BRIDGING PLANNING AND TECHNOLOGY: A DIGITAL OUTLOOK FOR SERBIAN SPA SETTLEMENTS

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ABSTRACT

This study explores the integration of digital technologies into the urban planning processes of spa settlements in Serbia, focusing on findings from the SPATTERN project's expert questionnaire. Conducted across 38 spa settlements, classified into 12 Role Models and 26 Replicators, the research engaged 141 respondents from eight professional groups, including urban planners, local government representatives, experts in tourism and resource management (nature and cultural heritage), and health sector representatives. The questionnaire section related to Planning and Technology specifically examines three core themes: (1) the extent and purpose of digital tool usage, (2) the impact of professional training, and (3) the potential for technological advancements to improve planning practices. By employing a combination of descriptive and thematic analysis, the study synthesizes insights that highlight critical disparities between Role Models and Replicators in utilizing digital tools such as GIS, AutoCAD, and BIM. While Role Models demonstrate more advanced integration, both categories identify common barriers, including insufficient professional capacity, limited interoperability of systems, and a lack of precise and accessible data. Findings indicate the transformative potential of digital technologies in addressing these challenges, offering opportunities to enhance efficiency and bridge existing gaps in planning processes. This study contributes to the broader discourse on technology-driven urban planning by showcasing practical insights and strategic recommendations for advancing planning practices in spa settlements. By emphasizing the role of digital innovation, it provides a roadmap for stakeholders to navigate the complexities of integrating technology into planning frameworks.

KEYWORDS _ *Digital technologies, Urban planning, Spa settlements, Expert questionnaire*

INTRODUCTION

The intensive transformation processes that spas in Serbia have undergone in the past decades are reflected in the increasingly pronounced tensions and extremely opposite processes that stand between different models of development and use of resources. On the one hand, the rapid expansion of wellness tourism globally and in the case of several spas in Serbia, greatly pushes towards touristification, with pronounced commercialization and focus on the growth of private investments often aimed at creating luxury facilities. In the literature, this shift towards a market-oriented tourist offer is usually promoted as a gradual adaptation of existing capacities, by extensive branding and expansion of offere, would reactivate resources and increase the flow of tourists, thus being the driver of the local economy (Jovanović Tončev & Podovac, 2014; Pantović et al., 2023; SKGO, 2021). On the other hand, the largest number of spas remains in the shadow of these trends related to tourism. The unevenness and selectivity of these processes is particularly pronounced through the persistence of the so-called redistributive tourism and a kind of continuity with the socialist model of social protection, i.e., adherence to state health insurance programs and the provision of traditional rehabilitation services (Official Gazette of RS, 36/2023). Again, precisely because of subjugating the rapid and often unplanned expansion of tourist capacities, some spas encounter increasing environmental pressures, endangering the sources of thermal water, air and vegetation. Such tendencies are further driven with insufficient articulation and transparency between different levels of government and private investors (Vranješević et al., 2024; Centre for Research, Transparency and Accountability, 2022). Hence, the key dilemma lies in creating a framework that, in the light of future spa trajectories in Serbia, can strategically circumvent various degradation scenarios these trends might produce. This is particularly relevant for the potential opened up by comprehensive socio-morphological analyses, which emphasize the socio-spatial interconnections and interdependencies dictated by spa development, as well as for the opportunities that digital technologies introduce in this domain.

This issue presents a focal point for the SPATTERN project. Employing an analytical-synthetic method grounded in a rigorous comparative strategy, the project aims to identify future patterns of spa development in Serbia by integrating historical-interpretative approach with urban morphology methods. The analysis encompasses an investigation of the historical aspects of spa development, spatial organization, urban and architectural characteristics, as well as the specific environmental conditions that shape the identity and functionality of each spa. Specifically, the project examines the current socio-morphological condition across 38 spas, of which 12 were identified as Role Models through preliminary analysis, while the remaining 26 were taken as Replicators. The Role Models present spas in that exhibit a high level of urban development, with a pronounced spa culture, valuable architectural heritage and specific ecological characteristics. In contrast, the Replicators, are those spas whose development remains nascent. By treating these spas as case studies, the SPATTERN project seeks to identify the common characteristics of their development, but also the specific socio-morphological characteristics, in order to understand their distinctive development trajectories (see particularly: Đokić et al., 2024a). This approach provides a better understanding of the current situation in spa settlements and establishes a basis for formulating future urban and development strategies, with a special focus on the use of digital technologies. Importantly, the project considers the role of digital technologies beyond improving technical planning capacities. Through the thoughtful incorporation and adaptation of digital tools into planning processes, the project envisions new pathways for urban transformation and improved collaboration among diverse stakeholders—local communities, governmental institutions, and civil society alike.

