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Unveiling Urban Narratives: eLEONAS ppWebGIS - A Multifaceted Digital Storytelling Journey through Eleonas

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Abstract:

Purpose – *During and alongside with the implementation of* eLEONAS ppWebGIS project*, an innovative digital storytelling initiative embarked on a multifaceted exploration of the Eleonas region in Attica, unveiling its unseen dimensions and weaving a captivating narrative of urban transformation. As the area undergoes a significant urban redevelopment from its industrial past, eLEONAS ppWebGIS seeks to shed light on three essential aspects: a) the often-overlooked invisible labour that shaped the region, b) the architectural significance of its building stock, and c) the intricacies of environmental and urban planning information. The pioneering project leverages local open networks (LBSN) and cutting-edge technology (φ-gital) to engage the public in an immersive and emotionally resonant experience that deepens their understanding and appreciation of Eleonas' past, present, and future.*

Design/methodology/approach – *The current research and implementation took place under the Eleonas ppWebGIS project which mainly aimed to introduce participatory planning in the Integrated Sustainable Development Planning as a "system" that can deliver at multiple scales, while responding directly to the needs of the public. For this purpose, the participatory processes emphasized correspond to the following planning/social needs: a. prediction, b. planning and c. prioritization.*

Findings – *The tools developed through the project were tested around three pilot applications in the Eleonas area of Attica, while supporting toolkits were created to enable the implementation of a same approach in other areas in Greece with similar characteristics. In this paper, we are focusing on the social innovation character of the methodology, which was achieved through the development of tools for re-appropriation of space by the residents themselves, namely: a. digital routes and narratives on the physical space (φ-gital) and b. Location based Social Network.*

Originality/value – *Through carefully curated digital routes, eLEONAS ppWebGIS introduced users to the unseen side of Eleonas, revealing the stories of the labourers whose contributions were fundamental to the area's industrial history and present. By incorporating personal narratives, archival images, and audio recordings, the platform humanizes the forgotten or unnoticed voices, giving due recognition to their essential role in shaping the region's identity.*

Index Terms — webGIS, digital storytelling, Location-Based Social Networks, urban development, environmental planning, immersive experience, community engagement, sustainable urban planning**.**

I. INTRODUCTION

Eleonas is an area of strategic location and importance for Attica and its spatial planning **[1], [2]**. During the Eleonas ppWebGIS project, it was selected as an urban area for piloting tools related to prediction, defining planning areas, and prioritization. The pilots were designed to include participatory decision-making processes and digital technologies such as webGIS and community engagement tools.

Spanning 9,000 acres, Eleonas contains areas with diverse characteristics, land uses, and identities. As such, it is a space suitable for different types of pilot applications and inquiries. We can classify the following types of areas based on their environmental importance: a) areas of significant environmental degradation (such as the streams of Profitis Daniel and Kifissos), b) residential areas (in 17 different enclaves of various typologies, such as workers' housing), and c) areas with concentrations of productive activities of different compositions and statuses. Reflecting its highly complex physiognomy, major urban interventions are planned or already taking place **[3], [4], [5]**. Alongside widespread area redevelopment policies, the discussion about the preservation of numerous historic buildings in need of conservation is gaining momentum **[6]**.

Additionally, Eleonas has been the focus of past research projects and studies, as well as institutional forecasts and planning efforts, none of which have fully met the criteria of an integrated approach. Thus, today it faces multi-level challenges for integrated spatial planning, which can unlock potential and address multiple social, economic, and environmental issues with a spatial dimension. The ICT applications developed in this project are designed to

substantially support integrated planning for Eleonas and find wider applications in other areas with similar needs and challenges **[7], [8]**.

As the area undergoes significant urban redevelopment from its industrial past to its complex future **[9]**, the storytelling approach of eLEONAS ppWebGIS aimed to highlight three essential aspects: a) the often-overlooked invisible labour that shaped the region, b) the architectural significance of its building stock, and c) the intricacies of environmental and urban planning information. To achieve the desired outcome, the project designed urban narratives that utilized local open networks (LBSN) and cutting-edge technology (ϕ-gital) to engage the public in an immersive and emotionally resonant experience. This engagement aimed to help locals, visitors, and potential policymakers understand and appreciate Eleonas' past, present, and future.

