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UTILISING GIS FOR DOCUMENTATION, CONSERVATION, AND SUSTAINABLE MANAGEMENT OF MIDDLE EAST TECHNICAL UNIVERSITY CAMPUS IN ANKARA AS A MODERN PERIOD LIVING HERITAGE PLACE

A.G. Bilgin Altınöz [1]*, T. Halıcı [1], M.A. Türkfiliz [1], E.C. Kara [1], F. Kuş [1], M. Çetiner [1], E.M. Kısaer Koca [1], Ö. Özçakır [1]

[1] METU, Department of Architecture, Graduate Program in Conservation of Cultural Heritage 06800 Çankaya/Ankara, Turkey
(bilging, thalici, turkfiliz.ayca, ceren.kara, fatma.kus, mcetiner, mkisaer, oozcakir)@metu.edu.tr

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ABSTRACT:

The Middle East Technical University (METU) Ankara Campus is one of the earliest and most prominent modern-period university campuses that resulted from an architectural competition in the 1960s in Turkey. However, METU Campus, as a modern-era heritage place, faces various threats, including pressure for new urban development. In addition, the increasing number of students and contemporary educational needs require changes in the physical infrastructure and campus settings. Thus, all these threaten the tangible and intangible values of the Campus. In this regard, conserving the METU Campus requires a multidimensional approach that considers a wide range of values and problems; herein, the Geographic Information Systems (GIS) becomes a useful tool for dealing with this complex work. Accordingly, the METU Campus GIS Project [METU_GIS] was developed to document and understand the multidimensional characteristics of the METU Campus, assess its values, and propose solutions to current issues while considering its values and potentials. Accordingly, the METU_GIS defines conservation policies and strategies that ensure the conservation and sustainability of the Campus as a living modern heritage place. Furthermore, the METU_GIS is a GIS-based conservation management plan created for a modern period campus for the first time in Turkey. Hence, it became an essential basis and a tool for conserving and managing the METU Campus as a modern living heritage place. All in all, the METU_GIS proves that Geographic Information Systems (GIS) are essential tools that can be used in the documentation, conservation, and monitoring of modern heritage places.

1. INTRODUCTION

The Middle East Technical University (METU), once located on the outskirts of Ankara, encompasses a vast area of approximately ten thousand hectares, which includes a lake, an archaeological site, an educational zone, social facilities, recreational areas, and natural landscapes. Since its design and construction in the 1960s, it has maintained its integrity and continuity with its distinctive educational and architectural characteristics. Moreover, with its exceptional academic standards and socio-political context, METU has emerged as a prominent institution in Turkey.

The construction of the Middle East Technical University (METU) Ankara Campus was a remarkable achievement "in a country trying to industrialize and having no building industry" (Akman and Bilgin Altınöz, 2015). It is a symbol of modern heritage and one of the earliest Republican Period university campuses in Turkey. The METU Campus is one of the outstanding examples of a modern heritage place that conserves the continuity and integrity of its large area while displaying the interconnectedness of its natural, human-made, educational, archaeological, cultural, and social features. The Campus possesses a distinctive and pioneering architectural style utilizing various materials, techniques, and patterns. Its relationships with other built-up, open, and semi-open spaces and its integration with the topography further contribute to its uniqueness. The Campus's built environment comprises brutalist buildings designed in the International Style, representing the architectural characteristic of rationalism. These buildings serve various functions, including education, accommodation, administration, and sports.

Moreover, the METU Campus represents the characteristics of the modern architecture approach by integrating artworks and in-situ furniture as components of the buildings and open spaces. Therefore, the Campus is a cultural landscape that carries a wide range of values, such as; architectural, aesthetic, and technical, with its modern heritage buildings and the built environment; natural values with the afforestation work and the Eymir Lake; and archeologic value with its archeologic sites and the museum. In addition, the Campus has been the basis and an integrated part of the social-cultural opportunities and activities offered by the education that has been given at the METU since 1956. For this reason, the Campus has an important place in social memory. Thus, the METU Campus is an important cultural heritage place for Ankara and Turkey according to its educational, social, and cultural values, collective memory, suitable natural and built environment, and archaeological sites.

