

# DIGITAL TWIN BIM MODEL FOR TOTAL DESIGN OF SMALL BUILDINGS

5/October/2023

PRESENTED BY:  
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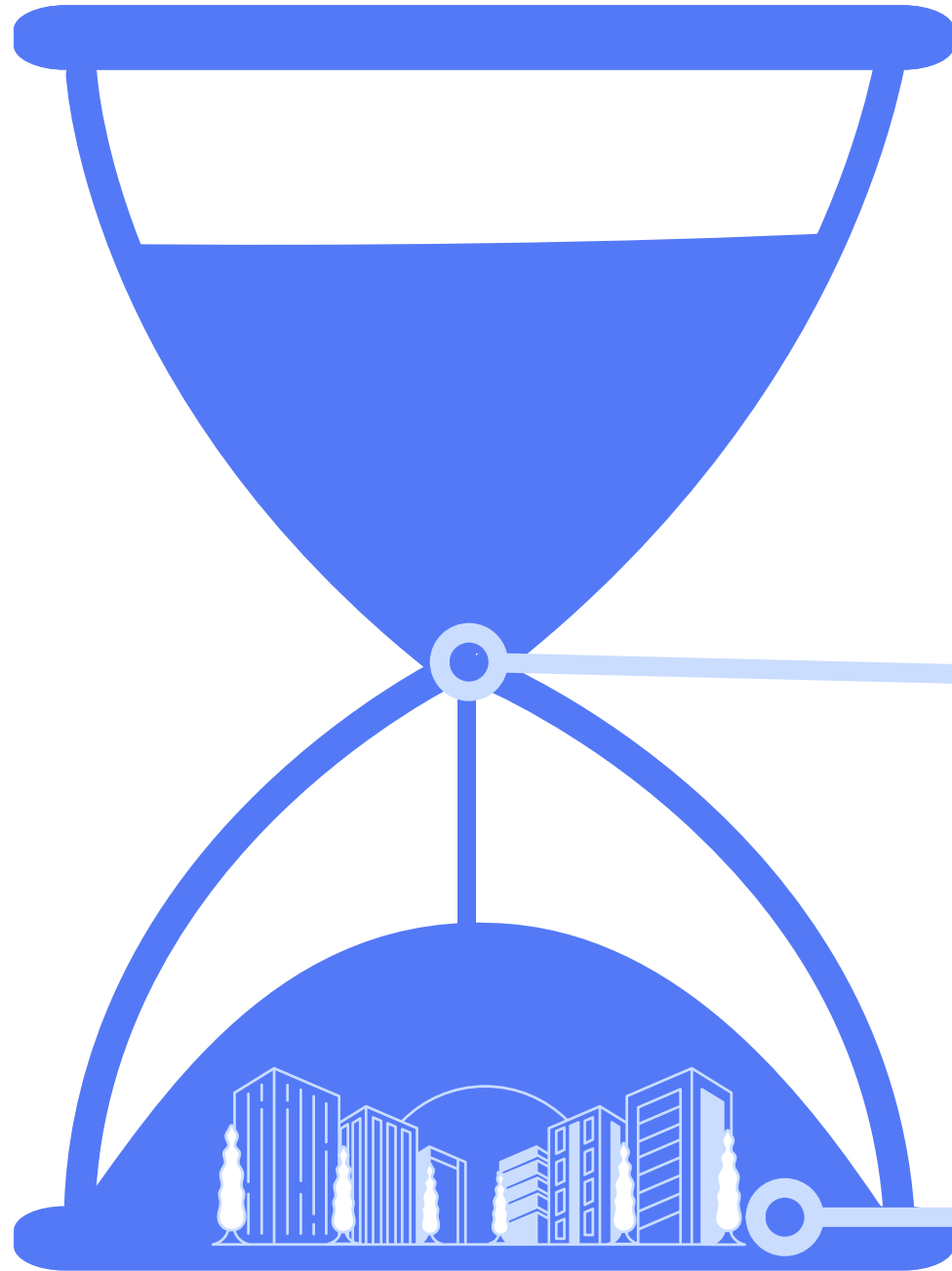
SUPERVISOR:  
HENRI ACHTEN, PROF. DR.,



**CTU**

CZECH TECHNICAL  
UNIVERSITY  
IN PRAGUE

FAKULTA  
ARCHITEKTURY  
ČVUT V PRAZE  
2023 PHD  
WORKSHOP



## A B O U T

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PhD studies in architecture

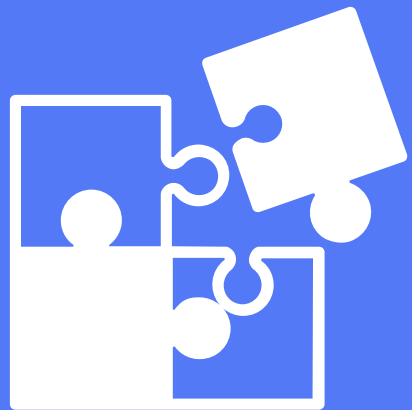
with Prof.Dr. Henri Achten on Digital Twin studies  
in field of Architecture-Theory-Design

