THE ARCHIVES OF TRANSPORT *ISSN (print):* *0866-9546*
Volume 33, Issue 1, 2015 *e-ISSN (online):* *2300-8830*
DOI: *10.5604/08669546.1160929*

DEVELOPMENT OF MODELS FOR DETERMINING THE TRAFFIC VOLUME FOR THE ANALYSIS OF ROADS EFFICIENCY

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Abstract: *The article presents different methods of estimating DHV, including traditional Factor Approach, developed Regression Models and Artificial Neural Networks models. As explanatory variables: quantitative variables (AADT and the share of heavy vehicles) as well as qualitative variables (the cross-section, roads class, nature of the area, the profile of seasonal variations, region of Poland and the nature of traffic patterns) were used. In addition, the results of preliminary analyses of the DHV estimates based on the maximum hourly volume derived from a few hours traffic measurement on weekdays where there is the greatest share of hours with the highest traffic volume in the year were presented. On the basis of comparisons of the presented methods, Multiple Regression Model was identified as the most useful.*

Key words: *roads, design hourly volume (DHV), multiple regression, artificial neural networks, automatic traffic recorder (ATR)*

1. Introduction

The basis for many planning, design and maintenance expediency or long-term aims is the traffic volume expressing the load of the analyzed elements of the communication system. Most often it is the volume at the specified time and it may refer either to the year in which the measurement was carried out or to the year of the forecast – the analysis period (Tracz et al, 2001). Because the traffic forecasting process is a separate extensive problem, the remainder of this article focuses on the characteristics of movement variability and calculation of the value of design hourly volume (DHV) in the year of measurement. DHV is the basis for determining the future volume in the year of the forecast. It can also be treated as so-called zero forecast for the calibration of the forecasting model and important characteristics of the traffic for current operational analysis. According to the current recommendations in Poland, as DHV for the design and evaluation of traffic conditions mainly on rural roads, 50 (alternatively 30, 100 or 150), the value of the largest hourly volume of the year for roads with a distinguished type of traffic (economic, recreational, tourist), is adopted. The design according to the maximum (over the year) traffic volume would be economically unjustified and lead to large capacity reserves. DHV value can be determined in an accurate and reliable way, solely on the basis of data from the continuous automatic measurement of traffic. Unfortunately, mainly due to the cost of collection and processing, there are no such data from the majority of road sections, so the value must be determined on the basis of short periods of random measurements. In practice, the most commonly used method is the traditional factor approach, in which the volume is determined as a percentage in relation to Annual Average Daily Traffic (AADT), while the conversion of the daily traffic volume (DT) to AADT is performed using the factors of weekly and seasonal variation in traffic volume. The development of Ruch Drogowy (Transprojekt, 2000; 2005; 2010a) provides both the relevant share of 30th, 50th, 100th and 150th hour in AADT and the conversion factors of DT to AADT for the national road network in Poland, depending on the nature of the movement. However, in the works on this issue (Capparuccini et al, 2008; Liu and Sharma, 2006; Sharma, Wu and Rizak, 1995) it is indicated that this method is very inaccurate and has many limitations, especially in the case of roads with high volume variation during the year (for freeways, the DHV estimation error is about 6%, while for recreational traffic roads, it is more than twice higher). The main problem lies in the fact that the relationship between AADT and 30^{th} highest volume (in the US and Germany, the DHV is recognized as the volume of 30th hour of the year) varies from year to year (in the case of roads with very heavy traffic, AADT increases and the share of 30th hour in AADT decreases), and the analysis estimating DHV involves the road section and not the distinction between the directions of movement (the directional structure is included only through the directional Split – D). The directional structure is variable in different hours of the day, during peak hours as well as different days and months. Generally, on different types of roads, directional distribution is not constant, even during the hours of the highest traffic volume of the year. It is, therefore, necessary (particularly for multi-lane roads) to introduce so-called directional design hourly volume (DDHV).

