TRANSPORT PROBLEMS 2016 Volume 11 Issue 1
PROBLEMY TRANSPORTU DOI: 10.20858/tp.2016.11.1.9

road accidents; road safety; statistical analyses; in-depth investigation on road

Katarzyna SICINSKA*, Anna ZIELINSKA
Motor Transport Institute
Jagiellońska 80, 03-301 Warsaw, Poland
**Corresponding author*. E-mail: katarzyna.sicinska@its.waw.pl

IN-DEPTH INVESTIGATION ON SCENE OF AN ACCIDENT – PILOT STUDY OF DaCoTA (ROAD SAFETY DATA, COLLECTION TRANSFER AND ANALYSIS) PROJECT

Summary. The article presents the procedure of in-depth investigation on-site of an accident data collection developed within the project DaCoTA (7th EU Framework Programme). Motor Transport Institute (MTI) participated in a pilot study to test practical usage of proposed methodology. The paper presents procedure, scope of collected data, analysis and the results of research carried out in Poland. After the end of DaCoTA, MTI continues in-depth data collection & analysis of Two Powered Wheel's accidents (with motorcyclists) as EU project named SaferWheels.

POGŁĘBIONE BADANIA NA MIEJSCU WYPADKU – PILOTAŻ PROJEKTU DaCoTA (ROAD SAFETY DATA, COLLECTION TRANSFER AND ANALYSIS)

Streszczenie. Artykuł przedstawia procedurę zbierania danych na miejscu wypadku, opracowaną w ramach projektu DaCoTA (7 Ramowy program UE). Instytut Transportu Samochodowego uczestniczył w pilotażu mającym na celu sprawdzenie w praktyce zaproponowanej metodologii. W artykule przedstawiono procedurę, zakres zbieranych danych i ich analizę oraz wyniki badań zrealizowanych w Polsce. Kontynuacją prac badawczych w tym temacie jest uczestnictwo ITS w kolejnych projektach pogłębionych analiz wypadków z udziałem motocyklistów w Unii Europejskiej (projekt SaferWheels).

1. THE STATE OF ROAD SAFETY IN POLAND – THE SCALE OF THE PROBLEM COMPARED TO EU COUNTRIES

Road Safety is a major societal issue on a global scale. In 2013 more than 30,000 people died on the roads of the European Union. For every death on Europe's roads there are an estimated 4 permanently disabling injuries such as damage to the brain or spinal cord, 8 serious injuries and 50 minor injuries [1].

The threat of road accidents in Poland is for years very high. Fatalities per million inhabitants in Poland despite the downward trend compared to other European Union countries is one of the highest (Fig. 1). There were 87 fatalities per million inhabitants in Poland in 2013. The average risk for European Union countries were 51 fatalities per 1 million inhabitants (Fig. 1) [2, 3].

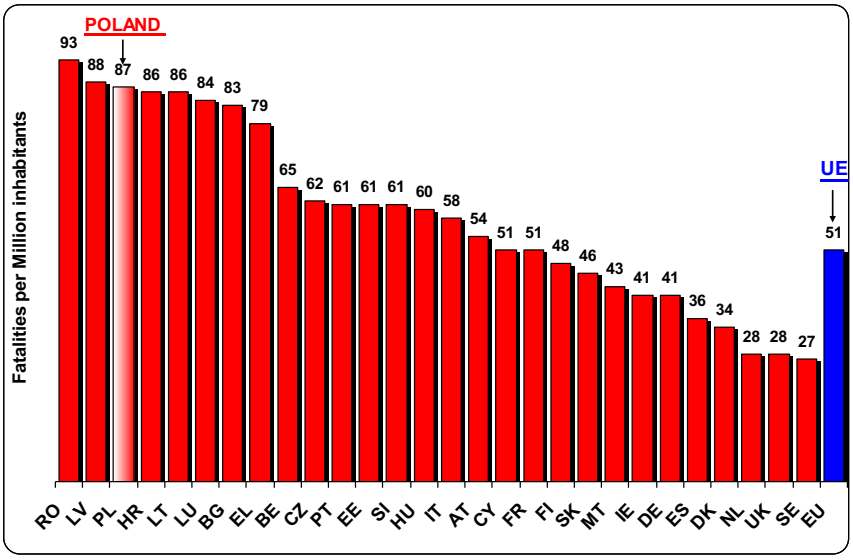

Fig. 1. Fatalities per million inhabitants by country in EU in 2013 [3]
Rys. 1. Ofiary śmiertelne wypadków drogowych na 1 mln mieszkańców w krajach UE w 2013 r. [3]

In 2013 the threat on Polish roads decreased [4,5]. In comparison with 2012:

- the number of road accidents decreased from 37 046 to 35 847 (-3%),
- the number of fatalities decreased from 3 571 to 3 357 (-6%),
- the number of injured decreased from 45 792 to 44 059 (4%),
- the number of seriously injured decreased from 12 046 to 11 672 (-3%).

