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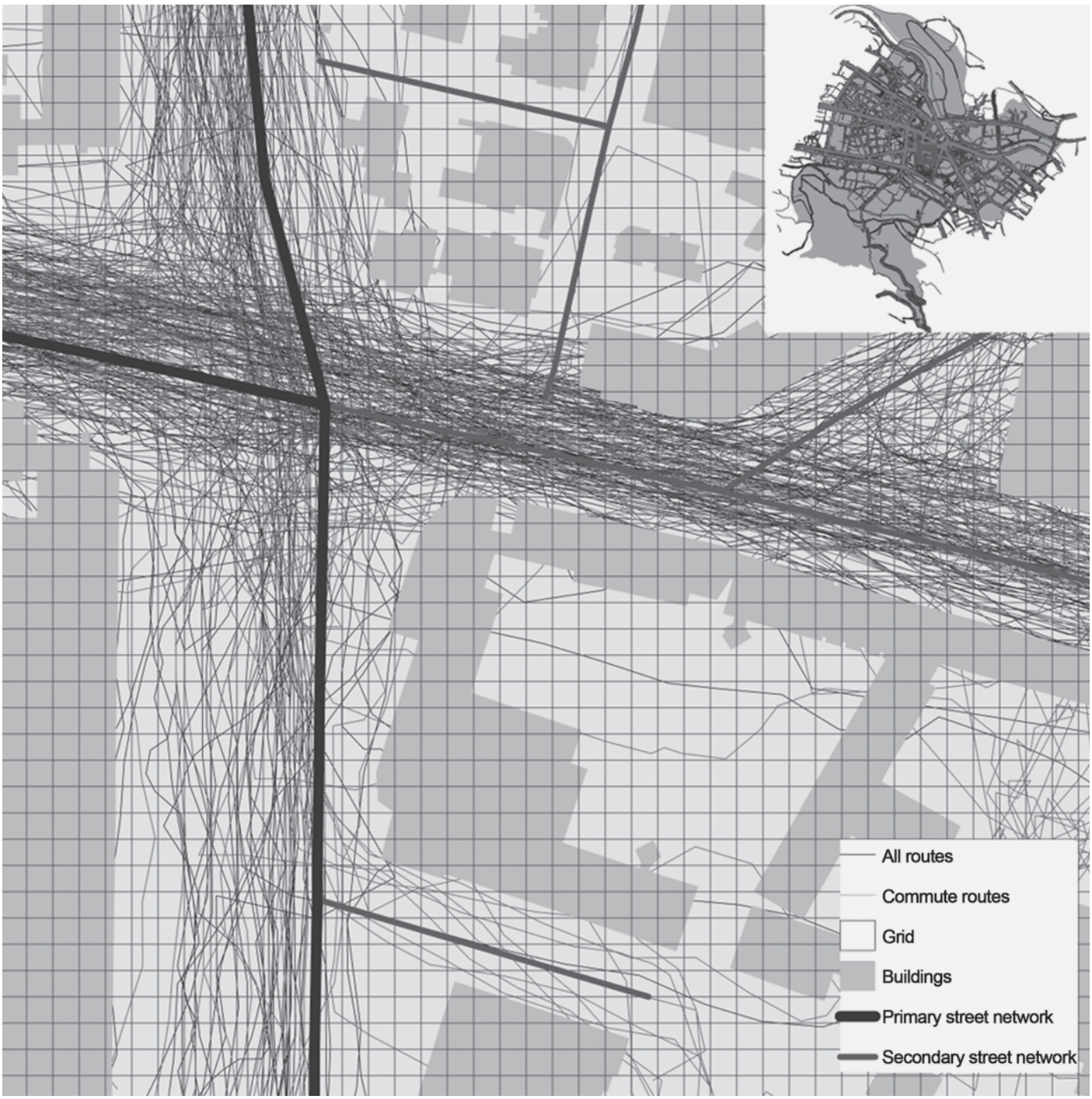

Fig. 1 Areal segment with all routes/rides and the axis of the streets presented over a grid (network of polygons 5×5m) into which the entire territory of the municipality was divided. For the analysis, the entire area of the municipality of Centar was divided into a grid (network of polygons 5×5m) used as a substrate/map. This approach was applied to mapping of activities, e.g. rides according to their characteristics and the areas of occurrence. The data obtained about the drives [GPS routes] are a series of points bearing their characteristics (the time at which they were recorded, the identification of the driver and riding, the previous and the next point relative to a given point). Points for each of the 1,868 registered activities as routes/rides were recorded at intervals of several a few seconds, for a period of three months thus, each route had several thousand points.

Sl. 1. Segment područja sa svim rutama i osima ulica prikazanih na mreži (mreža poligona 5×5m) na koju je podijeljen cjelokupan teritorij Općine. Za potrebe analize čitavo je područje Općine Centar podijeljeno u mrežu korištenu kao podloga/karta. Ovaj je pristup primijenjen na mapiranje aktivnosti, npr. vožnje prema njihovim obilježjima i područjima. Dobiveni podaci o vožnjama [GPS-rute] niz su točaka s obilježjima (vrijeme u kojem su zabilježene, identifikacija vozača i vožnje, prethodna i sljedeća točka u odnosu na zadanu točku). Točke za svaku od 1868 registriranih aktivnosti kao rute/vožnje zabilježene su u intervalima od nekoliko sekunda tijekom tromjesečnog razdoblja. Svaka ruta ima nekoliko tisuća točaka.

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Citizen Involvement in Planning Process Innovation
The Case of Centar Municipality in Skopje

Uključenost građana u inovacijski proces planiranja
Primjer Općine Centar u Skopju

bicycle infrastructure
information-centric cities
innovation process
living lab
VeloCentar2025 project

biciklistička infrastruktura
informatizirani gradovi
inovacijski proces
living lab
projekt VeloCentar 2025

The paper examines what smart planning and information technology can contribute to inclusive planning and the goal of sensitive city, through an innovative approach to creation of sustainable and efficient urban movement system and bicycle infrastructure in particular. Using the GPS tracking capability of a smartphone application, we carried out a study of cycling habits introducing urban *living labs* experiences, but also utilising data and activities undertaken in a traditional way by interest groups promoting cycling in the city.