In the foreign literature, alternative and more advanced methods of determining DHV can also be found, among other things: a model of artificial neural networks – where DHV is determined based on AADT, the number of lanes and road functional class (Ghanim, 2011), and the model using genetic algorithms – in which DHV is determined based on non-working days and the different types of roads (Liu and Sharma, 2006). DHV is also assumed as hourly peak traffic volume determined on the design day or in the design months of the year (Capparuccini et al, 2008), design months and day mean those in which the average daily share of largest hourly volume in a given month in AADT or in the case of a day, in a design month, is the greatest. Moreover, nowadays in Germany, works are being carried out on the determining of DHV directly based on short-term measurements (hours with maximum volume in the investigation period, ie. a working day: Monday – Thursday 6:00-8:00 and 15:00-18:00, Friday 12:00-19:00, Saturday and Sunday 9:00-19:00) carried out in the period in which there is the greatest volume in the year (Martin et al, 2013; Lemke, 2011). The best accuracy for estimating the volume was obtained on the basis of data from the weeks of months IV – X (especially VII and VIII), without weeks of extremely high traffic volume resulting from, for example sports events, the start of the holidays, festivals, sales etc.

The purpose of this article is to develop, in Polish conditions, the most useful (best accuracy for the cost incurred) methods for estimating design hourly volume. The following methods were analyzed: traditional factor approach, according to the design day of the design month of the year, multiple regression and model using artificial neural networks. As explanatory variables: quantitative variables (AADT and the share of heavy vehicles) as well as qualitative variables (the cross-section, roads class, nature of the area, the profile of seasonal variations, region of Poland and the nature of traffic patterns) were used.

2. The database and the choice of research methods

For the analysis, the data from a continuous measurement of traffic in the Polish network of roads from the years 2001 - 2010 were used (Golden River stations). The analysis used only the data from the stations in which the measurement took place every day of the year (55 points), or which lacked the measurement of up to 72 hours on the assumption that more than 48 hours in a row (17 points) could not be missing – Fig. 1. Missing data were replaced with data from the previous year (the same day of the week and month). Since the tests carried out in the work (Sławińska, 2013) have shown that, depending on the type of analysis, DHV should be adopted either in relation to the road cross-section or the direction of movement, further analysis was carried out correctly: two-lane roads in relation to the roads cross-section and multi-lane roads in relation to the dominant direction. Due to the dominant (about 90%) share of the analyzed roads that are located outside small towns or in the outer zone of large cities, the analysis is limited to the 50th highest volume throughout the year (50th HV). In order to develop the best model for determining the volume, the nature of the relationship between the 50th HV in the year (volume ranked from the highest to the lowest) and the AADT were first examined respectively for:

- all two-lane roads – Fig. 2 a,
- two-lane roads without stations 6 and 22 (the only stations with large seasonal traffic fluctuations according to Sławińska (2014) – SO4 profile) – Fig. 2.b,
- two-lane roads, stations 6 and 22 (4 points) – Fig. 2.c,
- all multi-lane roads – Fig. 2.d.

In addition, Fig. 3 shows a relationship between the share of the 50th highest volume throughout the year in AADT (u_{50thHV}) and AADT. Because of the linear character of the relationship between the 50th HV and AADT (Fig. 2), the following methods to estimate DHV were adopted: a traditional factor approach according to the first and second design day of the design month in the year (Capparuccini et al, 2008) and multiple regression. As a complementary method, allowing, inter alia, for confirming or excluding explanatory variables used in the models, a model using artificial neural networks was implemented. In order to determine the accuracy of each method, the values obtained were compared with the actual values. The results were presented: for particular years – as average values for all roads of the cross-section 1x2, the roads of the cross-section 1x2 without stations 6 and 22, the stations 6 and 22, all multi-lane roads (1x4, 2x2), all stations and as the average for the entire period of analysis (2001-2010), divided as above (Table 1, 2, 4, 7).

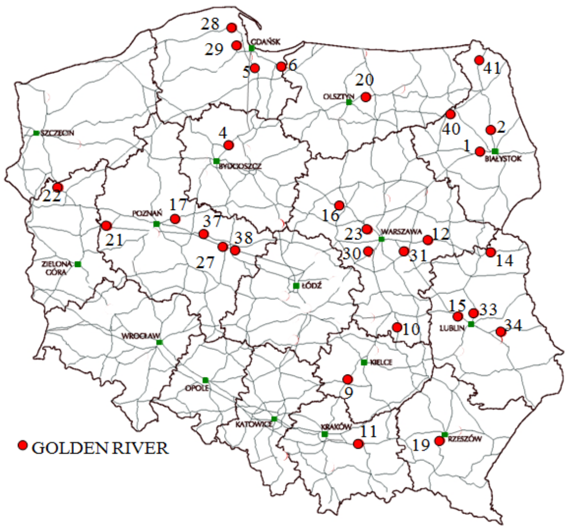

Fig. 1. Map of the location of the continuous measurement station (source: own elaboration based on Transprojekt, 2010b)