Within the past 10 years, i.e. since 2004 (Fig. 2) has decreased:

- the number of accidents by 30%,
- the number of fatalities by 40%,
- the number of injured by 31%, including the decrease among seriously injured by 33%.

In 10 years period of time the number of vehicles in the Poland has increased by 62% [5].

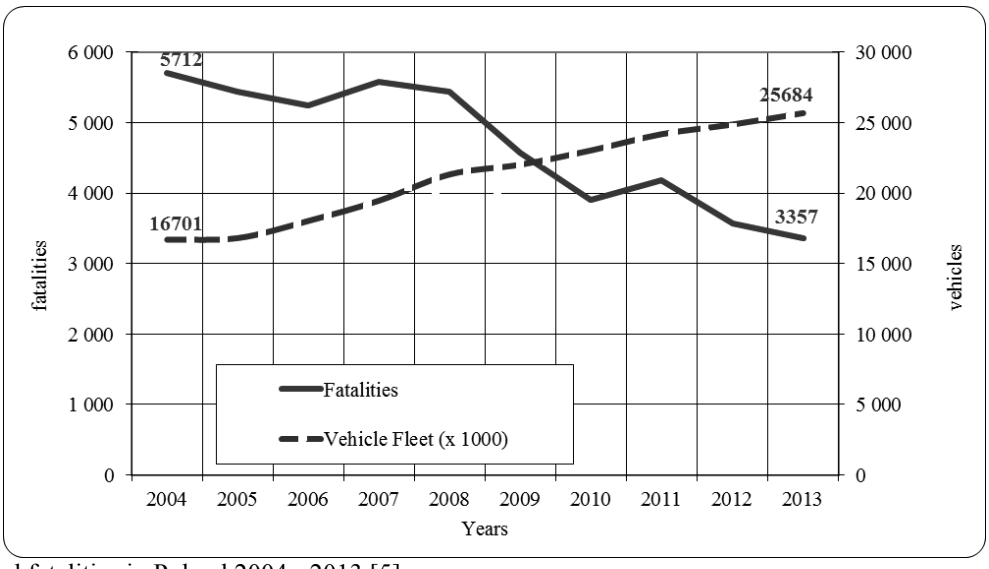

Fig. 2. Road fatalities in Poland 2004 - 2013 [5]
Fig. 2. Ofiary śmiertelne w Polsce w latach 2004 - 2013 [5]

With the exception of a slight increase in the number of victims in 2011, downward trend has maintained since 2008. Despite being optimistic, these changes have not met the objectives of the National Road Safety Programme, which assumed that in the period from 2010 to 2020 number of fatalities would drop by 50% and the number of seriously injured by 40%. This means that in the course of the implementation of the assumptions of the National Road Safety Programme 2020 (NRSP 2020) on Polish roads in 2020 should not be more than 2 000 fatalities and no more than 6 900 seriously injured people [6]. If this objective is to be achieved, each year should be followed by an average drop of 6.7% among fatalities. It means that there should not have been more than 3 193 fatalities in 2013 and no more than 9 861 seriously injured people (annual drop of 5 %).

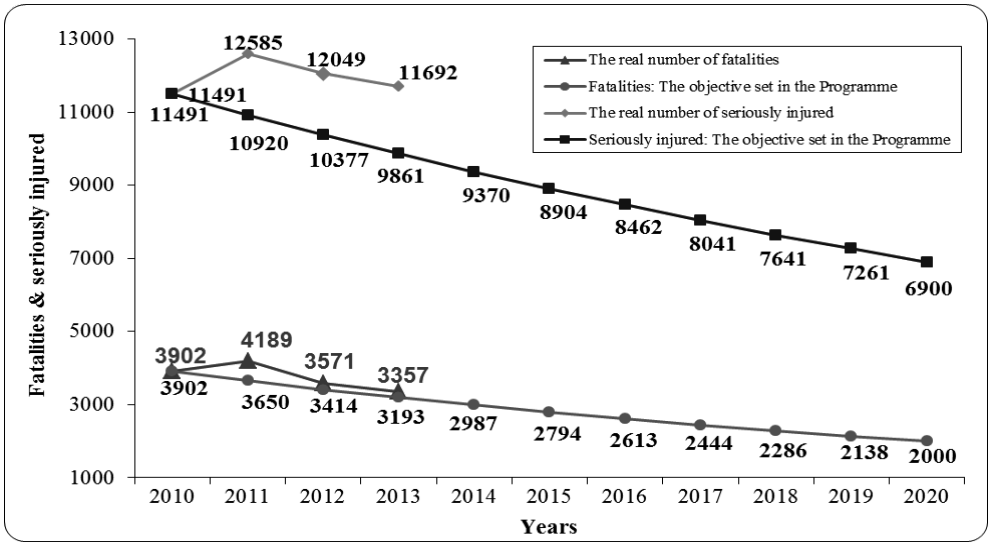

Fig. 3. The objectives set in National Road Safety Programme for 2010 - 2020 [6]
Fig. 3. Cele NP BRD w latach 2010 - 2020 [6]

Poland significantly approach achieving this objective in 2013 because there were 164 fatalities on roads more compared to the assumptions previously made (decrease by 14% as compared to 2010). In relation to set objectives, there is unfortunately small decrease in the number of seriously injured. There were too many of them by 1 811 (increase by 1.8% as compared to 2010) (Fig. 3).

