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DIGITAL TWINS

From dream to reality

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Topic presentation

Context

Software is eating the world!

-Marc Andreessen

Everything need to be tested

- Aviation
- Farming
- Health
- ...

Test, yes, but quickly !

A farmer can not try things directly on his field

A possible solution : Digital Twin
Simulates your system

"A DT is a virtual representation (or replica) of an Actual System (AS) that is continuously updated with real-time data throughout its life-cycle and, at the same time, can interact with and influence the AS."

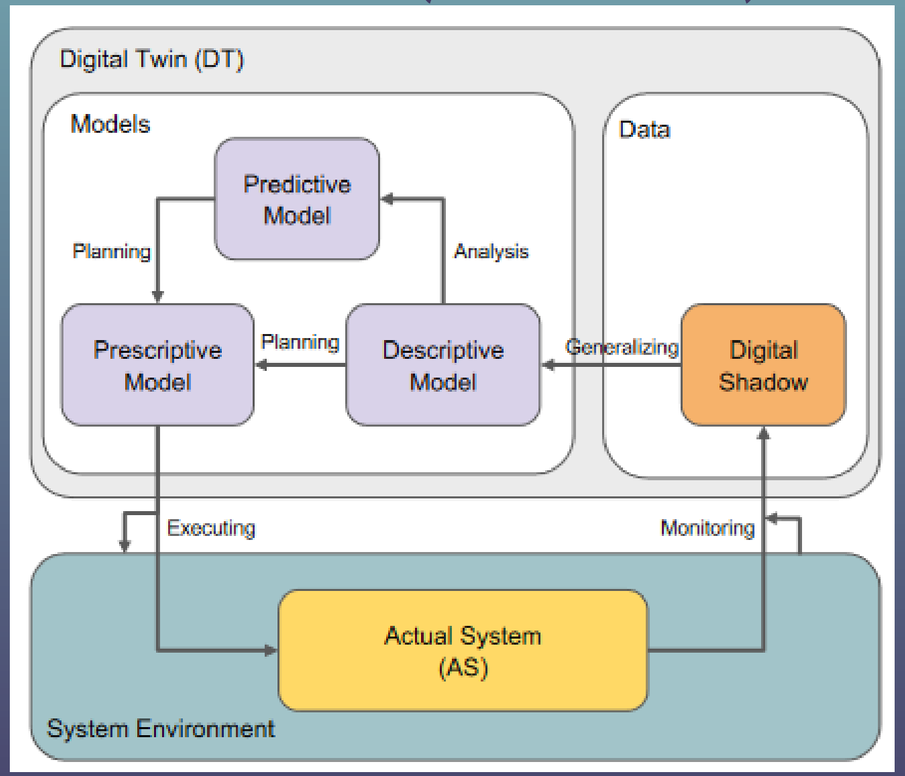
F. Bordeleau and al.
Towards model-driven digital twin engineering: Current opportunities and future challenges.
In Proc. of First International Conference on Systems Modelling and Management (ICSMM), volume 1262, pages 43–54, 2020.

Test on the digital twin (Does not dispense with testing on the current system)

Many different domains, for many different applications. Is there a common base ?

- MODA

Modèle MODA (Model and Data) :



https://ieeexplore.ieee.org/abstract/document/9626349

02

Research question

Research question

How can the application of digital twins vary depending on the industry?

