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Using a Software Methodology to Evaluate Public Interest in Cultural Park Heritage

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Abstract. *Scientific patrimony, whether actively employed for research or conserved as historical heritage, is a cultural resource for education, recreation, and tourism, and plays a decisive role in shaping urban identity. Nevertheless, a significant gap often exists between public expectations regarding the accessibility, functionality, and presentation of these cultural assets and their actual condition, thereby limiting their contribution to community engagement and urban development. In response to this challenge, this paper uses a software-based framework that leverages online search metrics to assess public interest in the cultural objectives of the Astronomical Institute of the Romanian Academy (AIRA). Specifically, the framework evaluates the extent AIRA's diverse assets in Bucharest - including historical buildings and scientific facilities - are searched online by users and additionally, if they are perceived as integral components of a broader cultural brand when considered in conjunction with the adjacent Carol I Park. The study covers the period 2021-2023 and employs rigorous keyword analysis, Boolean logic, and digital tools such as GetKeywords software platform, in order to capture detailed monthly search dynamics, as well as to process and model the resulting data. The application of this method yield insights into how digital interest aligns with, or diverges from, actual public engagement, thereby revealing specific or latent cultural demand. The results of this analysis are expected to inform strategic recommendations for better integrating AIRA's heritage with the urban landscape, ultimately promoting sustainable cultural development and enhanced accessibility. This approach not only offers a replicable model for assessing digital interest in heritage assets but also bridges the gap between virtual attention and physical visitation, providing a solution for an effective cultural heritage management based on objective data.*

Keywords: cultural heritage, scientific patrimony, urban integration, online search metrics, Astronomical Institute of the Romanian Academy, Carol I Park, sustainable management.

Introduction

Urban parks are vital constituents of contemporary cities, playing multifaceted roles that involve ecological functions by mitigating urban heat, purifying air, and promoting biodiversity, but also act for human well-being by providing areas for recreation, relaxation, and social interaction. Their contributions to public health, environmental sustainability, and societal cohesion are well-documented, making them indispensable for the development of urban environments.

Historical urban parks represent a subcategory within this broader context, offering more than just ecological services. They serve as repositories of collective memory and cultural identity, reflecting the historical and architectural narratives embedded within their landscapes.

Carol I Park in Bucharest exemplifies such spaces, blending natural elements, leisure facilities, and cultural monuments to form an integrated environment that fosters a sense of belonging and historical awareness among local and national communities. This part of

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Bucharest has played a significant role in Romania's cultural and political evolution over the centuries. Historically, it served as a critical gathering site during major events, such as the 1848 Revolution in Wallachia and the 1859 Union of the Romanian Principalities. Moreover, the 1906 General Romanian Exhibition, held in the area, underscored its cultural importance as a hub of sociocultural activity of national significance. Over time, this park embodied the dynamic interaction between heritage ideological remodeling and subsequent preservation and contemporary public use, where green pathways and historic landmarks coexist to deliver both recreational and cultural experiences.

Nearby, the Astronomical Institute of the Romanian Academy (AIRA) hosts a scientific and educational park that has the potential to complement the cultural significance of Carol I Park. Located in close proximity, the AIRA park features various assets, such as historic buildings, modern research facilities, and educational resources, all of which present a great potential for integrating scientific and cultural narratives within the urban fabric. The AIRA's capacity could enhance the socio-cultural and economic sustainability of the area by attracting visitors, supporting educational initiatives, and promoting tourism.

Despite its rich heritage and educational offerings, AIRA's park in Bucharest faces challenges in fully realizing its potential due to limited public access, as it operates under legal restrictions that confine entry to scheduled group visits and special events. This limited integration with the surrounding urban environment curtails its ability to act as a vibrant cultural hub. In stark contrast, the adjacent Carol I Park benefits of public access and high public visibility, serving as a well-frequented cultural landmark. However, the absence of effective connectivity between the park and nearby assets, including AIRA's facilities, diminishes its capacity to function as an integrated cultural and educational ecosystem.

This paper explores the underlying dynamics of this disconnect by analyzing user behavior through online search data. By examining search queries related to key cultural and scientific landmarks within the AIRA's scientific and educational park area, the study aims to uncover explicit or latent public interest patterns. The analysis focuses on monthly search trends, revealing how digital interest correlates with real-world accessibility and visibility. The insights gained from this analysis will inform strategic recommendations aimed at bridging the gap between AIRA and Carol I Park. The ultimate goal is to establish a unified cultural pole that integrates AIRA's scientific heritage with Carol I Park's recreational and historical offerings, thereby fostering a synergistic urban space that benefits both locals and tourists. Through this integrated approach, the region can become a model for sustainable urban planning, leveraging cultural, ecological, and scientific assets to create a dynamic and inclusive public space.

