



Specification of Planning Process of Adaptation to Climate Change in Urban Areas with Historic Objects

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Abstract

The quality of city life and well-being of city dwellers are a main goal of urban planning approaches. Unsystematic planning approaches of cities and the absence of relevant information can be a trigger that deteriorates the ecological sustainability of a city. This contribution focuses on how an increasing trend of co-creation between experts from different fields acts as a stimulus also for involvement of a broader spectrum of stakeholders and self-government into the process of spatial planning system in Slovakia.

The complex interrelationship enabling and disabling factors for the development of new planning systems as well as the utilization of databases, GIS tools, the cooperation with universities and other scientific institutions, and the application of new methodical approaches on risk and threat assessments are fundamental aspects of modern spatial planning. Using the example of the city of Bratislava, we demonstrate the incorporation of predicting threats and risks to historical areas caused by climate change into the spatial planning scheme.

Keywords: *planning process; climate change; historic areas; city.*

1. INTRODUCTION

In most European countries, a spatial planning process is subject to standard procedures, which consist of several stages or phases. The process starts with a preparatory phase, assignments (goal and purpose of the documentation), continues with data collection and preparation, and develops various types of documentation (land-use plans, territorial development studies, action plans, etc.). Throughout the stages, usually determined by binding methodological procedures, various stakeholders can participate in the process via reviews or statements (comments) on the materials and documents provided. Decision-making processes are carried out and finally the planning documents adopted by

local self-governments and implemented. Part of the preparation of such documentation is also the process of strategic environmental assessment, which aims to predict threats and impacts the plans might impose on the environment and the health of the population [8]. Once a plan is adopted, cities – as bodies of self-government – have strategic documents at their disposal, which represent key materials for their own territorial development.

Spatial planning is a dynamic process responding to current stimuli and practical needs. The inclusion of the impacts of climate change as well as new associations of various other stressors and indicators of development need to be considered in the process of developing strategic documents. This is an example of the complexity of the whole planning process, in which the cooperation of many stakeholders is key. Demonstration of good cooperation between the fields of disaster risk management, cultural heritage and climate change is the European project funded by the European Union's Horizon 2020 research and innovation programme (GA no. 820999) "ARCH – Advancing Resilience of historic areas against Climate-related and other Hazards", which started in June 2019 and will continue until May 2022. Aim of this project is to develop a unified disaster risk management framework for assessing and improving the resilience of historic areas to climate change and natural hazards. Tools and methodologies will be designed for local authorities and practitioners, the urban population, and national and international expert communities. The project will present various models, methods, tools and datasets to support decision-making. The project consortium includes 15 partners, four of them pilot cities: Bratislava (Slovakia), Camerino (Italy), Hamburg (Germany) and Valencia (Spain).

2. NEW APPROACHES IN URBAN PLANNING PROCESSES

The urban planning process is characteristic for a cooperation of experts from various professions and backgrounds. The effort to find solutions for land use in accordance with many rules and limits is often significant. In connection with the impacts of climate change, critical infrastructure, the impacts of extreme weather events, and measures to mitigate the impacts in terms of the comfort of urban dwellers are addressed as standard. Cities, besides being centres of economic activity, have a high concentration of historical monuments and other cultural heritage (tangible and intangible). Because of its crucial importance for society as well as its high vulnerability to climate-related hazards, cultural heritage is one of the key components that need to be considered in the sustainable development debate. Cities need to prepare themselves for the intensifying impacts of climate-related hazards and take protection of cultural heritage under these conditions into account. But in current planning process existing measures against climate change do not fully account for the specific conditions of heritage areas in Slovakia. Risks and vulnerabilities from climate change and other hazards need to be considered in the disaster risk management measures and policies for protection of cultural heritage explicitly. There are very few standardised tools in European countries for this specific area as well. There is an absence of relevant legal tools for enforcing adaptation measures by local authorities and self-government (cities, regions), absence of tools for assessing and improving the

resilience of historic areas with regard to local climate change impacts, urban development strategies, spatial planning, adaptation and mitigation goals, etc. The ARCH project is targeting all these gaps, in order to help local authorities and self-governmental authorities to increase the resilience of their cultural heritage, and if possible, with this increase their overall resilience as well.

