

# SEGMENTATION OF ACADEMIC COMMUNITY FOR THE PURPOSES OF MOBILITY PLAN DEVELOPMENT – CASE STUDY OF GDANSK UNIVERSITY OF TECHNOLOGY

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## **Abstract**

The objective of the paper is to analyse the structure of academic community for its transport behaviour and attitudes using the example of the Gdansk University of Technology (the GUT) in Poland. Once understood, the group can be divided into homogenous sub-groups and studied for their potential and ways to influence their behaviour, attitudes and transport patterns. The results may be used to develop dedicated actions designed to change the mentality and transport behaviour or to maintain sustainable transport patterns.

The purpose of the research was to help draw up a GUT mobility plan using market segmentation, a method commonly used in management and marketing. The segmentation was based on transport behaviour surveys among the University's employees. A total of 5 segments were distinguished: absolute car dependent (24%), conscious car drivers (27%), promising car drivers (7%), car free commuters (16%) and sustainable car owners (26%). In-depth analyses helped to aggregate the segments into 3 groups to be targeted with different measures aimed at changing mentality (24%), transport behaviour (34%) or maintaining sustainable transport habits (41%). Changing the proportion of particular segments and/or target groups can be one of the goals for the mobility plan.

Based on the results of GUT research some dependences between affiliation to the segment and other describing variables were observed. However, further research is necessary into the other cases. If positively verified, the research can be a basis for the development of a universal method for dividing the academic community into segments based on the available data or simple criteria. This would reduce the time to prepare the mobility plan and ensure that the measures are targeted properly and developed with less effort.

**Keywords:** market segmentation, transportation behaviour, transportation patterns, mobility plans.

## **1 INTRODUCTION**

With growing motorisation and increasing mobility needs, urban car traffic is becoming busier and busier. This may disturb the basic role of the city's transport system, make travel longer and deteriorate the level of service where road infrastructure is used. If the urban transport system operates above capacity, it causes congestion. Slower traffic means more emissions which leads to undesirable climate change globally.

Because local authorities are unable to handle these problems themselves, actions should be conducted and coordinated at the European level. The European Union's proposed remedy is a new mobility culture which requires communities to change their transport behaviour and choose more sustainable modes. The new mobility culture means giving up motorised private transport in favour of public transport and modes using alternative and renewable energy or the power of human muscles [1].

Promoted by the EU, the new mobility culture relies on mobility management. The concept seeks to promote sustainable transport and manage the demand for the car by changing travellers' attitudes and behaviour and by doing so preventing the negative effects of growing motorisation and car trips in cities.

To be able to shape a new urban mobility culture, organisations must have a strong influence on society or parts of it. This includes, in particular, the authorities (central or local government), employers, religious groups, the media and, of course, institutions of education [2]. The latter are best positioned for shaping sustainable transport patterns. The article concentrates on the role of public universities in this process. There are several reasons for that:

- universities bring together people who are open-minded, understand the value of culture and help create it,
- depending on the country public universities teach several thousand up to several million students; in Poland this may differ from several thousand to several tens of thousands of students (which ensures a strong influence),
- the academic community may represent a significant proportion of a country's and a university town's overall population; as an example, the share of academic community in Poland is nearly 5%, in particular Polish academic cities it is even more than 20% [3],
- because they are the destination of daily obligatory trips and commuting for study and work for such a high number of people, public universities are substantial traffic generators in the city or even region. The consequences of the trips they generate may affect districts and cities by causing problems with parking, more car traffic or increasing demand for public transport within their catchment area [4],
- because they are part of an educational organisation, both employees and students may be under its influence.

A university's social responsibility is an obligation towards reasonable, ethical and engaged citizenship of its stakeholders and environmental awareness. It also has an obligation to try and reduce the pressure of transport on its environment. The consequences of a university' transport services should be addressed as part of its social responsibility through its academic community mobility management plan. The university organisational culture may have a strong influence on how the academic community chooses to commute [5]. Before a plan is drawn up, the first step is to diagnose the current situation. If the attitudes and behaviour of academic community members are to change, they must first be studied and understood.

