



The 3rd Digital Twin International Conference

11-13 October 2023, Gif-sur-Yvette, France (Online)

Painting of the digital twin to better understand and implement it in manufacturing

By

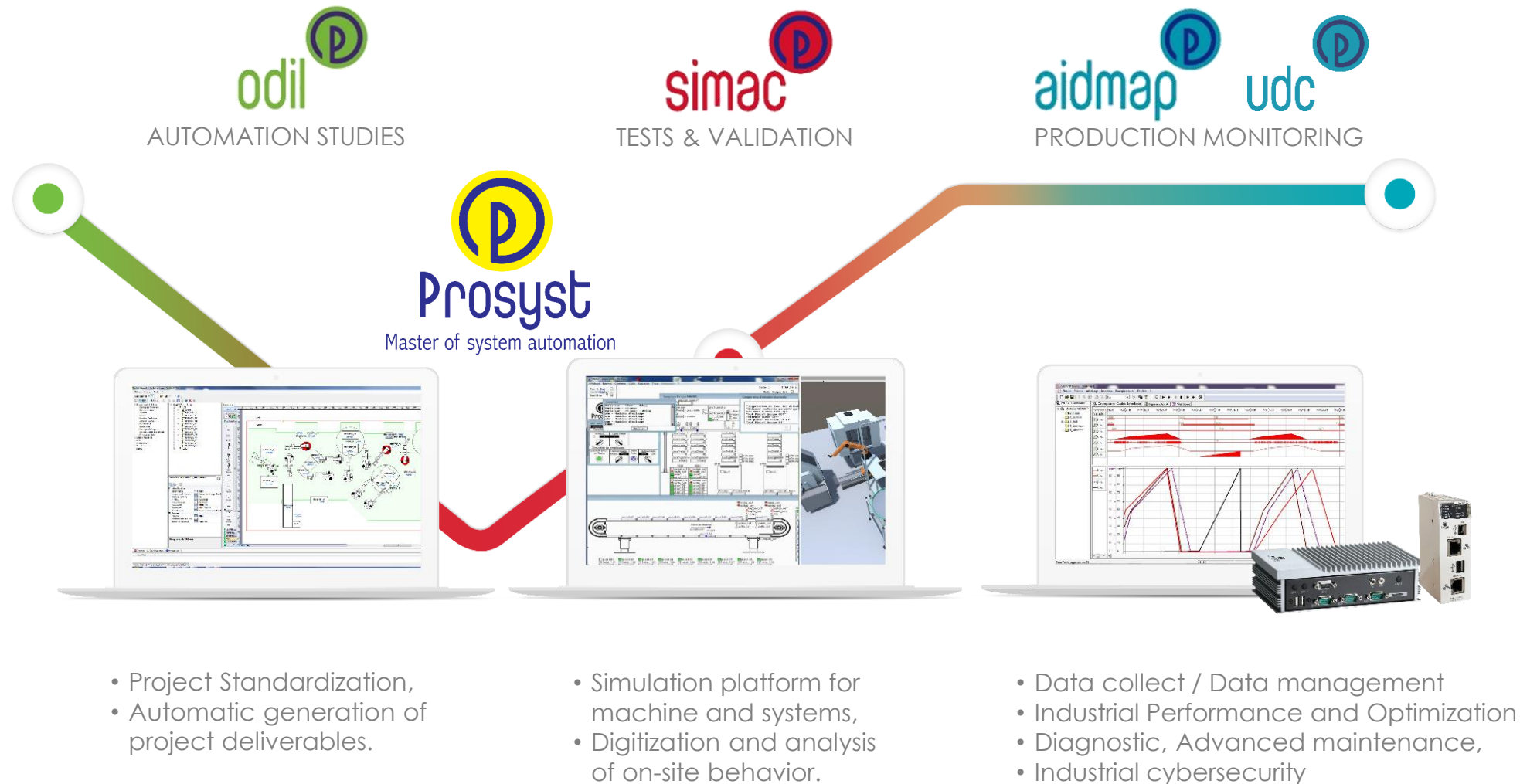


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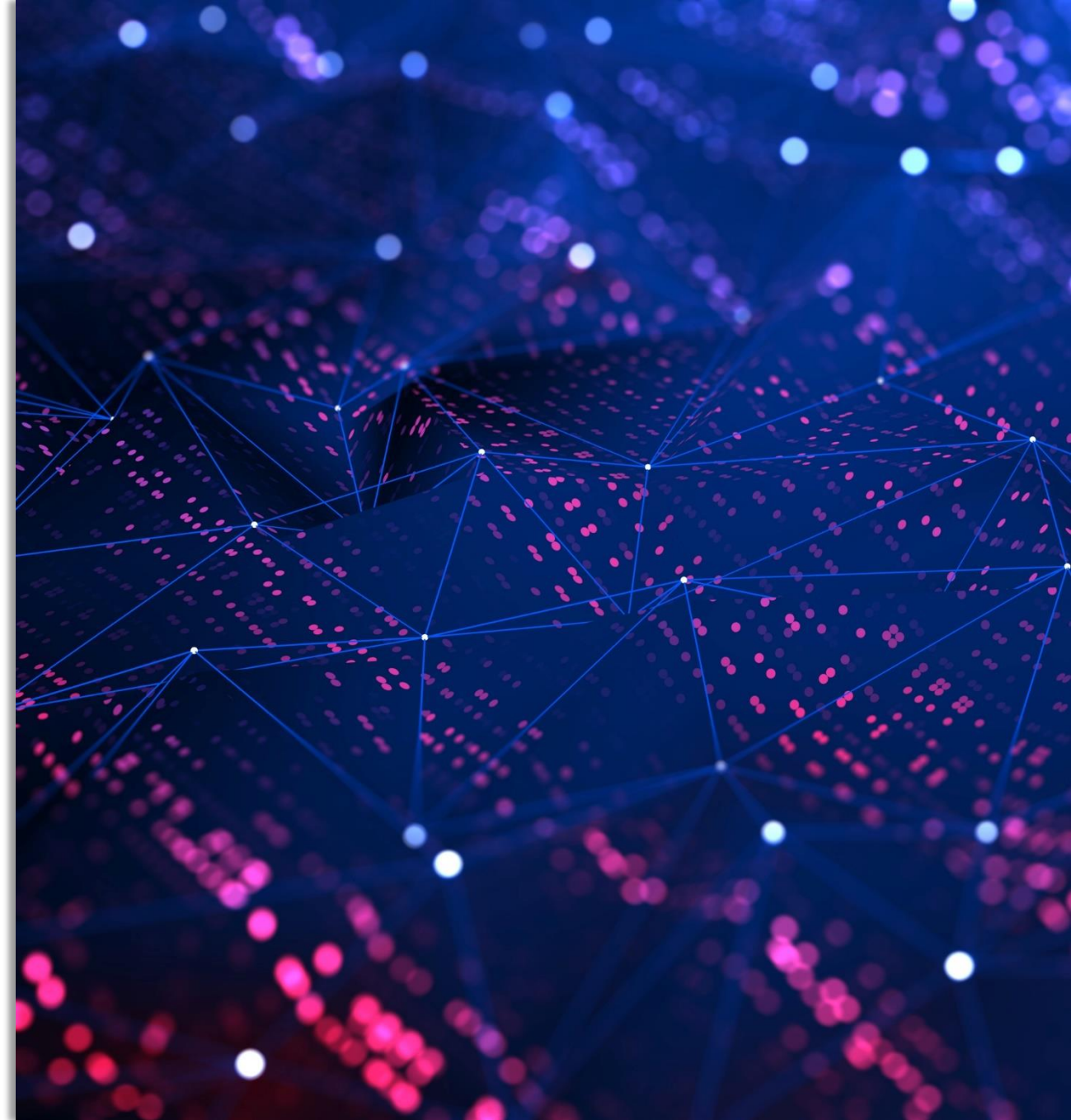