The objective of this paper is to demonstrate the social innovation element of these approaches to raise public awareness and activate participation. Thus, we will present the development and impact of the following two tools:

- ϕ-gital storytelling tours, enabled by the installation of open local networks and a mobile app (Eleonas Tales).
- the creation of a location-based social media platform (Eleonas Social), based on the reconfiguration of the open-source software Ushahidi.

II. METHODOLOGY

To develop a framework for introducing social innovation, Stilgoe, Owen, and Macnaghten **[10]** analyse the four dimensions of responsible innovation identified in the public debate to integrate them into the innovation process. These dimensions include:

- Anticipation, which involves systematic thinking aimed at increasing resilience, revealing new opportunities for innovation, and shaping agendas for socially robust risk research.
- Reflexivity, which means rethinking prevailing perceptions of the introduction of new technologies and processes, and analysing the policies required or potential changes to adapt reflections and initiate a process of reconfiguration.
- Inclusion, which involves incorporating new voices in the governance of science and innovation as part of a search for legitimacy.
- Responsiveness, which is the capacity to change shape or direction in response to stakeholder and public values and changing circumstances.

Based on the comprehension of this social innovation framework, the eLeonas ppWebGIS team proceeded with a series of methodological activities that included but were not limited to:

a) Data collection and organization: Creating a geographical database with the necessary data sets for each pilot application (satellite, vector, field, etc.), using existing open data, interfacing with open data sources, and making project data available as open data.

b) Field Work and Pilots: Collecting data for the pilot areas, managing mapping and visualization through 360° spheres in the WebGIS environment to support expert judgment and decision-making processes.

c) Analysis of the existing situation: Achieving this goal through the use and development of spatial analysis tools, creating add-ons for QGIS (open-source GIS), and implementing different visualization scenarios. Consequently, a standardized, customizable, visualized spatial analysis model was created.

d) Participatory Processes: Introducing these processes within an Integrated Sustainable Development Planning framework to address the urban challenges of the area.

e) Awareness and engagement raising: Developing necessary inclusion actions to support participatory planning and design, included in the LBSN and the ϕ-gital route.

These activities were interconnected to produce an integrated toolkit for participatory planning. To enable awareness and engagement raising, we employed technologies that we will examine in the next chapters. Since these technologies (LBSN and ϕ-gital) can be considered relatively novel and innovative technological assemblies in the Greek context, we will present the relevant literature review and then proceed with a description of their implementation in our case.

III. LBSN DEFINITION AND USES

A Location-Based Social Network (LBSN) can be defined as a digital platform that combines traditional social networking functions with geolocation technologies. These networks allow users to share their physical location alongside social media content, adding a spatial dimension to online interactions. LBSNs can be used to monitor human activities and patterns, particularly in urban environments, providing information on how city spaces are used and how they interact with people **[11]**.

The characteristics and applications of LBSNs are diverse. In emergencies, for example, LBSNs can be instrumental in providing real-time location data, which is crucial for effective response and management. The ability to track the location and movements of individuals can greatly assist in disaster response and crisis management scenarios. From a commercial perspective, LBSNs offer significant opportunities for commercial exploitation, notably through targeted advertising and location-based promotions. By analysing user location data, businesses can provide personalized advertisements and offers to users based on their current or frequent locations. This targeted approach benefits both businesses, which can reach their desired audience more effectively, and users, who receive more relevant and localized content.

LBSNs have been used in various urban applications, leveraging specific tools to enhance the management and planning of cities. Importantly, they have been identified and exploited in various environmental applications in an urban context.