Rad analizira na koji način 'pametno' planiranje i informacijska tehnologija mogu pridonijeti inkluzivnom planiranju tzv. 'osjetljivoga' grada kroz inovacijski pristup formiranju održivog i učinkovitog sustava urbanoga kretanja, osobito biciklističke infrastrukture. Korištenjem GPS sustava praćenja putem *smartphone* aplikacije proveli smo studiju o biciklističkom kretanju na temelju tzv. *living lab* koncepta, ali i kroz prikupljanje podataka i aktivnosti interesnih grupa koje promoviraju biciklistički način prijevoza u gradu.

Introduction

Uvod

With the massive increase of urban population and rising demand for resources, cities have become the primary sources of pollution, congestion and waste. However, cities are also a key part of the response to sustainability. Active living plans, policies and programmes that complement other urban planning initiatives lead towards the development and maintaining of opportunities for active transition (walking and cycling) and discouraging car use, including car ban from the city centres in the upcoming decades.

The interdependence of the built environment and human behavior has long been of interest to the field of urban planning. However, direct assessments of the links between the built environment and physical activity, especially when being concerned with the health infrastructure, is rather new in the field. The available evidence "lends itself to the argument that a combination of urban design, land use patterns, and transport systems that promote walking and bicycling will help create active, healthier, and more livable communities".[1] In the pursuit of more resilient and sustainable futures, the value of urban cycling from health, social and economic point of view is greatly recognised and it is becoming an increasingly popular mode of transport, while cities across the world are looking for improved methodologies to enlarge its modal share. But, whilst this is increasingly recognised by governments, widespread social and environmental change to increase the number of cyclists, as well as policy implementation actions, have not followed suit.

Sustainable Urban Transport and the Local Context

Održivi urbani transport i lokalni kontekst

The European commitment to participate actively in the process of global sustainable development is evident through the active political engagement of the EU member and candidate countries. In terms of the strategic determination of the Republic of Macedonia on its way to EU membership and obligations undertook, the National Strategy for Sustainable Development of the Republic of Macedonia was adopted in June 2009.[2] Prior to this, the National Transport Strategy was adopted for the period 2007-2017.[3] Nevertheless, the objectives incorporated in the strategies for sustainable transport development are still far from being accomplished, because the emissions of greenhouse gases in 2016 were among the highest in Europe.[4]

It is obvious that transport energy has to be reduced to a sustainable level through changes in public transport and introduction of environmentally-friendly transport that should enable the implementation of energy-efficient technologies and clean energy sources. In this context, we look at the changes and improvements that the City of Skopje and the Centar Municipality have undertaken. The City of Skopje, with official population of 527,842 according to the 2002[5] Census, has decided to carry out a Sustainability Review through the support of SIDA. The review features an integrated approach to sustainable urban development aiming to identify synergies in the interrelation between environmental aspects, institutional factors and so called subsystems, in order to get a better basis for prioritising improvement actions in the urban environment.

In 2011, as part of the preparation of the new General Urban Plan of the City of Skopje 2012-2020, *Ingeniería y Consultaría, Sociedad Anónima* completed an analysis of the transportation system.[6] The survey showed that of all generated and attracted trips in the city, 23% were in the Centar Municipality. In

1 Handy, et al., 2002: 65
2 *** 2009
3 http://arhiva.vlada.mk/registar/files/MTV_Nacionalna_transportna_strategija_31.07.2007.pdf. [12.12.2016.]
4 http://airquality.moepp.gov.mk/airquality/ [28.12.2016.]
5 *** 2005
6 IDOM, 2011
7 Krakutovski, et al., 2011

the modal share shown for the different modes of transport, the bicycle part was represented with only 1,4%. This is one of the lowest modal shares compared to most European capitals. An earlier study showed a decrease from 1,9% to 1,4% in the modal share of bicycle use for the period 1999-2009.[7]

Formally, cycling has been identified as a new sustainability policy priority in the city's attempt to decrease the environmental impact of urban transition and improve citizens' health. There are many initiatives already underway, but still a lot remains to be changed and done. Skopje already has some cycling infrastructure, but it needs enlargement and modernisation that will increase the safety and comfort in the movement of cyclists, at the same time motivating new ones to everyday bicycle use. As a result of the General Urban Plan 2012-2022[8] and the Cycling Participation Plan, Skopje authorities decided to invest in cycling culture and infrastructure over the period of two years through the bicycle infrastructure project Skopje Velocity 2017.[9] The plan aims to increase cycling participation across the city to 10%. Centar Municipality has supported the bicycle use increase with several activities, such as "All Centar on Bicycles", by giving subsidies to Centar citizens for buying bicycles and many other inconsequent activities.

The need to compare and improve the knowledge by means of other comparable approaches and best practices is more than evident. The issue of bicycle use has to become a part of a wider policy debate about what Skopje as a political as well as cultural environment, and especially the Centar Municipality as a territory to which most trips are orientated and transverse, should do.

Policy Learning and Comparative Knowledge: Other Experiences

Usporediva saznanja i druga iskustva

As cycling policies are integrated into long term plans and visions of sustainable urban mobility, it is vital for planners and policymakers to have sufficient and appropriate knowledge at their disposal. It is also vital for both research and practice to critically consider aspects of causality and complexity in accounts of policy success.[10]

Conventionally, the experiences of Copenhagen[11] and cities in the Netherlands have been circulated as best practice policy models for cycling promotion and prime examples of successful joint effort of knowledge, citizens' involvement and good local governance.[12] Recently, a number of other cities known for achieving rapid increase in the cycling levels in a relatively short time-frame have emerged as examples of valuable comparative knowledge. Various experiences, policy learning and changes in approaches that have been undertaken are visited and compared, such as those in Paris and Manchester. Berlin and Copenhagen in particular are cities noteworthy for experiencing significant upsurge in the modal share of cycling in the last few decades; but not any less for traffic calming measures, integration of cycling with public transport and introduction of educational schemes.[13]

Transport planning has become one of the most advantageous areas in using big data and technology. Thus, it was particularly interesting to look at different experiences and examine how smart planning and information technology contribute to the innovative approach towards the goal of a creation of sustainable and efficient urban movement system. Advanced smartphone applications are used as an urban planning tool in reshaping the streets of more than 70 places around the world, among which are six major cities: London, Amsterdam, Barcelona, Sydney, Paris and New York. In this way, many local authorities are provided with detailed aggregated data across large areas in a geographical information system and helped to plan their activities for future development and investment in safer and cycling-friendly streets.