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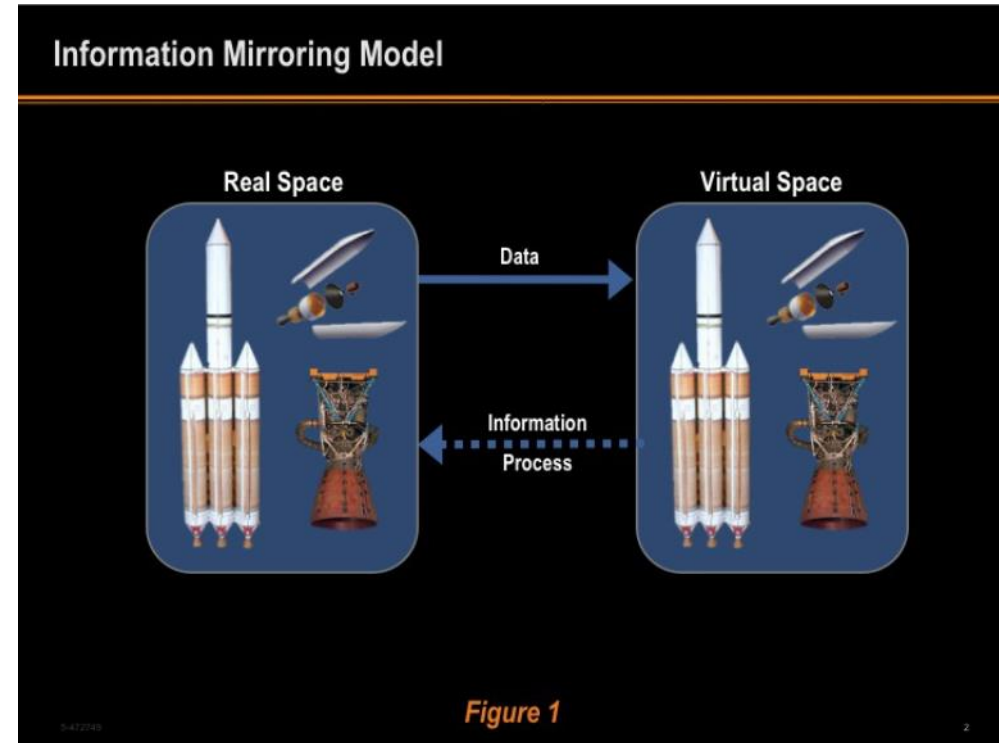


Definition history



“The Digital Twin concept model [...] contains three main parts: a) *physical products* in Real Space, b) *virtual products* in Virtual Space, and c) *the connections of data and information that ties the virtual and real products together.*”

M. Grieves, « Digital Twin: Manufacturing Excellence through Virtual Factory Replication ». 2014.



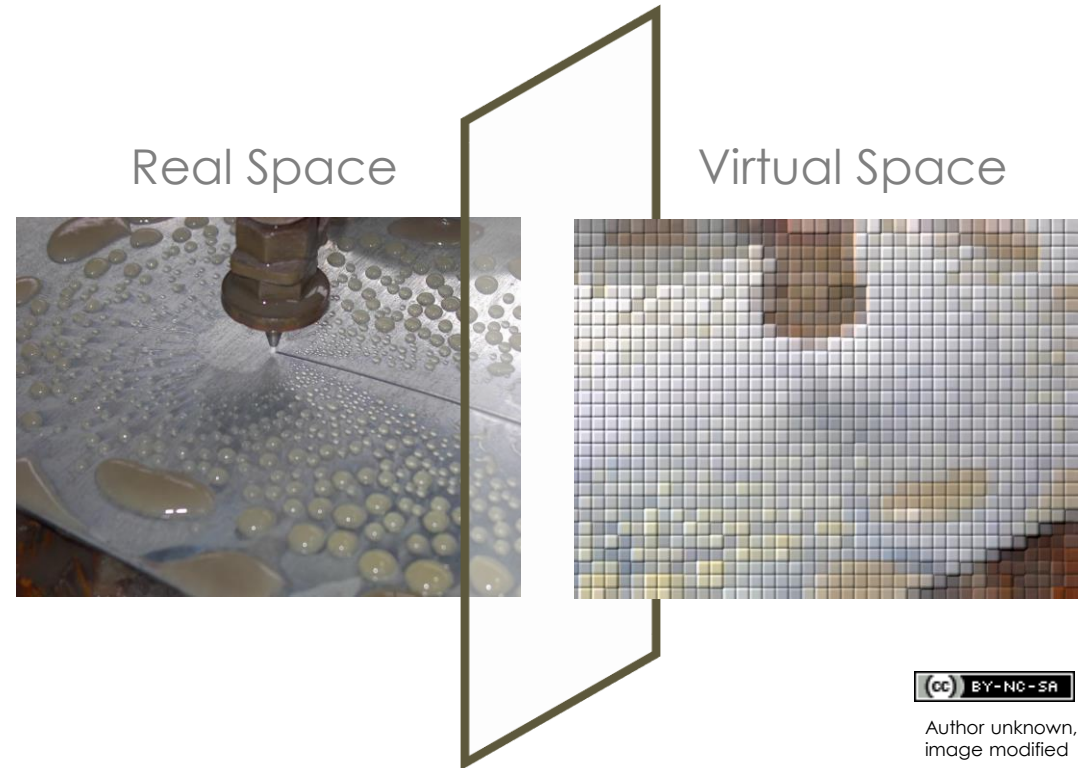
Digital Twin: Manufacturing Excellence through Virtual Factory Replication, Grieves

«five-dimensional digital twin model, including *physical entity, virtual model, connection, data, and service*»

Tao F, Liu W, Zhang M, Hu T, Qi Q, Zhang H, et al. Five-dimension digital twin model and its ten applications. CIMS 2019;25(01):1–18.

“digital twin is an integrated multi-physics, multi-scale, probabilistic simulation of a complex product and *uses the best available physical models, sensor updates, etc., to mirror the life* of its corresponding twin.”

GLAESSGEN, Edward et STARGEL, David, 2012b. The Digital Twin Paradigm for Future NASA and U.S. Air Force Vehicles. 14th AIAA. Hawaii



“<manufacturing> fit for purpose *digital representation* of an *observable manufacturing element* with *synchronization* between the element and its digital representation”

Automation systems and integration, Digital twin framework for manufacturing. ISO 23247, 2021.

What Utilities Digital Twins Have

2 extreme Primary functions of the Digital Twin

Interrogative

Current Data | Historical Data

Understanding what's going on
or what happened

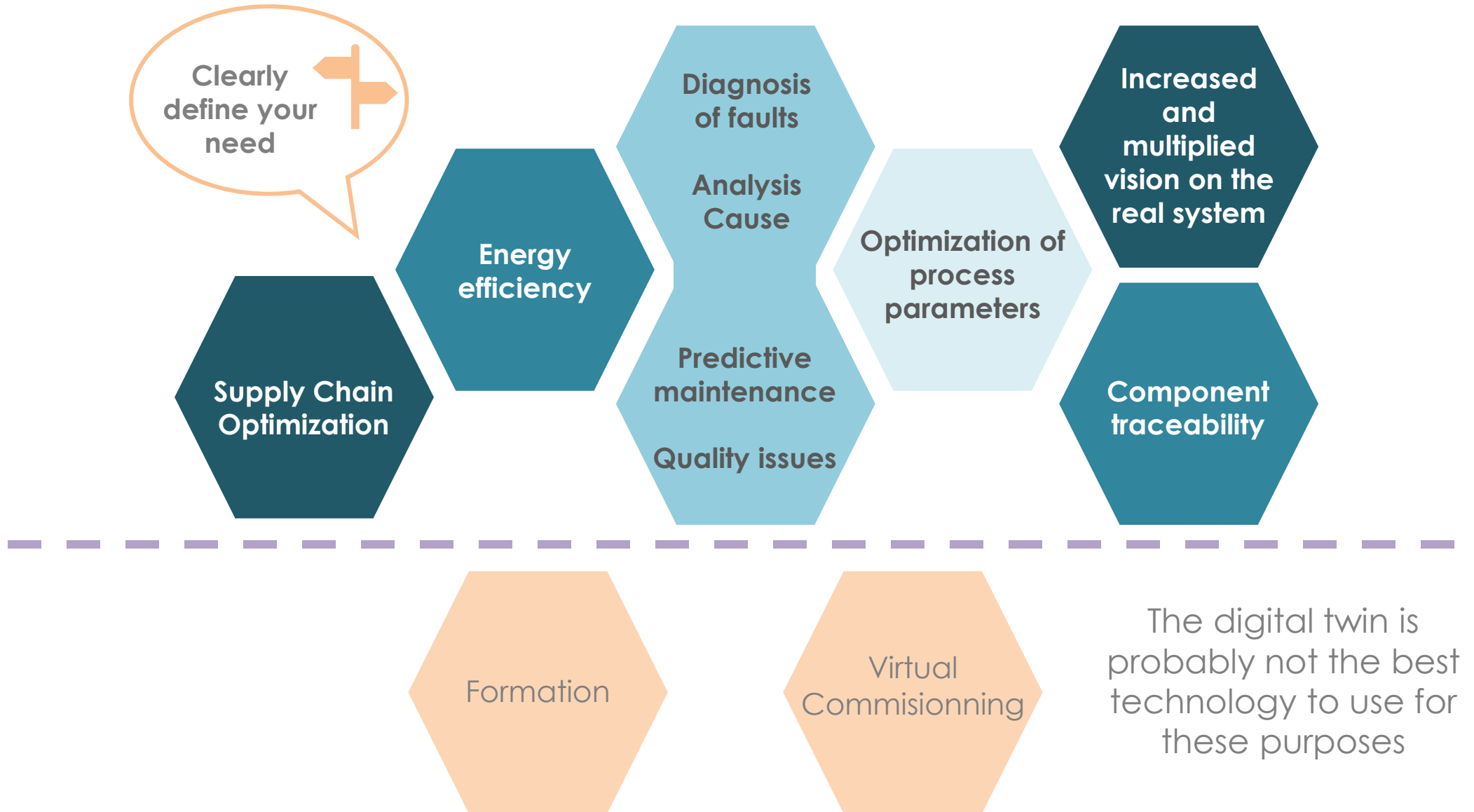
Predictive

Current Data | Historical Data

Anticipating the future



Ⓟ For what purposes ?



