

Post Covid19 topiography: Prospects of the polycentric operational model for a Greek city.

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Abstract

The COVID-19 pandemic prompted a reevaluation of urban dynamics worldwide, impacting economic, social, and daily life aspects. This shift, coupled with the imperative to combat climate change, has led to a reconsideration of modern city functioning. The polycentric city model emerges as a solution, integrating technological advancements to create user-centric, environmentally friendly urban spaces. Research demonstrates the feasibility of this model, emphasizing its economic, environmental, and social benefits. Greek cities, with their manageable scale and existing neighborhood structures, are particularly suited for this transition, offering a favorable cost-benefit ratio. Case studies aim to validate the effectiveness of the polycentric model in Greece, reinforcing its potential for sustainable urban development. This paper evaluates the prospects of the polycentric operational model for the city of Ilioupolis in Athens, Greece

Key words: post-pandemic city, urban environment sustainability, social inclusion

Introduction

Covid pandemic served as a benchmark for the reconsideration of the way users operate in the urban environment. The shifts that happened rapidly not only in the economic sector and the social activities but also in day-to-day life, leading to a global reconsideration of the way developed cities function under these new circumstances. In addition to this, the demands of the strategy towards battling climate change, promote the research for the optimal operational model of the modern city, regarding trivial functions and needs, car use, networking, and communication.

The model of a polycentric city formation is promoted as an answer to these challenges. This contemporary polycentric city theory is enhanced with the technological advancements and oriented towards the city user, aiming to create a greener environment-friendly urban space, that promotes the battle against climate change. Given the turn towards a more viable sustainable environment with a more user-friendly city formation that subjects to the principles of sustainable mobility, as well as the technological means available, the implementation of a structure with multiple centres, a mix of functions and extended networking, can produce a new urban topiography that derives from the environmental principles of the 21st century.

This paper follows previous research where this polycentric city model was evaluated using the economic theory, and specifically a cost-efficiency analysis, to establish a foreseeable outcome and determine and quantify the possible benefits on an environmental, economic, and social level. The analysis applied an ex-ante evaluation and uses simulation techniques and indicators to define the cost-effectiveness ratio, combined with mental mapping activities, in order to promote people inclusion in the decision-making process.

The findings showed that the cost that needs to be allocated to implement a polycentric model of operation in Greece, although dynamic and varied from case to case, is relatively low compared to the benefits that come as a result. In fact, the most of said benefits are linked to the European Sustainable Development Goals, the promotion of which is a strategy all European countries and cities are already committed in following.

The main reason why the cost may appear lower for Greek cities to shift to a polycentric model, is that Greek cities in particular, are characterised by a small scale of the urban fabric and a variety of uses, both equally important when implementing this model of operation. The formation of neighbourhoods is thus favoured and, on a first level, already present, which gives the Greek city an advantageous starting point regarding the possible cost of rearranging the city from scratch.

This paper builds on the previously established evaluation model and employs a case study to validate the evaluation method and furthermore produce a series of observations and results regarding the actual costs and benefits of polycentric city operations in Greece.

The polycentric city establishing the 15minute city

The polycentric city constitutes a development model that has been examined in various variations in urban planning theory since the last century. In contemporary discussions within urban planning, the concept evolved to the 15-minute city that emerged as a compelling vision aimed at fostering more livable, sustainable, and resilient urban environments. Essentially, the 15-minute city model advocates for reconfiguring cities to ensure that residents can conveniently access essential services, amenities, and job opportunities within a 15-minute walk or bike ride from their residences. This vision signifies a reappraisal of conventional urban development patterns, which typically prioritize automobile-centric infrastructure, towards a structure with multiple small scale centralities within the urban fabric.

Among the European cities, the city of Paris has been leading in the implementation of the 15-minute city concept, leveraging its distinctive urban layout and cultural heritage to redefine how urban life is organized spatially. Through strategic interventions and policy measures, Paris seeks to cultivate compact, polycentric neighborhoods where everyday needs can be met within close proximity. This approach aims to decrease reliance on cars, encourage active transportation, and improve overall quality of life.