However, the cultural, ideological, economic, and social development and change, the growing student population, and the demands of modern education threaten the tangible and intangible values of the METU Campus. Accordingly, it is required to develop strategies that consider the Campus as a whole, contributing to its significance as a modern heritage place within its integrity and authenticity. In this sense, the conservation of the METU Campus necessitates a multifaceted strategy that considers the wide range of values and challenges, spanning from tangible to intangible and in different scales. Furthermore, in the conservation of this multidimensional modern heritage, its requirements may vary and not be fulfilled over time. Thus, a large set of data had to be reevaluated. Therefore, the METU Campus GIS Project [METU_GIS] is

* Corresponding author

built to be used to comprehend, document, and evaluate the campus' multi-dimensional features and values; to identify solutions to present issues by considering the campus' characteristics, potentials, and values; and to develop conservation policies and strategies that ensure values, and to develop conservation policies and strategies that ensure the campus' sustainability as a living example of modern heritage. The information about the architectural, archaeological, natural and social components of the METU Campus is gathered and spatially documented during this process using the GIS database. Also, this project played a leading role with its methodology and results as the first GIS-based conservation management plan created for a modern period campus in Turkey.

2. METHODOLOGY

In parallel with the multidimensional context, characteristics, and values of the METU Campus, the project was carried out in two stages, consisting of researchers specialized in different disciplines, focusing on various aspects. The first stage of the project was initiated in February 2014 and aimed to create the "METU Campus Spatial Value Information System" by systematically identifying and documenting the existing values of the METU Campus to serve as a fundamental framework for future conservation efforts. As a result, it revealed the values of the campus and memory places according to the views of different stakeholders, and the project was concluded on December 31, 2015. The second stage was handled between March and July 2021 and aimed to enhance the GIS-based decision support system established in the first stage by updating, detailing, and monitoring the collected data. Subsequently, the gathered information was processed to create the METU_GIS Project, titled "Determination of the Values of the METU Campus Based on Conservation."

Figure 1. The site plan of the METU Campus by Altuğ and Behruz Çinici (Salt Archive, Altuğ-Behruz Çinici Archive).

2.1. Archival and Literature Study

In order to conserve, plan, develop, and manage the METU Campus as a cultural heritage site, it is necessary to systematically identify, document, present, and share all its values in a holistic and participatory approach. As part of this framework, extensive archival research was carried out. The Campus Library, public records, and archives of different institutions were the primary sources. In addition, a literature review was also conducted among the publications about the METU Campus. Related publications have a significant place in Turkey's history, theory, and practice of modern architecture.

Accordingly, old photographs, original drawings, aerial photographs from the 1960s onwards, previous research findings, and project data related to the METU Campus were compiled for documentation. The obtained data has been systematically organized and incorporated into ArcGIS Software, a flexible and continually evolving environment that allows for the inclusion of new materials.

2.2. Field Survey

The METU_GIS covers the original Campus design of Altuğ and Behruz Çinici dated 1961. The Project concentrates on the buildings and open spaces clustered around the *Alle* (Figure 2), which is the main backbone of the Campus and the pedestrian circulation line.

Figure 2. The *Alle* of the METU Campus: photo from the 1960s (top: Salt Archive, Altuğ-Behruz Çinici Archive) and a photo from 2021 (bottom).

In this context, a detailed study was conducted to collect data on the natural and built environment of the Campus with the participation of researchers from the METU Graduate Program in Conservation of Cultural Heritage. A 10-day field study was conducted between 26 March and 4 April to collect the spatial data of the METU Campus for the GIS environment. This survey was carried out under Covid-19 pandemic restrictions with getting special permissions. Three different survey sheets were prepared and used to examine the facades and plans of the structures and the open spaces.

Figure 3. Photos from the field survey in 2021.