To reach this goal, the ARCH project uses co-creation as means of cooperation. Co-creation is a democratically governed creation and joint development of knowledge, models, methods, tools, services, policies, and strategies by the project partners and their stakeholders based on trust, transparency and effective communication. The co-creation process in ARCH takes an adaptive approach that responds to changing realities and endeavours to transfer results to local governments. For Bratislava, one of the city cases, the results of ARCH will be used to work out a comprehensive disaster risk management process for cultural and natural heritage sites, taking into consideration multiple hazards to which they are exposed as a result of climate change.

The support tools developed in ARCH project will be bundled in the ARCH Hub – a single information and data platform. The support tools will include:

- two information systems for geo-referenced properties of historic areas (descriptive, structural, architectural, material, and environmental hazard parameters); which transfer structured data into the ARCH Decision support system (DSS),
- the ARCH DSS - produces hazard models for impact scenarios and vulnerability analyses,
- a resilience options inventory to support identification of feasible resilience measures, linked to suitable funding opportunities,
- a resilience pathway visualisation tool to support graphical design of resilience plans,
- a resilience assessment dashboard for resilience self-assessment and formulation of resilience action plans.

3. BRATISLAVA – CASE STUDY

Bratislava is the capital city of the Slovak Republic, the political, economic and cultural centre of the country. The city is situated in central Europe bordered by Austria and Hungary on both sides of the Danube River, the second-longest European river. Bratislava has a total area of 367.9 km². Administratively, Bratislava is divided into five districts (state local government). For self-governance purposes, the city is divided into 17 City Boroughs [1]. The built-up areas of Bratislava are formed by three fundamental kinds of surface: continuously build-up historical areas serving chiefly for housing and services; looser housing, industrial, transportation, and recreational areas; and finally, large residential areas from the socialist period, usually designed as dormitories, on the city fringes. The whole territory of Bratislava comprises many areas with non-urban function, for example, agricultural land, forests, and water [3] (Fig 1).



Figure 1. Bratislava City – divided by administrative borders into 17 city boroughs (municipalities with self-government).

3.1 STUDY SITES

Bratislava’s historical centre is situated within the former city walls in the Old town city borough. From the historical point of view the area is divided into a central historical monument zone and monument reservation (the medieval core of Bratislava) (Fig. 2).

The monument preservation zone is further divided into smaller areas called sectors, based on the character of built-up area, architecture, terrain and landscape. The monument reserve contains many historical buildings, fountains, historical gardens as well as other elements of tangible cultural heritage. Inside buildings as well as below ground level the area contains preserved heritage *in situ* such as the Celto-roman structures (masonry and floors) at Bratislava Castle hill [6], Celtic kiln and mint, which belonged to the manufacturing workshops in the Celtic oppidum that once spread across the centre of today’s Bratislava, remains of the city’s medieval fortification, St. James chapel [7] and

chapel house and the Fisherman's Gate [5]. These monuments as well as other (not yet examined) underground monuments are vulnerable to changes, for example surrounding surface permeability, intensive precipitation and rising groundwater levels, erosion and weathering, which are driven by climate change and urban development in the surrounding areas. Most of these monuments are under protection of the Bratislava City Museum and City Gallery and have the highest degree of monumental protection according to the Act no. 49/2002 Coll. of the national Council of the Slovak Republic on the Protection of Monuments and Historic Sites reflecting later amendments. Research on these sites was undertaken by the Bratislava Municipal Monument Preservation Institute, which is also partner in the ARCH project.