The objective of the paper is to analyse the structure of academic community for its transport behaviour and attitudes using the example of the Gdansk University of Technology (the GUT). The research used market segmentation, a method commonly used in management and marketing. Once understood, academic community can be divided into homogenous sub-groups and studied for their potential and ways to influence their behaviour, attitudes and transport patterns. The results may be used to develop dedicated actions designed to change the mentality and transport behaviour or to maintain sustainable transport patterns.

## 2 LITERATURE

Mobility management and a new mobility culture promoted by the EU rely on social attitudes. Changing them takes a long time and a lot of effort. Social attitude is one of the basic terms of social psychology and sociology and is usually defined as a relatively permanent system of beliefs, emotions and sentiments as well as behaviour of an individual towards a specific object (person, object, idea). The mechanisms that trigger a change in attitude are some of the most frequently studied phenomena of social psychology [6][7]. There is extensive research on transport patterns and changing transport attitudes by different social groups [8][9][10] and for different trip destinations [11][12]. Factors affecting transport choices of travellers have also been studied thoroughly [13][14][15].

One of the instruments of mobility management designed to change public attitudes and behaviour are mobility plans for areas (e.g. cities), events (e.g. concerts) and organisations (e.g. companies, universities). Mobility plans are packages of actions dedicated to specific groups (e.g. the population of a city, concert goers, company employees or students). They are designed to make a better use of existing infrastructure and foster informed and sustainable attitudes and transport behaviour. The first mobility plans were introduced 10 years ago by major companies mainly in Belgium, Switzerland, Austria and Scandinavian countries, but also in the United Kingdom, the Netherlands and France [16]. They are quite rare in Poland. The literature gives numerous examples from all over the world of how mobility plans were implemented for towns, events, companies and universities [17][18][19][20]. Poland's pioneer of mobility plans is the Krakow University of Technology, but some preparatory work has already started in several other Polish universities [2][3][4].

A well prepared mobility plan is based on a diagnosis of the current situation which includes gaining knowledge about the community being analysed. Derived from the transport attitudes and behaviours, the characteristics and its structure helps to identify the target groups and select the most effective actions. An effective mobility plan must be bespoke, i.e. work for a specific target group.

Market segmentation is a method for dividing heterogeneous group into homogenous subgroups. It is commonly used in management and marketing and increasingly more often in promoting sustainable transport. It is based on the demand side analysis of the market and is designed to be adopted to user requirements [21]. The process of segmentation involves analysing a community and disaggregating it to capture patterns and identify a set of smaller homogenous communities, referred to as market segments. An overview and evaluation of different approaches to segmentation in the transport sector is presented in [22]. The division into clusters when analysing transport behaviour and attitudes is given in [23][24][25]. The ability of marketing segmentation to persuade people to change their transport behaviour and motivate them to use less energy-intensive means of transport in a city was tested in a three year EU project called SEGMENT [26]. It helped to build a universal model of user segmentation for people's transport behaviour and attitude.

Some of the practical segmentation methods involve *a priori* and *post hoc* approaches [27]. When the *a priori* approach is applied, the project team defines the number and characteristics of segments. In the *post hoc* approach, segments are defined on the basis of experiments. Objects are grouped by their similarity according to a set of variables, in the majority of the cases groups are formed as a result of cluster analysis. The segments derived can then be used for defining target groups. A synthetic overview of possible approaches to segmentation in transport and examples are given in [22].

### 3 THE METHOD

#### 3.1 Research subject and objective

The paper presents the results of a study designed to help prepare a mobility plan for the Gdansk University of Technology (GUT). With 23,000 students and more than 2,700 staff, this Polish technical university is situated in Gdansk, a university city with a population of 450,000. Located on the city's main transport axis, the university generates 40,000 trips a day, a nuisance for the neighbours. With its significant impact on travel characteristics, the university is an important element of the city's transport system [4].