However, the incorporation of digital technologies into planning, particularly in the context of spas, presents a delicate challenge that goes beyond strictly technical matters. The integration of digital tools and planning practice is deeply conditioned by institutional, professional and organizational capacities, as well as by prevailing modes of decision-making. Building on a critique of technocratic models of smart urbanism and the risks their automated, often non-transparent application brings, the paper adopts the concept of Soft City Sensing (SCS) as an analytical corrective. Unlike the

optimization logic of smart urbanism, SCS refers to the phased, participatory and locally based use of digital tools in planning. Drawing on this conceptual framework, this study presents the findings from a survey conducted among 141 experts from 38 spas. The survey examines three key dimensions: (1) the scope and purpose of using digital tools; (2) the impact of professional training and institutional frameworks on their application, and (3) the perceived potentials and obstacles to planning digitalization. Combining descriptive and cluster analysis, the study identifies usage patterns of digital technologies within planning practice, placing a special focus on the differences between spa types and local specifities. The findings indicate that digital tools (most often AutoCAD, GIS and BIM) are employed unevenly – predominantly among planners and architects, while other actors in the planning process often remain excluded from digital workflows. Planners and architects cite insufficient staff expertise, poor software interoperability, but also a wider institutional deficit, including a lack of data (especially topographic and demographic) as key obstacles. Clusters analysis further indicates that these barriers are not universally experienced: one cluster primarily recognizes technical and information barriers, while the other highlights organizational shortcomings and lack of participation. Overall, these findings indicate that the digitalization of planning is shaped by structural constraints that determine operational capacities of experts within specific local contexts. Crucially, these constraints are not correlated to the type of spa, but rather to specific institutional arrangements that govern planning practices.

UNFOLDING THE AMBIGUITIES OF DIGITAL PLANNING

Although they are becoming conventional tools more frequently applied in planning practice, the use of digital technologies is only recently beginning to be more thoroughly rethought. Similar to critical excursions regarding the optimistic possibilities of overall optimization of urban environments through the so-called smart urbanism (cf. Kitchin, 2018; Luque-Ayala & Marvin, 2015), digitalization in planning faces parallel conceptual and operational challenges. Although digital technologies such as GIS, BIM and AutoCAD are often seen as platforms through which data availability is increased and which, thanks to improved software capabilities, can accelerate the day-to-day work of planners and improve decision-making, their broader impact remains insufficiently understood. As Potts, Lord & Sturzaker (2024) particularly point out, despite the increasing availability and technical sophistication of these tools, decision-making processes remain governed by administrative hierarchies and political dynamics. A central role in determining which technologies are included in planning, they note, is most often played by government bodies or corporate actors. Being largely shaped and managed by the private sector and technology companies, digital planning initiatives often improve efficiency, but at the expense of transparency. This gap is further deepened with the growing use of artificial intelligence. As Sanchez et al. (2023) emphasize, it brings growing confidence in algorithmic operations and machine learning, while it automates planning labour and the planning process itself according to predefined patterns. This results in a form of deepened blackboxing, where transparency becomes even more limited. Digitalization is therefore not neutral: in addition to the risks of transforming urban practice into a technocratic and opaque “black box”, it also raises questions related to the participation and involvement of local communities (Burns & Welker, 2022; Sadowski, 2020).

With these limitations in mind, the reception of digital planning requires special attention in order if the transformative potential of digital technologies is to overcome these barriers. An important corrective in this respect is what Madsen et al. (2021) refer to as Soft City Sensing (SCS). As a kind of alternative to the so-called Hard City Sensing (HCS), related to the smart city model grounded in efficiency, prediction and control of urban flows, SCS accentuates a phased, incremental approach to the integration of digital technologies into planning, with a significantly stronger emphasis on participation. Local knowledge is crucial for SCS. While Madsen et al. primarily link it to a broader participatory frameworks involving diverse urban actors, thus arguing for wider incorporation of spatial

experiences into planning practice, SCS, in a broader sense, also implies that digitalization demands a focus on adaptability and sensitivity to the specific uses of technology, echoing findings from other research concerning the functional and operational capacities of software and data (Christmann & Schinagl, 2023). Sensitivity to such localized aspects of digitalization, makes the use of tools such as GIS or AutoCAD far closer to contextualized practices, shaped by institutional capacities, technical affordances of planning systems and to particularities of data used in planning process.

