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hybrid event

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IT/OT Integration by Design

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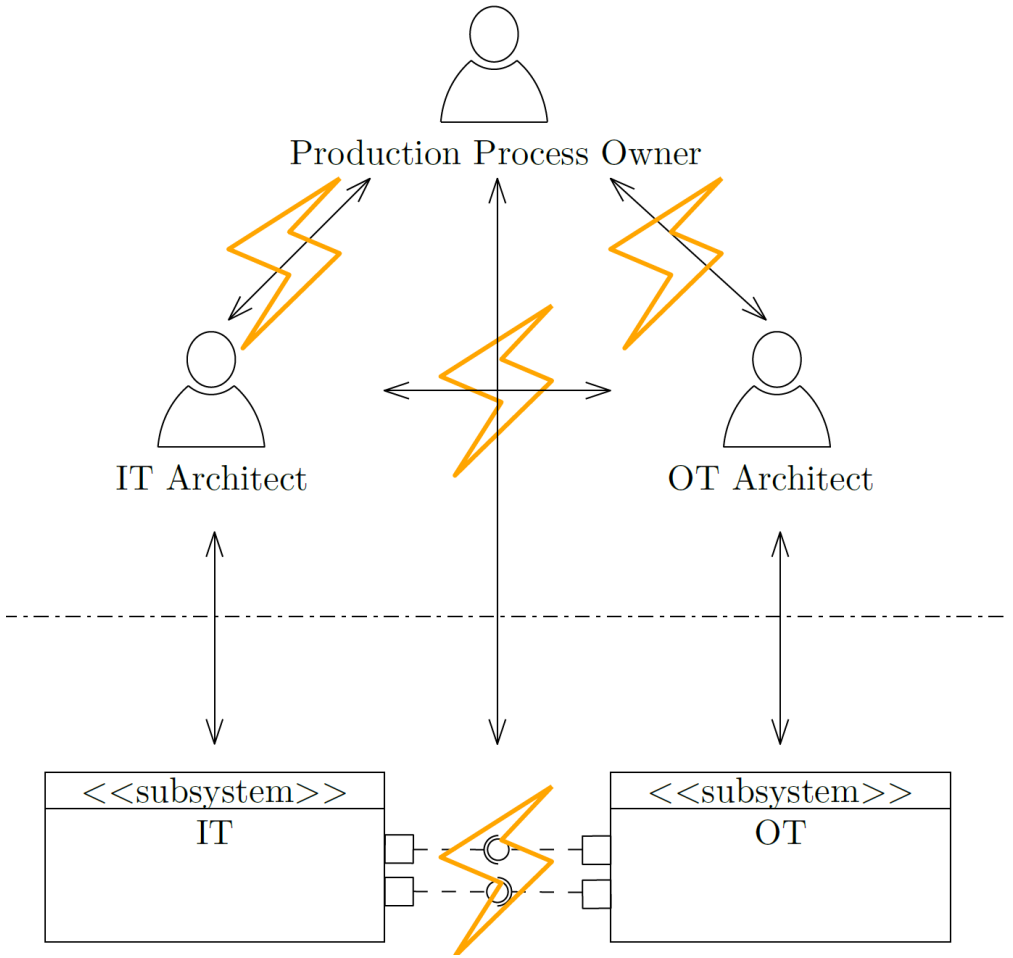
Motivation

- IT and OT are becoming more and more interconnected
- Different priorities between IT and OT
- Problematic communication interfaces



Research Goal and Main Contribution

Find a solution to seamlessly integrate the worlds of IT and OT and allow for an early validation during design time.

Main Contributions:

- Development of an Industrial Business Process Twin (IBPT), forming a middle layer between IT and OT and thereby minimizing critical interfaces between those worlds.
- Ensuring IT/OT Integration by design by using Model-based Systems Engineering and Reference Architecture Model Industry 4.0 (RAMI 4.0). This allows for evaluating the beneficial effects of an IBPT middle layer and for identifying possibly critical interfaces.