In comparison, the situation from which the evaluation of cycling in Skopje started, especially in the Centar Municipality, was characterised by the recorded significantly lower modal share of bicycling and percentage distribution of vehicular commuting in the city. This contextual misalignment should be observed in a much broader context and because of that, intervening will likely require different planning strategies.[14] Furthermore, Skopje is targeting greater participation by inexperienced cyclists, expressing what in theory is known as 'fear of cycling'. As a result, building safe roads and physically segregated bicycle infrastructure is equally important as the activities for building and increasing the consciousness for the benefits of higher bicycle use.[15] This means that both different mindset and behaviour are needed in order to initiate growth of sustainable movement mode, while working on strategic change of transportation habits and looking for more innovative approaches and methods.

8 *** 2012
9 http://www.skopje.gov.mk/ [24.12.2016.]
10 MacMillen, Givoni, Banister, 2010: 519-536
11 Gehl, 2008
12 Pucher, Buehler, 2008: 495-528
13 Sheldrick, Evans, Schliwa, 2014; Aziz, 2014
14 Schot, Geels, 2008: 537-554
15 Horton, 2007: 133-152

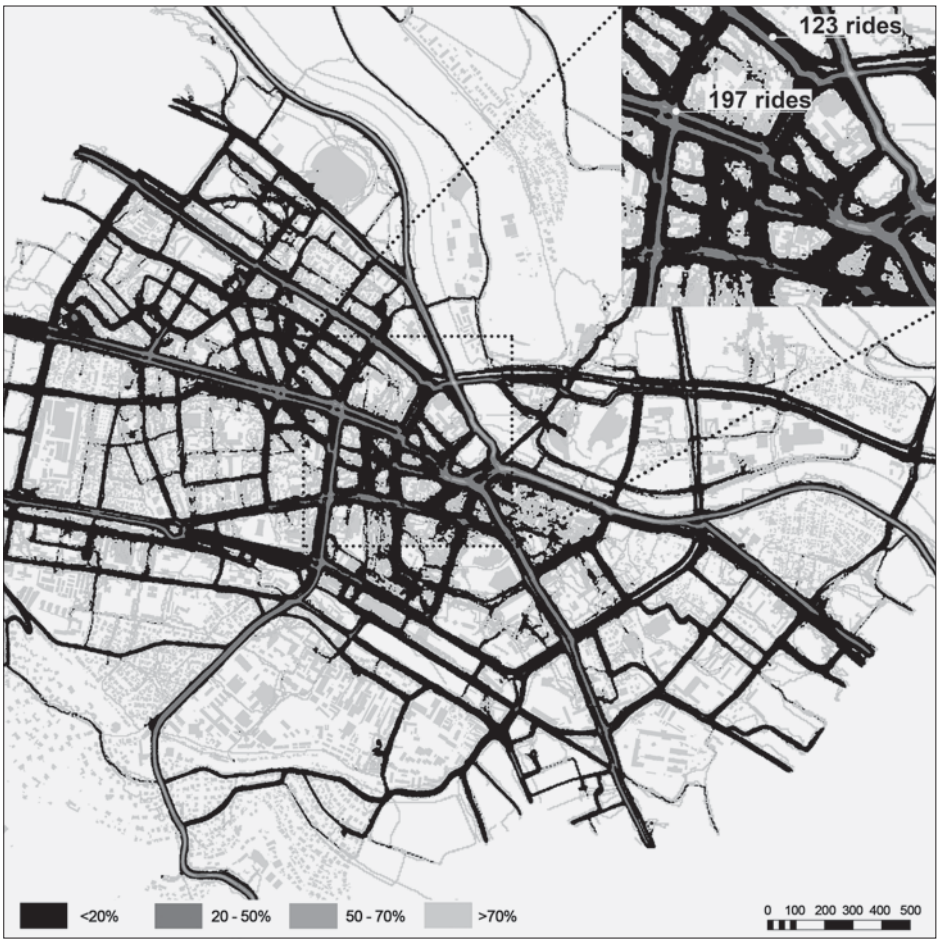

Fig. 2 Density of rides: layer AllRoutes: Layer represented over a grid substrate with all calculated routes of various drivers in each of the grid fields

Sl. 2. Gustoća vožnji: *layer AllRoutes* – sloj prikazan na podlozi mreže sa svim izračunatim rutama različitih vozača u svakom polju mreže

Theoretical Framework: Concepts of Inclusive, Cognitive and Smart City

Teorijski okvir: koncepti inkluzivnog, kognitivnog i 'pametnog' grada

Undoubtedly, city planning depends heavily on political commitment. The role of community participation is being differently evaluated and practiced in terms of user-driven information and decision making processes. But, on the other hand, only few political decisions could be sustainable and of merit if they ignored inclusiveness. Unfortunately, the current addressing of transport issues in the urban planning process of the Centar Municipality is characterised by an insufficiency of appropriate response by end users. It is noticed that measures to foster cycling had often been implemented on an ad-hoc basis, lacking strategic focus and a more profound understanding of bicycle cultures.

The current situation posed a real challenge to put forward innovative approaches and methods and to employ new tools for improving user involvement in the planning process. From a theoretical point of view, we were particularly interested in the *concepts of Inclusive, Cognitive and Smart city*.