B.Sc. architecture / M.Sc. urban design

Profession several projects

## structure of presentation

1



**Problem  
definition**

2



**Digital Twin-  
Progressive States  
of Digital Twin**

3



**Design process  
hypothetical  
scenario using  
digital twin**

4



**Research  
Conclusion**

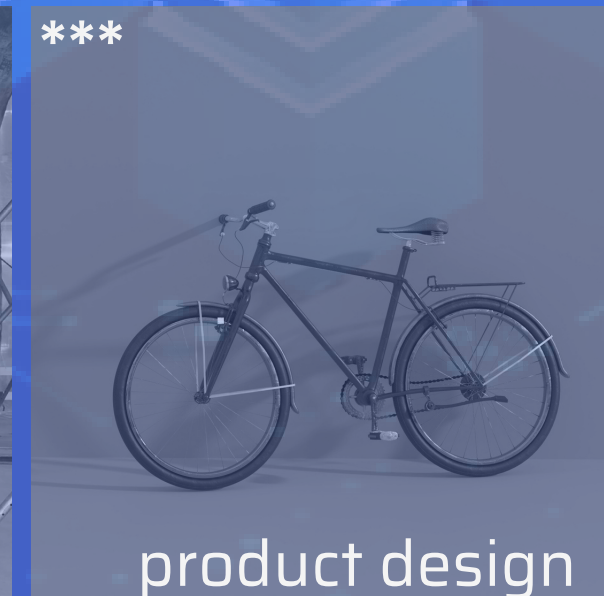
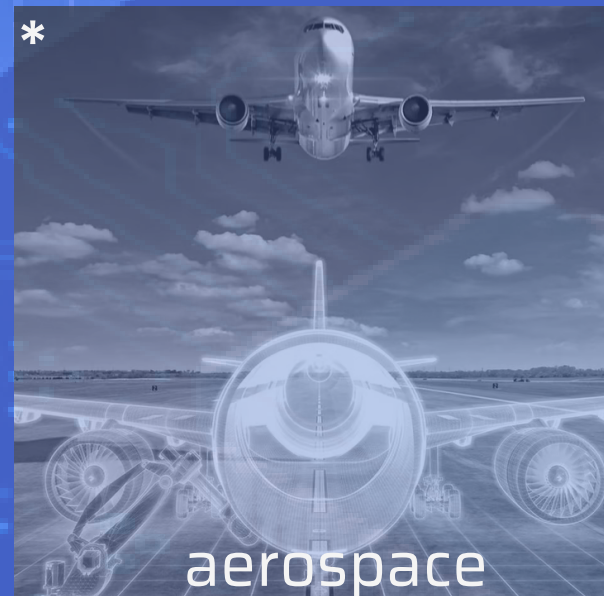
connections: set of sensor  
and data transfer  
technologies passively and  
actively read PT - feed DT

## DIGITAL TWIN

a mirrored representation of real  
objects or processes in real time  
updated via data through real system  
life cycle\*\*\*\*\*

## PHYSICAL TWIN

DT responds as a physical twin, living or  
non-living objects in real  
environment\*\*\*\*\*





## design information

|| □ || □ || □ || □ || □ || □

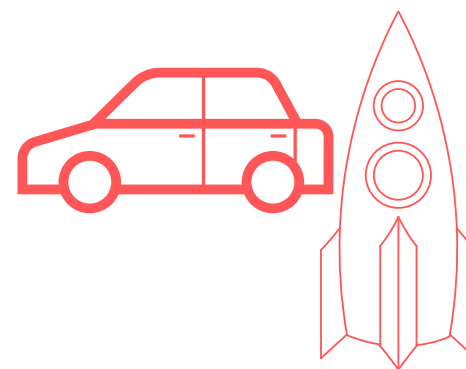
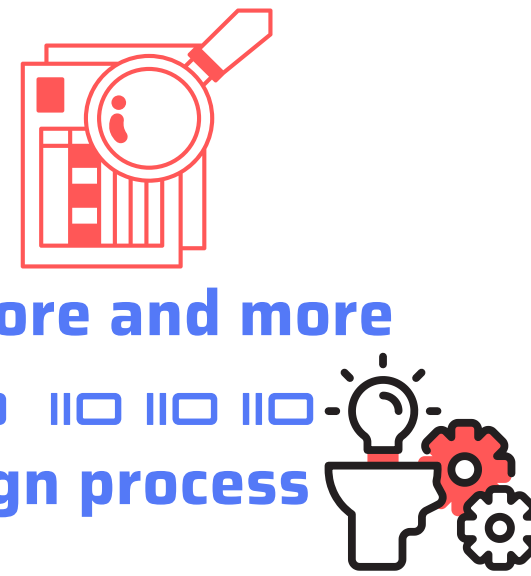


predicting future

knowledge\*



DT more and more  
|| □ || □ || □ || □ || □  
design process

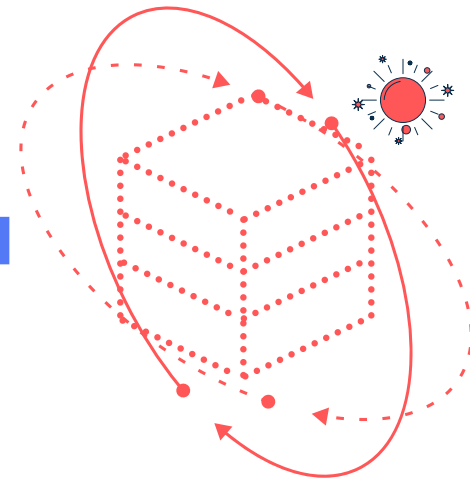


informing  
design and  
development of  
new products

Mainly digital models combined  
with simulation, and  
corrected/updated with data and  
experience from earlier DT of  
similar products.



We are not so  
far. Yet, we see  
potential of  
DT.



