

IPIC 2024

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Physical Internet Conference
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Unleashing the Potential of Early Digital Twin for HyperHub

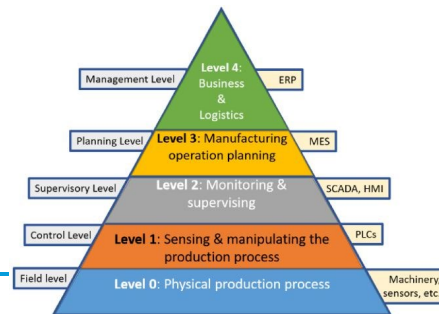
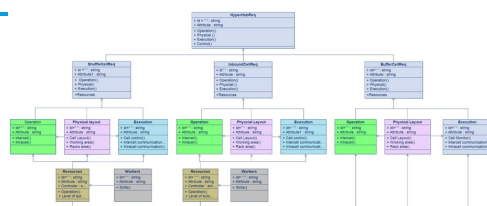
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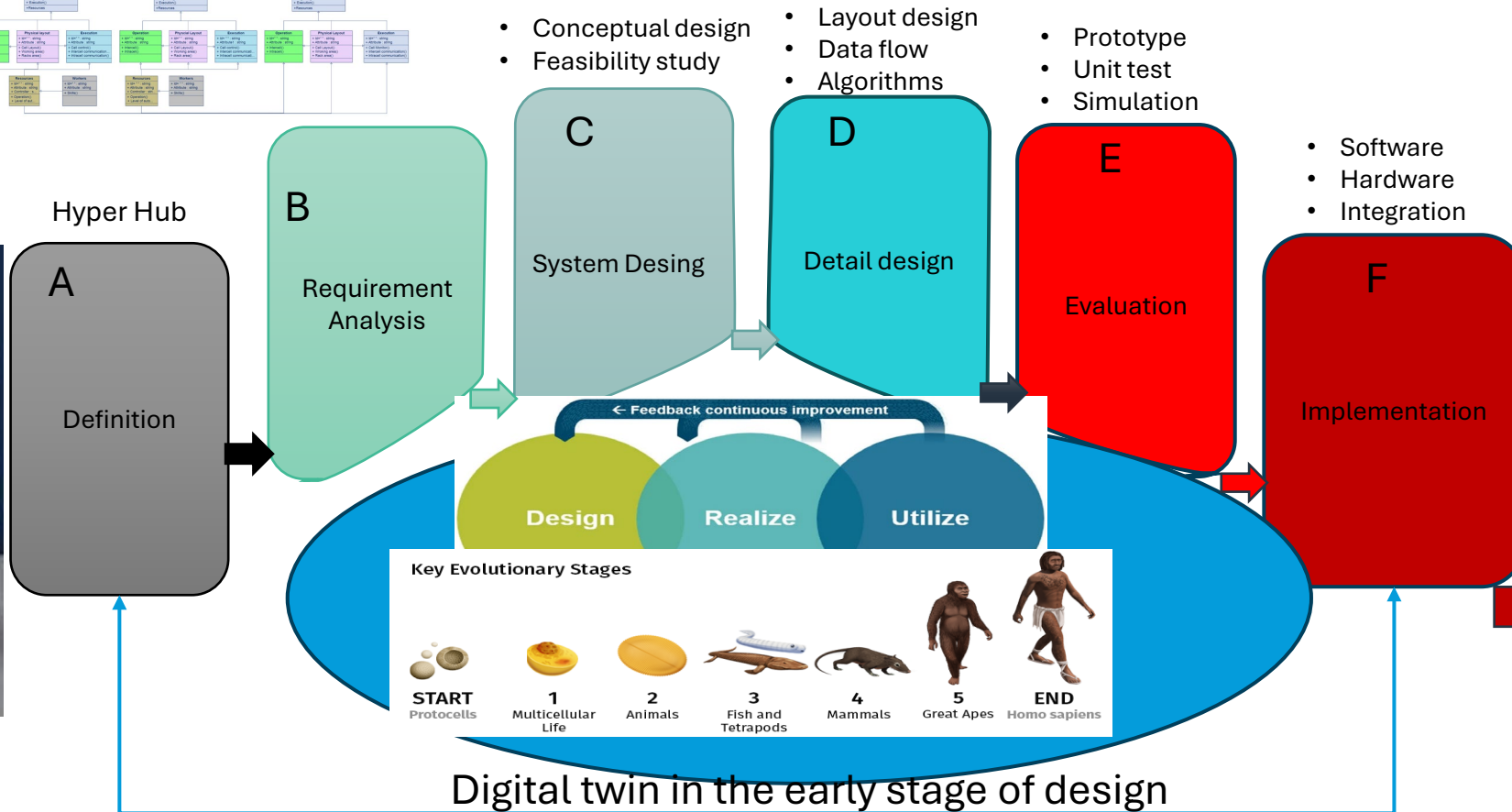


