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Abstract

The paper describes the legislative and technical problems regarding the application of Weigh-In-Motion (WIM) systems for direct identification of overloaded vehicles in Poland. The authors have referred to such WIM systems as "administrative WIM systems". The systems are meant to operate similarly to the so called photo-radars or speed cameras, though they are to ensure compliance with the regulations defining permissible vehicle weights and loads of individual axles.

Keywords: Overloaded vehicles, Weigh-In-Motion (WIM) systems, Administrative WIM systems

Introduction

The paper describes the legislative and technical problems regarding the application of Weigh-In-Motion (WIM) systems for direct enforcement of conformity with the permissible vehicle weights and axle loads. Practical implementation of this idea is subject to the following conditions:

1. defining the detailed procedures for the legalization and metrological control of administrative WIM systems,
2. defining the technical requirements for such systems.

The problem with the legalization procedures arises from the specific properties of WIM stations, where a section of pavement together with the sensors installed in it becomes part of a measurement system. In addition, many types of load sensors do not operate under static load, there are no commonly approved ways to determine WIM system errors and WIM system calibration procedures with well-defined properties.

To define the technical requirements for administrative WIM systems we need to:

- determine the number of load sensors, their structures and reciprocal distances,
- determine the set of disturbing quantities which affect the accuracy of the weighing result,
- determine the allowed variability subspace of all disturbing quantities, which ensures acceptable uncertainty of the weighing result,
- provide WIM site with additional sensors to ascertain whether the disturbing quantities originate from that subspace, and whether the weighing result may be used for the enforcement of conformity with the allowable gross weights and axle loads,
- develop procedures that ensure the required accuracy of weighing regardless of the vehicle manoeuvres while passing through the WIM stations.

There are many reasons for introducing automatic enforcement of the allowable vehicle weights and axle loads: preservation of the road infrastructure, safety of the road users, environment protection and ensuring conditions for fair business competition. It seems that introducing administrative WIM systems may significantly limit the practice of vehicle overloading.

The paper has been organised as follows: chapter two discusses the issue of overloaded vehicles in Poland. It also presents the results of long-lasting weighing of vehicles at the research weigh stations. The findings concerned have made possible a quantitative definition of the problem. Chapter three discusses the basic factors that limit the accuracy of the WIM systems and the resulting limitation of their use for administrative purposes. The fourth chapter presents the formal and technical conditions for applying administrative WIM systems. Chapter five presents the results of a survey carried out in 2015 among carriers and shippers who operate in Poland. The purpose of the survey was to find out about their opinions concerning overloaded vehicles, define the level of awareness of hazards caused by such vehicles, and find out about the prevailing opinion as regards the possible methods to eliminate such vehicles from road traffic. The sixth chapter summarises the paper and presents the conclusions that follow from experimental research and surveys.

The Issue of Overloading Vehicles in Poland

The applicable Polish regulations concerning the permissible Gross Vehicle Mass (GVM) and maximum permitted axle loads on the road surface have been defined in the Regulation of the Minister of Infrastructure[1]. Without going into much detail, one may assume that subject to the said regulation, the maximum gross weight of the heaviest vehicles, i.e. articulated vehicles with more than four axles must not exceed 40.0t, while the maximum static load on a single axle must not exceed 10.0t.

The Law on Public Roads permits movement of vehicles with loads on single axles up to 11.5t on selected state and regional roads. The roads have been defined by the Minister competent for transportation issues[2].

Conformity with the regulations concerning carriage of goods by road with motor vehicles is being ensured by the Road Transport Administration (RTA). The Administration’s organizational structure and scope of responsibility has been defined in the Law on the Road Haulage[3].

Maximum gross weights and maximum permitted axle loads are monitored all over the country by approximately 600 RTA’s inspectors on approx. 300 vehicle weighing stations, equipped with platform scales, in-motion weighbridges (for speeds up to 5km/h), and static scales placed under vehicles’ wheels. Each inspected vehicle is stopped and directed to a weighing station. It takes at least a dozen or so minutes to weigh one vehicle, which makes the system ineffective.

