

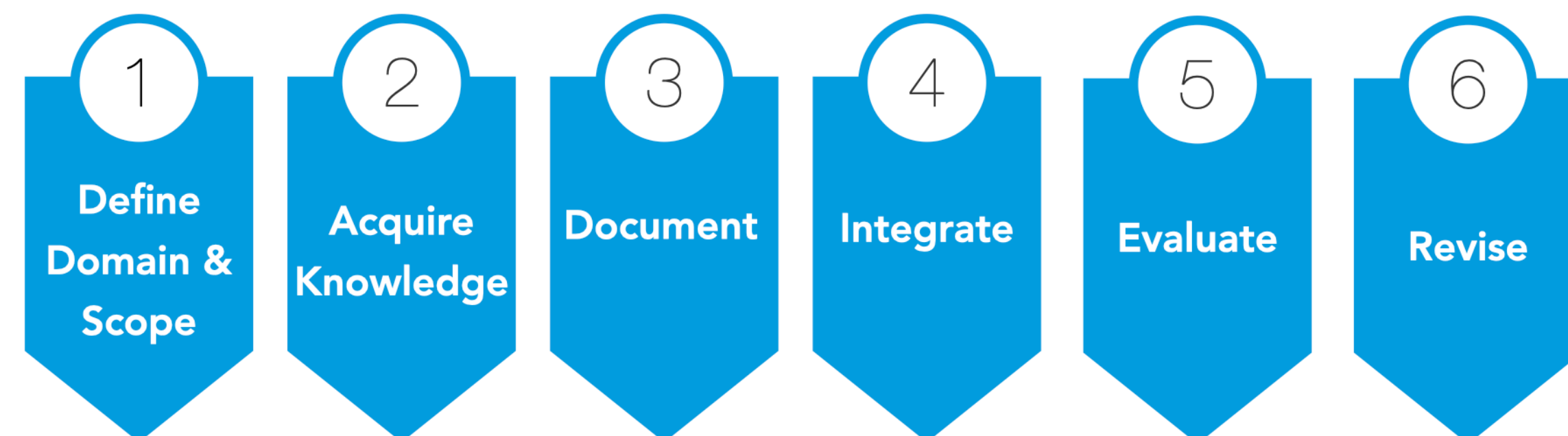
## ARCHITECTURAL ENGINEERING

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### Abstract

Operations and maintenance (O&M) costs represent a significant portion of a building's total lifecycle expenses. Digital twins (DTs) have emerged as a transformative technology, offering centralized operational data, real-time monitoring, and management tools for assets. This poster highlights the imperative need to understand and effectively leverage DTs for O&M. It proposes a categorical approach for defining DTs and introduces an ontology for DT use cases in the Architecture, Engineering, Construction, and Operations (AECO) industry. This ontology aims to enhance stakeholder communication and ensure practical relevance. Additionally, a data schema for documenting and communicating DT use cases consistently is proposed. Lastly, a process is introduced for designing and planning for DTs. By presenting real-life examples of DTs and their operational use cases, this poster provides valuable insights for both academic and practical adoption, advancing the understanding and application of DT technology in the AECO industry.

