



Sustainable Mobility System – a Challenge for Kaunas University of Technology

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Nowadays more and more universities include sustainability into their strategies and intergrate this concept into their activities. Kaunas University of Technology (KTU) seeks to gain the status of a sustainable university, therefore, in addition to already common ranges of sustainable management of waste, efficient consumption of water and energy, the importance of the transport sector impact on sustainability is continuously increasing. Based on the mentioned above and analyzing good practices of other EU universities, an attempt to develop sustainable mobility system platform for KTU has been made.

Evaluation is done on the KTU current situation, safety of traffic, pollution and noise from cars and other aspects. Also, there is a review of communication by public transport, bicycles and on foot. KTU sustainable mobility system, based on other sustainable universities good practices, is provided. The suggested KTU sustainable mobility system focuses on private cars reduction, public transport, car-pooling, car sharing, cycling and encouragement to walking.

Key words: sustainable transport, traffic safety, pollution, noise, cycling, walking, public transport, car-pooling, car sharing.

1. Introduction

In the mid-1990s sustainable development principles were put into practice at university campuses, mainly at North American campuses, and lately they were spread to a number of developed nations across the globe (E. Olszak). Universities, like any other organization, should have a holistic view of the roles and responsibilities and consider the long-term impacts of their decisions which are beyond the present time (R. Lozano). Universities have the potential to be leaders in all fields of research, teaching and learning, sustainability and community engagement (M. Nejati, M. Nejati). Nowadays, universities include sustainability into their strategies and try to improve sustainability in their activities. The same goal i.e. to become sustainable is sought by KTU. This paper focuses on both mobility of the university staff, students and visitors, and transport as a whole which bears economic, social and

environmental effects. Transportation as a concept includes commuting of students, staff and visitors to and from the campus, and it represents one of the most important impacts the university makes on the environment and society (C. Miralles-Guasch, E. Domene)

The system of sustainable transport ensures safe and qualitative roads for various modes of communication (motors, non-motor vehicles and walking) by giving preference to the environmentally friendly means of travelling. Majority of people understand that the most environmentally friendly ways of travelling are travelling on foot, by bicycles or public transport. Unfortunately, the most popular travelling is by car, which leaves the biggest footprint of carbon dioxide.

The definition of sustainable transport by the Council of the European Union states that a

sustainable transport system allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promises equity within and between successive generations; is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy as well as balanced regional development; limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses nonrenewable resources at/or below the rates of development of renewable substitutes while minimizing the impact on land and the generation of noise (Council of the European Union).

Three aspects of sustainable transport must fit together, namely:

- Social aspects: freedom of movement, saving of health, safety in the roads, emissions and noise;
- Environmental aspects: ecological stability, the effects made by machine production on the environment, the effects made by fossil fuel during its whole existence period, establishment of the transport infrastructure at the expense of green areas;
- Economic aspects: effective investments to the transport system, encouragement of the most efficient and environmentally friendly means of transport and travelling habits (Touba Amir Azodi Department of Geography, Islamshahr Branch Islamic Azad University).

An effective system of sustainable mobility must satisfy the needs of society. Due to the system of sustainable transport, transport pollution and noise are declining. Furthermore, green areas of cities are retained, accident rates and the need for fossil fuel are reduced. Finally, human health is improving there. Although the system of sustainable transport has many advantages compared to the current system, but it is not easy to change travelling habits of the people, because the infrastructure of an alternative, more environmentally friendly means of travelling is not sufficiently developed. Moreover, there is a lack of

safety in this system and drawbacks in education of the society.

Transport is a major contributor to the growing energy consumption and greenhouse gas emissions worldwide (A. F. Marique, S. Dujardin, J. Teller, S. Reiter). Reduction in energy consumption in the transport sector, which represents 32% of the overall energy in the EU, appears an important policy target (A.F. Marique, S. Reiter). Based on the data provided by the Lithuanian Department of Statistics in 2010, depending on petroleum equivalents used in the transport sector, 3806.5 thousand tons of carbon dioxide gases that cause the greenhouse effect, have been emitted into the environment. Thus, the transport sector emits 1.14 tons of carbon dioxide gases per capita in Lithuania. Kaunas University of Technology (KTU) has approximately 13 000 students and 2 759 employees, thus the statistical carbon dioxide footprint of the KTU community in the transport sector is 17.9 thousand tons, which can be reduced by applying sustainable transport principles.

In the past the universities played a holistic role in transforming society and in serving the greater public good (T. Waas, A. Verbruggen, T. Wright). KTU academic community, as progressive part of society, could be an example and promote a sustainable communication system.

The aim of this paper was to evaluate KTU current mobility system and suggested sustainable mobility system based on other sustainable universities good practices.

2. The object

This paper reviews some aspects of the commute of KTU academic community and its influence on traffic. Furthermore, it deals with the evaluation of traffic and its influence on the environment in the streets that are situated next to the KTU campus.

