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SOCIO-DEMOGRAPHIC AND LAND USE DETERMINANTS OF NON-COMMUTE TRAVEL GENERATION IN CRACOW, POLAND

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Summary. The circumstances of passengers' decisions and behaviours concerning non-commute urban travels in Eastern Europe is not well-studied; most of the studies on this topic was done on Western societies. This paper presents the results of a study on Cracow, Poland. This study is based on a survey in two neighbourhoods of different urban forms in Cracow, one with central structure with compact land use and the other a representative of socialist urban form with big residential blocks and no central local places. The survey was carried out from January to February 2019 with 426 inhabitants. The results of the Ordinary Least Square models reveal that age, daily activity, the place of shopping, frequency of shopping in the vicinity of homes, and frequency shopping activities outside in farther places are significantly correlated with the frequency of non-work trips in Cracow. The sprawled decentral district produces a high correlation between shopping trips outside the district and the overall non-work trip frequency, referring to the failure of the socialist urban form to keep non-work trips inside the districts by the presence of local facilities like shops and retail. It is discussed in this paper that such correlations may be very much context-specific, as there are some differences between the findings of this paper and those of international findings in high-income and developing countries.

Keywords: urban transportation planning, travel behaviour, non-work trip generation

1. INTRODUCTION

The existing studies about Eastern European cities provide limited understanding of the determinants of home-based non-commute urban travels. In other words, we don't know what exactly defines the characteristics of these urban trips. Like several Eastern and Central European countries, Polish cities are less studied compared to their Western counterparts. A literature review was done in this study, the results of which are presented below, show that there is some data about non-work urban travels in Polish cities, but it is difficult to integrate land use and urban form in analytic studies based on these data. Moreover, the number of studies that provide statistical models of non-commute trips using primary disaggregate data is limited, hence, it is difficult to draw an inclusive conclusion about the determinants of these urban trips. To be more specific, we do not know exactly if the socio-economic factors or other determinants such as land use traits lay significant effects on the number of home-based non-commute trips in Poland.

The goal of this study was to assess the socio-demographic and build environment relationships with mode choice for individual visitors found for non-work travel and contrast these outcomes with establishment-level analysis of mode shares in Cracow, Poland. To do this, we utilised a customer intercept survey at very different establishments—convenience stores, restaurants, and bars. The analysis depends on destination-based information, unlike a majority of the travel behaviour research, which generally depends on data gathered from home areas. Additionally, a couple of other studies control for specific land-use types.

This manuscript is continued by a literature review of urban travel behaviour in Poland and existing data about non-commute travels. Then, the methods including survey, data, case-study areas, and analysis methods of this study are introduced, and findings are presented in the form of descriptive statistics and model fit. Finally, the relations between the empirical

findings in Cracow, Poland with the international studies, and well as the concluding remarks about urban and transport planning in Poland were presented.

1. TRAVEL CHARACTERISTICS AND THE NON-COMMUTE TRIPS

Recent urban transportation planning literature has found various associations between transportation requirement and different elements like the accessibility of facilities, the dimension of motorisation, city structure, the pace of financial development, neighbourhood culture, etc. [14,18,19]. It is still desirable to investigate the connections among these components to have the capacity to get a handle on present and future travel request in many geographical contexts, especially Eastern Europe.

Individual travel choices are suppose to be impacted by the places where people live and work. Many blame "sprawl" for congestion and overuse of automobiles, and trust that transit access, roads, the distance to shops and services, and spatial attributes of the manufactured environment may all impact how people travel to shops, to activities, and to other places not related to work travel. In any case, it is widely acknowledged that such influences are complex. Some empirical research recommends that there is a strong connection between the built environment and non-commute travels, while other research, often using different model specifications, data, or measures of travel, find little or no relationship. This difference is partially because relationships between travel and the built environment are undertheorized. „The conceptualisation and operationalisation of "density" provide a primary example. Development density is a basic planning concept, however, in practice, it is complex and difficult to implement for use in controlling trip characteristics" [7,11,23].

In the course of the past three decades, a very large body of research has risen on how built environments impacts travel. Studies have analysed travel in numerous dimensions: the amount of trips, the frequency of trips, trip goals, and trip lengths, and travel modes. Measures of the built environment are incorporated as continuous objective measures, subjective measures got from survey participants, or categorical measures derived by specialists. Travel is normally analysed at either an aggregate level or a disaggregate level. Aggregate analyses are typically performed to estimate mode splits or vehicle miles travelled (VMT) at the level of TAZs, census tracts, or metropolitan areas. Disaggregate analyses are typically actualising at the level of the individual or household, and outcomes are often individual travel mode choices or number of trips made by mode. Disaggregate analysis let for more complete models, as there is finer detail in spatial, temporal, and personal information [12]. Fig. 1 illustrates the percentages of travels based on travel purposes in six international cities with different cultures. As seen, the share of non-work travels may differ dramatically in accordance with the culture and geographies of the cities.

The share of such studies in different regions and countries of the world is different. A large part of the studies done on urban travel behaviour and especially the characteristics of the non-commute travels are related to the USA. Although the territory of the USA is huge and diverse, some similarities can be noticed in the communication behaviour of the population. A lot of research has been done on this topic with most of them focused on large and medium-sized cities and commute travels. All studies regarding commute and not commute exchange such factors as age, sex, income, car ownership, land use mix, street networks employment and emphasise the importance of their role in shaping travel. Studies about preferences and dependencies on non-work travel among Americans were carried out, inter alia, in California (San Francisco Bay Area) and in Boston [6].

Generalising research that has been improved over the recent years; conclusions can be drawn about residential travel behaviour: people with high income prefer to travel alone rather than with someone else, preferring also the shared-ride mode than the transit mode. The more cars in the household, the less likelihood of using one vehicle by several people. If someone lives on the outskirts of the city, he uses more car to travel. Additionally, that person travels less on non-work trips than a resident who lives in the centre [2].
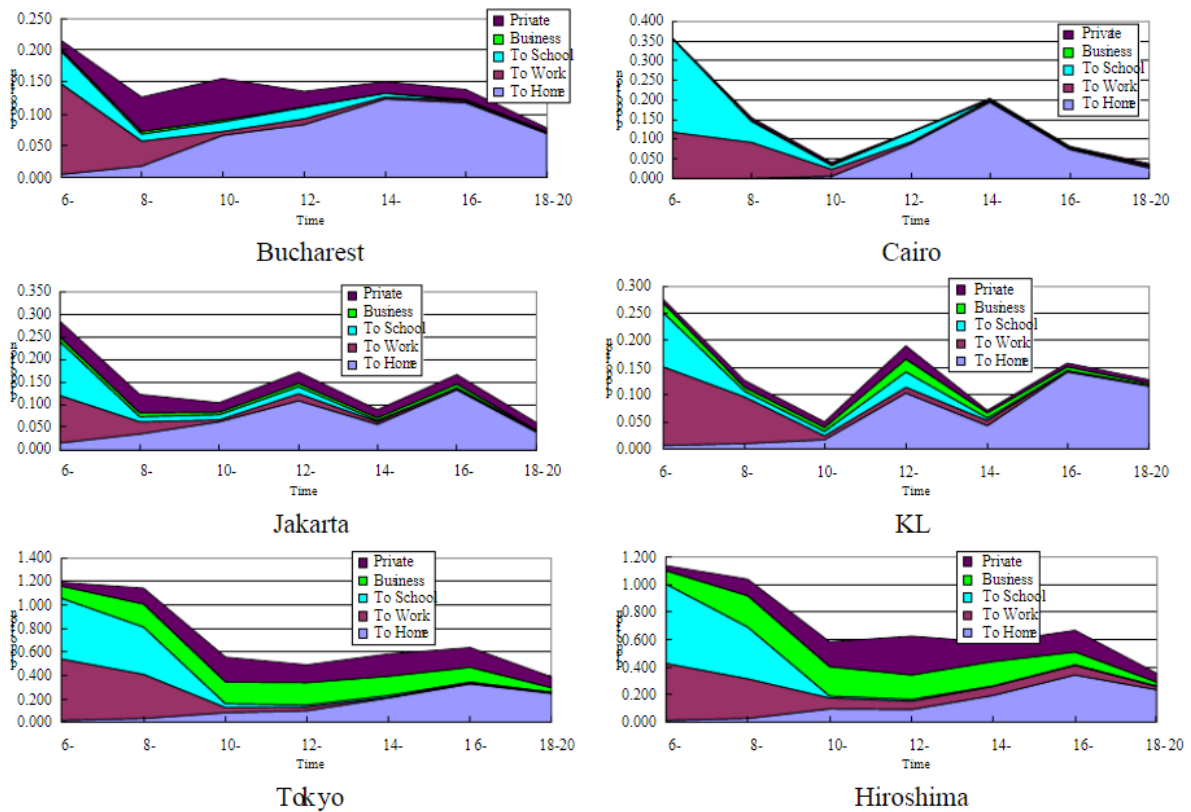

Fig. 1. Share of the trip purposes based on time of the day in six international cities [22]

High mobility of people contributes to the reduction of social and economic differences between regions. It is also very beneficial from an economic point of view. Several recent empirical studies have shed light on the causal relationships that underlie the correlations between a built environment and travel behaviour [13]. In Europe, as in the United States, people do not change their place of residence because of entertainment and other motivations like shopping and entertainment but their main motive is usually proximity to workplace. This is something common in parallel with Poland, where like several other European countries, people would travel on a small distance rather than long trips. It is a convenience to change the residence place when someone starts a new job. If one gets employment in another city, he rents a flat there and moves permanently.