Literature review

Recent studies have highlighted the role of urban parks in fostering community well-being and preserving cultural identity (Chiesura, 2004; Konijnendijk et al., 2013). Historical parks combine ecological functions with cultural significance by incorporating monuments, heritage sites, and thoughtfully designed landscapes. In addition, studies have demonstrated that these parks contribute to regional identity and community attachment by serving as repositories of collective memory and offering venues for cultural and recreational activities (Gómez-Baggethun & Barton, 2013). Research in this field also emphasizes the importance of public accessibility and functional connectivity; when parks are well-integrated within the urban fabric, their socio-cultural benefits are maximized (Dong et al., 2024).

On a related note, scientific heritage, particularly in the context of astronomical observatories, has traditionally been examined for its contributions to the history of astronomy, technological advancement, and the evolution of architectural design (Castro-Tirado, 2019; Dumitrache & Dumitrache, 2009). Historically, these institutions have been valued primarily for their scientific output and research functions. However, a growing body of literature now recognizes the dual role of such institutions in not only advancing scientific knowledge but also serving as platforms for cultural education and public engagement (Brazell & Espinoza, 2009; Ellegaard & Dorch, 2022). Researchers argue that these observatories, despite being established for scientific inquiry, hold substantial potential as cultural heritage sites that can stimulate educational tourism and foster community involvement (Heck, 2000).

Moreover, scholars have recently emphasized the necessity of integrating heritage into the broader urban cultural landscape. Studies suggest that linking such sites with established urban parks can improve public access and promote sustainable heritage management, and in this respect developed analysis methodologies regarding the users' online searches (Bazac et al., 2023). While much prior research has focused on the physical and historical aspects of heritage sites, a significant gap remains regarding the digital measurement of public interest. In particular, using online search metrics to gauge latent cultural demand is proving to be a valuable approach (Edwards & Bruce, 2002; Bhandari, 2023).

Methodology

The study focuses on the scientific and educational park of AIRA within the context of the Carol I Park area. Despite being home to significant heritage assets, such as those of AIRA's scientific and educational park, including the Equatorial Dome, Meridian Hall, Planetarium, and Bosianu House, the area adjacent to Carol I Park has remained isolated from the main cultural network of this park. The research area, therefore, represents a complex blend of historical significance and contemporary challenges, making it an ideal case for studying how digital interest can reveal specific or latent cultural demand and inform strategies for urban integration.

A structured four-step methodology was adopted for the study, drawing on reflective practices in online information searching. The first step involved defining a general research purpose and clear research objectives, which laid the foundation for the subsequent phases of the study. The general purpose of the study is to evaluate public interest in AIRA's scientific and educational heritage using online search metrics and to inform strategies for its integration into the urban cultural fabric of Bucharest. The research objectives are:

- Identify the key online search queries that reflect public interest in AIRA's heritage assets.
- Analyze monthly search trends over the period 2021-2023 to capture temporal variations in digital engagement.
- Quantitatively assess digital interest by deriving metrics such as the General Medium Search Value and the General Medium Value for Peak Searches.
- Develop evidence-based recommendations and potential solutions for enhancing heritage management and promoting urban integration through improved digital visibility.