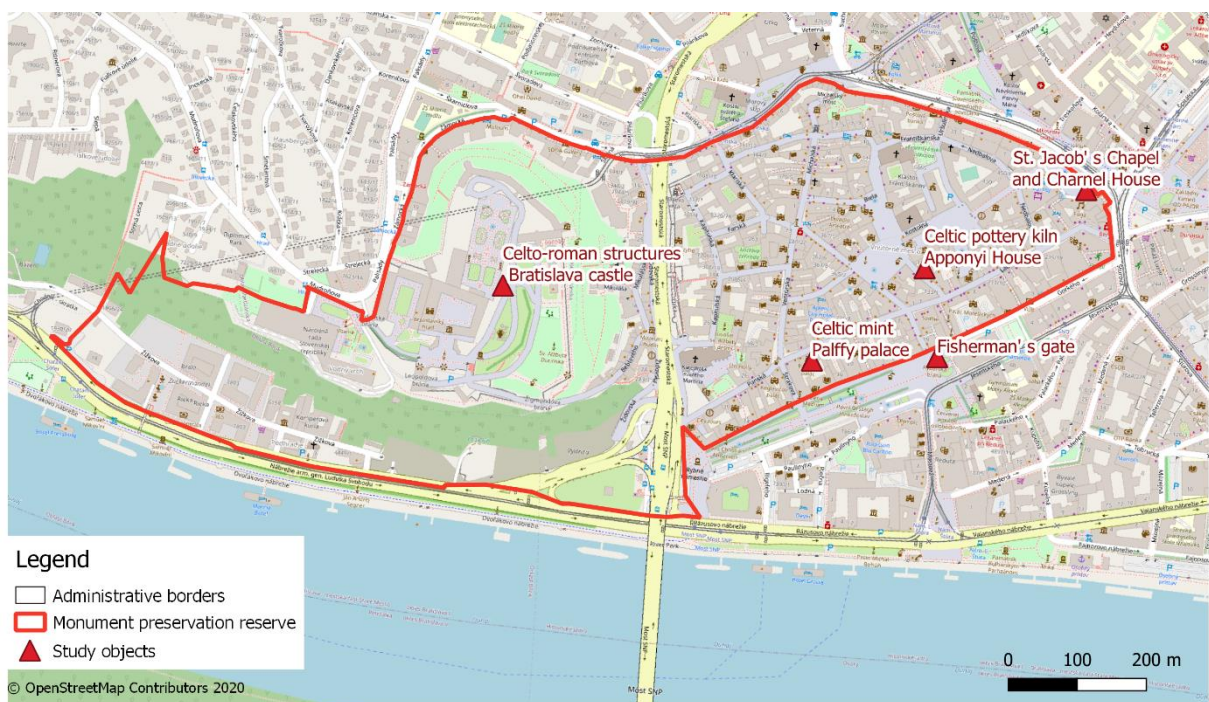


Figure 2. *The significant historical monuments in the preservation reserve in Bratislava.*

The Devín city borough is situated in the western part of the cadastral territory of Bratislava City at the confluence of the rivers Morava and Danube. It is well known for the Devín Castle national monument, the ruins of which are one of the most visited monuments in Bratislava (Fig. 3). Despite of its small size, the Devín Castle Hill is surprisingly rich in rock variety and geological history dating back to the Early Paleozoic to Late Tertiary period. Twelve open fissures with narrow karst and pseudo-karst caves (16 – 13 million years old) are beneath the castle in the rock cliff, where a permanent exhibition of finds such as ceramics, coins, weapons etc. was reopened in 2017 [2]. The castle is a historical monument of national as well as of European importance and is under the administration of the City Museum of Bratislava. Currently, there is ongoing archaeological and

geological research in the area as well as plans for the reconstruction of ruins (the walls) and buildings at site. The caves as well as other areas with permanent exhibitions and the middle castle are threatened by humidity from precipitation; the dolomite cliff on which the castle is located is threatened by erosion and rockfall.

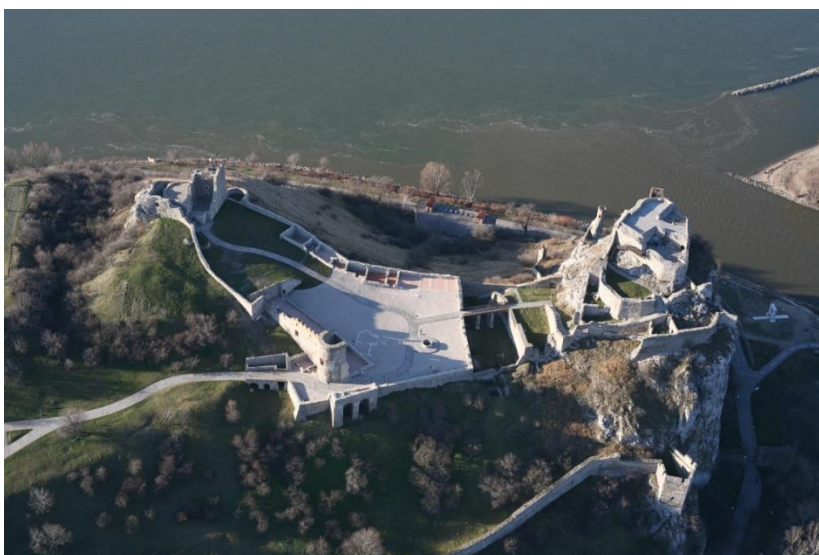


Figure 3: Devín Castle from the air. Photo: P. Chromek, Foundation for Cultural Heritage Preservation.