Agenda

I. Conway’s law / Mirroring Hypothesis

II. Industrial Business Process Twin (IBPT) Approach

III. IT/OT Integration by design using MBSE and RAMI 4.0

Conway’s law / Mirroring Hypothesis

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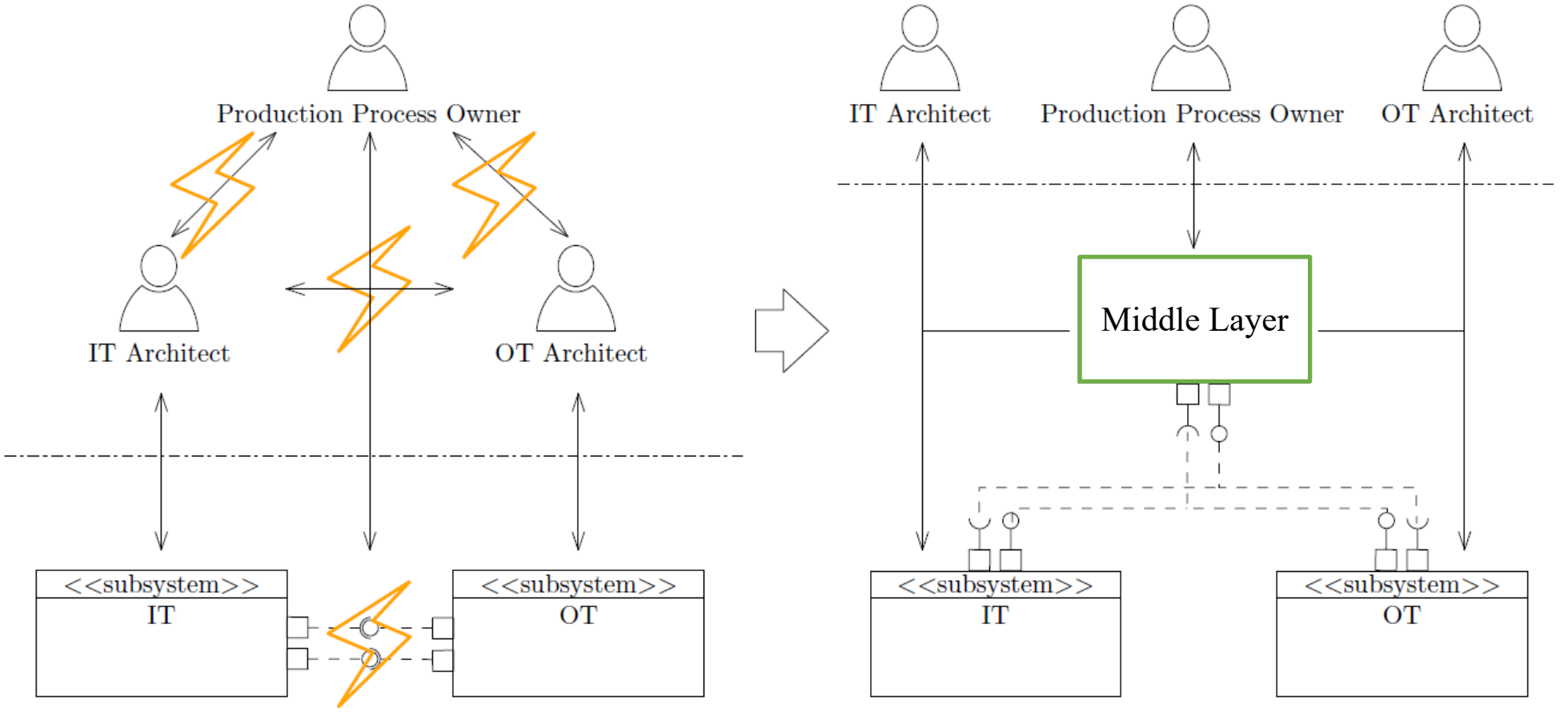
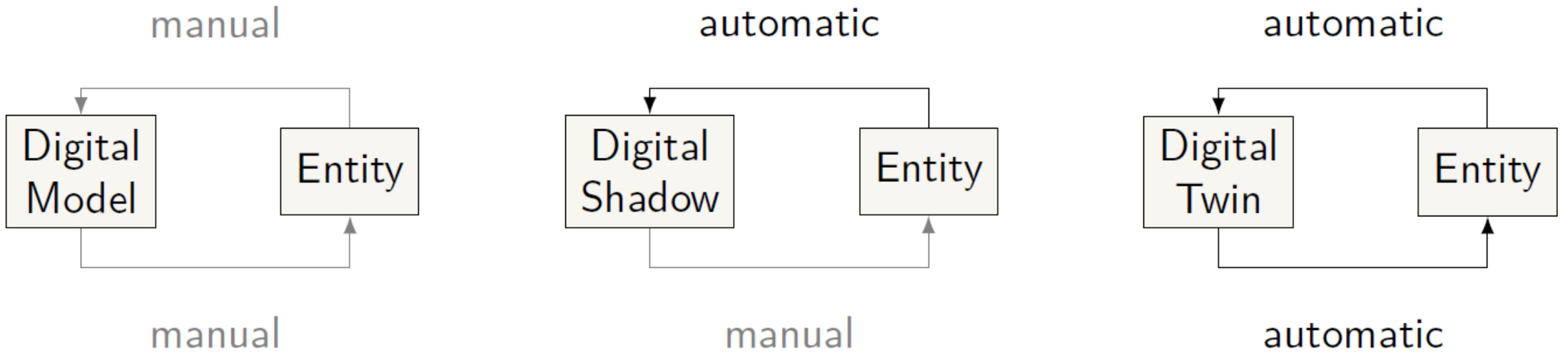


The Industrial Business Process Twin (IBPT) Approach

Classification of Digital Representations

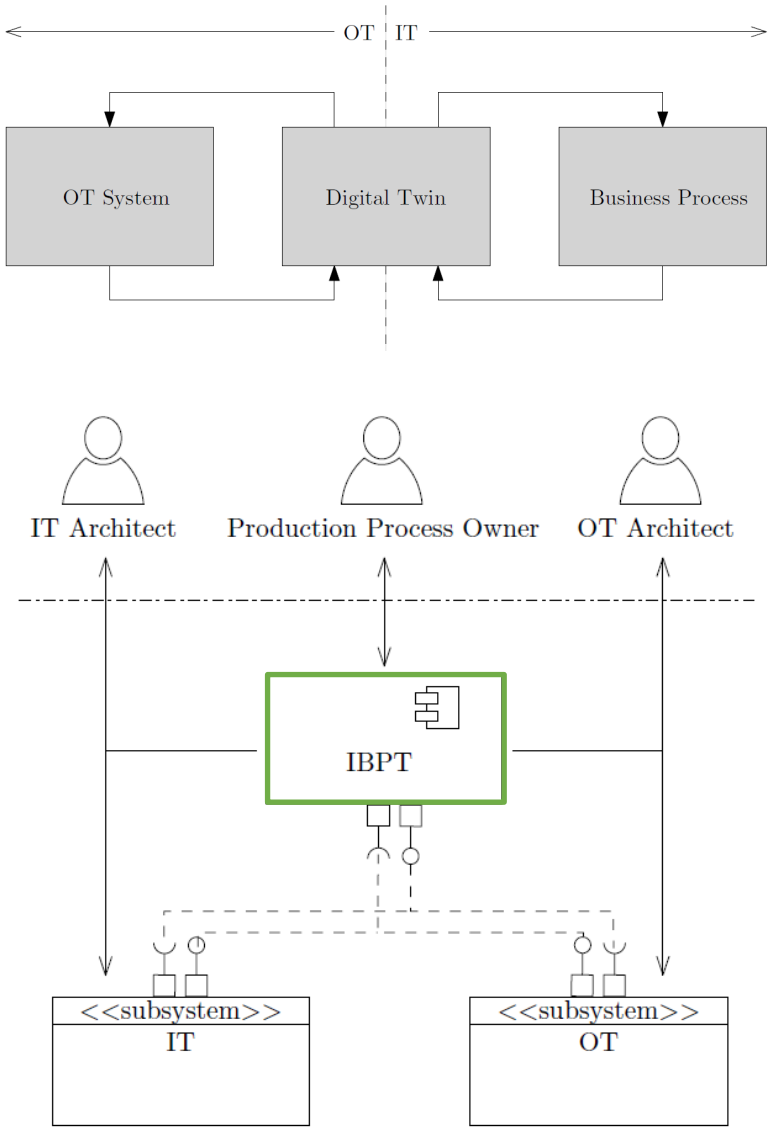
Taxonomy according to Kritzinger et al.