The objective of the work was to examine the structure of academic community for their transport arrangements (owning a car, other ways to commute, distance from home to university), daily transport choices and the propensity to use alternative modes of transport and reduce the use of the car. The data collected was used to:

- segment the academic community by behaviour, preferences and willingness to change,
- define the size of the segments,
- aggregate the segments into target groups,
- suggest ways to influence the groups,
- define the mobility plan objectives as regards changes in segment size or target groups,
- identify the relation between membership in a segment and other variables which the university keeps a record of.

#### 3.2 Data

The first stage of mobility plan work is to understand the commuting behaviour and transport preferences of the academic community. To that end a survey was conducted among university staff. 800 people responded representing 30% of all employees. The objective of the survey was to collect data for defining the diversity of the academic community and whether it can be divided into homogenous sub-groups. The questions asked about respondent characteristics, commuting choices and determinants and readiness for change from current transport behaviour to more sustainable behaviour.

Two sub-groups of academic community - students and staff - were identified while developing the survey. The assumption was that both groups have different transport possibilities because they are at a different stage in their lives [28]. More analyses of the academic community were conducted looking at the factors that influence transport behaviour and attitude.

The survey showed that despite the university's convenient location and accessibility, the majority of the trips are by car (62%). It was noted that the share changes significantly in relation to age, function, position and car availability (Fig. 1). As an example, use of a car increases with staff age, with professors, associate professors, older lecturers and assistant professors (67% up to 90%) using the car more often. Among administrative staff every other employee chooses the car and as many as 36% use public transport.

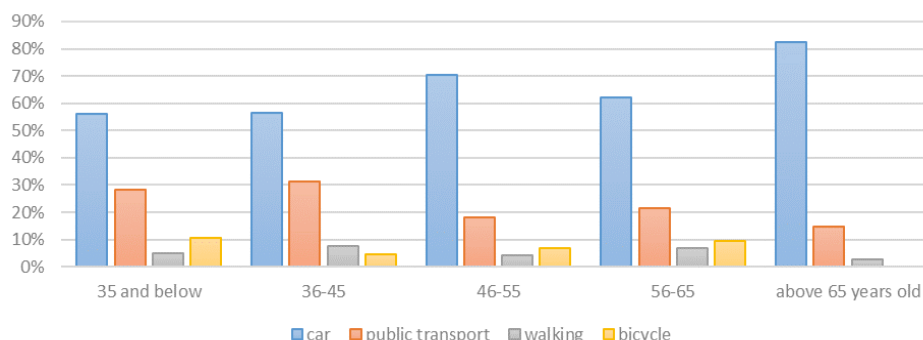


Fig. 1. Choice of mode of transport for commuting trips by staff age group (source: authors' work).

The survey showed that being able to commute as a driver significantly affects transport choices with an overwhelming majority of the respondents using the car. Nearly half of those commuting daily by car do not feel the need to change the mode of transport, more than 30% of respondents would change their daily transport patterns but cannot do so and nearly 20% are willing to change their transport behaviour if offered the right improvements and incentives by the university, city and urban transport operators. Based on this a natural division was made of respondents – drivers into three groups depending on how motivated they are to change their transport behaviour. Those already using sustainable modes of transport are motivated either because this is a deliberate choice or because there are no other possibilities (such as no access to a car - Fig. 2).

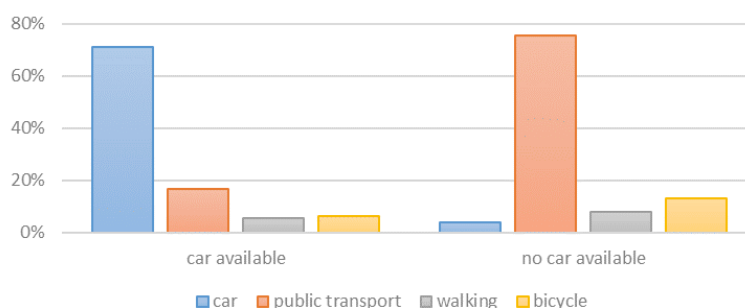


Fig. 2. Choice of mode of transport to the GUT by car availability (source: authors' work).