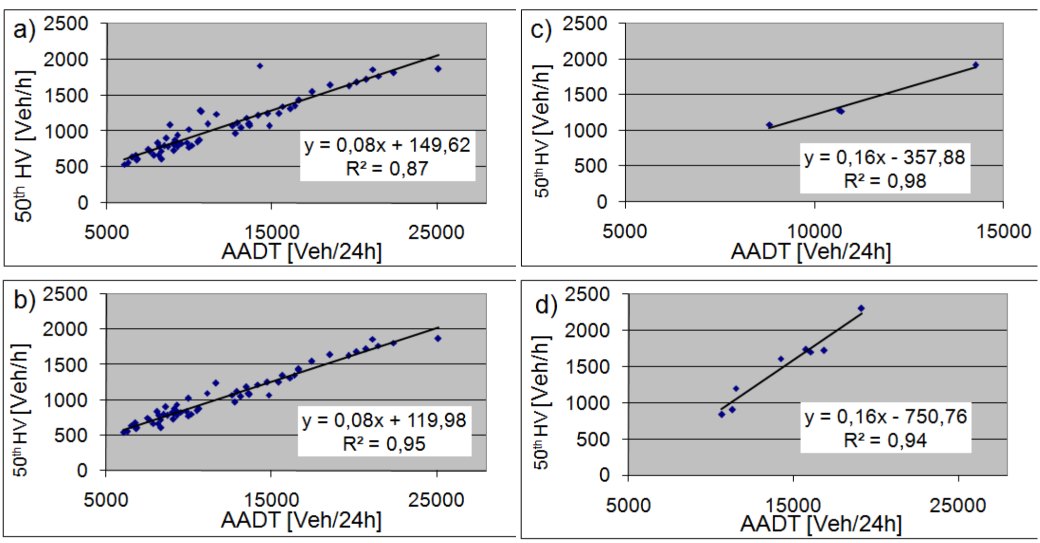

Fig. 2. Graph of the relationship between the 50^{th} HV and AADT: a) all 1x2 roads, b) 1x2 roads without stations 6 and 22, c) stations 6 and 22, d) all multi-lane roads

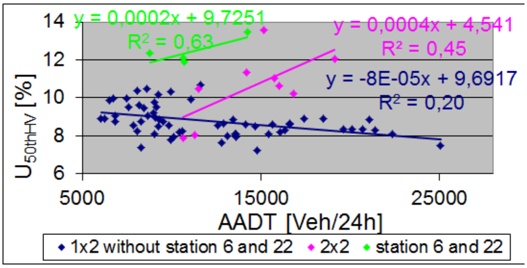

Fig. 3. Graph of the relationship between the share of the 50th HV in AADT and AADT (two-lane roads without stations 6 and 22, stations 6 and 22, all multi-lane roads)

3. Traditional Factor Approach of DHV Estimates (TF)

The conversion of the average daily volume of AADT to the 50th HV was performed according to the formula 1.

$$DHV = AADT \cdot K \text{ [Veh/h]} \quad (1)$$

where the K-factor is the percentage of AADT occurring in the design 50th highest hour according to Ruch drogowy (for year 2010 - Transprojekt (2000), years 2001-2005 - Transprojekt (2005), years 2006-2010 - Transprojekt (2010a)).

The conducted analyses show that the best estimation accuracy was obtained with this method for two-way single carriageway where the average MAPE is 5.7% (without stations 6 and 22 for which the average MAPE is 9.0%). In the case of multi-lane roads, using the K-factor for the dominant direction on the basis of the cross-section of the road (percentage share) results in making a significant error – MAPE average is 19.7%.