2.3. Stakeholder Meetings and In-depth Interviews

In the Project, participatory approaches were used to collect data on the values and problems defined by the users of the METU Campus. This process documents tangible, intangible, cultural, structural, or natural components and user values. In 2014, focus group meetings were conducted with stakeholders to identify spatial values, the relationship between users and the space, and the values they attribute to the Campus. These meetings were organized with an emphasis on ensuring the participation of representatives from different units, thereby preventing the formation of homogenous groups with similar value judgments. An online survey was also conducted with a broader group, including alumni, to determine the values and places of memory. Furthermore, in 2021, in-depth interviews were conducted with administrative staff, academic staff, and faculty members to comprehend the relationships between the buildings, open spaces, and the users of the METU Campus, as well as to identify the values attributed by the users to the campus during the restrictive Covid-19 pandemic conditions.

Figure 4. Photos from focus group meetings in 2014 and in-depth interviews in 2021.

2.4. Geographic Information System (GIS)

The conservation of the METU Campus required a multifaceted strategy necessitating a system that allows storing, organizing, and analyzing various features at different scales. For instance, extensive data was gathered during the archival research, literature review, field survey, meetings, and interviews. This information had to be categorized and assessed to understand and analyze values, problems, and potentials; and define conservation strategies. In this context, Geographic Information Systems (GIS) emerged as an essential tool to address such complex tasks.

Besides documenting, analyzing, and presenting the information as spatial data, GIS enables integrated analysis and evaluations by associating all information with each other. In this context, the METU Campus Conservation Project was developed as a GIS-based project, designed as a flexible and adaptable system capable of accommodating future alterations and developments.

3. METU_GIS: A DECISION SUPPORT SYSTEM FOR DOCUMENTATION, CONSERVATION, AND SUSTAINABLE MANAGEMENT OF METU CAMPUS

In the METU Campus Conservation Project, the "Esri ArcMap 10.4.1" GIS software was used for the collection and spatial documentation, analysis, and presentation of collected information. All data relating to the Campus's natural, architectural, archaeological, historical, and social features were structured in ArcGIS.

3.1 Defining the Project

METU Campus, one of the pioneering and original examples of the modern era, is a living cultural landscape with various contexts and components. The main goal of METU_GIS is to protect the project area, which is at risk of losing its existence, integrity, and continuity due to problems and threats from humans, nature, development, and management factors. To achieve this goal, all components of the campus were examined at different scales for the geodatabase (Figure 5,7).

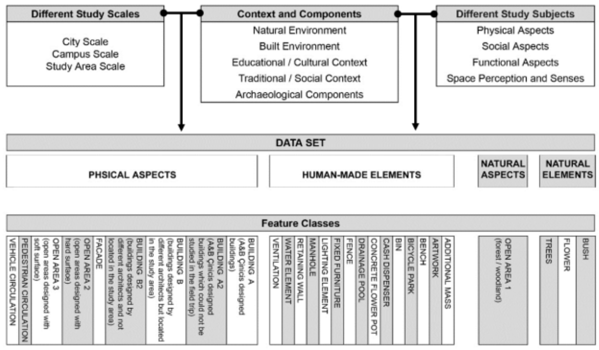

Figure 5. The project model of the geodatabase.

3.2 Creating the Project Model

Before entering the collected data, CAD drawings, historical aerial photos, original plan drawings, and maps gathered from the archival study were rectified through The World Geodetic System 1984 (WGS84) coordinates (Figure 6).

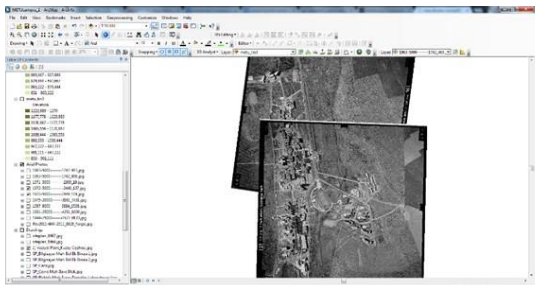

Figure 6. Georeferencing the aerial photos in ArcGIS.

