Group B-3 | Optimizing Campus Resource Management through Digital Twins: Conceptualization and Implementation

COA SHOWCASE

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Digital Twins (DTs) are becoming increasingly important tools for enhancing efficiency and decision-making within various sectors of the built environment. Their ability to replicate and simulate real-world systems in a digital environment offers significant potential for optimizing operations, improving resource management, and supporting data-driven planning. However, despite their growing relevance, several challenges hinder the broader adoption of DTs. Key issues include high costs, the complexity of implementation, difficulties in ensuring interoperability across different systems, and the challenge of integrating diverse data sources into a unified model. This research presents an innovative interactive visual analytics system designed to address these challenges. By applying it to a case study involving the simulation of class distribution and campus building capacity at Texas A&M University, we explore how DTs can be used in educational environments to optimize spatial and temporal resource management. The system converts enrollment data into a spatial-temporal format, allowing users to explore and analyze class distribution, resource utilization, and capacity constraints interactively. This format enables decision-makers to visualize trends, identify inefficiencies, and make informed adjustments to optimize building use and scheduling. The integration of visual analytics within the DT framework provides an accessible and user-friendly interface, making it easier for stakeholders without technical expertise to engage with the system. This adaptability is one of the key strengths of the proposed solution, as it ensures that the insights generated can be understood and acted upon by a broad range of users. Through the case study at Texas A&M University, we demonstrate the system's effectiveness in addressing real-world challenges, such as overcrowded classrooms and underutilized spaces. The system offers a practical approach to implementing DTs in educational settings, bridging the gap between complex data-driven technologies and their real-world applications. Our findings suggest that DTs, when coupled with interactive analytics, can significantly improve the management of built environments, making them more efficient, responsive, and adaptable. This research contributes to the growing body of work focused on practical DT implementation and offers a roadmap for overcoming the current limitations in this emerging field.