LogForum

> Elektroniczne czasopismo naukowe z dziedziny logistyki <

http://www.logforum.net

ISSN 1734-459X
2007
Vol. 3
Issue 4
No 3

FACTORS DETERMINING THE MANAGEMENT OF THE TRAFFIC CONGESTION IN THE URBAN AREA

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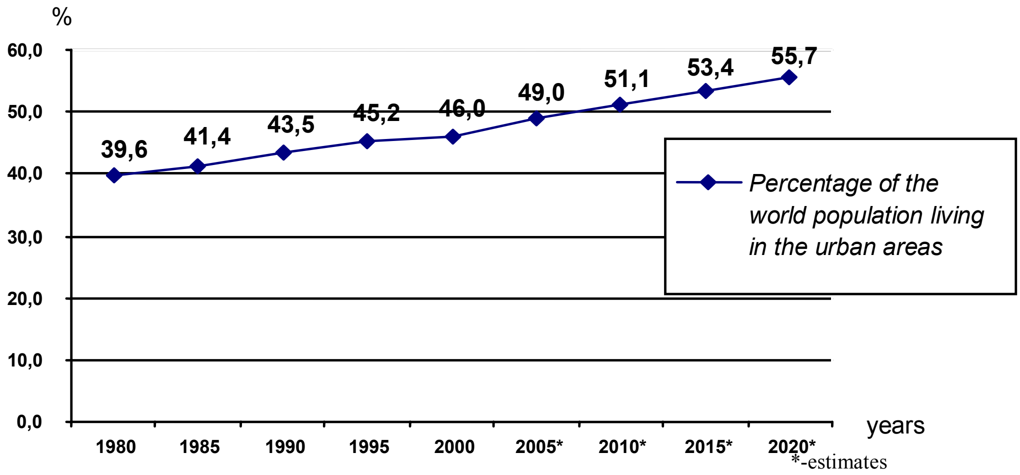
ABSTRACT. The aim of the article is to investigate factors that can affect management of the traffic congestion in the urban area. The predictions according to the theoretical background presented are that such factors as: migrations (commuting), location within a functional zone, road constructions, presence of public institutions and facilities, traffic network arrangement, suburbanisation, significance of the route, road type, presence and the nature of junctions, grade crossings, bridges or public transport presence can to a different extent influence the traffic congestion pattern. The level of this influence in the urban area of Poznan (Poland) is stated using the self-created indicator - Synthetic Congestion Ratio (SCR). Moreover, it was predicted that the traffic volume is higher on week days than during weekends. In order check the truthfulness of the hypotheses the research was conducted by establishing some checkpoints near crossings where investigated factors are present and later by measuring the traffic volume in the urban area researched. The conclusions are that the most influential factors determining the management of the traffic congestion in the urban area are: level of road's significance as a communication route, central business district (CBD) approach or thoroughfare and road type (expressway, two-lane, multi-level junctions), whereas the other factors' influence is significantly smaller (streets' layout, facilities attracting people, location within a functional zone). Furthermore, it was observed in one of the checkpoints that there was a discrepancy between the predicted and the actual traffic volume. This was probably a result of yet another, not known (not taken into consideration) factor e.g. car accident.

Key words: management, urban area, traffic congestion, synthetic congestion ratio.

INTRODUCTION

The problem of traffic congestion management concerns every bigger urban area in the world (although sometimes the issue is influenced on by the level of the economic development) and due to the fact that more and more people live in urban areas than in the rural, this trend is expected to continue in the future. By the term traffic congestion the following phenomenon is meant - the accumulation of vehicles leading to overloading of the traffic network and problems from it resulting [Szymczak 2002]. An urban area is an area with an increased density of human-created structures in comparison to the areas surrounding it [Pawlak 2006]. As it can be observed in the diagram (Fig.1) it is predicted that by the year 2020 more than 50% of the world population will have been living in the urban areas. Such an increase will surely lead to the increase of the usage of cars which may lead to the growth in the traffic congestion. This means that the problem will be acquiring importance.

Citation: Pawlak Zb., 2007. Factors determining the management of the traffic congestion in the urban area. LogForum 3, 4, 3
URL: http://www.logforum.net/vol3/issue4/no3
Accepted: 30.11.2007, on-line: 20.12.2007.



Source: "UN The World Urbanization Prospects: The 2005 Revision" Annex Tables.

Fig. 1. Percentage of the world population residing in urban areas
Rys. 1. Odsetek ludności świata zamieszkujący obszary zurbanizowane

The management of the traffic congestion is very closely connected to the process of urbanisation and this trend is true for both economically more and less developed countries. The most important role of the traffic transportation network is linking people, resources, activities and enabling the exchange of goods (trade) and ideas (information). However, different types of transports are appropriate in different situations and the road transport will be the most appropriate in the urban areas, because of [Waugh 2000]:

- The low cost of transportation over short distances
- The independence (the possibility of transporting regardless of time or to some extent weather conditions, which will be unable for other types e.g. air or sea transport)
- The flexibility of transportation (the possibility of changing the destination point without very high costs)
- The densely developed road network in the city, which enables to carry the goods in a "door-to-door" way.