The data set is categorized into two main sections: the natural and built environment. Natural aspects and natural elements are designated as subheadings for the natural environment. Similarly, physical aspects and human-made elements are introduced for the built environment. During the field survey, the visualization of each element, which would be entered in GIS, was determined. Accordingly, the visual representation of the data is defined as a point for the presence and location of the data, as a line if the data has physical boundaries, and as a polygon if the data defines an area.

Rectified materials were checked against any mistakes, changes, and other needs before the data entry process. As a result, several revisions, such as adding the missing geometries, were made in GIS software. Moreover, although there is an existing drawing, it was noticed that different data should be entered on the same item. For instance, for the façade data, a two-step procedure was followed. Initially, the building polygon was duplicated, and subsequently, this geometry was converted to a line format.

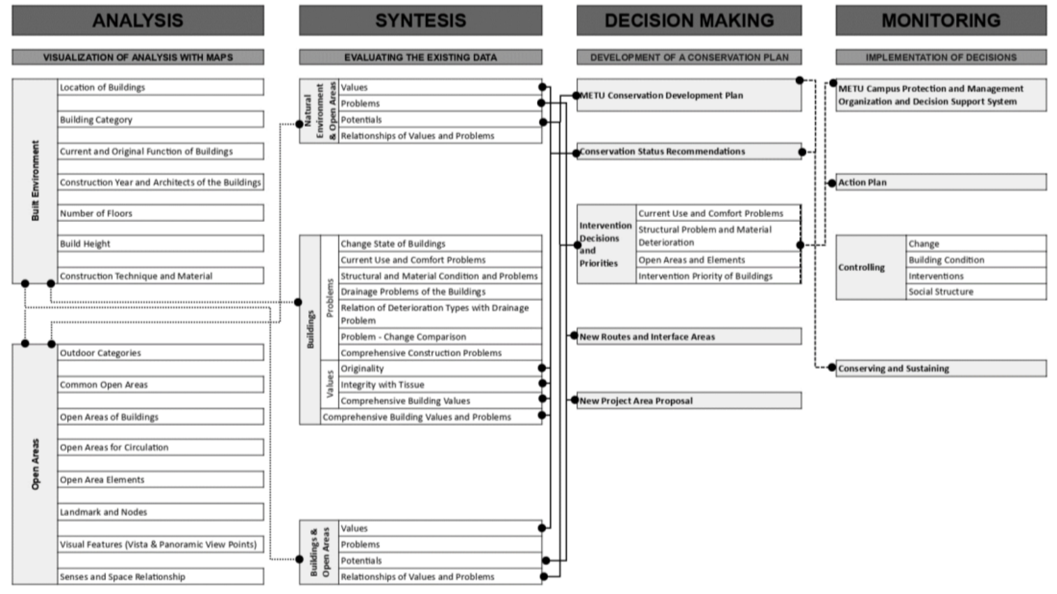

Figure 7. The mental model of the geodatabase.

