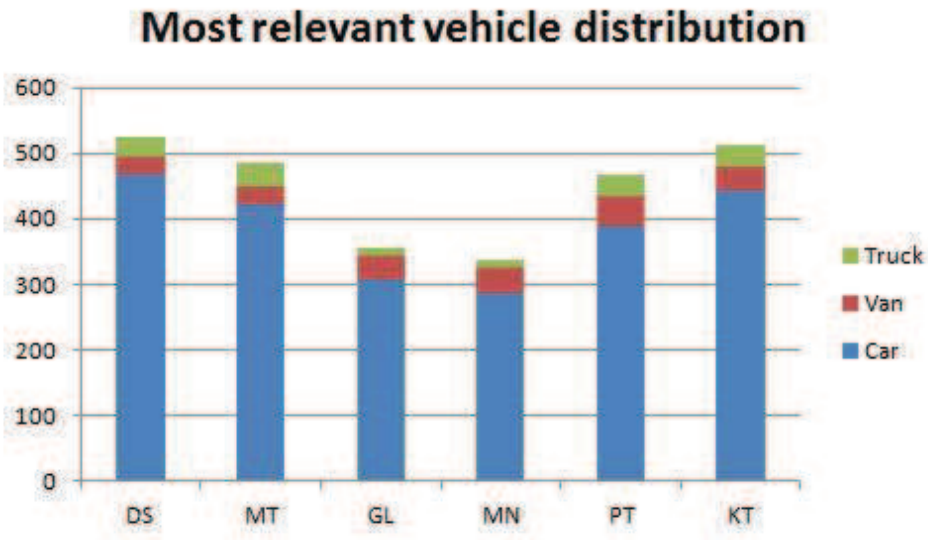
Figure 3: All vehicle distribution on each measured point.



Source: own study

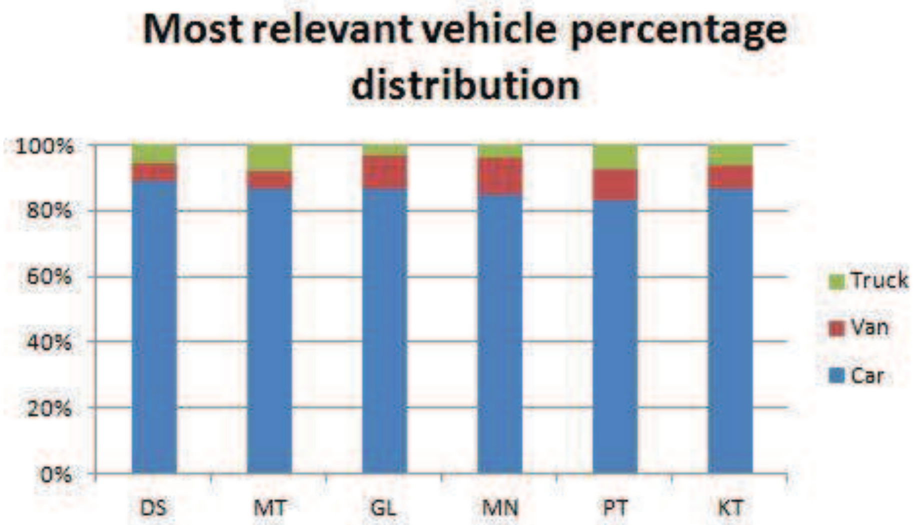
We also collected the 3 most relevant types of vehicles in our case. Which are the cars, vans and trucks.

Figure 4: Most relevant vehicle distribution



Source: own study

Figure 5: Most relevant vehicle distribution in percentage



Source: own study

We can conclude that most of the trucks are going to the city centre from the highway or back and most of the vans are heading on the parallel road with the highway.

Case study of Ljubljana was made for the purposes of the diploma thesis of one of the members of the laboratory. The idea or the main problem in the city of Ljubljana is a number of delivery vehicles in the city centre itself.

