MEASUREMENTS WITH TRAFFIC COUNTER IN CITY LOGISTICS

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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 processes and the evaluation of actions made by city authorities. In our essay we present possible applications of the Tracy system.*

Keywords: *City supply, traffic counting, measurement.*

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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 attraction, 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." [5] [6]

Reference [2] states 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 [3] 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 national and international markets have become a crucial element of dynamic metropolitan economies.

The next definition that comes close to what we are researching was stated by Reference [1]. According to 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 that live and work in the metropolitan areas. Shippers (wholesalers) 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) multi-criteria decision making based approaches, (d) heuristics based approaches and (e) cost-benefit analysis based approaches [1].

In our paper, we are mainly focusing on the traffic point of view and on-field research. As Reference [4] 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. [4]

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 analysed 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. [4]

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. [4]

2. TRACY ANDROID APLLICATION

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

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

The Tracy System was developed 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 can replace the old paper based systems. The data collection is much more exact and data processing is easier. There are no special logistics skills required by the observers, however, the application is powerful enough to have the capacity of gathering sufficient data.

The Tracy system is flexible and modular, observers able to measure different vehicles with different focus, different locations (from crossroads to roundabouts and traffic outbreaks), and we can perform special measurements (e.g. how many people are in the car, the cyclist wears a helmet or not). The system saves all the data with a time stamp, which allows us to analyse the time distribution of the traffic, and is able to record audio comments may special or unpredictable events occur. This system makes us able to monitor the time periods between the vehicles and we can also 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.

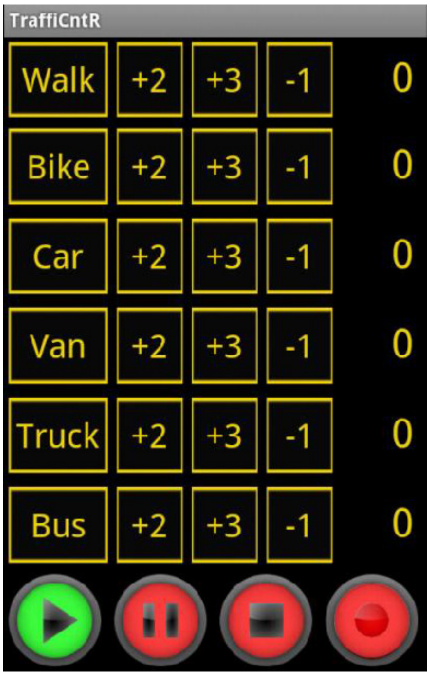

Figure 1. TRACY – FLOW screen capture

3. CUSTOMIZED SOLUTIONS WITH TRACY

In the near future, we are planning to convert the Tracy into a product line. The program can be used for numerous types of measurements on the road or railroad. The Tracy system covers all fields of transportation, and it is possible to customize the processes according to the field we need to measure. All of the sub-applications have the same advantages as the TRACY – FLOW, the only differences are the fields of studies and analyzations.

TRACY – FLOW

The Tracy flow is a cross-section traffic counter, with the function to distribute the vehicle categories and timestamps on each data input. The buttons on the screen are the official vehicle categories.

TRACY – BIKE

The Tracy bike is a measurement system, which concentrates on observing cyclists, with the focus on safety equipment, and rental bike usage. The buttons are customized according to the observation, therefore the followings: whether the cyclist has lamp, wears a helmet and vest or is it a rental bike or not.

TRACY – CARGO

The Tracy Cargo is a cross section observation platform similar to Tracy Flow, however, it focuses on cargo vehicles, such as different types of trucks, vans, and other types of commercial vehicles. The buttons are specified for cargo vehicle categories.

TRACY – FLT

FLT is the abbreviation of Fork Lift Trucks. The application is designed for warehouses and factories to monitor the fork lift truck traffic. These measurements may also be used to support WMS. With the Tracy FLT we are able to record forklift truck types, directions, and whether they are empty, half- or fully loaded.

TRACY – TRAINAPPROX

We can measure the passenger distribution in each section of the train from the pathway of the railway station. The observers check the train sections through the windows and choose a category from the previously declared ones. The pre-designed buttons are connected to the train capacity utilization categories.

TRACY – TRAIN

With the Tracy train, observers are measuring the passenger distribution at each door (e.g. how many passengers get on and off at a given railway station). The buttons indicate the doors (1, 2, 3, 4), and the number of get on or get offs.

TRACY – BUSAPPROX

We can measure the passenger distribution on buses from the pathway of the bus stop. The observers check the bus seats through the windows and record it through the previously declared categories. Buttons are connected to the bus capacity utilization categories.

TRACY – BUS

We can measure the passenger distribution at each door. We can measure how many passengers get off and how many get on at a given bus stop.

4. CASE STUDY

To test the Tracy system in a real-life environment, we measured the traffic flow in the city centre of Ljubljana. Logistically, the city is very unique, with only 7 roads leading to the city core, which is full of bars, restaurants and shops in needs of daily supplies. We set up a hypothesis that the number of delivery vehicles –especially during business hours - may cause traffic jams or congestions inside the city centre. In this chapter we are presenting our results we got using the Tracy – FLOW system.