However, the development of a given area is always entwined with the increase in the trade exchange, mostly in the urban areas where the majority of investment capital is concentrated. Hence the development of the road transport will be surely following the economic development of a city. Nevertheless the result of rapid development of the road transport may not be followed (due to either lack of funds or lack of possibilities) by the modernisation of the transportation network. This discrepancy is followed by the traffic intensity disturbances within the city. Therefore any changes in the traffic pattern (rapid increase in the number of cars in a given area) may result in traffic problems (jams, gridlocks). The factors that may affect the traffic intensity:

- Migrations, especially Commuters, but also rapid inflow of people due to some events with the national or international significance (e.g. fair exhibitions, football matches, cultural events, historical anniversaries)
- The location within a given city functional zone
- Road constructions
- Presence of institutions or trade facilities attracting people (e.g. tourist attractions, shopping centres)

- Buildings and the arrangement of the transport network originating from the pre-automobile times (e.g. narrow streets, narrowings)
- The process of suburbanization
- The significance of a road as a city, national and international communication route
- The nature of the road
- The presence and nature of junctions (e.g. two-level junctions)
- The presence of grade crossings or bridges
- The presence of public transport facilities (e.g. tram tracks)

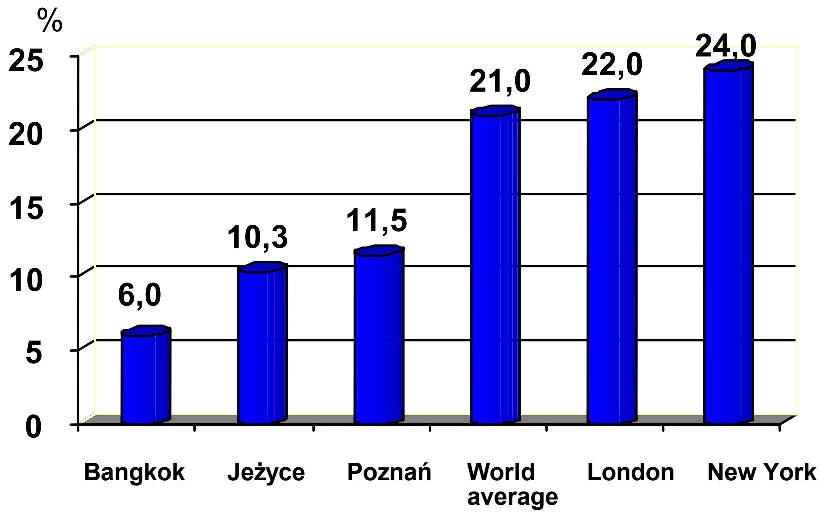
RESEARCH AREA AND HYPOTHESES

The investigation of the traffic congestion was carried out in the Jeżyce Urban Area (JUA) of Poznań - the city located in the western part of Poland. The city and the investigated area were chosen due to their accessibility and the personal experience of the author of this article.

In the year 2005 the population of Poznań was 574125 people on the area of 26130 ha determining the density of 2197 people per square kilometre, whereas the JUA with its population 81300 on the area of 5790 ha was characterised by the density of 1404 people per square kilometre. Moreover it should be clearly stated that Poznań, being the fifth biggest city in Poland, has many very important functions like:

- Educational and Scientific - 22 tertiary-level schools with more than 120 thousands students studying
- Cultural and Historical - a fair number of monuments, museums, theatres and cinemas (including 2 cinema complexes)
- Trade - Poznań International Fair with 42 exhibitions annually visited yearly by hundreds thousands of people from 142 sectors of economy
- Service - health services including hospitals, financial services, wholesale and retail services (shopping centres, shopping arcades)
- Transportation - international airport, important railway hub and the location on the international communication route E-30
- Industrial - factories from different branches of construction and industry
- Agricultural - Poznań Food and Agricultural Exchange
- Administrative - capital city of the Wielkopolska (Western Poland Province)

The number of cars registered in the city was 289700 (211000 passenger and 64800 lorries), whereas there were 367 passenger cars per 1000 people (2005). At the same time the overall length of roads within the city agglomeration was 1120 km (the density of the roads per 100 km^2 was 330 km). Last but not least the streets' surface (596.9 ha) makes 11.5% of city's surface, whilst in the JUA the same index is even smaller - 10.3%. However, both of these indices are relatively low comparing to the other cities and world average index (Fig.2.).



Source: Own elaborations based on city hall statistics.

Fig. 2. Percentage of the cities' surfaces used for streets.
Rys. 2. Odsetki powierzchni miejskiej zajętej przez ulice.

This situation is a result of both lack of investments in development of the traffic network and spatial problems resulting from the domination of pre-automobile times city's layout. The investigated JUA traffic network is largely based on the streets' layout created in the past. However, two stages of the greatest changes can be distinguished:

– The beginning of the twentieth century, when first tenement houses were built (the layout originating from this stage can be better observed in the eastern parts of the area adhering to the central business district). This network is called pre-automobile and hence it is characterized by very narrow streets. At the same time the network is dense.
– The 1970s, when due to the national programme of traffic network development (mostly expressways and motorways) the western part of the traffic network was converted into motorways and the transit street was converted into the thoroughfare in order to be able to receive the increased traffic volume on the international E-30 route (Warszawa - Berlin).