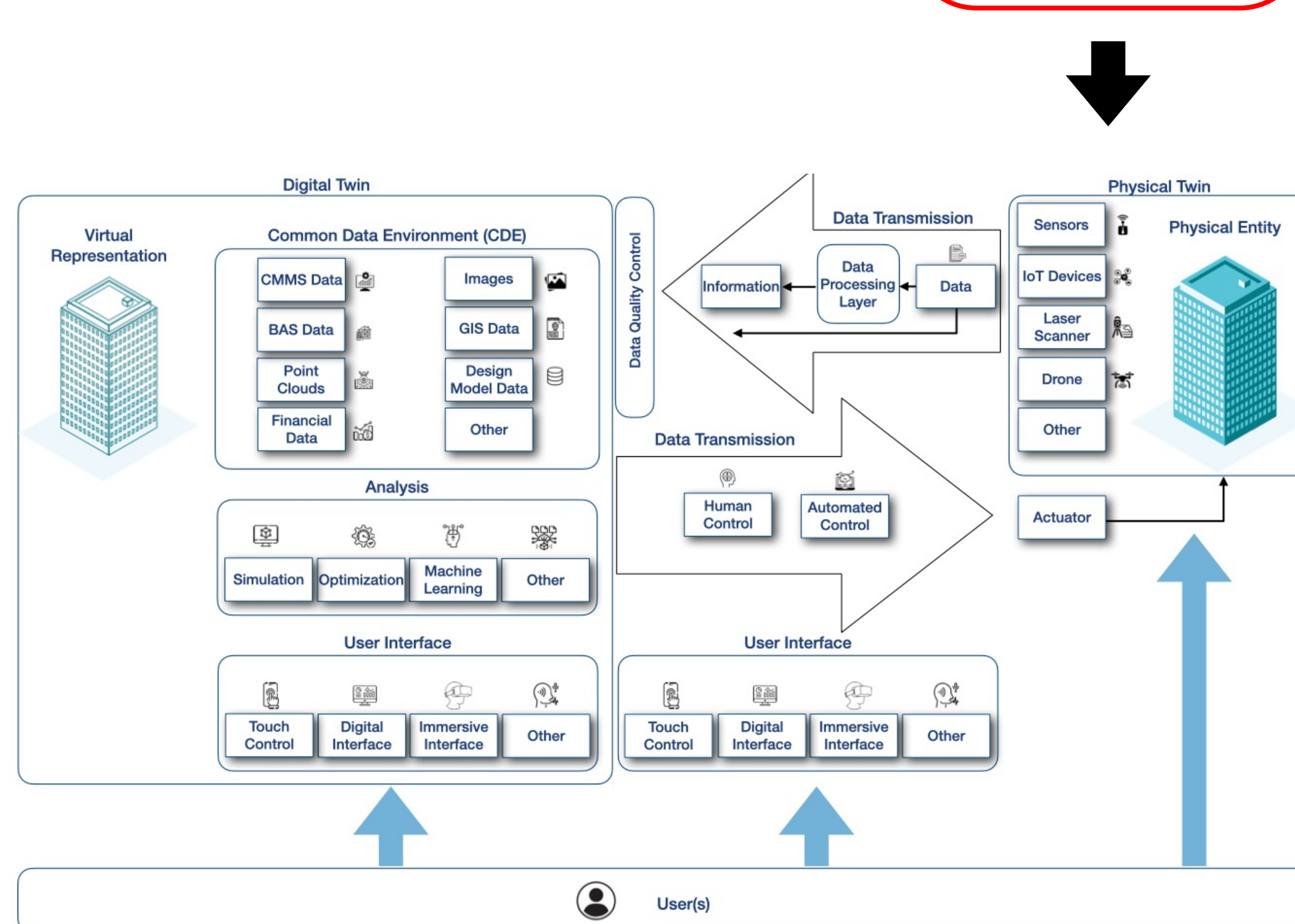
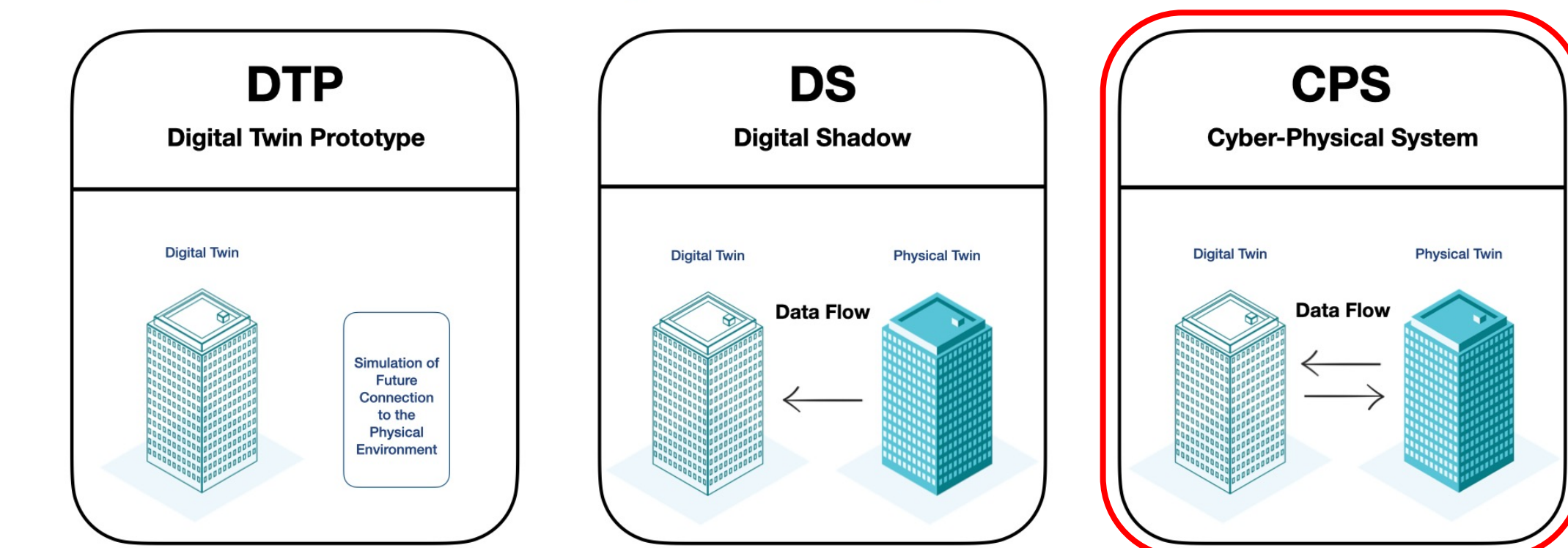
### Methodology