- Classification based on automatic or manual data exchange



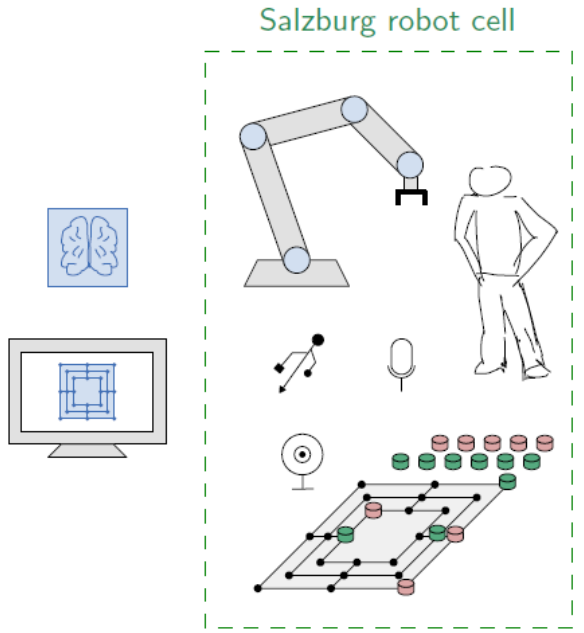
IBPT Concept

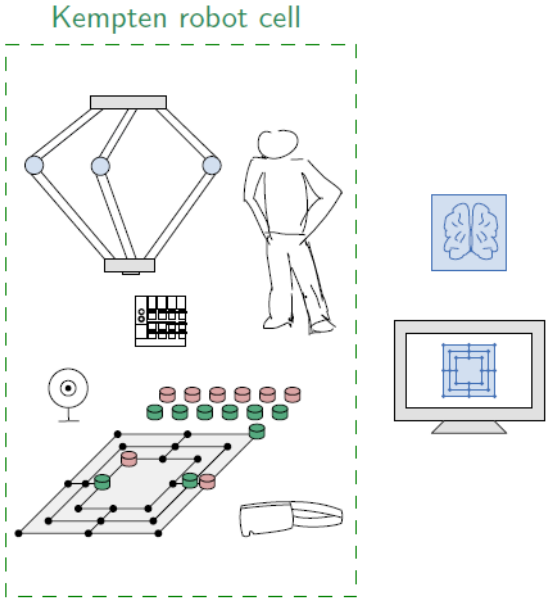
- Twinning business processes
- IBPT as intermediary between IT and OT
- Reduce system complexity for IT/OT stakeholders
- Common information and communication protocol (OPC UA)
- Suitable overall software architecture (SOA)



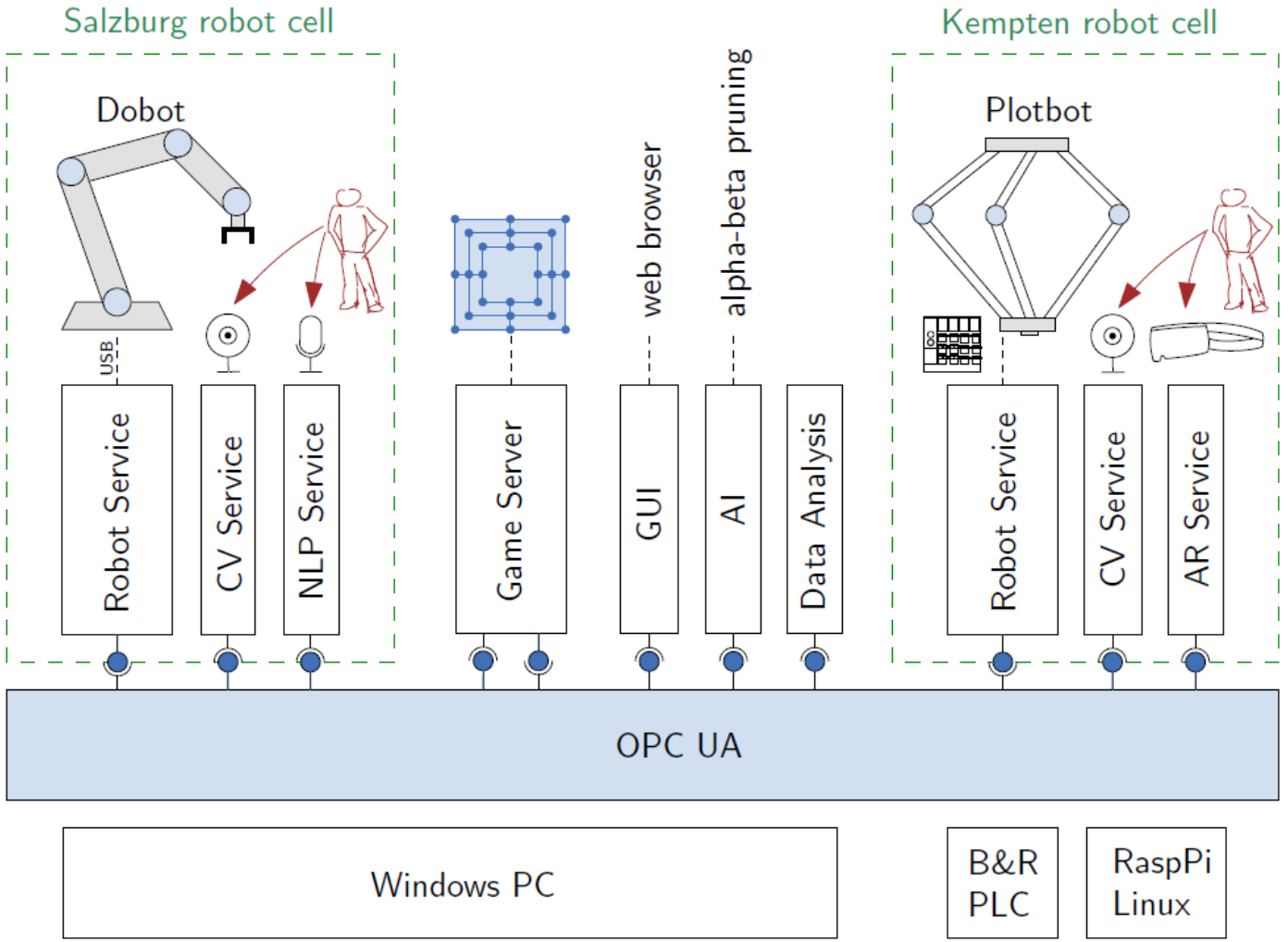
Case Study: Robots playing Nine Men's Morris

