

Smart Solutions for Guided Cultural Routes along the Iron Age Archaeological Sites of the Danube Basin

Szabolcs Czifra¹, Adrienn Pálincás¹, Zsolt László Márkus², Tibor Szkaliczki²,
Miklós Veres², Zsolt Weisz²

¹ Hungarian National Museum, H-1113 Budapest, Hungary, Daróczi u. 3.

²Institute for Computer Science and Control, Hungarian Academy of Sciences
(MTA SZTAKI), H-1111 Budapest, Hungary, Kende u. 13-17.

czifra.szabolcs@hnm.hu; czifra_sz@yahoo.com
palincas.adrienn@mmn.hu, markus.zsolt@sztaki.mta.hu,
szkaliczki.tibor@sztaki.mta.hu, veres.miklos@sztaki.mta.hu,
weisz.zsolt@sztaki.mta.hu

Abstract. Reverberating on the social expectations connected to the cultural heritage, international cooperation was launched in order to communicate a lively image of archaeological research and to raise awareness for the importance of fragile monumentalized landscapes. The EU funded Iron-Age-Danube project resulted in several working camps, scientific and informative papers, presentations and new museum programmes. A smart device solution offers easy and wide access to the outputs and is the best suited to the present-day experience-oriented tourism approach. The GUIDE@HAND application offers archaeological sites by using a variety of interactive multimedia objects including maps, serious games, augmented reality, videos, panorama pictures, guided tours and a lot of other functions. The content is based on archaeological researches and can be updated even by the non-experts.

Keywords: Cultural Heritage, Digitization, Public Value, Tourism, Smart Solutions, Multilingual Application

1 Introduction

Nowadays, cultural heritage is considered to be of essential significance. Starting with the protection of spectacular places (fortresses, castles and cathedrals) in the 19th century, through the recognition of historical settlements (or quarters), the focus was gradually extended from single monuments and sites on the landscape itself. One of the main reason of that shifting is that beyond its obvious ecological and economic roles, the landscape is being seen as „an important part of the formation of local cultures and that is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity” (European Landscape Convention, 2000). Recognizing the societal value of cultural heritage its identification, study, interpretation, protection, conservation and preservation was encouraged by the Council of Europe (Convention on the Value of Cultural Heritage for Society, 2005). This is in line with the result of cross-European research, which highlighted that the

public expectations placed on archaeology for understanding ourselves and our society greatly magnified from the economic crisis (NEARCH, 2019).

2 The Iron-Age-Danube Project: Synergy in Cultural Heritage

2.1 Contextualizing Iron Age heritage

Parallel to this, archaeological scope shifted from sites to the landscapes, which are defined as areas engraved with actions and interactions of natural and human factors. In many cases anthropogenic footprints as landmarks are clearly visible: e.g. castles, monumental church architectures, specific forms of cultivation (terracing). Occasionally these mutual interactions remain partly hidden, that is the case with imposingly attractive prehistoric landscapes of the Danube river basin. Focusing on the monumentalized archaeological landscapes, characterised by fortified hilltop settlements and tumulus cemeteries from the Hallstatt period (roughly the 9th-mid5th centuries BC) the Iron-Age-Danube project aims to transform the spectacular scientific value of our common heritage into a touristic potential.



Fig. 1. Location of the Early Iron Age key-sites within the Eastern Halstatt area

During the Early Iron Age, the Danube region was part of a cultural phenomenon stretching from the Loire valley to the central part of the Carpathian Basin. The area covering present-day Austria, Slovakia, Hungary and Croatia belonged to the East-Hallstatt cultural milieu. Elites coordinated monumental building activities (e.g. fortified hilltops settlements and tumuli burials) which either by their immense measures or by the exploitation of local resources (wood, stone, iron, salt) left visual signs on the landscapes. Fortified settlements were established on the top of the hills during the late Bronze Age and generally had continuously evolved in the Early Iron Age. These hilltop settlements with associated necropolises, smaller uplands settlements and extensive undefended lowland settlements are suggested to had ruled micro-regions and played a decisive role in hierarchical regional networks (Potrebica H. , 2012; Mlekuž & Črešnar, 2014; Mele, 2015; Mason & Mlekuž, 2016; Potrebica & Mavrović-Mokos, 2016). These settlement complexes were residential areas with defensive constructions, ritual centres and visual symbols of power, but the significance of different nature changed from site to site (Potrebica & Mavrović-Mokos, 2016; Tiefengraber &

Tiefengraber, 2015). Fortified settlements are generally surrounded by cemeteries and groups of burial mounds, where inhabitants buried their relatives. The large tumuli offer an insight into the wealth of local elites, who erected these monuments. Precious ceramic and metal artefacts and luxury items in the graves of wealthier individuals' often result in long-distant trade or exchange communication networks (Egg, 1996; Šimek & Kovačević, 2014). At the end of the Early Iron Age, fortified settlements became less important and most of them were abandoned (Collis, 2014).