As it appears from the PageGroup survey in Europe, private car access to for example shopping has the most proponents. 66% of all respondents admitted that they usually choose a private means of transport. Over two fifths are in a way forced into the car - because they have limited possibilities of using public transport. In all of Europe, 34% of people use public transit, with most of them (75%) appreciating its effectiveness. An additional advantage of public transport means is their relatively low costs (60%) and speed of getting to different

motivations (44%) – especially when you can commute by metro or high-speed train. For 40% of respondents, a significant advantage of public transport is to avoid parking problems. Among the surveyed countries: Austria and Switzerland exceed 90% satisfaction with public communication. The European average is lowered by Italians; only 54 per cent. People using public communication acknowledge its effectiveness.

In Poland, a series of deliberations titled Comprehensive Travel Study (KBR) have been carried out mostly in large cities. They concern surveys in household and measurements of vehicles and travellers in private and public transport. The intention is to learn about the daily transport user's behaviour of the inhabitants that pursue rational transport policy. On their basis is developing transport model, which analyses the volume and conditions of traffic in the road network and public transport depending on the changes in spatial development (construction of a housing estate, shopping centre) and changes in road infrastructure (construction of a road or tramway line) [22].

In Warsaw, six of such surveys was carried out, the last of which was in 2015. The mobility rate of Warsaw residential amounts to 1,99 trips. On a working day, almost 82 % of residents make at least one trip per day. Residentials who do not travel so much are elderly people (pensioners) and non- working and unemployed people. Fig. 2 shows a chart of travellers and non- travellers by age.
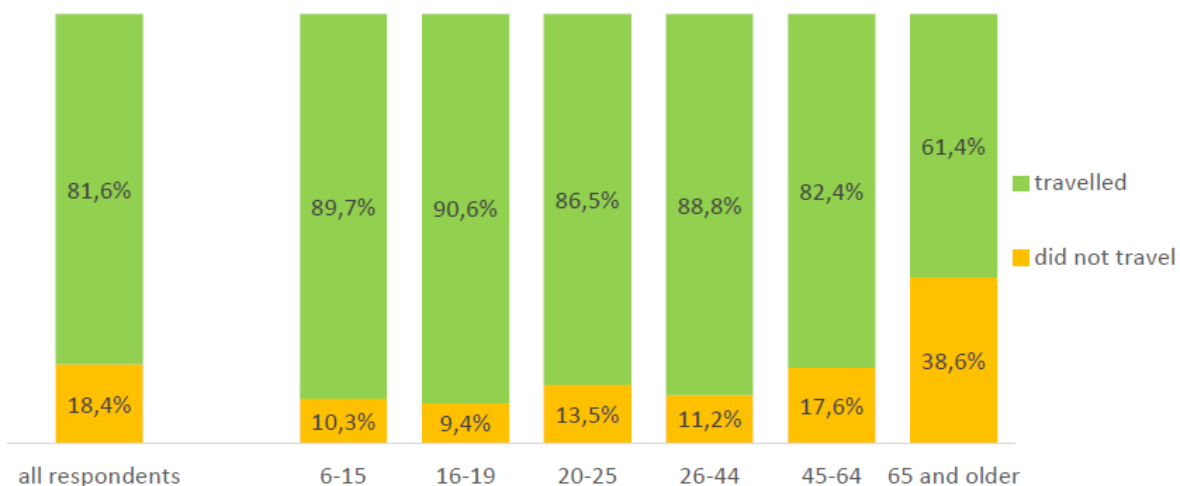

Fig. 2. Travels performed by residents of Warsaw on a typical working day [22]

Based on the chart (Fig. 3), the most frequent destination accounts for 44,1% trips about motivation home – work and work – home. Next, the travel between home and other destination 35,1% and 11,1% trips between home and place of study. The remaining 9,7% are trips not relevant to the home. Modal split shows (Fig. 4) that Warsaw residents primarily travel by public transport (46,8%) or as a passenger car (31,7%). Nearly, one in five (17,9%) trips are on foot and the rarest choice of transport is a bike (3,1%). In all the destinations (also trips between home and work), the choice of car in trips was purposeful by its ownership.

Three out of four non-pedestrian travels are executed without having to change vehicles. Trips by mass transit take place without transfers of 57,2%. The majority of trips of inhabitants of Warsaw begin and end in Warsaw (95,5%). Only 4,5% of all trips have their inception or destination outside Warsaw [21].
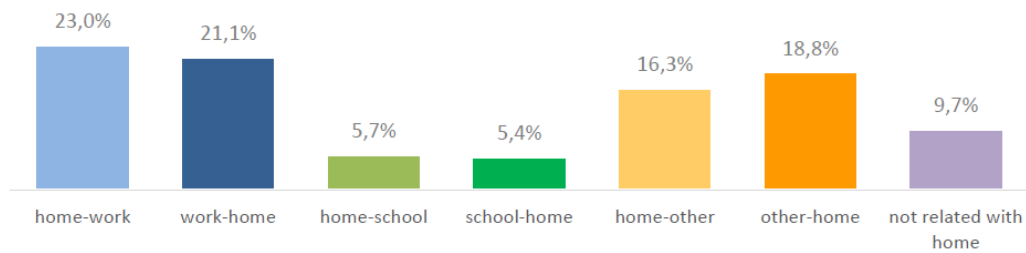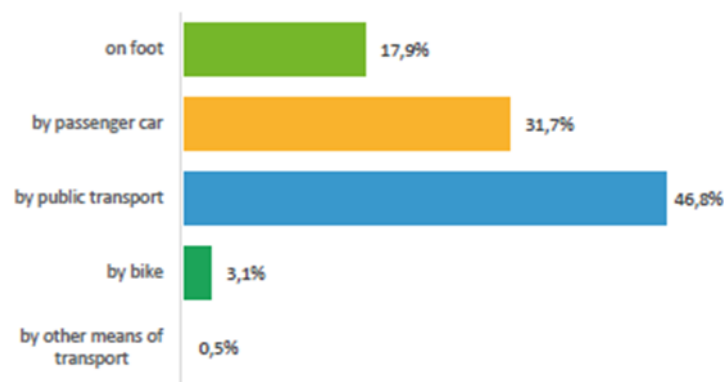
Fig. 3. Travel purposes of Warsaw residents [22]

Fig. 4. Modal split of the respondents [22]

In 2009, mobility estimate of Wroclaw residents amounted to 1,87 trips (1,87 daily trips for Wrocław inhabitants). The most trips by all day, on average 2,05 are complied by people who have got more than two cars and residents who are 26-39 years of age. The busiest occupational group are persons working on their own (enterprisers); they make an average of 2,59 trips daily. The house is the basic travel destination of the inhabitants of Wroclaw and constitutes 45% of all travels. Following destination is work, which accounts for 21% of trips [24].

Execution of the 2018 Comprehensive Travel Study shows that the mobility of inhabitants of Wroclaw is as follows 1,7 trip/ day. The average number of cars in the household in Wroclaw equal 0,5 (265 cars/ 1000 residents). The residents travel by car most often (41%). While the second most frequently chosen mode of transport is public transport (28%), then are trips on foot (24%) and travel by bike (6%). 38% of all trips have a motivation home - work (20%) and work - home (18%). The men often performed work and study trips. The reason for choosing car transport in commuting is the convenience of use and short commuting time. Whereas the reason for choosing public transport is more varied. Firstly, the convenience of use, and secondly, the close location of stops, and third short commuting time [8].

