Analysis of hydrotechnical data for the sewerage system through GIS for the city of Prizren

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INTRODUCTION

The use of geographic information systems in the management of wastewater services has an impact on improving services by creating and facilitating conditions in the management of the wastewater system. Since the wastewater system for the city of Prizren is complex and consists of various hydro-technical objects, including sewage lines, pumps, discharge points, etc., collecting data for these objects and processing them using applicable software creates the possibility for data analysis and presentation of results in real-time with great accuracy. Access to the collection and processing of hydro-technical data and their integration requires professionalism and dedication. Based on this, an organizational structure has been created that presents working groups and job descriptions for these groups with the aim of developing this study. Continuous monitoring of the study development phases is considered a key point of the study's activities.
Identification and categorization of priorities for investment are considered a process that contains challenges towards finding rational solutions through GIS and integrated software platforms. Possession of hydro-technical object data from the sewage system integrated into GIS enables presentation in collaboration with the Kosovo Cadastral Agency in the national geo-portal of the Republic of Kosovo, in which every individual or interested group can access information.

METHODS

When conducting an analysis of hydrotechnical data for the sewerage system in the city of Prizren using GIS, we employed several research methods. These methods were instrumental in exploring the intricacies of the sewerage system and understanding its performance.
Here are some of the common methods we utilized:

- **Data Collection**: This method involved gathering relevant hydrotechnical data pertaining to the sewerage system in Prizren. We collected data from various sources such as surveys, satellite imagery, topographic maps, and existing databases.
- **Data Integration**: Once the data was collected, we employed data integration techniques to merge and combine different datasets. This allowed us to create a unified and comprehensive dataset for the sewerage system in Prizren.
- **Spatial Analysis**: Spatial analysis techniques were utilized to explore the spatial patterns and relationships within the sewerage system. We conducted proximity analysis to determine the spatial relationships between sewerage infrastructure and other features like rivers, roads, and buildings.
- **Network Analysis**: Network analysis was a crucial method in examining the connectivity and flow of the sewerage system. Using GIS tools, we analyzed the network topology, identified bottlenecks, and assessed the capacity and efficiency of the system. This analysis aided in identifying areas prone to blockages, backups, or other operational challenges.
- **Visualization and Reporting**: To communicate our findings effectively, we employed visualization techniques to create maps, charts, and graphs. These visual representations helped stakeholders comprehend complex spatial relationships and patterns within the sewerage system.
- **Validation and Verification**: To ensure the accuracy and reliability of our analysis, we implemented validation and verification procedures. We cross-checked our results with ground truth data, conducted field visits to validate our findings. This rigorous process strengthened the credibility of our analysis and ensured the reliability of our conclusions.

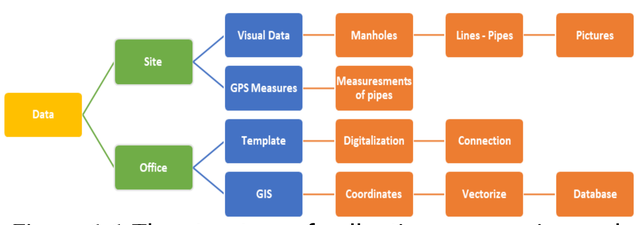

Figure 1.1 The structure of collection, processing and integration of sewage system data for the city of Prizren

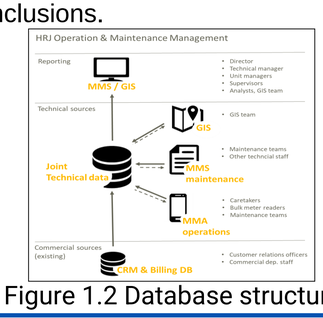

Figure 1.2 Database structure

RESULTS

In the management of the wastewater system, the main part is the planned maintenance of the sewerage network, an application which was developed during the study phase that will affect the prevention of emergency situations in terms of operational functioning.
After the consolidation of the sewage network in the GIS system and comparison with the assets registered in the asset database, it was identified that about 15.2% (figure 1.1) of the sewer lines were not part of the asset database. None of the sewerage manholes have been registered in the asset database, while now 4244 manholes have been entered into the database through the GIS system, it is now estimated that 98% of the sewage system manholes have been integrated into GIS system while 2% or 86 manholes, field teams for data collection do not have access to obtain information as a result because these manholes are located in private properties.