For a city to be inclusive, it has to support the concept of "open" city, e.g. open infrastructures, open innovation, open knowledge and, especially, open data. In the context of modern technology use, this means that the city is characterized by the development of new useful services and open public databases for citizens and innovations that can improve the quality of life. As such, e-services and web communication in these cities are used for mutual awareness and informing, as well as for inter-operability of databases with a sound impact on decision making.

In this respect, the concept of living lab is of critical importance, as it presents a real-life test and experimentation environment happening "in the middle of people's everyday living environment" and thus perpetuating the concept of inclusive city. The commitment of a large number of European countries to participate in order to enhance citizens' participation in urban processes is evident by the accomplishment of many urban living labs and the establishment of the European Network of Living Labs.[16]

The second concept refers to "smart city". The idea behind it might be explained with a city in which ICT is merged with traditional infrastructures, as well as coordinated and integrated use of new digital technologies. In theory, it is already well-known and accepted that smart cities are cities that use technology to constantly improve their interaction with the citizens. Within this context, one might argue that living labs also include the concept of smart city. Cities have become living labs where technology aids improvement of the relations among end-users and producers, as well as among policy makers, planning authorities and citizens. "Smart is a sort of collective intelligence where digital and structured knowledge is used to answer more efficiently to complex problems that have been formalized in ontologies."[17]

The third is the concept of "cognitive city", which was used until recently in an architectural context, but now cognitive cities are viewed as extensions of "smart cities", using cognition theory. Although there is still no clear common denomination of smart and cognitive cities, Mostashari et al. in 2011 distinguished the term cognitive from all other variants of information-centric cities. They used cognitive cities in a framework of intelligent

16 http://www.openlivinglabs.eu/livinglabs [12.12.2016.]

17 Conruyt, et al., 2013: 52

urban governance by making single processes more cognitive. "The cognitive city is a paradigm that leverages information technology and artificial intelligence along with human cognition for improving decision-making and resource allocations in urban services delivery. A cognitive city is one that learns and adapts its behavior based on past experiences and is able to sense, understand and respond to changes in its environment."[18] In fact, one of the distinguishing characteristics of a cognitive city is that in it "the citizen becomes an active element of urban governance, not only through civic participation, but also through serving as a sensor for the operational state of the urban infrastructure".[19]

Methodology

Metodologija

Research Outline – Transport data are amongst the most popular data used by digital application developers and customer-friendly services. Different examples of smartphone applications, offering different traffic information, are generated and used as a tool for innovative approach to planning activities. In relation to cycling, there are numerous applications that cyclists can use to record and monitor the journeys they make, typically tracking distances cycled and other data, based on user-generated information designed to meet different needs and aspects to improve the cycling experience.

It is well-known that cycling surveys can be prohibitively expensive, particularly if data are required over a large area or a long time period. That is why the use of smartphone applications may be particularly useful when conducting city-wide studies, as it was the case with Centar Municipality, where a limited budget for detailed investigation was available.

Evaluating different characteristics and advantages of smartphone applications in order to decide which application was adequate for sensoring the operational state of the bicycle infrastructure and new data acquisition, it was opted for the free and open version of Strava GPS Cycling and Running App. It was understood that if a correlation between Strava data and actual cycling levels was defined, the ability to use Strava data as an indication of bicycle use on specific roads could become a very useful tool. The ability to use Strava for obtaining instant estimates of bicycle use on most roads in the designated area and time, allowed for planning decisions to be based on more reliable data.[20]

Fig. 3 Density of the commute rides: layer CommuteRoutes. Layer represented over a grid substrate with calculated commute rides, the number of routes of various drivers in each of the grid fields. Density refers to the classification of the number of completed rides on routes throughout the municipality, viewed through different characteristics (all rides, unique rides, commuter rides, daily peak rides). The result shows how individual drivers have driven only once within each grid field. The entire map represents the density of drives of various drivers in the observed area and period. The values on the map are expressed in percentage of the number of rides in relation to the field with the most registered rides for the purpose of being comparable with other maps. The zoomed area shows the exact number of rides registered in the selected points of the grid.
Sl. 3. Gustoća vožnji od mjesta stanovanja do posla: *layer CommuteRoutes* – sloj prikazan preko podloge mreže s izračunatim vožnjama od stana do posla, broj ruta različitih vozača u svakom polju mreže. Gustoća se odnosi na klasifikaciju broja završenih vožnji na rutama kroz Općinu percipiranu kroz različite karakteristike (sve vožnje, jedinstvene vožnje, vožnje na i s posla, vožnje za vrijeme najveće dnevne gužve). Rezultat pokazuje kako pojedini vozači voze samo jednom unutar svakoga polja. Cijela karta prikazuje gustoću vožnji različitih vozača u promatranom području i periodu. Vrijednosti na karti izražene su u postocima broja vožnji u odnosu na polje s najviše registriranih vožnji kako bi ih se moglo usporediti s drugim kartama. Zumirano područje pokazuje točan broj vožnji registriranih na odabranim točkama mreže.

Thus, the project VeloCentar 2025 for cycling conditions and bicycle infrastructure improvement utilised the aforementioned advantages of the smartphone application for understanding how cyclists move throughout the city, how they use the existing infrastructure and where infrastructure interventions would be most beneficial. The prevailing consensus was based on a weak correlation between policy efforts and levels of bicycle use, but in most of the cases the data collected came from the voluntary non-formal groups and enthusiastically involved organisations, missing serious and related consideration of other possible causal factors.