Nevertheless, the 15-minute city model poses several threats along with its benefits. As pointed out in previous work [1] implementing the 15-minute city model in Paris, or any urban setting, presents both achievements and obstacles. While Paris has demonstrated notable adaptability in capitalizing on opportunities arising from the COVID-19 pandemic to advance its urban agenda, uncertainties persist regarding the applicability and efficacy of certain strategies, particularly in diverse urban contexts characterized by varying scales and socio-economic dynamics.

After drawing insights from Paris' experience, this paper aims to delve into the complexities of implementing the 15-minute city model and assess its implications for urban planning practice in the Greek city. By critically examining both the successes and limitations of Parisian initiatives, valuable lessons can be gleaned for other cities embarking on similar urban transformation endeavors. The chosen case study is the city of Ilioupolis, a municipality in southeast metropolitan Athens, with a characterizing urban plan similar to the 19th century garden city. The city is organized around several roundabouts that have become very closely related to the identity of Ilioupolis. In this paper, these roundabouts become the core of the proposed scenario of the 15minute city model.

The uniqueness of the urban design of the area predisposes and promotes centralities at the points where we encounter the roundabouts. When exploring the case study, the already existing

trend of centralization development at these points is taken into account, a trend that seems to have accelerated after the COVID-19 pandemic. In this way, the proposed centralities of the 15-minute city examined in this research are the product of bottom-up processes and not predetermined top-down locations, as in the case of Paris, for example. Moreover, this paper emphasizes the importance and necessity of flexible, context-sensitive approaches to urban planning that prioritize both equity and sustainability, both of which are significantly boosted via community engagement.

Ultimately, through a comprehensive analysis of the case study of Ilioupolis, this paper aims to contribute to the ongoing discourse surrounding innovative urban planning strategies and their potential to shape more inclusive, resilient, and vibrant Greek cities for the future.

Case study: The Municipality of Ilioupolis - Urban fabric characteristics

Ilioupoli is a municipality that was developed to meet the increased housing demands created by the large refugee influxes to Greece following the Asia Minor Disaster of 1922. It is a suburb of Metropolitan Athens, located in the southeastern part of the basin. It is situated at the foothills of Mount Hymettus and is only a few kilometers away from the center of Athens. It was declared a municipality in 1963 (Government Gazette 45/A/19-4-63). It has always been crossed by several streams, the most significant being 2-3 branches of the Pikrodafnis stream, most of which are now covered. In the area where the municipality of Ilioupoli is now developed, there was a small estate during Ottoman rule, called the "Kara estate." The buyer in the following years was A. Nastos, who later sold the land initially required for the construction of the Municipality of Ilioupoli.

In 1925, the "Greek Company for Urban and Rural Settlements Drandakis - Pagkalos, and CO" was established with the aim of constructing the settlement according to the plan of Aristomenis Valvis, as modified in 1928 after its first approval in 1925. Ilioupoli initially targeted a wide range of residents. It had a rural section, a semi-rural section, and a general population section, which were distinguished from each other based on the size of the available plots of the settlement. In the general population section, the size of the plots reached that of the center of Athens. The smallest acceptable plot size was set at 112.5 sq.m. and remained so until 1940. Along the way, the rural section was abolished as buyers could not afford it financially. According to the "General Guide to Ilioupoli" (1960), anyone "...found a place for a home, the rich and the poor, the scientist and the professionals, the employees and the workers...".



Figure 1. Plan of Ilioupolis (1925) [2]

The original plan by Valvis for the settlement of Ilioupoli was characterized by a clear effort to mimic the principles of a garden city. Strong curves, numerous concentric circles and roundabouts lead to the creation of small building blocks. This initial plan underwent modification with evident signs of improvement in 1928 (Government Gazette 227/1928).