Table 1. Comparison of the accuracy of the estimates of the 50th HV using traditional factor approach (TF)

		2010	2008	2006	2004	average
Average MAPE [%]	1x2	7,2	5,1	5,1	3,6	5,8
	without 6&22	7,1	4,8	5,1	3,6	5,7
	6&22	8,9	7,5			9,0
	1x4, 2x2		14,2		19,5	19,7
	all	7,2	7,3	5,1	8,9	8,1

4. DHV estimates approach according to the design day and month of the year (MPD)

In the first place, for each station, the so-called project month, that is a month in which the average daily share of largest hourly volume in a given month in AADT is the greatest, was defined in each year. Since, in the majority of cases, the design month coincides with the month with the highest value of seasonal variation index, also in this case, the same division of the road network was applied as for the seasonal variations (according to Spławińska, 2014). With this approach, the following design month was achieved: for SO1 profile (very small seasonal variations in traffic – as shown in Fig. 4) – October (the only case for which the design month does not correspond to the month of the highest value of the seasonal variation index), SO3 and SO4 (properly pronounced and large seasonal variations in traffic) – July and SO2 (small seasonal variations in traffic) – August. Then, in each case, first and second design days, which is the day of the week in which the average daily share of largest hourly volumes in the design month is the biggest (MPD1 method) or the next biggest (MPD2), were determined. The 50th HV was identified by formula 2 wherein, in the case of the method MPD1 and MPD2, h_{max} refers to the first and the second design day respectively:

$$DHV = AADT \cdot h_{max} \text{ [Veh/h]} \quad (2)$$

where: h_{max} – the average percentage share of the largest hourly volumes in the first or second design day of the design month (MPD1 and MPD2).

The analyses show that the best estimation accuracy was obtained for two-way single carriageways of SO4 seasonal variation profile and for multi-lane roads using MPD1 method (the average MAPE is 1.7% and 2.6% respectively) while for other roads the best accuracy was obtained by MPD2 (the average MAPE is 4.4%). Using the method MPD2 for single carriageways (apart from stations 6 and 22), the occurring error reduction is more than 50% compared to MPD1. In Table 2, exemplary values obtained for MPD2 were shown.

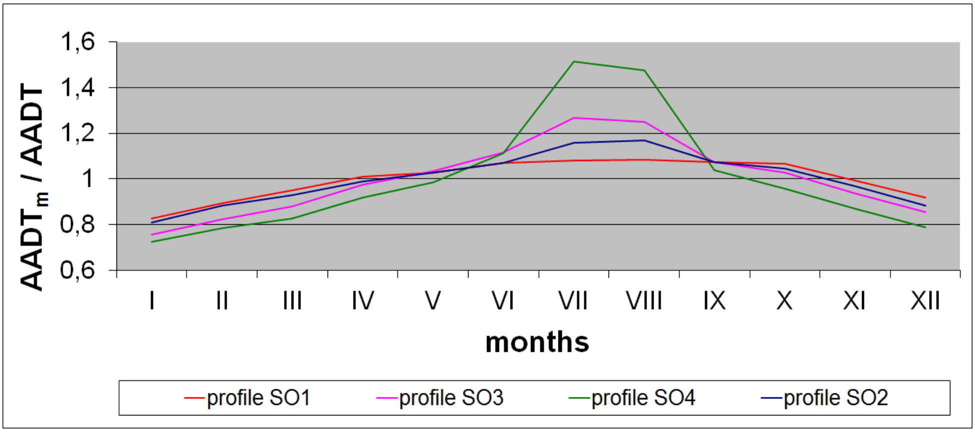

Fig. 4. Profile of the seasonal variability of traffic

Table 2. Comparison of the accuracy of the estimation of 50th HV using MPD2 method

		2010	2008	2006	2004	average
Average MAPE [%]	1x2	2,6	4,2	5,3	3,9	3,8
	without 6&22	1,9	3,9	5,3	3,9	3,8
	6&22	10,5	6,3			2,2
	1x4, 2x2		6,0		5,6	4,3
	all	2,6	4,6	5,3	4,5	4,4
σ [%]	1x2	4,0	3,9	6,5	3,6	4,1
	without 6&22	2,6	4,1	6,5	3,6	4,1
	6&22					0,7
	1x4, 2x2		1,3		6,7	0,8
	all	4,0	3,5	6,5	4,4	5,0

5. Multiple Regression Approach of DHV Estimates (MR)

As explanatory variables: quantitative variables (AADT and the share of heavy vehicles) as well as qualitative variables (the cross-section, roads class, nature of the area and the profile of seasonal variations) were used. Due to the lack of statistical significance, variables concerning, inter alia, the year of the measurement, region of Poland, spatial relationships, the nature of traffic patterns or the value of AADT were removed from the analysis. To use qualitative variables, they were transformed into zero-one variables (1 – the case has a particular feature, 0 – the case does not have this feature). Finally, the following linear regression model was adopted:

$$DHV = 526{,}1 + 0{,}1 \cdot AADT - 3{,}9 \cdot hv + 366{,}4 \cdot SO4 - 337{,}1 \cdot c1x2 - 305{,}1 \cdot F + 60{,}1 \cdot ta \pm 61 \text{ [Veh/h]} \tag{3}$$

where: AADT – the value of annual average daily traffic [veh/24h], hv – heavy vehicles [%], SO4 – profile of SO4 seasonal variation (large seasonal variations in traffic in accordance with Spławińska, 2014), c1x2 – cross section 1x2, F – freeway, ta – tourist area.