Fig. 1 - The borders, main cities and roads of Romania

Fig. 2 - Territorial location of Carol I Park in Bucharest

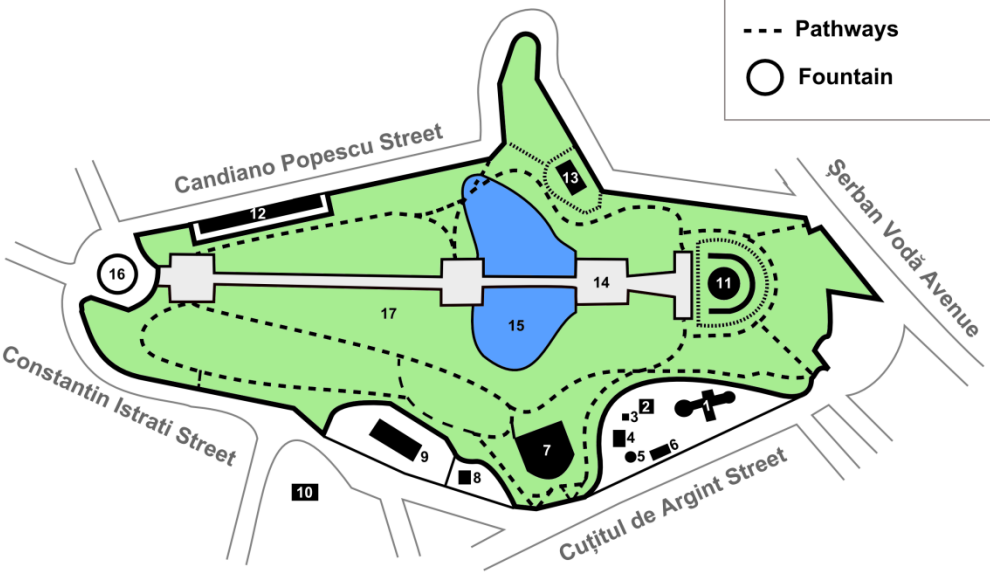

Figure 1. Map of Carol I Park in Bucharest, emphasizing the prominent landmarks located within its administrative boundaries and in the surrounding areas. The map includes the Astronomical Institute of the Romanian Academy and its buildings (1-6); Roman Arenas (7); Cuțitul de Argint Church (8); Carol Halls (9); the former Filaret Railway Station Building (10); the Memorial Complex of the Nation's Heroes (11), which includes the Mausoleum, Grave of the Unknown Soldier, and the Eternal Flame; Technical Museum of Romania "Dimitrie Leonida"(12); "Țepeș-Vodă Fortress" Water Tower Building (13); Carol I Park's monumental bridge and alley (14); Carol Lake (15); Zodiac Fountain (16); and the Carol I Park (17)

Source: Author's own research.

An initial set of keywords was identified to represent the core components of this research objectives regarding the AIRA's park and Carol I Park's heritage integration potential: "vila bosianu" (Bosianu House); "institutul astronomic" (Astronomical Institute); "observatorul astronomic bucuresti" (Bucharest Astronomical Observatory); "muzeul tehnic" (Technical Museum); "mausoleul din parcul carol I" (Carol I Park Mausoleum).

This keywords list was then expanded using semantic variations to include related terms that capture the broader functional context of these institutions as well as their various online

searches variants. Boolean operators (AND, OR, NOT) were systematically applied to refine the initial search queries database, ensuring that a comprehensive range of relevant online search data was potentially covered. This iterative process resulted in an extensive keyword database that reflected both the intrinsic cultural significance and the various functional aspects of AIRA's assets.

The semantic analysis of this theoretical database, reflecting actual user keyword searches was performed in the analysis software platform GetKeywords. This was essential for capturing unexpected semantic variants that were searched by the users, adding to the overall dataset, ensuring that the final keyword database was comprehensive and representative of the diverse ways in which the public searches for information related to AIRA's cultural and scientific heritage.

The entire data collection was carried out over a three-year period (January 2021 to December 2023) using the professional software tool GetKeywords.

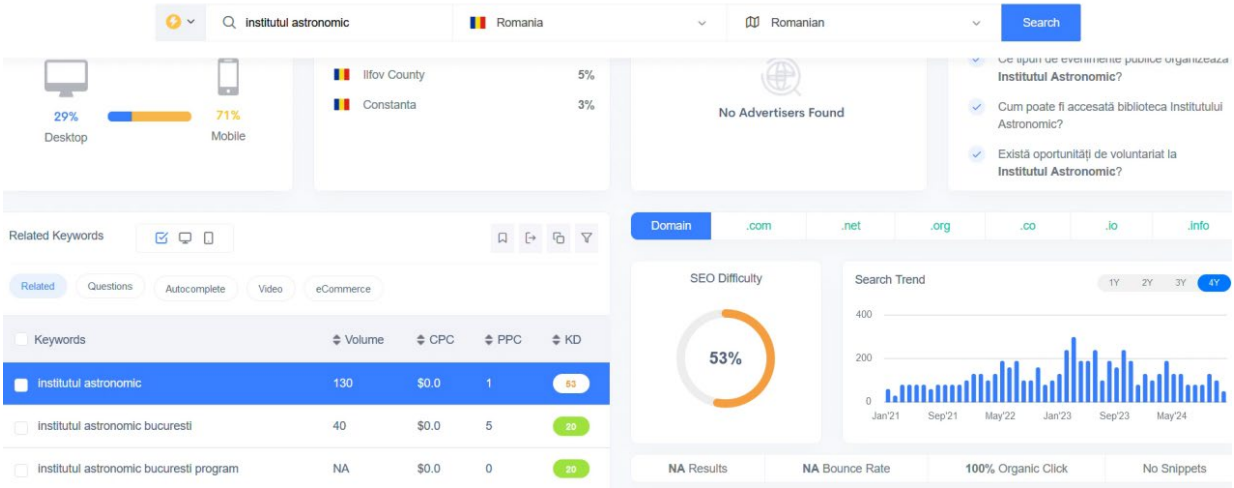

Figure 2. GetKeywords dashboard displaying results for the primary search phrase "institutul astronomic" (Astronomical Institute)

Source: https://www.getkeywords.io/.