According to police statistics the most frequent causes of road accidents for years in Poland are: exceeded speed, the right of way violation, improper behaviour towards pedestrians and drivers/pedestrians under the influence of alcohol. The most serious problem on Polish roads is a big threat to unprotected road users: pedestrians, cyclists, motorcyclists and moped riders.

Statistical data collected by the police are the base for determination of the scale of threats and identification of major road safety problems. Unfortunately police on scene of an accident has no chances or time for cause of the incident. The main task of police work is to assist victims, secure the accident site, control traffic (then the police collects data about the circumstances of the accident). Recreating the course of road accident and determining the perpetrators often is a task for forensic experts. Results from the forensic investigation are often not entered into the police database.

Therefore detailed and factual information from an independent perspective on what happens in a crash allows to gain an understanding of causes and consequences of most severe crashes. Such data can be a valuable source of information for manufacturers/constructors of vehicles, road designers and traffic managers but also those responsible for education and training, as well as policymakers.

2. IN-DEPTH ACCIDENT INVESTIGATION IN WP2 DaCoTA – DEVELOPING A PAN-EUROPEAN IN-DEPTH DATA INVESTIGATION NETWORK

In-depth accident investigating procedure based on the experience of several countries, was developed under the EU 7th Framework Programme project SafetyNet in 2004-2008. The procedure

has been improved and was tested in the project DaCoTA (Road Safety Data, Collection, Transfer and Analysis) Work Packages 2 Developing a Pan-European In-Depth Accident Investigation Network. The project was implemented in 2010-2012 [7]. DaCoTA Work Package 2 (WP2) was tasked with formulating a common methodology for research accident investigation and identifying and training new research teams across Europe. The main goal for WP2 was to harmonize in-depth crash investigation protocols and, at an EU level, identify and train crash investigation teams who were prepared for investigations according to these harmonized protocols. Crash investigation teams tested the DaCoTA methodology in a real life environment. So a Europe-wide in-depth pilot study was conducted.

2.1. Establishing in-depth accident investigation teams

WP2 DaCoTA project tested the possibility of establishing the Pan-European In-depth Accident Investigation Network (the "Network"). The Network created in DaCoTA consisted of teams from different European countries. Some teams have experience in-depth accident investigations, some have only been established for a short while so are still developing their skills and some are new teams that were created as part of the DaCoTA project. A map of the participating teams of DaCoTA project (Fig. 4) [8].

Fig. 4. Map location for teams participating in DaCoTA pilot study [8]
Rys. 4. Mapa lokalizacji zespołów uczestniczących w projekcie [8]

DaCoTA Network, methodology development and training were organised by the core teams who are the partners in DaCoTA WP 2. The investigation teams attended a week long training course held at the IDIADA complex in Santa Oliva (Spain) between 12th -16th March 2012. Both practical and theory sessions were used to train teams to conduct in depth accident investigations according to the DaCoTA methodology and use the DaCoTA database as the data entry tool.

During the training participants received guidelines for the investigation teams comprising general research principles and tasks of the research team. According to the DaCoTA principle investigating teams have to be independent (no representatives of other investigation services like police or prosecutors). They should consist of 6 people working on site of an accident to gather data for reconstruction (road, interviews, medical) in time of its occurring (on scene investigation) or after the accident (retrospective investigation). The team needed: vehicle and reconstruction specialists, psychology, person familiar with injury scale AIS, photographer and computer & database specialist.

2.2. Methodology of in-depth investigation accident on scene and range of collected data

Each Network team was asked to investigate 5 road accidents according to the DaCoTA methodology as part of a pilot study. First the in-depth accident investigation process required investigators to make observations and gather information to analyse the information to understand what happened and why. The methodology therefore covered both collection of data and case analyses. Data collection involved a wide range of activities such as making notes, measurements, interviewing people, collecting injury details from hospitals, taking photographs. As one of the most difficult task of an investigation was interviewing participants of an accident. The person responsible for this task should have some background in humans factor, psychology to ask correct questions. Personal security and safety of investigator during research operations on the road was paramount.

One of the principle of DaCoTA pilot study was establishing a good system of accident notification to arrive onto the scene within around 30 minutes of its occurring. Teams required to have agreements in place for access from police, hospital and others like: vehicle owner, injured. Gathered data must be fully anonymised, without any personal names, addresses, registrations numbers.