The observations suggest that staff as a community includes groups that have similar transport behaviour and motivation. Following up on this, the research continued more in-depth to identify and characterise these groups and decide whether the research will be useful when developing the university's mobility plan.

### 3.3 Segmentation

Staff sub-groups were identified using the method of segmentation. Cluster analysis was based on 7 variables: sex, age, unit, work function and position, car availability, means of transport, readiness for change (Table 1), using the relations captured in the university staff survey.

Table 1. Independent variables / factors included in the analysis (source: authors' work).

Sex	Age	Unit	Work function and position	Car availability	Mean of transport	Readiness for change
Male Female	≤ 35 years old 36-45 years old 46-55 years old 56-65 years old > 65 years old	University-wide Accompanying Faculties	Teacher assistant lecturer professor etc. Administration Library Technician Maintenance	Yes No	% use by particular person  e.g. ≤ 50% trips by car ≤ 25% trips by PT ≤ 10% walking ≤ 10% cycling	No need No possibility Predisposition

Several segmentation methods were used. The a priori approach proved difficult at the early stage of segment definition. The method using statistical software (cluster analysis, agglomeration method) did not produce clear-cut results when assigning employees to segments. As a result, the decision was made to use post-hoc segmentation and engineering approach based on data analysis inference.

The work with segmentation methods helped to identify criteria which are of significance for the process: car availability and the extent of using other modes with the additional criterion of willingness to change transport patterns. Finally, five segments are identified:

- absolute car dependent – people who own a car and travel (as a driver or passenger) mostly by car (90-100%), use other modes of transport sporadically or not at all and don't feel the need to change their transport behaviour,
- conscious car drivers - people who own a car and travel (as a driver or passenger) mostly by car (90-100%), use other modes of transport sporadically or not at all but are willing to change their transport behaviour under some conditions or think it is not possible after all,
- promising car drivers - people who own a car and travel mostly by car (up to 75%), but use other modes as well,
- sustainable car owners - people who own a car and use mostly (90-100%) active forms of mobility (walking, cycling), public transport or different modes, including the car at up to 50%,
- car free commuters - people who don't own a car and travel mostly (90-100%) by public transport, use active forms of transport or use different modes to commute, including the car at up to 50%.

Using the data and criteria respondents were assigned to specific segments. Table 2 presents the size of the segments and share in overall respondents.

Table 2. Size and share of the segments in the sample (source: authors' work).

S e g m e n t	Sample size	% share
absolute car dependent	195	24%
conscious car drivers	220	27%
promising car drivers	55	7%
sustainable car owners	207	16%
car free commuters	125	26%

Next, further analyses examined the relations between membership in a segment and other independent variables known from the research. They are:

- objective, available also in aggregated form for the entire academic community such as: age, gender, function, faculty, position,
- objective, obtained from a group of respondents that may be applied to the entire community (commuting time, place of residence, number of working days in a week),
- subjective, obtained from a group of respondents that may be applied to the entire community (readiness to use the solutions selected).

## 4 ANALYSIS OF THE SEGMENTS

The University's staff segments were analysed to establish relations between an employee's characteristics and their membership in a group. Another objective was to identify the differentiating factors between the segments.

The analysis of the structure and distribution of the features in the segments showed that:

- there is no clear relation between membership in a segment and gender (Table 3), membership in an organisational unit, frequency of travel to the university,
- there is a relation between membership in a segment and function, age, determinants of the choice of transport mode.

Table 3. Distribution of staff in the segments by gender (source: authors' work).

Sex	Segment					
	absolute car dependent	conscious car drivers	promising car drivers	sustainable car owners	car free commuters	total
women	25%	28%	6%	22%	20%	100%
men	24%	27%	8%	29%	12%	100%
total share	24%	27%	7%	26%	16%	100%

When analysing the relations between membership in a segment and other independent variables, indices were used that reflect the relative weights of the variables compared to the sum of all of a variable's values, the sum for a given case and the end sum. By using the indices, we can compare the significance of a specific variable and a specific case in the context of the entire data set, its variables and cases [29]. The formula for calculating the indices is as follows:

$(\text{Value of cell} * \text{Sum of values in the table}) / (\text{sum of values in the line} * \text{sum of values in the column})$

which, when applied to the data, can be translated into:

$(\text{number of employees with the specified feature in the segment} * \text{sum of all employees}) / (\text{sum of all employees with the specified feature} * \text{sum of all employees within the segment})$

The analysis above was used to examine the relation between a respondent's age and membership in a segment. The average age in the segments is presented in Fig. 3.