Physical
Internet
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Introduction



Most design twin cases (95%) are developed for existing physical systems.



- Conceptual design
- Feasibility study
- Layout design
- Data flow
- Algorithms
- Prototype
- Unit test
- Simulation

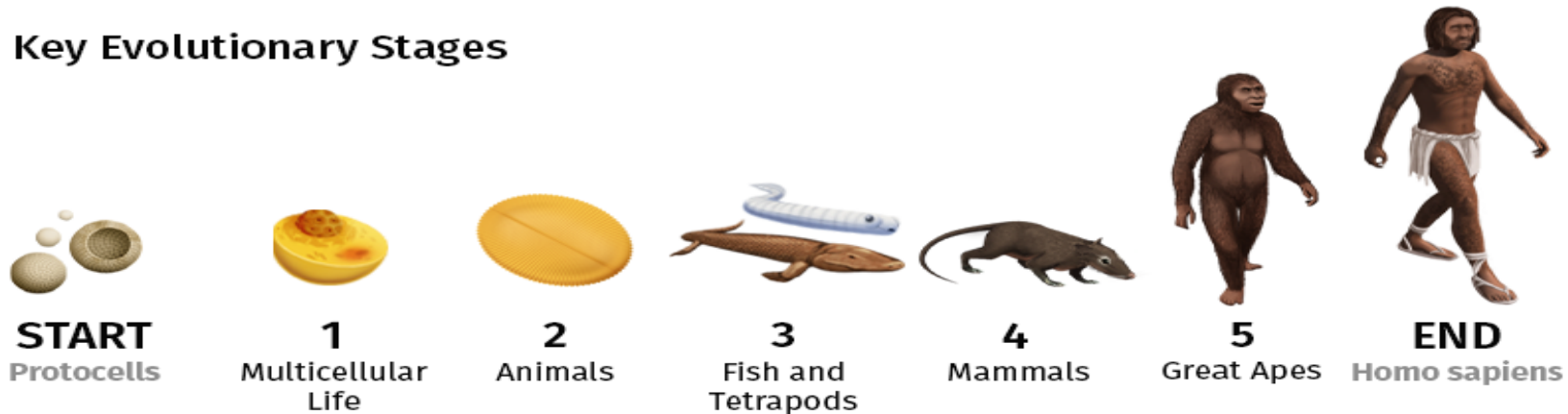
- Software
- Hardware
- Integration



Research questions

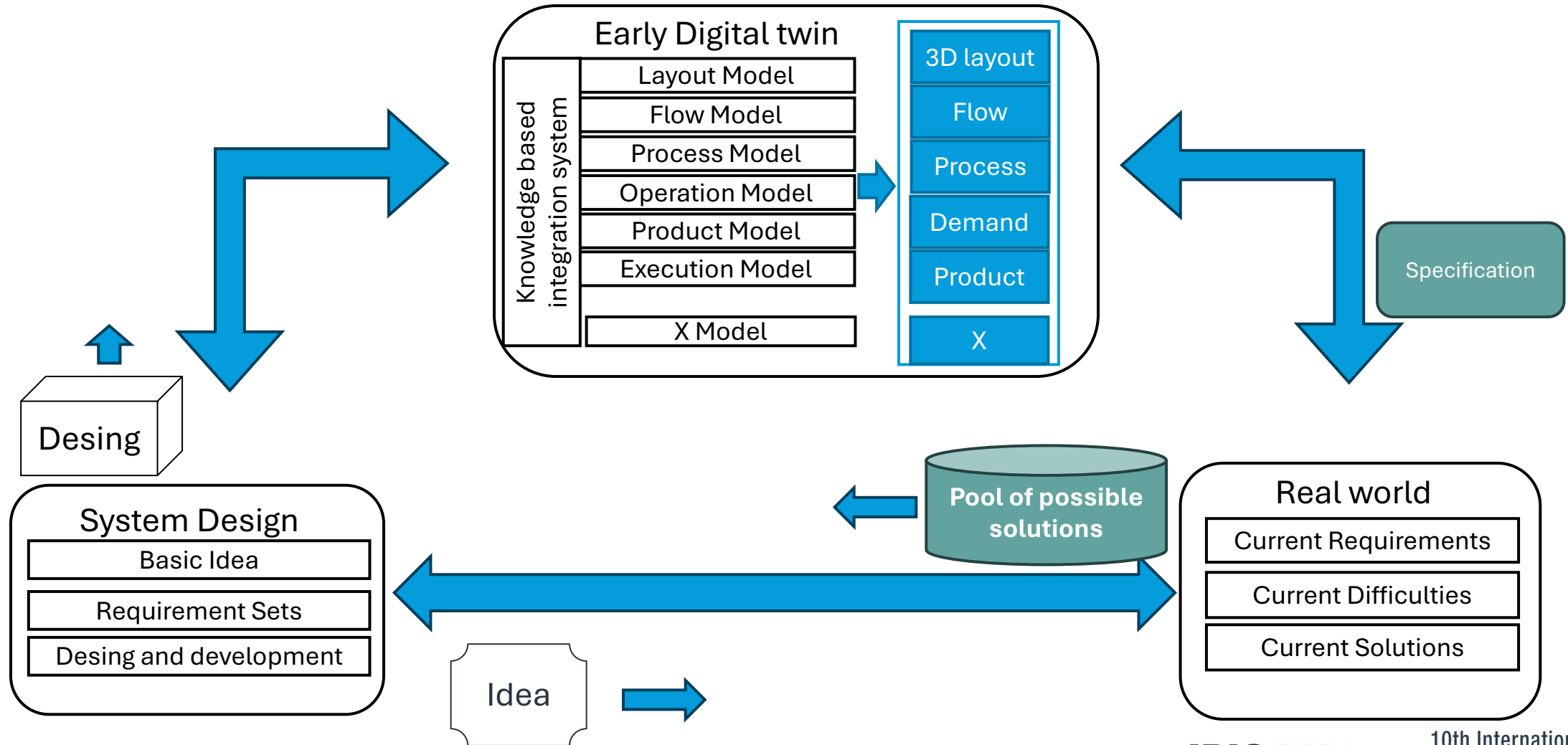
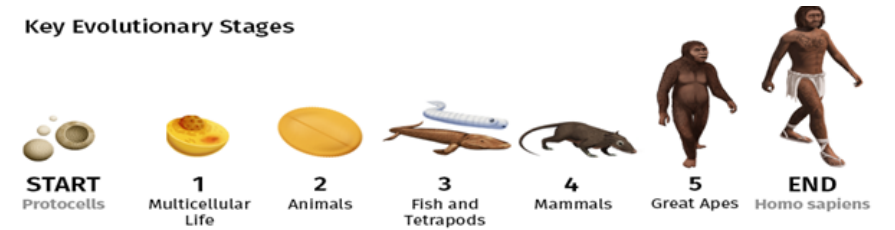
1. How can digital twin enhance the accuracy and efficiency of the design process in the early stages of system development?
2. What are the key challenges and barriers to integrating digital twin technologies in the early design stages, and how can these be mitigated?
3. In what ways can digital twin technologies support sustainable design practices and decision-making in the early stages of design?