This software platform was instrumental in providing detailed monthly search volumes for each identified keyword. The collected data were then aggregated and processed using Microsoft Excel, where monthly search volumes were summed to create an overall dataset. Two key metrics were calculated: the General Medium Search Value (GMSV), representing the average monthly search volume over the study period, and the General Medium Value for Peak Searches (GMVPS), representing the average search volume during peak months (defined as when search volumes exceeded the GMSV). These metrics provided a nuanced understanding of public interest levels, helped pinpoint periods of heightened engagement, and offered a quantitative basis for planning future cultural interventions and promotional campaigns.

In addition to the data analysis, the study addressed several methodological considerations. One major challenge was the potential confusion arising from similar search terms; for example, we believe that the phrase "Bucharest Astronomical Observatory" was sometimes used interchangeably with queries for the Amiral Vasile Urseanu Astronomical Observatory, a facility which doesn't belong to AIRA and isn't located in the Carol I Park's area. Such possible overlaps

underscore the importance of clear digital branding and highlight the need for further sociological research to avoid misinterpretation of the data.

MONTH	SEARCHES	SEARCH PHRASES	
		vila bosianu	*vila bosianu bucuresti*
January '21	210	120	90
February '21	90	50	40
March '21	80	50	30
April '21	110	80	30
May '21	60	30	30
June '21	30	20	10
July '21	20	10	10
August '21	30	20	10
September '21	40	20	20
October '21	60	30	30
November '21	70	50	20
December '21	70	50	20
January '22	260	230	30
February '22	270	230	40
March '22	140	120	20
April '22	160	150	10
May '22	160	150	10
June '22	60	50	10
July '22	50	40	10
August '22	90	80	10
September '22	110	100	10
October '22	160	150	10
November '22	130	120	10
December '22	160	150	10
January '23	850	790	60
February '23	200	190	10
March '23	300	290	10
April '23	160	150	10
May '23	300	290	10
June '23	200	190	10
July '23	130	120	10
August '23	200	190	10
September '23	240	230	10
October '23	360	350	10
November '23	300	290	10
December '23	240	230	10
TOTAL SEARCHES (2021-2023)	6100		
SEARCHES FOR THE YEAR 2021	870		
SEARCHES FOR THE YEAR 2022	1750		
SEARCHES FOR THE YEAR 2023	3480		

Figure 3. The Excel sheet sums up the metrics for the search term "vila bosianu" (Bosianu House) and its semantic variations, based on the monthly online search data provided by GetKeywords. We aggregated these monthly numeric values row by row in Column B. For instance, in cell B3, we used the formula = SUM(D3:E3) to sum the values from D3 to E3. This process was repeated for each row by automatically updating the calculation formula from B3 to B38. We conducted a similar analysis for the other primary search terms in this study: "institutul astronomic" (Astronomical Institute) and "observatorul astronomic bucuresti" (Bucharest Astronomical Observatory).

Source: Author's own research.