DT in design process Progressive states of  
digital twins: foetal, child, adult\*\*

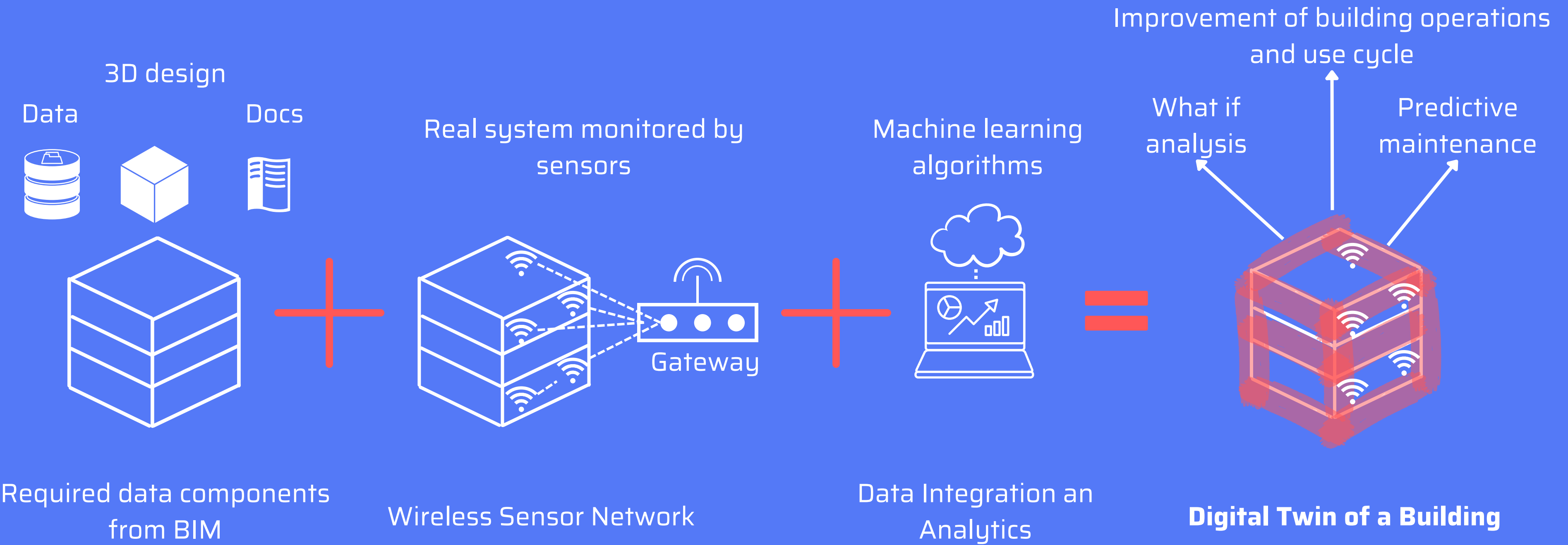
There seems to be a paradox: **How can we make a DT in design process, when there is no physical object of which to make DT?**

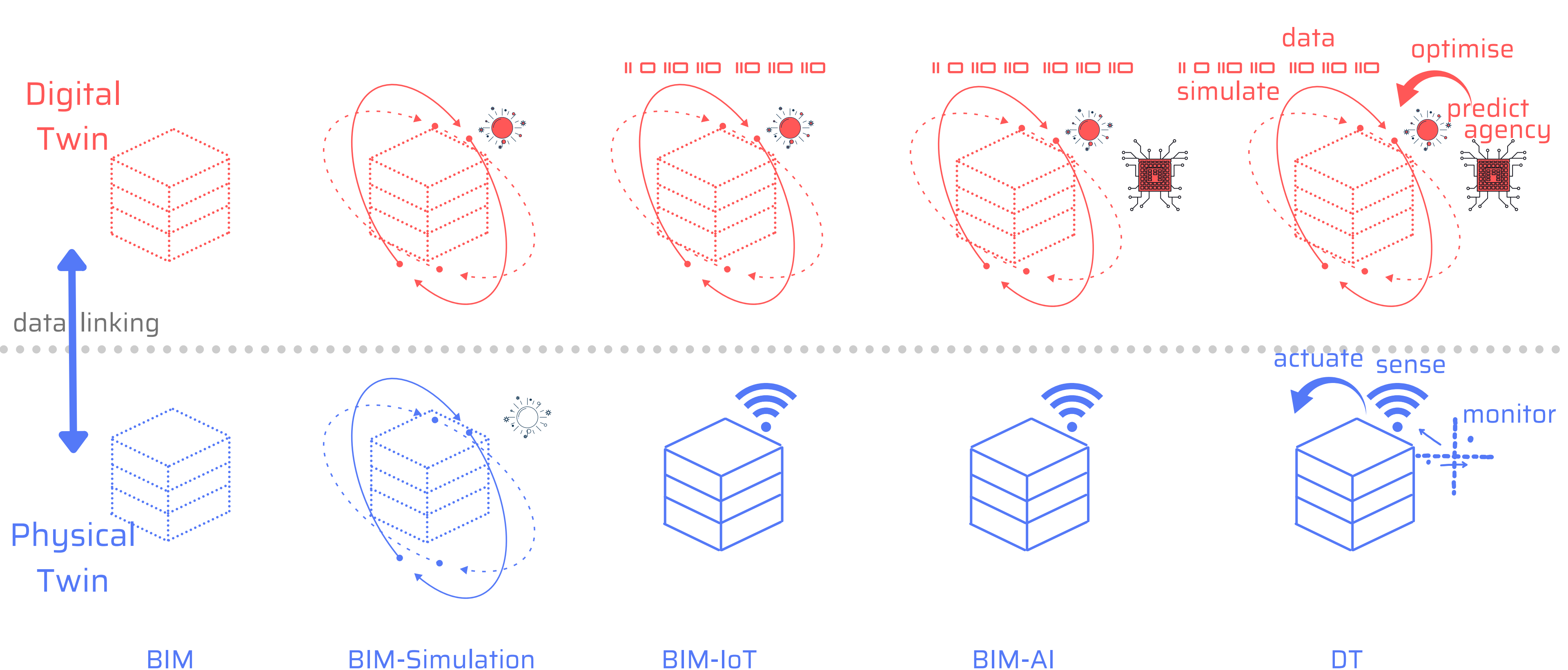
\*Rios et al., 2015, p. 657

\*\*Sacks et al., 2020, p. 16

How can digital twin technology be used in design process?