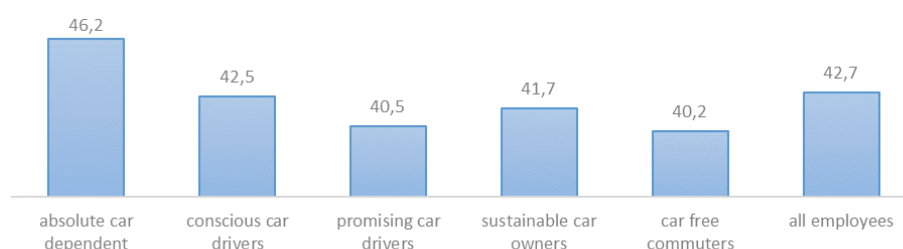


Fig. 3. Average age of employees by segment (source: authors' work).

The indices helped to establish the specific age groups that dominate in the particular segments (index value above 1) – Fig. 4:

- car dependent: people aged 45 and above
- conscious drivers: people aged 36-55,
- promising drivers: primarily people aged up to 35,
- sustainable car owners: no clear dependence; people aged up to 35 and people aged 56-65,
- car free commuters: people aged up to 35.

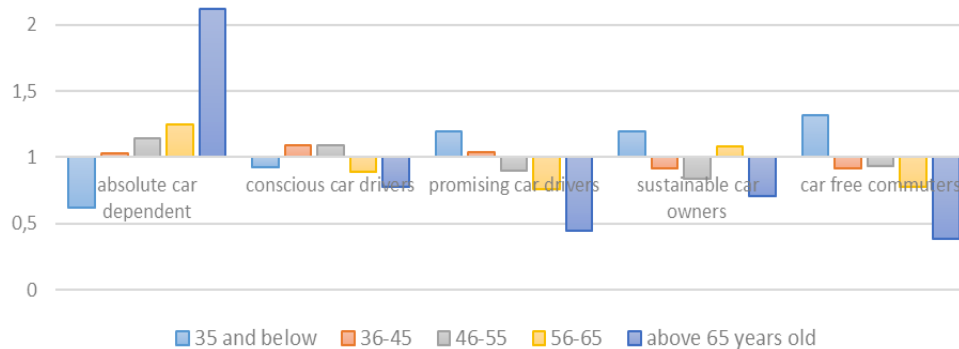


Fig. 4. Weight of age groups in the segments (source: authors' work).

A similar analysis was made of the effects of transport mode determinants when commuting to the University. It showed that the segments are quite diverse as regards the factors that determine the choice of transport mode for commuting. They are:

- absolute car dependent: directness, convenience, time, flexibility,
- conscious drivers: directness, convenience, time, flexibility, but also lack of other possibilities,
- promising car drivers: convenience, flexibility, enjoyment, physical activity,
- sustainable car owners: costs, ecology, physical activity, enjoyment, living nearby,
- car free commuters: costs, ecology, living nearby or lack of other possibilities.