3.2 CULTURAL HERITAGE AT RISK FROM CLIMATE CHANGE IMPACTS

The historical monument reservation is greatly threatened by pluvial flooding, as a majority of the most valuable objects are preserved in situ. Additional moisture and humidity threaten these objects, and there is risk of closing the sites to the public in order to safeguard the health of visitors as well as to avoid further harm done to the monuments. A recently developed pluvial flooding model of Bratislava showed that the historical monument reserve is the most threatened area by pluvial flooding in the city centre [4]. The remaining Devín Castle walls are threatened by the movement of the cliff as well as by the rapidly changing temperatures throughout the year. It is completely open how much time is left until Devín Rock finally erodes to an extent that the castle will have to be closed for visitors or – in the worst-case scenario – collapses into the Danube river. It would be highly useful for the Bratislava City Museum and Bratislava City and Devín city borough to know the trends of rock erosion and how they can be affected with regard to climate change scenarios. This would help the stakeholders determine which resilience options are suitable and in what intensity or volume they need to be implemented. Therefore, developing resilience option pathways for mitigation of the currently non-sustainable situation in the historical monument preserve and mitigation of erosion at Devín are priorities of Bratislava City, Municipal Monument Preservation Institute, Bratislava City Gallery and Bratislava City Museum.

After carrying out a first vulnerability assessment in 2018 to prioritise the most vulnerable sectors and groups, a second risk-oriented vulnerability assessment has been undertaken as part of a previous Horizon 2020 project, which analysed the impacts of recent heatwaves and pluvial flooding on the population and selected critical infrastructures. Bratislava would like to take a further step with focusing on additional sectors such as cultural heritage protection with the aim to adapt the historical centre and other valuable tangible cultural heritage sites to the impacts of future scenarios of climate change. The current Action Plan for Climate Change Adaptation reaches the end of its term in 2020, and a new action plan is already under preparation. The preparation phase of the action plan offers itself as a good opportunity for testing and co-creating the tools of the ARCH project.

In order to develop tools helpful not only to the city administration staff, but also to the city organisations which are in charge of the city museum and expositions or manage different urban subsystems, e.g. public space, public transport, technical infrastructures, etc., Bratislava City has established a local stakeholder group that supports the project implementation with their expertise and provision of input from the early stage in the project. The goal is also to be able to inform policy-making authorities in the area of climate change adaptation and cultural heritage preservation about the new norms and standards which the ARCH project shall also contribute to.

4. CONCLUSION

As a result of climate change, environmental conditions are changing rapidly. Combining climate change with urbanisation, environmental pollution, and the increased demands of civilization for food security, the world is currently globally exposed to one of the most extensive degradations in millions of years. Therefore, cities need a precise and high-resolution assessment, including prognostic climate models, in order to make fully informed decisions on territorial development. The creation of such documents requires the preparation of specific inputs, often dependent on local knowledge of the area and, of course, on the availability of various thematic data.

Bratislava is the Capital city of the Slovak Republic, a metropolis of European importance and as the historical hub of European migration routes from North to South (the Amber Route) and from East to West (the Lower Danube Route). The city is defined as the centre of regional and international business importance for the exchange of cultural and historical values of Eastern and Western Europe. The new approaches in planning process have an ambition to create a city with high quality of life for all its citizens including building measures and regulations to mitigate the effects of climate change and reserve cultural heritage. The city has been in the process of preparation of a modern and high-quality spatial plan, therefore new trends in territorial development, including the results of cooperation of international teams of experts, as well as the views of stakeholders is highly appreciated in Bratislava.

5. ACKNOWLEDGMENT

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