The variables representing the average daily volume are strongly positively correlated with the explanatory variable (correlation coefficient of 0.94). The remaining variables have a correlation coefficient in the range of -0.46 to 0.16. Table 3 shows the statistics obtained for the linear multiple regression model. Small estimates errors, high significance of the parameters obtained at $p < 0.05$ and the value of the index $R^2_S = 0.97$ indicate a good fit of the model. In order to confirm the correctness of the model, its verification was made based on the F-Snedecor's statistics, the analysis of variance – ANOVA and the analysis of residues – Fig. 5 (positive verification of the model and the normal distribution of residues, confirmed by the Shapiro-Wilk test, was obtained). In addition, the required sample size necessary to estimate the 50th HV with the maximum error equal to half confidence interval at the confidence level of 0.95 was checked. The required number is 65 (and there is 68).

Table 3.The results of the statistical analysis of the regression model

explanatory variables	R= ,99 R2= ,98 corrected R2= ,97 F(6,61)=418,48 p<0,0000			
	β	Standard Error	t(8241)	p
	526,12	43,02	12,23	0,000
AADT	0,08	0,00	42,89	0,000
hv	-3,85	0,89	-4,34	0,000
SO4	366,34	37,23	9,84	0,000
c1x2	-337,11	29,44	-11,45	0,000
F	-305,05	57,79	-5,28	0,000
ta	60,12	19,12	3,14	0,003

In addition, following the first German experiences (Martin et al, 2013), exploratory analyses were performed to estimate the 50th HV on the basis of the maximum hourly volume derived from a few hour measurement of the traffic on weekdays in which there is the greatest share of hours of the biggest traffic volume of the year. First, the graphs of the percentage share of 150 largest hourly volumes in the year were drawn up, respectively from: a) day of the week, b) hour of the day, c) the month of the year, d) in relation to 100th hour of the year (Fig. 6). Graphs a) – c) were made on the basis of the available data from the years 2001-2010, and graph d) from 2010 (in the case of multi-lane roads from the last year of measurement). This allowed for the selection of dominant in terms of occurrence biggest volumes in the year, days in the week and hours in each day, that is Friday 12:00 – 20:00, Sunday 9:00 – 20:00 (due to similar shares of hours in a day for Saturday and Sunday, and occasional Saturdays dominance, it was omitted) for traffic measurements. Three periods of the year, namely July/August (as the most dominant), December – February (with the fewest instances of maximum volumes) and the last (March – June and September – November) were identified as well. Furthermore, the stations 2, 10 and 37 of the largest hourly traffic flows in the year profile differing from the other stations in accordance with Fig. 6.d (without station 19 due to not diverged profiles in other years) were identified. Since the initial results did not confirm the literature data, that is more accurate estimation of the 50th HV based on data from:

- two days of measurement – 23% MAPE reduction was achieved by reducing data to Friday (25% at the dominance of Friday, and 20% at the dominance of Saturday or Sunday) and a 3% MAPE increase while limiting the data to Sunday. Choosing the peak hourly volume together for Friday and Sunday, the same accuracy was achieved as in the case of only Friday,
- summer months (July, August) – an increase of 2.0% MAPE while limiting the data to VII and VIII with respect to the months III-VI and IX-XI in the case of their domination and 2.4% for the dominance of Friday, with no change in other cases (in addition, the lack of correlation of each month with the explanatory variable). Furthermore, in the case of the restriction of data to months XII-II, average MAPE increase of 1.2% compared to the months III-VI, and IX-XI,

further detailed analyses were carried out only for Fridays in all months of the year, except public holidays and days directly related to them (values are significantly different from the average for the year). As explanatory variables: quantitative variables (hourly traffic volume and heavy vehicles – due to the large randomness of the occurrence of heavy vehicles in adjacent hours, the average of the hours 12:00 – 20:00 was adopted) and qualitative variables (dominant day of the week, the dominant period of the year, region of Poland, spatial relationship, cross-section, roads class, traffic patterns and the nature of the traffic patterns as well as the year of measurement – due to the correlation with other variables, the nature of the area, international traffic and the profile of seasonal variation were omitted) were used. In addition, analyses with limiting the data for months III – XI and III – VI / IX – XI in groups (dominant Friday or Saturday/Sunday) and including selected, detached stations (depending on the situation due to the correlation with other variables or the lack of statistical significance, the explanatory variables limited in accordance with Table 5) were conducted. Additionally, in order to estimate the impact of the year of the measurement, each time an analysis was carried out without taking into account the year variable.