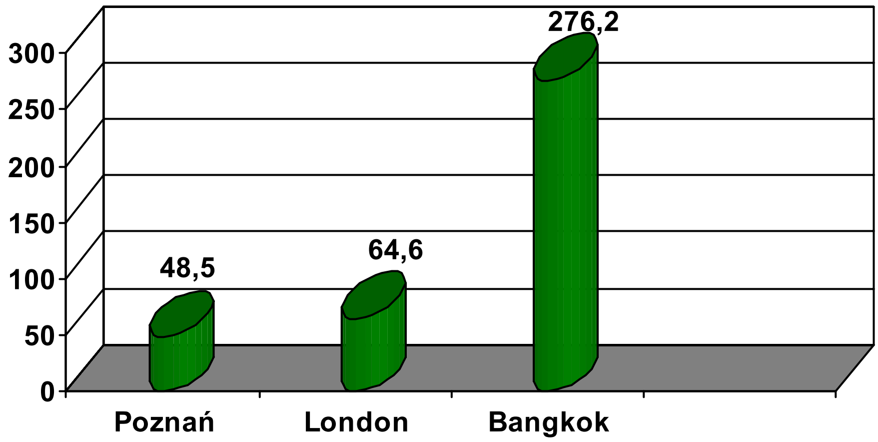
Due to these differences in the traffic network, some the increased traffic congestion may occur. In order to check the state of the traffic network, several indices will be used. First of all the number of cars registered in the city will be compared to the city's traffic network's surface. The length of the network is not going to be used, since the 3-lane expressway will be able to receive bigger traffic volume than extremely narrow, one-way street. Instead the traffic network's surface will be used, since this value includes as well network's length as the streets width. Hence for Poznań the car/surface ratio will be 48,5 (2005). Comparing to the other cities, the index is low (Fig.3.), therefore the traffic intensity disturbances will not result in traffic jams, or at least not in kilometers long jams characteristic for the compared megacities.

It can be seen particularly well in case of comparing the index of Poznań to the one of Bangkok, where the index is over 5 times higher. It means that there are 5 times more cars on the same traffic network's surface, resulting in 5 times bigger congestion. So according to the car/surface index the congestion in Poznań is quite high, nonetheless it will not cause many traffic jams. However, the index posses some limitations such as:

a) it does not take into the account the number of cars not registered within the city borders. This means that it does not include any cars coming from outside the cities whose impact on the city congestion may be severe, especially in case of megacities [London 2004], which can be surrounded by smaller cities, for instance Reading or Luton around London,

b) it does not take into consideration the quality and nature of the roads, which means that all streets are treated equally, e.g. expressways in the same way as wide city streets. This can be misleading due to the fact that for instance city motorways, rings help significantly in reducing the traffic congestion, especially when the thoroughfare traffic is considered (e.g. London's M25),

c) it does not say anything about traffic congestion prevention strategies that often help to reduce the traffic problems (e.g. The London Congestion Charges, one-way streets, parking-meters). Nonetheless, it can be used to estimate that theoretically the traffic disturbances in Poznań and JUA may result in traffic problems, especially in case the road is narrow and simultaneously plays an important role in the traffic pattern, receiving the significant traffic volume.



Source: Own elaborations based on the statistics.

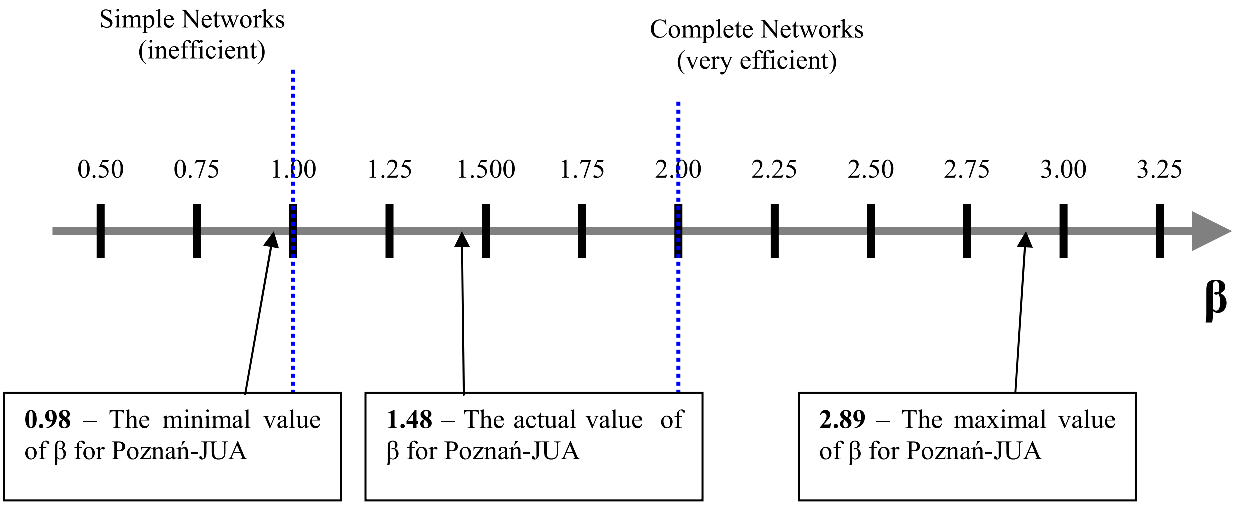
Fig. 3. Percentage Poznań Car/Surface Index (2005) compared to the other cities in the world in [cars/ha]
Rys. 3. Wskaźnik liczby samochodów przypadających na powierzchnię miasta dla Poznania (2005) w porównaniu z innymi miastami świata [samochody/ha]