Are foetal and child digital twins useful for design in process towards adult digital twin?





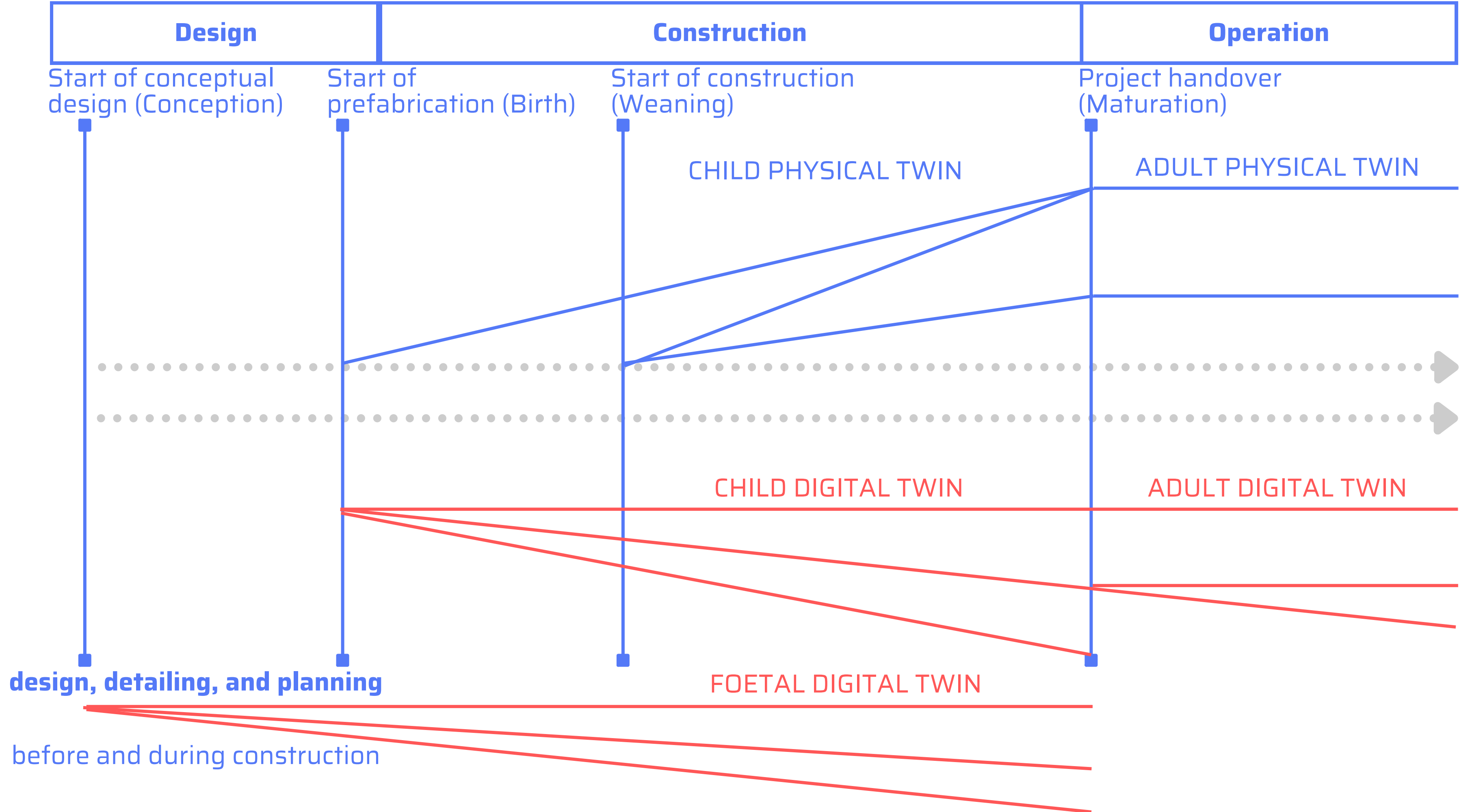
..... system incomplete  
 \_\_\_\_\_ system complete