Based on the information presented by the GIS system, the sewage network has been identified, where the red colored lines (figure 1.3) are categorized as non-functional lines and based on this categorization, they are planned by the service provider to be replaced with new sewage lines. This length is 8.2 km in the downtown area of Prizren, problems have been identified and the GIS system categorizes this length of 8.2 km as non-functional.

As a result of this study is also the use of new technologies such as augmented reality for the sewage system in the city of Prizren.

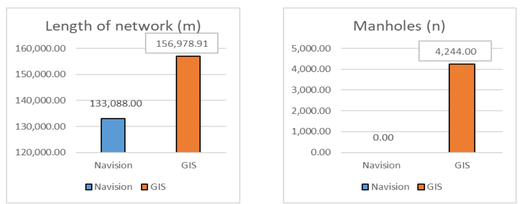

Figure 1.3 Comparison of sewer network data by GIS office and asset office (Navision)

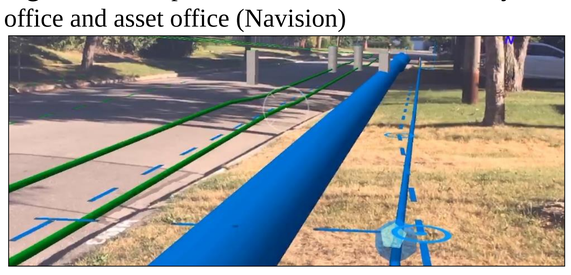

Figure 1.5. “Augmented Reality”

Figure 1.4 Lines for rehabilitation

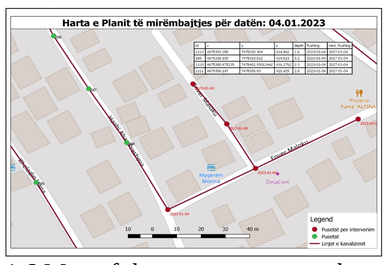

Figure 1.6 Map of the sewerage network maintenance plan for the city of Prizren compiled in the GIS system

