Integrated campus development plan

Report for the project 'Campus Areas as Labs for Participative Urban Design' supported by Interreg Central Baltic programme

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LIVE BALTIC CAMPUS

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'Live Baltic Campus' (LBC) was a project within Interreg Central Baltic programme, funded by European Development Fund, aiming to develop campuses as innovation hubs by creating better urban environment for business and residents, strengthen the collaboration within Central Baltic level, and accumulate expertise on using participatory design methods for urban development.

'Live Baltic Campus' project was performed in the collaboration of Tartu University, Latvian University, Riga Planning Region, Stockholm University, Uppsala University, University of Turku, City of Turku, City of Helsinki, Helsinki-Uusimaa Regional Council and led by Metropolia University of Applied Sciences.

Introduction

A city is a complex organism under constant spatial change, which influences the everyday activity nodes and mobility choices of people (Golledge & Stimson, 1997). University campuses are integral part of cities. As public spaces, university campuses connect students, academic and non-academic staff, entrepreneurs, officials, citizens, and visitors as a large community. The presence of university campuses strongly affects the activities provided in and the attractiveness of the particular neighbourhood as well as the whole city region. At the same time, the location and functionality of university campuses set the context for daily spatial decisions among students and staff regarding their activities and mobility options.

In order to be able to optimize the use of urban space and practice evidence-based and participatory spatial planning, it is of high importance to understand the impact of the location and functionality of workplaces/higher education institutions on the mobility and activity choices of the members of these institutions. Within the Live Baltic Campus project, the Department of Geography in cooperation with urban planners, city and university officials, and environmental and computer scientists, conducted a leading experimental space-time research study on people's use of urban space, mapped out by smartphone tracking. The aim of the study was to identify the impact of smart workplaces on the space-time use of citizens within Tartu by comparing the inner-city and suburban location of campuses. In particular, the study asked how the (re)location of educational, research, and cultural institutions influences:

a) people's mobility, use of transport, and their environmental consequences;
b) people's use of the city centre;
c) people's everyday activities and preferred places of activity in the city;
d) people's time use for various activities and travelling;
e) people's satisfaction with the location of their workplace and working conditions.

The experimental study was conducted among students and academic staff of the University of Tartu, and employees of the Estonian National Archive and Estonian National Museum. The latter institutions both faced workplace relocation from the central town to the fringe of the city during the research period. The study covered 269 individuals with 365 days of data collection in average. Smartphone GPS sensors were used to map out the use of urban space, visited locations and the preferred mode of transport of respondents. Smartphone data were complemented by semantic information from individual interviews.

In addition to the space-time survey, the spatial development principles and practices on both city and university level were set in focus of the discussions between the project team and the main stakeholder groups: university members, city planning officials, and spatial planners. On March 7–8, 2017, an international event 'Livable City Forum Tartu' was arranged within the project. The forum focused on the spatial development and impacts of university campuses with the special attention on the campuses of the University of Tartu. Participation at forums that were organized by other project partners as well as the project study tour to the Netherlands further promoted the discussions of the spatial development principles and possible roadmaps in Tartu/Estonia. These events also provided knowledge and experience about collaborative and participatory planning practice led by 'strategic design' approach among the project team and the main stakeholder groups.

Based on the results of the space-time survey and the discussions undertaken with the stakeholder groups, the current integrated campus development plan lists activities and planning suggestions for the spatial development decisions and practices of university campuses in Tartu. Explanatory data about the background and current stage in spatial development initiatives that are related to campuses of Tartu is given in the document. In addition, the current document also refers to the involved stakeholders of the project, and methodology and main results of the space-time survey.

Concept

Campus development and design may be organised on a wide scale: starting from classroom up to international cooperation and influence (Figure 1). Our pilot project in Tartu focused on building, campus, and city level initiatives.

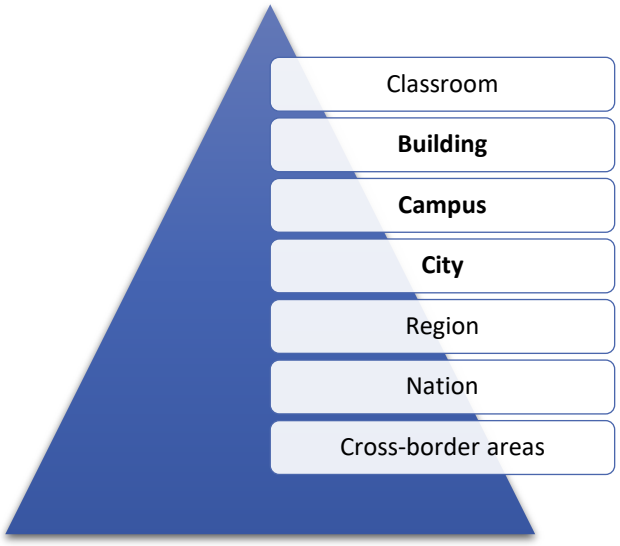

Figure 1. Levels of campus development and design.

The primary aim of any higher education campus is to provide supportive environment for learning and research activities (Hajrasouliha, 2017). However, nowadays society has understood that campuses are much more than places for provision education and undertaking research activities. Next to academic activities, contemporary campuses provide city-like functions such as residential areas, dining and shopping options, sport facilities, or greenery (Höger, Christiannse, 2007; Witlox, 2017). Campuses are integral parts of their surrounding areas and as such, they have mutual interconnections with their contextual settings. Campuses often act as small urban regions, having similar responsibilities together with other neighbourhoods in providing conditions for smooth functioning of the whole urban area and in preventing negative impacts on other city regions. The impacts of campuses may emerge in the spheres of social, physical, ecological, or economic environment of cities, or on individual level such as the health, wellbeing, or even academic results of individuals. Namely, recent research (Hajrasouliha, Ewing, 2016; Hajrasouliha, 2017) has shown that student retention and graduation rates are strongly influenced by the following spatial qualities of campuses: compactness, connectivity, context, greenness, and campus living.

Thus, good campus planning resembles good city planning: ‘the ultimate goal is to create more livable and sustainable communities’ (Witlox, 2017: 105). Witlox (2017) argues how this acknowledgement implies a need for policies and investment strategies that contribute to sustainable campuses. Shortly, land use functionality, design, and connectivity need to be addressed in campus planning. Figure 2 subsumes key aspects to be considered within these respective themes.

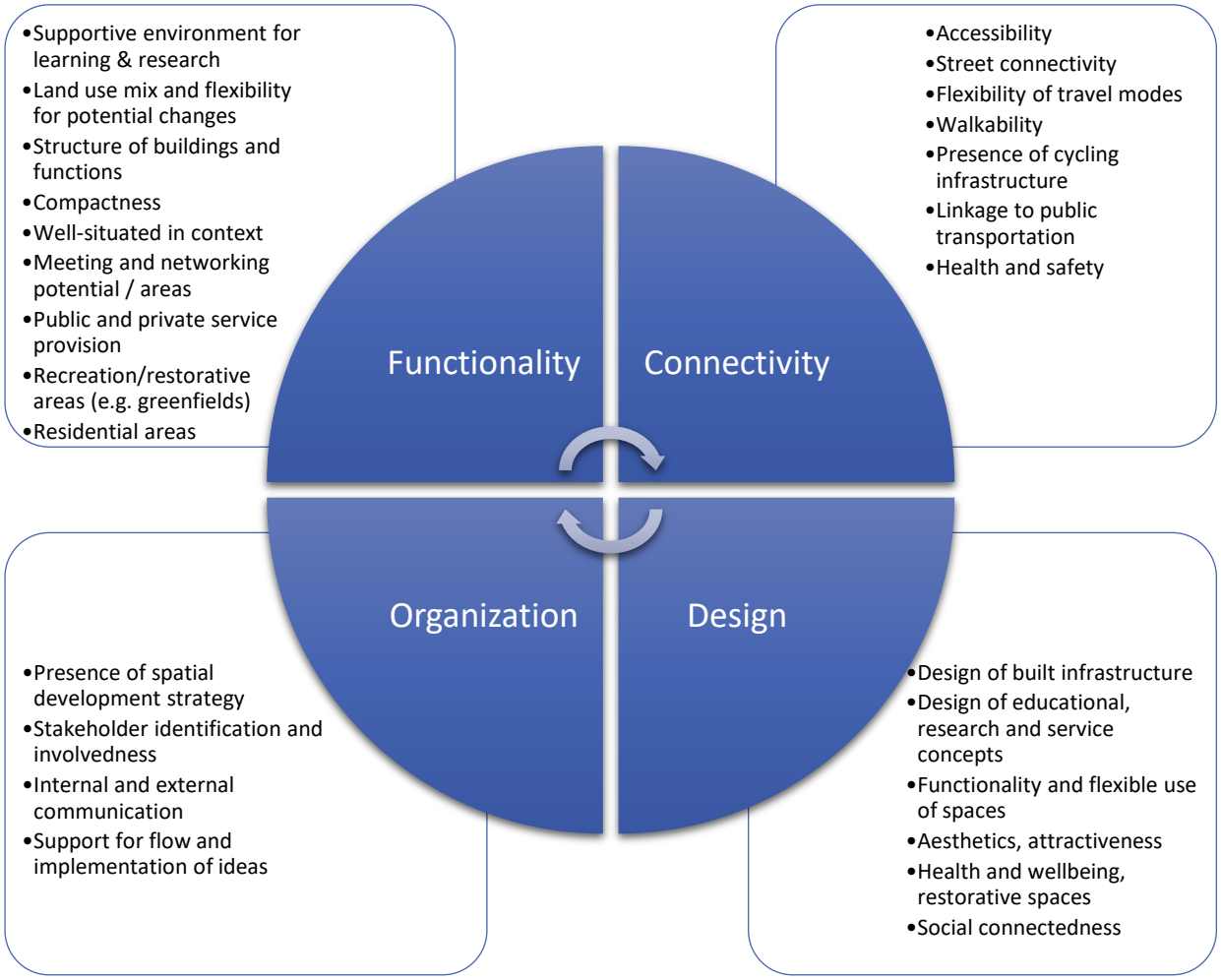

Figure 2. Areas of consideration in campus development apart from main academic missions (education and research).

Case description: Tartu as a university town

Historical traits

The University of Tartu has long been an integral part of and driver behind the development of the City of Tartu. The first compact university campus was founded in the beginning of the 19th century during the Age of Enlightenment, when architect Johann Wilhelm Krause planned a complex of buildings at Dome Hill and its foot (Maiste et al. 2017; Figure 3). During that time, the downtown area also experienced a massive renewal impelled by a previous fire, resulting in a compelling complex of classical style buildings mixed with greenery. This beauty has been preserved, and today still constitutes the core of the university and the old town of Tartu.