We developed few possible ideas or solutions about the delivery in the centre of Ljubljana. For that purpose, we intended to test our hypothesis about the number of vehicles going to the city centre and to simulate the traffic flow in the time dimensions and the number of different vehicle types. In this chapter we can see the Ljubjlana measurement time distributions, using the Tracy app.

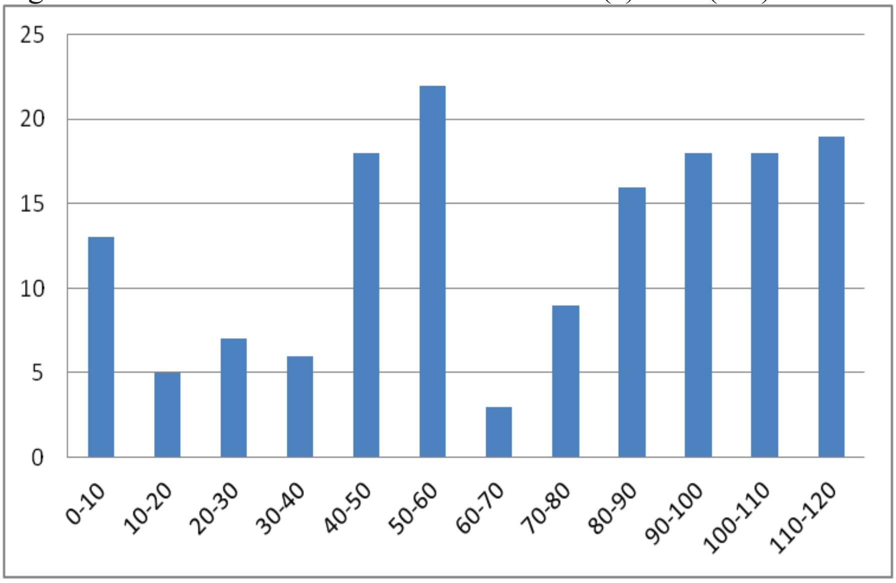
Their vehicles enter the centre quite frequently during the week and there are also a few vehicles entering that are taking care about maintenance. Mail is delivered with bikes or motorcycles (in Tracy, we put bikes and motorcycles as one type of transport), but we should add that the large packages are still delivered by cars or small vans. Delivery to the stores or restaurants is held by different (logistics) companies or owners of the places, which means, that there are cars or vans driving into the city centre. As we can see, regarding to the politics of the city centre that this should be pedestrian-only area, there is still a lot of traffic involved (Hodosi et al., 2013).

Figure 6: Observers in the city centre

Source: (Hodosi et al., 2013)

Next step was the measurement of the vehicles entering the city centre. With these measurements we wanted to test the hypothesis mentioned above and to gather sufficient data to propose possible solutions. Measurement was made in the morning, from 6.00 AM to 8:00 AM because that is the time of the delivery peak. We measured the incoming traffic on 7 different measuring points, for which we know from personal experience, drivers use for the entry into the city centre to make deliveries. We put our focus in this case only for van distribution.