In 1930, the "Anonymous Construction and Industrial Company of Ilioupolis Athens" was founded, a company that, along with the "Greek Company for Urban and Rural Settlements Drandakis, Pagkalos, and CO" and with the "Anonymous Transportation Company of Ilioupolis," undertook the execution of the plan.

However, the image of the city of Ilioupoli in its early years was not very encouraging regarding the completion of the plan and its settlements. Nevertheless, it was widely advertised in newspapers, urging buyers to invest in land purchases, which (according to said advertisements) would not lose their value, and thus the investors would profit from a potential devaluation of the currency (a practice not uncommon in 20th century Greece). The main service networks of the city were ultimately completed after World War II, a period during which the Municipality began to grow systematically.

Locating the city centralities

Existing centralities

In Ilioupoli, the General Urban Plan (GUP) was approved in 1988 (Government Gazette 407/D/1988, reissued Government Gazette 1225/D/1994) and is still in effect, defining the allowed land uses of the city (Fig.2). The GUP includes the entire current area of the Municipality, along with the successive expansions after the initial approval of the city plan. The same GUP separates 14 neighborhoods - Urban Units as they appear on the map below (Fig. 3). The division of neighborhoods seems to have been made based on geometric characteristics of the town plan and with the intention of an equal distribution of the covered area per unit. There does not appear to be an intention to create independent centers per

neighborhood, and the circular nodes are, in most cases, not placed at the center of each unit, but seem to serve as meeting points for two or more neighborhoods. Given that the already defined neighborhoods have a maximum distance range of 1.5 kilometers from each boundary, this distance can work perfectly with the scenario of the 15-minute city and promote accessibility using bicycles, walking, or other non-motorized vehicles.

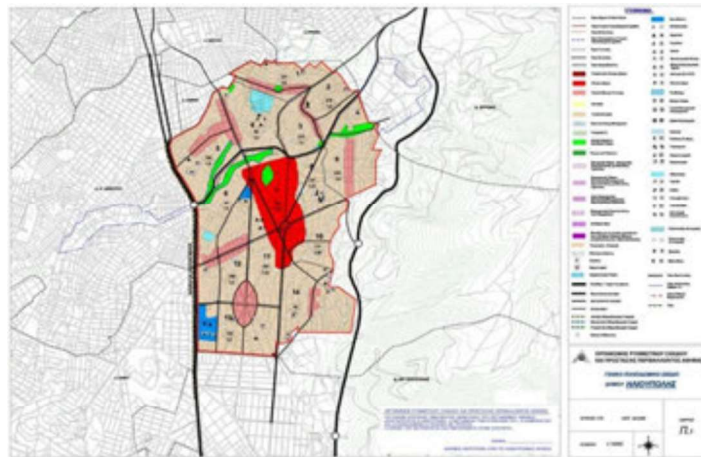


Figure 2. General Urban Plan of Ilioupoli [3].

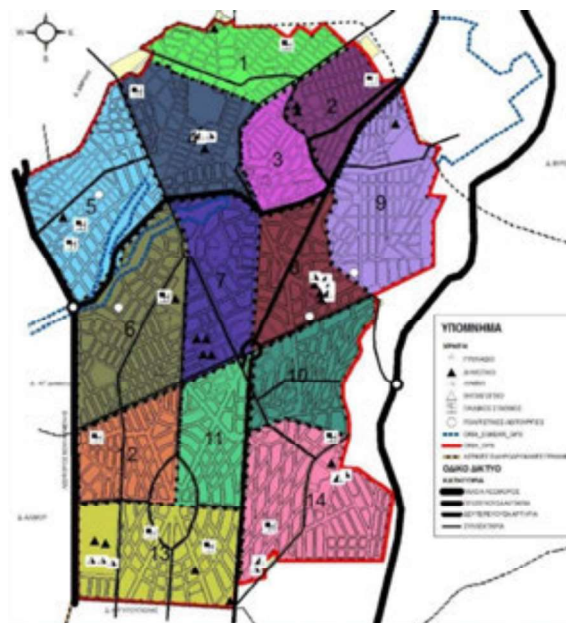


Figure 3. Neighbourhood division [4]

For many years, and up until the end of the 2010s, when the economic crisis changed the density of commercial uses, Ilioupoli developed commercial and recreational activities mainly around

Ethnikis Antistaseos Square, which is the central square of the Municipality and located at the intersection of neighborhoods 7-8-10-11. This development aligns with the General Urban Plan of the city, which designates the square and part of the axes leading to it as the "city center," differentiating it from other adjacent squares in other neighborhoods designated as "neighborhood centers."