During an investigation process team should gather information concerning:

- Accident site (road, elements),
- Vehicles involved and theirs damages,
- Accidents participants (injuries & behaviour) and witnesses.

The purpose of in-depth research was to collect a set of core data describing accident to make case analysis and established cause of incident. The DaCoTA on-line manual for in-depth road accident investigators was prepared to indicate the scope, characteristics and practical requirements of the methodology as well as detailed information on all variables in the database. The system provided approximately 1500 variables (or fields) possible to collect in a case. Normally around 200 variables were needed to be collected to describe the overall accident and road characteristics [9]. The board range of data collected according to the instructions (on-line manual) and selection of accident investigation tools (forms, lists and diagrams) were store in crash investigation cases on - line application. The on-line application stored data in a structured and organized manner in a database. Finally the database allows the results of the case analysis for each accident to be stored (Fig. 5).
For the medical data the injury scale AIS (Abbreviated Injury Scale) was implemented, but only the maximal severity of injury (scale range 6) were put into the database.

2.3. Examination of the vehicles as an important data for reconstruction

The purpose of in-depth investigation is collecting all data describing accident, road and road users. Each variable has to be detailed collected and analysed to take precaution measures. All collected data provide a major contribution for reconstruction and allow to answer research questions due to the causes and consequences ongoing crashes circumstances. Information about people involved /vehicles position after the crush, all marks on the road are crucial for accident causation. One of the core variables to be mandatory collected is vehicle inspection with description of all types of vehicles involved in each accident. Photographic evidence of the vehicle interior and exterior have to be taken, as well as measuring and collecting data for interior and exterior variables (with pre-crash distractions: food, phone). Collecting on-scene data of the vehicle refers to general condition and damages, including specification, safety equipment performance and occupant. The data from the accident scene

including the position of the collision vehicles and objects allow to undertake reconstruction of crash. It requires vehicle crash profile measurements for calculating crash energy and speed change at impact. Measurements are taken due to the general impacts (frontal deformation, rear deformation, side deformation – left/ right, top deformation measurements impact) according to the "Collision Deformation Classification" (CDC). For each impact of the vehicle a CDC is coded. The deformation-depth/ width of vehicle measurement (in mm) is divided into six segments from C1 to C6 (Direction of Force, General Location, Horizontal and Frontal Location, Crush Extend). For each segment of deformations detailed measurements depth/width damages is performed. The horizontal location of the deformation is presented as an example of very detailed measurement from the Car Investigation Questionnaire.

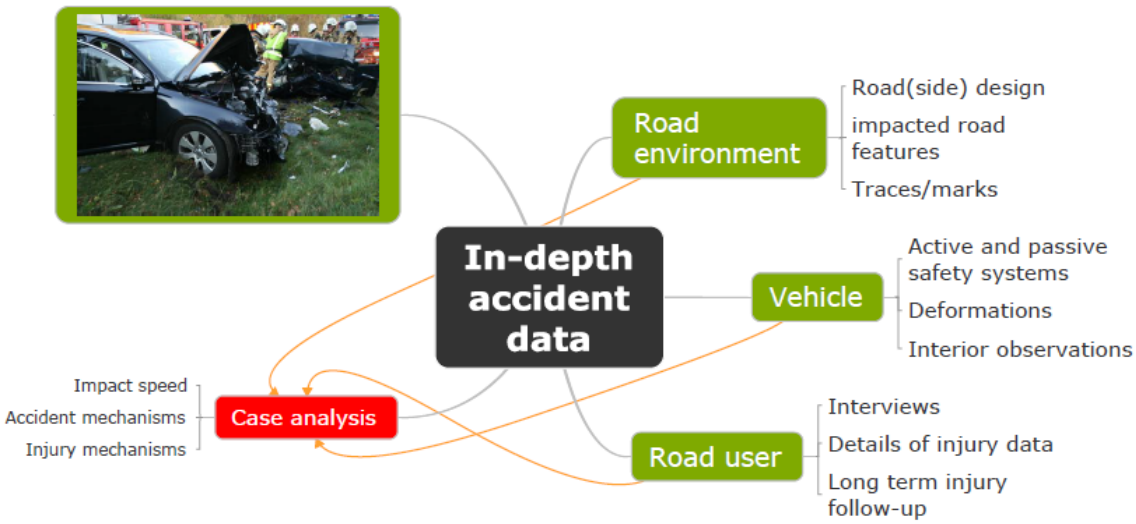

Fig. 5. In-depth accident data uses [8]
Rys. 5. Wykorzystanie zebranych danych z wypadku do analizy [8]

Deformation measurements on each segments, aaccording to the DaCoTA on-line Manual is taken with the rule, that C1 is always on the left side for a front or rear impact. C6 is always on the right side for a front or rear impact. C1 is always at the rear in a side impact. C6 is always at the front for a side impact. Measurements should be taken at frame height around the vehicle. For front and rear impacts this will be at bumper height and for side impacts at sill height. Fig. 6 below presents the detailed measurements of damages in the vehicle.