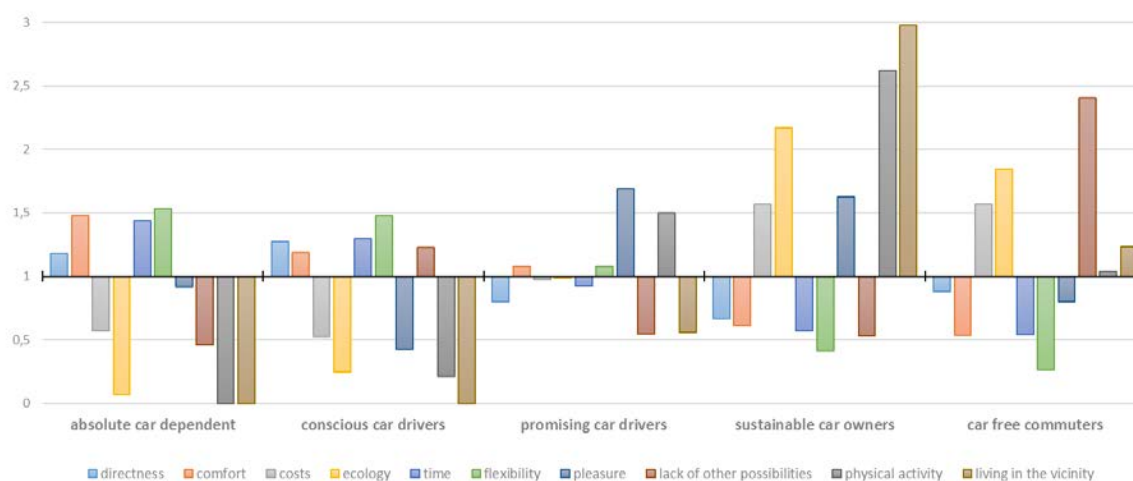


Fig. 5. Weight of the determinants of transport mode choice in the segments (source: authors' work).

The analysis helped to characterise the segments (Table 4).



Tab. 4. Description of the segments based on relation analysis (source: authors' work).

Segment	Segment characteristics:
absolute car dependent	90-100% of their commuting trips are by car and they don't feel the need to change their transport behaviour. Their choice of mode of transport is deliberate due to the convenience, flexibility and because it saves time. The segment's dominant group is aged 45 and more.
conscious drivers	90-100% of their commuting trips are by car; while they feel the need to change their transport behaviour, it is not possible or there are external factors. Their choice of mode of transport is made based on directness, time, flexibility and quite often lack of other possibilities. The segment's dominant group is aged 36-55.
promising drivers	75% of their commuting trips are by car, they use alternative modes otherwise. They have a conditioned propensity to change their transport behaviour. Their choice of mode of transport is based on convenience and flexibility. At times they choose alternative modes for mobility and pleasure. The segment's dominant group is aged up to 35.
sustainable car owners	While they have access to a car, the majority of their trips are by alternative transport modes with the car used significantly less often. Sustainable transport choices are mostly deliberate, due to environmental reasons, the costs and largely the need for physical activity, pleasure and living nearby. There is no clear relation to the age group.
car free commuters	People who cannot commute by car. They use mostly public transport and part of the trip involves physical activity. Their transport choices are primarily due to a lack of other possibilities, due to the costs and the environment. The segment's dominating group is aged up to 35.

## 5 PROPOSED PRACTICAL APPLICATION OF THE RESULTS OF SEGMENTATION

The research and segmentation conducted for the Gdansk University of Technology can be used for mobility planning.

The characteristics of the segments has helped to identify three target groups. They are the result of segment aggregation for transport behaviour and attitude. Dedicated actions for these groups should focus on: changing the attitude, changing the behaviour, reinforcing the behaviour and attitude.

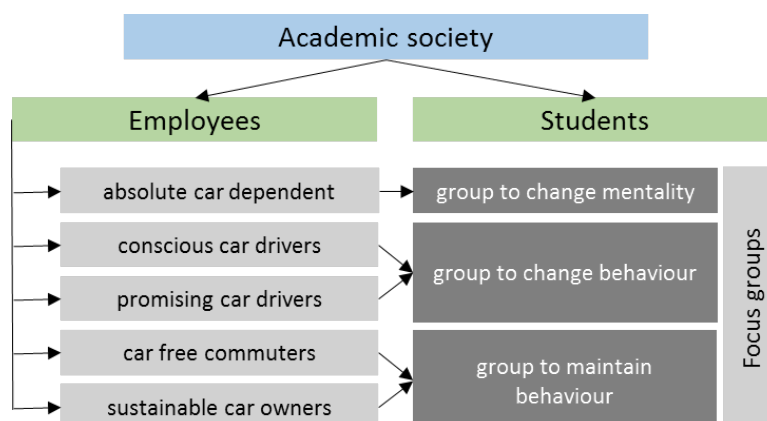


Fig. 6. Aggregation of segments by areas of focus (source: authors' work).