It is the conceptualization through the prism of SCS that forms an important starting point for this research, whose central intervention lies in examining the integration of digital technologies in the planning of spa settlements in Serbia. In this light, our intention is to examine the existing use of digital technologies in planning, with particular focus on the obstacles that relevant expert groups encounter. This includes examination of the general usage, presumed imperatives and the perceived potentials of digital technologies, as well as the obstacles encountered in the planning process itself. The underlying assumption is that the digitalization of planning, if adequately framed and implemented, can serve not only as an instrument for analyzing socio-spatial matrices, but also as a crucial platform for articulating the future development trajectories of spa settlements in Serbia, particularly in face of pressing challenges such as touristification and degradation. This is highly relevant in terms of fostering more responsive planning approaches (Hasler et al., 2017). Furthermore, digital planning holds the potential to generate a more integrated body of knowledge and data, offering a bridge across otherwise fragmented research initiatives and spa-related databases in Serbia. Hence, such "peripheral" contexts as spas can also be particularly fertile ground for the development of experimental and alternative models of digital planning.

METHODOLOGY

The consideration of these questions is based on a database collected through a survey involving experts from all 38 spa resorts, including 12 Role Models and 26 Replicators. The survey, conducted online during the autumn of 2024, involved 141 respondents from these spa settlements (cf. Đokić et al., 2024b). The recruitment strategy was designed to ensure the inclusion of relevant experts, i.e., professionals whose work is directly related to the functioning of the spa, selected in accordance with their administrative competencies. In addition to the planners, the sample includes local government representatives, experts in tourism and resource management (nature and cultural heritage), and health sector representatives. Respondents completed a questionnaire organized into a total of 5 sections. They were first asked about (a) the competencies and professional positions they occupy, followed by (b) their assessment of the decision-making power they have in the spa. Two additional sets of questions addressed (c) the assessment of existing strategic and planning documents, as well as (d) the identification of major challenges in strategic planning. Most importantly, the questionnaire explored the convergence of planning and technology through section (e), examining three main topics: (1) the extent and purpose of digital tool usage, (2) the impact of professional training, and (3) the potential for technological advancements to enhance planning practices.

In this paper, the analysis is specifically based on a combination of descriptive and exploratory statistical procedures, with an aim of gaining deeper insight into the localized aspects and the impact of digitalization within planning practices in spa settlements in Serbia. The analytical process unfolds in several stages. First, the basic patterns of digital tools usage are mapped, followed by the identification of obstacles related to technical, institutional and personnel capacities. first, the differences observed across professional groups in both the frequency and mode of digital tool usage, and second, the comparative analysis of spas based not only on their classification as Role Models or Replicators, but also according to their planning and strategic documentation status. To illuminate institutional and local conditions shaping the adoption of digital tools in planning, the database is supplemented with so-called "spa ID cards", that is, additional indicators that include the existence of spatial planning documentation, various local development strategies, institutional arrangements,

and the forms of expert involvement in decision-making processes. In addition to standard descriptive analyses, K-means cluster analysis was employed to identify latent groups based on perceptions of digitization barriers, data availability and relevance, and dominant technical or organizational challenges. Therefore, the analytical framework is designed not only to unveil potential institutional differences between the spa types, but also to identify distinct patterns in how of digital technologies are received and incorporated in spatial planning across Serbian spas.

RESULTS AND DISCUSSION

Digital Tool Usage and Planning Practices

In general, the need for digital tools appears to be increasingly permeating planning practices. Among the tools whose importance is most recognized for general spa planning, GIS and BIM are found, along with software for resource management and traffic analysis. However, the actual frequency and modes of usage vary considerably both across cohorts of experts and depending on the domains in which they are used. A majority of respondents report using these tools either often (30.5%) or on a daily basis (27.0%), while slightly less than a third (27.0%), describe their use as occasional. Importantly, this usage is highly uneven across professional groups: planners and architects are consistently at the forefront, while other experts report significantly lower engagement with digital tools—evident in the fact that approximately 39.0% of respondents do not use any specialized tools at all. Among those who do, AutoCAD (44.6%) and GIS (36.6%) are by far most frequently used, with SketchUp (10.8%) and Revit (3.3%) lagging behind. All other tools collectively account for only 4.8% of reported usage. This is especially reflected in domains of application: where urban planning (38.3%), architectural design (28.7%) and analysis and evaluation (21.1%) dominate, while other aspects (e.g. monitoring and management) are far less represented.