At the same time it is being estimated that approx. 25% of all trucks with the permissible GVM up to 40t are overloaded, i.e. their permissible gross mass or axle loads are exceeded[4].

The opinions are corroborated by the findings of the experiment carried out using a 16-sensor WIM system. The measurements were carried out

[1]Regulation of the Minister of Infrastructure of 31 December 2002, Journal of Laws no. 32, text 262.
[2]The Law on Public Roads of 21 March 1985 as amended, Journal of Laws no. 14, text 60.
[3]Law on the Road Haulage of 6 September 2001 as amended. Journal of Laws no. 125, text 1371.
[4]Rafalski L.; Road Safety in Poland with Particular Emphasis on Heavy Vehicles, DOI: http://www.not.org.pl/not/files/2012/bezpieczenstwo-transport/prezentacje/11.pdf

continually over a period of three months – from October to December 2014. Figures 1 and 2 show the cumulative probability distribution defining the probability of the weighing result exceeding a given value, i.e. the gross vehicle mass and load on a selected axle. The results refer to TT(2+3) 5-axle vehicles, i.e. vehicles composed of a 2-axle tractor and a 3-axle semitrailer. 30% of the 3746 vehicles that were weighed in the period concerned exceeded their permissible gross weights, and 9% exceeded their permissible loads on single axles.

Figure 1. *The Cumulative Probability Distribution for the Results of Measuring Gross Mass of TT(2+3) 5-axle Vehicles*

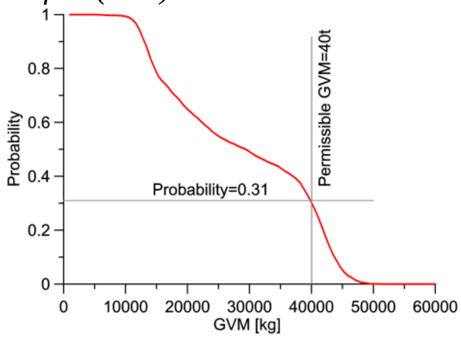
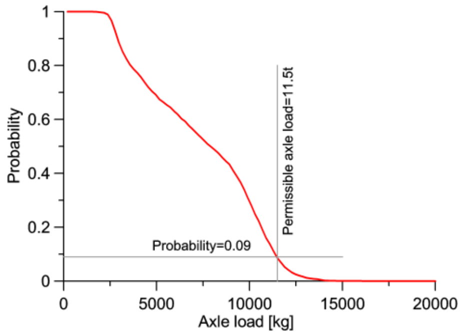


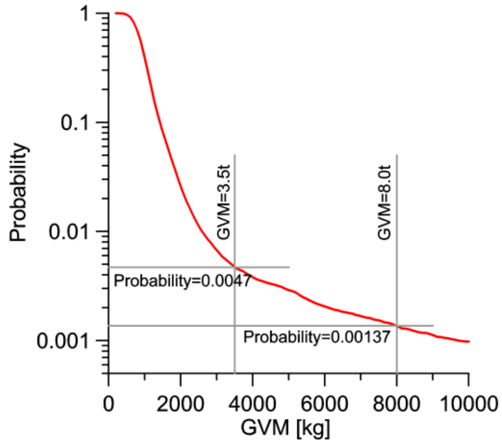
Figure 2. *The Cumulative Probability Distribution for the Results of Measuring of Axle Loads in TT(2+3) 5-axle Vehicles*



On the other hand, RTA inspectors emphasize the problem of overloading of vehicles with permissible GVM up to 3.5t[1]. Figure 3 shows the cumulative probability distribution for the measurement of gross mass of 2-axle vehicles, whose permissible GVM is <3.5t. 340 212 vehicles of this class were weighed over the 3-month period concerned.