### Digital Twin Definition

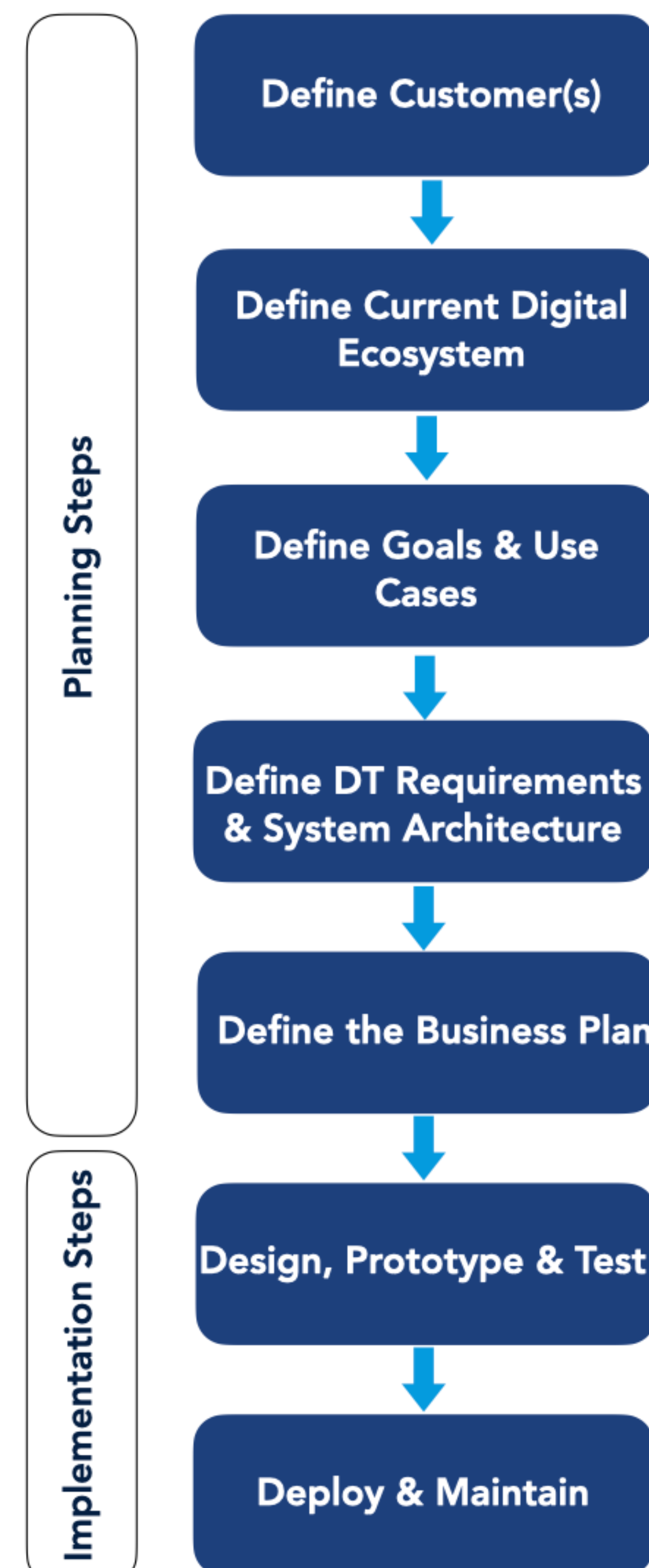
A digital twin of an asset is a **fit-for-purpose** and intelligent **virtual representation**, **synchronized at specified frequencies**, with an **existing or planned connection** between the virtual and physical twin that may include **analysis** and the ability to **actuate** physical changes from the virtual twin [1].