The fifth Comprehensive Travel Study in Cracow was held in 2013. Based on it, the most important indicators characterising Cracow's transport system were determined. 97.5% of the travels were internal (takes place in the city of Cracow), while 2.5% was outside of the city [3].

The survey shows that 57% of households have access to at least one passenger car and 45% do not have a car. The average number of home-based travels Is 2.02 trips per day. The largest number of trips is made by people aged 30-39 (mobility rate 2.13). The least number of trips is made by people after 60 years of age (mobility rate 1,42).

Travels about motivation home-work (18,1%), work-home (15,8%) and other-home (19,8%), home-other (17,2%) was the main destination of Cracow inhabitants. Public transport (36,3%) and car (33,7%) was the dominant means of transport in the travels residents. The share of pedestrian travel was 24, 8%. Moreover, the research indicated that 20% of residents reach Midtown by car. The reason for choosing a car is the accessibility of travelling and the inappropriate offer of public transport and "the nature of the work requiring the use of a car". An incentive to opt out of commuting to Midtown by car is the ability to reach public transport quickly (37,1%), free parking near the city centre (36,7%) and increase of the public transport frequency (28,3%) [20].

Primarily, the previous enactments about Warsaw, Wroclaw, and Cracow shows that the non-commute travels in these cities especially the home-based ones make a large percentage of the whole urban travels. In spite of the fact that we possess these data, statistical analysis is still needed to interpret the associations between different determinants of trip behaviours, as well as the provenance of the mobility decisions. The current data about Polish cities as such cannot be accurate about these circumstances. Thus, the present study about Cracow as a typical large Polish city was initiated.

1.1. Research Questions and Hypotheses

The research questions answered in this study are (1) what are the determinants of non-commute travel generation (shopping and entertainment) in Cracow, Poland?, (2) What are the differences in terms of travel generation in compact, central districts with those of the sprawled, decentral districts?

The general hypothesis of this study concerns the impact of various factors on the commute and non-commute travel generation. Traffic generating factors is location; individual factors and socio-economic considerations; transport aspects (modal split, availability of alternative means of transport in relation to the car, advantages and disadvantages of different modes of transport) or land use and urban form (number of public and commercial services, amount of greenery, distance from the destination).

1.2. Case study areas

For the analysis of non-commute travels in Cracow, two districts of the city were selected based on their characteristics: Piasek Północ and Kurdwanów. Residential area Piasek Północ is located in Stare Miasto district in the central part of the historical part of Cracow, while the residential area Kurdwanów is located on the edge of the city (south of the centre) in Podgórze Duchackie district. In Stare Miasto district (including Piasek Północ), 37 528 people live in a 5,59 km² area, so the population density of the whole district is 6 710 inhab./km², while in Podgórze Duchackie district (including Kurdwanów) 54 637 inhabitants live in 9,54 km², resulting in a population density of 5 435 inhab./km² [4].

Over the centuries, the districts of Cracow have been influenced by historical events, including the Austrian partitions or the German occupation. In 1991, 18 districts were established, the territorial division of which is still valid today. The locations of the analysed districts are presented against the background of the city of Cracow in Fig. 5.
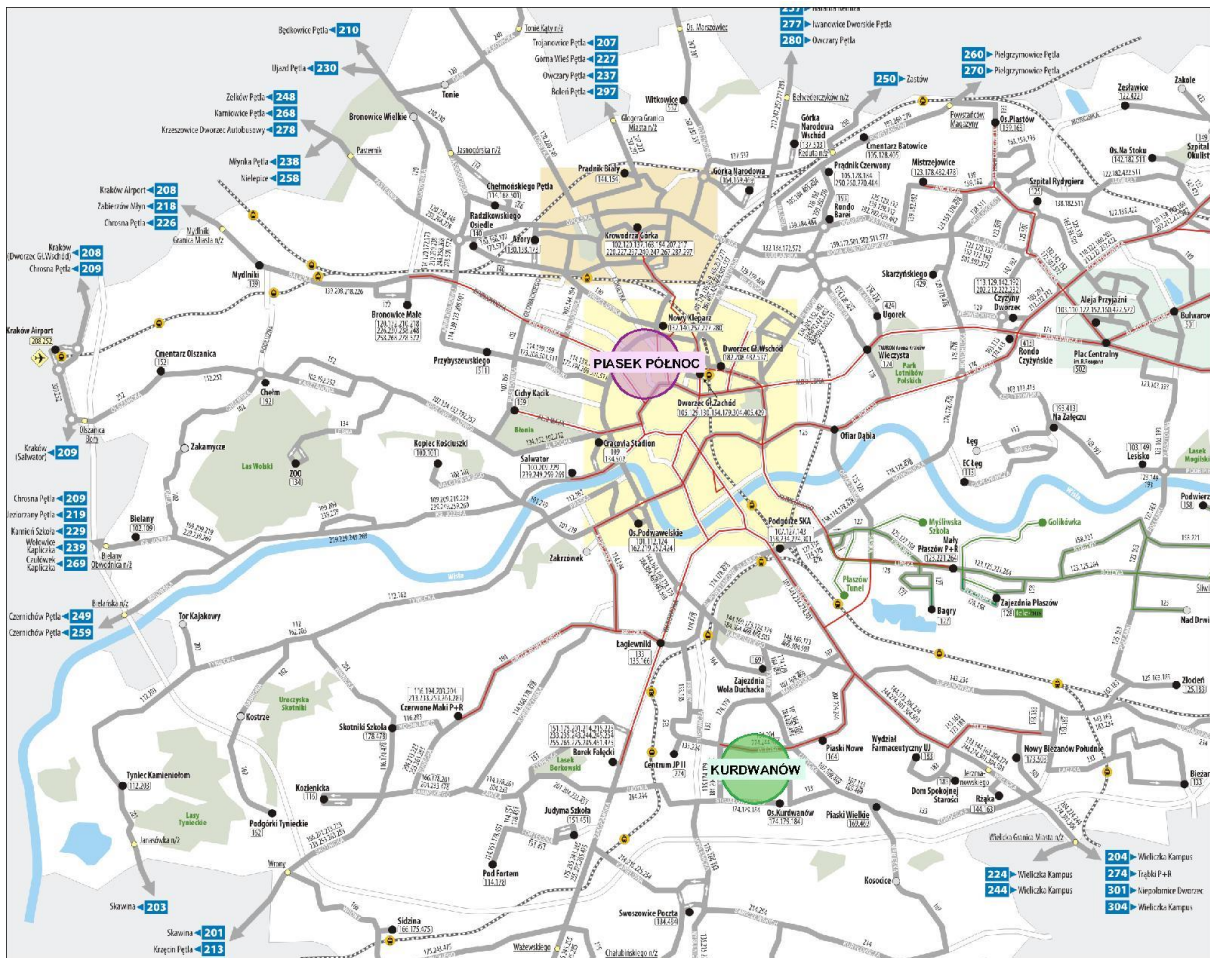
Fig. 5. The location of the two case-study areas: Kurdwanów and Piasek Północ

The territorial development of Cracow over the years is presented below. The map [15] from 1788 shows the location of the housing estate in relation to the old town. Then, Piasek Północ was not part of Cracow, however, it was annexed to the city in later eras. Due to its history, the area accommodates many historical and cultural values for centuries, the layout of the streets has remained unchanged. One can also notice the effect of urban sprawl by connecting nearby villages to Cracow. During the Four-Year Sejm (1788-1792), it was established that suburban areas (including Jura Piasek) joined the city. Then the city was divided into four circuits (the equivalent of districts), the second circulation included the analysed area.

In the map from the 19th century guide "Cracow and its surroundings" [16]. It can be noticed that the analysed Piasek Północ estate was then defined as Przedmieście Piasek, which was already entering the city limits. Piasek was the fourth district of Cracow in 1891 as indicated in the book titled "Guide to Cracow and surroundings" [17]. It is also interesting to present a public transportation network that depicts the tramline run by the two bypasses of Cracow – Adam Mickiewicz Avenue and Juliusz Słowacki Avenue.