Another index that can be used to describe the research area traffic network is the beta index (β), which is one of the simplest methods to describe the connectivity of the given network [Waugh 2000]. In order to calculate the index, it is essential to calculate the number of vertices (in this case - junctions) and edges (roads' sections between the junctions) of the network. These numbers are: 54 vertices (v) and 80 edges (e) .

Therefore the beta index for the JUA traffic network will be:

$$\boldsymbol{\beta = ev^{-1} \quad [\beta = 1.48]}$$

However, number 1.48 in order to be more meaningful needs to be compared with the minimum and maximum values that in this case beta index can adopt. The minimum value of the beta index in case of the investigated network is 0.98, whereas the maximum value is 2.89. The situation is presented on the axis (Fig.4.). As it is presented, the lowest value of beta index for Jeżyce Urban Area (0.98) is qualified to the group of the simplest networks (β <1), being very inefficient i.e. the connectivity is very poor. The highest value of the index (2.89) qualifies to the group of the most efficient networks (β >2), where the connectivity is the best. The actual value of the index (1.48) means that the JUA traffic network is mediocre being neither simple nor complete. Therefore in case of traffic network problems (road construction, an event resulting in closing a part of the network e.g. grade crossing closing) the flows may not find the alternative route which may result in traffic jams. Furthermore parts of the network linking the areas of the biggest significance i.e. international routes, thoroughfares, central business district (CBD) approaches - may not be able to receive the increased traffic volume and due to this fact severe traffic problems may occur [Vickrey 1969], including "triggernecks" and even "gridlocks".



Source: Own elaboration

Fig. 4. The value of β-index for Poznań - Jeżyce Urban Area (JUA)
Rys. 4. Wartości wskaźnika β dla obszaru zurbanizowanego Poznań - Jeżyce (JUA)

Therefore in case of JUA, the most vulnerable network sections will be thoroughfares and approaches to the CBD. The other factor that can have an influence on the traffic congestion is the functional zones' layout within the JUA. It can be noticed that the functional zones within the research area are rather stretched towards the CBD creating "functional wedges" and therefore showing some similarities to the Hoyt's sector model of urban structure [Waugh 2000].

What is more, similarly to what the model of the bid-rent theory suggests, alongside the main communication routes, there will be the most profitable functional zone able to afford the highest cost of rent i.e. the business zone. It can be clearly noticed if comparing the approaches to the CBD with the functional zones within the JUA - the business areas exist only alongside the approaches. This is because of the necessity of being accessible, hence it can be linked as well that many people will be willing to concentrate in the business areas, especially during the rush hours. However, it as also anticipated that the movement of cars will be taking place mostly between the residential and business areas, whereas the industrial areas and the green areas will be less frequently the aim of the people's travel. This is because the present industry within the JUA does not employ so many people as it used to be - some factories are even being closed or restructured. Hence the main migration movements within the city are predicted to be between the residential and business urban areas and within them alike. In order to verify whether the above factors influence the traffic congestion, several checkpoints were established to investigate the traffic congestion intensity and the influence of particular factors on this congestion. However, every factor has its own influence on the traffic congestion intensity and the risk of occurrence of traffic problems (reducing or enhancing) and the extent to which it affects the intensity (the influence can be for instance negligible or very significant). Therefore it has to be stated how the particular features will affect the congestion. The hypothetical influences of particular factors investigated in research urban area are stated in the table below (Tab.1).

Therefore in order to state hypothetically, whether at the given checkpoint the traffic congestion intensity will be high or low, a Synthetic Congestion Ratio (SCR) will be introduced. This ratio will indicate if the given checkpoint is vulnerable to the high congestion intensity and problems resulting from it (jams) according to the hypothetical factors' influence.

Table 1. The hypothetical factors influencing the traffic congestion in Poznań-Jeżyce Urban Area
Tabela 1. Hipotetyczne czynniki wpływające na kongestię ruchu ulicznego w obszarze zurbanizowanym Poznań-Jeżyce

Factors Reducing Congestion (FRC) And the risk of traffic problems		Factors Enhancing Congestion (FEC) And the risk of traffic problems	
Factor	Influence	Factor	Influence
Three-lanes road (expressway)	- - -	Approach to the CBD (commuters' migration)	+ + +
		Former communication route	+ + +
Two-lane road	- -	Thoroughfare	+ + +
Two-level junction	- -	Pre-automobile streets, narrowing	+ +
		Facilities attracting people	+ +
		Traffic lights	+ +
		Business	+ +
		Residential zone	+ +
		Industrial zone	+
		Grade crossing	+
		Tram track/ Tram track junction	+
		Part of junction closed for traffic	+

Source: Own elaboration.