[1]Szymaniak P.; Preselective Weighbridges Like Speed Cameras: Double Standards in Penalising Overloaded Vehicles, Dziennik Gazeta Prawna of 22.04.2014, DOI: http://www.gazetaprawna.pl/drukowanie/792017

Figure 3. *The Cumulative Probability Distribution for the Measurement of Gross Mass of Vehicles whose Permissible GVM is <3.5t, in the Population of 340 212 Vehicles*



The probability of 0.0047 shows a relative share of overloaded vehicles in overall population. Though it seems insignificant, one should bear in mind that the "denominator" includes all passenger cars. Given the size of the population of the weighed vehicles (340 212), such a probability means that 1599 overloaded vehicles of this class drove through the weighing station over the three-month period concerned. The gross mass of as many as 466 vehicles exceeded 8t (probability of 0.00137).

Overloaded vehicles have negative effect on the four elementary areas:

- they cause quicker destruction of infrastructure,
- pose hazard to the safety of other road traffic participants,
- pose greater hazard to the environment,
- breach the principles of fair competition in road haulage.

Therefore, it is necessary to improve the effectiveness of elimination of overloaded vehicles from traffic. Application of WIM systems aimed at an automatic elimination of overloaded vehicles from traffic will serve this purpose.

Chapter 5 ranks all the areas which are adversely affected by overloaded vehicles based on the relevant survey.

Preselective Weigh-In-Motion System

In order to improve the effectiveness of their controls, RTA's inspectors use the results of measurements originating from WIM systems that are preselective in nature. The systems help identify the vehicles, which are highly probable to have exceeded the permissible values of their gross weights or axle loads.

The WIM system includes load sensors placed along one, two or more lines (multi-sensor WIM systems)[1], perpendicularly to the direction of movement of the weighed vehicles. Such a system installed in the traffic lane automatically weighs all the vehicles passing through, without imposing any significant limitations to their speeds or routes, and make possible measuring vehicle length as well as numbers of axles.

The idea behind the WIM systems is to measure the dynamic loads that the wheels of a riding vehicle exerted on road surfaces. This allows estimate the target static loads of all axles as well as the vehicle mass.

The conditions under which weighing vehicles in the WIM systems is carried out determine the accuracy of results. The significant fact is that because vehicles are in motion, load sensors react to a dynamic load, which is the sum of the static load and a variable component resulting from vehicles' vertical oscillation. Therefore, the accuracy is affected by the vehicles' speed, condition and mechanical parameters of its suspension, and the quality of road surface on which the WIM sensors are installed[2]. Another factor that affects the accuracy of the system refers to the properties of the load sensors concerned and the way they have been installed, in particular any uneven distribution of the sensors' sensitivity along their length functions[3].

In addition, the accuracy of the WIM systems depends on the weather conditions under which the system operates, in particular on the temperature of the road surface in which the sensors are placed, as well as icing, and wind speed and direction[4].

All the said factors make the WIM systems which have two lines of load sensors prone to a too high and varying uncertainty. Therefore they cannot be used to directly enforce compliance with the regulations that define the permissible values of gross vehicle mass. Moreover, there are no regulations

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[1]Burnos P., Gajda J., Piwowar P., Sroka R., Stencel M., Zeglen T., 2007, *Measurements of Road Traffic Parameters Using Inductive Loops and Piezoelectric Sensors*. Metrology and Measurement Systems, vol. XIV, No. 2, pp. 187-203; Cebon, D., 1990, *Design of multiple-sensor weigh-in-motion systems*. Journal of Automobile Engineering, Proc. Inst. Mech. Eng., 204, pp. 133 – 144; Gajda J., Sroka R., Stencel M., Żegleń T., 2008, *Multi-sensor Weigh-In-Motion System*. Proceedings of International Conference on Heavy Vehicles, Paris, May 19-22, pp. 181 – 188.

[2]Jacob B., O'Brien E.J. Jehaes S., 2002, *Weigh-In-Motion of Road Vehicles – COST323 Final Report. LCPC*, Paris; Cebon D., 1999, *Handbook of Vehicle-Road Interaction*. Swets & Zeitlinger B.V., Lisse, the Netherlands; Jacob B. (ed.), 2001, *Weigh-In-Motion of Axles and Vehicles for Europe (WAVE).* General Report of 4th Programme Transport, Laboratoire Central des Pontes et Chaussees.