**Evolution of DT technology from BIM**

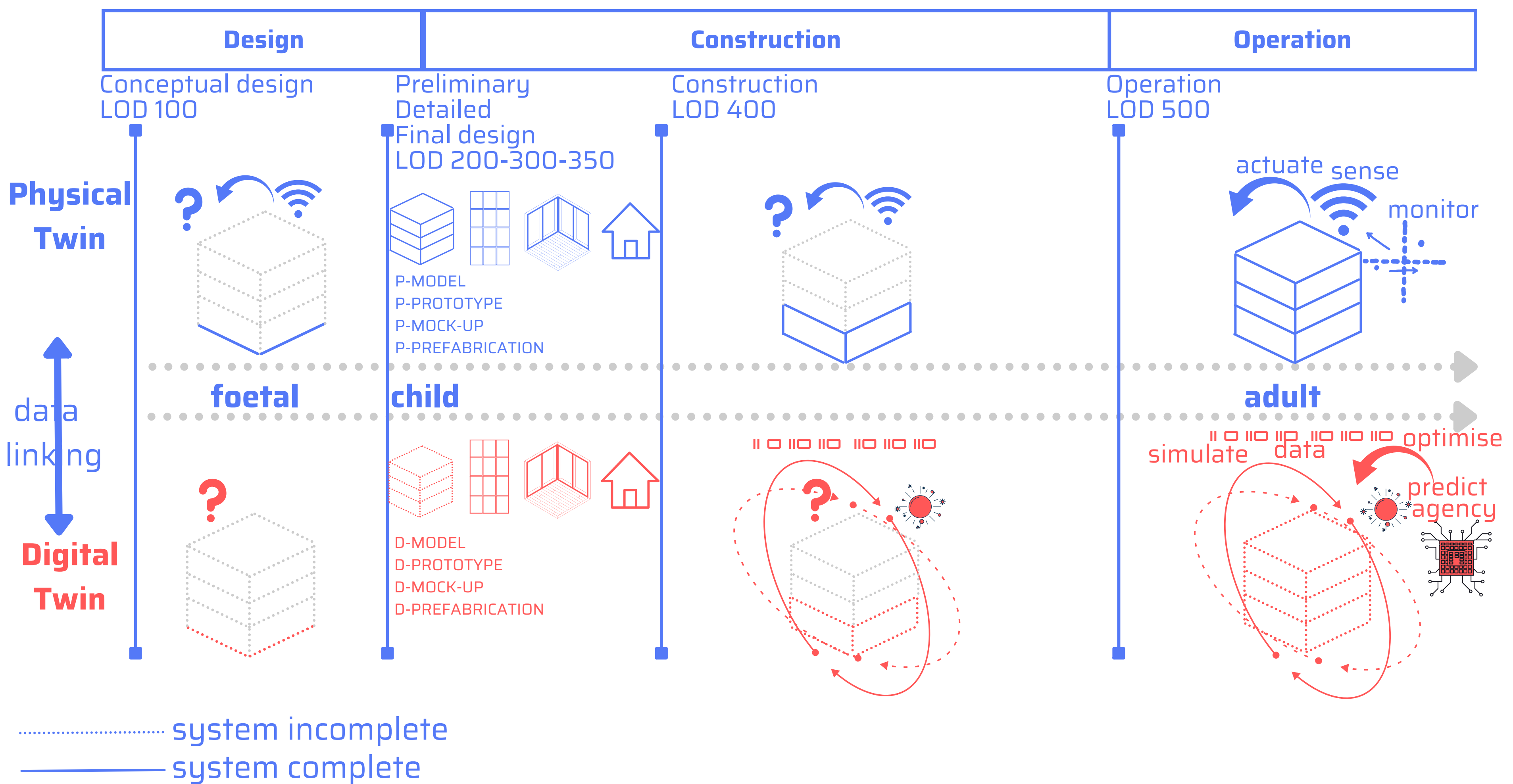
**2 DIGITAL TWIN TECHNOLOGY**