In order to find the ratio, the matrix showing the presence of particular factors at the given checkpoints must be created (Tab.2.). The SCR ratio is therefore the sum of the "influence points" at the given checkpoint and the higher the SCR is, the bigger the risk of high traffic congestion and problems resulting from it is. Therefore it can be noted that the highest risk is present at CP4 - 14, whereas the lowest one in the CP9 - 3. The other values are included between them, so it can be predicted that the highest traffic congestion and the most numerous jams will occur at CP4 and also at CP2, CP5, CP6, CP8 (the SCR value >10), whilst the lowest risk and traffic congestion alike will be at the CP9 and to some extent at CP1, CP3, CP7 (SCR<10).

One more hypothetical regularity that is predicted is that during the week days the average volume of traffic will be higher than it is during the weekends. Such a situation is predicted, because during the weekend fewer people will commute to the CBD to their jobs and more people are anticipated to either stay at home or to travel rarely (e.g. to the green zone and back home). Therefore the intensity is predicted to be lower. To verify this and the previous hypotheses, the research were conducted.

Table 2. Factors influencing traffic congestion vs. Chekpoints. Synthetic Congestion Ratio deriving matrix.
Tabela 2. Czynniki wpływające na kongestię ruchu ulicznego w punktach pomiarowych; macierz bazowa Syntetycznego Wskaźnika Kongestii

		Checkpoints								
		CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9
Factors	Approach to the CBD	+++	+++	+++	+++	+++	+++	+++	0	0
	Former com. route	+++	0	0	0	0	0	0	+++	0
	Thoroughfare	0*	0	0	+++	+++	0	0	+++	0
	Pre-automob. streets, narrow.	0	0	++	++	0	++	++	0	0
	Facilities attract. people	0	++	0	0	0	++	0	0	0
	Traffic lights	0	++	++	++	++	++	++	++	0
	Business zone	++	++	0	++	0	++	++	++	0
	Residential zone	++	++	++	++	++	0	0	++	++
	Industrial zone	+	+	0	+	+	0	0	+	0
	Grade crossing	+	0	0	0	0	0	0	0	+
	Tram track/ Tram track junction	0	0	0	+	+	+	+	0	0
	Partially closed	0	0	0	0	0	0	+	0	0
	3-lanes	---	0	0	0	0	0	0	0	0
	2-lanes	0	--	--	--	--	0	--	--	0
	2-level junction	--	0	--	0	0	0	0	0	0
SCR =Σ		**7**	**10**	**5**	**14**	**10**	**12**	**9**	**11**	**3**

Legend: * - "0" indicates that the given factor is not present at the given checkpoint;
+/- The value of influence by enhancing/reducing congestion

Source: Own elaboration.

ANALYSIS OF THE FACTORS DETERMINING THE MANAGEMENT OF THE TRAFFIC CONGESTION IN THE RESEARCH AREA

The research was conducted four times (twice on the week days and twice on the weekend days) at 12AM and 4PM. At every checkpoint (CP) the traffic volume in every direction was measured over 15 minute period, so that it is possible to investigate not only the volume of the traffic at the given checkpoint, but also the direction from which the biggest traffic volume reaches the junction Furthermore the occurrence of the traffic jams was noted as well. However, in order to make it more precise the values obtained during the two investigations were averaged and multiplied by 12 to obtain the number of cars crossing the checkpoint per one hour. Thus the following results can be presented in a table (Tab.3.). Nevertheless it is not yet clearly visible, whether the prediction according to the Synthetic Congestion Ratio is true or not.

Table 3. Traffic volume at the checkpoints on week and weekend days [cars/h] and the Synthetic Congestion Ration (SCR) for the given checkpoints.
Tabela 3. Wolumen ruchu ulicznego w punktach pomiarowych w dni robocze i świąteczne [samochody/godz] oraz wartość Syntetycznego Wskaźnika Kongestii (SCR) w tych punktach.

Checkpoint	Traffic volume [cars/hour]		SCR
	Week days	Weekend days	
CP1	3984	3120	7
CP2	3288	2688	10
CP3	3912	3792	7
CP4	5136	3600	14
CP5	4032	3000	10
CP6	2376	1536	12
CP7	2604	2016	9
CP8	3780	3060	11
CP9	408	312	3

Source: Own elaboration.

Therefore to make it clearer the results are presented with the use of a diagram (Fig.5.). This diagram clearly presents to what extent it was possible to anticipate the traffic congestion using the Synthetic Congestion Ratio. In several checkpoints the SCR value perfectly fits the collected data of the traffic volume. Such a situation can be observed in case of Checkpoints 2, 4, 5, 7, 8, 9. On the other hand, in cases of the other Checkpoints the ratio either fits the collected data to a very limited extent (CP1) or does not fit at all (CP3 and CP6). On the other hand, in cases of the other Checkpoints the ratio either fits the collected data to a very limited extent (CP1) or does not fit at all (CP3 and CP6). The discrepancy might have occurred because of:

- omitting some factors which could not be anticipated and therefore the SCR value may not be proper for the given CPs,
- too short research i.e. the volume of the traffic would fit the SCR value providing that the research had been conducted over a longer time,
- the occurrence of traffic problems (e.g. car accidents) that might have caused the jam leading to the sudden decrease in the traffic flows (the traffic volume decreased due to the people being unable to travel through the checkpoints which resulted in the lower traffic volume).