The use of digital tools is thus concentrated within core planning functions; significant variations do not go along the lines of spa type (i.e., Role Models versus Replicators), but rather according to institutional and strategic capacity. No statistically significant difference is observed in the overall frequency of tool usage between Role Models (55.1%) and Replicators (60.3%), where digital tools are reported as being frequently or always used. The only notable, though not statistically significant difference lies in the diversity of tools in use: Role Models exhibit somewhat broader toolset, including SketchUp and Revit, and also display a bit wider application of these tools beyond urban planning and architectural design. More pronounced differences emerge when institutional and administrative capacities are taken into account, particularly regarding the presence of spatial and strategic planning documents. Tool usage declines markedly in spas that lack detailed urban and spatial plans. For example, the absence of regional spatial plans does not exclude digital practices but diminishes them: roughly a third of respondents who report rare usage come from spas without such plans. Conversely, more frequent tool use correlates with the presence of comprehensive documentation. The same applies to the relationship with the level of generality of urban plans. Lower levels of use of digital tools are far more prevalent in cases where there are only general urban and general regulatory plans. The usage of tools, however, is significantly more intense in cases where detailed regulatory plans have been adopted.

Professional Training and Institutional Capacity

Previous findings highlight dividing lines in planning digitalization, primarily linked to variations in institutional capacity. Specifically, differences in the degree of digital tools usage suggest deeper structural disparities, from administrative to professional obstacles, that further lead to uneven digitalization of spa planning. While these differences do not align strictly with the Role model vs. Replicator typology, they nonetheless indicate broader discrepancies bureaucratic infrastructures,

management strategies and levels of professionalization. This becomes particularly salient when observing variables such as prior professional training, acquired competences and the extent to which these skills are applied in practice. Strikingly, regular training across all expert groups is exceedingly rare (2.84%), with just over a quarter of respondents (26.24%) reporting occasional opportunities for professional development. More than two-thirds have either attended training only once or not at all. Among those who received training, the most frequently cited competences are technical skills (32.46%), followed by communication skills (23.68%) and project management (23.68%), with analytical skills noted less (17.54%). However, permanent application of these skills in professional practice is reported by only a small proportion (9.93%), while most respondents indicate that such knowledge is used only occasionally (26.95%). Among planners and architects, the distribution slightly diverges: one third (30.23%) have never been to additional training, one third (34.88%) only once, while the remaining third (32.56%) participates occasionally.

Still, the relationship between professional competencies and institutional competences is not straightforward. K-means cluster analysis reveals that the level of training and skills among planners shows considerable convergence, transcending the differences between spas with stronger institutional infrastructures and those with weaker frameworks. While higher levels of institutionalization, embodied in the presence of regulatory plans and development strategies, should clearly separate the Role models from the Replicator spa, a relatively low level of professional development is noticeable, mostly focused on general skills such as project management. This ultimately suggests that, despite differences in formal planning frameworks, despite slightly more robust strategic frameworks in Role models, the institutional environments of spas do not significantly diverge in terms of supporting ongoing professionalization. Consequently, the digitalization of planning encounters multiple barriers: the potential of digital technologies is not sufficiently recognized and fostered through institutional mechanisms, ultimately resulting in contradictory outcomes. Therefore, even as planning becomes more dependent on software, the deepening of technical and administrative capacities and skills lags behind. When it exists at all, the limited professional training available is largely confined to short-term, task-specific skill acquisition, with minimal long-term integration into everyday planning practice.