The needs of the university have evolved over time, and a wider arc of buildings associated with the university has been gradually established towards the southern part of the city (Figure 4). In 1911, the university received the fields of Maarjamõisa manor as a gift from the state. This led to the establishment of a second campus, located 2–3 km southwest from today's downtown area. The Maarjamõisa campus is dedicated to medicinal and natural sciences, and hosts a nationally leading university hospital as well as labs, clinics, and general study areas. The campus is located in a low-rise residential district, together with Tartu Health Care College, Tamme Gymnasium, and the Estonian National Archives.

The case description of the campuses of the University of Tartu in this chapter is based mainly on the book chapters we have prepared for the joint Live Baltic Campus book *Dreams and Seeds: Campuses' Role in Sustainable Urban Development*.

Ahas, R., Poom, A. Aasa, S., Silm, S. 2017. Experimental study for planning Tartu campuses based on mobile phone tracking. In: Schewenius, M. *et al.* (eds.) *Dreams and Seeds. Campuses' Role in Sustainable Urban Development*. Stockholm: Stockholm Resilience Centre, Metropolia University of Applied Sciences, pp 82–85.

Poom, A., Arjus, T. 2017. Delta study complex – anchoring the university to the central city. In: Schewenius, M. *et al.* (eds.) *Dreams and Seeds. Campuses' Role in Sustainable Urban Development*. Stockholm: Stockholm Resilience Centre, Metropolia University of Applied Sciences, pp 96–97.

Poom, A., Metspalu, P., Ranniku, I. 2017. Campuses as influential players. In: Schewenius, M. *et al.* (eds.) *Dreams and Seeds. Campuses' Role in Sustainable Urban Development*. Stockholm: Stockholm Resilience Centre, Metropolia University of Applied Sciences, pp 92–95.

UNIVERSITY OF TARTU

The history of Estonian higher educational leads back to AD 1632, when the Swedish king Gustavus Adolphus founded Academia Dorpatensis, the forerunner of the University of Tartu. Since then, the university has been the leading centre of research and higher education in Estonia.

Currently, the university belongs in the top 1.2% of the world's best universities (QS World University Rankings 2017/18). It is the only classical university in Estonia and has approximately 13,000 students and 2,900 employees.

The University of Tartu together with other higher education institutions – the University of Life Sciences, Tartu Art College, the Estonian National Defence College, the Estonian Aviation Academy, Tartu Health Care College, and Tartu College of the Tallinn University of Technology – commonly make up the image of Tartu as a university town.

The employment of nearly half of the working-age population of Tartu is associated with the higher education institutions.

Figure 3. The plan of Tartu by J. W. Krause in 1819. The buildings associated with the university are marked on the Dome Hill, the university main building is located close to the Town Hall Square in the downtown area (marked in pink) and the recently established botanical garden is seen next to the River Emajõgi. (Illustration: EAA.402.5.28.L73)

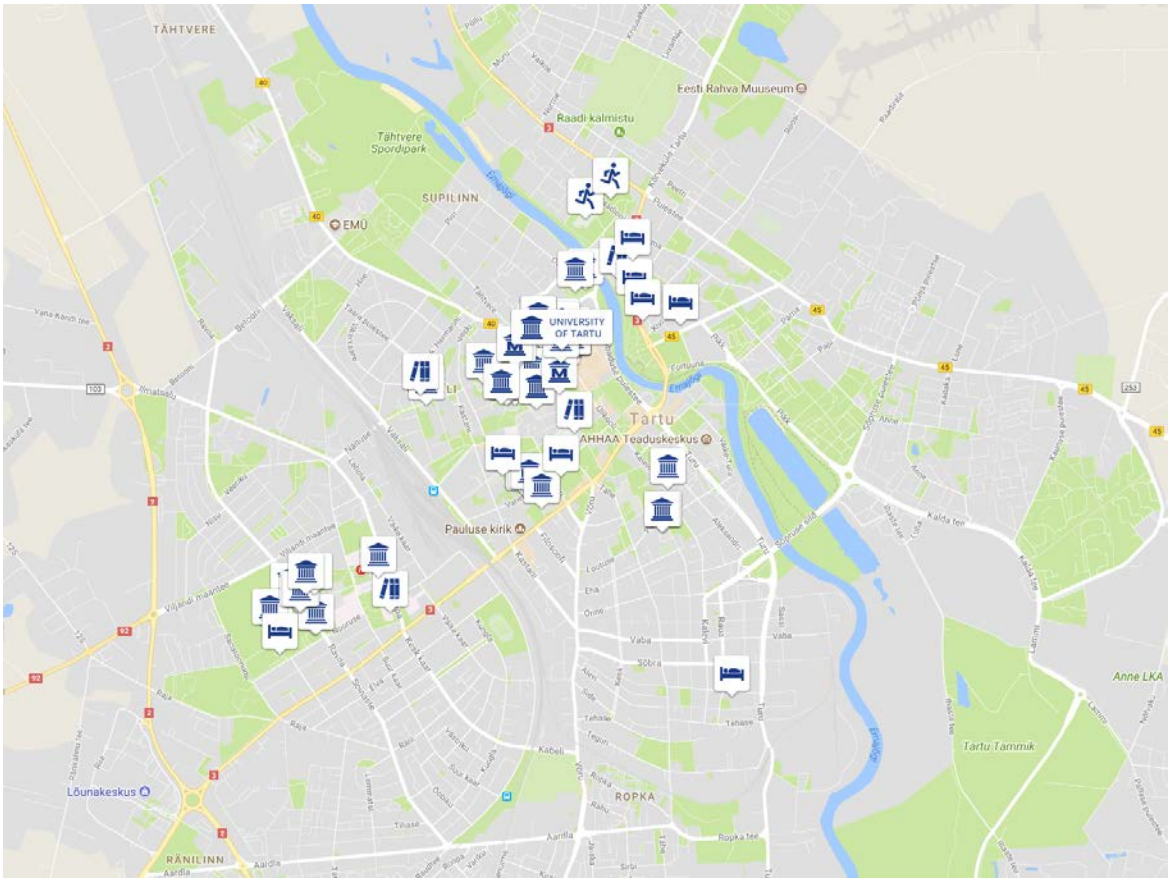

Figure 4. The University of Tartu is anchored primarily to the city centre and the Maarjamõisa campus in the south-east part of the city. The key concern in uniting the campuses is to overcome the spatial separation caused by the railway. (Source: Virtual tour of the University of Tartu, 2017, virtualtour.ut.ee. Basemap: Google.)

Dividing the roles of campuses

Today the students of the University of Tartu alone represent over 10% of the town's population. The large representation of students, their changing needs and expectations for the university, and a changing urban context calls for a revision of the roles for the different university campuses in Tartu.

New spatial development principles of the higher education institutions were established by the Thematic Plan of Higher Education in Tartu, developed between 2010–2013, and led by the Tartu City Government (Metspalu et al., 2013). The plan aimed to identify ways to maintain the character of Tartu as a vivid, young, and spatially integrated university town, and to improve the spatial connectivity of the campuses with each other and the city's transport infrastructure.

The decision was made to concentrate the *Humaniora* and *Socialia* fields of study to the historic central campus, and those of *Realia, Naturalia* and *Medicina* to the suburban Maarjamõisa campus. Dormitories for student accommodation remained in the town centre in order to keep students a part of the central urban fabric. The importance of the presence of the university in the town centre has been emphasized by the recent decision to develop a new IT-and-business-oriented study complex called Delta on the banks of the River Emajõgi, on the edge of central Tartu.

The development of the Maarjamõisa campus, which has hitherto been rather ad hoc, is now detailed in a recent zoning plan (Tartu Linnavalitsus, 2017b). The focus is on increasing the functionality of the area by establishing indoor and outdoor recreation areas, better dining options, and even some housing. An important part of the plan is to provide options for university-business cooperation models, and to reserve land for knowledge-intensive activities such as the development of a science park. Special attention is paid to connectivity of the facilities within the campus, and light travel transit options such as walkways and bicycle lanes. New parking lots will be located behind the buildings to prevent their visually dominating the area.

Connecting the city centre and suburban campus

Due to the distant location of the suburban Maarjamõisa campus, it is necessary to pay special attention to its accessibility and connectivity. Today, only two transit routes link the city centre to Maarjamõisa: one of them is loaded with heavy traffic, and both of them suffer from complicated railway crossings.

It is of vital importance to the University of Tartu to provide its students, staff, and visitors with a smooth spatial connection between the town centre and the Maarjamõisa campus. The accessibility of the Maarjamõisa campus is especially relevant since the university clinic serves as the primary health care centre for the whole of Southern Estonia.

Connecting the central town with the Maarjamõisa neighbourhood includes several issues that need to be addressed: finding solutions to the barrier that the railway currently presents, developing light travel mode routes, and improving overall transport safety.

The current situation is about to change, as railway crossings and parts of the connecting routes for the campuses are about to undergo major reconstruction work. The main railway tunnel on Riia Street, also the main artery of Tartu, will be reshaped into a more spacious, comfortable, and safe crossing for pedestrians and cyclists (Figure 5). In addition, Vanemuise Street, a major section of one of the routes between the campuses, will be opened up for light travel modes at the cost of less convenient car use and parking.

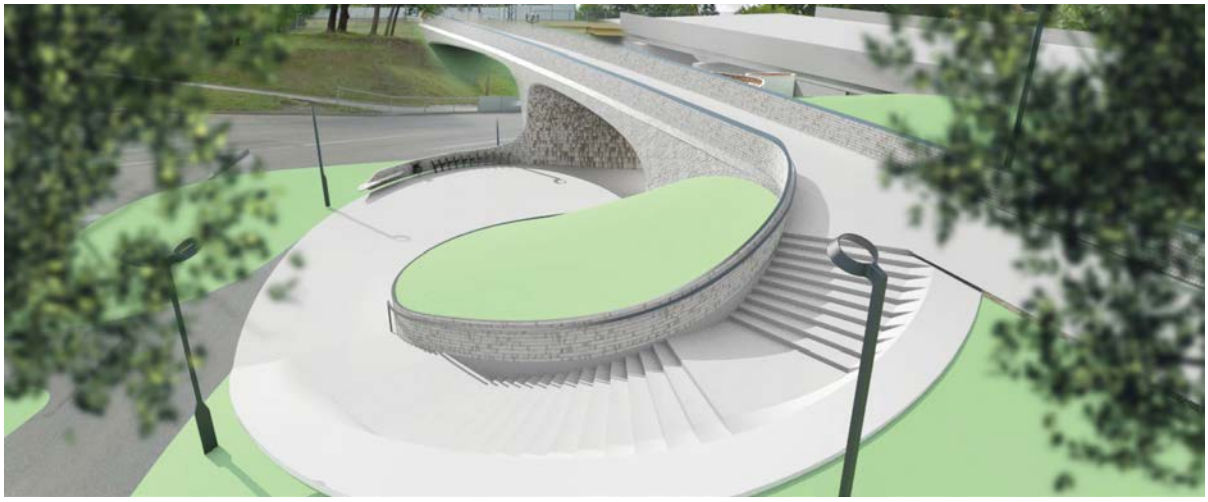

Figure 5. The winning design for the reconstructed railway tunnel at Riia Street. (Author: Part OÜ, Sille Pihlak, Siim Tuksam, 2017.)