The territory of the KTU campus is a peculiar place, since it is divided into two separate parts (Figure 1) that are approximately at a three kilometer distance from each other.

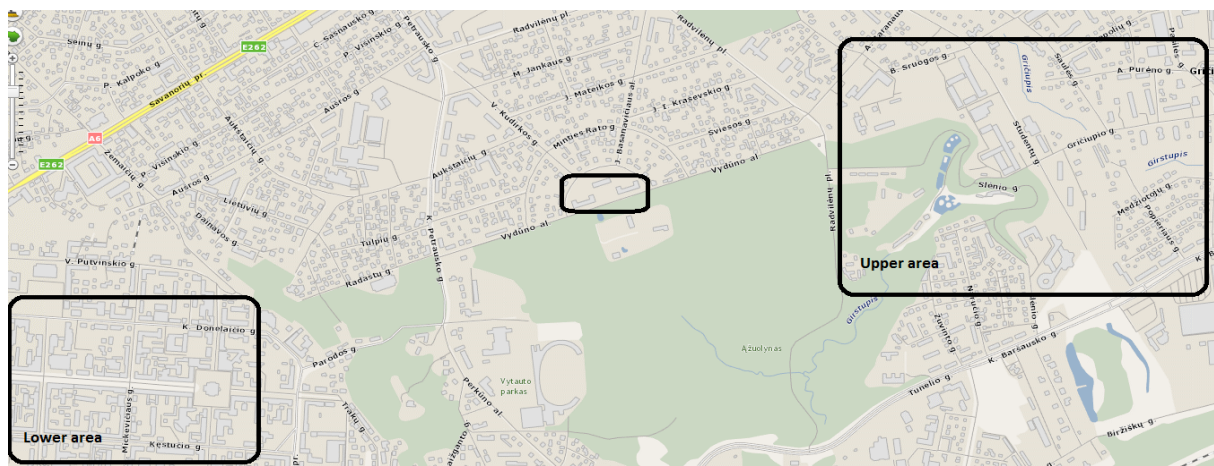


Fig. 1. Territories of the KTU campus (www.maps.lt source). Major part of KTU faculties (marked in red color) and students' dormitories (marked in green color) are situated in the "upper" territory (Figure 2). Students' dormitories that are among "upper" and "lower" parts are well visible in the general plan (Figure 1).

The "upper" territory is in a residential area of the town. There are 7 faculties and 11 dormitories. 3 of the latter are in the campus territory, while the others are not far from the campus and 3 of them are among the "lower" and the "upper" territories. Students staying in dormitories of the "upper" campus can reach their faculties on foot within 30 minutes.

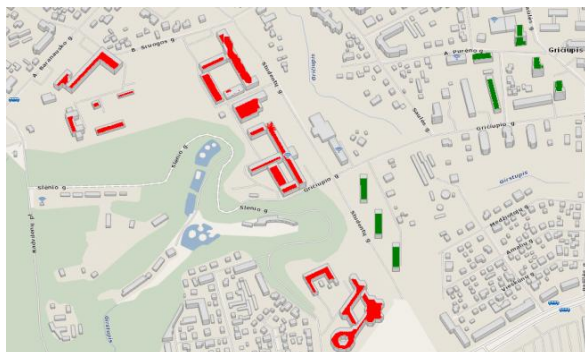


Fig. 2. Territory of the "upper" campus (www.maps.lt source)

Buildings of the "lower" territory are scattered in the city center (Figure 3). The distance between them is shorter than 1 kilometer. It is convenient to walk in the city center.

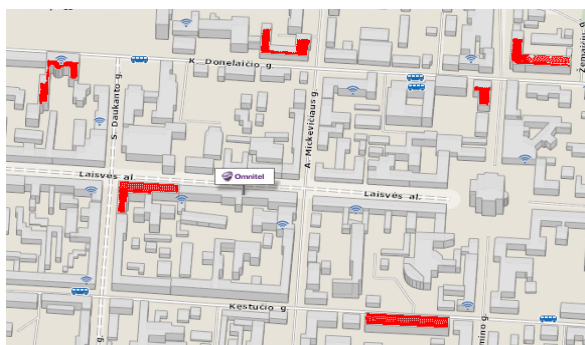


Fig. 3. The "lower" territory of the campus (www.maps.lt source)

During a usual working day a lot of short walks are taken inside the "upper" campus, as students attend lectures at different faculties. If they have to move from/to "upper" to/from "lower" campus they usually take the public transport or drive, walking is less popular, while cycling is absolutely abandoned.

3. Methodology

Comparison of the KTU mobility system to that of other sustainable universities is presented in this paper. Firstly, the evaluation is done on the KTU current situation (safety of traffic, traffic in the streets, car pollution and noise). Secondly, the focus is on the ideas and experiences of the sustainable universities and cities that make use of sustainable ideas. Moreover, recommendations are made for the KTU sustainable mobility system.