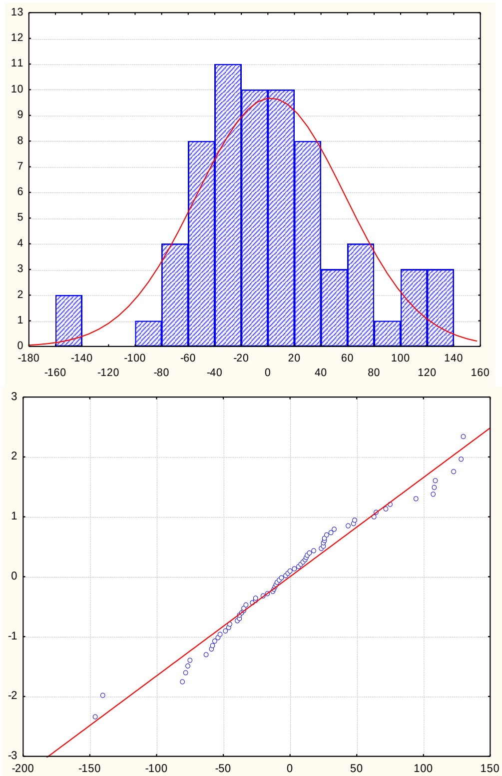

Fig. 5. Analysis of the residuals for the model regression

Table 4. Comparison of 50th HV estimation accuracy using multiple regression model

		2010	2008	2006	2004	average
Average MAPE [%]	1x2	4,8	3,9	4,3	3,5	4,5
	without 6&22	5,0	3,8	4,3	3,5	4,4
	6&22	3,5	5,0			6,0
	1x4, 2x2		1,1		6,6	3,4
	all	4,8	3,4	4,3	4,5	4,5
σ [%]	1x2	6,0	4,5	5,0	2,8	5,5
	without 6&22	6,2	4,4	5,0	2,8	5,2
	1x4, 2x2		1,5		9,4	5,4
	all	6,0	4,0	5,0	4,9	

Table 5. The range of explanatory variables of multiple regression models of the estimation of 50th HV based on the maximum hourly flow

case	Q_{max}	HV [%]	Dominant Fri	Dominant VII, VIII	Polish region	Impast of cities	Long-distancetraffic	1x2	freeway
III-XI	+	+	+	+	+	+	+	+	+
III-VI IX-XI	+	+	+	+	+	+	+	+	+
dominant Fri	+	+			+	+	+		+
dominant Sun	+				+	+	+		
without2,10, 37	+	+	+	+	+	+	+	+	+

The analyses show that the best model is based on all the stations of the Friday traffic measurement in months III - XI. The average MAPE is 7.5% while it stands at 8.9% for the dominant Friday and 6.4% for the dominant Saturday/Sunday (in months III – VI and IX – XI, 6.0%). In addition, when not considering the year of the analysis, MAPE increase of 0.1% was obtained in the case of dominant Friday and 0.5% in other cases. Moreover, the analysis was carried out in which, instead of the maximum volume, the average of the measurement was taken. However, in this approach, the rise in the average value of MAPE was about 0.2%.

6. Artificial Neural Network Approach of DHV Estimates (ANN)

For the construction of models based on artificial neural networks, input variables selected for multiple regression model (the value of the average daily traffic, the share of heavy vehicles, cross-section, roads class, traffic patterns, the nature of the area, the profile of seasonal variations and region of Poland) were used. The selection of the final and optimal set was made automatically by means of a genetic algorithm, wherein due to the permitted number of variables (up to 10% of the training set), four of them with the highest quotient error were selected.