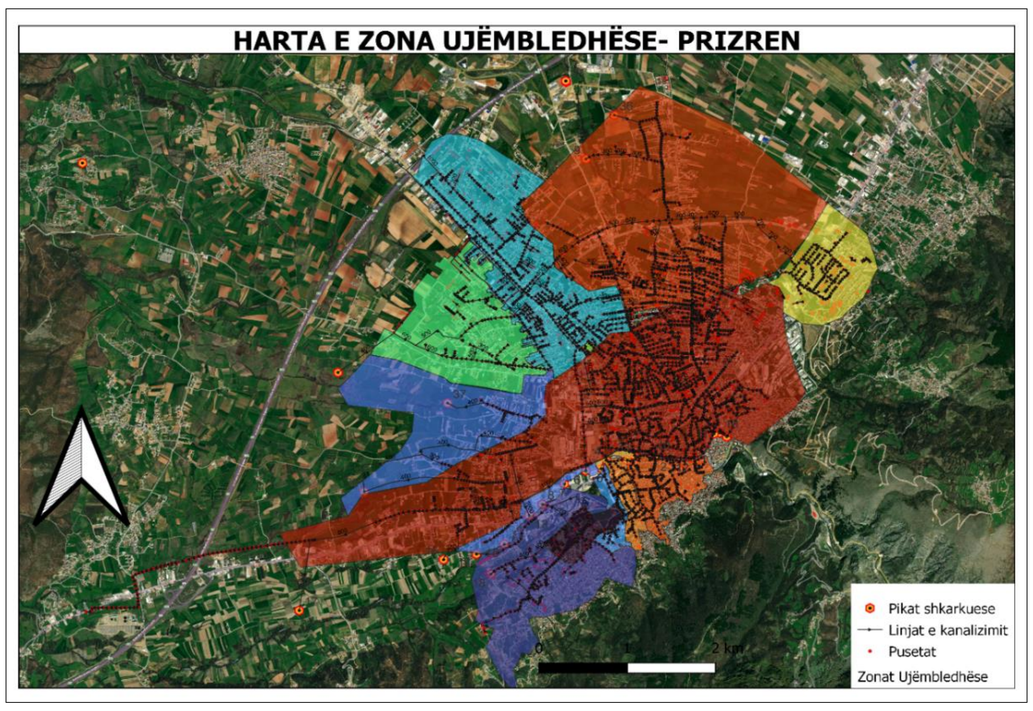

Figure 1.7 Map of sewage catchment areas in the city of Prizren compiled in the GIS system

DISCUSSION

The challenges we face, approach to facing these challenges is considered essential towards achieving results in overcoming these challenges in the sector of collection and treatment of waste water.

The service providers of the wastewater system continuously face challenges which affect the stagnation towards the development of the service providers. Technological developments, their application in the hydrotechnical facilities of the sewerage system facilitate the development processes and at the same time influence the creation of a history through data archiving, their updating and the generation of reports, the service provider in the study area KRU "Hidroregjioni Jugor" Sh.A is faced with a lack of information about the wastewater system.

Depending on the technological developments, all the data available in the wastewater database for the city of Prizren can easily be integrated into the future developed systems, and also with the available data, the possibilities of developing hydraulic models are created. This modeling enables the identification of the critical points of the system in terms of hydraulics and the continuity of the sustainable flow of waste water within the sewerage system.

CONCLUSIONS

The general objective of this study is the impact of the implementation of GIS technology on the digitization of data for the sewage system for the city of Prizren, as well as further analysis as an important step in terms of planning and decision-making.
An integral part of this work are the recommendations for the sewage system which were identified during the development in three phases of the work, the phase of collection, integration and use of data which are recommended for the service provider and interested parties, these recommendations are listed as lower:

- Application of the practices of this study in the development of the wastewater sector,
- Continuous control in the application of the operation of the software in updating the data,
- Development of professional capacities in the application of GIS,
- Rationalization in the selection of applicable software,
- Consolidation of the asset database in the GIS system in such a way that the information is provided from here.
- The use of technical analyzes provided by GIS for the sewerage system,
- Use of "Argued Reality" (3D) technology,
- Surveying sewer lines with cameras and Radar and incorporating them into the GIS database,
- Continuity in updating current data,
- The application of the "Underground Radar" system and the connection with the GIS system and
- Publication of these data on the state geoportal of the Republic of Kosovo

1. ArcGIS Blog. 2018/10/2. Manage content users. https://blog.esrij.com/2018/10/22/post-31562. [1]] 2. Arcgis.com: 2022. Introduction to Sewer Data Management. https://doc.arcgis.com/en/arcgis-solutions/latest/reference/introduction-to-sewer-data-management.htm [22] 3. Arctur D. and Zeiler M., 2004. Designing Geodatabases : Case Studies in GIS Data. Esri Press. [36] 4. Carver, C. S. (1998). Resilience and Thriving: Issues and Models and Linkages. Journal of Social Issues [38] 5. Kropla B., 2005. Beginning MapServer: Open Source GIS Development (Expert's Voice in Open Source). Apress . [37] 6. KRU “Hidroregjioni Jugor” Sh.A. 2021. Raporti vjetor 2021. https://hidroregjioni-jugor.com/wp-content/uploads/2022/08/220218_HJ_-RAPORT-VJETOR-JANAR-DHJETOR-2021.pdf. [3] 7. KRU “Hidroregjioni Jugor” Sh.A. 2022. Raporti i laboratorit [6] 8. KRU “Hidroregjioni Jugor” Sh.A. 2022. GIS Office [34] 9. Meha.M. 2020. Kadastri shumëdimensional, sistemi i informacionit të tokës dhe gjeoinformacioni. Botues UP Prishtinë. [9] 10. Shamsi, U.M. 2004. “GIS Applications for Water Distribution System/AccuracyofSpatialData ë21]

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