To exemplify LBSN, we share some emblematic uses of LBSN technologies:

- Urban planning with Foursquare data: Foursquare is the most widespread LBSN with significant tourism and economic exploitation. In addition, however, data from the app has enabled urban planners in understanding city dynamics. For example, its data has been crucial for land use analysis in Shenzhen, revealing discrepancies between actual and planned urban functions **[12]**.
- Public health monitoring via Weibo: Sina's Weibo, one of the largest Chinese social media, especially during the COVID-19 pandemic, provided valuable data for public health surveillance by tracking traffic patterns for implementing health measures in urban areas **[13]**.
- Environmental monitoring and conservation: LBSNs such as iNaturalist engage users in sharing wildlife and plant observations, contributing to biodiversity monitoring and conservation efforts in urban areas **[14]**.
- Air quality monitoring: Platforms like Plume Labs use location data to collect and disseminate real-time information on air pollution levels, helping urban residents make informed decisions about outdoor activities **[15]**.
- Sustainable transport: LBSN contributes to sustainable urban transport by providing data on cycling routes, walking paths and public transport use, thus supporting environmentally friendly transport options in cities. Strava, a city-level sports tracking application, is a notable example of an LBSN used for sustainable transport. One of its features, Strava Metro, collects anonymous user data to help urban planners understand and improve cycling and pedestrian infrastructure in cities. This use of LBSN data helps to enhance sustainable transportation options **[16]**.
- Crowdsourcing data for hydrological models: Several researchers have demonstrated the use of crowdsourced web content to inform water system operations in snow-dominated catchments. By integrating social media data with hydrological models, this approach enhances the management of water resources and supports sustainable water use practices **[17]**.

The successful urban applications of these networks inspired the implementation of a model LBSN network in Eleonas Social. Although our efforts were not focused on the collection of environmental data, as such data could be sourced through sensors, geodata platforms, and other means, we focused on using LBSN as a source of crowd data related to how people interact with the spaces they live in.

Hence, our LBSN model aims to harness these potentials for enhanced urban planning and community engagement. By collecting data on urban interactions and encouraging citizen participation, the project seeks to create a more dynamic, flexible urban landscape where the community actively contributes to shaping its future. This effort is aligned with the ppWebGIS broader perception of the needed elements for participatory urban development and the ability to harness the reconfiguration of technologies to promote more sustainable, inclusive urban spaces.

IV. Φ-GITAL: A ROUTE FOR PUBLIC AWARENESS AND PARTICIPATION IN SPATIAL PLANNING

The integration of public participation in spatial planning, particularly by using low-cost digital technologies, represents a significant shift in urban and regional development practices. Public participation is crucial for creating spatial plans that are not only sustainable but also responsive to community needs and expectations. Traditional methods of public participation in spatial planning often face limitations in terms of scope and inclusiveness. The availability of low-cost, scalable digital technologies, such as Raspberry Pi microcomputers, has opened new avenues for broadening public participation in this field **[18]**.

The advent of digital participation tools, including GIS systems, social media, and mobile applications, has revolutionized how public participation in urban planning is facilitated. These technologies, especially when they are low-cost and easily accessible, allow for more inclusive and dynamic public participation. They offer a scalable and flexible approach to engaging different community members, overcoming the limitations of traditional public participation methods **[19]**.

The concept of 'smart cities', supported by these low-cost digital solutions, demonstrates how technology can be leveraged to create flexible, connected, and participatory urban environments **[20]**.

In this context, innovative and combinatory technologies are emerging to achieve these goals, such as phydigital applications. The term 'phydigital' refers to the integration of physical and digital elements in urban design and public participation. It is a portmanteau of 'physical' and 'digital', highlighting the blending of these two fields.

This concept is particularly important for the creation of interactive, digitally enhanced spaces and infrastructure in urban environments:

- Physical Aspect: This includes the tangible, real elements of urban spaces, such as Raspberry Pi microcomputers, sensors, and other hardware installed in various locations. These physical elements are necessary for collecting data, interacting with users, and providing various services in public spaces.
- Digital Aspect: This encompasses the software, data processing, and digital communication technologies used alongside the physical infrastructure. The digital component is crucial for processing and presenting information, enabling interactive experiences, and facilitating digital engagement with the public.

In "phydigital" applications like the ϕ-gital route, the physical and digital components work together to enhance public participation in spatial planning. The physical infrastructure serves as a local access point or hub, while the digital technology provides the interface and tools for participation, information dissemination, and data collection.

This combination aims to create an interactive experience for users, allowing them to participate in urban planning processes in a more meaningful and accessible manner.