Another secondary center of smaller scale was developing at Independence Square in neighborhood 1, just before the intersection of neighborhoods 1-3-4, while with lower intensity and uses related only to commerce, two more centralities were found, located, one at Karaiskaki Square (Kanaria) at the intersection of neighborhoods 4-5-6-7 and one at 28th October Square in the heart of neighborhood 8.

We can observe that, unlike the central square of Ilioupoli, the secondary centers created initially did not follow the current General Urban Plan regarding the determination of the neighborhood centers. The General Urban Plan placed these units mainly along axes and not on circular nodes, not exploiting the centrality they provide due to their layout.

Emerging centralities

After the economic crisis, new centralities began to emerge, mainly around the development of commercial and leisure activity zones in areas that showed less interest until 2010. This trend strengthened towards the end of the economic crisis around 2019, and despite the slowdown experienced during the period 2019-2021 due to the pandemic, it accelerated at a faster pace in the last two years (Table 1).

The newly created centralities also tend to indeed move along axes, as initially predicted by the General Urban Plan (GUP), but still concentrate on those connecting the most developed squares of the Municipality. Thus, we observe a new center at 25th March Square at the intersection of neighborhoods 6-7-11-12, another one at Agia Paraskevi Square at the intersection of neighborhoods 11-12-13, and one more at Agia Mavra Square at the intersection of neighborhoods 8-9-10. The commercial and leisure uses also tend to expand on the axes between squares as shown in the consolidated map below (Fig.4).

CENTRALITIES NUMBER PER USES	RETAIL			LEISURE			MARKET			
	YEAR	2014	2019	2024	2014	2019	2024	2014	2019	2024
25th March Square		12	14	15	3	4	7	2	2	2
Agia Paraskevi Square		2	2	2	2	6	6	4	4	4
Agia Mavra Square		4	2	2	3	4	6	0	1	2

Table 1. Uses per centrality

The above-mentioned businesses are found either on the square or within a radius of less than 100 meters from it. The nearly doubling of leisure establishments along with the increase in retail and food market shops are trends encountered in all three cases. This trend was not -yet- present in other squares of the Municipality.

Proposed centralities

Examining the distribution of existing and emerging centralities in the Municipality, along with a 500meter radius of service for each centrality, we observe that there is a significant overlap across its entire extent of the city, with only two neighborhoods having room for improvement.

The first one is Neighborhood 14. The prominent topography of the neighborhood, located precisely at the foot of Mount Hymettus, as well as the strong boundary formed by Kyprou Avenue, which serves as the main and high-speed axis for vehicular traffic coming from Alimou-Karea Av. towards south Athens, dividing the neighborhood from the rest of the Municipality, result in the relative isolation of the neighborhood. Therefore, it is suggested to explore the creation of a local center in around the Ilioupolis municipal swimming pool, as the pre-existing use already establishes a degree of centrality to the area. The proposal aims to further strengthen this centrality and accommodate the part of the city that is relatively separated from the rest of the municipality.

The second point of low coverage from the existing and emerging centralities is the boundary between Neighborhoods 2 and 3, along which the General Urban Plan (GUP) initially established the use of the neighborhood center. While there is a market operating in the area with some shops, the intense adjacency with Alimou-Karea Av., the increased traffic, and the wide width of the road at this part of the city, have not favored cohesion in operations and the creation of a cohesive centrality up until today.