[3]Hoose N., Kunz J., 1998, *Implementation and tests of quartz crystal sensor WIM system*. Proceedings of 2nd European Conference on Weigh in Motion of Road Vehicle, Lisbon, pp. 461-466; Cole, D.J., Cebon, D., 1992, *Performance and application of a capacitive strip tire force sensor*. 6th International Conference on Road Traffic Monitoring and Control. IEE, London, pp. 123-127.

[4]Gajda J., Sroka R., Stencel M., Żegleń T., Piwowar P., Burnos P., 2012, *Analysis of the Temperature Influences on the Metrological Properties of Polymer Piezoelectric Load Sensors Applied in Weigh-in-Motion Systems*. Proceedings of IEEE International Instrumentation and Measurement Technology Conference. Graz, pp. 772-775.

which would permit for such a use of the WIM systems in Poland, or formal procedures as regards the systems' metrological control.

Technical and Formal Conditions for the Application of Administrative WIM Systems

Action aimed at the introduction and application of administrative WIM systems has already been taken in many countries[1]. A current example involves the formal regulations introduced by the Czech Institute of Metrology[2], and the work of the Forum of European Highway Research Laboratories (FEHRL)[3].

Certain requirements in respect of WIM systems and the methodology for their control can also be found at Organisation Internationale de Metrologie Legale[4]. The need to introduce administrative WIM systems has also been identified in other countries, as can be inferred from releases published in international press[5].

The application of administrative WIM systems calls for a solution to both formal and technical problems.

Formal Conditions

The main formal problems whose solution is a condition to introduce administrative WIM systems involve:

- determining gross vehicle mass by summarizing vehicle's axle loads,
- lacking formal regulations as regards the method for defining errors in the WIM systems and testing procedures,
- developing European standard describing specification and test conditions for WIM systems.

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[1]TOP TRIAL, 1998 - 2002, *Technologies for Optimizing the Precision of MS-WIM of Road Transports to Improve Automatic Overload Control and European Procedures for Enforcement*, Project founded by the European Community; van Loo F.J.; 2004, *Project WIM-Hand: Results of the project Weigh-In-Motion for direct Enforcement – interim report*. Directorate-General for Freight Transport, The Netherlands.

[2]Czech Institute of Metrology, 2010, *Metrological and technical requirements for specified measuring devices, including test methods for verifying specified measuring devices: high-speed weigh-in-motion road vehicle scale,* document number 011-00P-C010-10.

[3]Jacob, B., van Loo, F.J., 2011, *Application of Weigh-In-Motion to Enforcement*, International/ Brazilian WIM Seminar, Florianopolis, April 3-6; Poulikakos, L., 2012, *FEHRL Institutes WIM Initiative (Fiwi),* Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

[4]Organisation Internationale de Metrologie Legale (OIML R 134-1), 2006, *Automatic instruments for weighing road vehicles in motion and measuring axle loads-Part 1*. Metrological and technical requirements, www.oiml.org

[5]Compston T., 2013, *Direct approach*. Traffic Technology International, June/July; Smith D.W., 2014, *Weighty matters*. Traffic Technology International, June/July.

The parameter that is measured directly in the WIM systems is the dynamic load of individual axles of a weighed vehicle. Samples of the said signal are used to estimate the static load of each axle. GVM is determined as the result of addition of the estimated values of the static load of all axles. Such a procedure arouses some doubts. Firstly, because adding up the loads of all axles in articulated vehicles may lead to a wrong determination of the vehicle's weight because of the load transfer between the axles. The transfer occurs on the components of suspension and joints between the vehicle's modules. Secondly, axle load is expressed in force units, and vehicle weight in mass units. In order to eliminate the discrepancy, the paper by F.J. van Loo proposes the following definition: axle load means the total load by all wheels on a given axle on the ground, divided by the gravitational constant[1]. According to this definition load is measured in [kg].