2.2 Introducing the Iron-Age-Danube project

The Iron-Age-Danube project partnership consists of 20 institutions with complementary expertise in archaeological heritage and cultural tourism, aiming to build on joint approaches for researching and managing complex (pre)historic landscapes and their integration into sustainable tourism (Iron-Age-Danube, 2019). The project's major innovation is the methodological shift dealing with complex landscapes rather than with single sites. In accordance with this, the partnership created joint strategies and methodological tools for the research, protection, preservation and promotion.

The collected archive data referring to the focus countries were digitalized and uploaded into an online database in order to create a unified methodology to compare information on the regional level (Iron-Age-Danube Database, 2019). General tendencies are derived from the inputs and territorial distributions are visualized on maps, which are the basis for research, protection and preservation strategies.



Fig. 2. Workshop for kids in the **Hungarian** National Museum

Testing and implementation of the developed packages were done in eight micro-regions in four countries: Austria, Croatia, Slovenia and Hungary. International camps were organized in this purpose, in which archaeological research with in-door and outdoor public events and new visitors' programmes were connected. Non-invasive methods, as geophysical prospection, ground-penetrating radar geomagnetic measurements, together with a real archaeological prospection and airborne laser scanning have been prioritised. The results were verified and compared by systematic field surveys, metal detector surveys and test excavations (Czajlik, et al., 2017; Czajlik, et al., 2018).

By connecting and promoting the most prominent Iron Age sites of the programme area (Strettweg, Großklein, Poštela, Dolenjske Toplice, Jalžabet, Kaptol, Sopron, Süttő and additionally highlighting the importance of other key-sites as Hallstatt and Százhalombatta), the project is expected to increase the visibility of archaeological heritage. Results of our efforts can be measured by the fact that the Iron-Age-Danube project was officially granted to use the European Year of Cultural Heritage 2018 logo and was selected as one of the 21 finalists for the RegioStars Awards in the 2018 edition.

3 Cultural Routes

3.1 Creative Tourism

Over the last few years, new tourism trends have emerged in Europe. The creative tourism is amongst the most popular and fastest-growing trend as it creates a direct link between visitors, the local inhabitants and their intangible or tangible cultural heritage.

The following wording dates back to 2000 from Crispin Raymond and Greg Richards: “Tourism which offers visitors the opportunity to develop their creative potential through active participation in courses and learning experiences, which are characteristic of the holiday destination where they are taken” (Impact of European Cultural Routes on SMEs’ innovation and competitiveness, 2019).



Fig. 3. Scenes from the e-learning tool in the application

According to the definition, "creative tourism can be considered as a new tourist generation that includes tourists and locals in creating a tourist product (a common creation)." Thus the concept emphasizes curiosity and increases the role of the host by involving them to the programs and events. It is a much more experience-centric solution; a transfer of current knowledge.

In the Iron-Age-Danube project, there is a big demonstration of new types of tourism; tasks under the program, such as research, conservation and promotion methodological tools can be used also for tourism purposes.

This program offers several solutions for the current trends; for example, organizing children's camps in each partner country about learning and trying out the life of the Iron Age elite. The program prepared recipes for cookbook and handcraft booklet for kids, another instance is making e-learning available to the widest audience.

Nowadays, the easiest way to do this is to develop an application for smart devices (smartphone, tablet) for visitors. In this project, the mobile application has been completed and - instead of promoting the project and the sites - it has affected more of the visitor experience. With the creative tourism elements, the smart phone app offers a lot of extra content that makes it easy and enjoyable to learn about the Iron Age. Besides, this application includes guided walks in all micro-regions that provide additional information to visitors, as well as games and modern solutions such as AR technology, 3D models, and more information about project partners, making these sites a potential touristic destination. Descriptions and presentation materials used here, images and videos are made primarily during the project and thus make the database accessible to anyone via the application, do not need to go to this location or the data of any micro-region available (Impact of European Cultural Routes on SMEs' innovation and competitiveness, 2019).