Key Evolutionary Stages

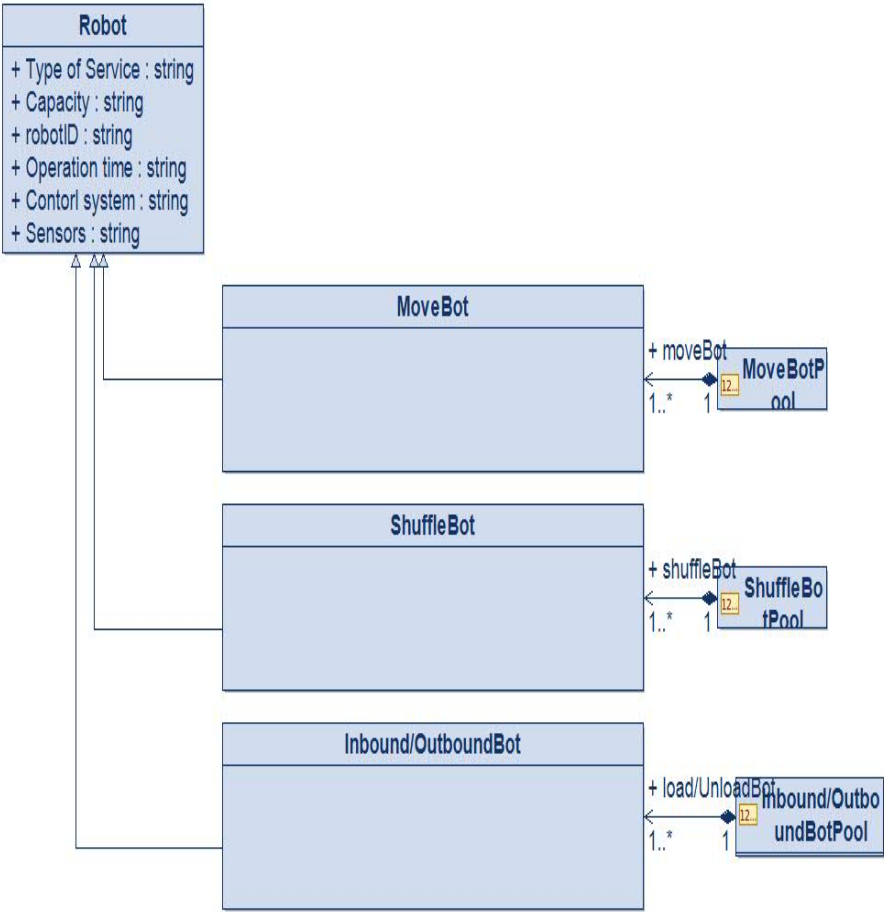


High level concept

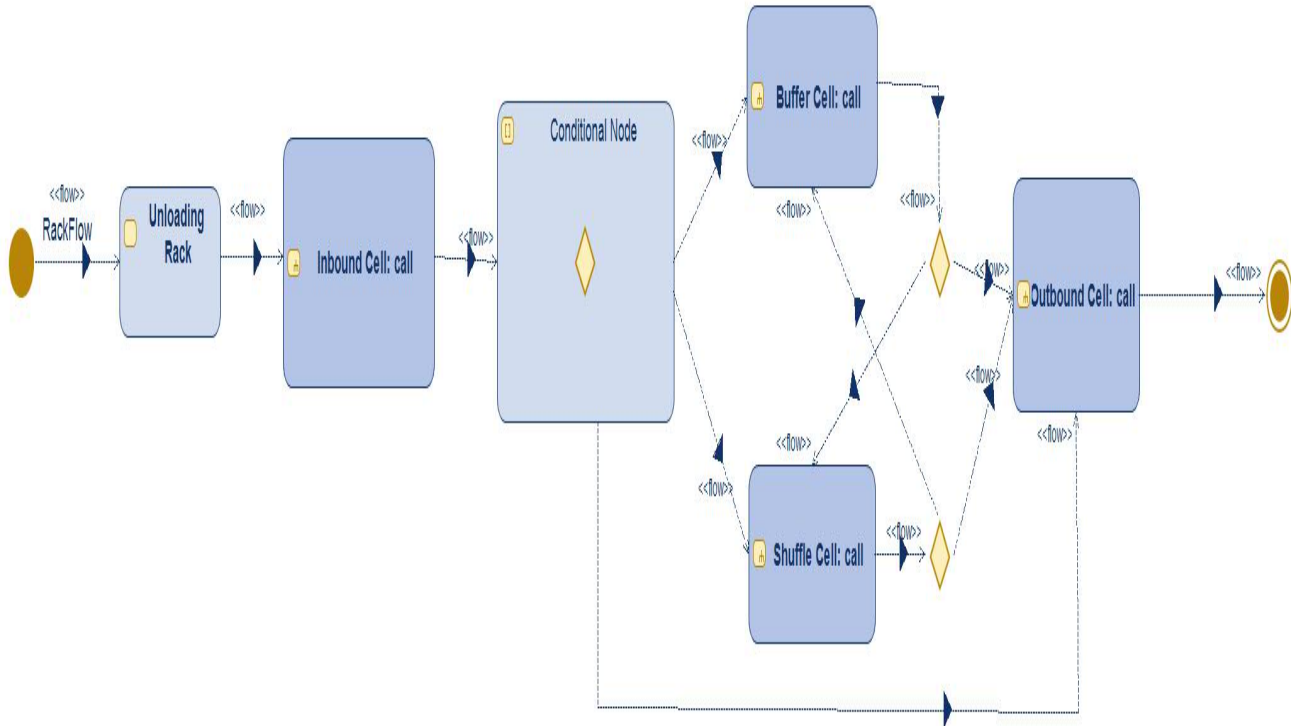