There is some example of rule described above. Fig. 7 presents the photograph and picture/sketch of real crash. Although the direct contact is only 77 cm, the measurable crush across the whole width makes damage width C1 to C6 as full width of the vehicle. Due to the sketch below the direct contact of a narrow pole impact is only 42 cm wide but transmitted forces have pulled the sills doors and other bodywork inwards making the damage width C1 to C6 to about 100 cm.

Damage width is the point of zero crush (or the end of the vehicle) on one side of the damage, to the point of zero crush (or the end of vehicle) on the other side of the damage. "Direct contact" is measure along the part of the vehicle that has come into contact with an object. Damage width (C1..C6) is a measure of all crush.

Accept notes of deformation and impact there are other information in the Car Inspections Form collected on-scene like: Vehicle Identification (Registration Number, VIN Number, Country of Registration), Conditions and Defects, Make and Model, Vehicle Geometry and Weight, Cargo. The check list of the equipment for examining the vehicle involves: tyre pressure gauge, road depth gauge, stands & rulers for measuring deformations, digital camera, magnetic arrows to indicate marks/deformations. The vehicle crash measurements profile allows to conduct detailed reconstruction, which includes guidance to use kinematic reconstruction and option in the coding of the crash.

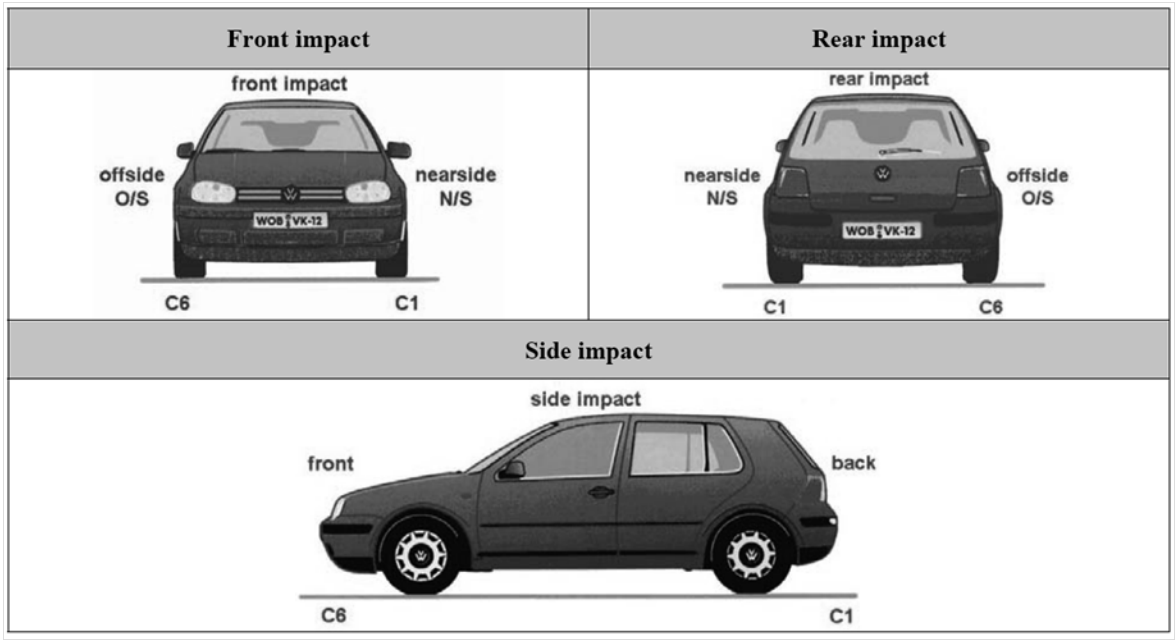

Fig. 6. The damaged vehicle measurements [9]
Rys. 6. Pomiary uszkodzeń pojazdu [9]