We are going to illustrate the existing discrepancies that occur while defining WIM system errors with an example. If the WIM sensor is located at a point whose y coordinate runs along the road, then the result of measurement of axle load W_y is described by the following equation (1).

$$W_y = P(t) + e = Ps + F(t) + e \tag{1}$$

where:

$P(t)=Ps+F(t)$ - axle load on the pavement as a function of time,
Ps - static axle load,
$F(t)$ - dynamic component of the load,
e - intrinsic error of the sensor.

It follows from the equation (1), that there are two possible ways to define WIM system errors:

a) WIM system error equals e i.e. it is caused only by intrinsic sensor error as defined by the supplier,

b) WIM system error equals the difference between the result of weighing W_y and the actual value of the static axle load Ps:

$$W_y - Ps = F(t) + e \tag{1a}$$

The value of error (1a) is more interesting from the WIM system users' perspective.

The duality of approach has often lead to misunderstandings between sensor suppliers and system users, especially that the e component is estimated either for sensors that do not operate in static conditions or, by measurements done in ideal laboratory conditions.

The variable component of $F(t)$ depends on many factors connected with vehicles themselves or with the condition of surface, as well as with the phase of signal of $P(t)$ which accounts for the fact that in some sensor locations

[1]van Loo, F.J.; *Project WIM-Hand… op.cit.*

F(*t*)=0, and in other the quotient of *F*(t)/*Ps* may range from 15% on even surfaces to as much as 40% on poorer surfaces.

Moreover, there is no commonly approved and statistically well founded method for expressing WIM systems' accuracy[1].

WIM systems calibration requires defined standard values. Because of the technology of the load sensors in use, mass standards cannot be used for this purpose as a rule. In practice, gross vehicle mass or axle load measured in static conditions are usually used as standard values. Subsequently, the weighed vehicles drive through the calibrated WIM station several times with varying speeds[2].

However, the quantity called "axle load" does not have its definition in the International System of Units. Neither has it its own metrological traceability chain. Therefore, the accuracy of measuring axle load has not been well defined, though a statistical method for determining standard value *Prs* for this quantity has been defined and described by equation (2). The value is determined by the results of multiple measurements of axle loads of a standard vehicle on static scales or in-motion weighbridges[3].

$$Prs_i = Vgw \frac{\sum_{j=1}^{n} P_{ij}}{\sum_{j=1}^{n} \sum_{i=1}^{k} P_{ij}} \tag{2}$$

where:

P_{ij} - the result of measurement of the load of an i^{th}-axle obtained in the j^{th}-weighing,
Vgw - standard vehicle gross mass as measured on platform scales,
k - the number of axles,
Prs_i - standard value for the static load on an i^{th}-axle,
n - the number passages through the weighing station.

It is recommended to adopt *n* in the region of 10. Depending on the number of experiments *n*, condition of surface, vehicle suspension, type of axle

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[1]Jacob B., O'Brien E.J. Jehaes S., 2002, *Weigh-In-Motion of Road Vehicles… op.cit.* ASTM, 2009, *Standard Specification for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Method*, Designation E1318-09; Technische Lieferbedingungen für Streckenstationen (TLS), 2000, Federal Highway Research Institute, German designation; TOP TRIAL, 1998 - 2002, *Technologies…op.cit;* van Loo F.J. (ed.), 2006, *REMOVE Applications Terms Utilized in Vehicle Weighing*. Final report of Work package 3 'Technical Issues', The Netherlands.

[2]Jacob B., O'Brien E.J. Jehaes S., 2002, *Weigh-In-Motion of Road Vehicles… op.cit;* Huhtala M., 1999, *Factors Affecting Calibration Effectiveness*. Proc. of the Final Symposium of the Project WAVE, Paris; Stańczyk D., 1999, *New Calibration Procedure by Axle Rank*. Proc. of the Final Symposium of the Project WAVE, Paris; Gajda J., Sroka R., Żegleń T., 2007, *Accuracy analysis of WIM systems calibrated using pre-weighed vehicles method*. Metrology and Measurement Systems, vol.14 nr 4, pp. 517–527; Burnos P., Gajda J., Piwowar P., Sroka R., Stencel M., Żegleń T., 2007, *Accurate Weighing of Moving Vehicles*. Metrology and Measurement Systems, vol.14 nr 4, pp. 508–516.