Key Evolutionary Stages



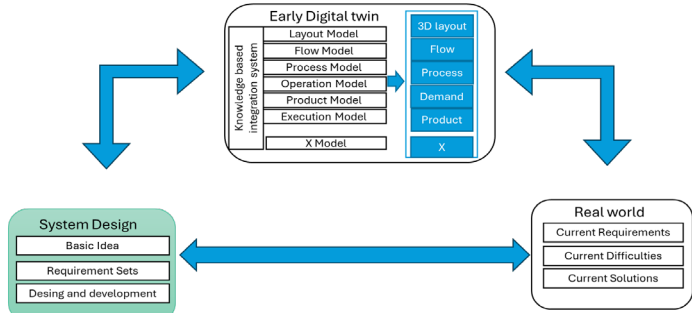
System Design



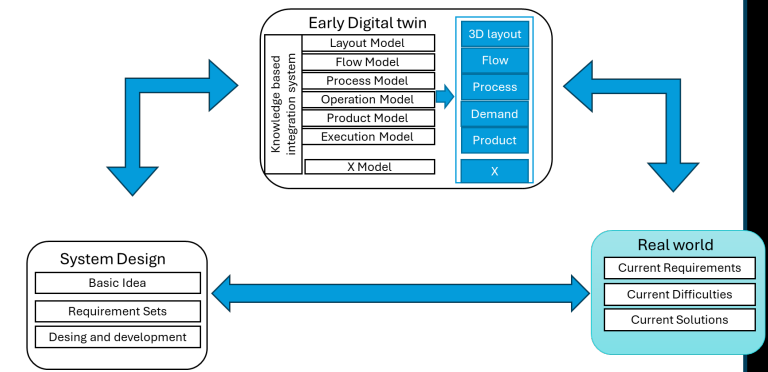
Resource definition