3.1. Evaluation of the current situation

Evaluation of traffic safety and its jams in the examined territory. Safety of traffic is one of the most relevant life quality aspects. Traffic accidents occur due to speed, road type, driving manner, day time, weather conditions. All traffic accidents are related to material and moral damage. Traffic safety is evaluated according to the number of traffic accidents and their nature.

Car pollution. Traffic is one of the biggest sources of air pollution in the cities. Kaunas is not an exception. A public enterprise "Investigation of the Environmental Quality in Kaunas city" deals with air monitoring there. General air pollution in Kaunas will be evaluated according to the air pollution measurements made by the above-mentioned enterprise. General air pollution is strongly influenced by the car traffic.

Noise. Noise made by cars is evaluated according to the Kaunas city noise map of 2011.

Review of alternative means of communication. Public transport, non-motor means of transport and travelling on foot communication are evaluated.

3.2. Review of good practices and recommendations for the KTU mobility system

The examples of good practice are found in reports of the sustainable universities and the information provided in their websites. There are a number of organizations which follow the principles of sustainable development and universities join them. Several of these organizations are: ISCN (the International Sustainable Campus Network), AASHE (The Association for the Advancement of Sustainability in Higher Education), ACTS (Australasian Campuses towards Sustainability), EAUK (Environmental Association for Universities and Colleges) and the others. Such organizations help their members to implement the ideas of sustainable development by declaring their good experience and organizing various workshops or even arranging trainings and recommendations. To tell the truth, not all institutions of higher education following the principles of sustainability are the members of one or another above-mentioned organization. However, these organizations also share their experience in the universities websites.

KTU is located in the city territory and the academic community is part of the city society. The experience of cities that apply sustainable ideas is extremely valuable and it can be used in developing KTU sustainable mobility system.

4. Results

4.1. Evaluation of the current situation

Evaluation of traffic safety and its jams in the examined territories. According to the traffic

accidents statistics provided by the Kaunas Police department, eight traffic accidents occurred close to the examined territory during the first half-year of 2012. Six of these accidents occurred on a pedestrian crossing, where people were slightly injured. One traffic accident occurred on the pedestrian crossing slightly hitting one person. During the other traffic accident two cars clashed, but people were unharmed. Four traffic accidents occurred during the morning peak hours. Six traffic accidents took place in the "lower" territory and two accidents - in the "upper" territory.

Lithuania is ascribed to the ES territories that have the highest accident rate. The frequent reason of accidents is speed excess, lack of caution or lack of tolerance to other traffic participants. It is possible that in the examined territory traffic accidents occurred due to lack of caution and tolerance.

Traffic jam is a very serious problem - it increases: travelling time, costs of vehicle exploitation, fuel consumption, discomfort, delays.

During the academic semester compared to the holiday time traffic increases 64 % in the "lower" territory, while in the "upper" territory it does even 119%. A huge number of passing cars during the semester and its significant reduction during the holiday time proves that the university community as well as the city society are not inclined to use the

public transport, if there is an opportunity to drive and conveniently to park their cars.

Car pollution. Main elements of transport pollution are carbonic oxides, nitric oxides, sulphur dioxides, hydrocarbons and solid particles. These pollutants have a negative influence on human health, buildings and the overall ecosystem. The emissions from passing cars in the examined territory are presented in the Figure below.

Since the amount of pollutants is directly related to the passing traffic, the biggest exhaustions emerge during the academic semester in the morning peak hours.

A public enterprise "Investigation of the Environmental Quality in Kaunas city" makes measurements of carbon monoxide, nitric dioxide, nitric oxide, sulphur dioxide and solid particles. According to the research carried out by the above-mentioned enterprise, there were not exceeded the pollutants limiting concentrations of Kaunas city (except the average day concentration of solid particles) set by the Minister of Environment and the Minister of Healthcare on 11th of December in 2001, in the Law No. 591/ 640 "Due to the Establishment of Air Pollution Norms" (adjustment on 7th of July, 2010, No. D1-585/ V-611). Diagrams of pollutant concentrations measured during the experimental period are presented in Figure 4.