Levels of Digital Twin Framework

Agrawal et al. (2023) :

“The concept of digitally twinning an asset that mirrors actual operating conditions but is also *practical and less costly* is precisely the motivation for the DT concept”

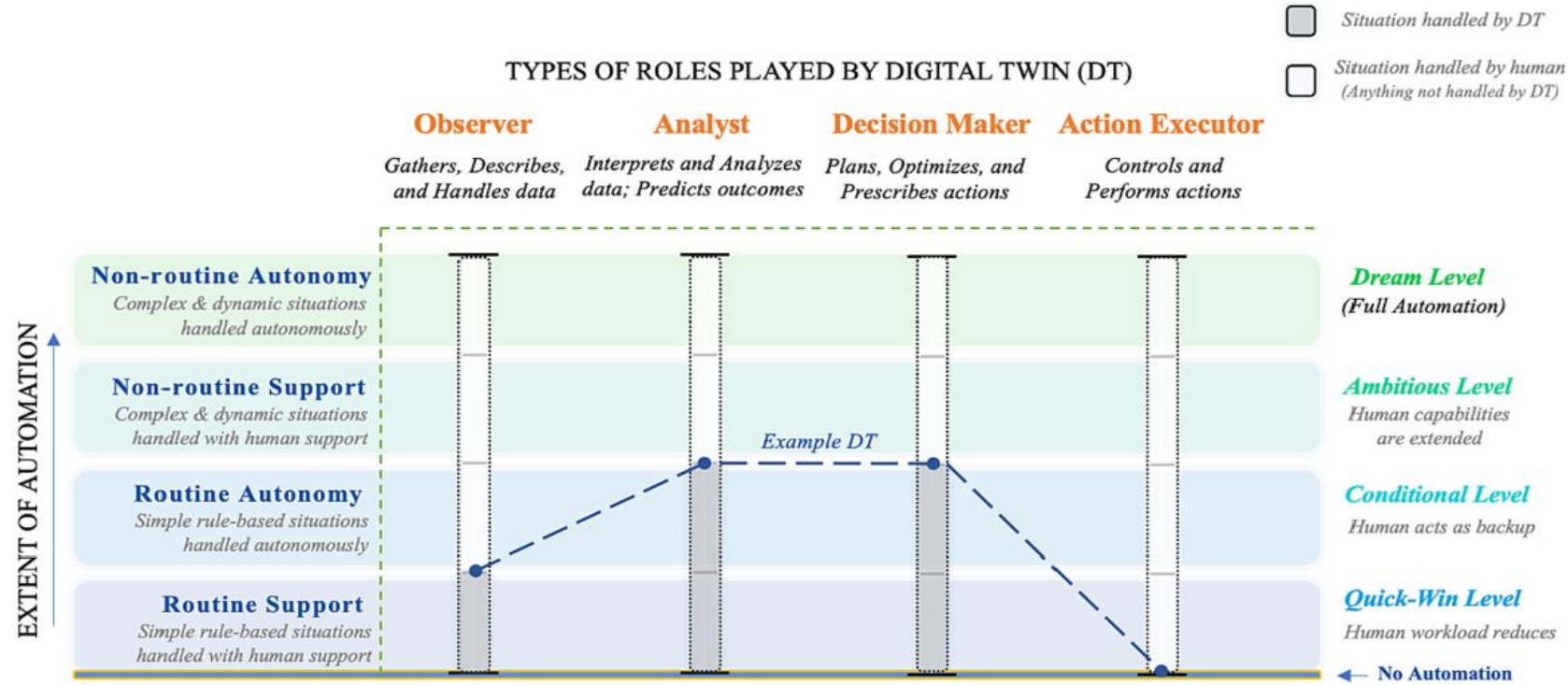
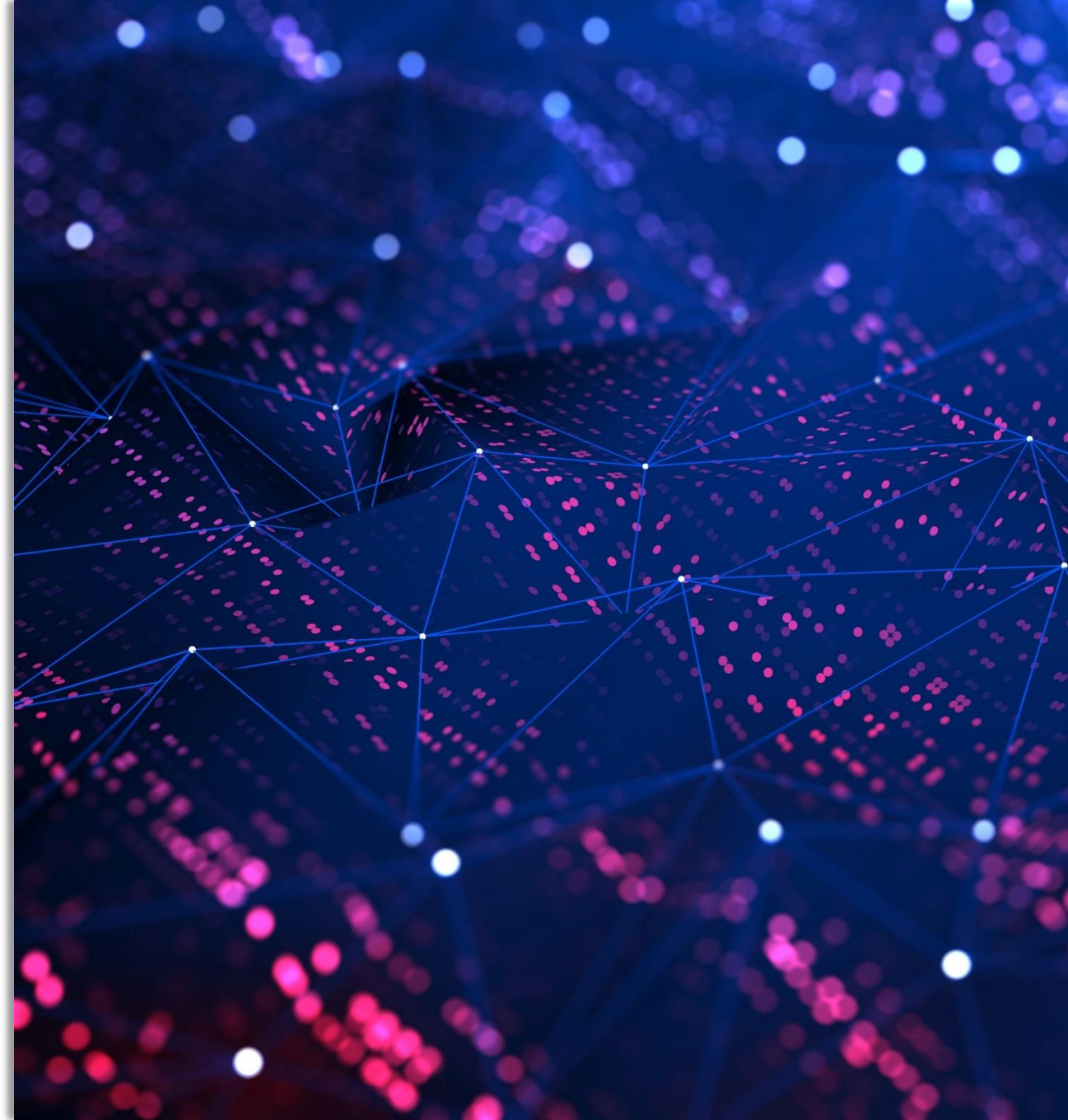


Fig. 4. Levels of Digital Twin framework. In the example shown with dotted lines, the DT would support data collection and observations in routine situations, perform routine data analysis and decision making autonomously, but not perform any actions. Humans would handle data collection, analysis, and decision making in non-routine situations. Actions in all situations would be performed by humans.