The starting point was the identification of the gaps in knowledge to be recognised, as well as the coordination and communication with end users who needed to be properly addressed and steered in order to directly apply environmental friendly innovation approaches into the policies and practice of the municipality. A variety of stakeholders were engaged to collaborate closely with the Department of Urbanism and the Mayor of Centar Municipality on the project, from local authorities, citizens,

18 Mostashari, et al., 2011a: 196-206
19 Mostashari, et al., 2011b: 120-127
20 https://www. strava.com [12.11.2016.]

FIG. 4 DENSITY OF POINTS OF DOWNTIME, COMMUTEROUTES LAYER. DESCRIBED ARE THE DENSITY AND PLACES WHERE OBSTACLES SLOWED DRIVES BUT DID NOT STOP THEM, WHILE ANALYSING A RANGE OF ASPECTS SUCH AS DURATION, REPETITION IN VARIOUS DRIVERS AND RANK OF THE STREET NETWORK. SINCE THERE ARE MORE THAN 400 POINTS, ONLY 50 POINTS-WITH BIGGEST FREQUENCY OF SLOWDOWN ARE PRESENTED FOR THE PURPOSE OF BETTER VISUALIZATION, WHILE THREE POINTS WITH EXACT NUMBER OF STOPS/DOWNTIME ARE PRESENTED ON THE MAP.
SL. 4. GUSTOĆA TOČKI KOJE POKAZUJU PREKID AKTIVNOSTI: *COMMUTEROUTES LAYER*. OPISANE SU GUSTOĆA I MJESTA GDJE ZAPREKE USPORAVAJU VOŽNJU, ALI IH NE ZAUSTAVLJAJU, KROZ ANALIZU NIZA PARAMETARA, KAO ŠTO SU TRAJANJE, PONAVLJANJE KOD NEKIH VOZAČA I MREŽU ULICA. BUDUĆI DA IMA VIŠE OD 400 TOĆAKA, PRIKAZANO JE SAMO 50 S NAJVEĆOM FREKVENCIJOM USPORENIJE VOŽNJE U SVRHU BOLJE VIZUALIZACIJE, DOK SU TRI TOČKE S TOČNIM BROJEM ZAUSTAVLJANJA/PREKIDA AKTIVNOSTI PRIKAZANE NA KARTI.

NGOs and informal groups, as well as researchers from the Department of Urbanism of the Faculty of Architecture, University Ss. Cyril and Methodius.

The project aimed to develop novel techniques of community interaction and citizen participation, allowing them to actively observe, report, analyze and disseminate information about the city and areas they cycle in. In particular, the project was interested in the effectiveness of the smartphone application to be used as a tool where individual citizens can act as sensors for urban service performance in real time. This innovative, open, smart and inclusive approach might provide an opportunity for the municipality to address future problems that dominate urban life in the same manner.

The project methodology involved geo-information analysis of the traffic network and infrastructure, analysis of the characteristics of a representative sample of completed rides through the municipality and gathering of comprehensive features of the cycling traffic in the municipality. The results enabled analysis of the data obtained in combination with other information from the area, becoming "live" data available in different formats that could be processed further. In the future, it is expected for this already embraced innovative approach to be used in defining other analytical systems requirements and methodological concepts for the development of objectives and policy learning in the Centar Municipality.

Primary Data Collection Methods – When examining interactions between the built environment and travel behaviour, various elements of the built environment were qualitatively and quantitatively examined and measured at various scales of territories and local geography. Two segments of the survey were performed by comparing bike counts from the questionnaire carried out as a web survey and the Strava tracking data obtained from different segments of the street corridors over the territory of the Centar Municipality.

– The web survey was carried out using in-depth, structured and semi-structured interviews to establish a greater idea of what the study intends to emulate from the current cycling participation. This allowed participants to provide impartial responses and raise additional questions in order to emphasise the perceived possible causes and key processes for analysis for future improvement of the infrastructure and the habits of the cyclists. The Rating Agency, in collaboration with the Faculty of Architecture, conducted the web survey on a sample of 895 respondents, subsequently analysing and interpreting the data collected.

– The second segment of the analysis was based on a sample of completed rides through the municipality and on the acquisition of data for the movement and features of the cyclists who used Strava GPS Cycling and Running Application. The cyclists were monitored when logging onto the smartphone application during three different periods from March 28 to June 25, 2016. The period when the voluntary activation of the cyclists was performed was from 7-17 h, Monday to Friday, during widely accepted "neutral" days and months in order to eliminate the effects of long weekends or other holidays on travel activity. The data collected from Strava users, uploaded directly from their devices, was analyzed and compared with the data from the defined segments in the traffic network.

Additionally, the project team obtained some of the necessary on-site information as justification of the data gained both from the smart phone application tracking and the questionnaires. Afterwards, the results were compared with real-life observations on the same road segments.

The methods used in the second segment of the comprehensive survey undertaken were introduced in the municipality for the very first time, hence the particular interest the paper puts in them.

All Strava users' activities were aggregated into a single map interface which could be viewed online, highlighting the routes and other information on cycling. The results displayed have a great potential for interpreting the data, aiming to answer specific questions at any specified area within the territory observed. This was done through a feature called "segments". Users created designated route segments, each having "leaderboards ranked by speed" that provide information on sections of a cyclist route, including the total number of users and journeys made, the demographics of the user, the distance and average journey speeds, points of congestion or traffic jam and deadlock, junction delays and the impacts of infrastructure changes, points of user access or departure, etc.

Registered activities were imported into a GIS environment and available as a series of points with attributes which might identify the activity time for each point and elevation. Thus, each point of activity is based on GPS, calculated (stored as attributes) and used for further analysis of time, distance and speed. This way, any specific area and spot within the territory could be observed live and information registered continually.

Another approach was applied concerning the mapping of activities and characteristics of the rides and the areas to be realized. For the analysis, a Grid (network of 5´5m polygons) was used as a substrate/map which covered the entire area of the Municipality of Centar, in which activities were generalized and characterized (Fig. 1).

The data obtained are a serious indication of the aspects examined and a valuable source of information. Besides, the analysis may be amended, specified or combined with other research activities, thus rendering reliable information for further use and examination. Using smartphone applications has proven to be a relatively easy way of collecting data (by voluntary engagement), forming a rich base for understanding of cyclist behavior, availability and malfunctions of the infrastructure and for planning future developments.

Outcomes and Key Findings – It is important to note that the paper does not intend to present an extensive description of the obtained results, which is a matter of consideration for itself. Rather, it is focused on the description of new approach and methods involved in the collection of representative data through the application of new technologies.