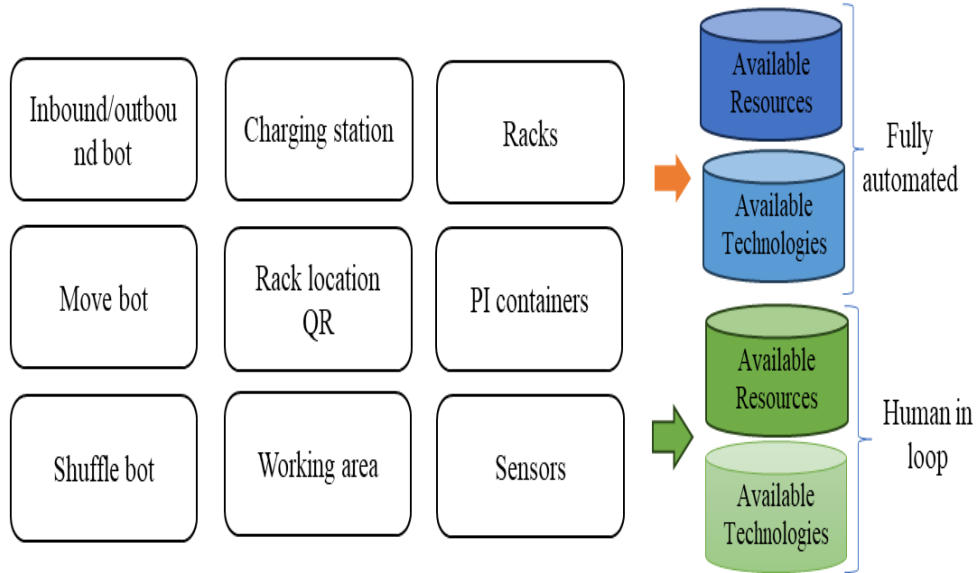
Concept of operations



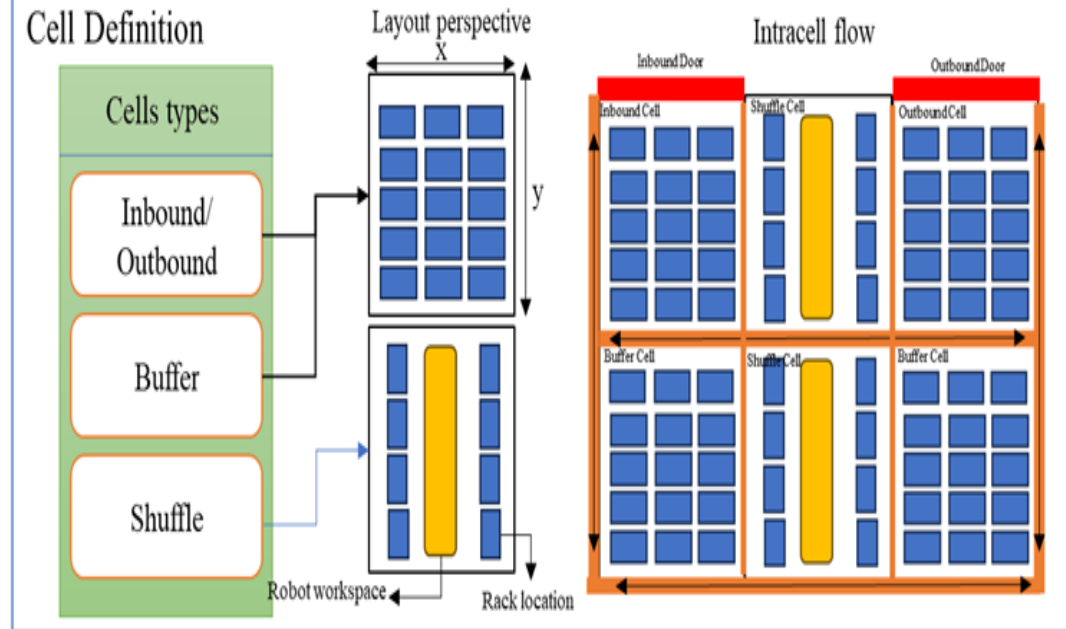
Real world