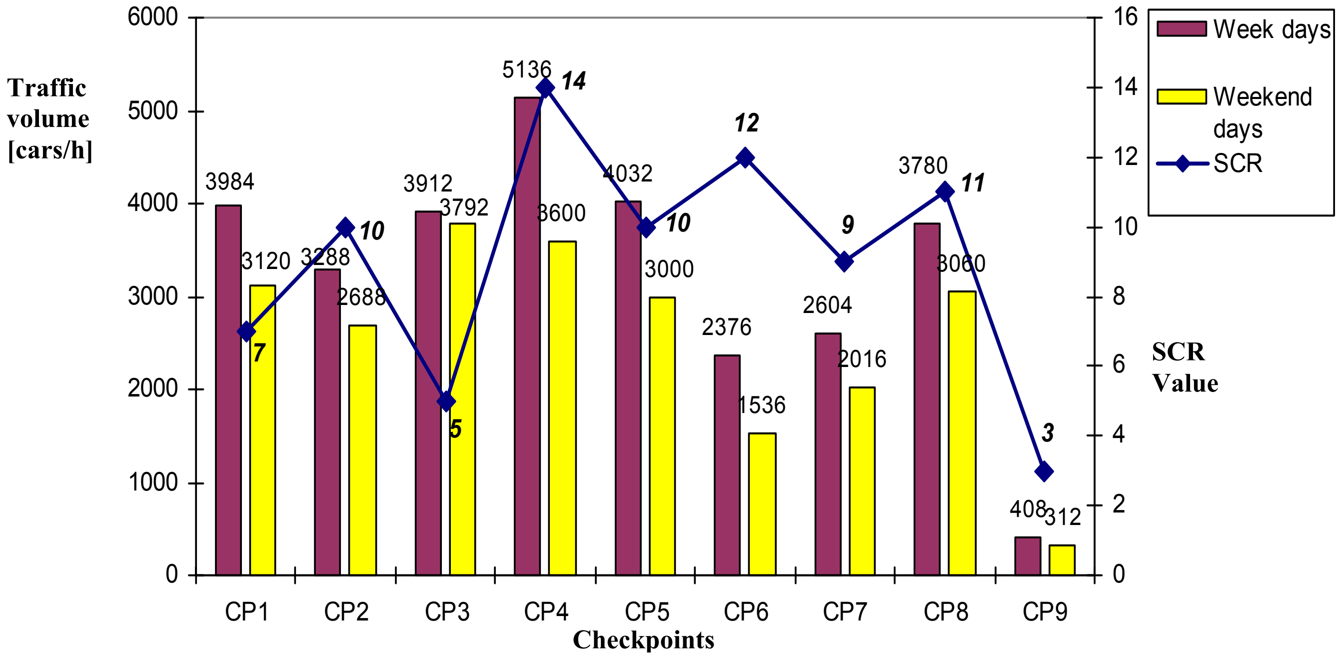
Because it is very hard to predict now what the factor might have been and to conduct once again the longer research, only the third possible cause of the discrepancy between the SCR and the traffic volume will be investigated further. In order to present clearly the traffic flows in the JUA, the flow line map can be used (Fig.6.). From the map several regularities can be observed:

a) The sections with the greatest traffic volumes are along either CBD approaches or thoroughfares. This may be a result of Commuters' movement from the outer residential areas and small towns located either West or North from research area which are not only the city's dormitories, but due to the lower cost of maintenance are very good locations for the branches of some Transnational Companies. As a result the movement between these branches and the city's residential areas will take place along the CBD approaches or thoroughfares.

b) The volume of the traffic is bigger in the outer sections than in the sections closer to the CBD. This may result from the fact that the sections outside the city are rather wide three- or two-lane roads constructed with respect to possible increase in traffic intensity, whereas the streets' layout closer to

CBD originates from the pre-automobile epoch and therefore is rather denser and the streets are narrow. Hence the whole traffic volume from one wide expressway must be divided among the greater number of narrow streets.

c) Traffic jams are rather present along the CBD approaches and thoroughfares, which may be the result of the increased traffic volume. What is more their most frequent occurrence can be noticed near the checkpoints, where the discrepancy between the traffic volume and the Synthetic Congestion Ratio was observed, so near CP3 and CP6. This may be a result of overloading the traffic network in these areas.