The data obtained were divided into several groups: Density of rides, Speed of riding, Points to slowdown, Points of start, and Stop riding. Some of the key findings and analytical contributions of the methods involved in the survey were the following:

– The data collected have shown variations according to time of day and day of the week, and in the most crowded and commuting "neutral" working days; spatial variables; age, gender, and other demographic characteristics; the use of the existing and availabil-

Fig. 5 The spots with congestions and downtimes duration. The results are shown as spatial relation of spots classified according to the duration of congestion in the section of the traffic network (congestion within the primary, secondary or the crossing of the two traffic networks). Using a set of data represented on CommuteRoutes layer over a grid substrate the number of stops and the average downtime in any of the fields were calculated. All points with a minimum of 10 delays were taken into consideration, in order to avoid the individual or unusual. The result indicates the total number of stops in each of the grid fields. Dots that show the average time of stopping are indicated with different shades, while the number of individual stops is represented by variations in the size of the circle/dots. The map represents the total number of stops in terms of duration of congestion. Three points with exact number of stops and average time span of slowdown are presented on the map.

Sl. 5. Točke koje pokazuju trajanje prometne zakrčenosti i stajanja. Rezultati su prikazani kao prostorni odnos između točaka klasificiranih prema trajanju prometne zakrčenosti u segmentu prometne mreže (zakrčenost unutar primarne, sekundarne i dvije ukrštene prometne mreže). Korištenje podataka prikazanih na tzv. *CommuteRoutes layer* preko podloge karte omogućilo je izračun broja zaustavljanja i prosječnog prekida aktivnosti u bilo kojem polju. Sve točke s najmanje 10 zastoja uzete su u obzir kako bi se izbjegli pojedinačni ili neobični slučajevi. Rezultat pokazuje ukupan broj zaustavljanja u svakom polju mreže. Točke koje pokazuju prosječno vrijeme stajanja označene su različitim nijansama, dok je broj pojedinačnih zaustavljanja prikazan varijacijama veličine kruga/točke. Karta pokazuje ukupan broj zaustavljanja u smislu trajanja zakrčenosti. Tri točke s točnim brojem zaustavljanja i prosječnim vremenom usporavanja prikazane su na karti.

FIG. 6 PROPOSED PARKING SPOTS AS A RESULT OF THE SUPERIMPOSED SPOTS POINTED IN THE WEB SURVEY AND THE START/END POINTS OF RIDES WHICH WERE REGISTERED WHEN CYCLISTS LOGGED SMARTPHONE APPLICATION. THESE ANALYSES WERE MADE TAKING INTO ACCOUNT THE POINTS WHERE STARTING AND ENDING POINTS OF DRIVING OFTEN OCCURRED. WHEN THIS INFORMATION WAS SUPERIMPOSED WITH THE POINTS OF INTEREST FOR THE NECESSARY BICYCLE PARKING LOCATION OR ENLARGEMENT OF THE EXISTING ONES EXPRESSED IN THE WEB SURVEY, A CLEAR PICTURE OF ALL POINTS NEEDED FOR SAFE BICYCLE PARKING WAS OBTAINED, MOST OF THEM ALONGSIDE PUBLIC SPACES OR PUBLIC BUILDINGS, SUCH AS SCHOOLS, UNIVERSITIES, SHOPPING MALLS, ETC. THREE POINTS WITH EXACT NUMBER OF STOPS OR ENDS OF THE RIDES ARE PRESENTED ON THE MAP AS REGISTERED.

SL. 6. PREDLOŽENE PARKIRNE TOČKE TE TOČKE POČETKA I ZAVRŠETKA VOŽNJI KOJE SU REGISTRIRANE KAD SU BICIKLISTI AKTIVIRALI *SMARTPHONE* APLIKACIJU. OVE ANALIZE UZIMAJU U OBZIR TOČKE KADA SU VOŽNJE ZAPOČELE ILI ZAVRŠILE. KAD SE TA INFORMACIJA PRIDODA TOČKAMA KOJE SU ZANIMLJIVE KAO LOKACIJE PARKIRNIH MJESTA ZA BICIKLE, DOBIVA SE JASNA SLIKA SVIH TOČAKA POTREBNIH ZA SIGURNO BICIKLISTIČKO PARKIRANJE, VEĆINOM UZ JAVNE PROSTORE ILI ZGRADE KAO ŠTO SU ŠKOLE, SVEUČILIŠTA, TRGOVAĆKI CENTRI ITD. TRI TOČKE S TOČNIM BROJEM ZAUSTAVLJANJA ILI ZAVRŠETKA VOŽNJI PRIKAZANE SU NA KARTI KAO REGISTRIRANE.

ity of appropriate infrastructure; preferences of the cyclists and reasons for infrastructure avoidances. The potential uses included analysis of minute-by-minute cycle flows, origin/destination data, the total number of users and journeys made, the demographics of the user, the distance and average journey speeds, speed and junction delays, points of congestion and deadlock, user access or departure and endpoints (Figs. 2-3).

– By encouraging the use of the smartphone application, it was tested whether the application provided a representative picture of the actual cycling patterns. The obtained results suggested that the data correlate reasonably well with actual cycling activity and indicate how cyclists use the city's infrastructure, providing a representative picture of actual cycling patterns, availability and malfunctions of the infrastructure. It was proved that Strava data can be used as a cost-efficient and complementary planning tool. The data obtained in this way have affirmed a very positive contribution to the enhancement of inclusion and user driven information.

– The data have shown who already cycles and what were the key motivations to cycle in the city, besides the common motivations such as the cost of travel, getting exercise and reducing one's environmental impact. Both the web survey and the Strava data recorded two types of journeys: one as commute, and the other as leisure. The results revealed that the majority of journeys were commuting trips. Centar segments were classified in 64,3% of the journeys as commute trips, compared to leisure with 35,7%, while the web survey recorded commute trips with 60,8%. The frequency of using the bicycle as an everyday means of transport to get to school, university or work, shows a percentage of 36,4%. The data have confirmed the need to improve the infrastructure and organise an efficient bicycle network for wider uptake of cyclists commuting in the city, as the bicycle is the most environmentally friendly and cost efficient vehicle for urban transportation.