- Geographically distributed robot cells playing Nine Men's Morris
- Multiple possibilities of triggering a game move
- Central game server for Game Move Validation and Execution

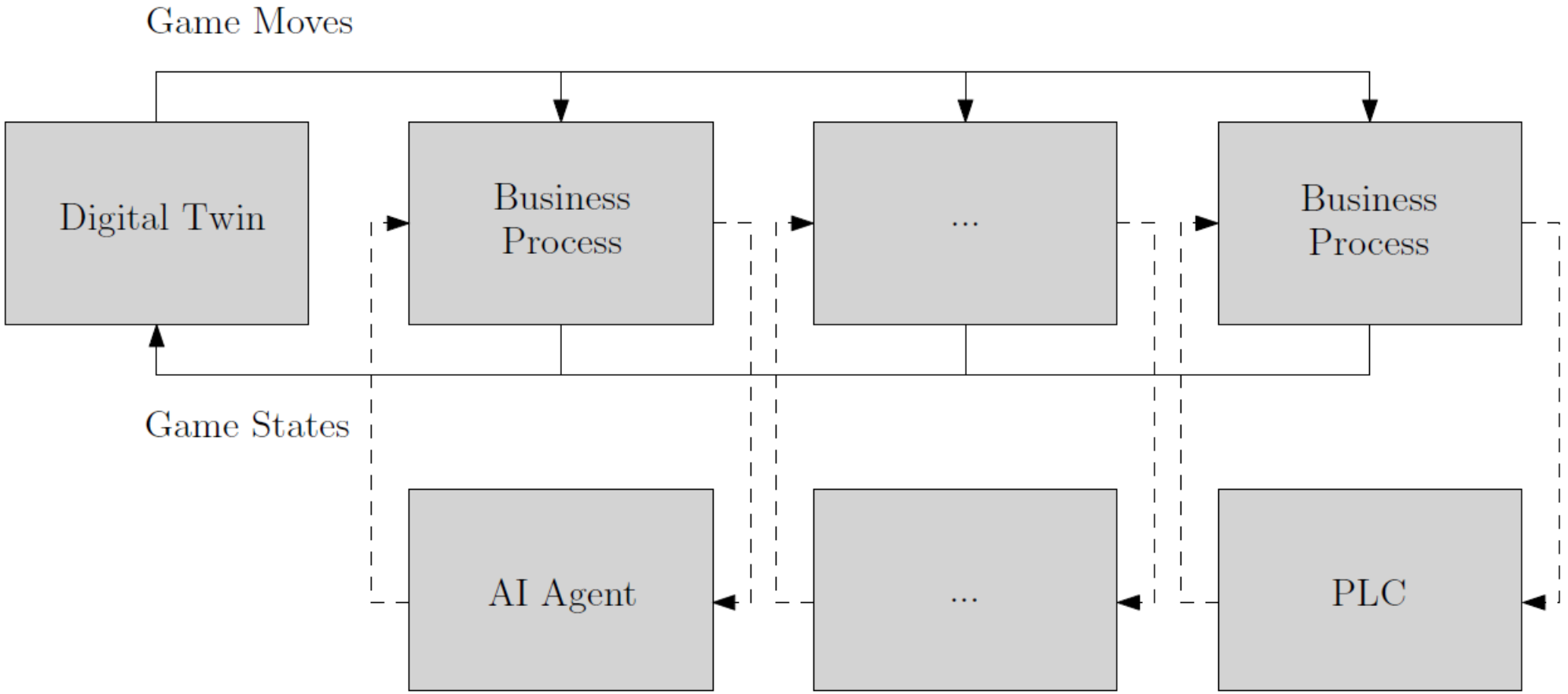




Case Study: Robots playing Nine Men's Morris