During weekdays, numerous delivery vehicles enter the centre, in addition, there are few vehicles taking care of maintenance. Mails are delivered by bikes or motorcycles (in Tracy, we considered bikes and motorcycles as one type of transport), however, larger packages are still delivered by cars or small vans. Delivery to the stores or restaurants within the city core is executed by different logistics companies or owners of the places, which means, that there is a huge number of cars or vans driving into the city centre. Although the city centre is meant to be a pedestrian-only area – closed by automatized platforms –, as we can see, there is still a big amount of traffic inside the limits (marked with red on Figure 2).

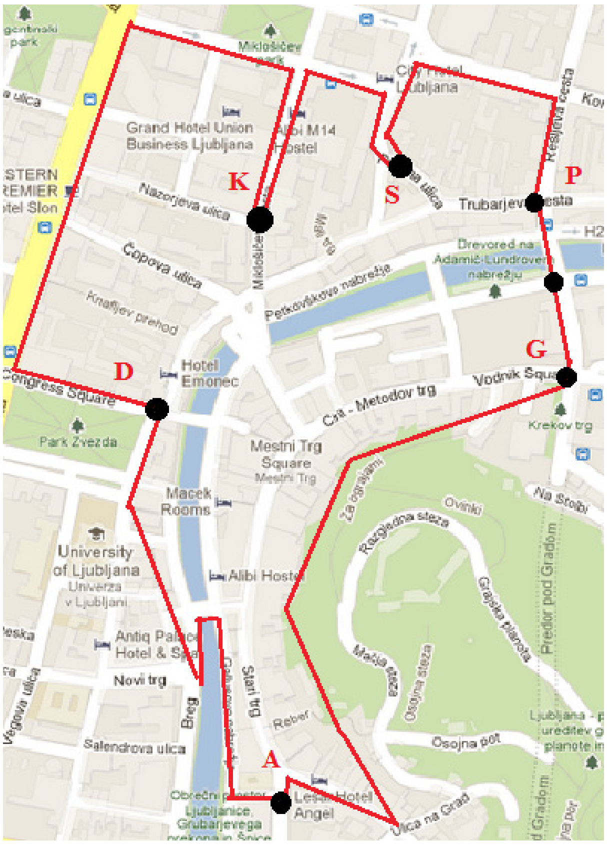

Figure 2. Observers in the city centre

After defining the main outbreaks (D, A, G, P, S, K) we measured the number of vehicles entering the city centre. Our goal was to test the hypothesis mentioned above and to gather sufficient data to – if our hypothesis proved to be right - propose possible solutions. Measurements were 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 the 7 different measuring points defined above. In this case, we put our focus only on van distribution.

Considering congestion and waiting time problems a lot depends on the arrival time of the delivery vehicles. As seen on Figure 3 there is a gap between 6 and 7 (10-40 minutes) and the constant 15-20 vehicles / 10 minutes level arrive after 7:30.

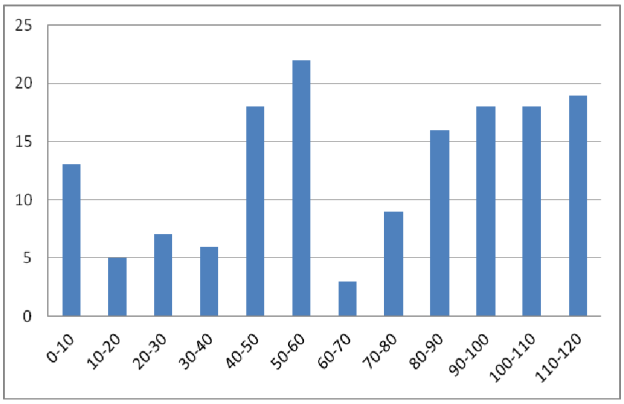

Figure 3. Distribution of Van arrivals from 6 (0) to 8 (120) AM

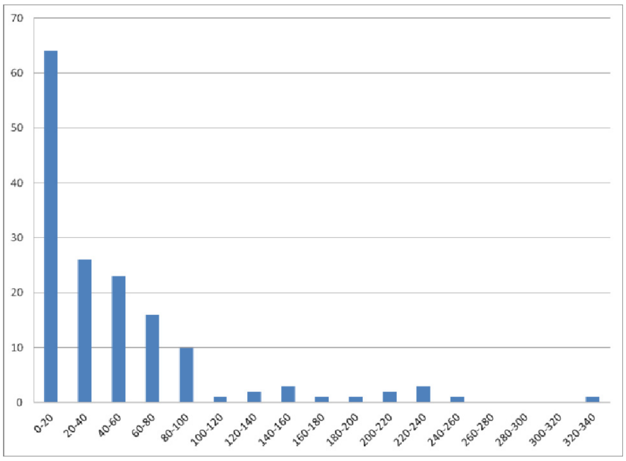

Figure 4. Distribution of time (seconds) between Van entering

In addition, we decided to focus on the time distribution between the vehicles entering the city centre. During the rush hours we recorded more than 60 arrivals 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 that there is a need for more accurate city supply planning and re-designing discussion.

5. CONCLUSION

The Tracy system is a flexible and adoptable framework which enables us to easily record data and additional information about wide variety of traffic and passenger flows. The customized Tracy applications are under continuous development in our laboratory, with the goal to cover every field of traffic measurements and support logistics decisions or re-designs.

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