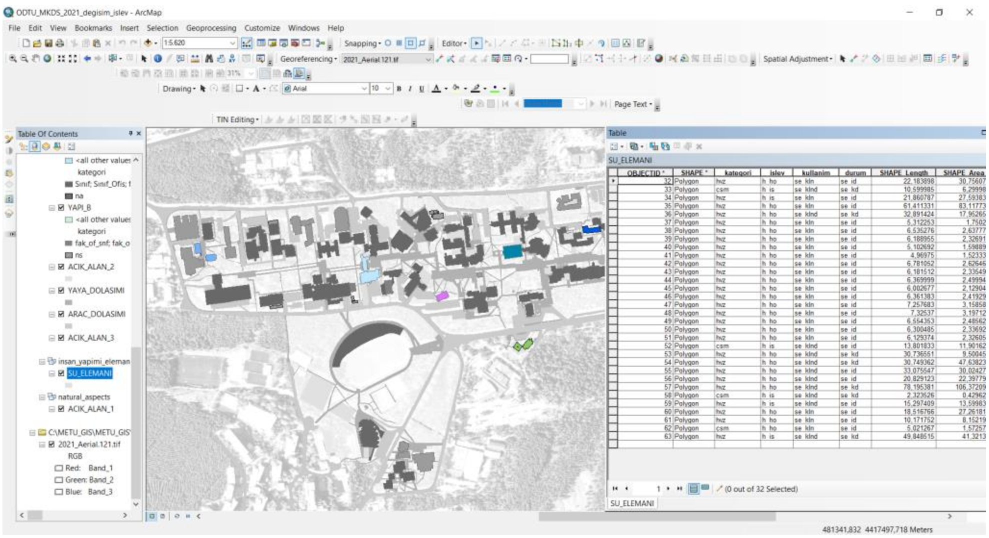

Figure 8. Attribute table used in the data entry process.

3.3 Analyzing the Data

The classified data was transformed into a database (Figure 8.) by utilizing ArcCatalog 10.4.1 software which is a plugin of Esri ArcMap 10.4.1.

Once the collected data were merged, their relationship was also examined. For instance, if building problems need to be addressed, it was seen that one problem could be the cause or result of another problem, and accordingly, the problem data were associated with each other. In another example, information about the change in the buildings in terms of plan, mass, and facade was collected, and the overall change status was determined by relating these data with each other (Figure 9.). For example, associating the problem data with value data assisted in prioritizing interventions in the decision-making process.

Change in Façade and in Mass		Change in Mass				
		K1 No change	K2 Minor changes that do not disturb visual relationships and do not prevent perceiving the design of the mass (wires and canopies)	K3 While preserving the outline and design of the mass, adding vertical elements such as a fire escape	K4 Major changes that alter the perception of mass, such as adding floors	K5 Unreadability of the original design of the mass / major changes (added steel mass to the existing building)
Change in Façade	C1 No change / Minor changes in façade covering	A1	A1	A2	A3	A4
	C2 Change in façade covering / Minor changes in architectural elements (original dimensions are conserved, but the material was changed)	A1	A2	A2	A3	A4
	C3 Change in façade covering / Major changes in architectural elements (original sizes, materials and openings were changed	A3	A3	A4	A4	A4
	C4 Major changes in architectural elements / Minor changes in mass (elevator etc.) façade organization is partially readable	A4	A4	A5	A5	A5
	C5 Façade organization is changed majorly and cannot be read	A4	A5	A5	A5	A5

Figure 9. Matrix of the change analysis in façade and mass.

3.4 Presenting and Sharing the Results

Through ArcGIS, maps showing the analyses were created based on the meta-data in the geodatabase (Figures 10-13.). Subsequently, other maps were created to visualize the correlation of different data.

In ArcGIS, maps giving information about both tangible and intangible components of the Campus were produced. In addition to the 2-dimensional map, 3-dimensional analyses such as slope, height, and number of floors are easily visualized thanks to the database. Moreover, the subject of senses affecting the perception of space has also been discussed, and maps based on the senses of smell and sound, which detect the natural components of the campus, have been produced in addition to the sense of sight (Figure 12.).

The values, problems, and potentials identified within the study area were transferred to the database and represented through detailed mapping. The results of the GIS-based analysis were used to prioritize potential interventions. Ultimately these analyses contributed to developing an action plan to define conservation principles, strategies, implementation decisions, and actions.

3.5 Monitoring the Data

Throughout the project, the comparison between the data from 2014 and the current 2021 revealed that the GIS could effectively be utilized to monitor changes, identify problems, and assess the needs of the Campus. Consequently, the METU GIS and its findings, as in a book and database format, were shared with the university Administration for their usage to maintain and monitor the METU Campus as a contemporary living modern heritage place.