Barriers and Opportunities (Common Limitations)

These findings highlight numerous points of convergence in the barriers to greater inclusion and institutionalization of digital planning in Serbian spas. Interestingly, although surveyed planners and architects identify numerous challenges, as well as potential pathways to improve technological planning capacities, there are certain differences. First, when examining the recognition of existing shortcomings in planning, software limitations, and the kinds of data that could improve daily work, the results largely confirm earlier findings. The most frequently cited challenges to planning are the lack of coordination (43.2%), followed by missing resources (22.7%) within local governments, while recognizing insufficient community involvement (18.2%) is also not negligible. These institutional problems are also reflected in assessments of local planning practices, where the lack of professional staff (45.5%) stands out most prominently, followed by the lack of precise data required for the development of plans (29.5%). Software-related barriers present another limitation, with one in five planners and architects (20.5%) citing the poor interoperability as the primary technical limitation. Regarding missing data, over half of respondents (54.5%) identified topographic data as the most needed, while demographic data (60.7%) and economic data (60.7%) took second and third place, respectively.

While no significant differences were observed across types of spa, perceptions of these obstacles are nonetheless diverse. Cluster analysis revealed two distinct groups, each emphasizing different categories of limitations. Notably, both clusters agree on the hierarchy of missing data types (topographic, demographic, economic, and environmental) suggesting widespread deficiencies in the knowledge infrastructures and data systems necessary for planning. Nevertheless, the main dividing

line is related to the way institutional barriers are framed. Roughly speaking, material, technological and information deficits are far more prominent in the first cluster. Thus, the lack of resources needed for planning is most pronounced here, and software shortcomings are attributed primarily to data unavailability and poor interoperability, with staff limitations noted only afterward. In contrast, the second cluster foregrounds human and organizational deficits. Here, the key planning challenge is insufficient community involvement, and among software limitations, the lack of professional staff is listed first, followed by weak interoperability and limited data access. This divergence suggests that barriers to the deeper incorporation of digital technologies into spa planning are shaped more by localized, context-specific institutional dynamics than by generalized typologies of spa settlements.

CONCLUSIONS

Regardless of the increasing incorporation of digital planning in the spa settlements of Serbia, the outcomes of these processes remain ambiguous. On the one hand, digital tools significantly shape planning practice and architectural design; on the other hand, their further reception and expansion of usage encounters numerous obstacles. This is especially reflected in relation to additional training, as well as the acquisition of skills necessary to enhance professional competencies. Contrary to initial assumptions that variations in the application and scope of digital tools would correspond to spa typologies, it is evident that the reception of digital planning is more closely tied to institutional and administrative arrangements. Precisely these structures either facilitate the functional integration of digital tools or constrain their implementation. This pattern is particularly visible in relation to the existence and development of planning and strategic documentation. Where present, it has at least partially supported the adoption and enhancement of digital planning practices. A significant difference in this regard arises between the two identified clusters, as they point at the possible directions of future digitalization. At the same time, these are related to administrative and bureaucratic constraints, as well as those of a technical nature. Thus, the first cluster particularly highlights technical and informational constraints: the lack of reliable data, poor system interoperability and limited access to technical training are underlined as greatest obstacles. In contrast, the second cluster reveals a different set of impediments, where the primary barriers are organizational deficits, especially the absence of participatory planning mechanisms and weak inter-institutional coordination.

Although these differences in the perception of constraints among planners themselves are not negligible, they possess numerous points of convergence and hence point to broader issues of balancing between technological potentials and institutional transformations. The most salient point of convergence is the shared recognition of shortcomings in knowledge infrastructures, particularly, the need for more comprehensive incorporation of topographic, demographic and economic data into digital spa planning. At the same time, the findings underscore that obstacles to the integration of digital technologies in spa planning extend beyond purely technical domains. They also include organizational and professional dimensions, such as work structure and access to training. The generally low frequency of professional development activities, the sporadic use of more sophisticated tools such as BIM and Revit, as well as the overall low degree of participative engagements, suggest that digitalization often remains tethered to a minimum of functionality, without transformative potential. In this regard, rethinking digitalization further demands much greater attention to the interplay between technical and institutional capacities. Aligned with the imperatives of the SCS approach, this means moving beyond a linear model of technological modernization toward a more synergistic strategy, focused on localized, context-sensitive incorporation of digital tools. Bearing in mind the different, contradictory tendencies in the development of spas in Serbia, such an approach certainly requires interventions that would simultaneously increase technical capacities, enhance availability of data, while not bypass the participative engagements and greater transparency of data and plans. Also, this entails providing a flexible framework for continuous improvement of planning procedures. It seems that only in this way, digital technologies in planning can become not only

operable in technical terms, but also meaningful instruments that contribute to wider imperatives of inclusive and informed articulation of spatial development.

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