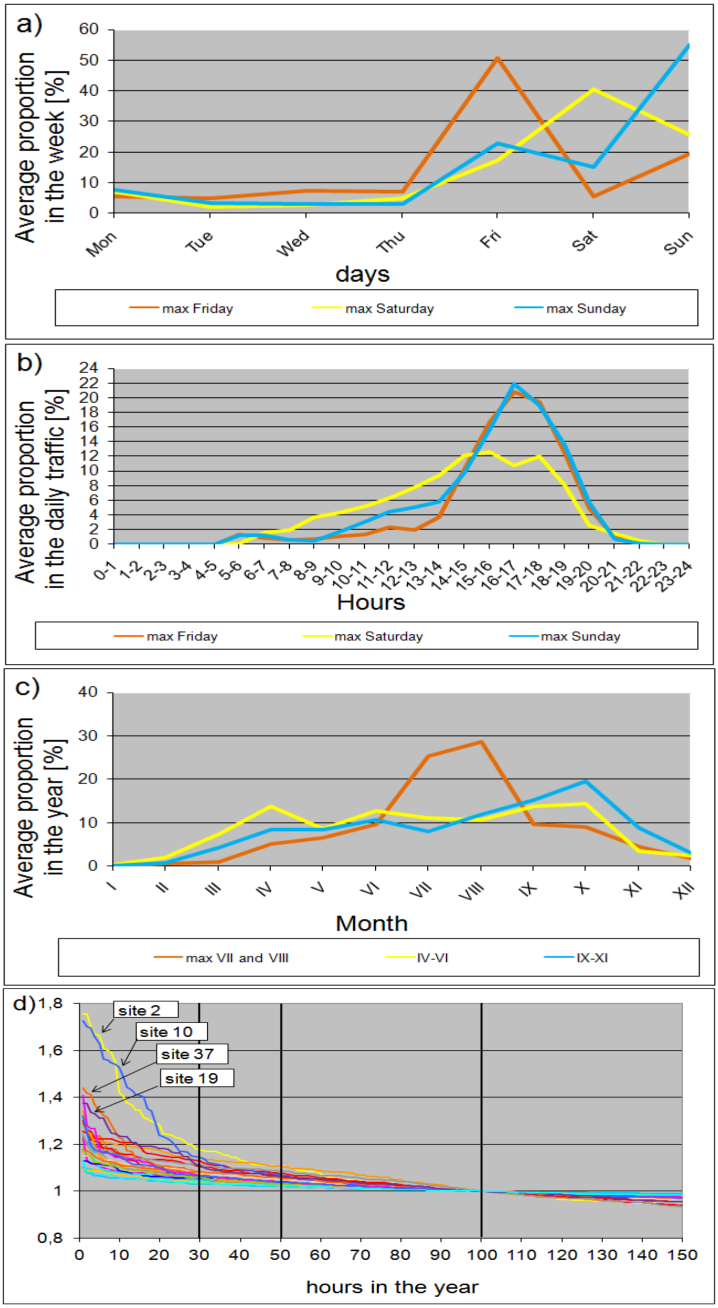

Fig. 6. Percentage of the share of 150 largest hourly volumes in the year in: a) the day of the week, b) the hour in the day, c) month of the year, d) with respect to 100th hour of the year – all vehicles, cross section of the road (multi-lane roads – the dominant direction)

Table 6 below shows the results of modeling for top 3 best models obtained (one-way multi-layer MLP network with one hidden layer), including: the structure of the network (number of independent variables on the input and output of the network and the number of neurons in different layers of the network), the value of the quotient deviations and correlations and the quotient error obtained from the sensitivity analysis for each variable in the model (assessment of the impact of the independent variables). The high correlation value and low value of quotient deviations indicate a good fit of all of the determined models. As expected, in all cases, the highest value of the quotient error was obtained for AADT variable, which shows its greatest impact on the quality of the ANN built. Similarly, other variables selected for multiple regression models show the relevance, which proves that their selection was good. Table 7 shows the average value of MAPE and σ for the best model (shown in red in Table 6) obtained in selected years, and their average values from all the analysis period (years 2001-2010).

Table 6. Descriptive statistics for the artificial neural network models

type and structure of the network	quotient deviations	correlation	AADT	1x2	freeway	international traffic
4:4-7-1:1	0,31	0,95	2,7	1,4	1,2	1,3
4:4-5-1:1	0,33	0,95	2,6	1,6	1,1	1,7
4:4-8-1:1	0,34	0,94	2,6	1,5	1,0	1,6

The best estimation accuracy was obtained for the multi-lane roads (average MAPE is 3.7%). It should also be noted that the high value of MAPE obtained for stations 6 and 22 is due to the failure to take into account the seasonal variation profile in the analysis.