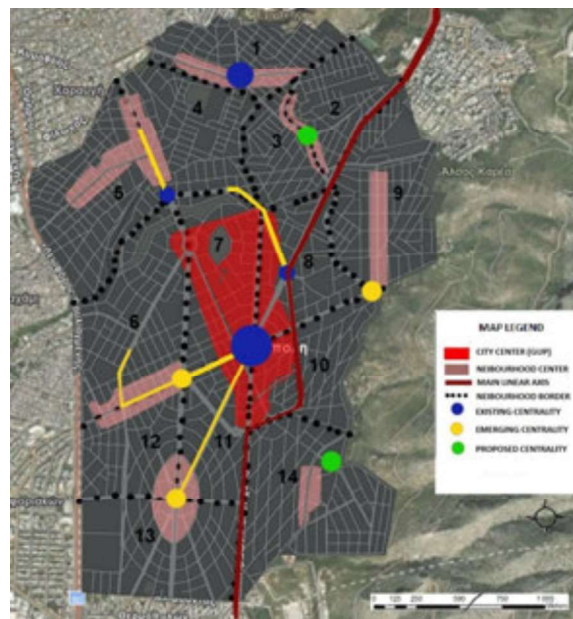


Figure 4. Centralities per type

Model implementation cost and effectiveness assessment

The centralities identified in the study area create a dense network capable of covering the entire Municipality with a service radius ranging from 500 to 700 meters. A total of 7 centralities were identified, and two more were proposed. In proportion to the city's population, which, according to the 2021 census, stands at 76,730 residents, this means that approximately 8500 residents are

served per centrality. During the implementation of the 15-minute city model, it is important to protect specific established features defined by urban planning legislation. This means that the new proposed centralities are not intended to compete with the current commercial center of the Municipality. The Ethnikis Antistaseos Square, representing the municipal center, retains its primary central character in any case, as reflected in the intense overlap of service radius of the neighboring centralities under examination. The goal is to strengthen smaller local units that can maintain a degree of differentiation among them in terms of character, functions, and size.

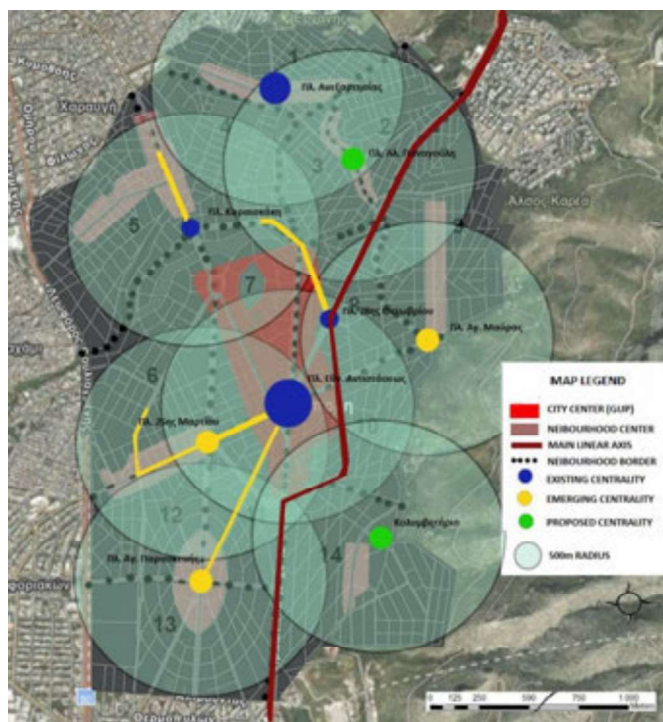


Figure 5. 500m radius per centrality

In this section, we proceed to the parameterization of the centralities according to the desired outcome. This means determining the expected character of each centrality, the desired functions per point, while assessing the degree of satisfaction of the desired condition from the current situation. This comparison will highlight the necessary interventions needed to achieve the predetermined goal for each centrality. These requirements can then be evaluated in terms of cost and effectiveness.