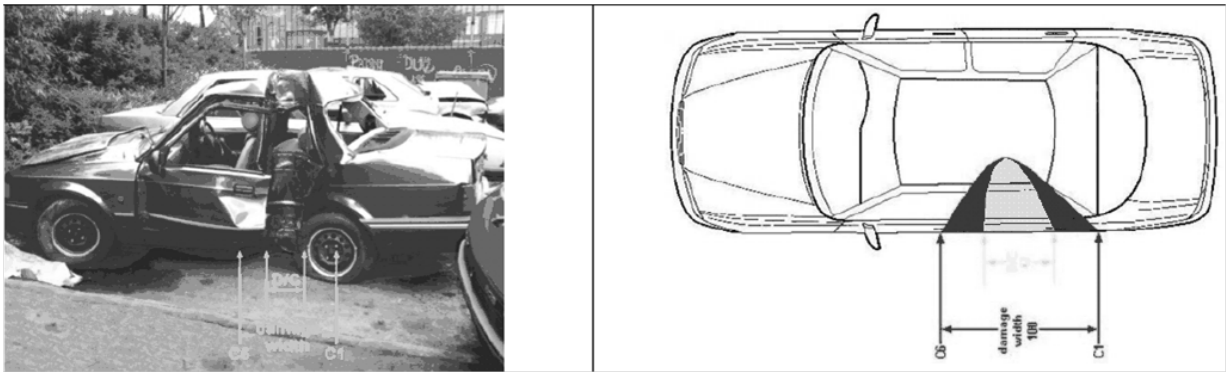

Fig. 7. Real crush and appropriate measurements on impact side [9]
Rys. 7. Właściwy pomiar wgniecenia po stronie uderzenia [9]

3. PILOT STYDY AT THE MOTOR TRANSPORT INSTITUTE IN POLAND

Poland was one of the 19 European countries carried out pilot study according to the methodology of DaCoTA WP2. Motor Transport Institute (MTI) as a Network organization, developed in-depth accident investigation, established team, investigators with Mrs. Anna Zielinska, team leader and co-author of her paper.

Polish pilot study on in-depth accident investigation of DaCoTA WP2 project was conducted in Radom (100 km from the Polish capital, city located in the province of Mazovia) between 14th and 28th August 2012. Trained 6 person investigation team got all necessary agreements from police and hospital and prepared Protocols and Form (in Polish language version) to collect data. Data on 5 road accidents was collected in the pilot study with 2 reconstructions cases. All investigation were conducted during the investigation on site. There was no reconstruction for 3 cases, because the rest position of damaged vehicles and their parts were unable to established as well as the point of collision. Those two variables are critical data in-depths investigation for reconstructions. Missing data unable to reconstruct 3 crushes. In the pilot study medical data of 2 injured were gathered, interviewed 8 roads users/ participants of incidents. Collected and complete data were entered onto the web-based

DaCoTA database. The other documentation were prepared to continue the research for further in-depth investigation. All questionnaire, with photographs, layouts, sketches from accidents' site of 5 cases were entered into on-line database. The Final Report No 6206/CBR on Analysis of road safety in Poland summarised the DaCoTA WP 2 project and pilot study performed by Motor Transport Institute [10].

3.1. Establishing investigating team and pre-departure preparations

The most important part of the pilot study was establishing necessary infrastructure including local permission for in-depth researches from the police, receive accident notification and agreements from hospitals for collecting medical data about injured participants. MTI obtained the Memorandum of agreements from Mazovian Police Headquarter in Radom. After getting all permissions, team investigating training, preparing 13 forms/ questionnaires (for data collection in Polish language and agreements for participating in DaCoTa WP2 project), acquiring all equipment and facilities to undertake pilot study activities, the team was ready to go on a scene.

3.2. Research on arrival on the scene

On arrival on scene of an accident according to the methodology of DaCoTA WP2 project research team has following tasks to:

- secure safety environment for investigating team (reflective vests, setting position of the vehicles),
- prepare to be ready forms & questionnaires and measurements equipment,
- observe & wait for the approval of police (and other on-scene authorities) to start collecting data,
- start to collect data with agreed labor division,
- exchange of information on established/collected data, uniform numbering for incident vehicles, participants, complete all notes and sketches separate for each case.
- complete the documentation at MTI.

While examining a vehicle the investigating team has to collect data in accordance with the form of Car Investigation Questionnaire, which are as follows:

- setting position of vehicles, vehicle data type, model, year, VIN, registration number,
- establish external deformations: impact deformation measurements: width/length of crushes, contact with the object (barrier, lantern, etc.), marks on the car body (by hitting road users, damage width), description of the damage caused by emergency operation on scene, photos,
- establish inside marks of the inspected vehicle, place of contact with the victim and components of a vehicle which caused injuries, marks on the road & environment before the collision: food, phone, etc.,
- inspect seat belts and safety devices for children (type, certificate), describe of damages,
- attempt to reconstruct phases of accident,
- make photographic evidence of the accident scene (marks on roads: braking/shards of glass/ body parts,/specially for transient data: blood), which enables the creation of a general description of an accident scene for detailed reconstruction and investigation.

Information collected for infrastructure conditions (road, environment) according to the Road Inspection Questionnaire included general info about the road/ hard shoulder geometry and design: address /road number and type; type/condition of the road surface; traffic organization, signs; speed limits; road conditions: traffic congestion; area type (built-up, undeveloped, residential, commercial, industrial); position of vehicles/ traces on the road/ hard shoulders - measurements; road component type (barriers) - damages; objects/obstacles on the road/hard shoulders hit during the incident – crushes.