The latest plan of Cracow published in 1935 by the Polonia publishing house is the second edition of the plan by Stanisław Wyrobek [1]. It can be noticed that Piasek Północ has slightly changed since then, the street layout and building quarters are very similar to the current state. Contributing to this may be the fact that during the Second World War and the occupation, Polish Cracow was not destroyed and devastated. One can also observe the

differences in the aforementioned tramlines. In this edition, it was not planned to be built along the alley, its place was taken by a green belt in the middle of the street. A side map was also inserted showing the surroundings of Cracow, where it is shown that Kurdwanów does not belong to the city yet. In 1941, the German occupation authorities extended the administrative boundaries of the city by joining the surrounding municipalities and towns, creating districts of Cracow from them, among others X – Borek Fałęcki in which Kurdwanów is located [9]. In 1948, this extension was confirmed by Polish authorities. In the 1980s, on the border of Wola Duchacka and Kurdwanów, a large housing estate began, which adopted the name Kurdwanów Nowy (a central part of the estate was created). Actual construction of the estate began in 1980. At that time, tens of 5 and 11-storey blocks were built. Until the early nineties, the urban structure of the housing estate was formed. Buildings were built after the era of socialist urban planning, where they were popular affordable housing encouraged by socialist approaches. Many new multi-family blocks erected in various technologies and styles have been created and are still being built.
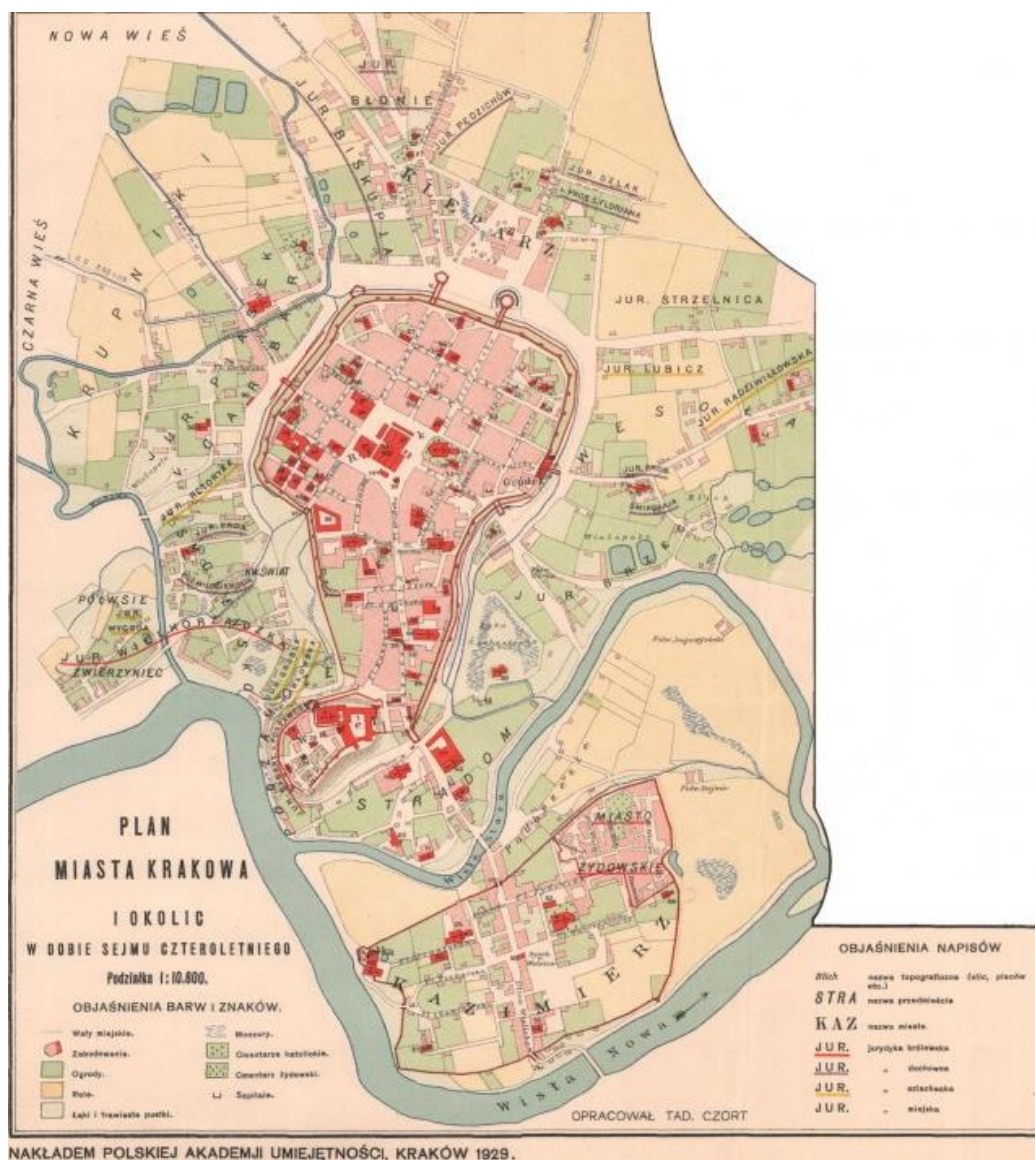

Fig. 6. Plan of the city of Cracow and the surrounding area in the year 1788
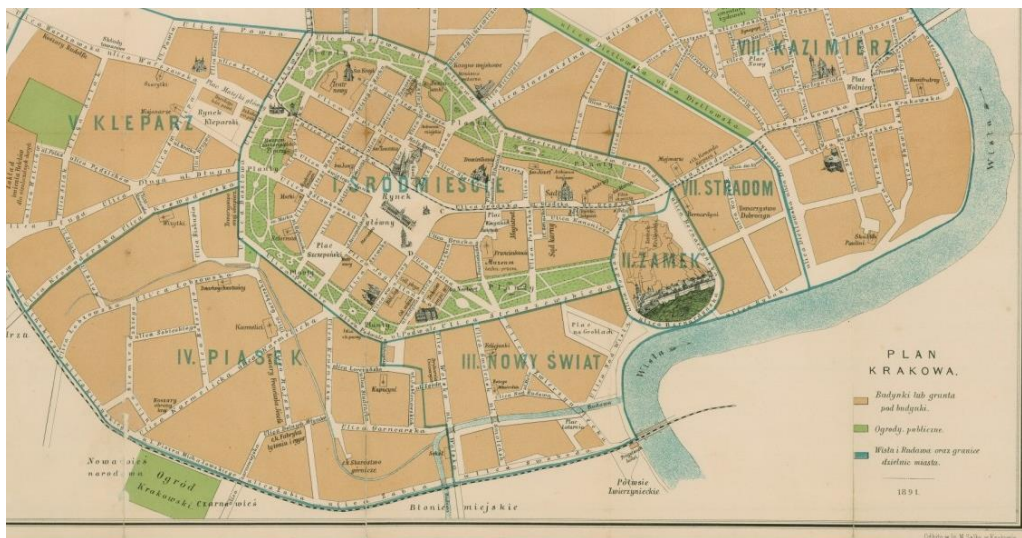
Fig. 7. Location of Piasek Północ Cracow in the year 1891 [10]

Piasek Północ is mainly characterised by multi-family housing in the form of urban block and frontage along the street. All these create a dense downtown development, in addition, are services on the ground floor of tenements. There is a negligible amount of greenery there. The opposite can be seen in Kurdwanów, where there are multi-family buildings, but in the form of modernist blocks or detached houses. The service buildings are mainly free-standing buildings or services on the ground floor. Green areas are green companion plants or small parks and green squares.

In terms of public transport service, both analysed areas are good. In the case of Piasek Północ, there are five public transport stations (all serviced by bus, including three serviced by tram). The arrival times and distance are convenient for transport users. While in Kurdwanów, there are seven stations (four serviced by bus and three serviced by tram). A huge difference is in the case of the parking situation in the two areas. Piasek Północ does not have enough space, so the number of parking spaces is limited, whereas Kurdwanów does not suffer from this issue so much. In the north-western part of the estate, there is a park and ride car park integrated with trams.

Worthy of note is the bicycle infrastructure. In Cracow, there is a city bike system named Wavelo. It can be noted that there are four city bike stations in Piaski Północ and three stations in Kurdwanów. In Kurdwanów, there are no bicycle routes, only suggested roads are indicated, while in Piasek Północ, there is a cycling route network.