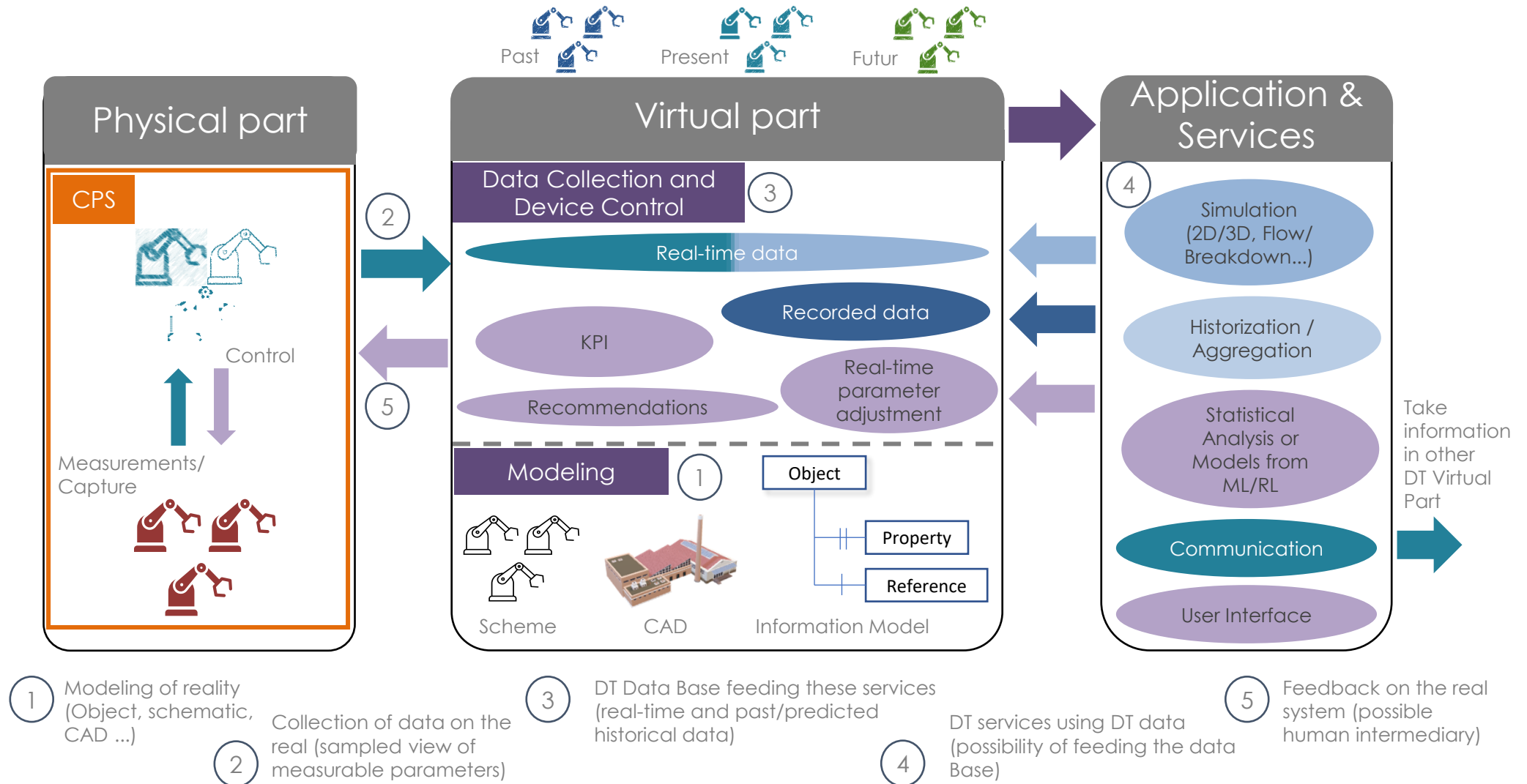
A. Agrawal, R. Thiel, P. Jain, V. Singh, et M. Fischer, « Digital Twin: Where do humans fit in? », *Automation in Construction*, vol. 148, p. 104749, avr. 2023, doi: [10.1016/j.autcon.2023.104749](https://doi.org/10.1016/j.autcon.2023.104749).