Overall, the phydigital approach to spatial planning focuses on creating hybrid spaces where digital technology enhances physical environments, making them more interactive, informative, and responsive to community needs and inputs **[21], [22]**.

V. AN LBSN FOR ELEONAS

The LBSN for Eleonas was designed to facilitate asynchronous public participation in the project's progress. Users could share "stories" and points of interest by geo-tagging, encouraging the collection of valuable content and fostering a digital community around the project. Additionally, users could comment on existing stories, contributing to the development of user-generated content.

Users were empowered to create detailed profiles, enabling a personalized experience on the platform. They could accurately identify locations using mapping technology, which was crucial for associating discussions and content with specific geographic areas.

The platform was meticulously designed to respect user privacy and maintain data integrity. As such, mechanisms for dynamic content posting and interactive participation were implemented. Furthermore, Eleonas Social included features for real-time discussions, news sharing, and community forums to enhance user engagement and collaboration.

There was also a content categorization and filtering tools, allowing both the public and researchers to access relevant and personalized content efficiently. Through the platform's design and its different layers, we developed a User Experience (UX) design oriented toward active community participation in content creation and data collection, harnessing the power of crowdsourcing for enriched urban development knowledge. Additionally, the UX offered a seamless and consistent user experience across devices, particularly optimized for mobile use.

Our LBSN model, Eleonas Social, was built on a robust three-tier architecture—a development framework that separates an application into three interconnected layers: presentation, application logic, and data storage. This architecture enhances scalability, performance, and maintainability.

Initially, we considered using Mastodon software due to its compatibility with the intended functionalities **[23]**. However, upon delving into customization requirements and technical complexities, we realized that Mastodon did not meet our expectations. Its limitations prompted us to explore alternatives, ultimately leading us to adopt Ushahidi as the preferred software for the Eleonas Forum LBSN prototype.

Ushahidi's flexibility and scalability aligned best with our goals, allowing us to create a highly customized and efficient spatial social network. At the presentation layer, React.js and Redux form the backbone of our application's front-end, providing dynamic and interactive interfaces. These technologies enable users to engage with the platform effortlessly, ensuring a smooth and enjoyable user journey.

Moving to the application and data logic layer, Ruby on Rails drives the core functionality of our LBSN. It powers the REST API and other web pages, handling user registration, content posting, profiles, hashtags, and reports. Simultaneously, Node.js, a flexible and high-performance runtime, supports the streaming API, facilitating real-time interactions and ensuring users stay updated on the latest content and activities. The data tier is built on PostgreSQL 9.5+ for robust and efficient data management. This relational database system ensures data integrity and supports complex queries critical to the diverse operations of an LBSN. Additionally, Redis 4+ enhances data access speed through caching, optimizing overall platform performance. Together, these technologies establish a solid foundation for the application. The app's API plays a pivotal role, enabling users to publish content, access real-time updates, and actively participate in discussions.

VI. "ELEONAS SOCIAL" – THE PLATFORM

The Eleonas Social platform **[Fig. 1]** was designed to facilitate community engagement and information sharing through a structured and user-friendly interface. It supports various categories of posts, encouraging diverse types of user interaction and information sharing. General posts are fundamental units of content sharing, while Reports indicate active user engagement with critical information. Community Discussions promote interaction and dialogue among members. Help and Support posts address user queries, and Events and Announcements keep the community informed about upcoming activities. Resource Sharing enables the exchange of valuable information or materials within the community.

Fig. 1: *The logo of Eleonas Social*

To enhance user experience and facilitate content discovery, Eleonas Social offers several filter options. Users can save their settings for quick access and apply filters

based on post status, categories, timeframe, and geographical location. Resetting filters to default allows users to start afresh.

Eleonas Social includes specialized views such as the Map View **[Fig. 2]**, featuring an interactive map interface with geolocated points of interest, user location indicators, and data filters. This view facilitates the visualization of data distribution and density with features like color-coding and clustering.