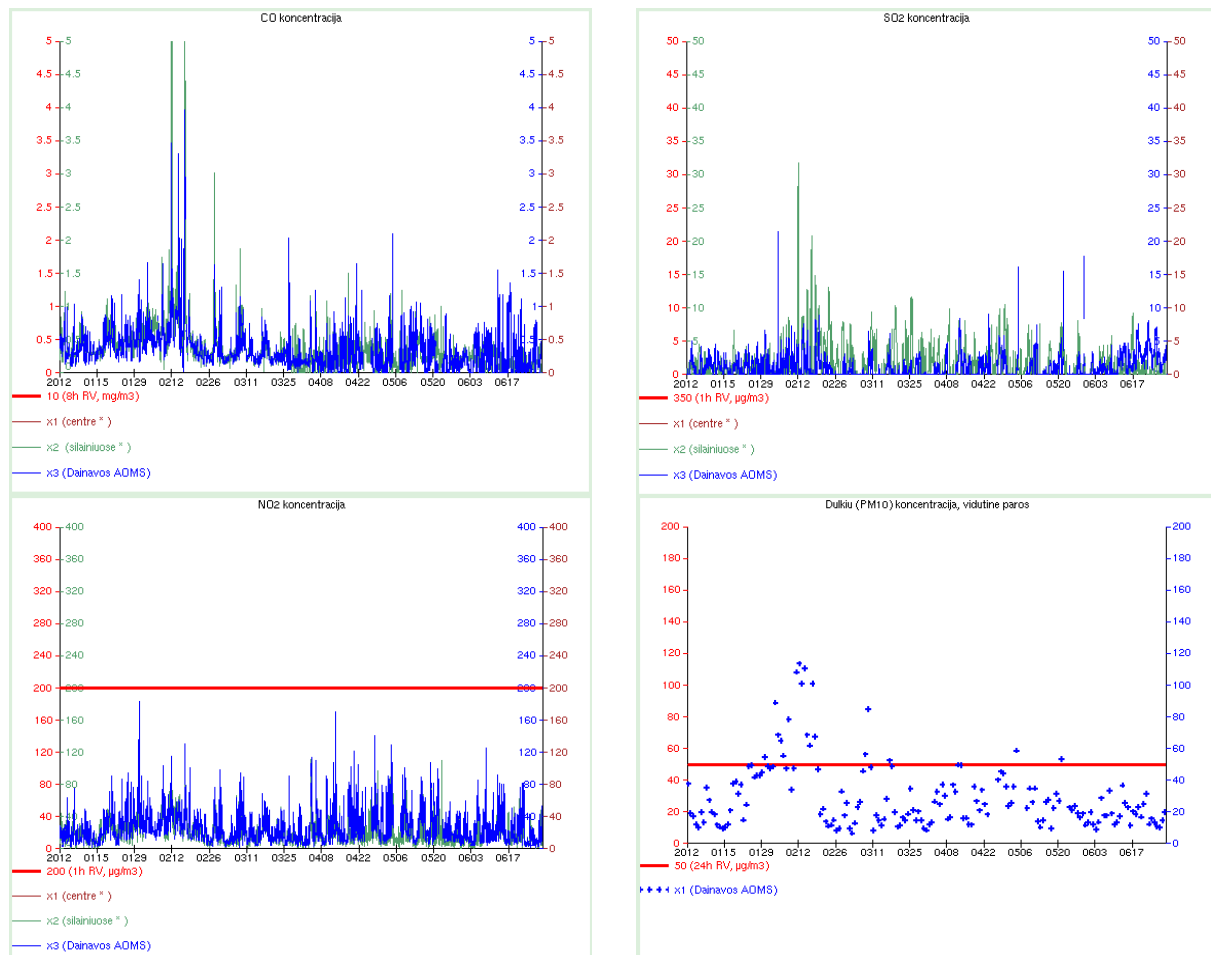


Fig. 4. Concentrations of carbon monoxide, sulphur dioxide, nitric dioxide and solid particles in Kaunas city (in January-June, 2012)

Pollutant concentrations were measured in three places (in the city center, which has plenty of visitors; in Dainava area, which has intensive traffic, and in Šilainiai area, which is a residential area). Data on the air quality of the "lower" territory are reliable as it is located in the city centre, but there are no data for the "upper" territory. Šilainiai being a residential area as well as the "upper" territory, its air quality assessment indicators are taken for the "upper" territory.

As it was mentioned above, the average concentration of solid particles was exceeded during the experimental period in Dainava area, but there are no data for other two areas. In January and February, the limiting concentration was exceeded even twice. During the cold period the amount of solid particles in the air is known to be increased by burning fossil fuel and sprinkling street with sand. During the whole year the air quality is negatively influenced by solid particles exhausted from passing cars. During the warm season, the concentration of solid particles in the air is decreased by the rainfall. However, when the weather is dry, their concentration in the air often exceeds the average allowable one.

Thus, it can be concluded in case the traffic is decreased the exhaust of solid particles will be reduced.

Noise. According to the Kaunas city noise map (<http://maps.kaunas.lt/gis/triuksmai/>) of 2011, the noise of the traffic, which reaches the buildings, does not exceed the maximum level of sound pressure (70 dBA) according to the Lithuanian hygiene norms HN 33:2011, in both territories. The highest rate of noise reaching the buildings in the "upper" territory is up to 65 dBA, and in the "lower" territory it is 70 dBA. The requirements indicated in the hygiene norm HN 33:2011 are applied inside the building, as the building walls and closed windows keep the noise off. For this reason, we can make a premise that the level of noise inside the building does not exceed the requirements of the hygiene norm HN 33:2011.

The noise made by the traffic can be reduced by reducing the number of cars or by changing petroleum products powered cars into the electricity-powered ones causing less noise.