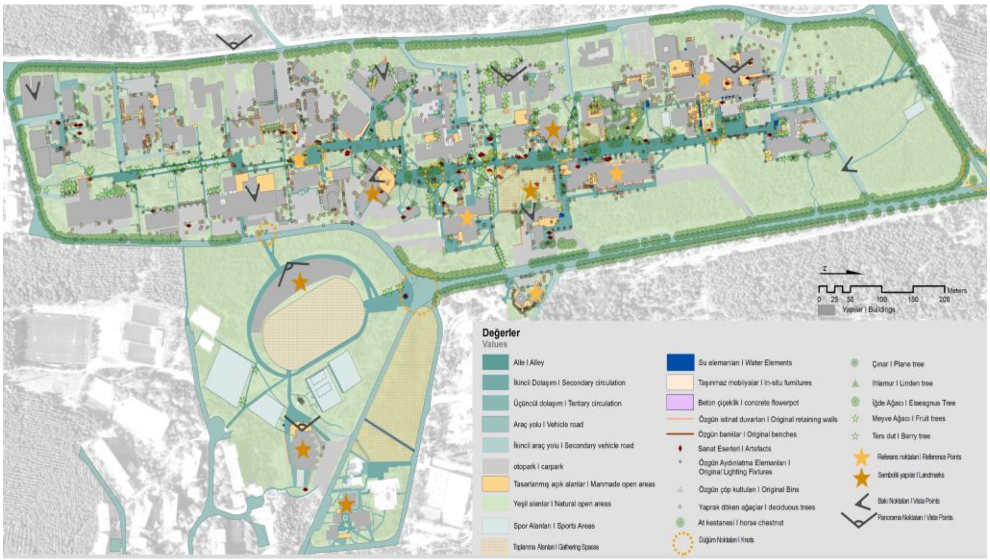

Figure 10. The map of the values of the METU Campus, produced in ArcGIS.

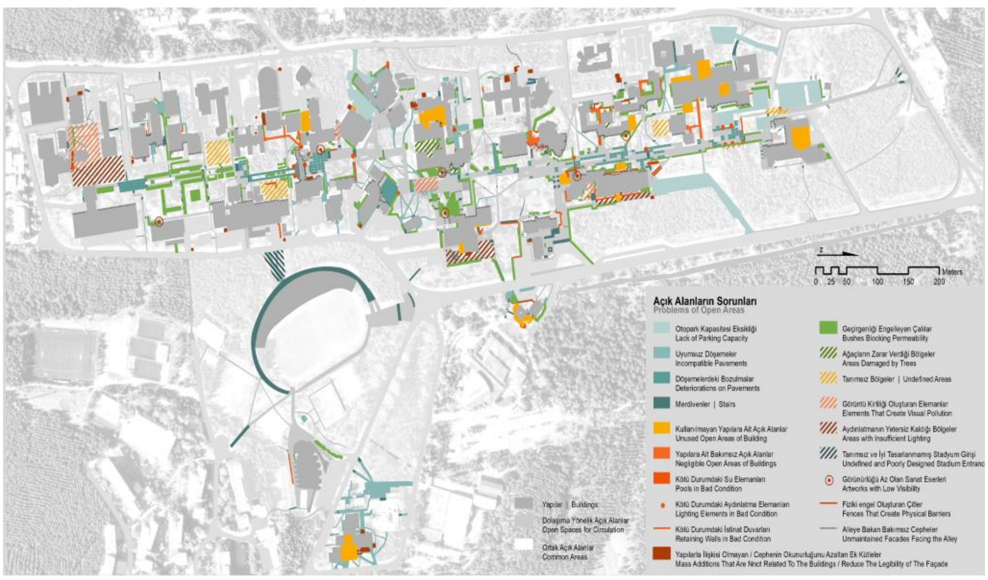

Figure 11. The map of the open area problems of the METU Campus, produced in ArcGIS.