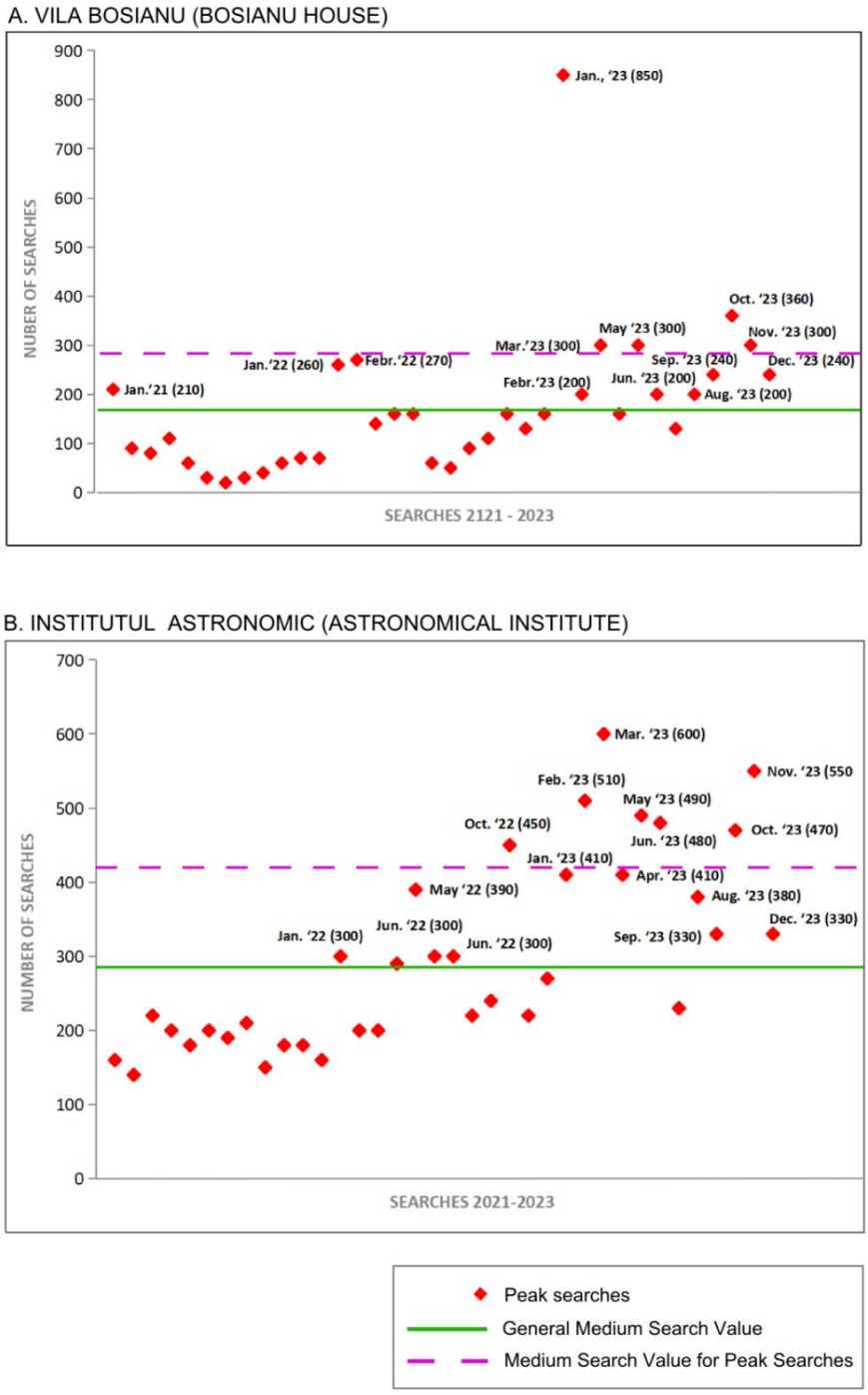

Figure 4. The two referential levels, the General Medium Search Value (GMSV), and the General Medium Value for Peak Searches (GMVPS) for the search terms "vila bosianu" (Bosianu House) and "institutul astronomic" (Astronomical Institute) and their semantic variations (2021-2023). The search volume for "observatorul astronomic parcul carol" (Astronomical Observatory of Carol I Park) was included in the results for the term "institutul astronomic" (Astronomical Institute) and its semantic variations.

Source: Author's own research.

Results and discussion

The analysis of online search data revealed key information regarding public interest in AIRA's heritage. One of the most notable findings was to reveal a significant search volume for Bosianu House. Despite its limited physical accessibility - resulting from administrative restrictions and physical barriers such as fencing and lack of connecting alleys with the Carol I Park - Bosianu House registered monthly search figures that were comparable to those of well-established and more accessible landmarks in Carol I Park, such as the Technical Museum and the Carol I Park Mausoleum. This interest suggests that there is a significant demand for this historical asset, which may be underappreciated in its current state due to the lack of public access and integration with the urban environment. Such a digital demand points to the possibility of reimagining Bosianu House as a more accessible cultural attraction, provided that appropriate measures - such as temporary open-door events or enhanced virtual tours - are implemented to bridge the gap between online interest and physical accessibility.