Review of alternative means of communication. Public transport communication between the "upper" and "lower" territories of KTU campus is regular. The distance is not long and the public transport plies quite often. The public transport between the campus and the other Kaunas areas is well developed, too. Students showing their student cards get discounts for travelling by public transport.

The communication by non-motor means of transport is rather difficult between the "upper" and the "lower" territories. The biggest obstacle is the Parodos hill, which is rather steep and there is no infrastructure for safe touchdown from it. The track between "upper" and "lower" territories is divided into a part for cycling and a part for pedestrians. In addition, this track does not have proper signs and proper off-goings. The more serious problem is a safe

bicycles parking. At present, places for bicycle parking can be found near the faculties, but because of their frequent stealing it is far from being safe to park them there.

The pedestrian tracks are in both territories. Pedestrians experience discomfort in the winter season, when the covered with snow tracks are not properly cleaned, or after heavy rain big puddles emerge due to disreputable road pavements. Walking between the "upper" and the "lower" territories in the dark time is not safe because of rowdiness. The problem of safety is to be solved, if there is a will to implement the program of sustainable communication. "I think it is a key to understand that sustainable transportation means safe streets, because you can't get people to bike or to walk, unless they feel safe doing so". (Janette Sadik-Kahn, 2011).

4.2. Review of good practices and recommendations for KTU sustainable mobility system

There are quite a big group of universities, cities and communities that change the old habits of travelling to more environmentally friendly practices. This experience can be used in creating your own strategy of sustainable transport. KTU sustainable mobility system should include main goals of sustainable transport, namely:

- Reduction in cars traffic;
- Assurance of communication by alternative means of transport;
- Encouragement to travelling by bicycles and on foot (S. G. Beltrán).

Cars and their parking. As it was mentioned above, commuting to the campus by car has environmental and social consequences (C. Miralles-Guasch, E. Domene). During the first half a year of 2012, almost all traffic accidents registered near the examined territory took place in the crosswalks. For this reason, the municipality officials could install speed bumps which cost approximately 4 000 Lt. If we evaluate the damage suffered by the country when one person is slightly injured, it is 6 503 Lt (V. Skaržauskas, A. Pikūnas). This shows that the costs of speed bumps are economically efficient.

Main reasons for car usage include reasonable distance, shorter commute time, free parking. Main barriers of individual car use are not having driver's licence and high cost of running a car. Measures aimed at reducing car use are:

- Car pooling program;
- System of car sharing;
- Environmentally friendly university's car park;
- Changing of parking system:
 - Payable car parking;
 - Establishment of parking quotas;
 - Parking of registration numbers on different days (even and uneven numbers).

Car-pooling program. The car-pooling program may be implemented by involving the students of the faculty of Informatics to set up the forum "Fellow-

Traveller“ which would help to find easier travelling friends. This forum should be placed in the KTU website. Involvement of students into establishment of the system could hasten the implementation of innovations. Students' involvement in a sustainable mobility system development is a very important psychological tool, which would assist in changing students' behavior into more sustainable. According to the join theory people follow social norms because they inform whether a behaviour is morally right or wrong (S. Bamberg, S. Fujii, M. Friman, T. Garling). It can be concluded that the more academic community is involved in development of the sustainable system, the more more widely and the more faster sustainable behavior becomes a norm.

Car sharing system. A wide, convenient and financially available car rent is one more possibility to reduce the number of cars in the streets and to preserve the areas needed for parking. Berkeley University of California has three organizations of the car rent that offer their services to students in noticeably favorable conditions. Now a car rent center is hardly imaginable in the KTU campus. However, such possibility should be raised in the strategy of the sustainable transport system. In Lithuania the service of car sharing is provided by Ecomobility Ltd which works only in Vilnius now. However, if the demand increases, the company will reach other cities, too. Besides, there is a possibility that new companies offering such services will be set up. Ecomobility Ltd offers the cars that are powered by fossil fuel. In the future such cars probably will be replaced by the environmentally friendly cars powered by electricity. A good example is a car sharing net *Car2go*, which works in many cities of the world and offers the environmentally friendly cars (fuel saving, powered by solar cells or electric). Kaunas city certain officials are concerned about the introduction of electric cars. The town municipality allows to park electric cars free in the payable parking places and establishes an electric car charging station. Having a look at the future, during the preparation of the KTU strategy of the sustainable mobility system, the possibility to build an electric car charging station should be taken into consideration. As a stimulus electric car drivers should get the possibility to park cars free.

Environmentally friendly KTU car park. When talking about the KTU sustainable mobility system, the item about its car park should be discussed. When buying new cars for the university car park, more environmentally friendly models (hybrid cars, cars powered by electricity) should be preferred. Besides, a possibility to purchase the transportation service instead of car buying is to be evaluated. Usually the bought service results in sustainability.