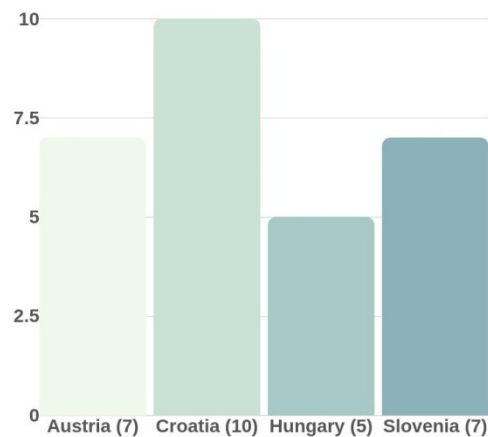


Fig. 4. The number of cultural routes in the Iron-Age-Danube project countries.

3.2 Cultural Routes

Another important initiative that needs to be mentioned when we are talking about cultural tourism and this is the cultural route. The idea was outlined already in the 1960s, but the first route was only established in 1987 based on the historical pilgrim route El Camino; Santiago de Compostela (Spain) was chosen as the starting point, which can now be categorized as cultural routes. To create these roads (and analyse potential regions and routes for developments) a council was set up in 1987, which is located in Luxembourg. The three basic criteria for cultural routes: that they must involve at least three countries, operate in a legal form, base the project on research and link the past and the present appropriately and present it for the audience (Jászberényi, 2014).

Now, these roads have become more and more popular and different routes with different themes are distinguished. Besides religious paths, there are, for example historic, culinary and artistic routes. Currently, 33 cultural routes are on the official website, but this affects almost all European countries (Cultural Routes, 2019). With the development and acceleration of travel conditions and communication, tourists can also travel longer distances in less time. However, there are even more thematic routes within some countries that link smaller or larger sites and regions.

Visitors are looking for a more complex experience, so the most important calling word is the experience-centred approach. The three important pillars of cultural tourism are the cultural heritage (can be tangible or intangible), the knowledge (that is increasingly identified with creativity), and maximizing the experiences and attractions according to the tourists expect (Cultural Routes, 2019).

| Language | Number of native speakers (million) | Number of 2 nd language speakers (million) |
|-----------|-------------------------------------|---|
| Slovenian | 2,0 | 0,2 |
| Croatian | 5,5 | 1,3 |
| Hungarian | 12,6 | - |
| German | 76,1 | 56.0 |
| English | 379 | 753.3 |

Table 1. The number of native and second language speakers (languages relevant for the Iron-Age-Danube project)

In addition to the fact that the project countries joined - in a total - to 15 cultural routes, the number of affiliated institutions, organizations and companies at the national level are even higher; in Austria more than 30 organizations, in Croatia 38, in Hungary 12 and 11 in Slovenia (Explore all Cultural Routes by country, 2019).

In the INTERREG project and the visitors' application, a smaller area is relevant in this case, namely the Danube basin with 115 million inhabitants (Routes4U Feasibility Study, 2018). As this region is well known for its vibrant cultural heritage and great cultural diversity, it is therefore adapted for cultural routes connecting several countries in a smaller expanse. The establishment of the Iron Age route perfectly fits this scheme and offers a new grand narrative for the Early Iron Age Hallstatt period of the middle part of the Danube area. An essential part of the GUIDE@HAND application is that this summary shows how diverse and multilingual Europe is, so there need for an intermediary language (in this case English). Furthermore, the application pinpoints the role of new digital technologies and sight elements, which helps to create a tourist-centred tourist attraction of all ages from cultural heritage elements.

4 Smart Solutions

4.1 Content Development Concept - Languages

Our aim was to create a multilingual mobile application to present project related information on smart phones and tablets for national, regional and international visitors. The application provides all content in English. Besides that, the content is available in the native languages of the project partners (Slovenian, Croatian, Hungarian and German). Table 1 shows the number of native and second-language speakers of the languages used in the application. The provided data are based on the 2019 edition of Ethnologue (Eberhard, Simons, & Fennig, 2019).

4.2 The GUIDE@HAND Iron-Age-Danube Application

The eLearning Department of the MTA SZTAKI started mobile-based software development in 2005. As a result, a new mobile application family was created with the brand name of GUIDE@HAND. These applications can meet a wide variety of demands and trends of the present life. It consists of more than 60 multilingual offline applications running on smart phones and tablets for providing tools and interactive services for mobile exploration of places, events, organisations, cultural objects, etc. The contents provided by the system can be downloaded in advance, therefore, the visitors do not have to pay for the Internet. The application includes offline or online interactive maps. The content of the applications can be uploaded, stored, managed and managed with the help a Web-based Administration System (Márkus & Wagner, 2011).