The town's agenda is, however, even more ambitious. The recently adopted comprehensive plan foresees a tramway to Tartu, which is notable considering the town only has 100,000 inhabitants. The idea of the tram has received considerably high support, while the exact route is still undefined. The tramway should interlink Annelinn, the main high-density residential district, via the city centre to the Maarjamõisa neighbourhood (Figure 6). Linking the campuses spatially improves student and staff mobility, integrates different academic fields, and improves the flow of knowledge throughout the city.

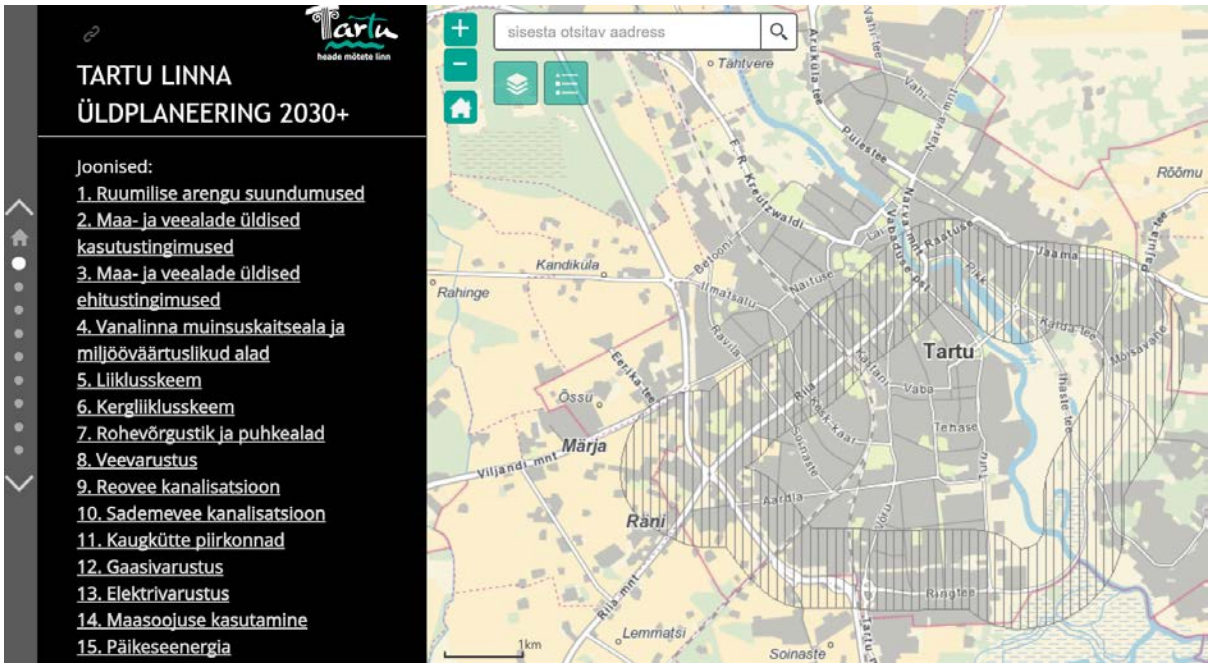

Figure 6. The potential area for tramline trajectory according to the Comprehensive Plan of Tartu 2030+ (Tartu Linnavalitsus 2017a; www.tartu.ee/et/planeerimine-info#tartu-uldplaneering).

Delta study complex – anchoring the university to the central city

The most influential spatial decision by the University of Tartu in the year 2016 was on how to find the best location for a new IT study complex, later named Delta. The main question was whether the university was going to move its IT-related units away from the central town to the Maarjamõisa science-and-technology-oriented campus, or let the units remain in the town centre where the IT study complex could be developed together with its business-and-practice-oriented extension.

The city government together with IT enterprises strongly favoured the location in the centre, where the historical university campus is tightly interwoven with the central town. The university administration initially favoured the Maarjamõisa campus. The local community near the central campus was concerned about the need to fell trees at the fringe of a park to make space for the new campus. A compromise was made, placing the Delta study complex on the west bank of the river Emajõgi, in an area that has struggled to recover after it was destroyed during the Second World War. This location connects Delta to the town centre, while it simultaneously densifies and revitalises the local neighbourhood.

The prominent position of Delta being adjacent to the town centre required the arrangement of an architectural competition in order to determine the most suitable design for the new campus. The guidelines of the competition stated that the complex had to provide a welcoming and contemporary urban space to tenants and visitors alike, encourage activity on the river bank via an open design, and retain the visual corridor to the old town; particularly to the town hall that is located on the other side of the river. The winners, the architects from the company Arhitekt11, situated the complex between the neighbouring park, the river, existing houses, and transport routes; and, they designed it as a pedestrian-friendly urban environment with high quality landscape architecture that addresses both aesthetics and social and ecological functions (Figure 7–8). The spatial arrangement and technical settings of Delta also support low-carbon energy and transport solutions.

Figure 7. The winning architectural design of the Delta study complex at the River Emajõgi. (Author: Arhitekt11 OÜ, 2016.)

Figure 8. The study complex activates the connection with the River Emajõgi. (Author: Arhitekt11 OÜ, 2016.)

The multifunctional indoor environment will provide inspiring conditions for studying and working. In addition to traditional lecture or seminar halls, labs, and office spaces, the study complex will involve a variety of flexible and open workspaces, and recreation areas offering various activities such as table tennis, cooking, or relaxing, for both students and staff. Delta is being designed as a joint centre for education, research, innovation, businesses, and student activities; a heart for the university on the left bank of the river. Suitably, the IT study complex became “Delta” as a result of a public naming competition.

Delta is planned to open in late 2019 or early 2020. It will host the Institute of Computer Science, the Institute of Mathematics and Statistics, the School of Economics and Business Administration, related student unions, an innovation lab, and a large number of IT firms. It is expected to attract 2,500 students and about 600 staff members. The cooperation with the IT sector enables spatially and structurally integrated study and practice options for students throughout their studies, from bachelor to doctoral level, with strong incentives for future entrepreneurship. The Delta study complex will become a landmark of contemporary standards in education, research, and university-business cooperation.

Space-time survey

The University of Tartu conducted a leading experimental space-time research study on people's use of urban space as the main activity within the LBC project. The experimental study applied infotechnological tools and methods for data collection and analysis for the purposes of evidence-based and participatory spatial planning. The most influenced target groups of campus planning, namely students and staff members, participated in the study. The main data collection method was smartphone GPS tracking combined with detailed individual interviews with the participants, covering the semantic information of the use of urban space.

The aim of the study was to identify the impact of smart workplaces on the space-time use of citizens within Tartu by comparing the inner-city and suburban location of campuses. The study asked how the (re)location of educational, research, and cultural institutions influences:

a) people's mobility, use of transport, and their environmental consequences;
b) people's use of the city centre;
c) people's everyday activities and preferred places of activity in the city;
d) people's time use for various activities and travelling;
e) people's satisfaction with the location of their workplace and working conditions.

Sample

The experimental study was conducted among students and academic staff of the University of Tartu, and employees of the Estonian National Archive and Estonian National Museum. The latter institutions were involved in the study because both faced workplace relocation from the central town to the fringe of the city during the research period. This enabled real-life experiment about the changes in mobility, activities, and time-use among the employees of knowledge institutions.

The sample of the students and staff of the University of Tartu was designed to cover both the central campus and the suburban Maarjamõisa campus in order to bring out the effect of workplace location on space-time use of campus tenants. The number of people from different campuses represents the proportion of campus tenants in Tartu. Campus areas and locations of relocated institutions before and after the relocation are seen on Figure 9.

The study covered 269 individuals and the breakdown to sample groups is shown in Table 1. The number of data collection days varied individually, starting for the test group of students and staff already in 2015. The majority of the sample was recruited in 2016. Data collection with the smartphone lasted until October 2017. The average number of data days for the sample was 365.

Table 1. The breakdown of the experimental study sample and covered data days within LBC project.

	Students of the University of Tartu		Staff of the University of Tartu		Employees of relocating knowledge institutions		Total	
	No	Average data days	No	Average data days	No	Average data days	No	Average data days
Central campus	94	219	55	506	52	115	149+52	271
Suburban campus	37	291	23	386	59	359	60+59	343
Total	**131**	**239**	**78**	**471**	**60***	**501****	**269***	**365**

* The number of people in total avoids double counting the employees from relocating institutions.

** The average number of data days in total for employees from relocating institutions covers also days during relocation not shown elsewhere in the table.

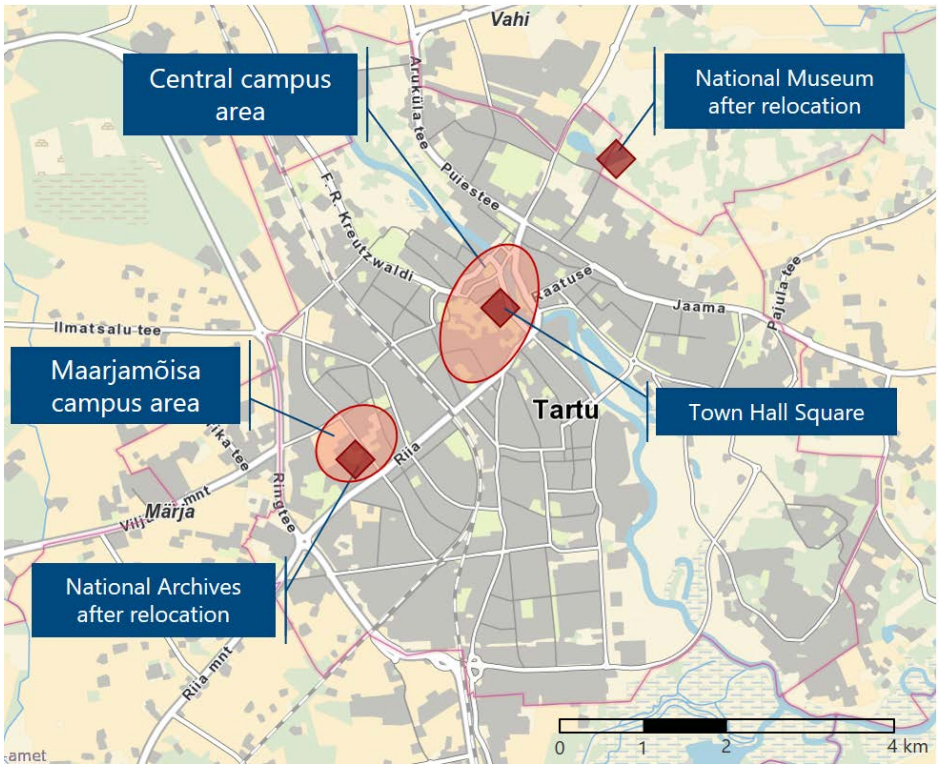

Figure 9. The inner-city and suburban campus areas in Tartu. Relocating institutions were situated in the central campus area before relocation. (Basemap: Estonian Land Board.)