The two areas were selected for analysis due to the diversity in terms of land development, the number of services, and the accessibility to public transport. An important factor was also the proximity to the centre, which generates a large number of tourists in Piasek Północ and the fact that there are many more commercial and public services within walking access. These above characteristics motivated selection of the two areas, aiming at having two different case-study areas in terms of land use.
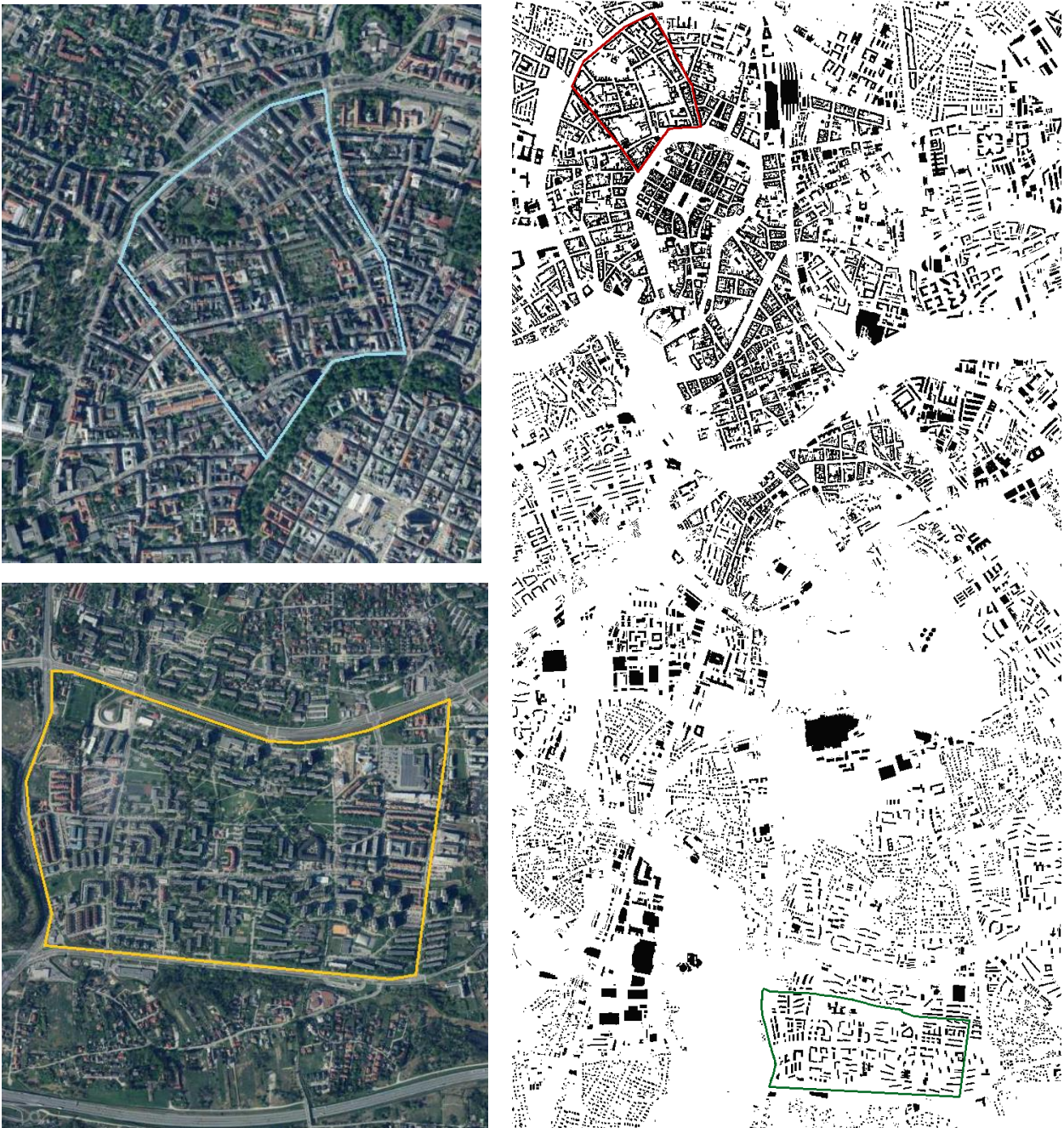
Fig. 8. The urban form and layout of the two selected areas: up: Piasek Północ; bottom: Kurdwanów
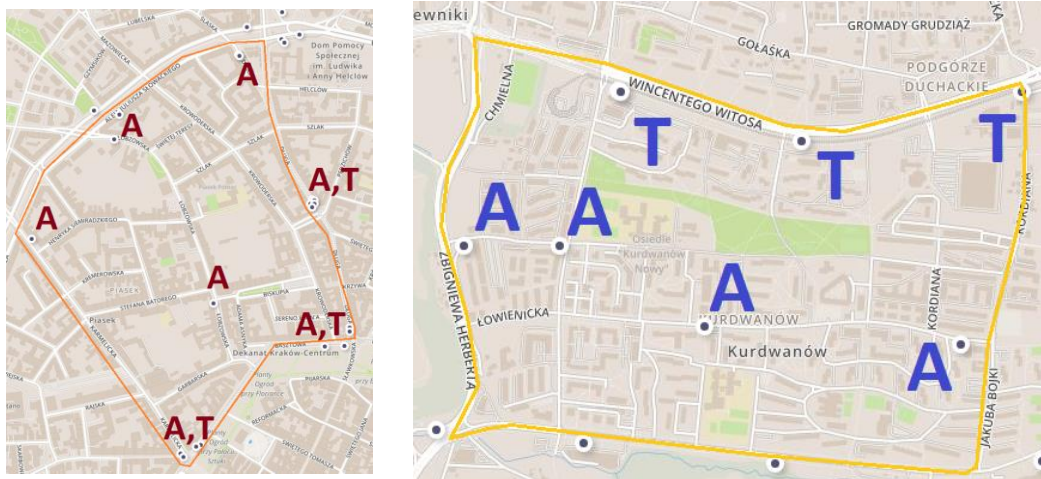
Fig. 9. Accessibility to bus stations (A) and tram (T) in Piasek Północ (left) and Kurdwanów (right)

1.3. Data and survey

The data used for this study come from responses to questionnaires with 42 questions that included information on urban travel behaviour of Cracow's adults. The survey was carried out from January to February 2019 on 426 inhabitants of the two neighbourhoods in Cracow. Randomly selected persons on the streets of these neighbourhoods were asked to participate in the interview. The two areas selected for the survey differ in terms of spatial layout and structure as mentioned in the previous section.

Piasek Północ is a neighbourhood in a high-density area. It has a mix of residential, business and commercial functions. There is also access to the public transport system and good conditions for pedestrians. A little bit different is Kurdwanów. It is a neighbourhood where building densities and the land use mixing are lower. There residential locations dominate due to lack of retail facilities, distance to the nearest shop is longer. However, there is access to public transport system.

The questionnaire consisted of four parts. The first one was related to socioeconomics. The survey asked respondents among others about gender, age, and gross income. The second part was focused on activities and special issues of inhabitants. The questions referred to the frequency of travel and trip purpose. The mobility patterns were the subject of the other part of the survey. Respondents were asked about transport mode choice for commute and non-commute travel. The last part was focused on perceptions, attitudes, and self-selections. The questions referred to inhabitants' feelings about their neighbourhood. Table 1 summarises the variables developed based on the questions asked in the interviews.

Summary of variables

Section	Variable number	Variable	Data Type	Description
Socioeconomic	1	Gender	Binary	Male or female.
	2	Age	Continuous	Reported age of the respondent.
	3	Daily Activities	Binary	Work/study or none.
	4	Driving License Ownership	Binary	Possession of a driving license by the respondent: yes or no.
	5	Car Ownership	Categorical	The number of personal cars possessed by the respondent.
	6	Monthly Living Cost	Continuous	Reported gross household monthly income.
	7	Daily Travel Cost	Continuous	Reported daily travel cost
Activities and special issues	8	Frequency of Non- Commute Trips	Continuous	The number of non-commute trips of the respondent during the past seven days.
	9	Shopping Place	Binary	The place the respondent usually shops daily living stuff: inside the neighbourhood or farther.
	10	Frequency of Shopping Inside the Neighbourhood	Continuous	The number of shopping inside the neighbourhood during the past seven days.
	11	Attractive Shops in the Neighbourhood	Binary	Presence of attractive shops in the neighbourhood of the respondent according to him/her: yes or no.
	12	Frequency of Shopping Outside the Neighbourhood	Continuous	The number of shopping outside the neighbourhood during the past seven days.
Mobility patterns	13	Shopping/Entertainment Mode Choice Inside the Neighbourhood	Categorical	Mode choice for respondent's shopping or recreational activities inside the neighbourhood: car, on foot, bicycle, taxi, taxi apps, bus, train, tram.
	14	Shopping/Entertainment Mode Choice Outside the Neighbourhood	Categorical	Mode choice for respondent's shopping or recreational activities outside the neighbourhood: car, on foot, bicycle, taxi, taxi apps, bus, train, tram.