The aim of the application family is to enable the visitors to change their perception of new or familiar locations, objects and motives and explore the past and present of an area in an entertaining and exploring way. The GUIDE@HAND application family covers many destinations in Hungary and abroad. In addition to its original objective as an audio tourist guide, the GUIDE@HAND applications have been adapted to several application domains as follows: museums, events, municipalities, zoos, musicians, universities, conference series, sport teams, books, etc.

The GUIDE@HAND Iron-Age-Danube application presents the project and the related contents on mobile devices. It is available on iOS (iPhone, iPad) and Android platforms.

The main menu of the application contains the following items:

- The *Map* function provides interactive maps on the regions selected for the application.
- The *Routes* function presents content packages called as walks containing sights on an area.
- The *Regions* function enlists the regions presented in the application. After selecting an item, the description and the sights of the region can be viewed.
- The *Best of I-A-D* function contains some highlighted contents and services from the application.
- The *Playground* contains games related to the project content.

- The *Projects* menu item provides general information on the Iron-Age-Danube project. It presents the project description and its goals, the description of the partners.

Some general functions can be accessed through the top-right icon of the screen. The most common functions from them include:

- Update. Although the application looks for a content update at the start the user can manually check for updates from this menu.
- Select language. The user can select a language at the first start which can be changed here.
- Favourites. Users can label any sight as the favourite in the application. They can see the list of the favourites in this function.

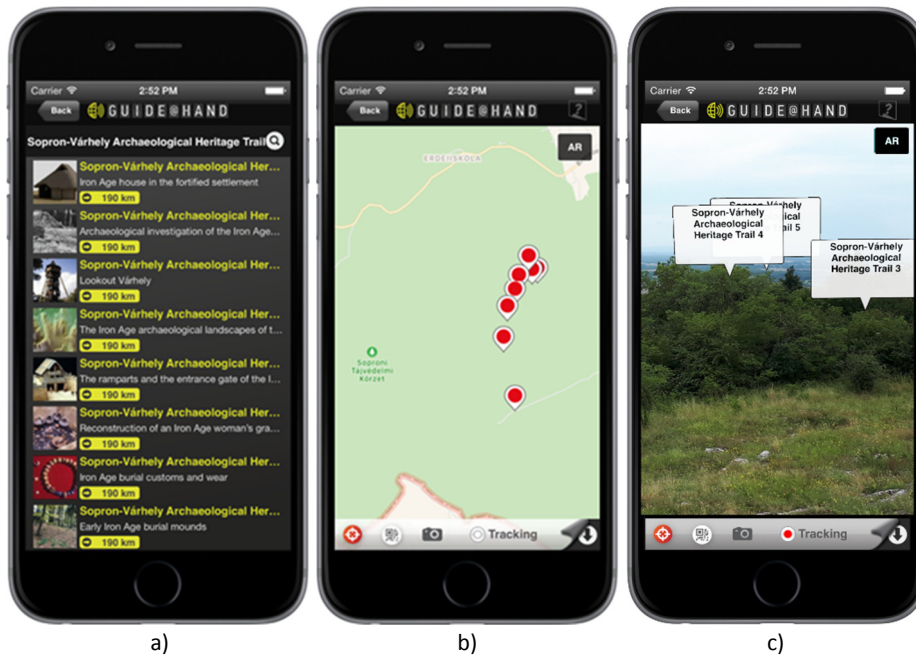


Fig. 5. a) A walk presented in a list mode. b) A walk presented on a map. c) A walk presented in AR mode.

4.3 The GUIDE@HAND Iron-Age-Danube Walks

Walks represent optional content packages that can be downloaded in the *Route* menu. The application can present a walk in three ways:

- as a list. The list contains a picture, title and distance of the sights included in the walk (see Fig. 5a). Users can find further information on them by selecting an item from the list.
- on a map. The sights of a downloaded walk appear as Points-of-Interest (POIs) in the Map function (see Fig. 5b).

- in Augmented Reality (AR) mode. Labels show the sights of the downloaded walks on the camera image (see Fig. 5c).

4.4 Special Multimedia Content

The application contains further special multimedia contents as well including:

- 3D images and videos
- panorama pictures.