Parking system. The driving academic community are subsidised, as car parking in the university parking zone is free. When the situation needs to be changed, it is not enough just to have good will. If you want to reach a desirable result, you should undertake more strict measures. At the moment, in the "upper" territory near the faculties and

student dormitories, cars are parked not only at the parking places but also on the streets in non-designated areas. Such parking makes the traffic more difficult for both cars and bicyclists. Furthermore, the ordered aesthetic view of the campus disappears. To change the established situation, the car parking on the streets of the campus should be banned. However, before this, the problem of car parking should be resolved. The easiest way to reduce the need of the parking places, and at the moment this method is applied in the city center, i.e. in the "lower" part of the campus, is the paid parking. The process known as "parking pricing" achieves a double goal: to raise funds, discourage commuters from parking (B. Alex, S. Ruth). It is necessary to establish the system of getting the parking permits, where everyone (employees and students), who wants to park a car near the university should register in the system. This practice is done in most of sustainable universities. People, who live near the university, i.e. at the distance that can be travelled in 30 minutes on foot, should not get the parking permits. This practice is introduced in the Northwestern University. According to the practice of sustainable universities, the parking tax is paid by all drivers, both students and employees, with no exceptions, for parking cars. The most rational way would be to give parking permits and to collect the tax for one month. Visitors have a possibility to pay a one-time parking tax. The parking price for one day is equal to the price of two one-time public transport tickets. The price of one month (approximately 20 working days) is recalculated according to the price of one day, while the price of one year is calculated by multiplying the price of one month by twelve months. The participants of the Car-Pooling program get a possibility to park their cars cheaper. The discount rate for car-pooling participants may depend on the number of passengers in one car; the lowest discount for 2 people car-pooling, higher discount for 3 people car-pooling and the highest discount or free parking for 4 people car-pooling.

The funds generated from the parking can be used in refunding the costs of car parking management, while the other money can be used for improving the bicycles infrastructure or for renovation of pedestrian tracks and cleaning in the winter season.

The other possible way of improving the situation is the parking in line with the car registration numbers. Cars with even numbers are parked on even days of the month, while uneven numbers are parked on uneven days.

Before choosing the parking system, it is necessary to evaluate the number of cars being parked and according to this number the most effective and economically efficient parking system is chosen. This system should ensure the reduction of the number of cars in the campus.

Due to the occasion of the International Day without a Car (September 22), KTU car parking lots could be closed.

Cycling and walking. KTU student dormitories are situated either in the territory of the campus or close to it, thus, students can walk to the university.

Public transport communication is rather convenient. Students, who live in the students dormitories or those, who rent accommodations not far away from the campus, tend to walk to the lectures or choose a public transport. Though cycling is a cheaper way of communication compared to driving or even taking public transport, there is no cycling tradition in Lithuania. Here cycling is usually associated only with sport and leisure activities. Also, cycling is not popular because of the lack of the proper infrastructure and, of course, due to the weather conditions, especially, after the snow, when cycling is hardly imaginable. The unfavorable weather conditions usually last for about three months, but during the other period the bicycle could become a sustainable way of communication. For this reason favorable cycling conditions should be created (bicycle tracks, parking, and safety). KTU students acquire various specialities, and they can be organized into various teams (a team of architecture, construction, economics) and prepare the Project of Bicycles and Pedestrian Tracks Renovation and safe bicycles parking. If such a project were prepared by students, the government would save the resources needed for the projection, whereas, students would gain a valuable experience. In the majority of sustainable universities, the service of bicycle parking is free. Everyone who wants to park bicycles must register and get the parking permits. In order to strengthen the safety, the bicycle parking places in the University of Ottawa are fenced. To ensure extra safety, the cameras could be installed, moreover, only those students and employees, who have special permits for bicycle parking, could enter the parking zone.

A well developed bicycle sharing system works as a stimulating means of bicycle communication. The usage of a rent service reduces the worry concerning the safe parking, and bicycle communication becomes more financially available and more convenient. Melbourne bike sharing program works by using a bank card. If a person wants to rent a bike, there is an automat near the bike stands, which reserves the bail for the bicycle, records the time when the bicycle was taken and takes the tax of the rent, when the bicycle is given back.

The other way of communication, which is environmentally friendly and useful for a person, is walking. Unfortunately, due to the fast living, enormous distances, greater comfort of driving or inadequate safety we reject walking.

Cycling and walking helps to avoid the waste of time such as waiting for the public transport. It is a cheap, environmentally friendly, quiet way of travelling, which does not need a lot of space. Travelling by bicycle or on foot has many advantages compared to the parking costs. If a person wants to feel well, he/ she needs at least 30 minutes of activity per day. As Hippocrates states: "Walking is the best prevention of diseases."

A major part of KTU students are from other cities or towns, thus, in order to obtain the initiative of

the bicycle communication, KTU should place the maps of Kaunas city bicycle tracks in its website.

Public transport. The cycling or walking is not always convenient, especially because of the lack of time or longer distances. In this case, the public transport can be used.

The use of the ordered public transport helps to save time and money. Some streets have separate public transport lanes, so that it can move easier and faster during the peak hours. Travelling by public transport is always cheaper than travelling by car (except the cars that have fellow-travellers).