3.3. Case study

There is a case study one of five accidents, according to the methodology of pilot project DaCoTA WP2 [10]. The accidents investigations were carried out in city Radom in August 2012. After receiving an accident alarm from the police the MTI research team arrived on scene within 30 minutes. The team consisted of:

- road & reconstruction expert (2 persons),
- vehicle expert (2 persons),
- psychology (interviewer),
- photograph.

An investigation has been carried out at the accident site. The case involved two types of vehicles: two trucks (Scania with a BODEX trailer and DAF) and one passenger car (Renault Megan Coupe). The duration of the visit at the accident site was 30 minutes, at the hospital 45 minutes. The rescue operation was attended by one fire truck and three ambulances. The causes of the accident according to the research team were the weather conditions and poor visibility. According to the description of the incident (made by the research team) the Renault Megan car turned left. On the left lane his engine stalled. The right front passenger door were struck by the Scania truck, travelling in the opposite direction. Passenger car was pushed into the second DAF truck, standing in the transverse street and waiting for a traffic light to turn right. There were three people in the car, all taken to hospital. The passenger of the Renault car seek medical attention who was diagnosed with cervical spine sprain; hip contusion; fracture of the thoracic vertebrae severing the spine. Renault driver experienced moderate pain in the cervical spine. Extensive interviews with the participants of the accident were carried out: with the injured Renault Megan passenger a telephone interview was conducted, which lasted 30 minutes, with her mother (a telephone interview lasted 2 minutes). There was an interview at the accident scene with a witness - DAF truck driver who was standing at the corner of the intersection, waiting to join the movement (duration of the interview ~ 5 min.)

The collected data on the site of the accident, rest position of vehicles after the collision, the damages of vehicles and eyewitness enable to perform precise sketch of the accident (Fig. 8) and undertake reconstruction. The great helped in this process was use of special computer program CybID V-SIM 3.0. software designed for traffic simulations and vehicle's crushes reconstruction [11]. There are some data collected on site for the reconstruction. The reconstruction Form SCANIA + trailer BODEX was made by CYBORG IDEA V-SIM. Vehicle type: fifth wheel tractor + Semitrailer; Engine: 12 000 cm^3; Weight: 40 000 kg; Length: 16 m initial speed of 75 km/h; Collision speed: 37 km/h; tolerance +/- 4 km/h. Source: tachograph. Type of vehicle: passenger engine 1600 cc; Weight: 1255 kg; length; 3930 cm; The initial speed of 14 km/h; speed at the moment of collision: 14 km/h tolerance of +/- 10% Source: PEG V-SIM.

4. CONCLUSIONS AND RECOMMENDATIONS

As a result of accident researches according to the DaCoTA WP 2 methodology concluded that the proposed method of in-depth investigations enables to gather much more information about the accident and its occurrences than can be obtained from police databases. The method of accident investigation provided a reliable base for the reconstruction of an incident and allow to assess the consequences of the accident (severity of injured participants). Investigators analyzed collected data to have credible response of accident causation. Unfortunately, the research organization with involvement of 6 high qualified experts makes this method rather expensive and difficult to implement.

The most important problem, before arriving on the scene of an incident, was obtaining the agreements from the police, prosecutors and medical services to access data in place. According to The Law on Personal Data Protection, gathering information for research purposes makes the process difficult and in many cases information are impossible to get (lack of hospitals' agreements).

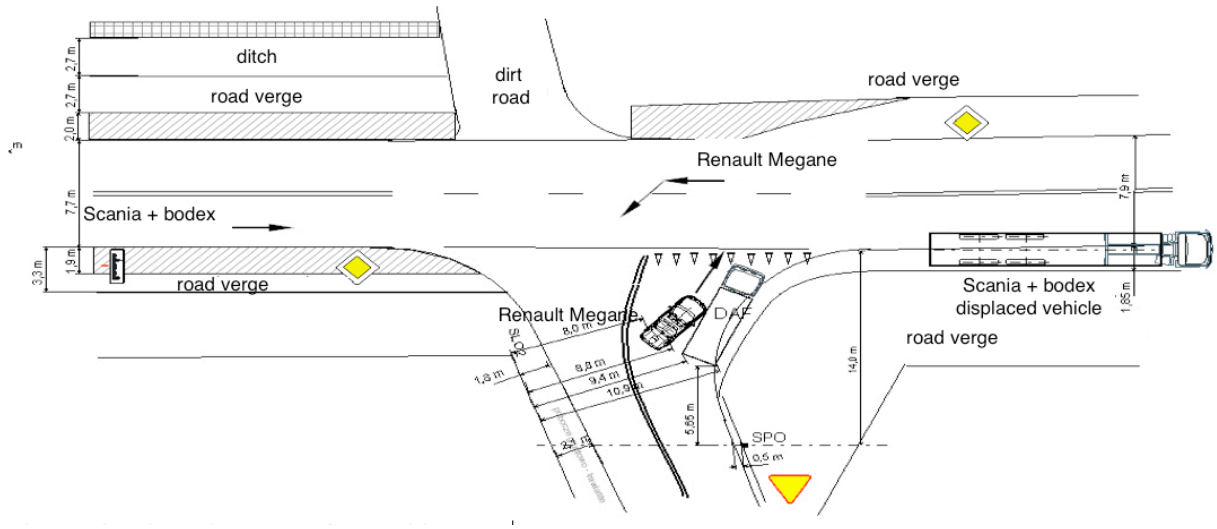

Fig. 8. Sketch on the scene of an accident [10]
Rys. 8. Szkic na miejscu wypadku [10]