Participation in the survey was voluntary. Participation agreement and data protection contracts were signed with all the participants. All the participants have received or will shortly receive individual feedback of their space-time use from local to global scale.

Data collection with smartphone tracking application and individual interviews

The data collection of the experimental study was conducted mainly with the help of a tracking application for smartphones called MobilityLog (initial name of the application being YouSense). For data collection purposes, all participants of the survey received a personal smartphone that was supplied with the application.

MobilityLog is an Android application that is designed for long-term mobility tracking and social-network-related experiments (Linnap, Rice, 2014ab). The Computer Laboratory of the University of Cambridge and the Mobility Lab of the University of Tartu jointly developed the application. MobilityLog tracks location with the help of GPS, WiFi access points, accelerometer, and mobile network cells. It records also other phone use such as call events, battery level, screen activation, or alarm clock. Raw data collected by the application MobilityLog are packed and automatically uploaded to the secure information systems of the University of Tartu.

The other data collection method applied in the study was interview with each participant. The aim of the interview is to gather semantic information about the places visited, travel habits, and socio-economic data of the participants. All the participants were interviewed either once (94 persons) or twice (175 persons) during the study: in the beginning and end phase of data collection with the smartphone application.

Data management scheme of MobilityLog-based spatial mobility studies is shown on Figure 10. After compiling the pre-interview and starting the GPS data collection phase, raw data collected by

smartphones are uploaded to a secure data server where they are stored, cleaned and used for further processing. During this phase, a durational model of space-time use is computed based on GPS points. The model consists of individual stops, moves, and timespans with no data. Data about individual stops is further aggregated into meaningful locations and matched with the semantics collected during pre-interviews. Follow-up interview using map interface enables verification of this relation and amendment of semantics of other meaningful locations detected on the basis of GPS tracking. It also gives additional information about travel modes used on particular trajectories. Equipped with this dataset, social analysis of space-time use is enabled.

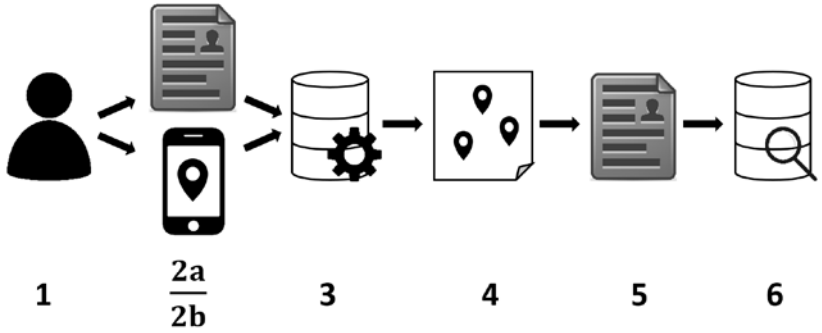

Figure 10. Data management scheme in MobilityLog-based studies: (1) respondent in sample, (2a) pre-interview + (2b) smartphone data collection, (3) server-based data storage and processing, (4) map interface, (5) follow-up interview, (6) data analysis. (Source: Mobility Lab of the University of Tartu.)

Smartphone GPS tracking is a battery-demanding task where the energy cost depends, inter alia, on the frequency of individual location updates (Linnap, Rice, 2014a, Read et al., 2016). Therefore, MobilityLog application has been optimised to save energy according to the data received from accelerometer. This means that we have good temporal data coverage in case of movements and occasional or no data coverage when the smartphone is standing still. As a result, raw GPS data covers approximately 5–10% of tracking time. During the smartphone-based data collection of the study, altogether close to 300,000,000 data points were gathered.

In the following section, we show the effect of workplace location by analysing the GPS tracks and stops of participants. The study area is defined as the city of Tartu with a 1 km buffer zone around the city borders. We arrange the quantitative spatial analysis by implementing a 100 x 100 m grid on the study area. Semantic data about activity nodes is gathered from interviews.

Results

Mobility depending on workplace location

The location of campuses on the inner-city – suburban scale significantly influences the space-time use of campus tenants. By (re)locating the institutions to suburban campuses, the average commuting distance increases. In the case of the employees of relocated institutions, the median home-to-work distance increased from 1.5 km to 3.1 km (Figure 11). Due to the decreased accessibility of out-of-centre workplaces, the employees and students of suburban campuses tend to use more car and public transport at the cost of less walking and cycling than the tenants of inner-city campuses. In addition to individual level discomforts of increased use of motorized transport, large and visually unappealing parking areas around the new workplaces contribute to creating a negative impression of the research, educational, and cultural institutions.

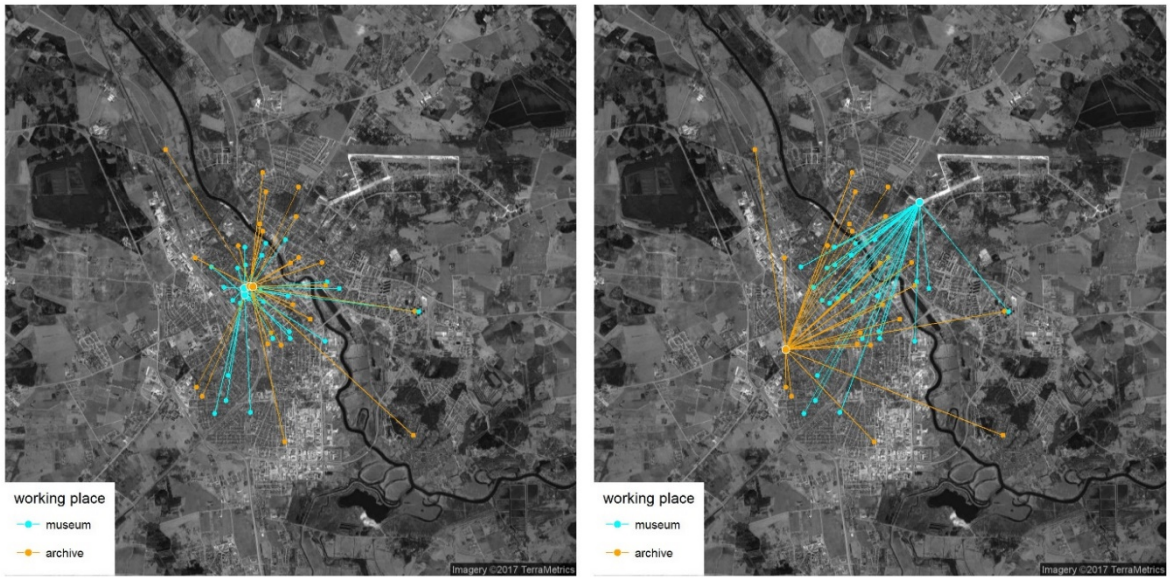

Figure 11. The location of places of residence and work of respondents before (left) and after (right) the workplace was relocated from the central city to the urban fringe. (Source: Mobility Lab of the University of Tartu. Basemap: Google.)

Figure 12 characterises the effect of workplace location on median trip lengths throughout the study period. Staff members from relocating institutions and the university tend to travel longer distances than students do. Large differences occur depending on the workplace location: people working or studying in the suburban campuses undertake significantly longer trips than people who are working or studying in central city.

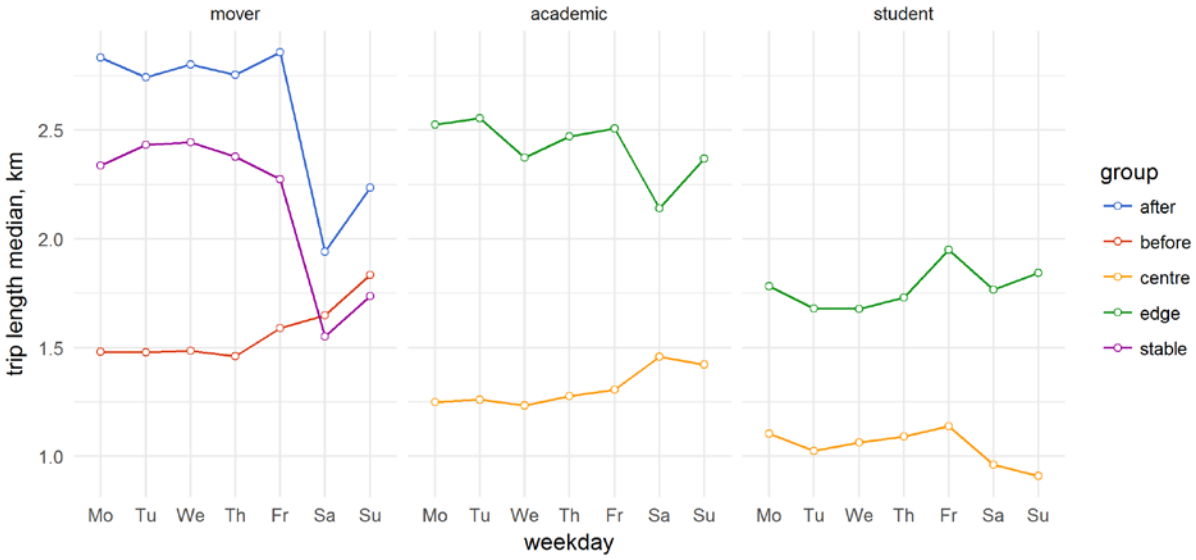

Figure 12. Median trip length of respondents depending on the location of workplace, social group and weekday. Red lines indicate the median trip length of employees of relocating institutions before moving from the centre while blue lines show the median trip length after the relocation to suburban campuses. In the case of staff and students from the university, orange lines indicate the amount of mobility among people working/studying in the city centre and green lines refer to suburban campuses. (Source: Mobility Lab of the University of Tartu.)

By travelling longer distances, employees and students of suburban campuses also spend more time in travel (Figure 13). The median trip length during weekdays is approximately 4–6 minutes (~25%)

longer in the case of suburban campuses than among people working or studying in the centre. Tartu is a relatively small and compact city with 100,000 inhabitants and the increase in average travel time has a moderate effect on the life quality. In larger settlements, travel time increase due to workplace relocation to suburban areas also incorporates stronger effect on personal life.