IBPT for Playing Nine Men's Morris



IT/OT Integration by design using MBSE and RAMI 4.0

Reference Architecture Model Industry 4.0

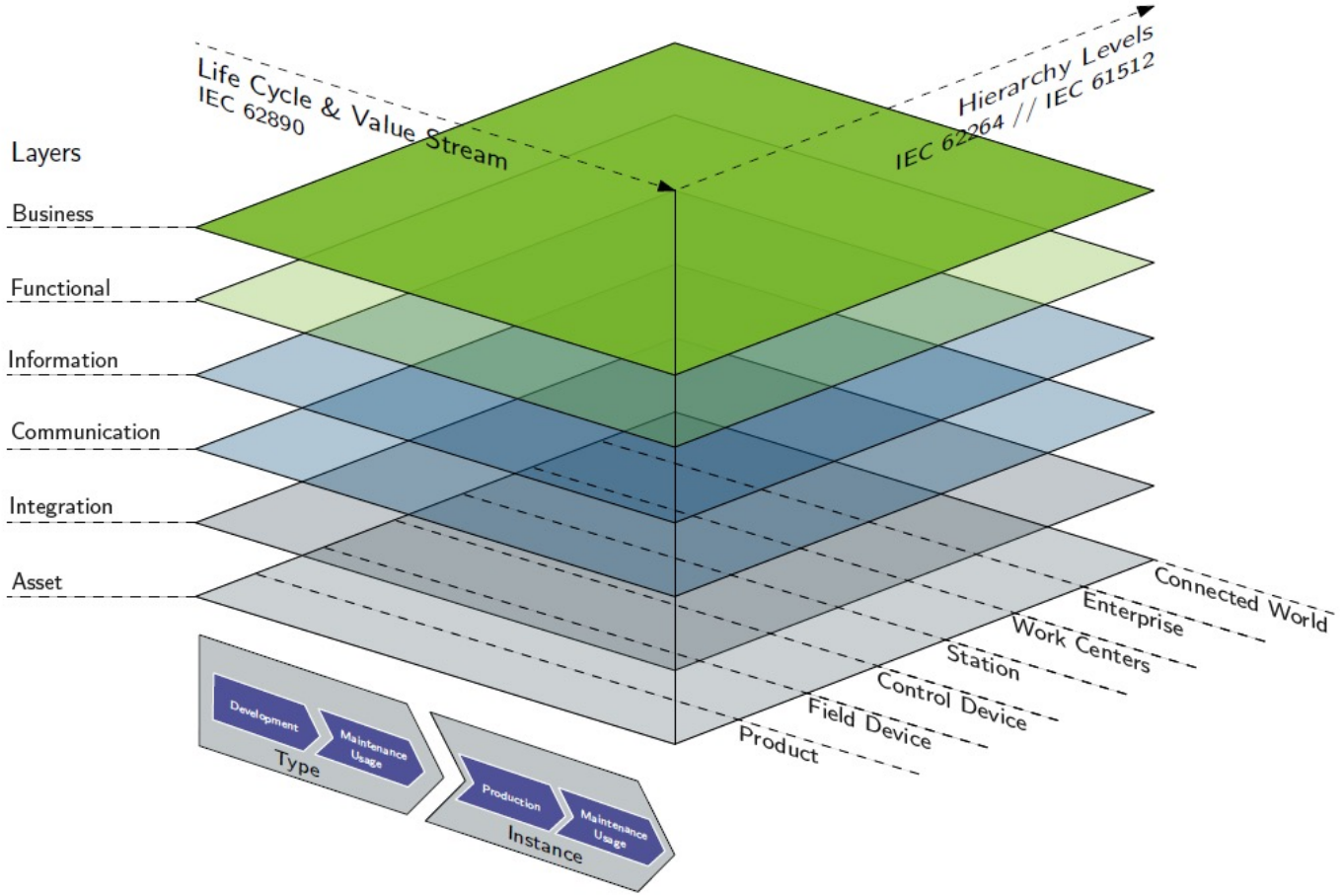
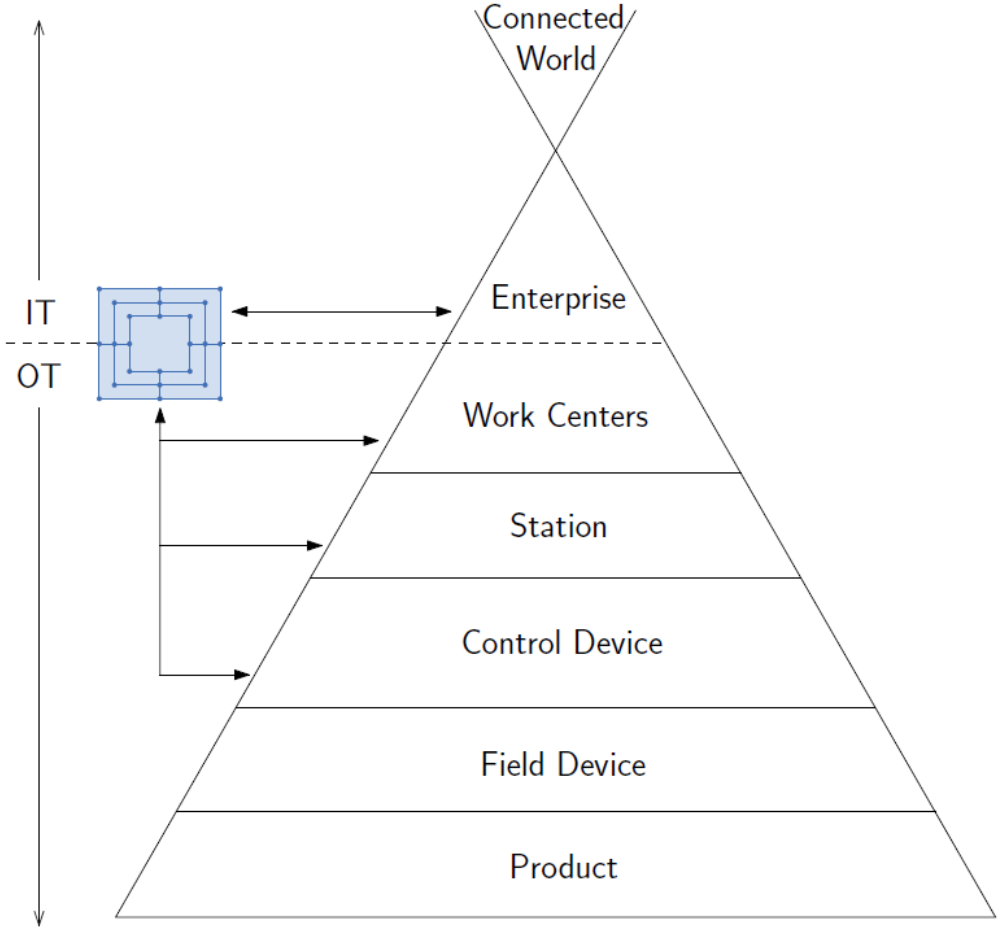
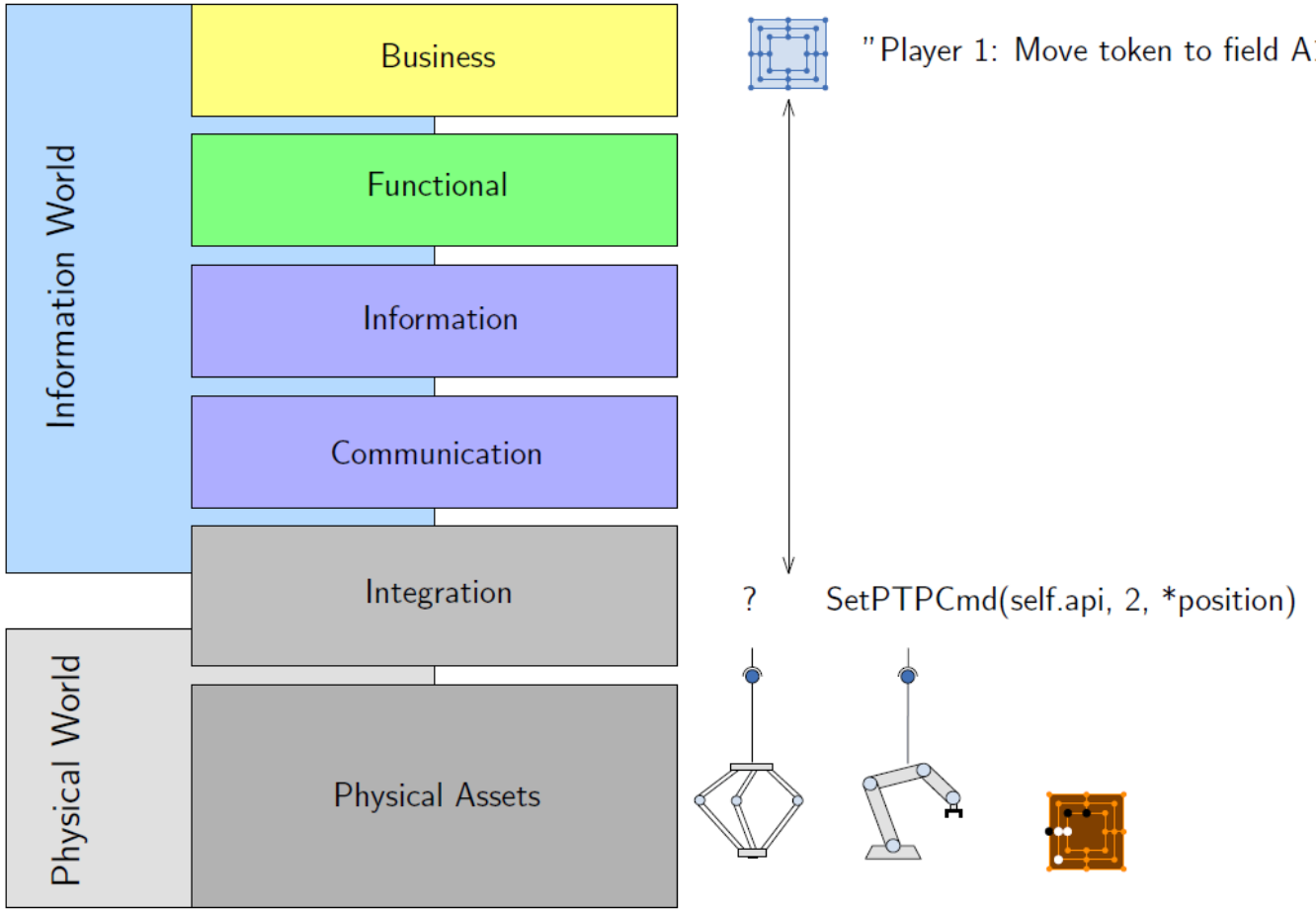