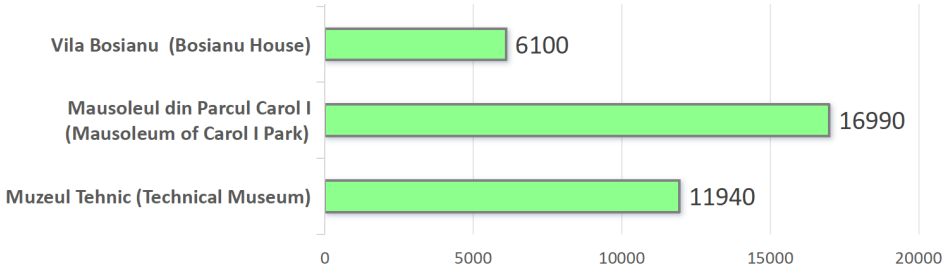

Figure 5. Search volumes for "vila bosianu" (Bosianu House), "mausoleu parcul carol" (Carol I Park Mausoleum) and "muzeul tehnic parcul carol" (Technical Museum in Carol I Park) and their semantic derivatives. Reference period: 2021 - 2023

Source: Author's own research.

The derived metrics - the General Medium Search Value and the General Medium Value for Peak Searches - provide a quantitative basis for identifying optimal times to launch cultural events, promotional campaigns, or open-door days. The General Medium Search Value represents the average monthly search volume and offers insight into the baseline level of public engagement with AIRA's heritage, while the peak search values identifies periods when interest significantly exceeds this average. These metrics allow heritage managers to strategically plan interventions that align with natural surges in public curiosity, thereby maximizing the potential for converting digital interest into physical engagement.

In addition to Bosianu House, the analysis showed that all keywords related to AIRA - including "Astronomical Institute" and "Bucharest Astronomical Observatory" - exhibited a steady increase in search volumes throughout the study period.