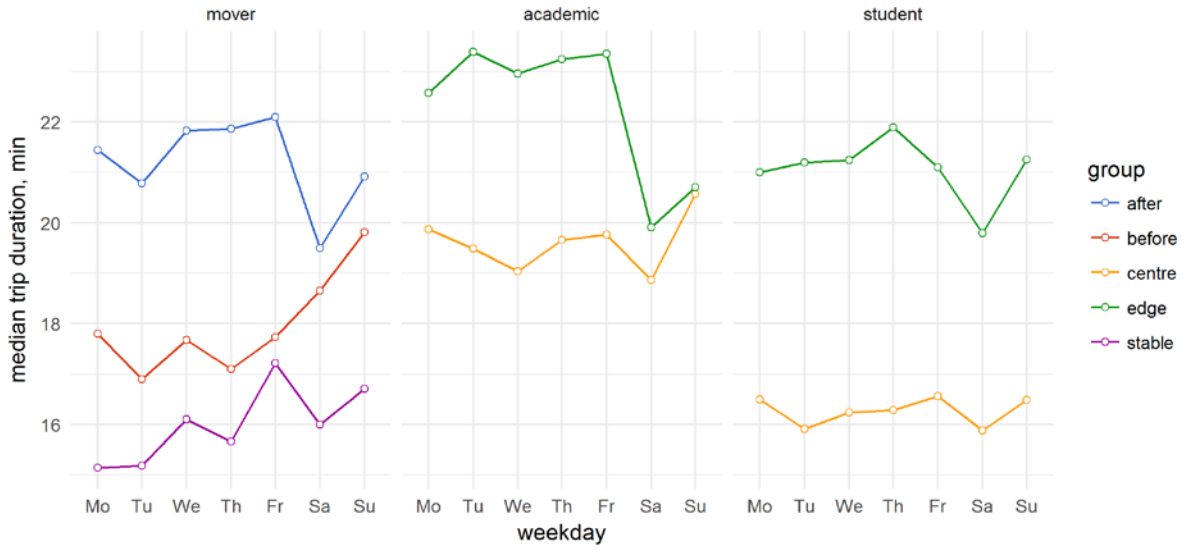

Figure 13. Median trip duration of respondents depending on the location of workplace, social group and weekday. For the clarification of the legend, please refer to Figure 12. (Source: Mobility Lab of the University of Tartu.)

Longer trip lengths between main activity nodes drive the change towards the use of motorized travel. The median speeds of respondents are shown on Figure 14. The graph clearly indicates the switch towards motorized travel modes during the weekdays among those who work at suburban location. It is interesting to note that students are using low-speed travel modes in both cases, possibly due to their limited financial opportunities. It means that this group is the affected the most by a distant study location in terms of lost of time. At the same time, walking or cycling to study buildings tend to have beneficial health effect; this can be taken as a positive side effect.

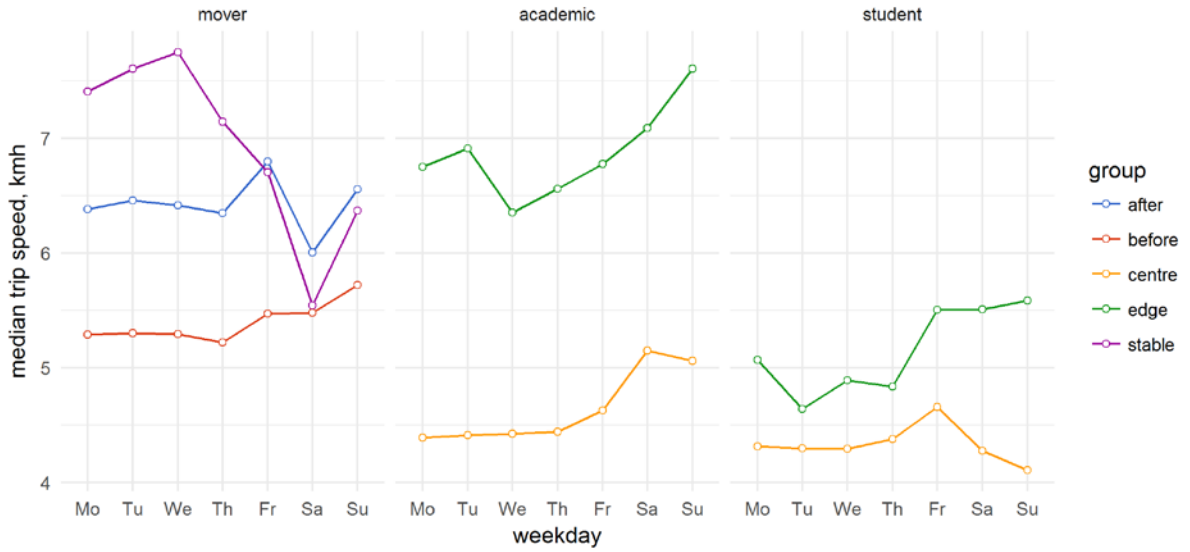

Figure 14. Median trip speed of respondents depending on the location of workplace, social group and weekday. For the clarification of the legend, please refer to Figure 12. (Source: Mobility Lab of the University of Tartu.)

Activities in comparison of workplace location

The workplace location affects the number of places visited during the day. In central city, people undertake more visits to different places than in the case of suburban campuses. It shows that the suburban campuses are favourable places for concentrated working, but suburban location decreases the possibilities of employees to access various service providers during the lunch break or after working hours due to the monofunctional land use in the campus neighbourhood.

General space-use differences between the participants of central and suburban workplaces are shown on Figure 15. The graph is based on the number of grid cells that host either GPS points or stops calculated from GPS data. The number of cells hosting GPS points shows the overall mobility of the participants while the number of cells hosting stops addresses visits made to certain places.

By analysing the mobility and spatial coverage of activities of different sample groups within Tartu, we noticed that the students constitute the most active social group. Students tend to have the highest number of places visited during working (studying) days (Figure 16). In addition, students are the only group analysed who have similar number of places visited during school days indifferent from campus location. This is related to the curriculum design that foresees visits to different study buildings in the city for all students.

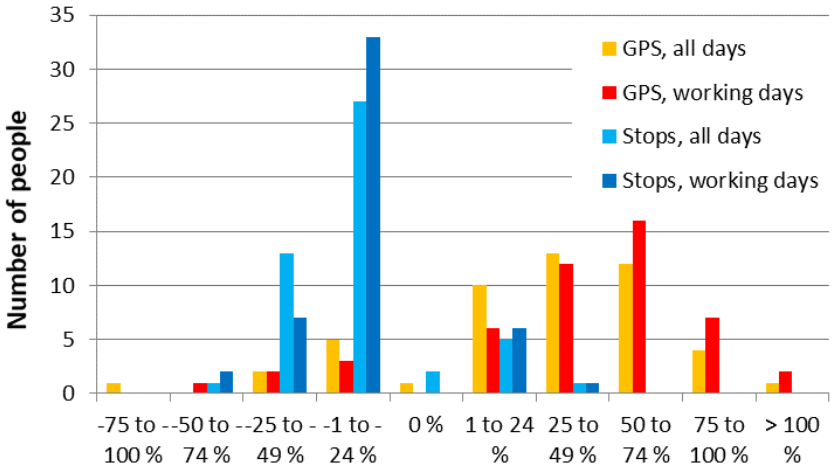

Figure 15. The difference in spatial activity between people working/studying in the suburban campus compared with the central campus (baseline). The number of cells where people have stopped (blue bars) generally decreases in case of suburban location while the number of cells with GPS points, i.e. the overall mobility and spatial coverage of the city tends to increase (yellow/red bars) with suburban location. (Source: Mobility Lab of the University of Tartu.)

Visits to city centre

Smartphone tracking showed that the employees at relocated workplaces made fewer and shorter visits to the city centre and its close vicinity than before the relocation took place (Figure 17–18). However, relocation significantly increased the frequency of transits through the city centre due to the need to surpass the bridges over the River Emajõgi, and traffic via the main transportation routes around the city centre. This in turn added significant traffic load to the already problematic travel routes in Tartu, especially during peak hours. The results indicate the need for a strong city planning policy that supports rich functionality in urban cores including the places for work and study.

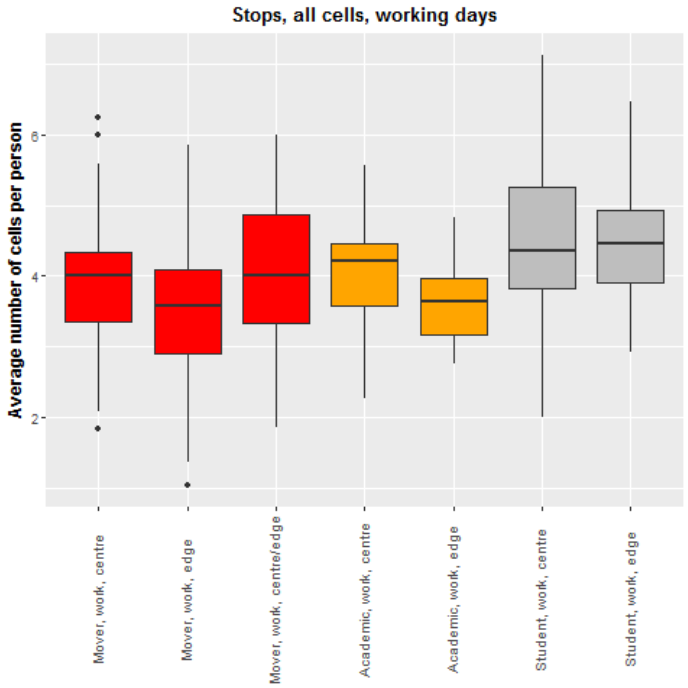

Figure 16. The spatial extent of activities depending on the workplace location and status of respondents. Red: employees of relocating workplaces. Orange: academic staff of the University of Tartu. Grey: students of the University of Tartu. (Source: Mobility Lab of the University of Tartu.)