Figure: Adapted from German Electro and Digital Industry Association.

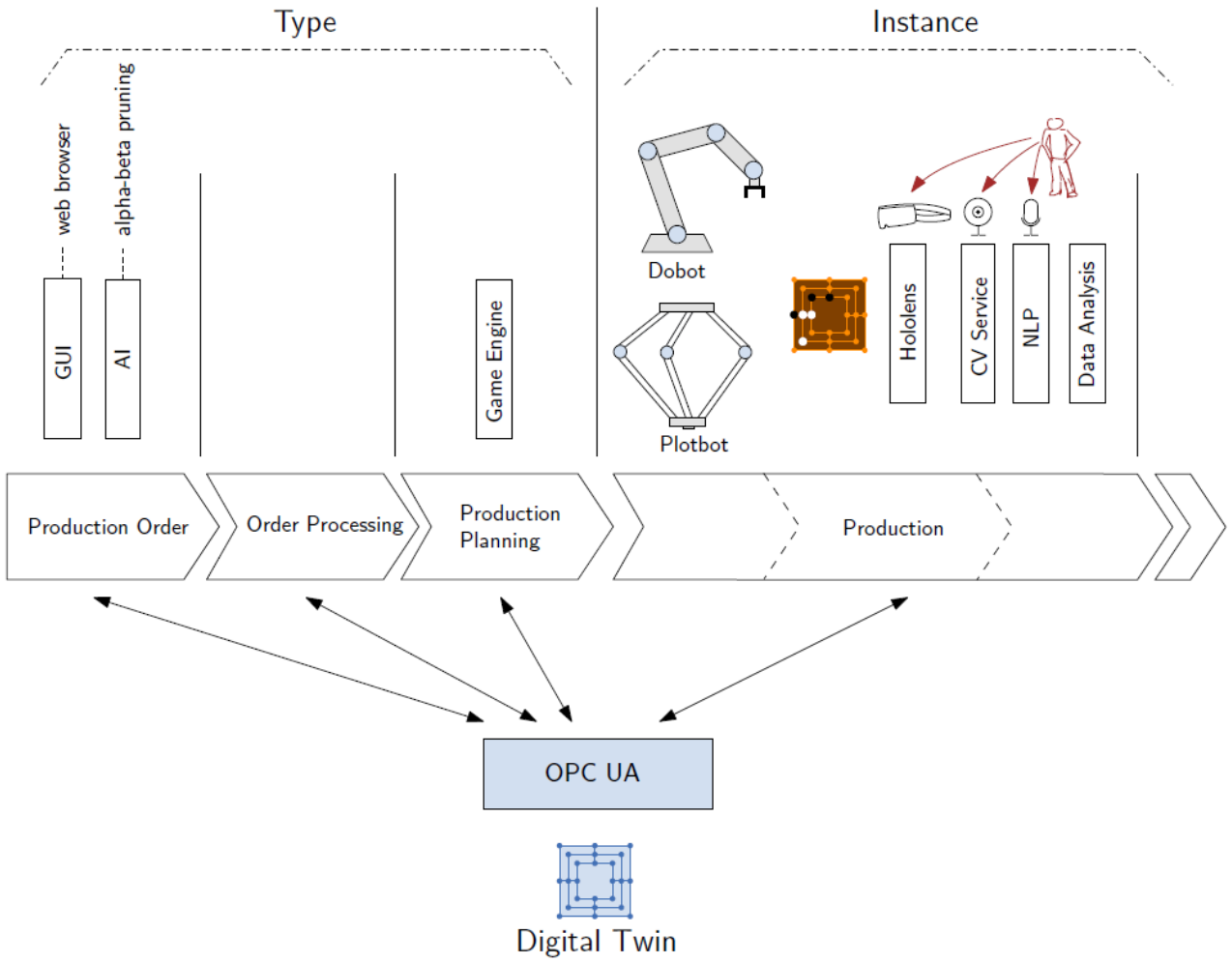
IBPT: RAMI 4.0 Hierarchy Layers View