– Males expressed a greater tendency to cycle than females and this situation in gender imbalance is even more evident in Centar municipality than it is in most of the examined cities. When compared with other modes of transport, cycling displayed the biggest gender imbalance of all modes of transport. The vast majority of male cyclists, who account for 77,9%, was revealed in all segments observed when the app activated, while the web survey indicated males account for 63,9%. When narrowing these segments to side roads only, the share of female users is higher.

– The data obtained about the average recorded speed of 18,5 km/h, on all Centar segments for all road types and riders, was confusingly high when compared to the average speed of other European cities (16 km/h in Copenhagen). It could be explained by the fact that voluntary participants were predominantly young, but the situation changed and the average speed was considerably lower when recorded from the commuters during the week days. According to the speed, streets "categorized" to faster and slower, where faster were the streets of the first, city wide category (speed 16-20 km/h), and slower the streets of the second category, municipal level category (speed 12-16 km/h). Cyclists preferred the main streets mostly and the streets where split traffic modes existed. This is due to the other streets' poor infrastructure condition, frequent intersections with other streets, parked vehicles next to the right edge, but as well due to the perception of using the bicycle as a transport vehicle (Figs. 4-6).

– The majority of cyclists share the view of cycling as being a dangerous activity, and the study has pointed on safety concerns as main reason for gender imbalance. It was interesting to reveal what were the reasons behind

the "fear of cycling" that prevent the wider uptake of cycling and why the fear is prevalent among female cyclists. This "fear" explains why the road preferences differ during the morning and afternoon, or any other congested peaks, and why the average speed for the morning peak was much higher (18,5 km/h) compared to the afternoon peak (17,6 km/h). As for the reasons that influenced the choice of routes and prevented cyclists to commute, the data have been specified for each observed segment and mostly referred to factors of missing sense of security, such as dangerous traffic and lack of cycling infrastructure, encounters with vehicles in movement, badly organized intersections, isolated and poorly connected routes, or streets with vehicles parked on both sides of the driveway and high curbs as barriers.

Conclusion

Zaključak

One of the major goals of the VeloCentar 2025 project was the creation of synergies for joint experimentation and learning, while sensoring the end users' needs and accelerating the impact to the municipal planning towards improvement of the urban infrastructure and faster transition towards a cycling city. For the first time in the municipality, citizens-cyclists served voluntarily as an information supplier for the state and the functioning of the urban cycling system, delivering important information.

The survey showed how the data collected could be employed meaningfully in the planning process, and how services delivered by traditional means can be organised more efficiently, while using the advantages of new technology which will enable a more sustainable urban environment and transport by:

– A better understanding of how cities function through the synthesis of citizen generated reports and sensed data available in real time or near real time, with new possibilities to analyze, correlate, and visualize the information;

– A better forecasting and decision-making based on interactive communication, generating future outcomes that can be surveyed ever more frequently, which is essential for the establishment of different forums for public participation, along with big data;

– New forms of participatory design involving different communities of interest that will engage through new forms of sensoring their urban future and the livability of the places they inhabit;

– A new understanding of how populations are able to create sustainable cities where technology and smartphone devices might be used at all stages of city infrastructure design, from analysis to action, and embedding the very technologies we use for analysis and design of the urban form and fabric itself.

We hope that the project will make a paradigm shift in the way the city is governed and supply a positive contribution to a more substantial inclusion of citizens participation in the decision making process, in this case related to the improvement of bicycle infrastructure. It will, hopefully, pave the way in making any advanced application or technological tool a regular form of data gathering of the next generation.

The questions ultimately posed by the study are long term and the changes to be made are as much cultural and behavioural as they are procedural and physical. The benefits from the project and the survey used include the initiation and establishment of a new way of communication with the users and their inclusion in the planning process.

[Translated by authors]

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ILLUSTRATION SOURCES

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FIG. 1-5 Luka Jovičić, GIS consultant, 2016