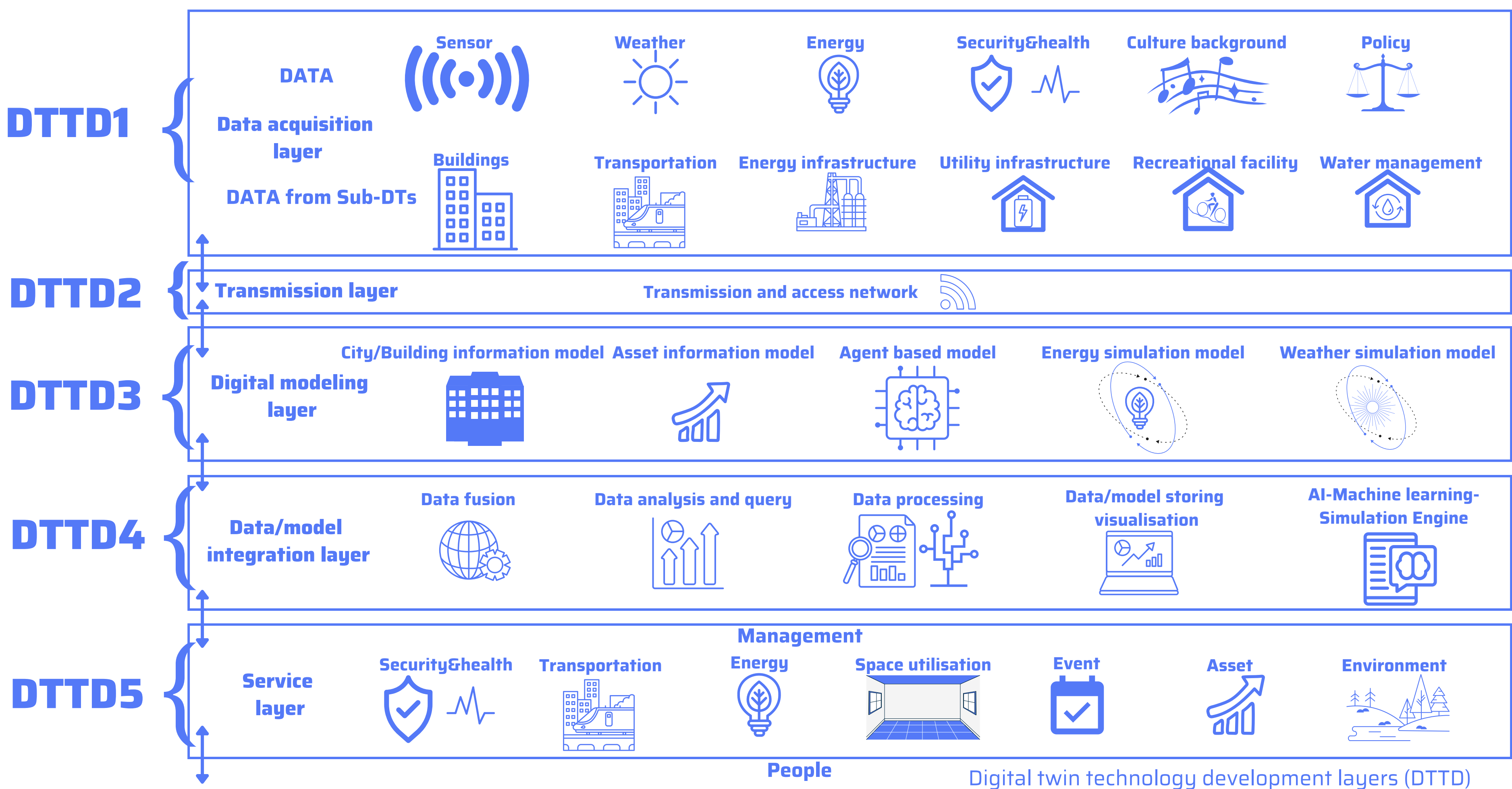
\*Deng et al., 2021

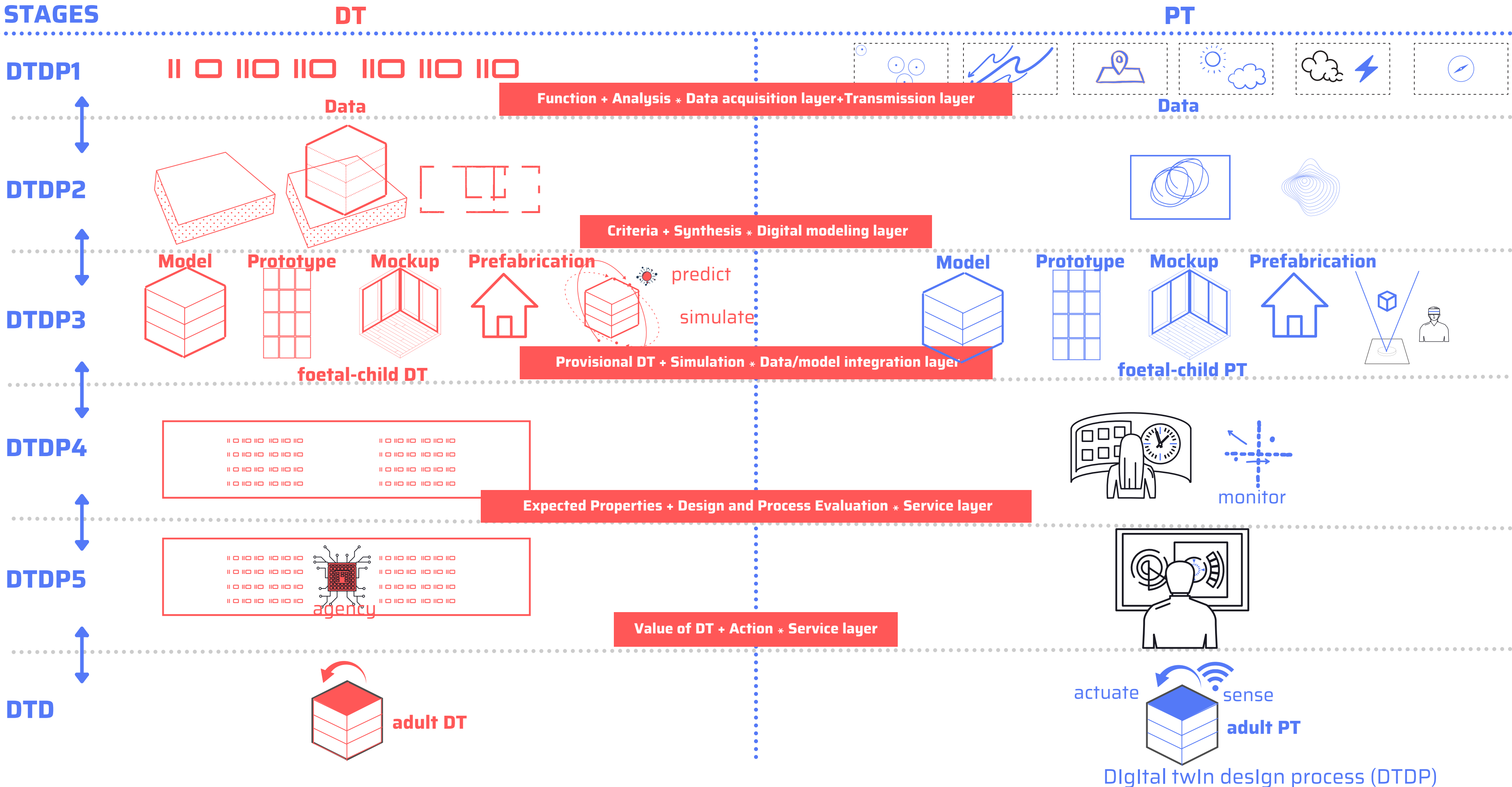