#### Digital Twin Categories

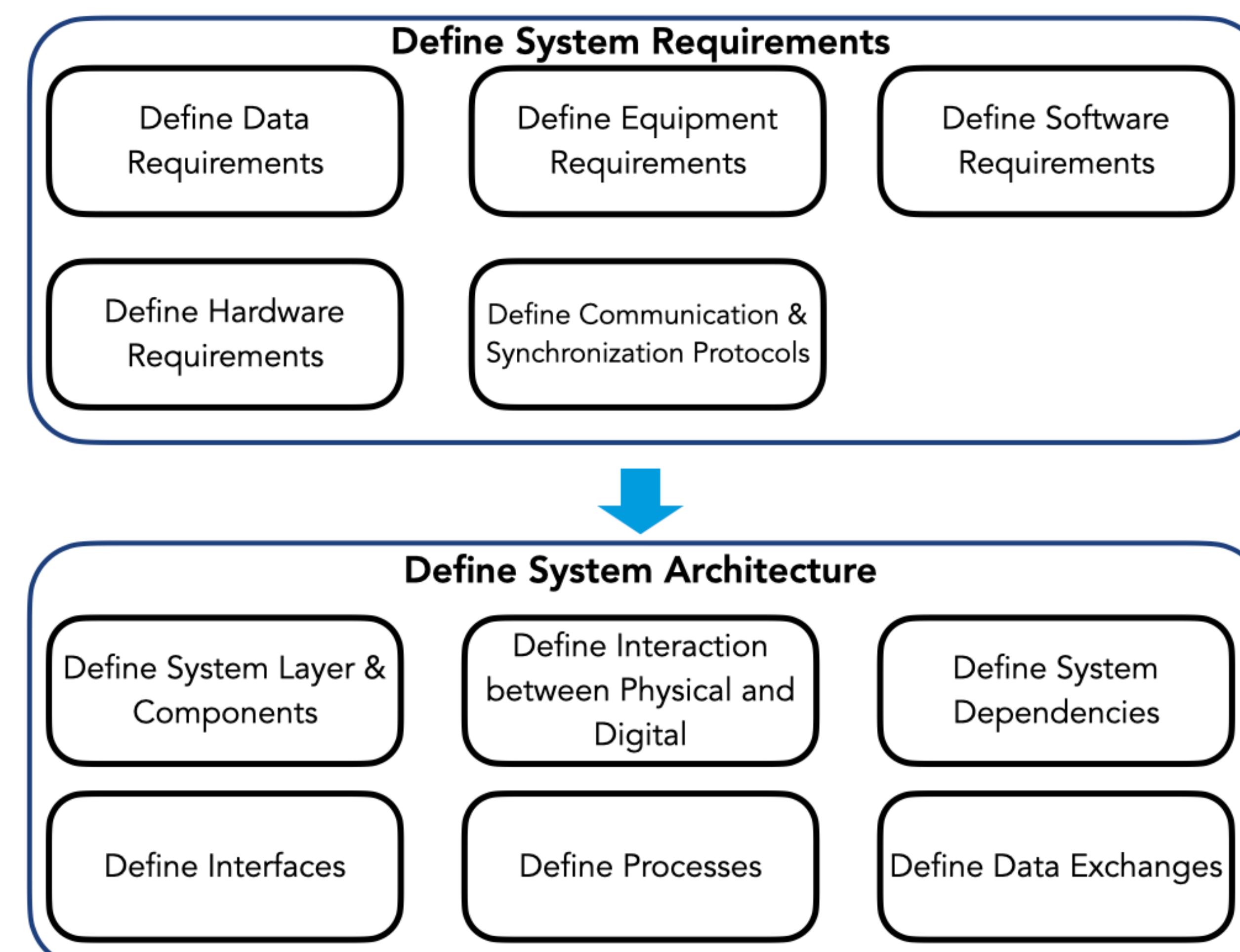


### Digital Twin Planning and Implementation

#### DT Planning and Implementation Process

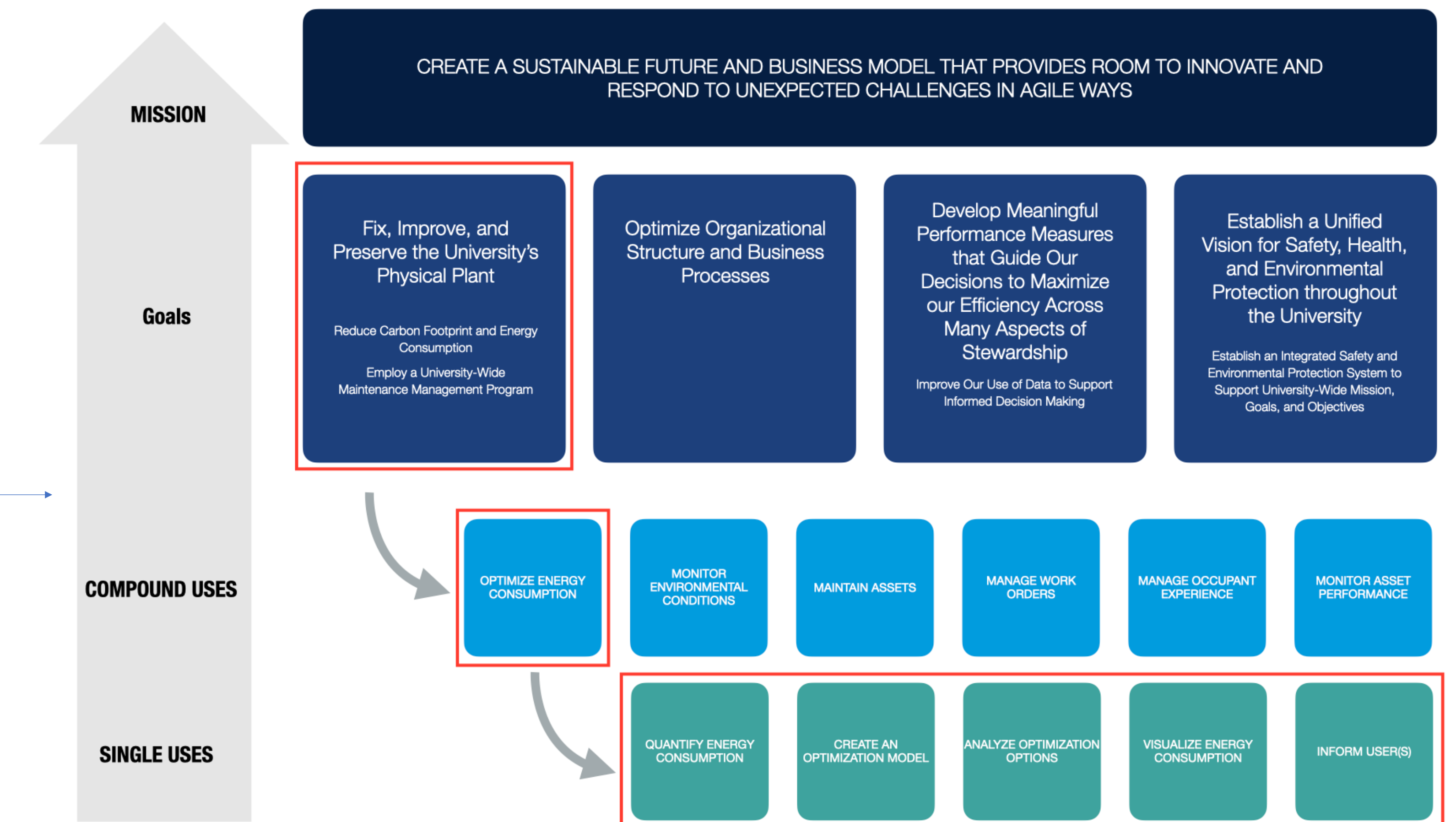


#### Define DT Requirements & System Architecture

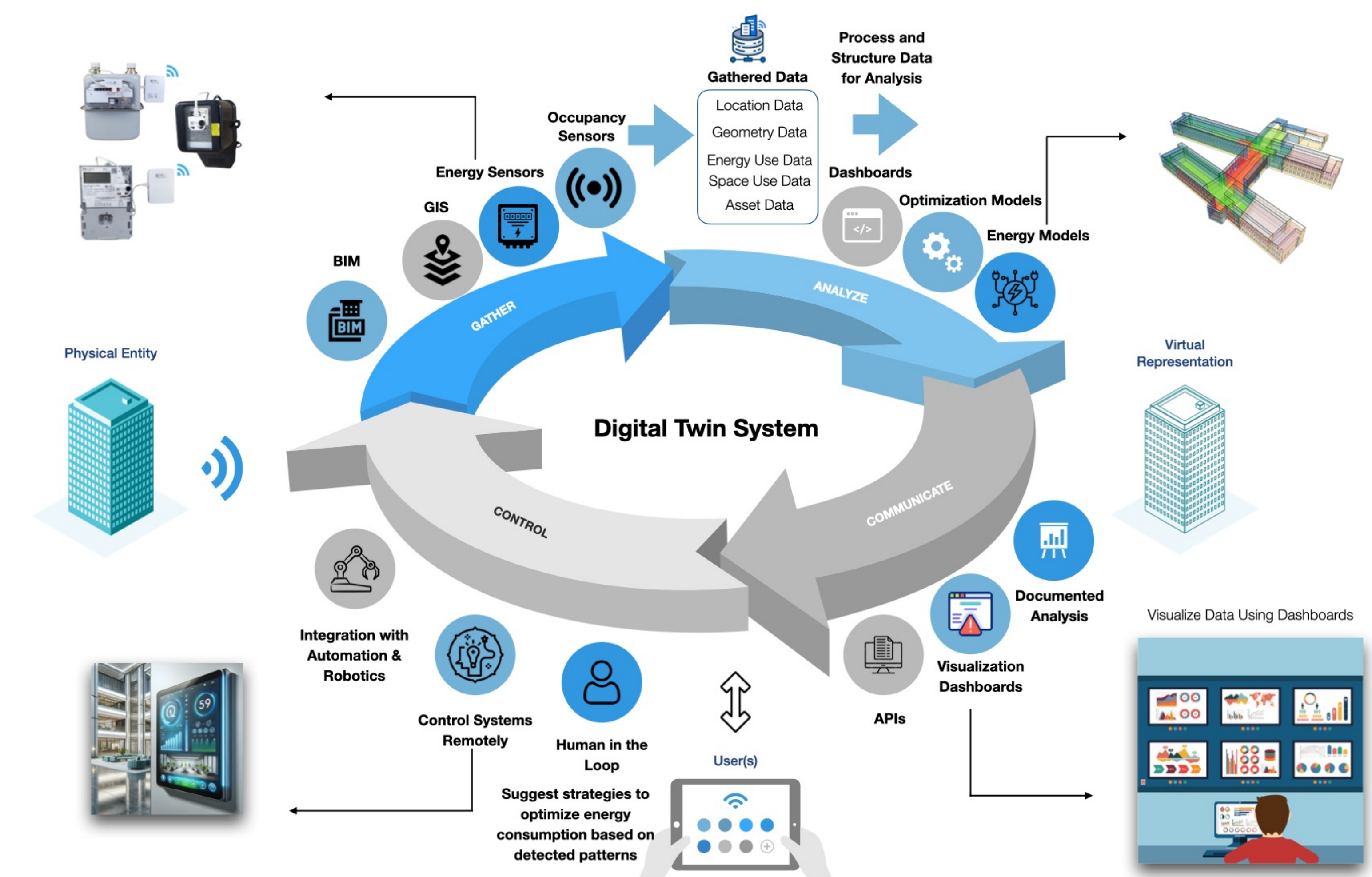