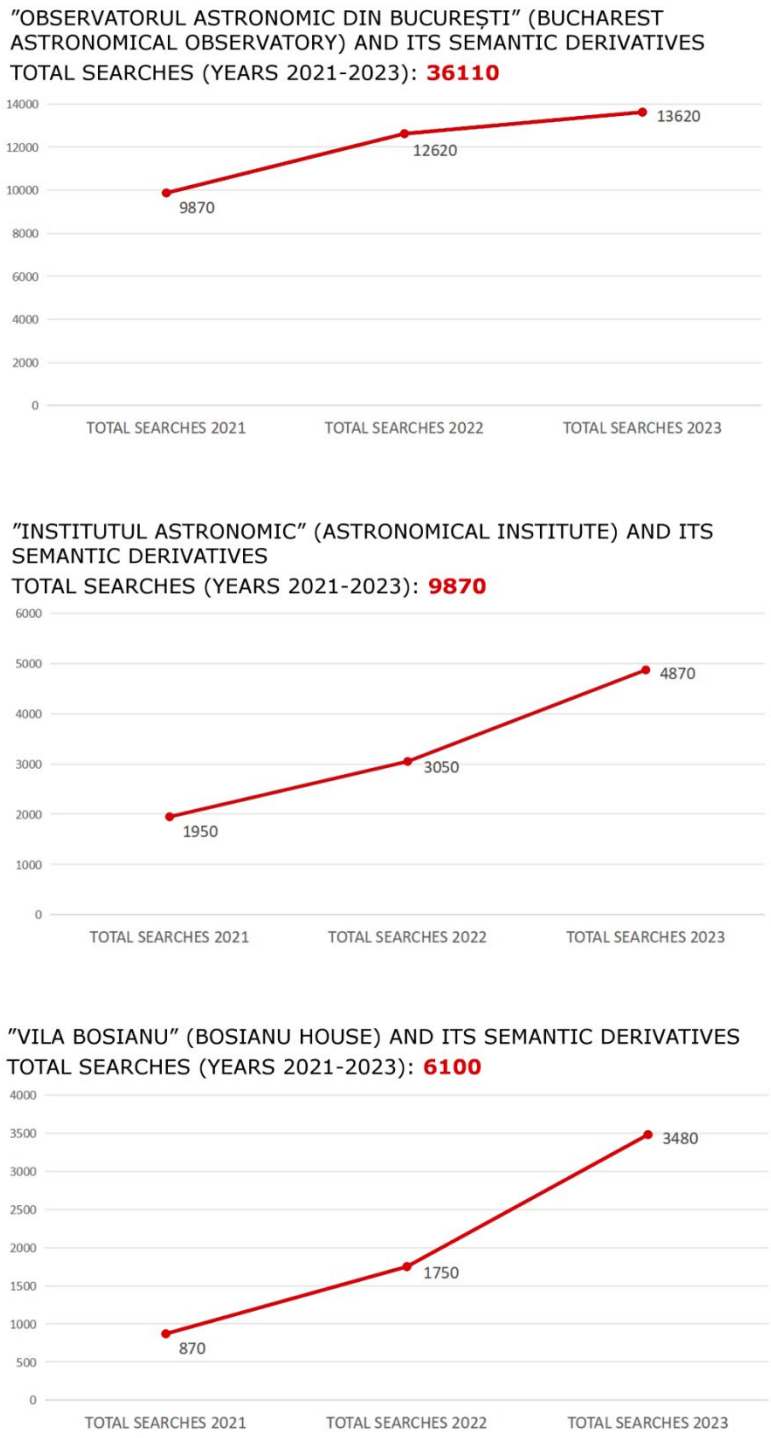

Figure 6. Analysis showed a constant increase in the online search interest for the phrases "observatorul astronomic" (Astronomical Observatory), "institutul astronomic" (Astronomical Institute) and "vila bosianu" (Bosianu House). Reference period: 2021-2023

Source: Author's own research.

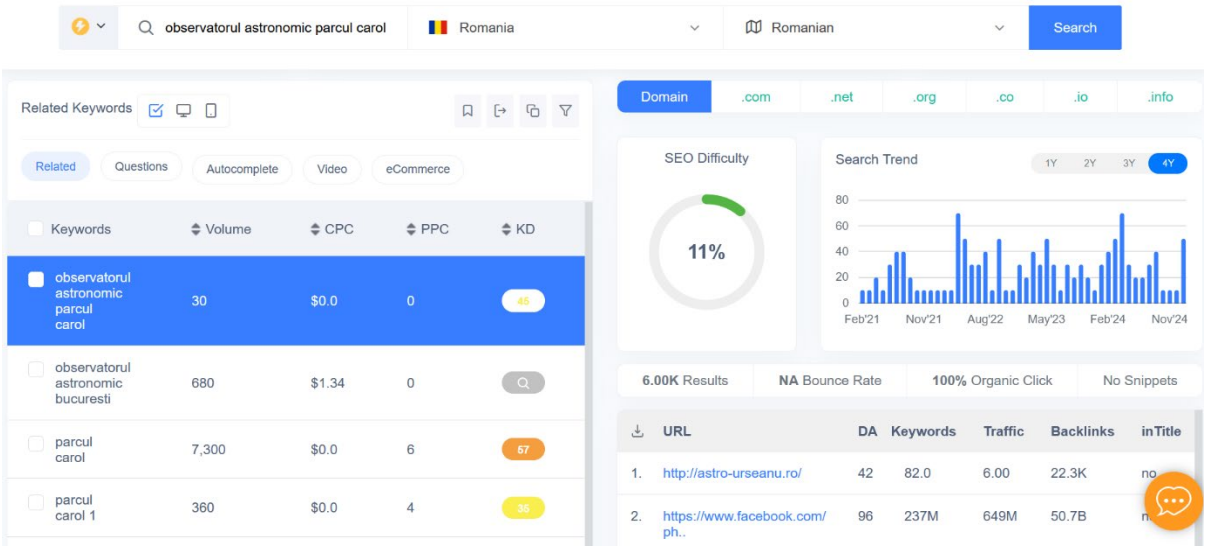

Figure 7. Although there is currently no public astronomical observatory in the Carol I Park area - AIRA being an academic research institution not open to public observations - online users searched for an astronomical observatory in semantic association with Carol I Park. This indicates a latent public expectation for the functional reorganization and opening of a public astronomical observatory in the Carol I Park area

Source: https://www.getkeywords.io/.

The assessment of public interest in the cultural heritage of parks aligns with the development of methodologies for evaluating attractiveness generators within urban systems (Peptenatu et al., 2012; Pintili et al., 2015; Andronache et al., 2016; Herman et al., 2020) or within emerging urban systems, where such evaluations contribute to optimizing integrated development strategies (Ianos et al., 2012).

In this theoretical framework context, the rich dataset of this study, derived from the online search metrics demonstrates the potential of leveraging digital data to inform heritage management strategies. These digital metrics serve as a reliable indicator of public interest, providing actionable insights that can guide targeted marketing strategies and event planning. For example, understanding the temporal patterns of search activity enables cultural managers to schedule events during periods of heightened interest, thereby enhancing visitor engagement and optimizing resource allocation. The nearly comparable online visibility of AIRA's assets and the more accessible Carol I Park further suggests that integrating these cultural areas - through improved physical connectivity and coordinated promotional efforts - could significantly enhance the overall cultural landscape of Bucharest. This approach offers a replicable model for other heritage sites facing similar challenges, providing a pathway for more informed and effective cultural heritage management. It highlights the transformative potential of digital engagement in reshaping the way historical assets are managed and experienced, paving the way for innovative strategies that enhance both accessibility and public participation in cultural life.