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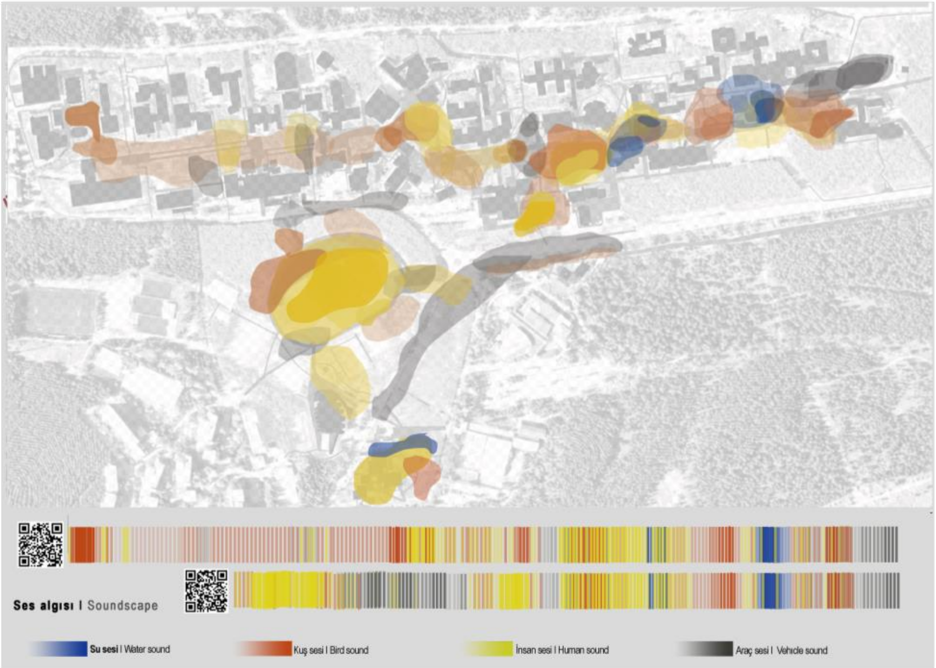

Figure 12. The map of the soundscape, produced in ArcGIS.

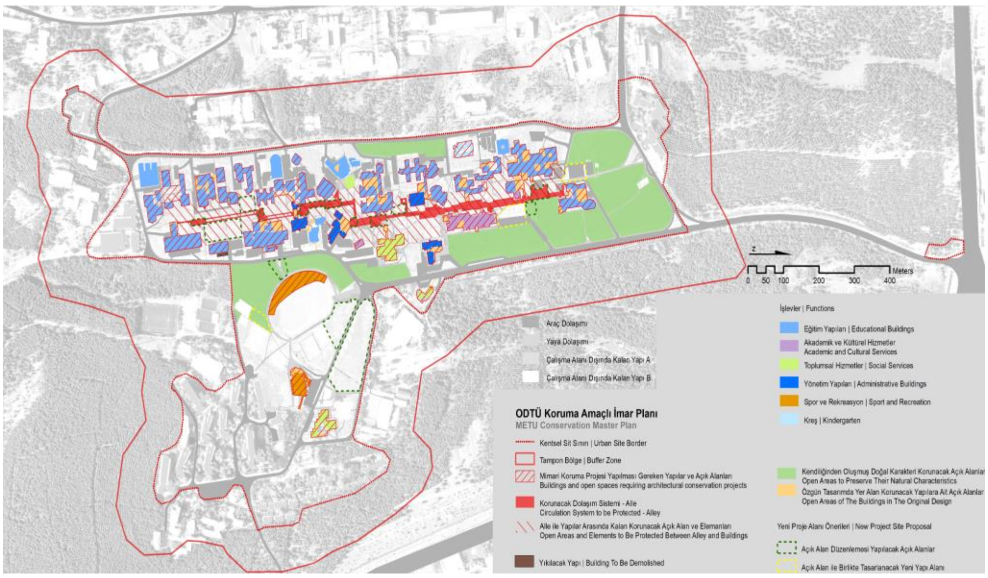

Figure 13. The map of the conservation strategies, produced in ArcGIS.

4. RESULTS & DISCUSSIONS

In the METU_GIS, ArcGIS played a significant role as a vital component of the project enabling the storage, structuring, processing, evaluation, presentation, and sharing of spatial and complex data. The Project was designed as a flexible and adaptable system that accommodates future alterations and developments. The software's data storage and management capabilities have provided the means to store, structure, analyze, and visualize numerous data related to the natural and built environment of the Campus, in the form of thematic maps. Although the advantages have been mentioned, the disadvantages of ArcGIS were also encountered throughout the process.