Building upon the functions introduced by the model of K. Moreno for Paris, where the key operating axes were proximity, mixed-use, density, repetition, we observe a high degree of satisfaction of these conditions in the case of the Municipality of Ilioupoli. The city is indeed characterized by a dense fabric with mix of uses and its small scale favors proximity to each center.

In terms of proposed uses, K. Moreno positioned schools at the center of neighborhoods and set the six basic uses that need to be satisfied: residence, work, market, education, health, and

recreation. In the present context, we choose to set open spaces/squares as the center of the unit, which already demonstrate a dynamic concentration of mixed functions. Additionally, while in the case of Paris, where the stronger separation of uses and the size of the city are evident, residence needs to be defined as a default requirement, in the context of the Municipality of Ilioupoli (and the broader Greek cityscape), the function of residence is considered to be satisfied throughout the examined area. Specifically, in the Municipality of Ilioupoli, according to the Operational Program of the Municipality of Ilioupoli [5], which drew data from the 2011 Census, out of a total of 11,885 buildings, only 677 are not used for residential purposes (exclusive or mixed use).

On the contrary, given the inadequate public transportation network in the greater Athens area, which results in increased use of private vehicles mainly for commuting to and from work, it appears that additional public service points and remote working opportunities are much more necessary in the present context.

During the pandemic, three points were highlighted regarding remote work and public service in Greece: a) remote operation without the requirement for physical presence is largely feasible and effective, b) remote work burdens employees with the need to secure a workspace at home, which is not always feasible in terms of living conditions, space, and equipment, and c) there is an inevitable shift of operational costs from businesses to employees.

In this case study, the proposal for municipal remote work operational centers (hubs) ensures a safe environment close to home, allowing employees to have a fully equipped workspace in a common working space open to the public and businesses. The available space can be a public or private building, and private capital can be leveraged with incentives provided to private enterprises. The successful development of such a structure within the Municipality will achieve a reduction in private vehicle usage, decrease commuting time to and from work, create job opportunities for single-parent households and/or young parents, and improve the user's quality of life. All of these are Sustainable Development Goals as adopted by the EU.

However, in the case of examining central Athens or any other city with significant tourist interest, the aspect of residency should revert to the parameters, while the demand for remote work structures would decrease. It should be noted that the exclusion of residency from this specific parameterization does not imply that protective measures for residency should not be considered to the extent that it is estimated that the proposed interventions will affect it (e.g., to avoid the phenomenon of gentrification). These measures should be examined during the stage of establishing the institutional framework for the implementation and execution of the 15minute city model in Greece.

Table2 presents the coverage of functions (YES/NO) per identified centrality in the Municipality of Ilioupoli. The indication "+" is used in case of desired enhancement of the specific use:

CENTRALITIES/USE	RETAIL	LEISURE	MERKET	GREEN SPACES	EDUCATION	HEALTH CARE	REMOTE WOKRING
EXISTING							
Eth. Antistaseos Sq.	N	N	N	N	N	O	O
Aneksartisias Sq	N	N	N	N	N	O	O++
Karaiskaki Sq.	N	N	N	N	N	N	O
28th October Sq	O	N+	N	N	N	O++	O

EMERGING/TO BE ENHANCED							
25th March Square	N+	N	N	N	N	O	O++
Agia Paraskevi Sq	N+	N	N+	N	N	O++	O
Agia Mavra Square	N+	N+	N	N	N	O	O++
NEW PROPOSALS							
Al. Panagouli Sq.	N+	N+	O	N	O	O	O
Swimming complex	O	O	O	N	N	O	O

Table 2. Coverage of functions (YES/NO) per identified centrality

To save resources, specifically concerning public service/healthcare facilities and remote working spaces, a larger radius per central point can be utilized. It is thus proposed a service clustering every three centralities. In this case study, remote working spaces may be established at 25th March square, at Anexartias square, and at Agias Mavras square, while healthcare/public service facilities may be located at 28th October square and Ag. Paraskevis square, in addition to Karaïskaki square, which is in close proximity to the existing municipality's healthcare infrastructure. Even with this proposed clustering for these specific functions, the user's commute will not exceed the one-kilometer limit. Data on employment in the municipality of Ilioupolis, sourced from the Operational Program of the Municipality of Ilioupolis, report that out of a total of 30,527 employees in the municipality, 84.79% are employed in the tertiary sector of services [5]. This implies that even if there is a possibility of remote work for 1 out of 3 employees in the service sector, over 8,500 commutes to and from work are prevented per user.