[3]van Loo F.J.; 2004, *Project WIM-Hand… op.cit.*

(a single axle or a group of axles), brakes condition, the variability of the standard value *Prs* determined in this way ranges within 1 – 5%.

The accuracy of administrative WIM systems must not be too low. Thus, the more accurately the system works, the higher the rate of directly identified overloaded vehicles. It is assumed that such systems should fall within the accuracy class defined as A(5) or B+(7). A(5) is a class where the error of determining gross vehicle mass should be below 5%, and the error for a single axis below 8%. The probability of exceeding these values should not be higher than 0.05. The uncertainty in determining standard value for the axle static load must not be too high as the calibration procedure must make possible verification of the required accuracy of administrative systems[1].

It is particularly important to bring to uniformity opinions regarding the formal issues in respect of the introduction of the administrative WIM systems all over Europe, which is justified by the internationalization of transportation services.

Technical Conditions

Another group of problems whose solution conditions the application of the administrative WIM systems in practice, involves technical problems connected with limiting the uncertainty/accuracy of weighing results. Let us now discuss the issues briefly.

The main factors that have most significant effect on accuracy include the temperature of the surface in which load sensors are installed, the speeds of the weighed vehicles, the variability of their speeds during their passage through the WIM stations, wind speed and direction in respect of the direction of motion of the weighed vehicle, precipitation, surface icing, vertical oscillations of the vehicles' suspended mass and wheel hop, the characteristics of road surface where the load sensors are installed, changing surface parameters where WIM sites are installed, calibration frequency and method, the frequency of tests aimed at detecting system errors between subsequent calibrations, the implemented algorithm for the estimation of static axle loads and gross vehicle weights, voltage fluctuation, and electromagnetic interference.

Error or uncertainty in WIM systems changes depending on the intensity of the said influential factors. Without controlling the intensity of these factors, at the time when the vehicle is weighed one cannot determine the accuracy of the result. Therefore, the result is useless from the administrative point of view.

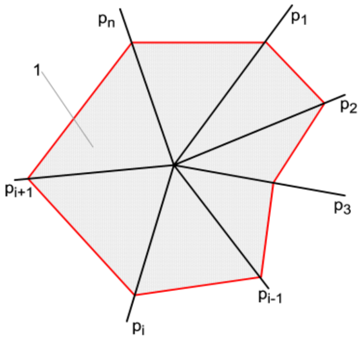
The solution which seems most useful for WIM systems involves experimental determination of multidimensional maps that describe the dependence of error and uncertainty of the weighing results on the influential factors (Figure 4). Such maps will enable controlling the uncertainty of the results of weighing by monitoring the intensity of the influential factors. If the values of these factors as measured during the passage of a weighed vehicle

[1]Jacob B., O'Brien E.J. Jehaes S., 2002, *Weigh-In-Motion of Road Vehicles… op.cit.*

through a WIM site, exceed the limits permissible for the required accuracy of weighing, then such results are considered inaccurate and must not be used in administrative procedures.

The aforesaid uncertainty maps should be built separately for various classes of vehicles. The application of such uncertainty maps is possible only where WIM systems are equipped with measuring sensors for all significant influential factors.

Figure 4. *Uncertainty Map. p_i - i^{th}-Influential Parameter, 1 – Multidimensional Area in which the Uncertainty of the Weighing Result is within the Permissible Limit*



Carrier and Shipper Survey

A comprehensive approach to the application of WIM systems whose purpose is to directly eliminate overloaded vehicles from traffic should – in addition to the legal and technical aspects – take into account the opinion of road traffic participants. In order to acquaint themselves with that opinion, the authors – in cooperation with ABC Szkolenia, the company which deals with carrier training, counselling and auditing for haulage companies – have carried out a quantitative survey.

The survey had 60 participants – owners or employees of transportation and shipping companies that operate in Poland. 94% of the respondents originated from haulage companies with mostly Polish capital. 47% of responders involved represented small enterprises having up to 50 employees (Figure 5).