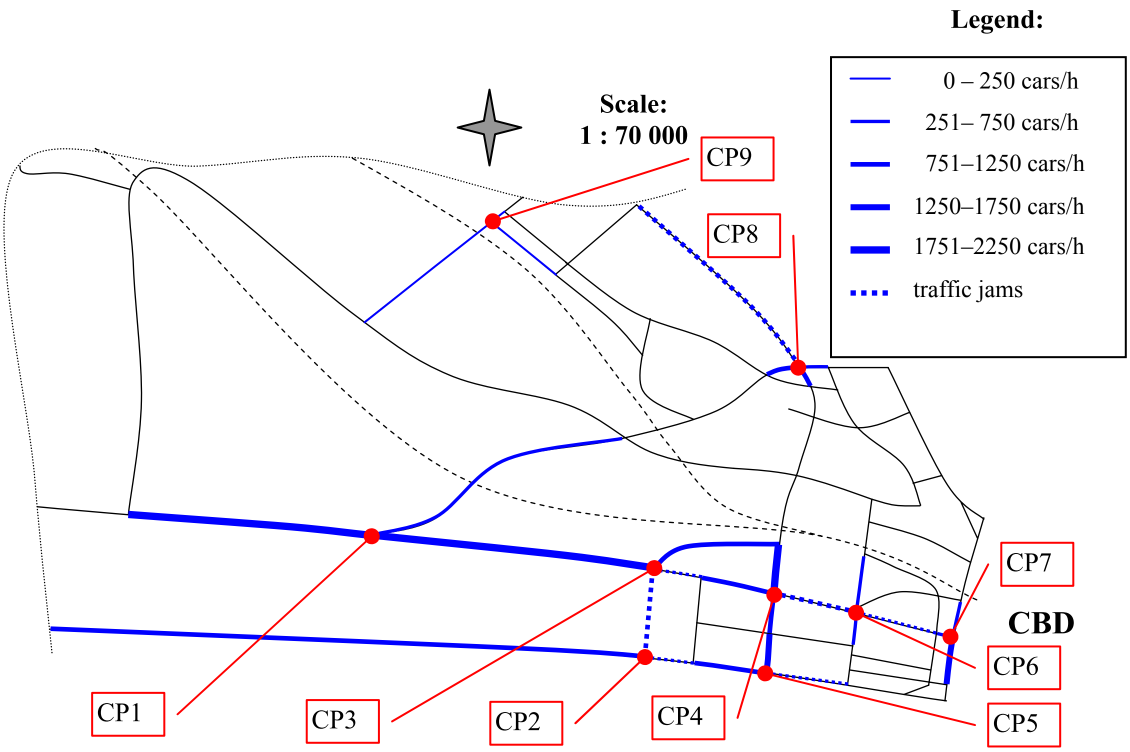


Source: Own elaboration based on own research.

Fig. 5. Traffic volume at the checkpoints on week and weekend days (cars/hour)and the Synthetic Congestion Ration values (SCR) for the given checkpoints
Rys. 5. Wolumen ruchu ulicznego w punktach pomiarowych w dni robocze i świąteczne [samochody/godz] oraz wartość Syntetycznego Wskaźnika Kongestii (SCR) w tych punktach

The regularity observed near Checkpoints CP3 and CP6 can therefore explain to some extent the discrepancy between the Synthetic Congestion Ratio predictions and the actual traffic volume as a result of traffic jams. These jams caused a sudden slowing down of the flows and therefore the rapid decrease in number of cars per one hour could have been observed. Nevertheless, it must be stated that other factors might have also caused that the predicted factors' influence (determined using SCR) does not fit the collected data. However, still the situation at Checkpoint 1 is not clear, because the difference between the predicted and the actual congestion level exists and no traffic problems were observed there. It therefore might be a result of a factor(s) that had not been anticipated e.g. car crash.

Last but not least regularity observed during the data collection was the difference between the traffic congestion intensity during week days and weekend days. According to the collected data the volume is generally lower, but the difference ranges from 3% (CP3) to even 30% (CP4). The general lower number of cars is probably a result of fact that majority of people either do not work on weekends or work less and therefore traveling with the car is limited rather to green areas or shopping centres located very often outside the city.



Source: Own elaboration

Fig. 6. Traffic flows within the Poznań-JUA on the week days during rush hours.
Rys. 6. Natężenie ruchu ulicznego w dni robocze w godzinach szczytu w obrębie Poznań-JUA

CONCLUSIONS

During the conducted research several factors' influence on the traffic congestion intensity was investigated using self-invented Synthetic Congestion Ratio. It appears that the anticipated impact and its strength of the investigated factors was to a large extent successful (the SCR in many cases fitting the collected data values), nevertheless in some cases the discrepancies between the predictions and the reality could have been observed as well. These discrepancies proved, however, that the occurrence of traffic problems i.e. jams (which were predicted to exist as well, for example using the beta index - β) may disturb the whole traffic flows' pattern and in such a case it is very hard to predict the influence of particular factors. However, it is also possible that the list of possible factors was incomplete and there are more influential factors (for example in case of CP1 where there is no hypothetical solution of the discrepancy) that can be still a subject of the research.

In the scale of the whole network the hypothesis was verified by conducting the research, that the most influential factors determining the management of the traffic congestion in the urban area are: road's significance as a communication route, central business district (CBD) approach or thoroughfare and road type (expressway, two-lane, multi-level junctions), whereas the other factors' influence is significantly smaller (streets' layout, facilities attracting people, location within a functional zone).

Still it may be true that providing the research were carried out over a longer period of time at more checkpoints (i.e. large scale research) the results might be different and therefore the unsolved problems resulting from this investigation could be solved. However, the issues like finding the further factors influencing the intensity, traffic pattern changes or even traffic network modernization are problems for different investigation.