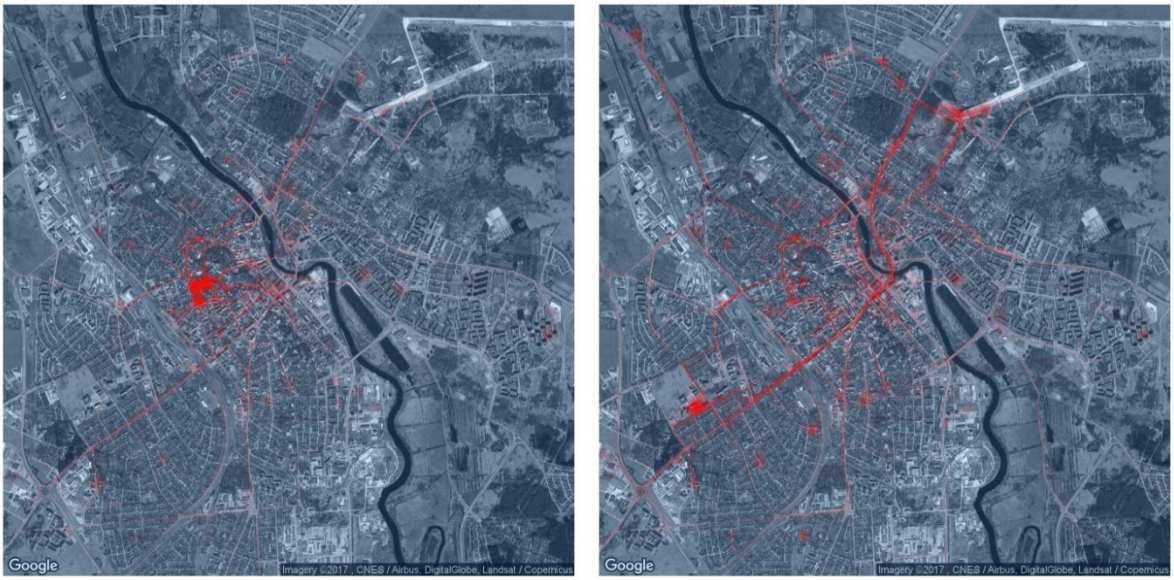

Figure 17. A comparison of the use of city space before and after workplace relocation in 2016 (respondents from relocating workplaces only). Left: Before relocation from central city, the city centre hosted various activities of employees, and supported the use of light travel modes. Right: After the relocation to the northeast or southwest fringe of the city, employees have fewer opportunities to use services close to new workplaces, they undertake significantly less visits to city centre, and they spend more time in motorized travel. (Source: Mobility Lab of the University of Tartu. Basemap: Google.)

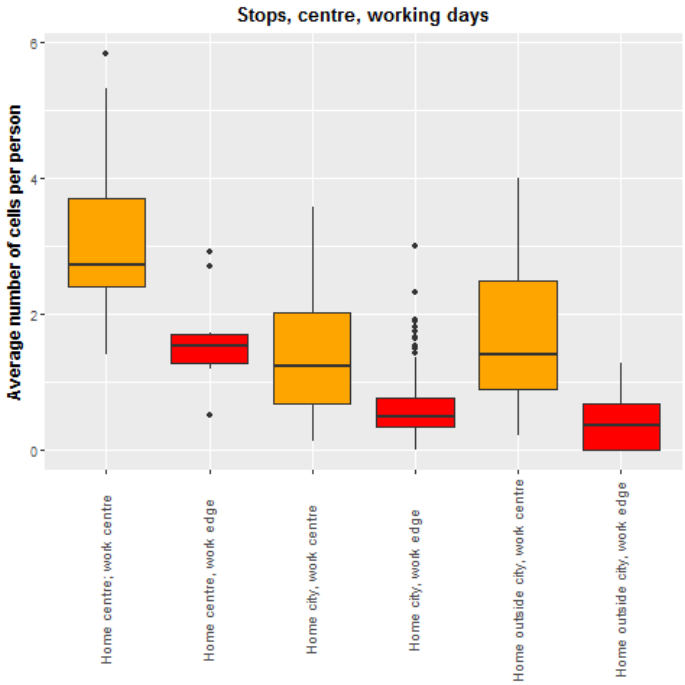

Figure 18. Visits to the city centre during working days depending on the location of residence and workplace (all respondents). Orange: workplace in city centre, red: workplace in suburban campus. (Source: Mobility Lab of the University of Tartu.)

Impact of the place of residence

The place of residence has a stronger effect on the overall mobility of participants than the workplace location (Figure 19). People who live and work compactly in the city centre cause the smallest transport related load.

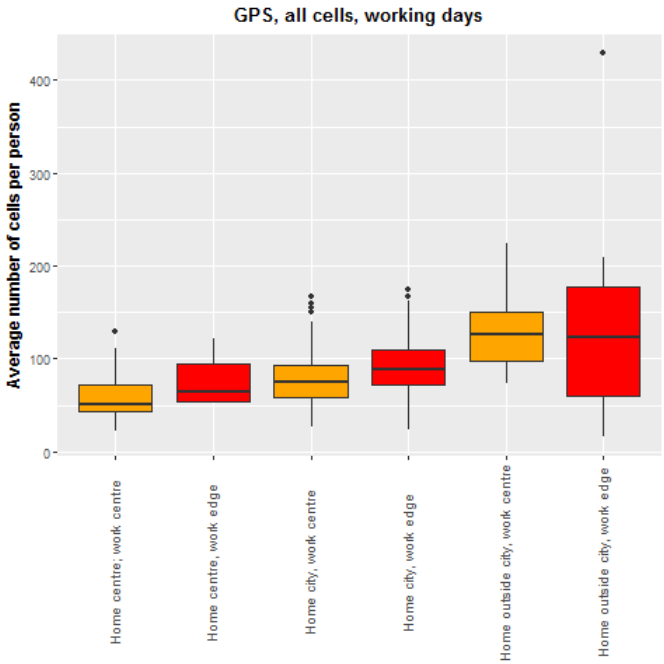

Figure 19. The mobility of respondents during working days: number of grid cells hosting GPS points depending on the location of residence and workplace (study building). Orange: workplace in city centre, red: workplace in suburban campus. (Source: Mobility Lab of the University of Tartu.)

The intensity of the use of space and the spatial coverage of Tartu by respondents depending on their home and workplace location is illustrated on Figure 20. The most compact use of space and the least travel amount occurs if home, workplace (study buildings), and places for service provision are located close by. This combination is typical for city living and as such, it results in the optimal spatial use of an urban area. Living elsewhere in the city, but working in the centre shows also reasonable spatial usage of respondents as they gather to the centre from scattered areas throughout the city. Living outside the city, either in suburban areas or even further away from the city borders, however, shows more intensive travel load that is concentrated to specific transit routes. This effect is exaggerated due to the limited number of main roads that connect the city to the outer areas, especially to the urban sprawl neighbourhoods, and due to the prevalent use of car as travel mode in case of urban sprawl.

The main effect due to working at the edge of the city is seen from the intensive usage of the main street that connects the suburban campus to the city centre. As stated already above, the respective street in Tartu, Riia Street, faces severe traffic problems, and new car-dependent developments to the outskirts of the centre deepen the accompanied problems related to health, safety, social wellbeing, and environment even further. While planning any development to the outskirts of the city centre, this kind of effects need to be wisely addressed, evaluated, and where possible, mitigated.

Figure 20. The intensity of the use of space during working days depending on the place of residence and work/study. (Source: Mobility Lab of the University of Tartu.)

Differentiation of activities

Figure 21 illustrates the time-use of respondents by comparing the time spent for various activities of a typical employee and a typical student from central campus throughout the diurnal rhythm. Similar amount of time is devoted on work/study purposes while the spare time activities are dedicated on either family or hobbies. Lunch time is often spent outside the work/study building.

Comparative graphs are presented for a typical employee and a typical student from the Maarjamõisa suburban campus (Figure 22). Daytime is compactly devoted to work/study purposes while the time before and after the workday is used for family-related and social activities. Due to the limited number of dining options in the suburban neighbourhood, lunch breaks are spent at workplace/in the study building.

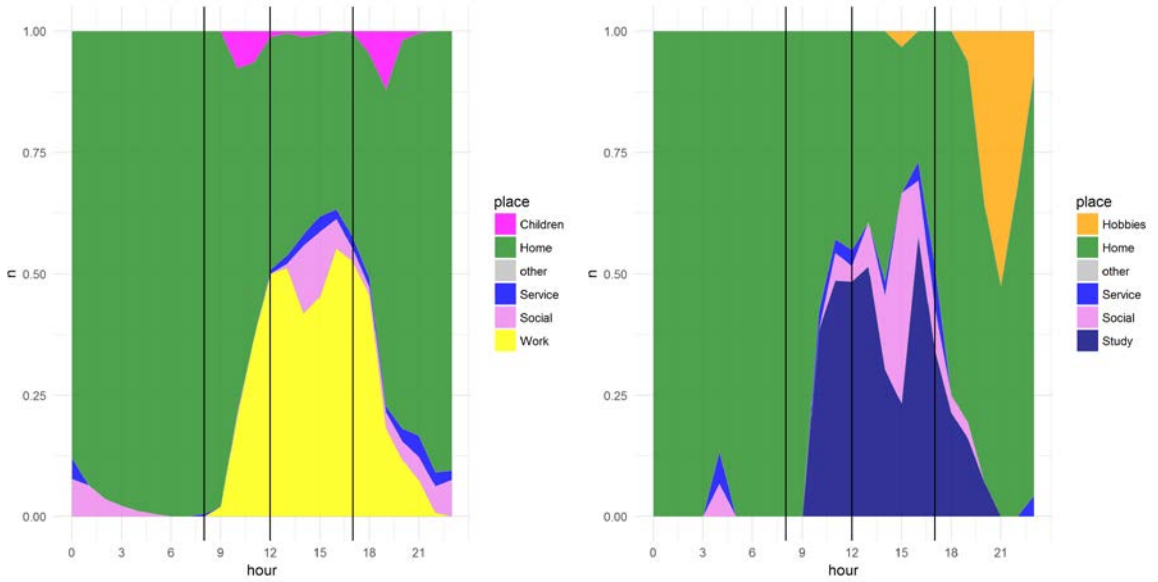

Figure 21. Characteristic time-use of an employee (left) and student (right) from the central campus over the whole study period. Graphs incorporated only data from activity nodes (stops), not movements. (Source: Mobility Lab of the University of Tartu.)

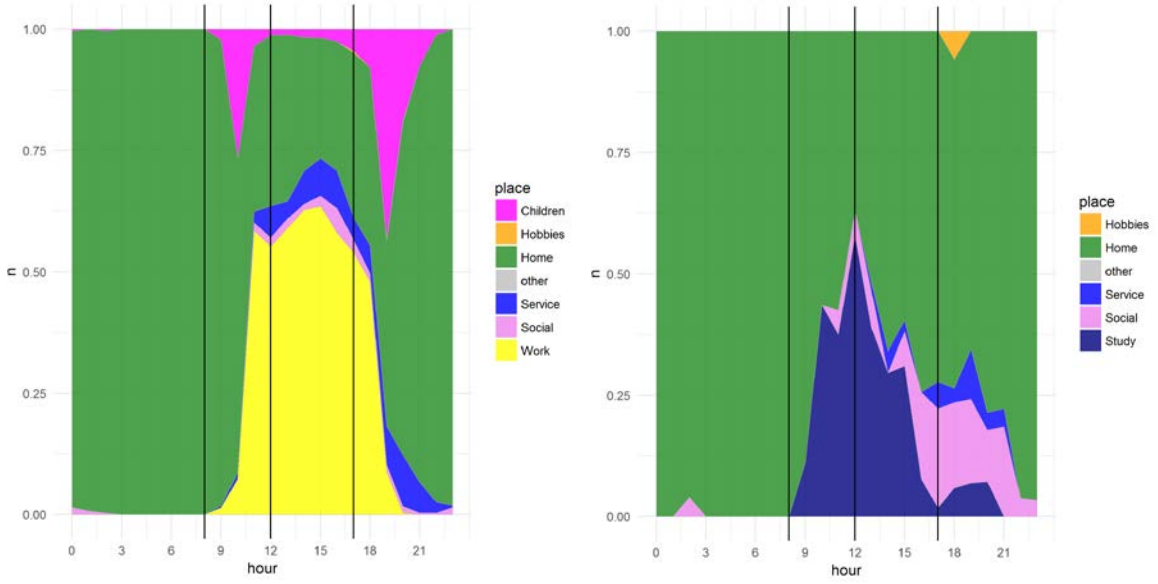

Figure 22. Characteristic time-use of an employee (left) and student (right) from the suburban campus over the whole study period. (Source: Mobility Lab of the University of Tartu.)