The panorama pictures provide an attractive and informative way to present cultural heritage sites (Luchev, et al., 2017). Visitor can look around in the presented environment explore details without visiting the site. The eLearning Department of MTA SZTAKI has created a new service to present, virtually walk around and interactively explore real spaces and special environments. High-resolution 360° spherical panorama pictures are taken of the target spaces. The panorama pictures can be nested together to accommodate the virtual walk whereas an interactive map can facilitate the orientation. The movement between the rooms and the interaction within a room is determined by the control facilities of the applied display. Refinement of the panorama pictures taken in the Archeological Park in Százhalombatta (Hungary) is in progress.

The content for the panorama pictures was created and published by using the Multiplatform-based Content Development System for Content Management and Presentation. The system has been already successfully applied in an earlier project to present the ancient Thracian culture (Márkus, et al., 2018).

5 Conclusions

Human curiosity has long been attracted by the ancient monuments. But for academic researchers, it is not easy to interpret and visualize the past for the wider public. The appearance of digital devices not only powered archaeological investigations but quickly become popular and primarily instruments to portray cultural heritage remains. The smart phone application is a straightforward solution to link digital generation to local inhabitants and cultural offers, as the tools are already at the disposal of the visitors, as well as this is the easiest and fastest update information source. Unlike traditional exhibitions, publications, or information boards, these applications can be upgraded at any time as new information, data, documents, or any other visual content is produced on the subject. Last but not least, there is no need for experts to upload this content, as costumers are given access to manage this database.

The GUIDE@HAND Iron-Age-Danube application operates with a wide variety of interactive multimedia items on smart phones to bring the ancient age closer to the users. The application transfer knowledge about the past in an attractive, adventurous and entertaining manner. The great advantage of mobile applications is that they can provide information about archaeological landscapes on the site, as well. In addition, users get the information through their own devices (smartphones or tablets), therefore there is no need to invest in equipment nor to learn the usage of an extra device.

The content can be updated even after the formal close of the project. The project can be considered as the first step of a large cooperation series and the mobile application can be extended with further contents and functions in future project proposals.

From this article, it is clear that without the latest tourist guidelines, there is no successful long-term destination management. Involvement in cultural routes also seems to be a good example, as it places the sites in a country-to-region program. And with this program, national-level sites still form an international chain.

Acknowledgements

The conference participation and paper is related to the Iron-Age-Danube project, which is implemented under the Danube Transnational Programme (DTP1-1-248-2.2), founded by the European Regional Development Fund and co-funded by Hungary. We would like to express our gratitude to our project partners, whose enthusiasm helped to achieve our goals and initiated new streams of cooperation.

References

- Collis, J. (2014). Urbanisation in Temperate Europe in the Early Iron Age: Mediterranean Influence or Indigenous? In M. Fernández-Götz, H. Wendling, K. Einger (eds.), *Paths to complexity: Centralisation and Urbanisation in Iron Age Europe* (pp. 15–23). Oxford: Oxbow Books.
- Convention on the Value of Cultural Heritage for Society. (2005, October 27). *Council of Europe Treaty Series – No. 199*. Faro.
- Cultural Routes. (2019, June 6). Retrieved from <https://www.coe.int/en/web/cultural-routes/home>
- Czajlik, Z., Kovačević, S., Tiefengraber, S., Pusztá, S., Bödőcs, A., Rupnik, L., . . . Holl, B. (2017). Report on magnetometer geophysical surveys conducted in Hungary, Austria and Croatia in the framework of the Interreg Iron Age Danube project. *Dissertationes Archaeologicae Ser.* 3(5), 343–359.
- Czajlik, Z., Novinszki-Groma, K., Rupnik, L., Bödőcs, A., Fejér, E., Jáky, A., . . . Czifra, S. (2018). Archaeological investigations on the Süttő plateau in 2018. *Dissertationes Archaeologicae Ser.* 3(6), 527–540.
- Eberhard, D. M., Simons, G. F., & Fennig, C. D. (2019). *Ethnologue: Languages of the World* (Twenty-second edition ed.). Dallas, Texas: SIL International. Retrieved June 04, 2019, from <http://www.ethnologue.com>
- Egg, M. (1996). Zu den Fürstengräber im Osthallstattkreis. *Akten des Internationalen Symposiums, Sopron, 10-14. Mai 1994.* (pp. 53–86). Budapest: Archaeolingua.
- European Landscape Convention. (2000, October 20). *Council of Europe Treaty Series – No. 176*. Florence.
- Explore all Cultural Routes by country. (2019, June 4). Retrieved from <https://www.coe.int/en/web/cultural-routes/by-country>
- Impact of European Cultural Routes on SMEs' innovation and competitiveness. (2019, June 4). Retrieved from <https://rm.coe.int/0900001680706995>