The methodology used in this study provides objective information to evidence-based strategies aiming to enhance heritage management and promote urban integration. The integration of this digital tool and of others not only aids in the preservation and documentation of cultural assets but also facilitates broader public engagement, thereby fostering a harmonious relationship between heritage sites and urban development.

Together with this SEO analysis and processing platform, a complementary effective approach to enhance AIRA's heritage management is the creation of digital twins of its heritage buildings. This way, by creating virtual replicas of physical structures that allow for detailed analysis and monitoring, employing technologies such as Terrestrial Laser Scanning (TLS) and Unmanned Aerial Vehicle (UAV) photogrammetry, accurate 3D models of heritage sites can be developed and subsequently integrated in the surrounding urban fabric dominated by the Carol I Park objectives. These models can serve multiple purposes, including conservation planning, structural analysis, and virtual tourism.

Another potential accessibility and enhancement development of the AIRA patrimony and cultural outreach, especially after revealing and quantifying an increasing online public interest by using the methodology of this study, is granting virtual public access to its heritage sites, especially in the context of their public access legal restrictions, insufficient staffing, and lack of infrastructural connectivity with Carol I Park.

To address these constraints, the implementation of immersive technologies, specifically Virtual Reality (VR) and Augmented Reality (AR), offers an complementary or even alternative solution to enhance public engagement and promote urban integration of this heritage. The initial step involves the comprehensive digital documentation of AIRA's interiors and collections. Utilizing advanced techniques like 3D laser scanning and photogrammetry, precise virtual replicas of architectural spaces and artifacts can be created. This process not only aids in preservation but also serves as the foundation for developing immersive experiences.

With digital assets in place, AIRA can establish a Virtual Museum Environment (VME) that allows users to explore its heritage sites remotely. Through VR headsets or interactive web platforms, visitors can navigate through Bosianu House, its library catalogs, in the Meridian Hall, Equatorial Dome, examining documents and exhibit items in a richly detailed, immersive setting. This approach has been effectively utilized by institutions worldwide, which offer fully virtual exhibitions, enhancing accessibility and engagement.

In addition to VR, AR, the AIRA's heritage virtual immersion in the Carol I Park cultural pole area could be done by developing a mobile application. This way, visitors can point their devices at specific locations to access overlaid digital content related to AIRA's heritage. This could include historical information, 3D models of artifacts, or interactive narratives, thereby extending AIRA's presence into the park and fostering a seamless cultural connection.

To optimize these digital platforms, machine learning algorithms can be utilized to analyze visitor interactions. By collecting data on user behavior, similarly with this SEO methodology but by using different software and analysis platforms - such as for navigation patterns, time spent on exhibits, and interaction preference, AIRA can gain additional insights into visitor engagement. This data-driven approach enables the customization of content and the improvement of user experience. Research has demonstrated the efficacy of machine learning in predicting visitor engagement, allowing for the tailoring of exhibits to better meet audience interests.

Implementing robust metrics is crucial for assessing the impact of these digital initiatives. Key performance indicators may include the number of virtual visitors, user engagement levels, educational outcomes, and the reach of AR applications. Regular analysis of these metrics will inform ongoing improvements and demonstrate the value of immersive technologies in heritage management.

Nevertheless, Search Engine Optimization (SEO) could play a role in the long run, depending on the evolution of this technology within the web development environment and the

search engine rules, in order to improve the digital visibility of the AIRA heritage sites. By optimizing online content with relevant keywords, metadata, and high-quality images, AIRA can enhance its online presence, making information more accessible to the public.

The development of comprehensive digital repositories and insuring online access to them, is another vital strategy that could provide integrated access to the AIRA's digital profile (such as to the information about its telescopes, fundamental clocks, calculating machines, building interiors and so on) from multiple national museums, thereby promoting cultural heritage and facilitating research. Such repositories ensure the preservation of digital records and enhance public accessibility.

Implementing digital storytelling through various media formats can also promote urban integration. By narrating the historical and cultural significance of heritage sites within the urban context, these stories can foster a sense of community identity and continuity. Digital narratives can be disseminated through social media, interactive websites, and mobile applications, reaching a broad audience and encouraging public participation in heritage conservation. For example, the public presentation of the role of the Bosianu House in the historical moment of the Union of the Romanian Principalities in 1859, which formed modern Romania, will definitely consolidate the historical dimension of the AIRA heritage, as well as of the whole cultural pole represented by the Carol I Park.

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