	15	Frequency of Commute Trips	Continuous	The number of commute trips of the respondent during the past seven days.
	16	Commute Mode Choice	Categorical	Mode choice for respondent's commute trips: car, on foot, bicycle, taxi, taxi apps, bus, train, tram.
	17	Reason for Mode Choice	Categorical	The respondents were asked: "You travel by the above mean of transport because?" Options: It's cheaper than other modes, It's more secure, It takes less time, It's more comfortable, I have direct connections, Public transport stops are located close to my place of living, No possibility to use other modes of transport.
	18	Frequency of Public Transport Travels	Categorical	The usual frequency of the respondent's public transportation ridership according to him/her: every day, a few times per week, a few times per month, rarely, almost never.
	19	Reason for Non-Public Transport Use	Categorical	The respondents were asked "If you do not use public transit, what is the reason?" Options: It is not comfortable, It is expensive, Station/bus stop is far away, There is no public transport, It is slow Social problems, I prefer my own car.
	20	Subjective Security of Public Transport	Categorical	The level of the securing of public transportation according to the respondent's perception: very secure, secure, medium, insecure, and very insecure.
	21	Reason for Public Transport Use	Categorical	The respondents were asked "If you do use public transit, what is the reason?" Options: It is not comfortable, It is cheap, Station/bus stop is near, It is fast, I do not have a car.
Perceptions, Attitudes & Self Selections	22	Sense of Belonging to the Neighbourhood	Binary	Respondent's perception about his/her sense of belonging to the neighbourhood: yes or no.
	23	Entertainment Place	Binary	The place the respondent usually goes to entertainment activities: inside the neighbourhood or farther.
	24	Residential Location Choice	Categorical	The main reason of choosing the living place and the neighbourhood from the following options: affordability, proximity to working place/school, attractive surrounding environment, live here since I was born/my childhood, good public transport.
	25	Advantages of the Neighbourhood	Categorical	The respondents were asked: "What kind of advantages does your neighbourhood have?" Options: Lots of public space, There is good public transportation, Well connected to the centre.

26	Disadvantages of the Neighbourhood	Categorical	The respondents were asked: "What disadvantages does your neighbourhood have?" Options: Lots of traffic jams, Polluted area, Lack of safety, Loud at night, High costs of living.
27	Last Relocation Time	Continuous	The number of years passed from the last residential relocation of the respondent.
28	Personal Character	Binary	The respondents were asked: "Which personal character is true about you?" Options: I enjoy driving a car very much, I am pro-environment, I work all the time, I strictly follow my hobbies, I am a social person: yes or no

1.4. Analysis method

Based on the data obtained as a result of the surveys, linear regression models were generated, with the aim of finding the correlation between the frequency of home-based non-work travels as an independent variable and the dependent variables that were considered to be important according to the existing literature. The modelling was continued by eliminating insignificant variables until a satisfactory R^2 resulted. Three models associated with non-work travel frequency was developed for individual areas. Each model was developed assuming a confidence level equal to 95%.

2. FINDINGS

2.1. Descriptive statistics

In the linear regression model for non-commute travel generation model, 8 variables were used: 4 discrete and 4 continuous. These variables are presented in Table 2.

Tab. 2

Description of variables

Variable	Type	Description
Age	continuous	Person's age
FreqNonCommuteInDistrict	continuous	Frequency of non-commute travels in district
FreqNonCommuteOutside	continuous	Frequency of non-commute travels in district
NonCommuteTotal (dependent variable)	continuous	Total number of non-commute trips
DailyActivity	dummy	Daily activity: work or study (1), no work or study (0)
DistrictShoppingPlace	dummy	The most frequent place of shopping: district (1), farther (0)
AttractiveShops	dummy	Attractive shops In the neighbourhood: present (1), not present (0)
DomModeOutside	dummy	Dominant mode outside district: car (1), non-car (0)

Descriptive statistics for discrete variables used in the model is shown in Tables 3 and 4, respectively. Other variables were not significant enough for use in the model.

Tab. 3

Discrete variables used in the model

Variable	*n*	*Range*	*Minimum*	*Maximum*	*Mean*	*Std. dev.*	*Variance*
Age	426	68	10	78	34.51	14.71	216.33
FreqNonCommuteInDistrict	426	15	0	15	3.02	1.88	3.52
FreqNonCommuteOutside	426	18	0	18	1.75	2.10	4.41
NonCommuteTotal (dependent variable)	426	26	0	26	3.41	3.37	11.36

Tab. 4

Continuous variables used in the model

Variable	Option	Overall Sample		Kurdwanów		Piasek Północ	
		Count	Column N %	Count	Column N %	Count	Column N %
DailyActivity	work/study	386	90.6%	196	90.3%	190	90.9%
	no work/study	40	9.4%	21	9.7%	19	9.1%
DistrictShoppingPlace	district	281	66.0%	138	63.6%	143	68.4%
	farther	145	34.0%	79	36.4%	66	31.6%
AttractiveShops	yes	293	68.8%	149	68.7%	144	68.9%
	no	133	31.2%	68	31.3%	65	31.1%
DomModeOutside	car	148	34.7%	92	42.4%	56	26.8%
	non-car	278	65.3%	125	57.6%	153	73.2%