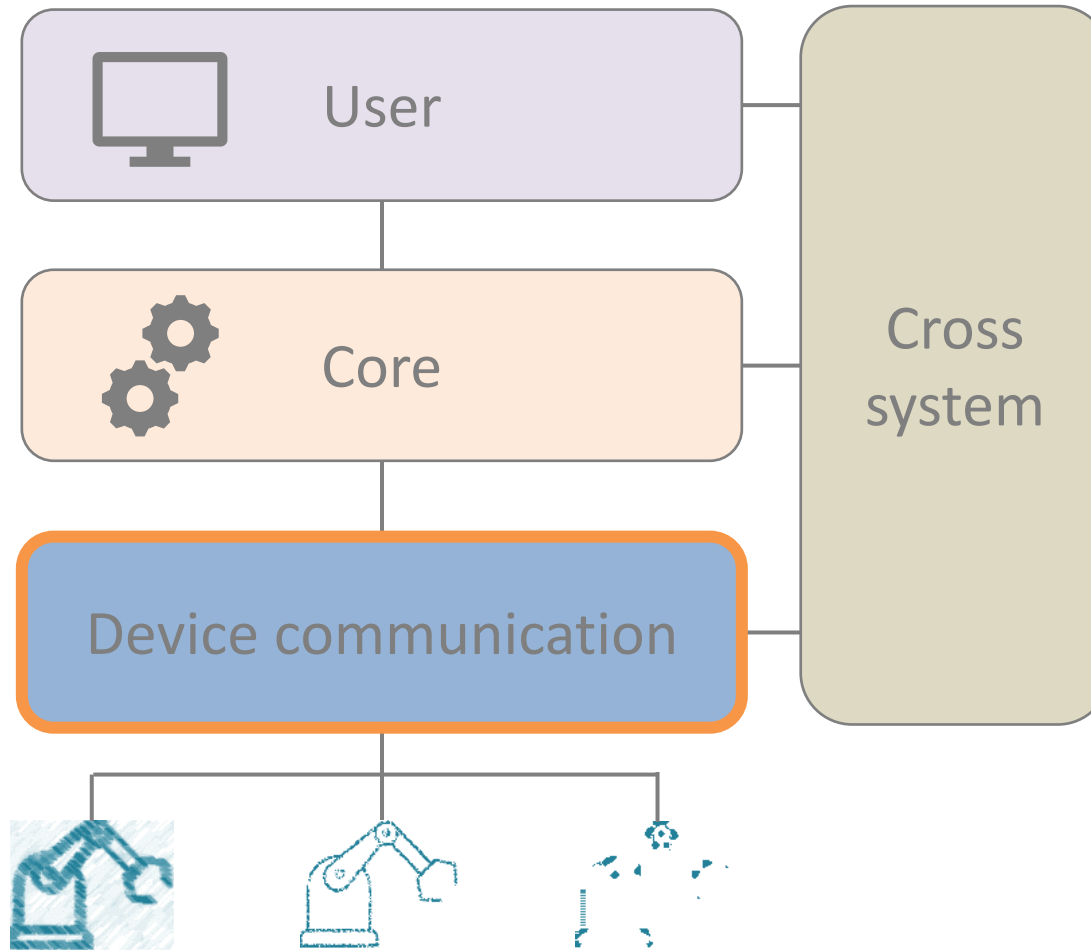
Another way to see
the digital twin



Digital Twin Framework

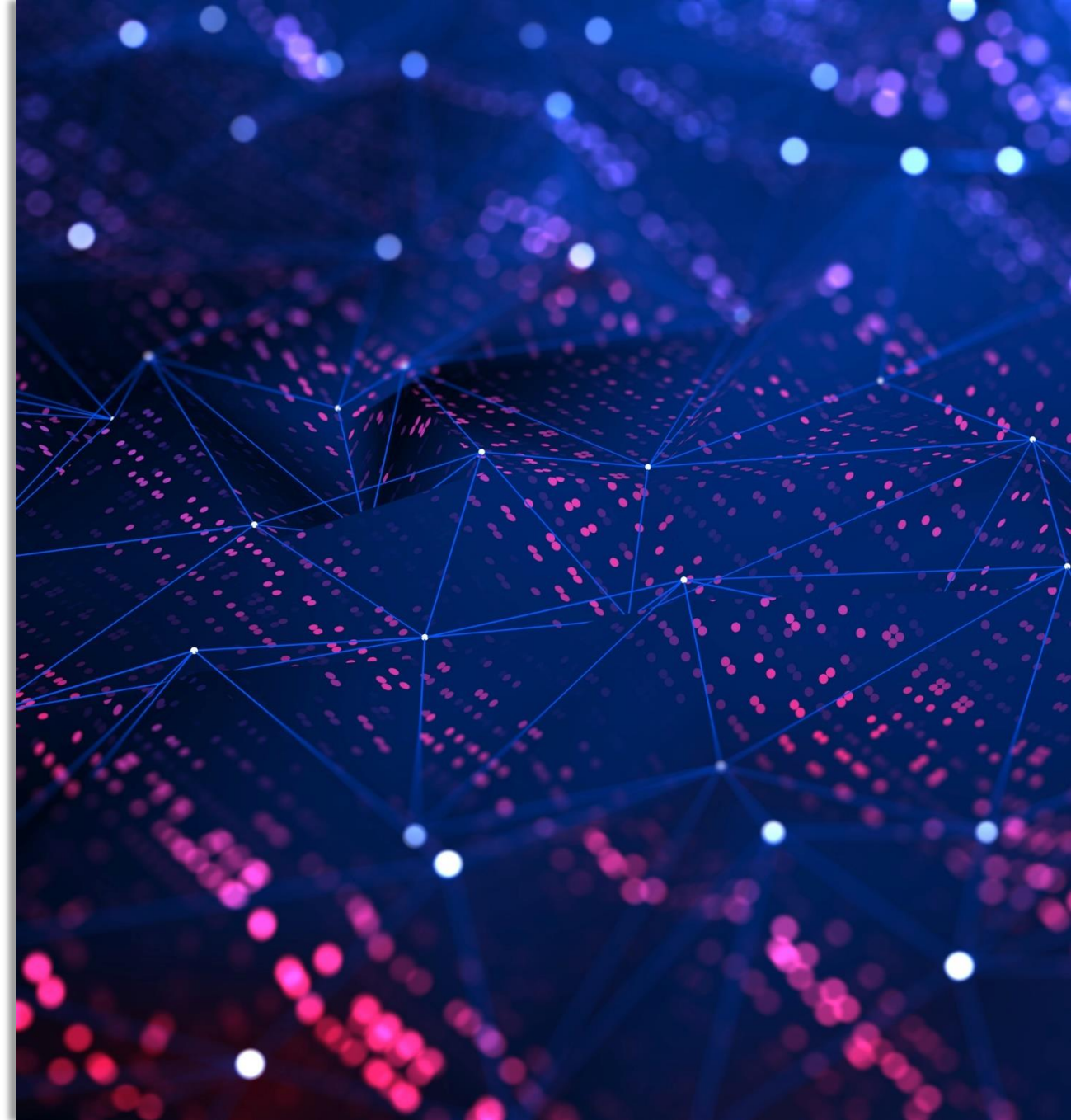


ISO 23247-2 Framework



ISO, « ISO 23247-2:2021, Automation systems and integration — Digital twin framework for manufacturing — Part 2: Reference architecture », 2021.

Paint the Digital Twin





The Water-Lily Pond,
Claude Monet, 1899,
Princeton University Museum of Art



White Water Lilies,
Claude Monet, 1899,
Pushkin Museum



The Japanese Footbridge and
the Water Lily Pool, Giverny
Claude Monet, 1899,
Philadelphia Museum of Art

All the data collected is an impression of
reality through the sensors of the collection

It is important to take this into consideration when designing
the digital twin

Data collect like painting

Every point is like a data

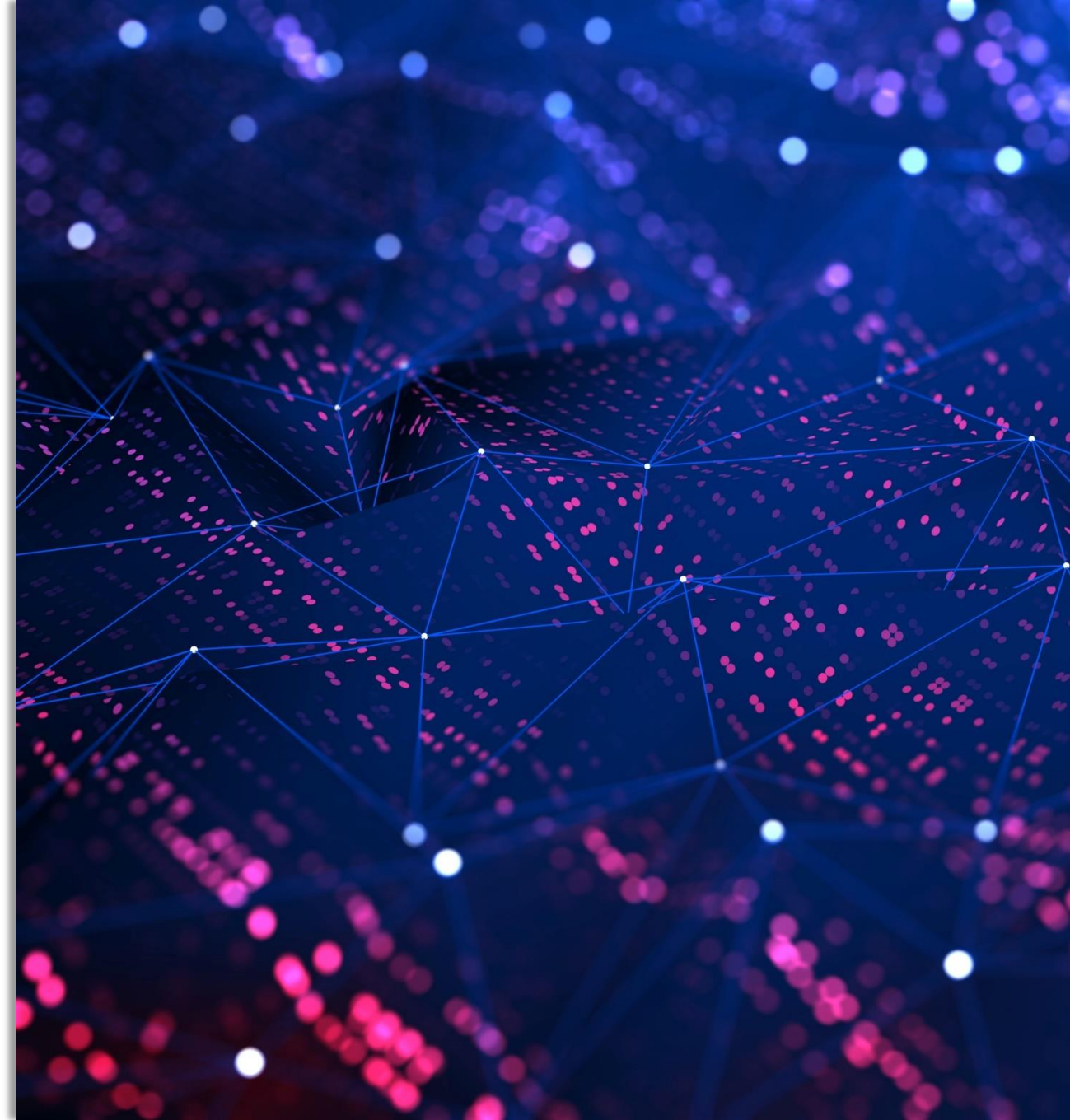
We get to understand the picture because we contextualize with our thoughts the data