To begin with, using ArcGIS in the Project has facilitated the storage analysis and presentation of information in a geodatabase. Within the ArcGIS platform, the geodatabase includes evidence-based geospatial data about both material and immaterial aspects of the METU Campus, derived from archival research, field survey, interviews, and focus group meetings. The user interface allows for the examination of data interrelationships through techniques such as overlapping, classifying, and systematic organization of data outputs. Consequently, the spatial analysis is effectively visualized through the creation of maps. Within ArcGIS, multiple features can be mapped simultaneously and structured within a template. In the context of the Project, these superposed maps were instrumental in identifying values, problems, and potentials, thereby informing proactive conservation measures.

Moreover, ArcGIS has widespread usage across various disciplines for spatial analysis and data management, offering significant advantages in integrating and combining data from different sources, facilitating collaboration among users, and providing access to tutorials and online resources for problems. The METU_GIS project has greatly benefitted from these advantages, especially the multiple working environments. Each participant contributed diverse attributes for different feature classes; subsequently, these individual files were merged and integrated. Additionally, the data storage capabilities of ArcGIS facilitated effective project monitoring, as exemplified in the case of METU_GIS. The geodatabase for the METU_GIS project was established in 2014, and subsequent updates and improvements in 2021. Remarkably, the geodatabase is open to new data entries, ensuring its adaptability and continued relevance.

On the contrary, when examined from different perspectives, ArcGIS exhibits certain disadvantages. Firstly, the data entry process is susceptible to minor errors and can be time-consuming. Great caution must be taken while entering data attributes, as even a single typographical error, such as the incorrect capitalization of a letter, can lead to inaccuracies in the system during map creation. Furthermore, resolving data compatibility issues to merge and harmonize data obtained from different sources and in other formats necessitates additional effort and time, which constitutes another disadvantage of the program. Moreover, data entry constitutes the most extended process in the ArcGIS workflow. For instance, in METU_GIS, in 2021, the data entry for the dataset took a month to finalize. Secondly, combining different ArcGIS files requires careful attention; any minor mistakes could result in data loss. During the METU_GIS project, each team member created files labeled with their names and dates to avoid any issues while merging files. Furthermore, ArcGIS necessitates a substantial amount of storage space as the geodatabase can potentially occupy a significant portion of computer memory, potentially preventing the launch of other software applications.

To conclude, despite its technical disadvantages, ArcGIS is a valuable GIS software for collecting, processing and analyzing diverse data from various sources. Within the context of the METU_GIS project, ArcGIS has emerged as a guiding tool for making informed conservation and management planning decisions.

5. CONCLUSION

The METU_GIS has played a pioneering role in terms of its methodology and outcomes as the first GIS-based conservation management plan developed for a modern-period university campus in Turkey. Furthermore, the project has ensured that all historical, recent, visual, and written sources related to the METU Campus are collected through a comprehensive archive and literature research. These data were systematically classified and stored in a digital dataset, while the information gathered during the site survey was transferred to the ArcGIS database.

In addition, the 2021 METU GIS Project provided both the monitoring and updating of the existing data, collected since the project initiation in 2014, of the spatial characteristics and the components of the natural and built environment. As a result of these studies, the METU Campus GIS database has been created, serving as a repository for all the data collected about the METU Campus within the GIS environment, utilizing ArcGIS. This system encompasses the historical data obtained regarding the METU Campus and all the data collected throughout the process. The creation of the multi-layered spatial information system has provided a base upon which future studies and new data can be seamlessly integrated. Moreover, this system can be effectively utilized by management and regularly updated to accommodate changing data for future projects.

GIS has demonstrated its capability to efficiently process large datasets in studies such as the one conducted at the METU Campus. The swift processing capabilities of GIS have proven invaluable in handling the extensive data associated with the campus. This project is compelling evidence that GIS is a highly useful tool for collecting, processing, and analyzing the tangible and intangible aspects of conservation projects.

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