The group to be targeted with mentality changing actions includes 24% of respondents who commute to work by car almost daily and do not feel the need to change their transport patterns.



The group to be targeted with attitudinal actions includes 34% of respondents: they are people who are strongly car dependent but will sporadically use alternative modes and people whose declared willingness to change their transport behaviour suggests that they are likely to use their car more sustainably. The group also includes people who are strongly car dependent but are willing to change their transport behaviour under specific conditions or claim that it is not possible.

Respondents who own or do not own a car but use mainly other modes to commute to work (public transport, cycling, walking) represent 41% of all respondents. Their target group should be addressed with actions designed to maintain sustainable transport patterns.

A possible objective of a mobility plan could be to change the proportions between the segments and target groups to reduce the size of the group requiring attitudinal changes. The size of the target groups is important for:

- how mobility plans are developed,
- identifying the group that should be the focus of further work,
- agreeing on a criterion to set the proportions between efforts designed to change mentality, behaviour and reinforcing current sustainable patterns,
- choosing a criterion for mobility plan evaluation.

## 6 DISCUSSION OF THE RESULTS IN LIGHT OF THE LITERATURE

The article presents the results of research and analyses whose purpose was to understand the academic community for their transport behaviour and attitude. The work has shown that while academic community is not a homogenous group, it can be divided into relatively homogenous groups. Successfully used with different social groups [8][11], including other academic communities [12][30], segmentation helped to identify homogenous groups with the University's academic community. Just as with the SEGMENT project [26] and other work on segmentation in transport [22][11], it was observed that in the case of transport behaviour membership in a segment depends on objective and subjective variables such as respondent profiles, daily travel, transport attitude and motivations and determinants that influence transport choices. The work has demonstrated, however, that the decision to choose a transport mode is a complex process which is often based on subjective criteria, as observed in [31][32].

The objective of the research and analyses was to help prepare, orientate and implement the University's mobility plan. Its main goal is to change the modal split in university travel and reduce the negative impacts of the traffic generated by a large public university with an academic community of several thousand to tens of thousands of people on the transport system within the catchment area of the university and the city. The scale of the impact was shown earlier in [3][4] using the example of the Gdansk University of Technology.

The results of the segmentation suggest that a detailed data analysis helps to identify groups that are most likely to change their transport behaviour. At the University the group which seems willing to change their transport patterns and behaviour and use alternative modes accounts for a relatively high percentage of academic staff. As shown in [10] identifying these people can be the key to achieving the objectives of the mobility plan. With the right division and knowledge of group characteristics, the actions can be better targeted and more effective.

## 7 CONCLUSIONS

Public universities generate significant daily and obligatory traffic which may impact severely their immediate transport system or that of the entire city. This is why it is important to work towards more sustainable transport patterns of academic community and shape the attitudes of students and university staff. To achieve these goals we must first diagnose the existing situation and learn about the transport attitudes, habits and behaviour of academic community.

The objective of the article was to highlight the capacity and ways to influence the transport behaviour, attitude and patterns of academic community by using mobility management tools. The research confirmed that academic community is not a homogenous group. By using the method of segmentation, homogenous groups could be distinguished and characterised. The analyses helped to identify the groups for how perceptive they will be to bespoke actions designed to change their

transport behaviour and attitude. The structure of the groups can be helpful with developing a mobility plan, defining its goals and evaluating its effects.

The survey presented in the article was conducted among the University's staff. Future work will concentrate on the student community. The results will help to understand the behaviour and attitude of the entire academic community and use this to define the size of the segments to represent the entire community. Once the size of the target groups is known, actions can be developed within the mobility plan designed to change the proportions of the modal split among staff and students on their journeys to and from the Gdansk University of Technology. Thanks to dedicated actions the mobility plan will be more effective.

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