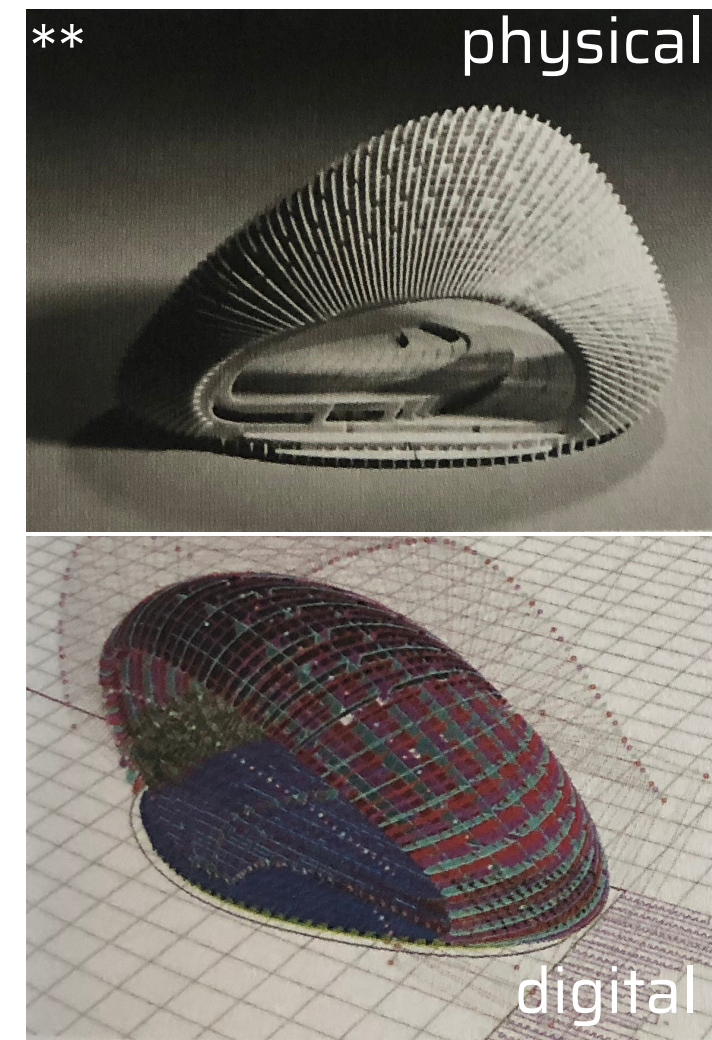
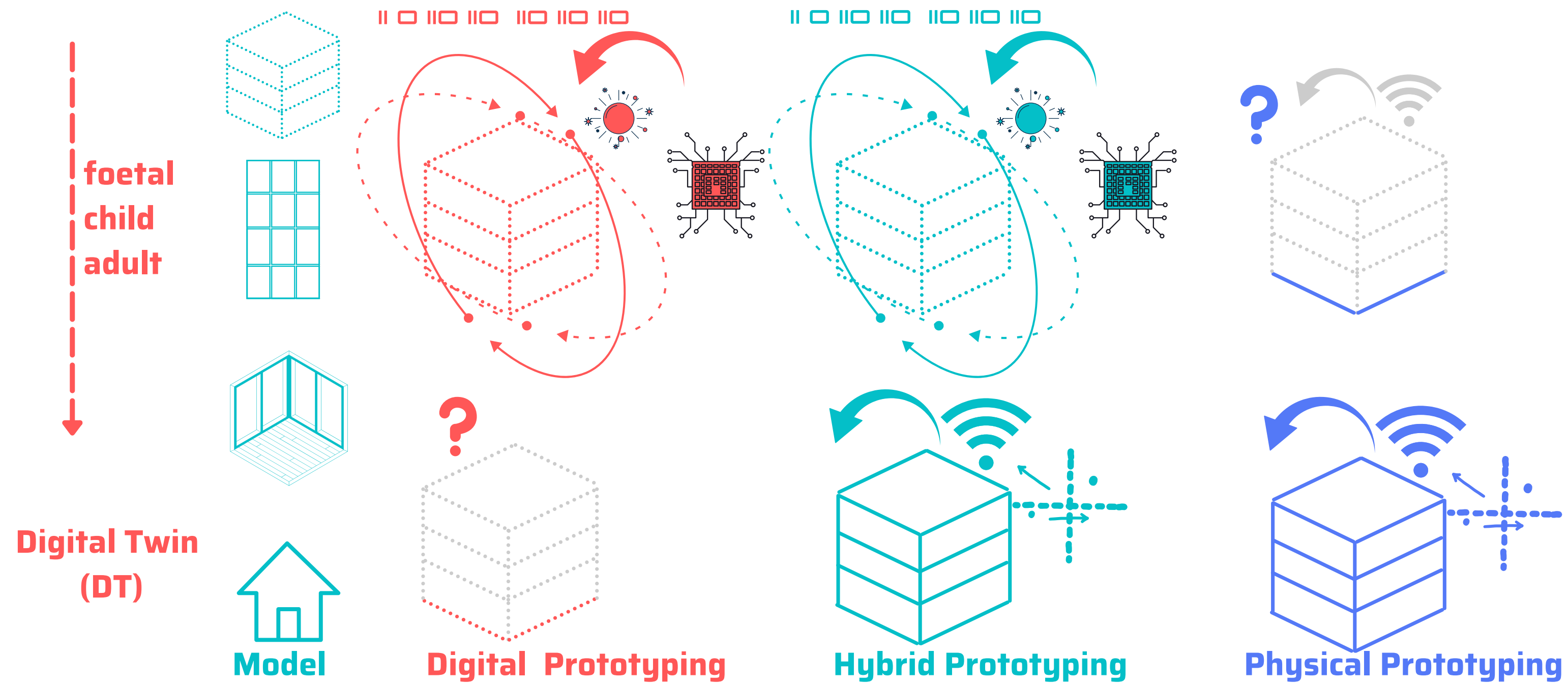
\*Sacks et al.2020