### Digital Twin Planning and Implementation

#### Penn State's Mission, Goals, Compound Uses, Single Uses



#### Schematic DT Design of an Example Compound Use Case: Optimize Energy Consumption



### References & Resources

[1] Ghorbani, Zahra, and John I. Messner. "A Categorical Approach for Defining Digital Twins in the AECO Industry." Journal of Information Technology in Construction (ITcon), vol. 29, no. 10, Mar. 2024, pp. 198–218, <https://doi.org/10.36680/j.itcon.2024.010>.



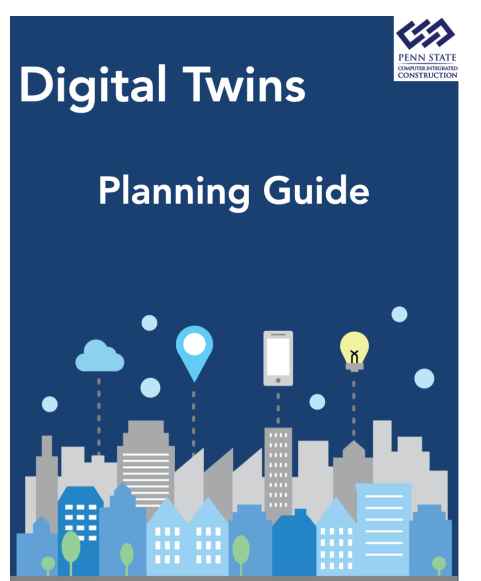
DT Use Catalog



DT Use Case Schema



DT Definition Paper



Stay Tuned!