But a digital data collection does not have this characteristic naturally

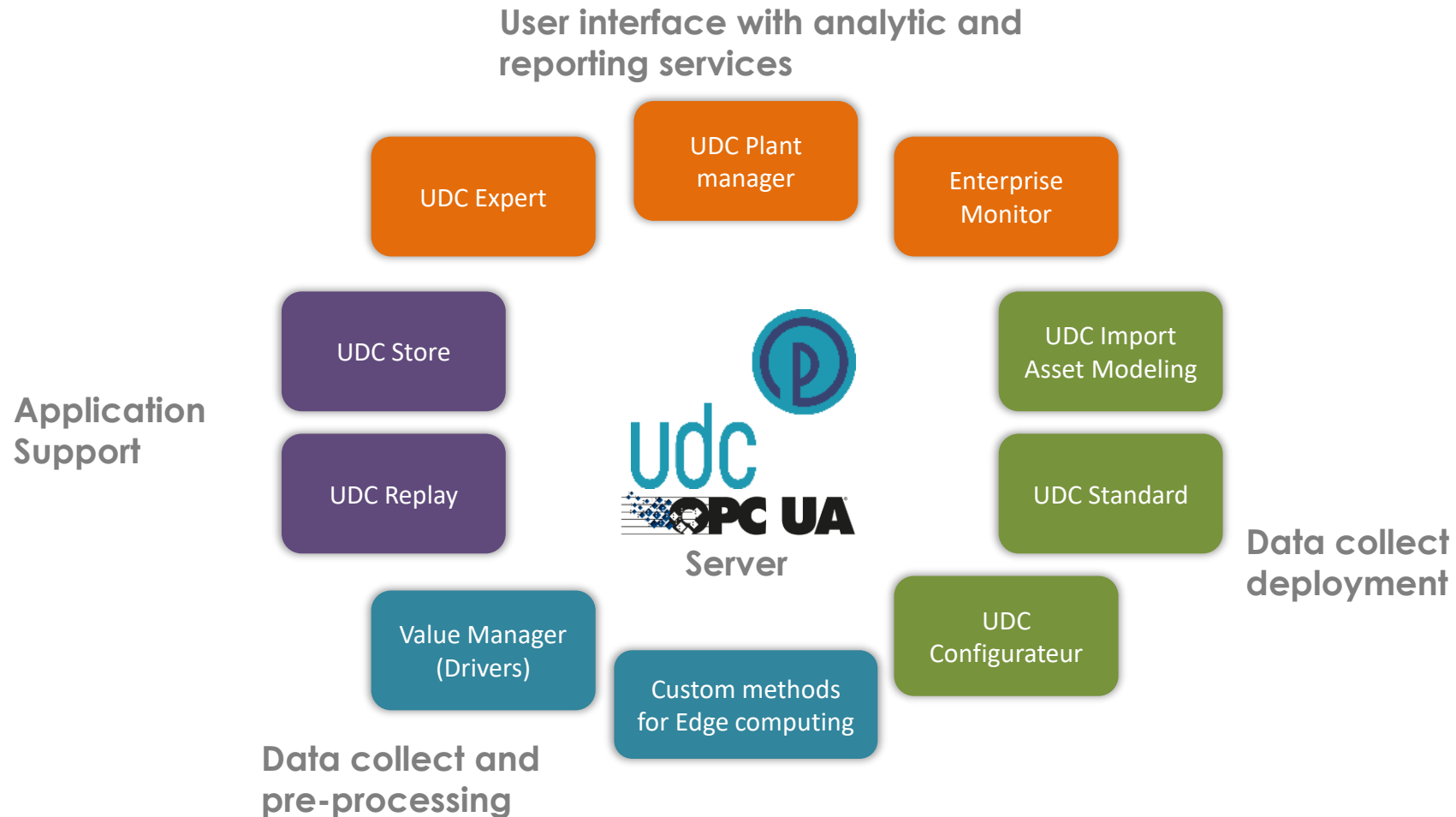


Théo Van Rysselberghe, L'Homme à la barre, in 1892 , oil on canvas, H. 60,2 ; L. 80,2 cm., Donation subject to usufruct Ginette Signac, 1976, © Musée d'Orsay, Dist. RMN-Grand Palais / Patrice Schmidt

Our Industrial implementation

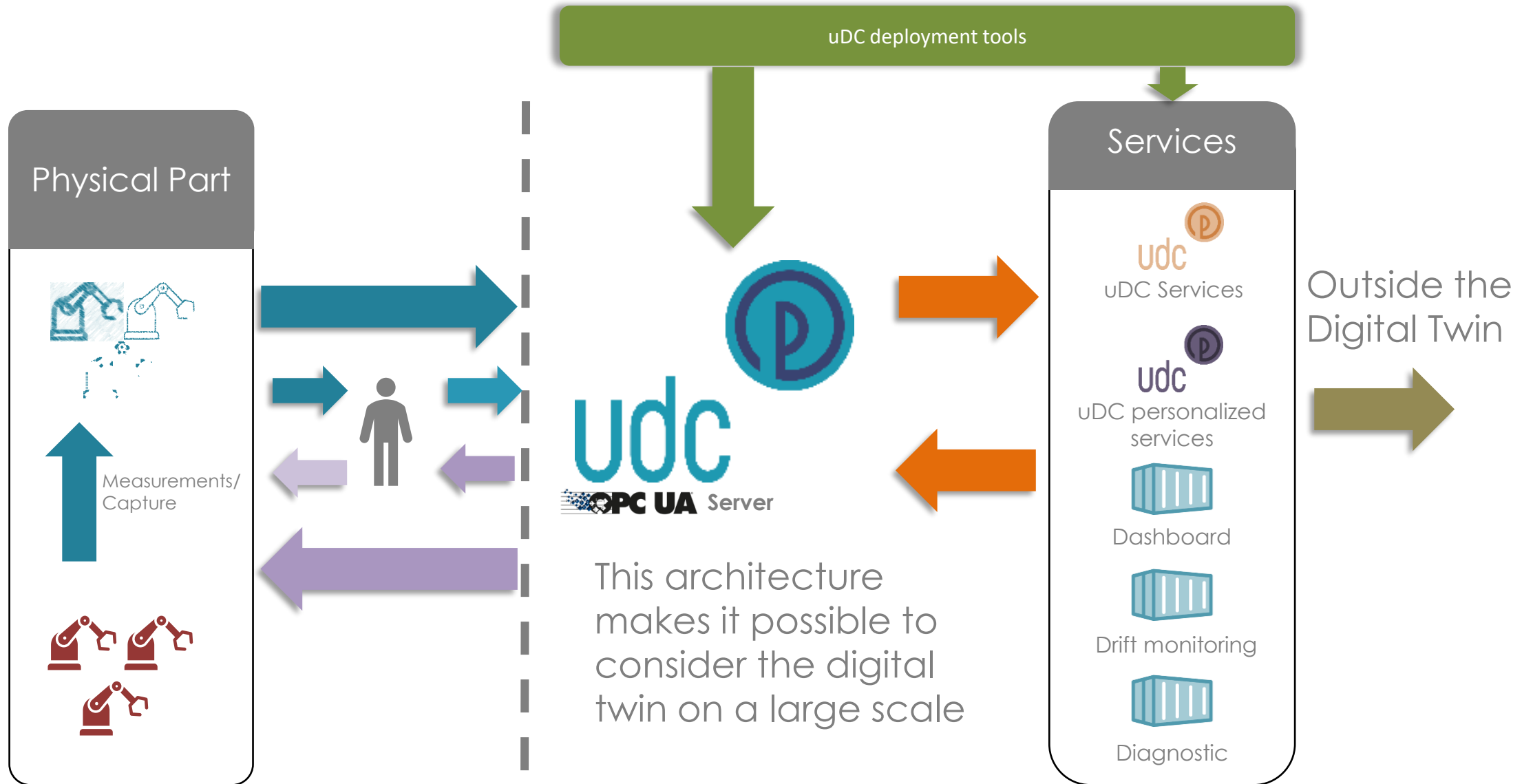


Our Industrial Implementation



uDC an environment for the deployment of standardized and contextualized data collection and their associated services