Table7. Comparison of estimation accuracy of 50[th] HV using ANN model (MLP 4:4-7-1:1)

		2010	2008	2006	2004	average
Average MAPE [%]	1x2	8,8	7,5	5,0	6,6	7,5
	without 6&22	7,4	5,5	5,0	6,6	6,3
	6&22	24,7	23,6			25,8
	1x4, 2x2		5,0		8,8	3,7
	all	8,8	6,9	5,0	7,3	7,2
σ [%]	1x2	10,5	10,3	5,8	11,4	10,4
	without 6&22	9,0	7,6	5,8	11,4	9,1
	6&22					9,2
	1x4, 2x2		1,8		12,3	7,0
	all	10,5	8,9	5,8	10,7	9,2

7. Conclusions

The need for raising the subject stems from a number of limitations in the currently recommended procedures for estimating DHV, among others: low accuracy of the results and conducting analyses of the cross-section of the road and not the distinction between the directions of traffic. The article presents different methods of estimating DHV, including the traditional factor approach, widely used in Poland and abroad, and multiple regression models and models using artificial neural networks developed for Polish conditions. From their comparisons, the following conclusions can be drawn:

1. In the case of single carriageways (except for stations 6 and 22 characterized by large seasonal fluctuations in traffic), a high estimation accuracy of 50[th] HV through all four methods (TF, MPD2, MR, ANN) was acquired – the average MAPE equal to 5.0%.
2. The best accuracy was achieved by using the method in relation to the second design day of the design month.
3. In the case of roads with seasonal variations profile SO4 (large seasonal variations in traffic) and multi-lane roads, the best accuracy was achieved in relation to the first design day of the design month. The reduction of the average value of MAPE in relation to the currently used traditional factor approach was achieved,

respectively, the stations 6 and 22 and multi-lane roads by about 84%, the remaining single carriageways in the case of MPD2 method by 33% (Table 8).

4. In the case of the multiple regression model, the reduction of the average value of MAPE (in relation to the traditional factor approach) in the case of two-lane roads was obtained by about 22%, for the stations 6 and 22 by 34% and for multi-lane roads by 83%.
5. In the case of ANN, owing to the lack of possibility of taking into account significant variables in the model, the reduction with respect to the TF was only achieved for multi-lane roads (MAPE average value reduction by 81%).

Due to practical limitations in the use:

- Traditional factor approach – knowledge of the distribution of the road network due to the volatility of the share of the 50th highest volume in AADT, which due to the significant variation within a single station in the following years and between stations is very difficult, is required
- MPD methods – in addition to the knowledge of the distribution of the road network, due to the design month (the same division as for seasonal variation) and the volatility in the coming years of the design day, weekly measurement period is also required,
- ANN models – the inability to write mathematical interrelationships occurring in the models and the need for implementing adequately large sample,

the most useful is the implementation of regression models. The use of these models is also supported by: - lack of statistical significance of the year of the measurement which allows for building regression models based on historical data and – their versatility both in relation to the cross-section of the roads and directions of traffic (multi-lane road) for single and dual carriageways as well as for diverse nature of traffic patterns.

It should be also noted that, due to the promising preliminary results of the DHV estimation analyses based on the several hour Friday traffic measurement, these analyses should be continued. With such an approach, the length of the traffic measurement can be reduced and the multiplication of errors can be avoided (no need to determine AADT). In addition, the measurements can be performed virtually all year round (except XII-II as well as VII and VIII with dominant Saturday/Sunday). However, due to the insufficient sample, it was not possible to build a desired, in terms of the statistical significance of the year of the measurement, model for one year and determining the accuracy of estimating the future years. It is, therefore, not possible to draw definitive conclusions regarding the estimation of the DHV based on the measurements of several hours on Friday.

Table 8. Comparison of estimation accuracy of 50th HV

method	Average MAPE [%]				
	1x2	1x2 without 6&22	site 6 and 22	2x2	allroads
TF	5,7	5,6	9,0	19,7	8,0
MPD1	7,8	7,8	1,7	2,6	7,4
MPD2	3,8	3,8	2,2	4,3	4,4
MR	4,5	4,4	6,0	3,4	4,5
ANN	7,5	6,3	25,8	3,7	7,2

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