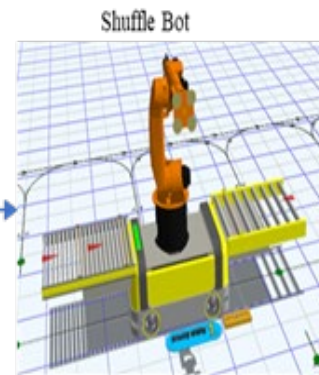
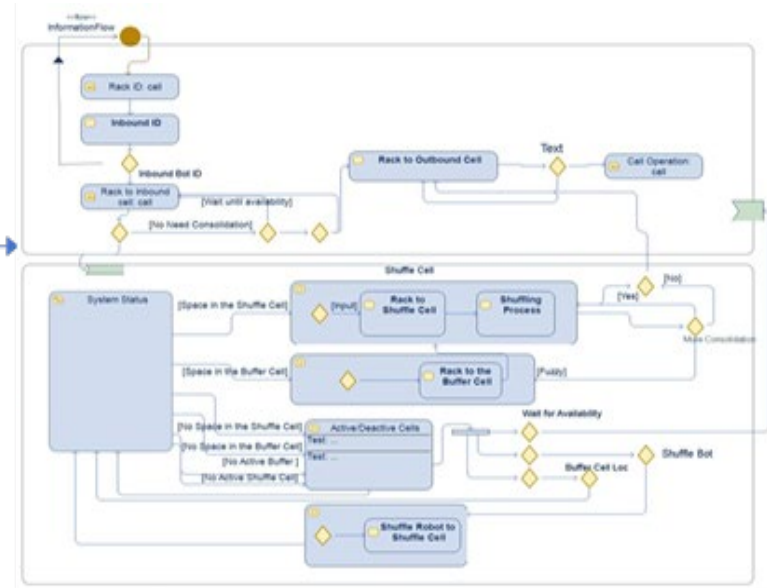
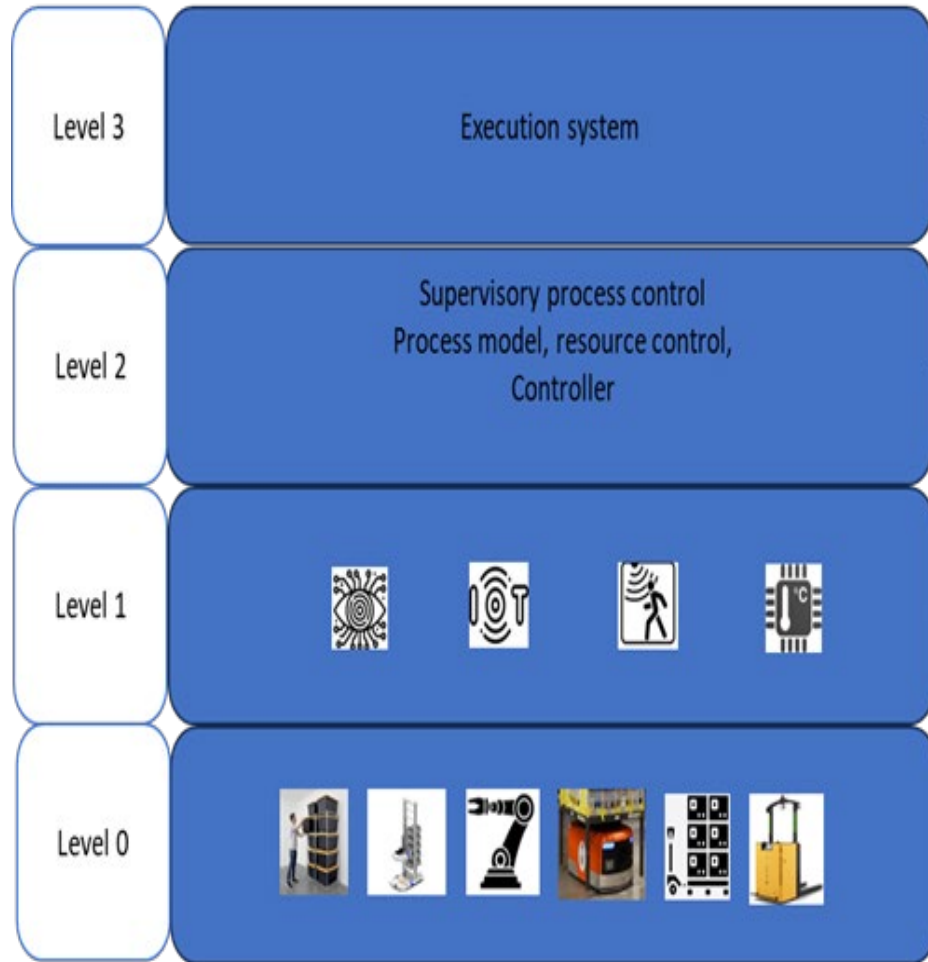
Resource Definition