FIG. 6 Authors' superimposed results from both surveys, 2016

Summary

Sažetak

Uključenost građana u inovacijski proces planiranja

Primjer Općine Centar u Skopju

Rad prikazuje rezultate projekta *VeloCentar 2025*, odnosno analizu biciklističkoga prometa u Općini Centar u Skopju s osobitim osvrtom na način na koji 'pametno' planiranje i informacijska tehnologija mogu pridonijeti inovacijskom pristupu i inkluzivnom planiranju u cilju formiranja tzv. 'osjetljivoga' grada kroz stvaranje održivog i učinkovitog sustava kretanja kroz grad i biciklističke infrastrukture.
Kako je urbanističko planiranje u velikoj mjeri ovisno o političkoj volji i participaciji zajednice, uloga pojedinaca/građana od presudne je važnosti u procesima upravljanja gradom i urbanističkom planiranju, jednako kao i integriranje raznih potreba i vrijednosti brojnih sudionika u urbanom okolišu. Pri razmatranju na koji se način rješavaju problemi prijevoza u urbanističkom planiranju u Općini Centar zaključilo se da građani nisu dovoljno uključeni u proces planiranja te da u tom smislu nema kvalitetne komunikacije niti se uzimaju u obzir različite potrebe brojnih zainteresiranih sudionika. Zbog toga se predlaže suradnja s Općinom Centar te primjena novih i inovativnih metoda i pristupa problemu uključenosti korisnika u kompliciran proces odlučivanja. Proces je započeo identificiranjem slabih točaka u pogledu informiranosti, kao i u koordinaciji i komunikaciji s krajnjim korisnicima, što bi trebalo rješavati na odgovarajuce načine u cilju primjene prikladnih inovativnih pristupa u kreiranju politike i prakse rješavanja ovih problema u Općini Centar. U tome smislu najbolji je pristup učiti iz iskustva drugih gradova kako bi se omogućila poboljšanja u procesu planiranja i u budućim aktivnostima. Različita su iskustva stoga uzeta u obzir i uspoređena, osobito ona koja su donijela brze rezultate u najkraćem mogućem roku. No kad se Skopje usporedi s ostalim analiziranim gradovima, na vidjelo izlaze mnoge razlike. Naime, u odnosu na ostale analizirane europske gradove, Skopje ima značajno manji udio biciklističkog prometa i upravo zbog toga nove strategije moraju biti drukčije.
Iz teorijske perspektive, stvarni je izazov razviti inovacijski pristup i metode uvođenja i korištenja novih alata kojima bi se poboljšala uključenost korisnika u proces planiranja. U tom smislu osobito nas je zanimalo poboljšanje koncepata inkluzivnog, kognitivnog i pametnog grada. Ovi koncepti koji se odnose na visokoinformatizirane gradove, a koji se obično nazivaju *„smart city", „intelligent city", „digital city", „cognitive"* itd., koriste informacijsku tehnologiju i umjetnu inteligenciju u sprezi s ljudskim iskustvom u cilju kontinuiranoga poboljšanja u upravljanju gradom i procesu odlučivanja. Svi ovi pristupi teže razvijanju sustava planiranja koji povecava uključenost korisnika u inovacijske procese.
Primarni je cilj ovoga projekta razvoj novih tehnika u promoviranju pozitivne interakcije i sudjelovanja građana te njihova aktivnoga doprinosa kroz promatranje, izvještavanje i širenje informacija o gradu u kojem žive i u kojem se koriste biciklom kao prijevoznim sredstvom. Osnovna ideja jest formiranje tzv. *„living lab"* sustava kako bi se proučile navike biciklista, kao i infrastruktura, u cilju poboljšanja biciklističke mreže i sigurnosti biciklističkih ruta u Općini Centar. U tu svrhu građani biciklisti dobrovoljno postaju informatori koji pribavljaju informacije o načinu na koji urbani biciklistički sustav funkcionira putem korištenja *smartphone* aplikacija za vrijeme vožnje. Time je grad pretvoren u tzv. „laboratorij stvarnoga života u gradu" za potrebe proučavanja biciklizma kao sredstva urbanoga prijevoza kako bi se Općina transformirala u biciklističku zajednicu. *Living lab*-koncept usmjeren je prema prikupljanju reprezentativnih podataka putem novih tehnologija, što otvara put integriranoj biciklističkoj infrastrukturi te učinkovitijem i inkluzivnijem načinu planiranja.
Rezultati do kojih se došlo prikupljeni su uglavnom aktivnim trudom i zalaganjem biciklista koji su dobrovoljno sudjelovali u projektu. Prikupljanje podataka o kretanju i karakteristikama biciklističkih ruta i vozačkih navika omogućeno je korištenjem aplikacije GPS praćenja putem mobilnog telefona i interneta, što korisnicima omogućava praćenje udaljenosti, brzine, ritma i zaustavljanja tijekom biciklističkih aktivnosti. Podaci se odnose na različite aspekte biciklističke vožnje. U kontekstu projekta, podaci predstavljaju vrijedan izvor informacija o obilježjima biciklističkog prometa.
Ovaj sustav omogućava analizu biciklističkoga prometnog toka iz minute u minutu, podatke o početku i završetku vožnje, ukupan broj korisnika i ruta koje prelaze biciklom, udaljenost i prosječne brzine putovanja, točke na kojima nastaje zagušenje i zastoj prometa, početne i krajnje točke biciklističke rute. Svi dobiveni podaci podijeljeni su u nekoliko grupa, kao što su: gustoća vožnji, brzina, točke usporavanja, početne i završne točke u vožnji.
Odluka o korištenju *smartphone* aplikacije u prikupljanju podataka predstavlja pozitivan doprinos povecanju uključenosti korisnika u prikupljanje podataka u cilju poboljšanja infrastrukture. Nadamo se da će to postati osnova budućih promjena u našoj infrastrukturi. Područje Općine Centar postalo je na neko vrijeme *living lab* za proučavanje biciklističkih navika i infrastrukture, otvarajuci time put integriranoj biciklističkoj infrastrukturi te efikasnijem i inkluzivnijem načinu planiranja. U budućnosti se očekuje da će se rezultati dobiveni ovim inovativnim načinom moći koristiti u definiranju nekih drugih uvjeta i koncepata razvoja u Općini Centar.

Biographies

Biografije

Jasmina Siljanoska, Ph.D., is full professor of Urban Planning and Design at the Faculty of Architecture, University of the Ss. Cyril and Methodius in Skopje. Her interest is focused on theory/history of urban development and on contemporary transformation planning processes. She has been member of numerous scientific and organizational boards of national and international projects and conferences dealing with issues of planning and education.
Vlatko P. Korobar, Ph.D., is full professor of Urban Planning and Design at the Faculty of Architecture, University of the Ss. Cyril and Methodius in Skopje. He has coordinated or participated in numerous national and international projects and scientific conferences. His research interest is related to the ongoing changes of cities in transition countries, the transformations of the system of urban planning and the challenges of contemporary education in planning.

Dr.sc. **Jasmina Siljanoska**, redovita profesorica urbanizma i projektiranja na Arhitektonskom fakultetu Sveučilišta „Sv. Ćirila i Metoda" u Skopju. Njezini profesionalni interesi usmjereni su prema teoriji i povijesti urbanoga razvoja i suvremenim transformacijskim procesima planiranja. Članica je brojnih znanstvenih i organizacijskih tijela u domacim i međunarodnim projektima i kongresima posvecenim problemima planiranja i obrazovanja.
Dr.sc. **Vlatko P. Korobar**, redoviti profesor urbanizma i projektiranja na Arhitektonskom fakultetu Sveučilišta „Sv. Ćirila i Metoda" u Skopju. Sudjelovao je u brojnim domacim i međunarodnim projektima i na znanstvenim skupovima. Njegovi znanstveni interesi usmjereni su prema promjenama koje se odvijaju u gradovima tranzicijskih zemalja, transformacijama sustava urbanističkog planiranja te izazovima suvremenog obrazovanja u planiranju.