Another problem was the access to the scene of the accident. Used by the MTI research team method of waiting for accidents that happen in the area, was too cumbersome (wasted of time and a negative ethic aspect). Conducting interviews with the participants of accidents (who mostly were very reluctant to undertake the conversation) were very difficult as well. Persons who caused road accidents were reluctant to any interview. Interviewing accident's victims at hospitals was another problem. Injured, often suffering from injuries person doesn't want to give any information about the event. Difficult was finding the persons in the hospital and get permission from the hospital staff to interview the injured.

In accordance with DaCoTA WP2 procedure there were prepared forms and questionnaires for collection about 1 500 variables (information) about accident, vehicles and road users. In opinion of MTI's team this amount of data was far too much and makes the research project rather difficult.

In conclusion, the implementation of pilot study allowed the research team to gather some experience in this area. This was a good starting point to conduct in-depth accident researches in a systematic way in the future. In-depth accident investigation should be a subject to the accidents with the most severity injuries. As a recommendations for undertaking in-depth accidents investigations in the future, the new research teams evenly develop on Polish territory are needed, as well as funds and formal agreements to have an access to the sensitive/protected data.

After the end of DaCoTA MTI continues in-depth data collection & analysis of Two Powered Wheel's accidents (with motorcyclists) as EU project named SaferWheels.

References

1. *Statistics, Road Safety*. European Commission. Available at: http://ec.europa.eu/transport/road_safety/specialist/statistics/index_en.htm
2. *CARE, EU Road Accidents Database*. European Commission. DG MOVE. Available at: http://ec.europa.eu/transport/road_safety/pdf/observatory/historical_evol_popul.pdf
3. *Road safety problems in Poland, Polish Road Safety Observatory*. Available at: http://www.obserwatoriumbrd.pl/en/road_safety_analyses/road_safety_problems/road_safety_problems_in_poland
4. *Dane o wypadkach drogowych w Polsce - Komenda Główna Policji baza SEWiK, Dane statystyczne GUS*. Warszawa, 2013 [In Polish: *Data on Road Accidents in Poland: Police database. Statistical data on the population and vehicles, Central Statistical Office.* Warsaw. 2013].

5. Zielińska, A. *Road Accidents in Poland in 2013, Polish Road Safety Observatory*. 04. 2015 Available at: http://www.obserwatoriumbrd.pl/en/road_safety_statistics/reports/
6. *Narodowy Program Bezpieczeństwa Ruchu Drogowego 2013-2020.* Available at: http://www.krbrd.gov.pl/files/file/Programy/KRBRD-Program-P1a-20140422- S4-K1-PL.pdf
7. Thomas, P & Muhlrad, N. & Hill, J. & Yannis, G. & Dupont, E. & Martensen, H. & Hermitte, T. & Bos, N et all. *Road Safety Data, Collection Transfer and Analysis DaCoTA. Project co-funded by the European Commission within the Seventh Framework Programme*. 2013. Available at: http://www.dacota-project.eu
8. Hill, J. & Aldah, M. & Talbot, R. & Giustiniani, G. & Fagerlind, H. & Jänsch, M. *Final Report, Deliverable 2.5 of the EC FP7 project DaCoTA.* 2012. Available at: http://www.dacota-project.eu/Deliverables/DaCoTA_D2.5_finalreportv2.pdf
9. Atalar, D. & Talbot, R. & Hill, J. (Eds) *Training Package including training manual and draft protocols, Deliverable 2.3 of the EC FP7 project DaCoTA*. 2012. Available at: http://dacota-investigation-manual.eu/pmwiki.php
10. Zielińska, A. & Buttler, I. & Hitczenko, D. & Inowolski, J. & Krupińska, A. & Pasieczny, W. & Sicińska, K. Raport końcowy nr 6206/CBR *Analiza stanu bezpieczeństwa ruchu drogowego w Polsce.* Instytut Transportu Samochodowego. 2015 [In Polish: *Final Report No 6206/CBR on Analysis of road safety in Poland*. Motor Transport Institute. 2015].
11. CybID V-SIM 3.0 *Traffic simulations and vehicle's crushes reconstruction*, CYBORG IDEA S.C., Kraków, 2011.

Received 27.05.2014; accepted in revised form 28.01.2016