03

Results

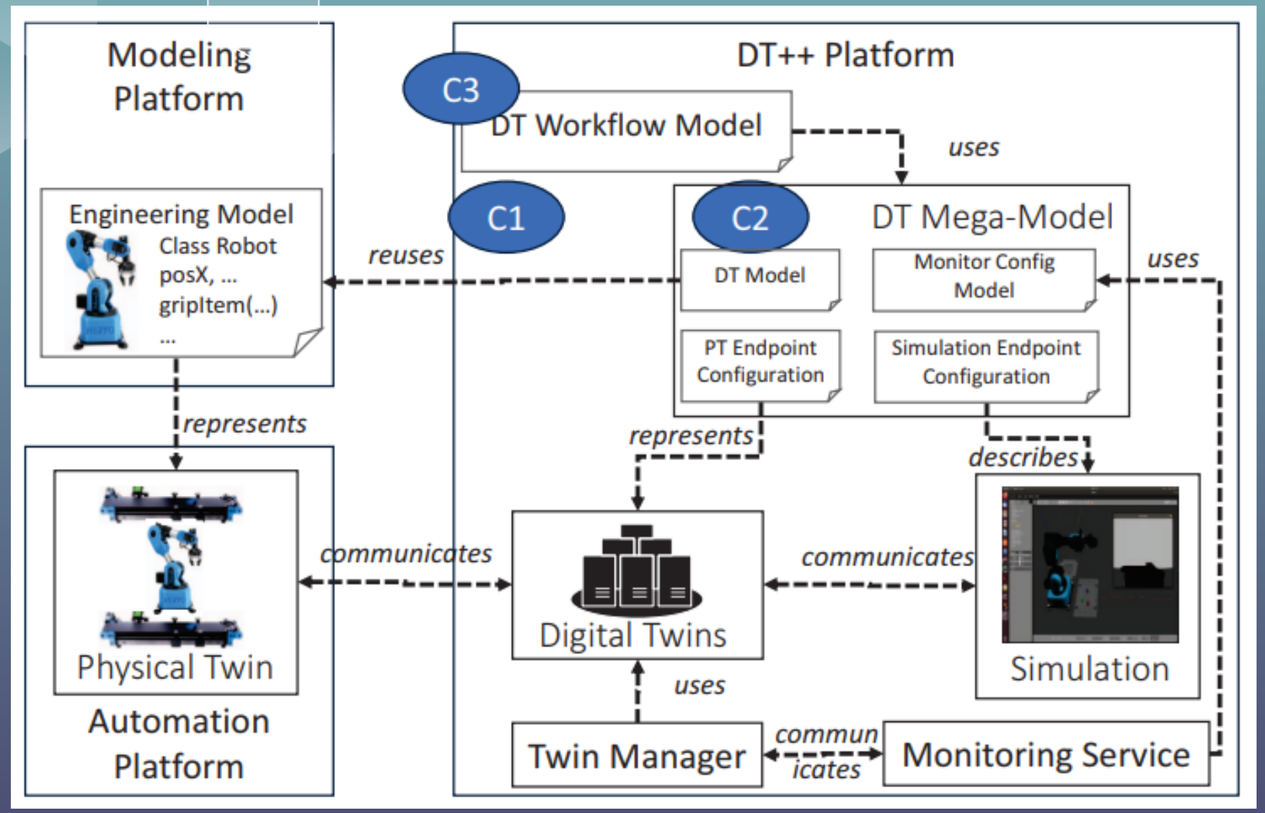
Existing plateform

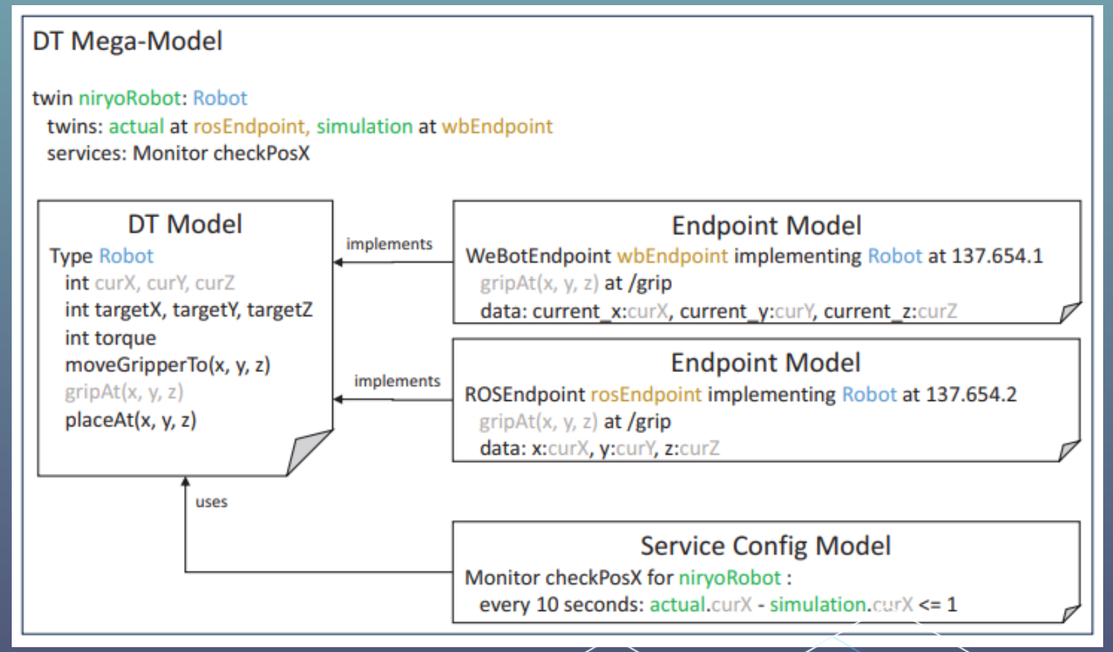
Needs for representing behavior or infer it from runtime data modernization languages like UML/SysML/AML are integrated to DT platform

We already know how to implement each block separately

Variability of DT architectures makes it time-demanding to integrate different existing tools into a working architecture

DT++ plateform





Images source : https://ieeexplore-ieee-org.passerelle.univ-rennes1.fr/abstract/document/10350749

04

Conclusion

Challenges of maintaining and upgrading Digital Twins

Heterogeneous model

Systems are made up of numerous modules that do not necessarily communicate in the same way.