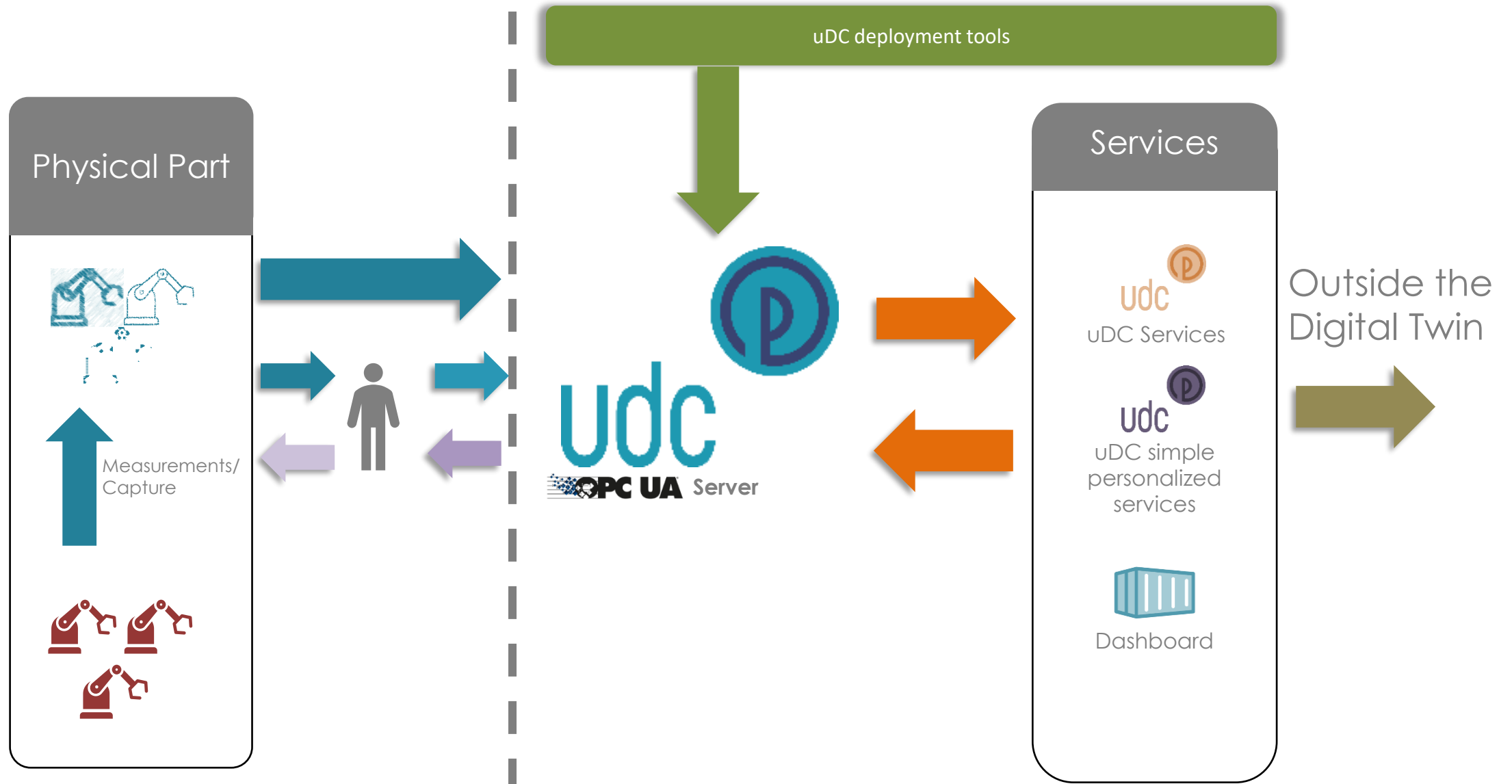
UDC and these services

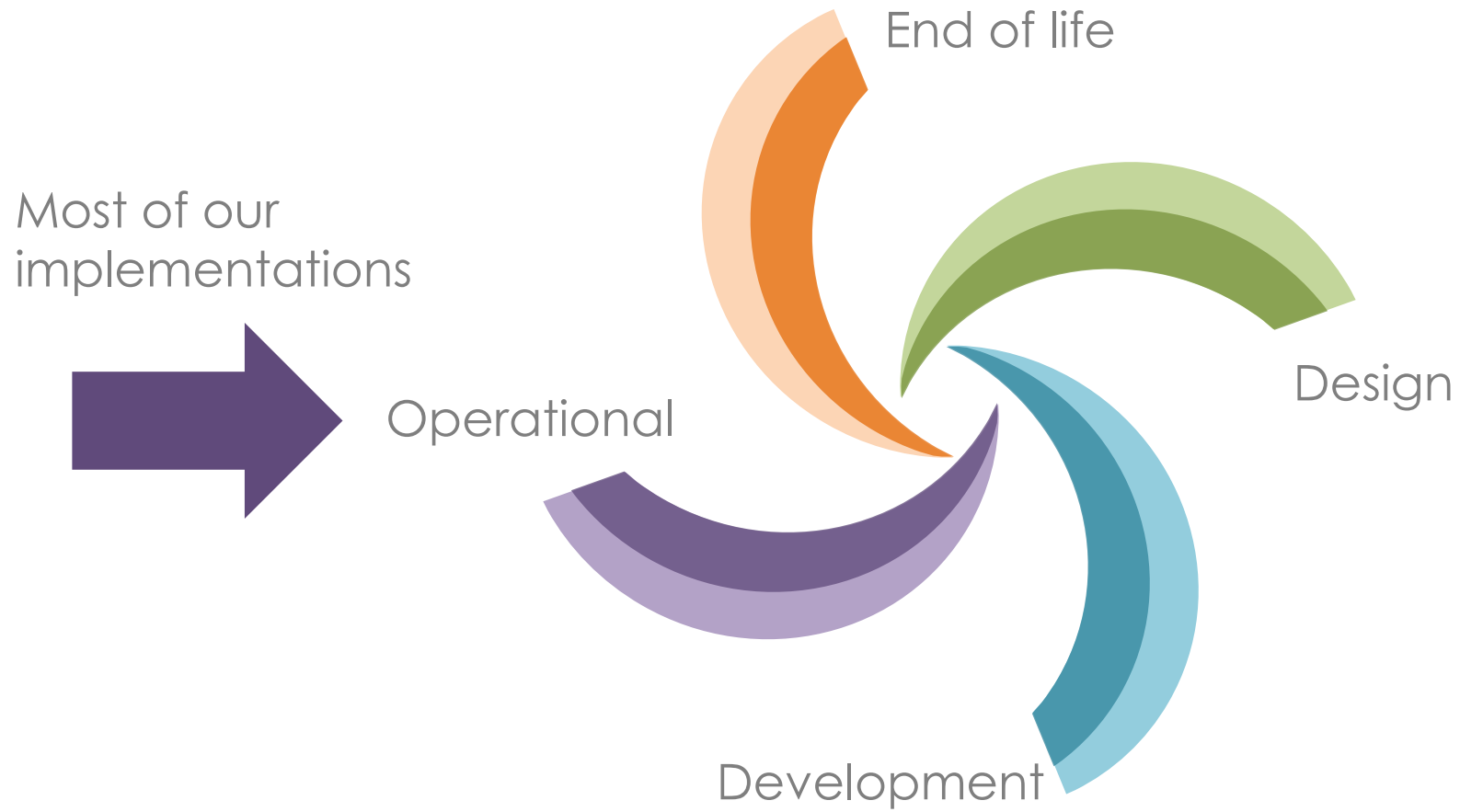


This architecture makes it possible to consider the digital twin on a large scale