2.2. Model fit

As shown in Table 5, for the overall sample, the strongest impact over number of the non-commute travels has the number of non-commute travels outside the district (*FreqNonCommuteOutside*), which is 0.650. It means that for a one-point increase of non-commute travels outside the district is an increase of 0.650 non-commute travels overall. Less significant variables are the frequency of shopping in the district (*FreqNonCommuteInDistrict*), which is 0.247, and Age, which is -0.200. For frequency of shopping in the district, it is 0.247 change of dependent variable per one travel increase, and for Age, it is -0.200 change of non-commute travels per one-year increase of age. The rest of the independent variables are the least significant. These are daily activity (*DailyActivity*), main district of shopping (*DistrictShoppingPlace*), presence of attractive shops in the district (AttractiveShops) and dominant mode outside the district (*DomModeOutside*).
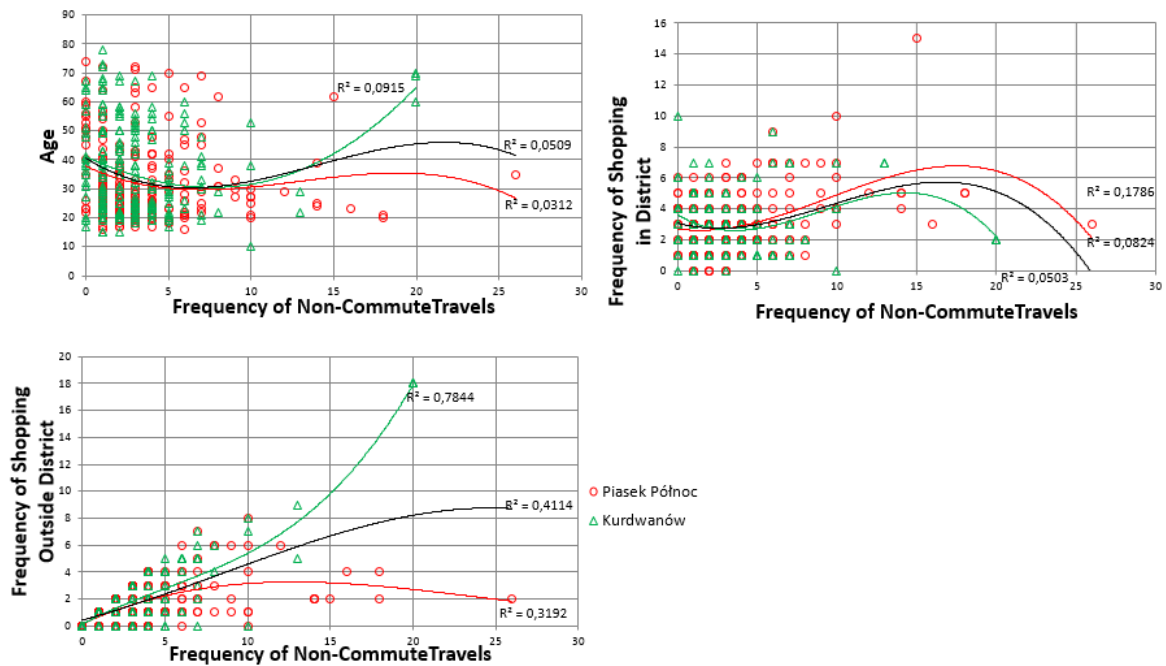
Fig. 10. Continuous variables in relation to frequency of non-commute travels and curves with the best R^2
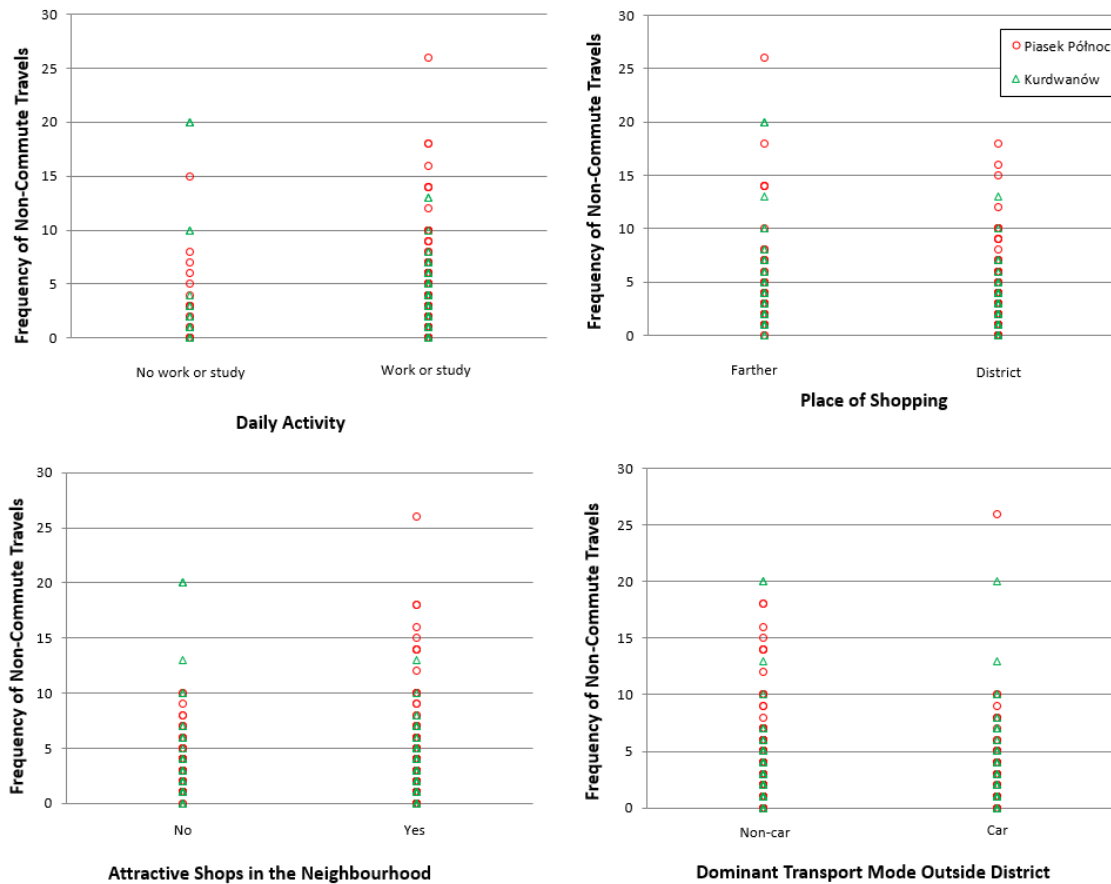

Fig. 11. Dummy variables in relation to frequency of non-commute travels

Tab. 5

Model parameters for the frequency of non-commute travels in the overall sample

Variable	Unstandardised Coefficients		Standardised Coefficients	t	P
	B	Std. Error	Beta		
Intercept	2.854	0.721	0.000	3.956	<0.001
Age	-0.046	0.009	-0.200	-4.883	<0.001
DailyActivity	-0.915	0.464	-0.079	-1.971	0.049
DistrictShoppingPlace	-0.576	0.281	-0.081	-2.049	0.041
FreqNonCommuteInDistrict	0.445	0.067	0.247	6.657	<0.001
AttractiveShops	0.463	0.261	0.064	1.777	0.076
FreqNonCommuteOutside	1.043	0.061	0.650	17.117	<0.001
DomModeOutside	-0.390	0.255	-0.055	-1.528	0.127

Achieved model fit is shown in Table 6 - R^2 is equal 0.496, being decent according to linear regression analysis method, explaining 50% of the variability of the response data around its mean.

Tab. 6

Model validation for overall sample

Measure	Sum of Squares	df	F	P
Regression	2395.6	7	58.78572968	<0.001
Residual	2433.5	418		
Total	4829.1	425		
Multiple R	0.704			
R Square	0.496			
Adjusted R Square	0.488			

It is notable that the impact of independent variables in both districts is different, as shown in Tables 7 and 8 for Kurdwanów and Piasek Północ, respectively. While the frequency of non-commute travels outside the district (*FreqNonCommuteOutside*) has a very strong impact in the Kurdwanów sample (0.877), in the Piasek Północ sample, it is less than a half of that (0.418). The other significant difference between the two samples is for the frequency of non-commute travels in the district (*FreqNonCommuteInDistrict*) – 0.094 for Kurdwanów and 0.357 for Piasek Północ. In the case of dependent variable *Age*, there is compliance between two districts, however, they differ in numbers – in Kurdwanów, the impact of variable *Age* is higher than in Piasek Północ (-0.213 and -0.140). Other standardised coefficients of independent variables of both districts also comply in sign but in some cases, the numbers are different. Independent variable *AttractiveShops* does not have considerable impact in Kurdwanów as it has in Piasek Północ (0.017 and 0.101) and similarly for other independent variables. Results show how big the differences are between the two districts. For Kurdwanów, there are different variables affecting the dependent variable than in Piasek Północ.

Tab. 7

Model parameters for frequency of non-commute travels in Kurdwanów sample

Value	Kurdwanów				
	Unstandardised Coefficients		Standardised Coefficients	t	P
	B	Std. Error	Beta		
Intercept	3.030	0.576	0.000	5.259	<0.001
Age	-0.043	0.007	-0.213	-5.711	<0.001
DailyActivity	-0.792	0.382	-0.077	-2.070	0.040
DistrictShoppingPlace	-0.292	0.241	-0.046	-1.211	0.227
FreqNonCommuteInDistrict	0.163	0.063	0.094	2.600	0.010
AttractiveShops	0.109	0.226	0.017	0.482	0.630
FreqNonCommuteOutside	1.051	0.045	0.877	23.390	<0.001
DomModeOutside	-0.275	0.209	-0.045	-1.314	0.190

Tab. 8

Model parameters for frequency of non-commute travels in Piasek Północ sample

Value	Piasek Północ				
	Unstandardised Coefficients		Standardised Coefficients	t	P
	B	Std. Error	Beta		
Intercept	1.602	1.482	0.000	1.081	0.281
Age	-0.036	0.020	-0.140	-1.818	0.070
DailyActivity	-0.149	0.952	-0.012	-0.157	0.876
DistrictShoppingPlace	-0.848	0.516	-0.107	-1.644	0.102
FreqNonCommuteInDistrict	0.655	0.114	0.357	5.752	<0.001
AttractiveShops	0.779	0.473	0.101	1.647	0.101
FreqNonCommuteOutside	1.013	0.155	0.418	6.553	<0.001
DomModeOutside	-0.253	0.502	-0.032	-0.504	0.615

For Kurdwanów sample, model fit is significantly better than for Piasek Północ Sample, as shown in Tables 9 and 10. While 77% of cases can be explained for Kurdwanów Sample, only 35% can be explained for Piasek Północ Sample.