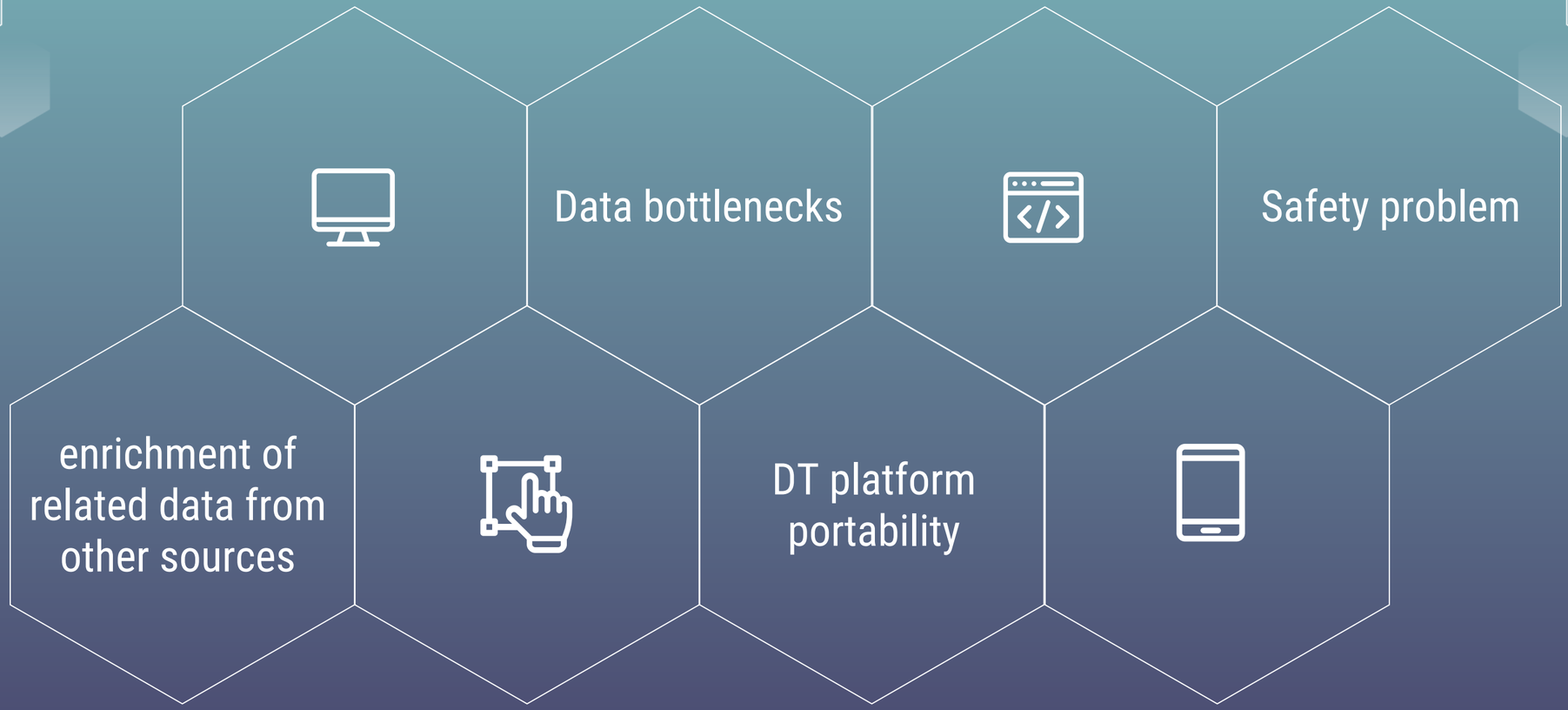
Collaborative environment

Systems are made up of numerous modules that do not necessarily communicate in the same way.

Bi-directional synchronization

Digital twins is based on their ability to exploit runtime

Focus on IoT challenges



Answer to RQ

Unfortunately, this technology is not mature enough to provide an out-of-the-box solution, despite all the initiatives that have been taken.

Thanks for your attention

Bibliography

R. Eramo, F. Bordeleau, B. Combemale, M. v. d. Brand, M. Wimmer and A. Wortmann, "Conceptualizing Digital Twins," in IEEE Software, vol. 39, no. 2, pp. 39-46, March-April 2022, doi: 10.1109/MS.2021.3130755.

Francis Bordeleau, Benoit Combemale, Romina Eramo, Mark van den Brand, Manuel Wimmer. Towards Model-Driven Digital Twin Engineering: Current Opportunities and Future Challenges. ICSMM 2020 - International Conference on Systems Modelling and Management, Jun 2020, Bergen, Norway. ffhal-02946949

R. Minerva, G. M. Lee and N. Crespi, "Digital Twin in the IoT Context: A Survey on Technical Features, Scenarios, and Architectural Models," in Proceedings of the IEEE, vol. 108, no. 10, pp. 1785-1824, Oct. 2020, doi: 10.1109/JPROC.2020.2998530.

D. Lehner, "A Model-Driven Platform for Engineering Holistic Digital Twins," 2023 ACM/IEEE International Conference on Model Driven Engineering Languages and Systems Companion (MODELS-C), Västerås, Sweden, 2023, pp. 179-185, doi: 10.1109/MODELS-C59198.2023.00045.

P. Spaney et al., "A Model-Driven Digital Twin for Manufacturing Process Adaptation," 2023 ACM/IEEE International Conference on Model Driven Engineering Languages and Systems Companion (MODELS-C), Västerås, Sweden, 2023, pp. 465-469, doi: 10.1109/MODELS-C59198.2023.00081.