The pocket sized public transport time tables (G. Moser, S. Bamberg), free transport public ticket for the first month (September) of the study year, when a lot of first years students do not have student cards and can not get discounts for public transport use, could make the public transport more attractive. By invoking the students of Informatics and by collaborating with the public transport organizations, it would be possible to make the public transport even more attractive. This could be done by creating a program, which would help to see not only the timetable of the public transport but also the real time of the arrival to the stop. In this way, the sticking around the stop would be avoided. Such a program of the public transport arrival to the stop in the real time is created by students of Berkeley University.

Education. As it was mentioned before, to ensure the efficient system of sustainable transport, it is necessary to have an appropriate infrastructure and safety. Besides, the consumers' education is also very important. The international community is in agreement that education has an enormously important role to play in educating and motivating citizens to participate in environmental improvement and protection (J. K. Staniškis, Ž. Stasiškienė). The sustainable principles should be understood and practised by all members of the organization (M. Nejati, M. Nejati). Sustainable consumption and lifestyle take only the first steps in our society. Therefore, if we encourage young and open to various innovations people to live in a sustainable way with the surrounding environment, we can expect to save rather good living conditions for the future generations.

The ideas of sustainability are to be integrated into all the modules that are taught in KTU. The greatest attention should be dedicated to first year students. They should be introduced to the university sustainability program. One of its items would be sustainable communication.

5. Conclusions

This paper provides a platform for KTU leaders and decision makers in the field of development of the sustainable mobility system.

The sustainable mobility system of KTU should be orientated to reduction of personal cars. It may be done by putting into effect car parking charges,

which must be the same for all stakeholders with no exceptions. Taxes from parking should cover the administrative cost of the parking system. Also, instead of the car parking charges, tax free parking may be used according to even and uneven numbers, or by following the principle of equality, everyone who wants to park a car gets an equal number of the days per year. After reducing the attractiveness of car parking by the above stated methods, the car-pooling program "fellow-travellers" may be easier encouraged, as car parking discounts for car-pooling participants could be introduced.

One more future possibility (the long-term goal) for reduction of individual cars use is a car sharing system. Meantime, this service exists only in one Lithuanian city, i.e. Vilnius. It is believed that the car sharing service should be provided in KTU in the future. This system is very successful in the majority of sustainable universities.

The public transport is a cheaper and more sustainable way for communication compared to the personal car. The pocket sized time tables and especially the program of public transport arrival on the real time can do the public transport more attractive.

There is a significant potential for an increase in cycling, as cycling is one of the most favourite leisure activities of young people in Lithuania. But the lack of the cycling infrastructure around KTU, i.e. lack of paths, secure parking and all that makes cycling non-attractive. The funds generated due to the car parking could be used to finance the cycling infrastructure. Moreover, the safety of walking, as most sustainable way of communication, and the quality of pavements should be ensured. It should be noted that cycling and walking yield further health benefits.

Before taking the decisions based on sustainability, it is necessary to have the understanding about the idea of sustainability. Therefore, sustainability should be integrated into all modules that are taught at the university. Moreover, according to the join theory, students and staff involvement in development of sustainable system could lead to better results, as the ideas of sustainability become a norm.