- Iron-Age-Danube*. (2019, June 4). Retrieved from <http://www.interreg-danube.eu/approved-projects/iron-age-danube>
- Iron-Age-Danube Database*. (2019, June 4). Retrieved from <https://iad-dev.acdh.oeaw.ac.at/>
- Jászberényi, M. (ed.). (2014). *A kulturális turizmus sokszínűsége*. Budapest: Nemzeti Közzolgálati és Tankönyv Kiadó.
- Lučev, D., Paneva-Marinova, D., Pavlov, R., Pavlova, L., Márkus, Z. L., Kaposi, G., . . . Veres, M. (2017). Presenting Bulgarian Cultural and Historical Sites with Panorama Pictures. *Digital Presentation and Preservation of Cultural and Scientific Heritage*. 7, pp. 113-122. Sofia, Bulgaria: Institute of Mathematics and Informatics - BAS.
- Márkus, Z. L., & Wagner, B. (2011). GUIDE@HAND: Digital GPS Based Audio Guide that Brings the Past to Life. *Digital Presentation and Preservation of Cultural and Scientific Heritage*. 1, pp. 15-25. Sofia, Bulgaria: Institute of Mathematics and Informatics - BAS.
- Márkus, Z. L., Kaposi, G., Veres, M., Weisz, Z., Szántó, G., Szkaliczki, T., . . . Lilia, P. (2018). Interactive Game Development to Assist Cultural Heritage. *Digital Presentation and Preservation of Cultural and Scientific Heritage*. 8, pp. 71-82. Sofia, Bulgaria: Institute of Mathematics and Informatics – BAS.
- Mason, P., & Mlekuž, D. (2016). Negotiating space in the Early Iron Age landscape of south-eastern Slovenia: the case of Veliki Vinji vrh. In I. Armit, H. Potrebica, M. Črešnar, P. Mason, L. Büster (eds.), *Cultural encounters in Iron Age Europe. Archaeolingua Series Minor 38* (pp. 95–120). Budapest: Archaeolingua.
- Mele, M. (2015). Eine ausgewählte Fundstelle: Der Burgstallkogel bei Kleinklein (Gemeinde Grossklein). In B. Hebert (ed.), *Urgeschichte und Römerzeit in der Steiermark* (pp. 497–509). Vienna.
- Mlekuž, D., & Črešnar, M. (2014). Landscape and Identity politics of the Poštela hillfort. In S. Tecco Hvala (ed.), *Studia Praehistorica in Honorem Janez Dular* (pp. 197-211). Ljubljana: Založba ZRC.
- NEARCH. (2019, June 4). Retrieved from <http://www.nearch.eu/>
- Potrebica, H. (2012). Kaptol – a centre on the periphery of the Hallstatt world. In C. Tappert, C. Later, J. Fries-Koblach, P. Ramsil, P. Trebsche, S. Wefers, . . . (eds.), *Wege und Transport. Beiträge zur Ur- und Frühgeschichte Mitteleuropas 6* (pp. 235–245). Langenweissbach: Beier & Beran.
- Potrebica, H., & Mavrović-Mokos, J. (2016). Encounters on borders of world: The Kaptol group in the Early Iron Age communication network. In I. Armit, H. Potrebica, M. Črešnar, P. Mason, L. Büster (eds.), *Cultural encounters in Iron Age Europe. Archaeolingua Series Minor 38* (pp. 39–66). Budapest: Archaeolingua.
- Routes4U Feasibility Study. (2018). *The Cultural Routes of the Council of Europe and the Danube Region (EUSDR)*.
- Šimek, M., & Kovačević, S. (2014). Jalžabet – Bistričak: u susret novim istraživanjima (Jalžabet – Bis-tričak: On the eve of the new research). *Prilozi Instituta arheologiju u Zagrebu*, 31, 231–238.
- Tiefengraber, G., & Tiefengraber, S. (. (2015). Zum Stand der Erforschung hallstattzeitlicher “Zentralsiedlungen” in der Obersteiermark. In C. Gutjahr, & G.

Tiefengraber (Ed.), *Beiträge zur Hallstattzeit am Rande der Südostalpen. Internationale Archäologie. Arbeitsgemeinschaft. Symposium. Tagung. Kongress 19. Hengist-Studien Band 3.* (pp. 217–275). Rahden: VML Vlg Marie Leidorf.

Received: June 10, 2019

Reviewed: June 25, 2019

Finally Accepted: July 07, 2019