Stakeholder engagement

Campus development is strongly related to the stakeholder groups of the university (Figure 23) due to mutual influences and interests. Participatory campus planning involves key stakeholder groups to the (re)design and implementation processes of campus plans. Within LBC project, we defined the key stakeholder groups to be involved in the experimental study of space-time research of campus users. These groups either incorporate the most influenced individuals of campus development, such as students and staff members, or involve planning authorities and practitioners who actually set the campus development principles in Tartu urban region. These stakeholder groups have given indispensable input to the activities of LBC project and the current campus development plan. Table 2 lists the persons who have been involved in the project activities during its different phases (next to the experimental study).

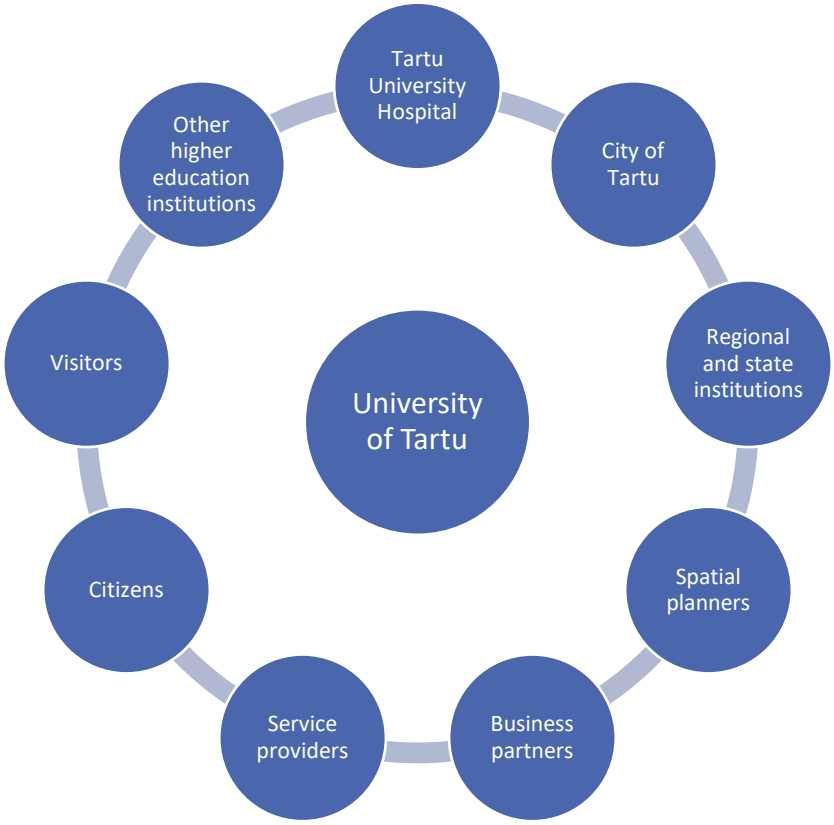

Figure 23. The potential outer stakeholder groups of the University of Tartu in the process of the spatial development of campuses. Inner stakeholder groups involve students and academic and non-academic staff.

Our key out-of-university stakeholders where Tartu City Government and the members of the Estonian Association of Planners. Members of these institutions also took part in the Livable City Forums that were held in Turku, Helsinki, Uppsala, Tartu, and Riga, in the campus study tour to the Netherlands (Amsterdam, Delft, Rotterdam, Eindhoven), and the final conference in Stockholm.

We chose our stakeholder groups as we find that spatial planning decisions strongly guide the impact of the campus. Especially the role of the city government can be hardly underestimated as the city government is responsible for planning strategy and framework, and integrated planning decisions within the city. The key contacts of the project from the city government were Mr. Indrek Ranniku, city planner, and Mr. Tõnis Arjus, city architect.

Next to the official city planners, free market consultants, complying with the occupational standard of spatial planners, provide real planning solutions as their daily practice. SME Hendrikson & Ko, one of the leading spatial planning companies in Estonia, has its headquarters situated in Tartu and has as such been actively involved in the spatial planning practice in Tartu. The portfolio of Hendrikson & Ko include the Thematic Plan of Higher Education Institutions in Tartu (Metspalu et al., 2013) and the Strategic Impact Assessment of the Comprehensive Plan of Central Tartu (OÜ Hendrikson & Ko, 2016, leading expert P. Metspalu). These two documents are directly related to the LBC project theme. Therefore, we have actively involved the consultants Pille Metspalu and Ann Ideon to the project activities. Stakeholder feedback letters from both Hendrikson & Ko as well as Tartu City Government are included to the current documents.

In addition to outer stakeholder groups, a wide spectre of university staff has taken part in the discussions of the spatial development decisions of the university and its particular study buildings. Especially the decision to develop the new Delta study building to the central city has gained significant attention and support.

In the light of the approaching 100th anniversary of higher education in Estonian language in 2019, the University of Tartu Foundation is organizing an alumni gift campaign to *alma mater*. Our project team has proposed a 'Cosy student room to every study building' project to be supported by alumni. This project has been selected as one of the four donation campaigns for the year 2018.

Involved people

Table 2. People involved in the pilot activities and discussions at various stages in the Tartu pilot case of the LBC project.

Project team, University of Tartu	Involved, University of Tartu and service providers	Stakeholders, Tartu City Government	Stakeholders, other
Prof Rein Ahas, Project leader, Head of the Chair of Human Geography and Regional Development, University of Tartu	Prof Volli Kalm, Rector, University of Tartu	Urmas Klaas, Mayor, Tartu City Government	Pille Metspalu, Spatial planner, Hendrikson&Ko, Board member of the Estonian Association of Planners
PhD Age Poom, Scientific coordinator, Lecturer in Environmental Management, University of Tartu	PhD Erik Puura, Vice rector, University of Tartu	Jarno Laur, Deputy mayor, Tartu City Government	Ann Ideon, Spatial planner, Hendrikson&Ko, Member of the Estonian Association of Planners
MSc Kristi Post, Project assistant, University of Tartu	PhD Leho Ainsaar, Director, Institute of Ecology and Earth Sciences, University of Tartu	Indrek Ranniku, City planner, Head of the General Planning and Development Service, Tartu City Government	Martin Kikas, Director, Tartu Region Energy Agency
MSc Mattias Linnap, Application developer, University of Tartu	Prof Ülo Mander, Head of the Institute of Geography, University of Tartu	Tõnis Arjus, City architect, Head of the Department of Architecture and Building, Tartu City Government	Marek Muiste, Specialist, Tartu Region Energy Agency
PhD Anto Aasa, Researcher, University of Tartu	Prof Jaak Jaagus, Chair of Physical Geography and Landscape Ecology, University of Tartu	Raimond Tamm, Project manager, Tartu Science Park, and later Deputy Mayor, Tartu City Government	Timo Aarmaa, Director of the Division of Development Projects, State Real Estate Company
PhD Siiri Silm, Researcher, University of Tartu	Prof Tiit Tammaru, Chair of Human Geography, University of Tartu	Karin Kangur, Planner, Tartu City Government	Evelin Arak, Coordinator of science and development, State Real Estate Company
MSc Mihkel Truman, Interviewer, data quality control, University of Tartu	Associate Prof Garri Raagmaa, Chair of Human Geography, University of Tartu	Alo Lilles, Senior specialist, Department of Business Development, Tartu City Government	Mari Loss, Coordinator of science and development, State Real Estate Company
MSc Pilleriine Kamenjuk, Interviewer, University of Tartu	Prof Jaak Vilo, Head of the Institute of Computer Science, University of Tartu	Jaanus Tamm, Project manager, Tartu City Government	Ermo Kontson, Owner of the electric taxi company, Tartu

Project team, University of Tartu	Involved, University of Tartu and service providers	Stakeholders, Tartu City Government	Stakeholders, other
MSc Janika Raun, Junior researcher	Acad Prof Urmas Varblane, Head of the Chair of International Business and Innovation, University of Tartu		Mart Hiob, Spatial planner, Artes Terrae, Member of the Estonian Association of Planners
	Prof Raul Eamets, Dean of the Faculty of Social Sciences, University of Tartu		Uku Põllumaa, Architect, Arhitektibüroo Siim & Põllumaa OÜ, Member of the Estonian Association of Planners, member of Estonian Association of Architects
	Kristel Reim, Head of Technology Transfer Unit, University of Tartu		Tavo Kikas, Councillor, Spatial Planning Department, Ministry of Finance
	Heiki Pagel, Head of Estates Office, University of Tartu		Prof Michael Hebbert, University College London
	Prof Frank Witlox, Visiting professor, University of Tartu, Ghent University		
	PhD Erki Tammiksaar, archive researcher, University of Tartu		
	MSc Annika Väiko, research assistant, University of Tartu		
	MSc Erki Saluveer, IT developer and service provider, Positium LBS		
	MSc Kaisa Vent, IT developer and service provider, Positium LBS		
	MSc Karl Tõnissoo, IT developer and service provider, Positium LBS		
	MSc Arvi Kiik, IT developer and service provider, Positium LBS		

Participating in the Interreg project 'Live Baltic Campus' provided us valuable knowledge of the spatial planning and design framework in the context of both university campuses as well as larger functional regions. We highly acknowledge the design-oriented approach provided by partners from Helsinki, Metropolia University of Applied Sciences. This approach, which can be called as 'design as strategy' or 'user-centred design', is advanced as both a process as well as the result it creates.

The application of strategic design stood out from the pilot activities of especially Finnish and Latvian colleagues. Estonian pilot activities provided a conceptually and methodologically advanced basis for the user-centred design to be implemented in the strategic and spatial decisions of the University of Tartu and Tartu City Government.