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CZYNNIKI DETERMINUJĄCE ZARZĄDZANIE KONGESTIĄ RUCHU ULICZNEGO W OBSZARZE ZURBANIZOWANYM

STRESZCZENIE. Celem artykułu jest zbadanie czynników wpływających na zarządzanie kongestią ruchu ulicznego w obszarze zurbanizowanym. Zgodnie z zaprezentowanymi przewidywaniami teoretycznymi, czynniki takie jak: migracje (dojazdy do pracy), lokalizacja w obrębie danej strefy funkcjonalnej miasta, roboty drogowe, obecność obszarów użyteczności publicznej, układ sieci transportowej, suburbanizacja, znaczenie danego szlaku drogowego, rodzaj drogi, obecność i charakter skrzyżowań, przejazdy kolejowe, mosty oraz infrastruktura transportu publicznego w różnym stopniu wpływają na wzorzec kongestii ruchu ulicznego. Poziom wpływu danego czynnika w obszarze miejskim Poznania wyrażony został za pomocą wskaźnika własnego opracowania - Syntetycznego Współczynnika Kongestii (SCR). Dodatkowo zostało przewidziane, że natężenie ruchu ulicznego w dni robocze jest wyższe w porównaniu z weekendami. W celu zweryfikowania powyższych hipotez, zostało przeprowadzone badanie polegające na ustaleniu kilku punktów pomiarowych w pobliżu skrzyżowań charakteryzujących się obecnością wcześniej wspomnianych czynników. W tych miejscach zmierzono natężenie ruchu ulicznego, co umożliwiło dalsze analizy. Pozwoliło to na wyciągnięcie wniosków, że do najważniejszych czynników wpływających na zarządzanie kongestią ruchu ulicznego w obszarze zurbanizowanym należą: ranga danego szlaku ulicznego jako trasy komunikacyjnej, położenie na szlaku dojazdu do centrum biznesoewgo miasta (CBD) lub innego ważnego obszaru użyteczności pobliczej oraz rodzaj drogi (droga szybkiego ruchu, dwupasmowa, wielopoziomowe skrzyżowania). Z kolei wpływ innych czynników (układ ulic, obszary użyteczności publicznej, lokalizacja w obrębie danej strefy funkcjonalnej) jest znacznie mniejszy. Zaobserwowano również w jednym z punktów pomiarowych, pewną rozbieżność pomiędzy oczekiwanymi a uzyskanymi wynikami, co prawdopodobnie jest wynikiem oddziaływania dodatkowego, nieprzewidzianego czynnika np. wypadku drogowego.

Słowa kluczowe: zarządzanie, obszar zurbanizowany, kongestia ruchu ulicznego, syntetyczny wskaźnik kongestii.

EINFLUSSFAKTOREN FÜR DAS STAUVERHALTEN IN STADT-GEBIETEN

ZUSAMMENFASSUNG. Ziel des Artikels ist die Ermittlung von Faktoren, die das Stauverhalten in Stadtgebieten beeinflussen. Aus der Literatur ist bekannt, dass Faktoren wie: Pendler, Standorte innerhalb von funktionellen Zonen, Straßenbau, Anwesenheit öffentlicher Einrichtungen, Verkehrsnetzwerk, Vorstädte, Bedeutung der Strecke, Straßentyp,

Präsenz und Bedeutung von Knotenpunkten, Bahnübergänge, Brücken oder das Vorhandensein öffentlicher Verkehrsmittel können sehr unterschiedliche Einflüsse auf Verkehrsstauungen nehmen können.
Das Niveau dieser Einflüsse im Gebiet von Poznan (Polen) wird in einem selbst entwickelten Indikator - Synthetic Congestion Ratio (SCR) - erfasst. Außerdem wird vorhergesagt, dass das Verkehrsaufkommen während der Arbeitstage höher ist als am Wochenende. Um den Wahrheitsgehalt dieser Hypothesen zu prüfen, wurden Untersuchungen an bestimmten Kontrollpunkten in der Nähe besonderer Einflussfaktoren durchgeführt und später mit allgemeinen Verkehrsmessungen im Stadtgebiet ergänzt.
In der Zusammenfassung ist festzuhalten: Die Faktoren mit dem größten Einfluss auf das Stauverhalten sind: Bedeutung der Straße als Verbindungsstraße, Funktion der der Straße als Zufahrt zu zentralen Geschäftsvierteln und der Straßentyp (Autobahn, zweispurige Straßen, Hauptkreuzungen). Andere Faktoren wie Straßenlayout, Sehenswürdigkeiten oder Funktionsgebäude haben dagegen eine untergeordnete Bedeutung. Des Weiteren wurde an einem Kontrollpunkt eine Abweichung vom vorhergesagten Verkehrsvolumen beobachtet. Dies kann das Ergebnis eines vorher nicht berücksichtigten Einflussfaktors sein, wie zum Beispiel eines Verkehrsunfalls.

Codewörter: Management, Stadtgebiet, Verkehrsstau, Stauvorhersage, Synthetic Congestion Ratio (SCR)

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