Figure 5. *Enterprises' Size Structure*

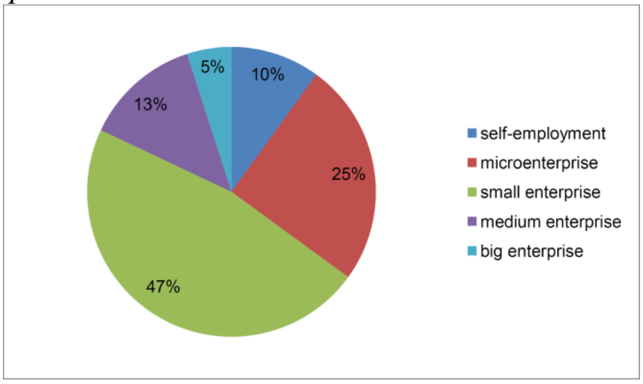


Figure 6. *The Number and Class of Vehicles used by Respondents*

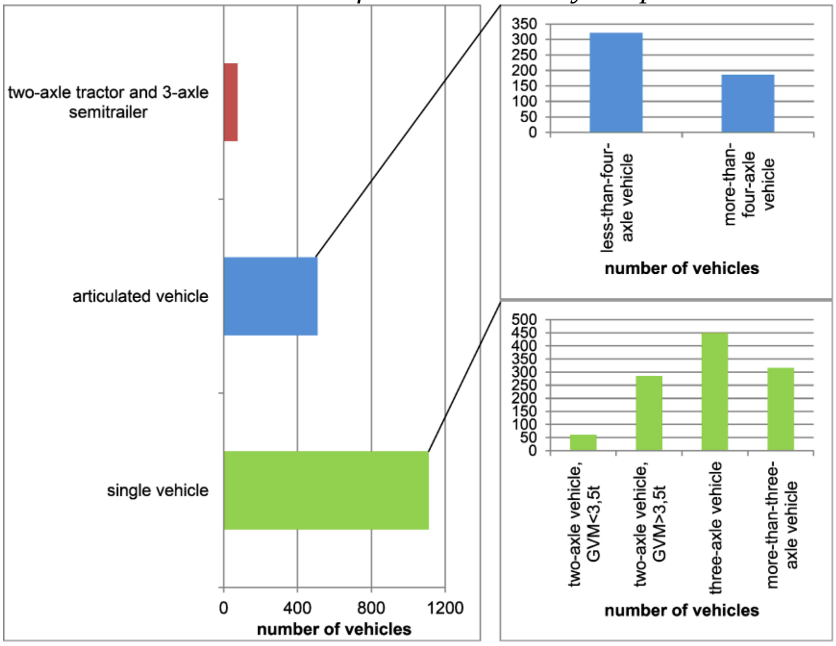


Figure 6 shows the numbers of vehicles used in the enterprises concerned, by vehicles class: single vehicles, articulated vehicles, and articulated vehicles that consist of a two-axle tractor and a 3-axle semitrailer. Most of the vehicles used in the research group are single vehicles (1111) and vehicles with more than three axles (507). Vehicles that consist of a three-axle tractor and a 3-axle semitrailer, on the other hand, are the least frequently used ones (74 vehicles).

The results of the survey show unambiguously that the overwhelming majority of respondents (97% responses) are of the opinion that overloaded vehicles should be eliminated from the road traffic. Additionally, 94% respondents are critical of the action of those enterprises that regularly overload their vehicles, as being in breach of the applicable provisions of law. The survey concerned has taken account of:

- the reasons why – in the respondents' opinion – overloaded vehicles should be eliminated from the road traffic,
- opinions in respect of the current action taken by governmental bodies and aimed at the elimination of overloaded vehicles from the road traffic,
- suggested changes that could – in the respondents' opinion – contribute to a more effective elimination of overloaded vehicles from the road traffic in Poland.