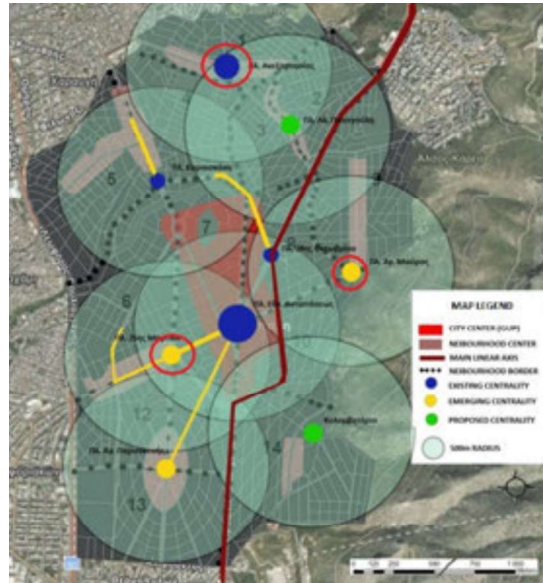


Figure 6. Proposed locations for remote working hubs

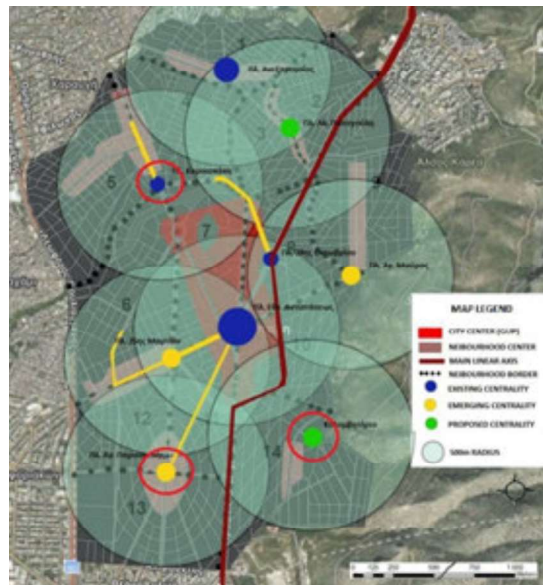


Figure 7. Proposed locations for healthcare facilities

In the previous section, the goals and needs for the operation of centralities in the Municipality of Ilioupolis were outlined. From the table that presented the coverage of functions (YES/NO) per identified centrality in the Municipality of Ilioupolis, we observe that the actual requirements of the local centers mainly involve enhancing existing functions and uses rather

than adding new ones. This ensures that the proposal follows a dynamic already present in the area and guarantees a reduction in potential disruption of balance, as well as an increased likelihood of acceptance by the public.

Specifically, as concluded from the above, the following are required:

Enhancement of existing use:

Retail in 4 centralities
 Leisure in 3 centralities
 Market in 1 centrality

Installation of new use:

Remote working facilities in 3 centralities
 Healthcare/public service in 2 centralities

It should be noted, however, that an exact estimation of the level of enhancement needed is not yet possible, given that both remote work and public service/healthcare facilities are expected to attract daily users to the proposed locations, thus boosting retail and leisure uses to some extent either way. Furthermore, requirements for enhancing uses overlap with the installation of the new uses in all cases except for Panagouli Square, meaning that the city interventions can and will have multiple impact on several sectors.