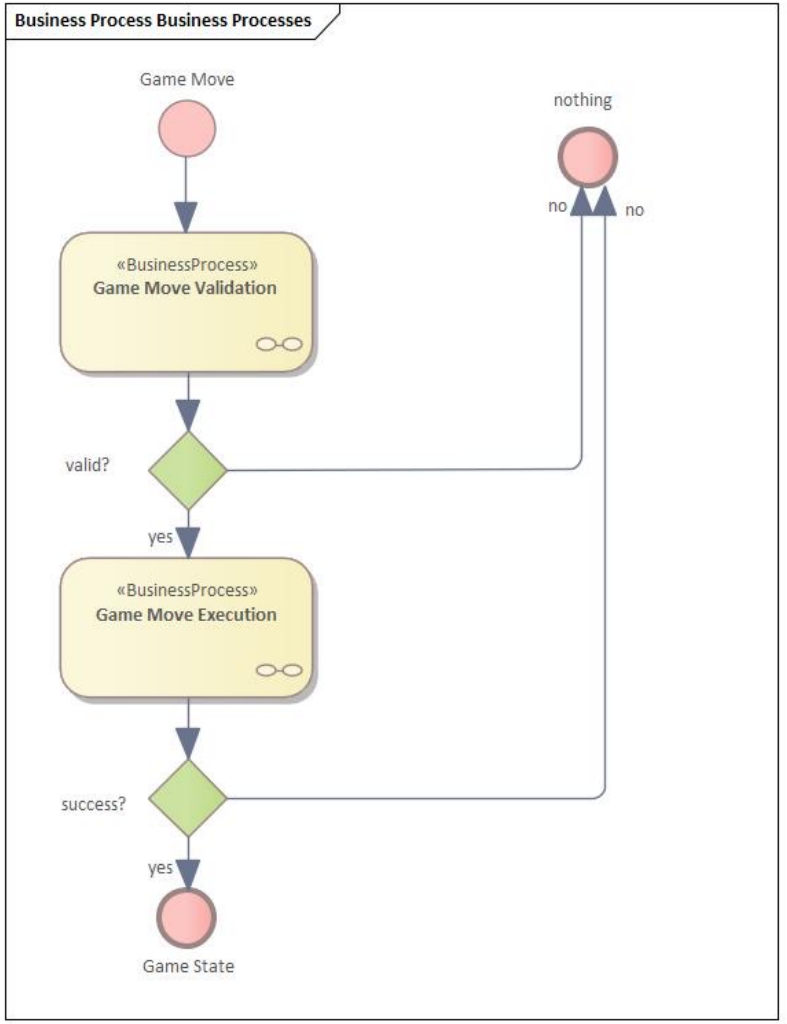
IBPT: RAMI 4.0 Layers View



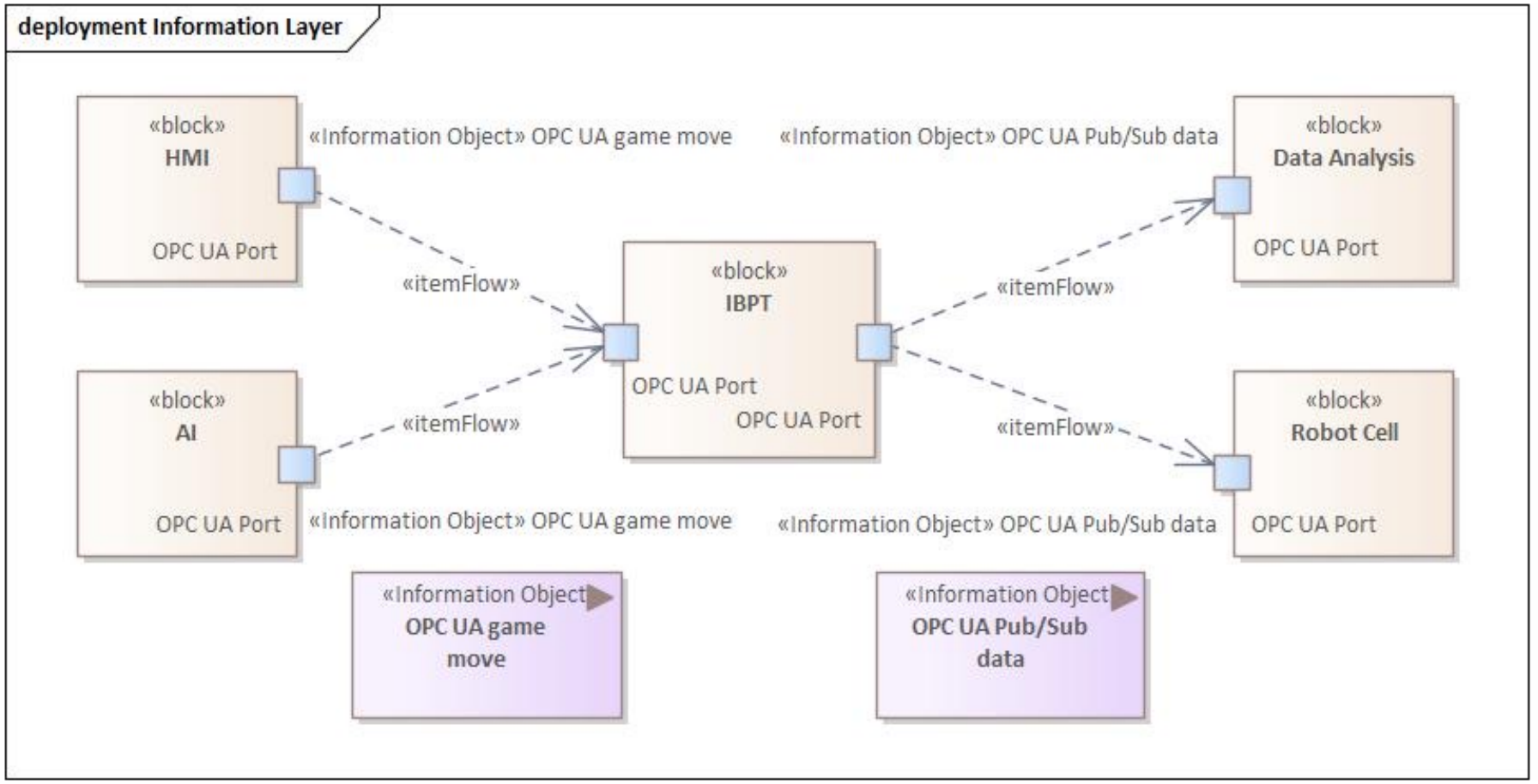
IBPT: RAMI 4.0 Life Cycle & Value Stream View