Prototyping with a DT

\*Emir Isik & Achten, 2022

\*\*Burry and Burry, 2016

### 3 DESIGN PROCESS HYPOTHETICAL SCENARIO USING DIGITAL TWIN

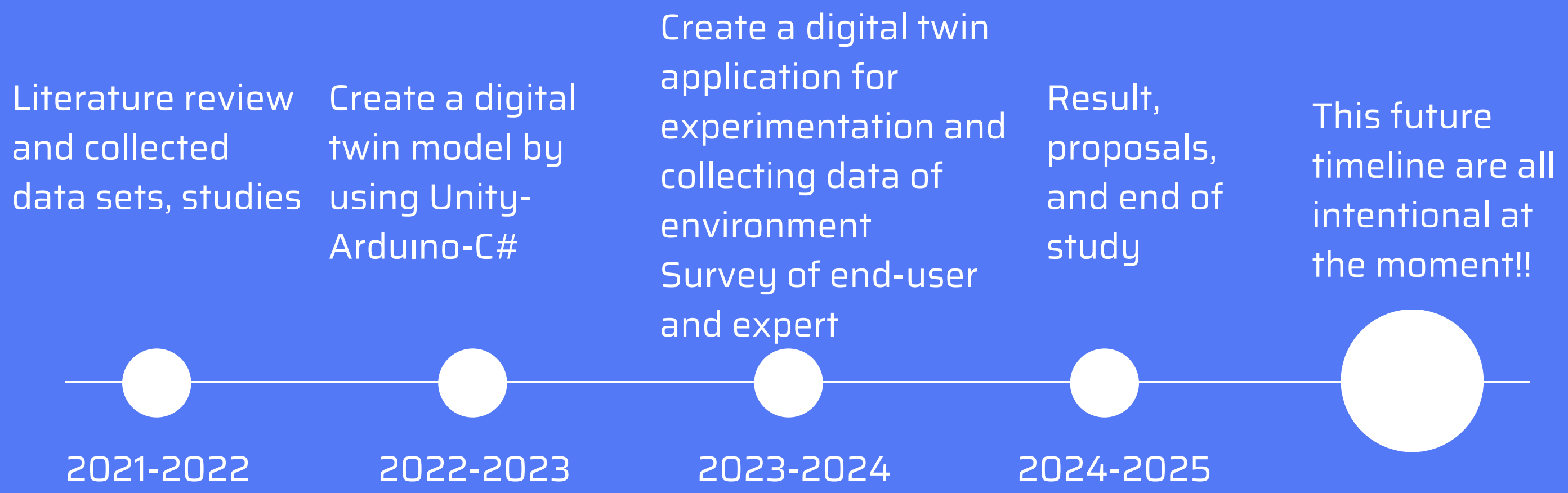
Can designers design a building using a digital twin: devised scenario?

What if we already started to use foetal and child physical and digital twins through prototyping?

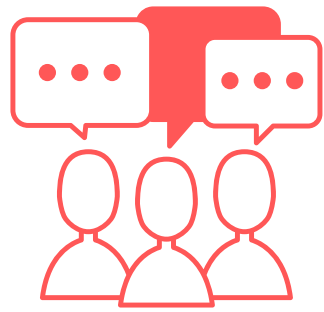
Hybrid prototyping tools can increase connectivity of digital twin. Many prototypes are produced during design process, but what if adding more sensors makes it smarter?

**Methodology** Literature review and collecting data sets  
Surveys with end-user and experts  
Analysis results  
Proposals  
Case study: Create a DT of a --small building or a --realized part of structural prototyping for experimentation

**primary potential sources** State of art  
Realized part of structure such as model, prototype, mockup or prefabrication  
Digital twin BIM model  
Follow up projects and research  
Interview with practice



**timeline**



### Conferences:

Emir Isik, G. & Achten, H. (2022). Can we use digital twin technology in the design process? A theoretical framework, In ARCHDESIGN '22 / IX. International Architectural Design Conference Proceedings, Istanbul, Turkey, May, 2022, pp. 45-54.

Emir Isik, G. & Achten, H. (2023). "ARCHITECTURAL HYBRID (PHYSICAL-DIGITAL) PROTOTYPING IN DESIGN PROCESSES WITH DIGITAL TWIN TECHNOLOGIES," Architecture and Planning Journal (APJ): Vol. 28: Iss. 3, Article 4. DOI: <https://doi.org/10.54729/2789-8547.1199>

Emir Isik, G., & Hubertus Achten, H. (2023). OPERATIONALISING CONCEPTS OF DIGITAL TWINS ON DIFFERENT MATURITY LEVELS (FOETAL, CHILD, ADULT) FOR THE ARCHITECTURAL DESIGN PROCESS. Proceedings of the Design Society, 3, 2825-2834. doi:10.1017/pds.2023.283

Emir Isik, G., & Hubertus Achten, H. (2023). Foetal, Child, and Adult Physical and Digital Twins in Design Process Through Hybrid Prototypes. 1st International Conference on Digital Architecture Research-DARe Conference in Bialystok University of Technology, 1st - 3rd of March 2023.

### PhD Workshop:

40th (eCAADe) Conference-PhD Workshop Ghent, Belgium

World CAAD PhD Workshop, December 12-14, 2022, CAADRIA 2023, online

ICED PhD Forum, July 24, 2023, ICED 2023 in Bordeaux, France

### International Study:

Munich Technical University in Germany-DAAD Scholar 2023 October-December



- New insights into generating digital twins in architectural design of buildings:

Progressive states of digital twins: foetal, child, and adult digital twins (Sacks et al., 2020, p. 16)

Traditional design approaches and innovative processes with digital twins

- Benefits of digital twin design manager in architectural design process
- Cataloguing and using previous digital twin databases for the same building type in the initial design phase
- Utilizing data sources for future design improvements
- Cost-effectiveness and efficiency of using digital twins in design process
- Prototype-connected child digital twins can enhance estimations
- Future work should focus on hybrid prototyping to measure actual impact of digital twins on design process
- Utilizing existing prototypes to advance the use of digital twins in design process
- Studying models by incorporating digital twins at progressive maturity levels in design process

# Thank you!



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