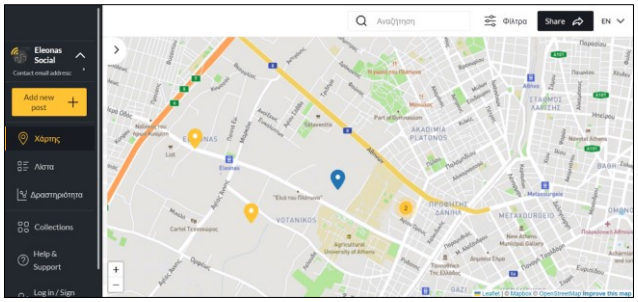

Fig. 2: *Map view in Eleonas Social*

The Data View presents geolocated content in a list or grid format **[Fig. 3]**, offering sorting and filtering options for a personalized user experience. Users can manage their content through View Collections, allowing organized content storage with drag-and-drop functionality **[Fig. 4]**.

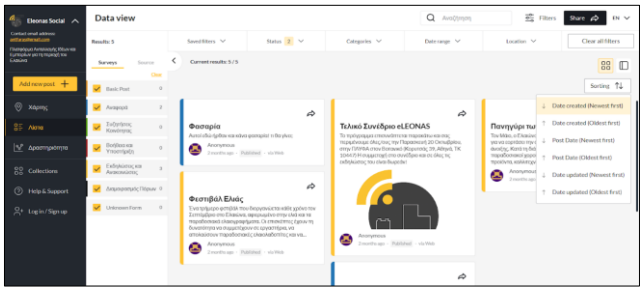

Fig. 3: *List view in Eleonas Social*

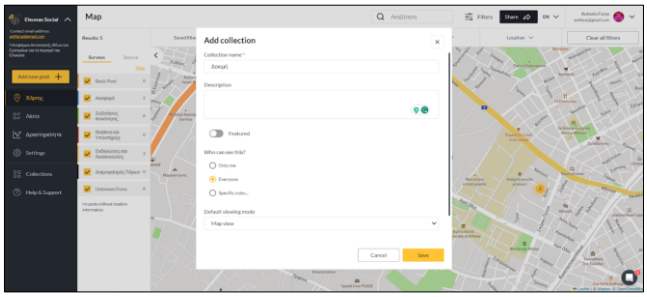

Fig. 4: *Collection view in Eleonas Social*

Interaction with entries is intuitive, with modal windows displaying entry details and a simplified posting process that includes media uploads, categorization, and optional additional information.

User rights and moderation on Eleonas Social are structured to provide varying levels of control based on user roles. Administrators have full moderation control, manage user roles, and configure system settings. Coordinators oversee content review, edit submissions for clarity or compliance, and moderate comments. Contributors have limited editing capabilities for their own posts and can flag inappropriate content. Public users can flag content for review by moderators.

In summary, Eleonas Social enhances community engagement through advanced filter options, specialized views, and clear user roles, ensuring an interactive and efficient user experience

VII. "ELEONAS TALES" – THE APPLICATION

The Eleonas Tales app **[Fig. 5]**, was developed to support the digital route of Eleonas and enhance the experience of exploring the area through interactive storytelling and rich multimedia content. Available on Android (PlayStore) and web devices, the app provides a comprehensive and user-friendly interface for both residents and visitors, ensuring cross-platform accessibility. Developed using NativeScript, the app's key features aim to create an immersive and engaging experience for users.

Fig. 5: *The logo of Eleonas Tales*

One of the core features of Eleonas Tales is its real-time, location-based information accessed through GPS technology, enhancing the user experience by guiding them to nearby points of interest within Eleonas.

Content is organized into thematic pathways, each reflecting unique storytelling efforts. Users select routes based on cultural, historical, or architectural interests, personalizing their exploration.

QR code scanning unlocks digital content at physical points of interest, integrating the app seamlessly with on-site experiences, enhancing engagement.

The interactive map view displays routes and points of interest, aiding navigation and offering detailed location information, facilitating intuitive exploration.

Eleonas Tales supports diverse content types—text, images, audio—appealing to various user preferences, providing a rich, multi-sensory experience.

Powered by Strapi CMS, the app ensures flexible content management and immediate updates, maintaining relevance and incorporating new stories.

Physical content installation across routes, such as the Landscape Reserve pilot, showcases architectural significance and community stories, enriching understanding of Eleonas.