Tab. 9

Model fit for Kurdwanów sample

Measure	Sum of Squares	df	F	P
Regression	1533.5	7	97.964	<0.001
Residual	467.4	209		
Total	2000.9	216		
Multiple R	0.875			

R Square	0.766
Adjusted R Square	0.759

Tab. 10

Model fit for Piasek Północ sample

Measure	Sum of Squares	df	F	P
Regression	980.4	7	15.812	<0.001
Residual	1789.2	202		
Total	2769.6	209		
Multiple R	0.595			
R Square	0.354			
Adjusted R Square	0.332			

3. DISCUSSION

The findings of this study provide some basic ideas on how to manage non-commute travels within the Polish or Central/Eastern European large cities. It is often intended to decrease the number of commute trips, however, due to the psychological needs for mobility, this is not the aim for non-commute trips. However, it is meant to decrease the levels of car dependency on these trips. For that, it is necessary to have a clear understanding of the relations between the frequency of non-commute travels with several perceived, socio-demographic and built environment factors. These interrelations and associations are hypothesised to be under the influence of the geographic and cultural context. The context can have influences on mobility behaviours such as the decision to go for shopping or entertainment in case there are limited facilities for doing these activities in the vicinity of the living place. Such a decision may or may not be a context-sensitive one. Nevertheless, very limited studies have tested this hypothesis in the case of travel generation, particularly non-commute trips.

There are examples that show the presence of such cultural differences. For instance, age is not a significant descriptor of non-work trip generation in Southern California [5] but it is in Cracow according to the findings of this study. In contrast, gender is a significant descriptor in California but it is not in Cracow (it was eliminated from the model because of its insignificance). Moreover, the presence of more retail in the living area is marginally associated (in 10 per cent level) with less non-commute trips in Southern California, while in Cracow, it is marginally significant but the direction is opposite, in other words, more retail is correlated with more non-commute trips. Such contextual differences in travel behaviour are also observable between Cracow and Nigeria as a representative of developing countries. In a semi-urban industrial cluster of southwest Nigeria, a significant positive correlation was found between monthly income and car ownership with a non-work trip, while in Cracow, these variables were eliminated from the models because of their insignificance.

These examples show how non-commute travel behaviours are context-specific, but such comparisons are usually difficult to conduct, because of the methodological inconsistency of non-work travel investigations. However, the above two comparisons can slightly prove the hypothesis of the existence of such cultural differences. However, more similar studies are needed in order for it to be accepted or rejected.

The most influencing factor determining the generation of non-commute travel in the two studied areas (Piaski Północ and Kurdwanów) is the frequency of non-work related activities (entertainment, shopping) within the analysed urban unit. Social and cultural issues also affect the analysed model, however, to a lesser extent. First of all, it concerns age; the older the respondents were, the less non-commute travels they did. In the case of the Kurdwanów, the daily activity of the respondents and the choice of the dominant mode of transport, which they use to make purchases outside the area of residence, have a major impact on the generation of non-work-related journeys. However, in the case of the Piaski Północ estate, the frequency of shopping in the vicinity of the place of residence and the availability. Attractive stores in the area also played a large role. The presence of attractive service premises near the place of residence for both analysed areas does not affect non-commute travel significantly. However, from the point of view of spatial planning, this is one of the most important determinants. This emphasises the role of urban and spatial planning in providing attractiveness in urban form and local facilities. This confirms the hypothesis that the attractiveness of spaces and destinations can encourage people to change their mobility patterns and behaviours.

Piaski Północ, due to its historical compact urban layout, is difficult to modernise. However, some small free spaces can be found in it to improve the attractiveness, especially combined with active transportation routes and tracks. Quarters in the form of a frontage are a spatial barrier that is difficult to circumvent. To respect its history and character, it is worth using in this area instead of hard infrastructural instruments – "soft" measures instruments. Above all, it is worth focusing on better mobility management in this area, by creating good conditions for travelling with pedestrian trips, public transport, bicycles, it is also worth focusing on the promotion of sustainable transport. In the case of bus transport, Piaski Północ has good access to public transport, so improving the public transport service in the form of the launch of a new bus or tram is unnecessary. It is worth focusing on cycling, which is in poor condition in the estate. It may be valuable creating a one-way street or removing parking spaces for a designated cycle route. Moreover, in the place of the gaps between the side buildings, create a multi-storey car park, whose façade will harmonise with the character of the area. As a result, there will be more space for cyclists and pedestrians on the street, and the space will be less chaotic. It is worth entering a cycling route between city bike stations and Łobzowska Street. The introduction of attractive pedestrian routes between public transport stops and large traffic generators is also worthy of notice. Pedestrian access, varied with small architecture and greenery in the form of rows of trees, shrubs and low noise level, increases non-motorised trips. It is also advisable to pay attention to people with reduced mobility - mothers with prams, people with disabilities, elderly people or tourists with suitcases. The topography of the estate indicates that the area is flat, so there is no need for any additional ramps, but it is necessary to lower the sidewalks and ensure that the pavement surface is as good as possible – without any curves or convexities.

The situation is different in the second analysed area (Kurdwanów), where there are large differences in altitude in the southern part. There are stairs, which are not enough that in many cases are not adapted for people with limited mobility. In the older, southern part, there is a lack of access for disabled people, and the sidewalks are in a poor technical condition - with visible losses, bumps and irregularities. The entire estate should be adapted to this group of people, because many older people, families with children and prams or shoppers move around the place. The space itself is well-designed, there is a park, alleys designed only for walking and cycling, hiking trips take place among greenery and the noise is low. Due to the occurrence of many crimes against the pseudo-football background, the entire facility should be better lit, and additional city monitoring system should be introduced at stops and access

points. In the case of bicycle traffic in the analysed area, there are no higher-order roads than local and collective roads (except for roads that are the boundaries of the housing estate), which is the reasoning cycling is carried out on streets without designating additional bicycle lane. It would be better to separate bike traffic from pedestrians and cars on the busiest streets - such as Herberta, Stojałowskiego, Halszki or Witosa Street. Public transport in the form of bus and tram transport is also in good condition. It would be a good idea to introduce an accelerated route to the city centre. Presently, from the "Os. Kurdwanów" stop (the southern boundary of the estate) to the city centre is about 45 minutes, which is twice as long as in the case of the tram suburb located in the north. It is also worth introducing an accelerated bus line that would lead through the interior of the estate. The road should have a meander-like character, that is, it should take as many people as possible, it could be led through Bojki and Wysłołuchów streets, which would make the middle of the estate better communicated. In the case of spatial planning, there should be at the bus stops, buildings with the greatest building intensity, so that the stops will be able to handle the appropriate number of passengers. However, it should be remembered that too high building intensity and too high building density can reduce the quality of life of residents. It is also worth introducing a greater functional diversity, which will increase the amount of pedestrian travel over car journeys because the distance between the source and the destination will be reduced.

In general, the feedback of this study to spatial planning for the purpose of affecting non-work travels is to provide more attractive local facilities such as shops and retail. According to the findings of this paper, this will lay influence on the number of non-commute trips of older people in the vicinity of their houses. Since these travels are done in short distances, it is probable that they are non-motorised. If so, spatial planning can have causal impacts on the sustainability of urban mobility.

When considering the contribution to knowledge, this study has identified the impact of various factors on the commute and non-commute travel generation. A major limitation of this study is the inability of the available data to capture dynamic changes. The investigation is limited by self-reported travel behaviours. Furthermore, employment status and job type are important contributors in determining residential location, neighbourhood preference, and mode of travel to work, and these were not examined in any detail in this study. Neighbourhoods were defined based on administrative units. This synthetic use of aggregating administrative spatial units into neighbourhoods may not reflect how respondents define their neighbourhood. It could be more meaningful to try to find ways to improve the match. In future works, it is recommendable to generate more urban form variables to find more built environment-related significant variables. This was not done at a satisfactory level, due to scarcity of resources and time.

In Europe and around the world, research is being carried out into travel for work, services and entertainment with results that may be surprising. The above research was conducted in Kurdwanów and Piaski Północ districts. People met were asked about things related to travel so that they could create a more accurate travel model. In this study, we focused on non-work travel; these places are where people go on the same road and therefore, have no alternative. When travelling to services or entertainment, people have a choice of where, which way and how to go. This study reveals that age, daily activity, place of shopping, frequency of shopping near homes, and frequency shopping activities outside in farther places significantly correlates with the frequency of non-work trips in Cracow. Moreover, the availability of attractive shops is marginally significant in the overall model. However, the differences made for the two districts of different urban forms, show that the decentralised district of Kurdwanów, which has several large residential buildings marked as

socialist urban form, produces more outbound non-work trips to other districts, which may be more or less connected with higher levels of car use. This means the more compact and central district of this study generates low outbound but more domestic non-commute trips. The findings of this study suggest the provision of more attractive shops and retail for keeping non-work urban travellers, especially older ones, within the vicinity of their living place. Implementing urban and spatial planning measures are suggested by this paper to strengthen the concept of short distances within the city.

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