6. References

- E. Olszak. Composite indicators for sustainable campus-Design rationale and methodology: The case of the Catholic Institute of Lille. *Ecological indicators* 23. 2012. P. 573-577.
<http://dx.doi.org/10.1016/j.ecolind.2012.05.021>
- R. Lozano. Envisioning sustainability three-dimensionally. *Journal of clean production* 16. 2008. 1838-1846
- M. Nejati, M. Nejati. Assessment of sustainable university factors from the perspective of university students. *Journal of cleaner production*. xxx. 2012. P. 1-7.
- C. Miralles-Guasch, E. Domene. Sustainable transport challenges in a suburban university: The case of the Autonomous University of Barcelona. *Transport policy*. 17. 2010. P. 454-463.
<http://dx.doi.org/10.1016/j.tranpol.2010.04.012>
- Council of the European Union. Council resolution on the integration of environment and sustainable development into the transport policy. Report from the Committee of Permanent Representatives to the Council 7329/01. 2001.
- Touba Amir Azodi Department of Geography, Islamshahr Branch Islamic Azad University, Tehran, Iran. Sustainable urban transport management & its strategies. *American Journal of Scientific Research* ISSN 1450-223X 56 (2012). P. 41-44..
- A. F. Marique, S. Dujardin, J. Teller, S. Reiter. School commuting: the relationship between energy consumption and urban form. *Journal of transport Geography*. 26. 2013. P. 1-11.
<http://dx.doi.org/10.1016/j.jtrangeo.2012.07.009>
- A.F. Marique, S. Reiter. A method for evaluating transport energy consumption in suburban areas. *Environmental impact assessment review*. 33. 2012. P. 1-6.
- T. Waas, A. Verbruggen, T. Wright. University research for sustainable development: definition and characteristics explored. *Journal of cleaner production*. 18. 2010. P. 629-636.
<http://dx.doi.org/10.1016/j.jclepro.2009.09.017>
- Kauno miesto triukšmo žemėlapis
<http://maps.kaunas.lt/gis/triuksmi/>
- S. G. Beltrán, T. Coakley, N. Duffy, D. Finta, H. Kern, M. Iancu, C. McCarthy, G. Pugliese, H. Raupenstrauch, Fabio Tomasi. Sustainable transport & mobility. Student handbook. 2010. P. 44-46.
- C. Miralles-Guasch, E. Domene. Sustainable transport challenges in a suburban university: The case of the Autonomous University of Barcelona. *Transport policy*. 17. 2010. P. 454-463.
<http://dx.doi.org/10.1016/j.tranpol.2010.04.012>
- V. Skaržauskas, A. Pikūnas. Nuostolių patiriamų dėl neigiamo transporto poveikio urbanistinėse zonose, įvertinimas. 2008.
- S. Bamberg, S. Fujii, M. friman, T. Garling. Behaviour theory and soft transport policy measures. *Transport policy*. 18. 2011. P. 228-235
<http://dx.doi.org/10.1016/j.tranpol.2010.08.006>
- B. Alex, S. Ruth. Sustainable Campus Transportation through Transit Partnership and Transportation Demand Management: A Case Study from the University of Florida. 2006.
- G. Moser, S. Bamberg. The effectiveness of soft transport policy measures: A critical assessment and meta-analysis of empirical evidence. *Journal of environmental psychology*. 28. 2008. P. 10-26.
- J. K. Staniškis, Ž. Stasiškienė. An integrated approach to environmental education and research: a case study. *Clean technologies and environmental policy*. 8 (2006). P. 49-58

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Darnios transporto sistemos diegimas Kauno technologijos universitete

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Pastaraisiais metais universitetui į savo strategijas vis dažniau įtraukia darnumo idėjas. KTU siekia darnaus universiteto statuso, todėl, be kitų svarbių sričių: darnaus atliekų tvarkymo, vandens ir energijos vartojimo, žaliųjų pastatų, žaliųjų pirkimų, biologinės įvairovės išsaugojimo, ne paskutinis yra ir susisiekimo (transporto) sektorius. Šiame straipsnyje dėmesys skiriamas būtent susisiekimo sektoriui.

KTU studentų miestelis ypatingas tuo, kad išsidėstęs keliose vietose. Didžioji dalis fakultetų ir studentų bendrabučių yra vadinamojoje „viršutinėje“ teritorijoje, kuri įsikūrusi miegamajame rajone, likusieji pastatai išsidėstę miesto centre – „žemutinėje“ teritorijoje. Paprastai paskaitos vykta ne vienuose rūmuose, ypač pirmo kurso studentams, todėl susisiekimo klausimas tiek abiejų teritorijų viduje, tiek tarp abiejų teritorijų yra aktualus.

Darbe vertinamas eismo saugumas, tarša ir triukšmo lygis šalia universiteto esančiose gatvėse. Remiantis darnių universitetų patirtimi ir įgyvendintomis idėjomis, pasiūlyta KTU darnaus susisiekimo sistema. Didžiausias dėmesys skiriamas tam, kad būtų kuo mažiau automobilių ir būtų skatinimas susisiekimas ne motorinėmis transporto priemonėmis. Automobiliams mažinti gali būti panaudojamos organizacinės priemonės: skatinimas keliauti automobiliu su bendrakeleiviais (programa „bendrakeleiviai“), dalijimosi automobiliu programa, automobilių statymo apmokestinimo programa ar kitų automobilių statymo būdų, kaip mažinti automobilių, pasirinkimas (pavyzdžiui, vienomis dienomis automobiliai statomi tik tie, kurių lyginiai numeriai, kitomis dienomis tik tie, kurių nelyginiai numeriai, ir pan.)

Susisiekimas dviračiais ir pėsčiomis – darniausi susisiekimo būdai, kurie naudingi ne tik aplinkai, bet ir žmogaus sveikatai. Norint jaustis gerai, per dieną reikėtų pasivaikščioti bent 30 minučių. Dėl laiko trūkumo, per mažo saugumo, o susisiekiant dviračiais dažniausiai dėl infrastruktūros trūkumo pasirenkami aplinkai mažiau palankesni susisiekimo būdai. Straipsnyje siūloma sukurti saugią susisiekimo dviračiais struktūrą, kuri iš dalies galėtų būti finansuojama iš lėšų, surinktų už parkavimą.

Kai suprantama pokyčių svarba, jie įgyvendinami lengviau ir sparčiau, todėl būtina darnumo principus sujungti su visais KTU dėstomais modeliais. Taip pat, norint pasiekti darnumą, labai svarbu, kad ir personalas, ir studentai reaguotų į KTU vykstančius pokyčius.