The People's Route focuses on personal narratives but isn't

digitally mapped due to spatial challenges in commercial areas, highlighting community life and events.

The draft Urban Growth Route explores Eleonas' urban history and development, incorporating historical data, urban planning documents, and narratives, offering insights into its evolution.

Eleonas Tales, embodies phygital routes-a novel approach to urban exploration and public participation. These routes blend physical spaces with digital accessibility, enhancing city tours for residents, organized groups, and visitors, regardless of internet connectivity.

Phygital routes integrate physical locations with digital narratives, marked by visible signs guiding users to specific points of interest. This transforms urban spaces into interactive hubs where physical and digital worlds converge. Users equipped with smartphones access a repository of digital content linked to these locations, akin to navigating an augmented reality experience **[Fig. 6, 7]**.

Fig. 6: *List of viewpoints in Eleonas Tales*

Fig. 7: *Internal page of a point of interests in Eleonas Tales*

These routes support diverse digital content types—photos, videos, 3D models, text, audio, and interactive questionnaires—ensuring a comprehensive user experience. For instance, users can view archival videos or listen to audio stories about historical landmarks, catering to various preferences and learning styles **[Fig. 8]**.

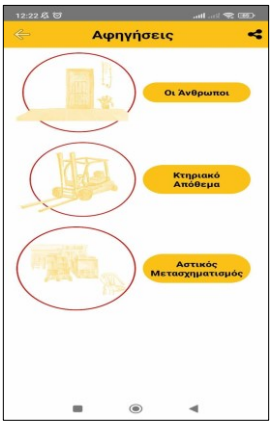

Fig. 8: *Narratives viewing page in Eleonas Tales*

Central to digital routes are local information hubs linked to physical signage throughout the city. These hubs, facilitated by signs or QR codes, connect users' physical locations to digital nodes via the dedicated mobile app. This system enriches environmental understanding and encourages interactive city exploration **[Fig. 9]**.

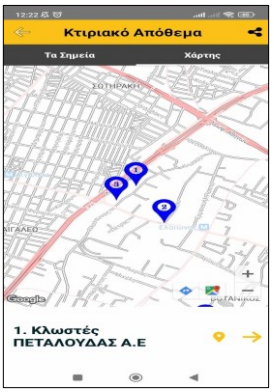

Fig. 9: *Map of points in Eleonas Tales*

In conclusion, digital routes redefine urban exploration by integrating accessible digital layers with physical city journeys. They enhance exploration experiences and serve as educational and participatory tools, fostering deeper connections between individuals and their urban environment.

VIII. CONCLUSIONS

To conclude our presentation of the multifaceted digital storytelling journey crafted by the eLeonas ppWebGIS team, we critically analyse our chosen methodology. We integrated anticipation, reflexivity, inclusion, and responsiveness deeply into the fabric of the eLEONAS ppWebGIS project's methodologies and tools.

Anticipation in our context went beyond mere prediction; it embedded systematic thinking into our toolkit. This foresight enabled us to design and deploy digital tools resilient in the face of urban challenges and capable of uncovering new opportunities for innovation within Eleonas. Each tool was evaluated for its potential to proactively shape

urban agendas, ensuring our research is future-ready and aligned with emergent urban dynamics.

Reflexivity added a critical dimension, prompting continuous evaluation and reassessment of our assumptions and practices. This was evident in developing participatory platforms where we challenged prevailing notions, ensuring ethical grounding and adaptability to new insights and perspectives.

Inclusion was realized through our commitment to diversifying voices in science and innovation governance. Our tools democratized planning, engaging traditionally marginalized stakeholders. This enriched our understanding of urban complexities and ensured interventions were rooted in community needs and aspirations.

Responsiveness was central, adapting to Eleonas' dynamic environment and stakeholder needs. Our tools and methodologies were flexible, swiftly responding to changes and feedback, maintaining relevance and impact.

In summary, integrating anticipation, reflexivity, inclusion, and responsiveness represents a comprehensive approach to urban redevelopment. This strategy advances urban narratives and highlights digital storytelling's potential in sustainable, inclusive, and responsive urban transformation. Our project lays groundwork for future urban planning, emphasizing these dimensions to create resilient and vibrant urban spaces.

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