In the respondents' opinion, the most important reason why overloaded vehicles should be eliminated from the road traffic is the concern about the quality of the road infrastructure (95% responses). Secondly, the respondents mentioned the safety of other participants of the road traffic (89% responses). Thirdly, they pointed to the negative effect of vehicle overloading on the environmental protection (81% responses). Efforts to assure fair competition comes fourth (79% responses) in the ranking. In addition, only as many as 32% of the respondents are of the opinion that desisting from overloading vehicles impedes enterprise competitiveness as compared with that of companies which are in breach of the relevant provisions of law.

Carriers and shippers who participated in the survey stated that the provisions of law that define the permissible gross vehicle mass are rarely respected in Poland (42% responses). Nearly a fifth of the respondents state that the permissible gross vehicle mass in Poland should be increased to 60t, as it is in Scandinavia. Only 10% of the respondents think it is necessary to reduce the permissible gross vehicle mass for infrastructural and environmental reasons. The rest of the responders state that the provisions of law that define the permissible gross vehicle mass should not be changed.

The respondents are of the opinion that the number of controls carried out by the Road Transport Administration (RTA) is too small to be able to result in the elimination of overloaded vehicles from the road traffic (55% responses). Only one in three respondents finds RTA's action effective.

All the respondents see the need to introduce changes in the present Polish system for the elimination of overloaded vehicles from the road traffic. However, their opinions differ in terms of the direction of such changes.

As many as 67% of the respondents quoted the need for introducing an automatic system for the control and elimination of overloaded vehicles from traffic which would operate similarly to the speed cameras that are now in use. One in five respondents sees the need for the RTA to carry out more frequent controls. At the same time, fewer than 11% of the respondents think that severe penalties should be imposed for exceeding the permissible gross vehicle masses or axle loads. At present, the Polish fines for vehicle overloading range from PLN 500 to 15000, depending on the seriousness of breach [1]. The research has shown that the respondents' opinions as regards the amount of fines imposed on enterprises that overload their vehicles vary. Though 95% of

[1]The Road Traffic Law of 20 Jun 1997 as amended, Journal of Laws no 98, text. 602.

the respondents agree that penalties should be imposed for overloading vehicles, only 32% of them state that the amount of penalty should be increased or maintained at the present level. At the same time, 20% of the responders are of the opinion that the amount of penalty should be reduced.

Summary

It has been found that the carriers and shippers who participated in the survey are in favour of eliminating overloaded vehicles from road traffic. They are of the opinion that the relevant provisions of law are frequently breached in Poland, and they are critical of the fact.

One may state that the respondents' awareness of the hazards involved in overloading vehicles is high. Firstly, the respondents mention its adverse effect on road infrastructure. Given the fact that one fifth of the respondents are in favour of increasing the permissible Gross Vehicle Mass (GVM) in Poland to 60t, one may suppose that they expect an improvement in the quality of the road infrastructure so that vehicles that weigh 60t have no adverse effect on the roads.

In the respondents' opinion, the present action taken by the Polish state authorities in order to eliminate overloaded vehicles from the road traffic are not fully effective. Inspections carried out by the RTA are, in their opinions, too rare to be effective. One may suppose that this is why the majority of the respondents are in favour of an automatic Weigh-In-Motion system and of the elimination of overloaded vehicles from the road traffic. The respondents think it is necessary to penalise the enterprises that are in breach of the relevant provisions of law. However, there is no uniform opinion as regards the amounts of such penalties.

The survey concerned has been carried out on a sample with a limited number of respondents. Therefore, one should be cautious when generalizing on the basis of the said results and conclusions.

The problem of monitoring the issue of overloaded motor vehicles in Poland is highly urgent. Both the Polish state authorities as well as the carriers and shippers who operate on the Polish transportation market are interested in the introduction of an automatic Weigh-In-Motion system and in the elimination of overloaded vehicles from the road traffic. The authors are therefore of the opinion that further interdisciplinary research is necessary to solve the said legal and technical problems on the one hand, and to contribute to the integration of opinions of various interested parties concerned, on the other.

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Regulation of the Minister of Infrastructure of 31 December 2002, Journal of Laws no. 32, text 262.

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