According to the above analysis, the actions that the Municipality of Ilioupolis should take to support the above scenario are as follows:

- Δ1. Enhancement of commercial, leisure and market uses in the designated areas.
- Δ2. Establishment of 2 healthcare/public service facilities and 3 remote work facilities.
- Δ3. Development of a network between centralities with safe routes that comply with the sustainable mobility principles.
- Δ4. Modernization of regulatory framework to facilitate proposed interventions.

In the table below, we have defined the minimum requirements for promoting the scenario of multiple centralities in the case study of Ilioupoli Municipality. We observe that, apart from the need for equipping, leasing, and/or adapting municipal buildings to accommodate the new uses of healthcare/public service and remote working facilities, there is a strong overlap of requirements per set Action. This implies increased efficiency of the resources allocated to meet each predetermined requirement.

Actions	Δ1	Δ2	Δ3	Δ4
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Costs/Requirements				
Leasing of building infrastructure				
Adapting building infrastructure				
Technical equipment				
Operating costs/Consumables				
Operating costs/Energy				
Incentives for private individuals				
Urban equipment				
Creation/upgrading of pedestrian traffic network				
Upgrade/Enhancement of green network				
Enhancement of public transportation				
Consultation organization				
Person-hours for consultation				
Diffusion of results				

Table 3. Requirements/costs per Action

Furthermore, we observe that overall, the requirements consist of mild-scale interventions that are either explicitly included in existing strategic priorities of the Municipality (e.g., the Operational Program of the Municipality of Ilioupolis 2015-2019) or are part of the requirements arising from compliance with European Sustainable Development goals. This fact, on the one hand, makes such interventions a constant target of the municipal authority and, on the other hand, entails the possibility of securing funding from European sources that will not burden the municipal budget.

It is therefore estimated that the substantial burden that the exploration of the 15-minute city model will impose on the Municipality of Ilioupolis will be small and mainly focused on issues of strategic development and management, consultation organization, resource leverage, and incentive development. In terms of efficiency however, this cost, besides being a constant need of Greek local government at all levels, is estimated to be much smaller in comparison to the benefits that the city and the user will derive in terms of daily living, resilience, risk management, as well as in relation to today's requirements for environmental protection.

Concluding observations

In summary, the examination of the polycentric operation implementation within the Municipality of Ilioupoli, advocating for the 15-minute city model, offers valuable insights into the multifaceted implications of this urban development strategy. By meticulously scrutinizing the identified functions and requirements of the centralities, the study reveals a nuanced understanding of how the proposed approach harmonizes with the existing fabric of the community and aligns with strategic priorities. This alignment not only mitigates potential disruptions but also garners widespread public acceptance.

Furthermore, the delineation of requisite measures to bolster this initiative underscores the municipality's steadfast dedication to fostering sustainable urban growth. Leveraging both established strategic frameworks and available European funding avenues, the municipality demonstrates a proactive stance towards realizing its vision. Despite projections of a modest upgrade in administrative and organizational demands, the anticipated benefits for residents—ranging from enhanced quality of life to heightened resilience and ecological preservation—far outweigh any associated costs.

In essence, the pursuit of the polycentric 15-minute city model epitomizes a forward-looking urban planning practices that places paramount importance on safeguarding the well-being and sustainability of the Ilioupoli community. This progressive approach not only sets a precedent for the region but also holds promise for emulation in other Greek cities, signaling a potential paradigm shift in urban development practices nationwide, if evaluated and implemented correctly and according to the needs of every case study.

It's important to note that the findings presented above are part of an ongoing research endeavor, and as such, the results are not final. While the insights gleaned thus far shed valuable light on the potential benefits and challenges associated with the implementation of the polycentric operation in the Municipality of Ilioupoli and the promotion of the 15-minute city model, they represent only a preliminary analysis. Further in-depth examination and data collection are necessary to fully understand the complexities of this urban development approach. In the subsequent stages of this research, more detailed observations will be made, providing a comprehensive understanding of the implications and outcomes of adopting the polycentric model. Thus, these initial findings serve as a foundation for future exploration and refinement of urban planning strategies in Ilioupoli and beyond.

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