In the context of spatial planning, user-centred design is often called co-creation or participatory planning. The concept has been partially applied in the planning practice of Estonia as in the rest of the EU countries, but has still a tremendous development potential. Implementation of the concept needs to be context-sensitive in order to avoid the bottlenecks and backslashes that have been addressed at the LBC forum in Uppsala, 2016.

We feel pleased that by experiencing the approach of user-centred design and its applications in spatial planning throughout the LBC project, we can advocate it further among our Estonian colleagues. We have started deconstructing the concept and defining its further potential in the context of Estonian planning practice (e.g., at the Tartu Planning Conference 2017, co-organized with the University of Tartu). The discussants involve colleagues from the Estonian Association of Planners, the Estonian Association of Architects, Department of Geography at the University of Tartu, and local and state level planning institutions. Together we need to define the most feasible roadmap for Estonian spatial planning development, including strategic design thinking.

The LBC project has provided also a fruitful arena for conceptual and practical spatial planning discussions, especially with the representatives of the university and Tartu city government. This experience has been and will further be transferred to the planning practice of Estonian Association of Planners as well as our spatial planning SME Hendrikson & Ko.

Pille Metspalu

Head of the Department of Comprehensive Planning and Regional Development, Hendrikson & Ko,
Board member of Estonian Association of Spatial Planners,
Certification of the Occupational Standard of Spatial Planner No. 105740

Tartu City and the University of Tartu have agreed that the spatial development of the university will be concentrated to two university campuses. The historic campus is designated to the fields of Humaniora and Socialia and the Maarjamõisa campus incorporates the fields of Realia, Naturalia, and Medicina. During the Live Baltic Campus project, the development of both campus areas and their mutual connectivity have been on the agenda of the negotiations between the university and the city government. The impact of these discussions and of the LBC project is already represented in several planning decisions and has given ground for future decision-making. I could name five major related development themes:

– the location decision of the IT study complex Delta of the university to central Tartu (2016);

– the comprehensive plan of central Tartu (2016);

– the comprehensive plan 2030+ of whole Tartu (2017);

– the zoning plan of the Maarjamõisa campus of the university (2017);

– connectivity improvements between the historic campus and Maarjamõisa area.

The strong support from city government on the development decision of the location of the future IT study complex Delta within central Tartu was carried by the idea of a strong, multifunctional, attractive, and mutually beneficial central city region. The development of the Delta study complex serves a distinguished example of university-business-city cooperation model. It has been supported by the empirical evidence collected during LBC project in Tartu by utilizing mobile phone tracking of employees and students of both campus areas.

By analysing the current state of the Maarjamõisa campus, we have to admit that the milieu of the campus suffers from low-functionality (especially poor service provision), large parking areas, and low attractiveness. Due to the suburban location, people need motorized travel for commuting to the campus. Relying on intensive car transport causes severe problems to the city logistics and air quality, especially during peak hours, and creates urban regions dominated by parking lots.

During the LBC project, we addressed these issues in the development of the zoning plan of the Maarjamõisa campus. Several ideas that we gathered during the LBC project influenced the final solution of the zoning plan:

– identifying the role and future pathway of the campus that resulted in the vision of a cutting-edge-technology-oriented science park;

– increasing the functionality of the area and enabling wider service provision by dividing the land-use functions of the campus area between education/science (50%) and service (50%) instead of former complete devotion to education/science;

– defining travel directions for pedestrians and cyclists within campus, and on suburban and urban scale;

– foreseeing inner-campus walkways and separating those routes from motorized travel modes.

…

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While the further development of both the Delta study complex and the Maarjamõisa campus is now in the hands of the university, the city government is responsible for smooth connections between central and Maarjamõisa urban regions. During the last years, we have analysed the state of current connectivity, mapped out areas of improvement, and started to implement the roadmap. We have set our focus on improving the coherence of using low-carbon travel modes like walking and cycling, and even on introducing the idea of a tramline in the recent comprehensive plan of Tartu. Recent projects in action that serve the aim of smooth low-carbon connections between two campus areas and are in line with the LBC project aims are as following:

– introducing bicycle-sharing system in Tartu (electric bikes);

– reconstructing railway crossings at Riia and Näituse Street, and organizing an architectural competition for the best solution at Riia crossing;

– reconstructing Vanemuise Street for improving cycling options at the cost of less convenient car travel/parking.

I highly value the cooperation with various departments of the university, such as the Estates Office or the Department of Geography, in order to improve the living environment and attractiveness of Tartu as a student town. I appreciate the possibility to be involved in the project activities of Live Baltic Campus, and take part in Livable City Forums and study tour to the Netherlands where we experienced well-planned and -designed campus areas that have now influenced also the spatial decisions of Tartu. I highly appreciate the empirical outcome of the long-term GPS mobility experiment of the Department of Geography within LBC project. This data enables to develop significantly the evidence-based planning practice in Tartu.

Indrek Ranniku

Head of the General Planning and Development Service, Tartu City Government

Member of the Estonian Association of Planners

Integrated action plan for campus development activities in Tartu

Based on the historic developments of the campuses in Tartu, the current needs and developments on campus and city scale, as well as the results of our space use survey analysis of campus tenants, Table 3 lists the implementation themes for spatial planning of campuses and their connectivity solutions in Tartu.

Table 3. Implementation themes for campus development in Tartu in order to enhance the university-city cooperation and impact prevention/mitigation, and to improve the supportive environment for academic missions.

Theme	Issue, subtasks	Spatial level	Involved institutions
Functionality	Keeping and developing active and multifunctional land-use in central city		University of Tartu
	Preserving the historical campus area in central town by keeping and developing the fields of *humaniora* and *socialia*	Campus, city	
	Developing and constructing the new interdisciplinary Delta study complex at Narva Street	Building, campus	
	Developing the business corpus of Delta study complex	Building, campus	
	Relocating academic work of sports sciences to current sports hall by enlarging the facilities at Ülejõe district	Building, campus	
	Establishing contemporary student-oriented study spaces to central campus buildings	Building	
	Implementing the land-use principles of Tartu Comprehensive Plan 2030+ (2017)	Campus, city	Tartu City Government
	Diversifying the functionality of Maarjamõisa campus		University of Tartu, Tartu City Government
	Implementing the land-use principles of the Zoning Plan (2017) of Maarjamõisa campus	Building, campus	
	Improving dining options in the campus area	Building	
Connectivity & mobility	Improving physical connections between central and Maarjamõisa campus and the coherence of the use of low-carbon travel modes		Tartu City Government, Estonian Railways Ltd
	Reconstructing Riia railway crossing	City	
	Reconstructing Näituse railway crossing	City	
	Reconstructing Vanemuise Street and rearranging current traffic to introduce bicycle lane	City	
	Introducing bicycle-sharing system with bike stations at all study buildings	City	
	Constructing pedestrian and cycle routes within Maarjamõisa campus according to the Zoning Plan (2017)	Campus, city	
	Adjusting public transportation timetable to lecture times on key routes	City	
	Improving the attractiveness of using low-carbon travel modes for commuting		University of Tartu

Theme	Issue, subtasks	Spatial level	Involved institutions
	Introducing good-quality and roofed cycle parking areas next to all study buildings (both existing and buildings in development)	Building	
	Introducing screens with public transportation timetables to the foyers of study buildings	Building	
	Proceeding with the idea of introducing tram line to Tartu that would connect Maarjamõisa campus with central city and major residential area Annelinn		City of Tartu
	Initiating a thematic plan for tram traffic	City	
Design	Establishing contemporary student-oriented study spaces to all study buildings (both existing and in the phase of development)		University of Tartu, The University of Tartu Foundation
	Arranging alumni donation project in the framework of celebrating 100 years of higher education in Estonian language in 2019	Building	
	Recruiting university architecture and/or environmental manager	Campus	
	Improving the attractiveness of campus areas and their active relation with city space		University of Tartu, City of Tartu
	Improving landscape architecture and active grounds around existing study buildings	Building, campus	
	Taking into consideration landscape architectural issues while planning new facilities/extensions	Building, campus	
	Avoiding the construction of large parking areas at new study facilities	Building, campus	
	Within central city, considering the construction of underground parking areas by new study facilities (e.g., Delta study complex)	Building, campus	
	Limiting the number of parking places at existing study buildings by putting the ground in active use with landscape architectural elements and pedestrian/bicycle routes	Building, campus	
Organization	Encouraging staff and students to use low-carbon travel modes by arranging an information campaign	Building, campus	University of Tartu
	Encouraging staff and students as the citizens of Tartu to use the bicycle-sharing system organized by city government	Campus, city	City of Tartu

Conclusions

Our results show that the optimal workplace location of knowledge workers is in the central city due to optimal level of total travel load as well as high quality and functionality of urban space. Strong city planning initiatives supporting compact developments, rich functionality in central areas, and the use of low-carbon travel modes are needed to mitigate the travel load caused by scattered activity nodes throughout the urban area. Rich functionality of an urban core supports the identity building of the city and increases its attractiveness. This is especially relevant in attracting knowledge workers and students to the city in the global world where cities compete for talented people.

There has occurred a qualitative shift in campus development in Tartu during the LBC project. To mark some of the major and well-seen steps, we may name the decision for developing the Delta study building in the central city, strong emphasis that is put on the development of central city / central campus area in the comprehensive plans of both the city centre as well as the whole city, or the zoning plan of Maarjamõisa campus that has remarkably changed the land use principles of the area. In addition, improving the connectivity between campuses and promoting the use of low-carbon travel modes has gained significantly more direct attention than ever before. Notable system change will be introduced by implementing electric bike sharing system in one and a half year to Tartu. Another major future project – establishing tram lines to Tartu – is anchored in the recent comprehensive plan.

The case of Tartu presented in the current report / development plan shows that functionality, integration, and connectivity of spatial areas are scale-dependent and constantly evolving. The activities within the Live Baltic Campus project have helped to create and disseminate an understanding of the importance of these elements in Tartu, and of possible approaches to local campus transformations. Campus development in Tartu has, in the cooperation of the university and the city government, undergoing the transformation towards a contemporary well-integrated and connected university town that wisely, delicately, and innovatively combines the historic heritage with contemporary solutions to the challenges we face. The project activities have strongly risen the wisdom and acknowledgement of the needs of campus development and have helped to strengthen its position on the agenda of city and university development plans.

New research methodology and software solutions for space-time research, based on smartphone data, were developed within the study. Interest in applying the results to other cities and programmes has been expressed, for example by Riigi Kinnisvara AS (the State Real Estate Ltd.), which supported parts of the project with funding and which is developing a state housing programme in Estonia. This initiative will significantly change the location of workplaces in several Estonian cities in order to improve the accessibility to work and decrease the travel load caused by unnecessary travel. Combining new technologies and international wisdom with local know-how and context-sensibility helps us to pave the way towards sustainable urban areas.

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