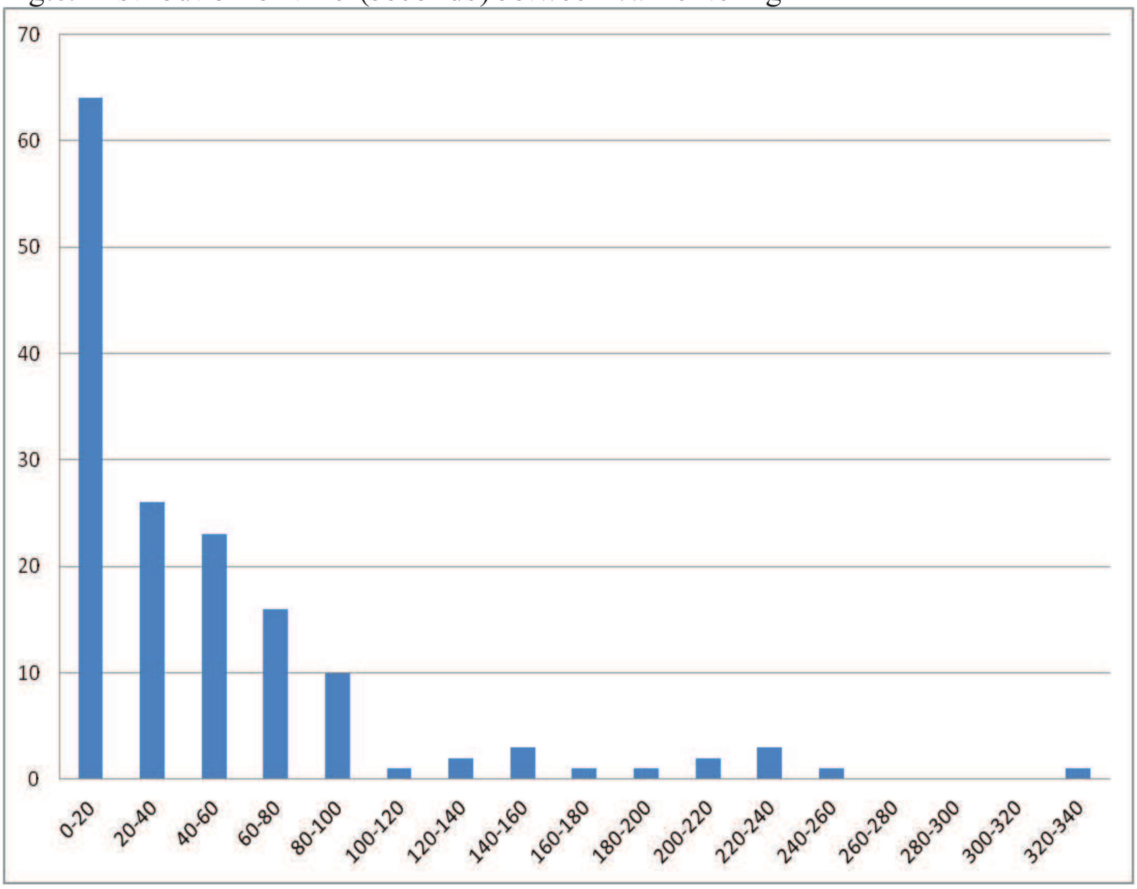
Figure 7: Distribution of Van arrivals from 6 (0) to 8 (120) AM



Source: (Hodosi et al., 2013)

Considering congestion and waiting time problems a lot depends on the arrival time of the delivery vehicles. As can be seen there is a gap between 6 and 7 (10-40 minutes) and the constant 15-20 vehicles / 10 minutes level arrive after 7:30.

Fig.8. Distribution of time (seconds) between Van entering



Source: (Hodosi et al., 2013)

What is more, we should focus on the time distribution between the vehicles entering into the city centre. In the rush hours more than 60 arrivals are in less than 20 seconds after each other (cumulative data, all entering points included) In spite of the fact that there was no serious congestion during the measurement we can highlight the need for city supply planning and re-designing discussion (Hodosi et al., 2013).

4. CONCLUSION

In our essay we presented the Tracy traffic counter monitoring tool we developed in Szabó-Szoba Laboratory, Győr Hungary. There is a real need to measure and analyze the traffic flow in city centres or focus for only a route, intersection or only for special type of vehicles and specifications as We illustrated on the example of Ljubljana city centre measurement case study. The Tracy system is a flexible and adoptable frame for further research and evaluation. Based on the measurements we opened some questions to discuss, like: How can we eliminate the traffic (vehicles such as vans, cars, etc.) in the city centre? What are the real alternatives for consolidation of goods in city supply? How can we reduce the level of carbon footprint? How can we use sustainable transport methods as alternative solutions due to environmental and noise pollution? In the frame of our further research we will develop the plotting board model of special city supply environments from different European countries and model the effect of innovative delivery methods.

The TRACY application family under continous development, to cover every field of traffic measurements.

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