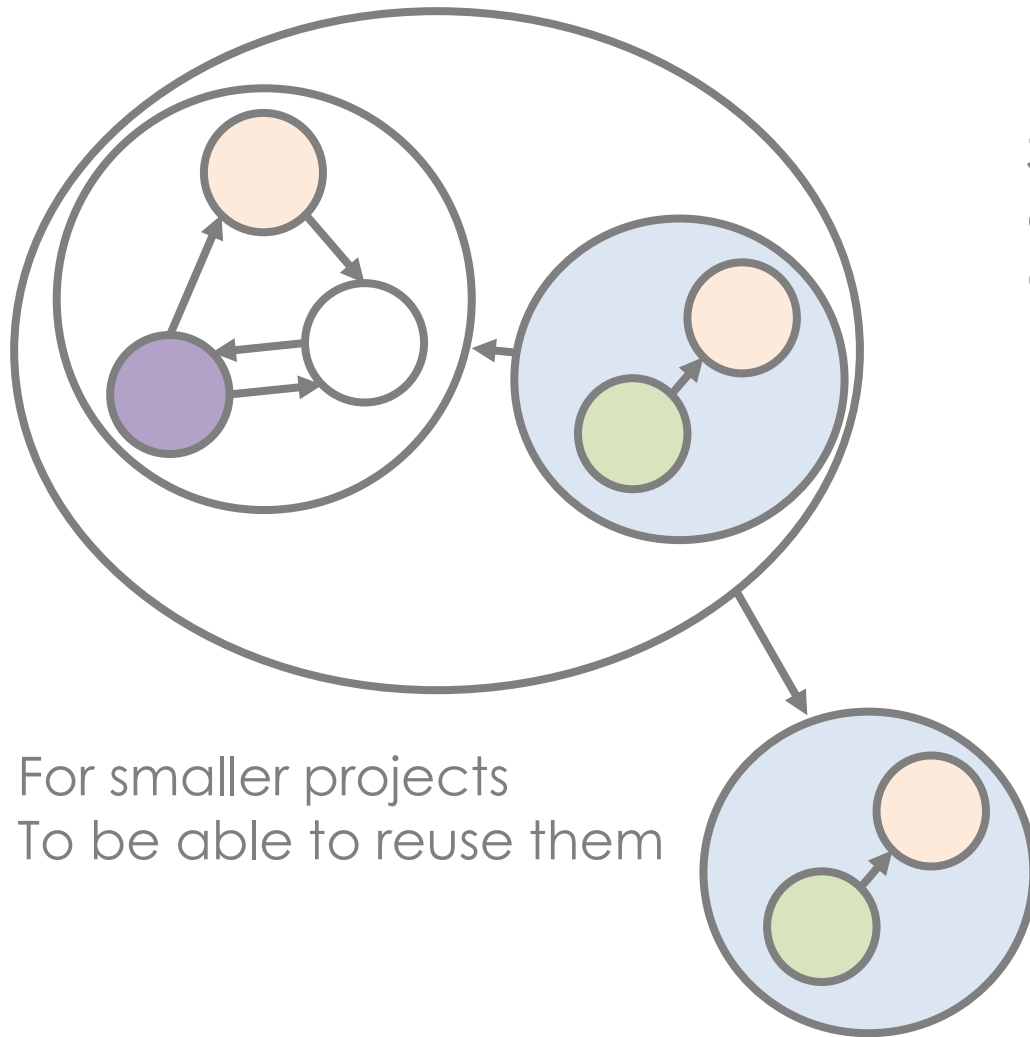


Implementation to meet the majority of today's needs



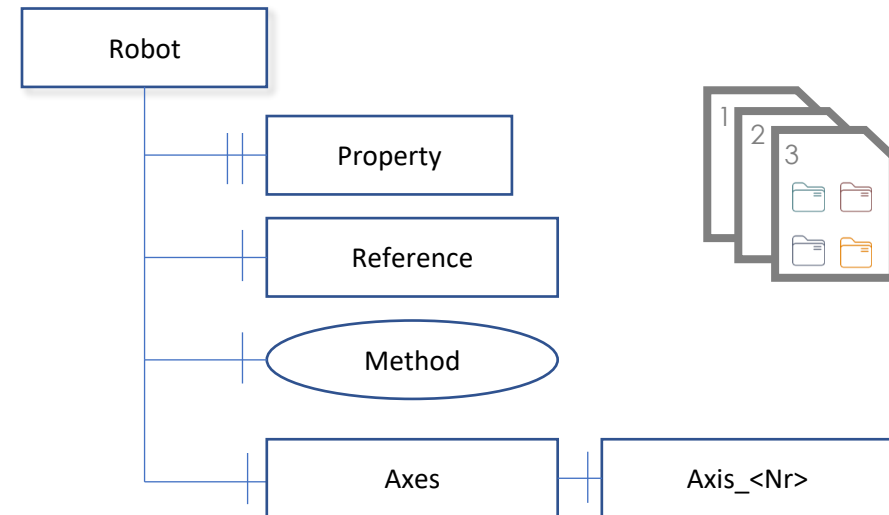


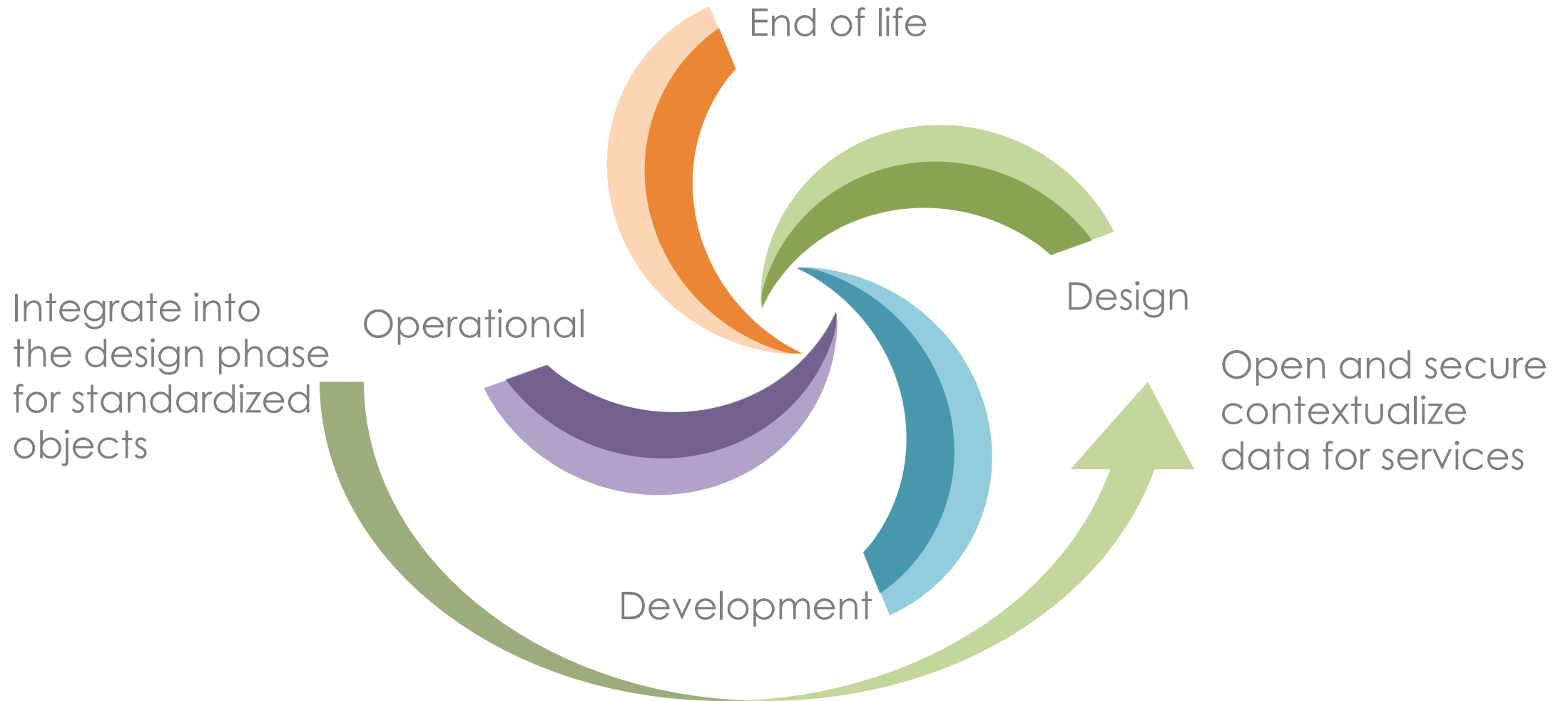
Breaking down your digital twin



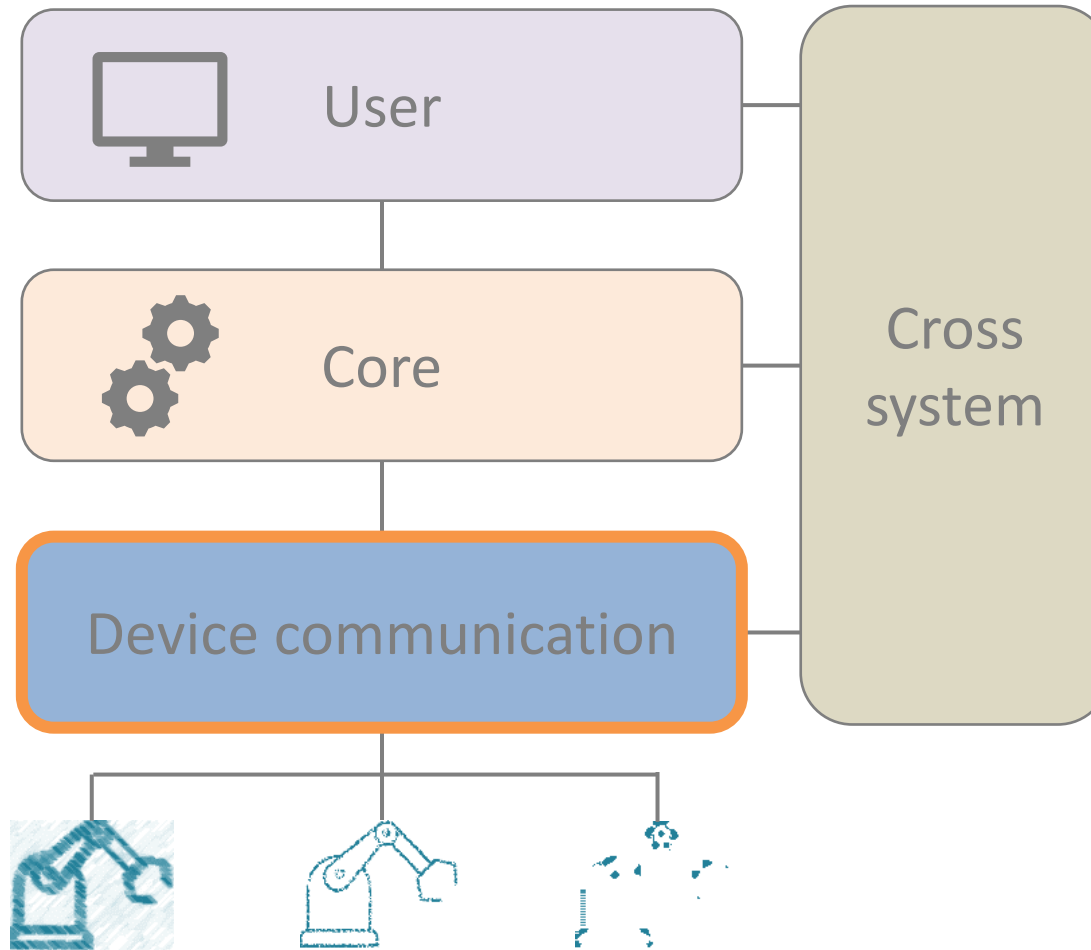
For smaller projects
To be able to reuse them

Standardize and contextualize their data collection
Offers scale-up and modularity capability

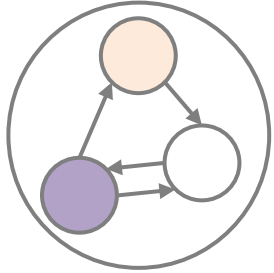




ISO 23247-2 Framework



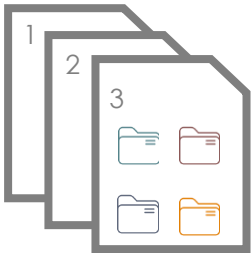
ISO, « ISO 23247-2:2021, Automation systems and integration — Digital twin framework for manufacturing — Part 2: Reference architecture », 2021.



Breaking down and implement by stages the Digital Twin



Think about standardized and contextualized data collection by design



Maintain and evolve services and models

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Thank you.