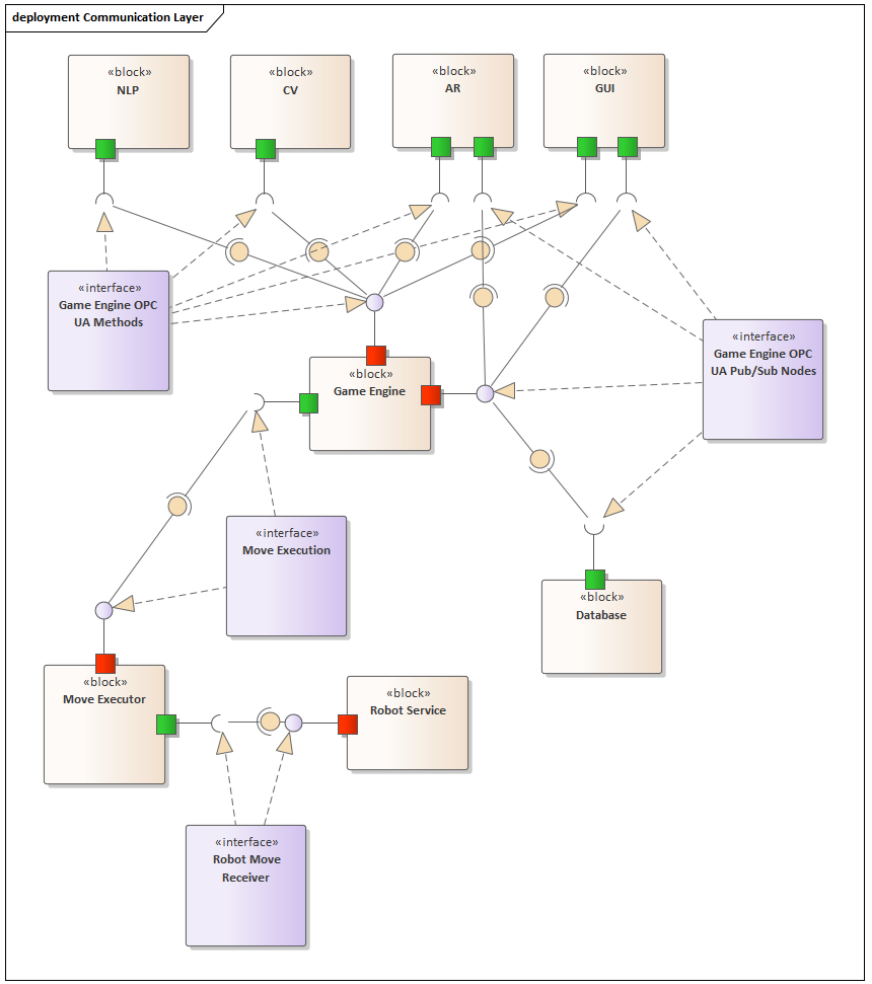
Business Processes Integration

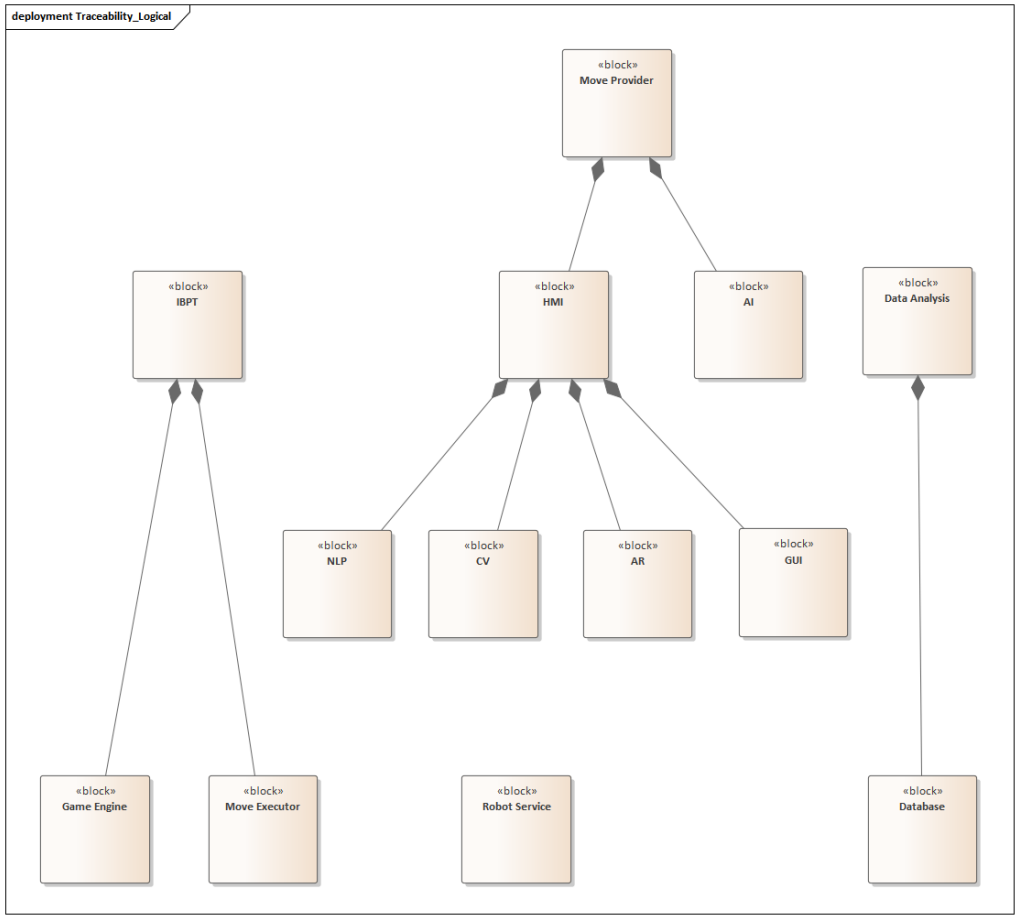


Information Layer



Communication Layer





Conclusion

- The IBPT entity is a suitable intermediary between IT and OT systems
- The IBPT helps to abstract functionality of the OT system to the level of business logic and thereby benefits IT/OT Integration
- MBSE is essential in establishing early verification and validation and identifying potentially conflicting IT/OT interfaces

Thank you very much for your attention!