Cell Definition

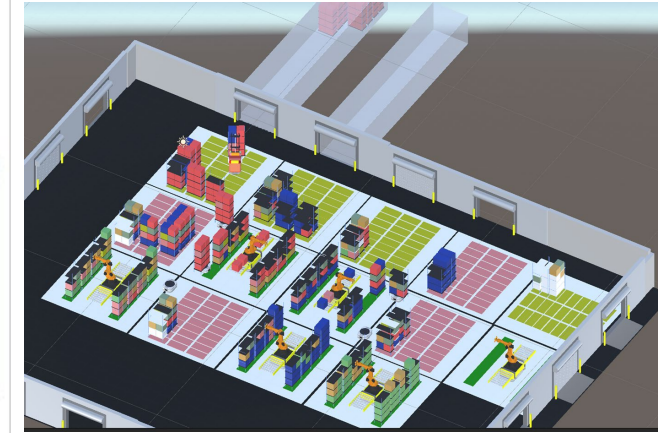
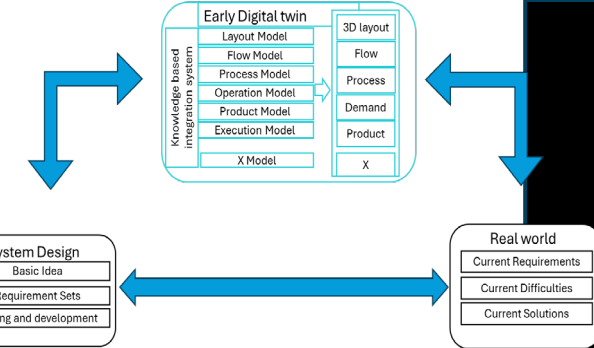


Early digital twin



Vehicle Acceleration : 6.56 ft/s²
Vehicle Deceleration: 13.1 ft/s²
Vehicle speed : 190 ft/min

Axis data / Range of motion		Speed with robot applied 200kg	Speed with robot applied 250kg	Speed with robot applied 300kg
Axis 1 (X)	+/- 100"	100%	100%	100%
Axis 2 (Y)	+/- 20" 100"	90%	90%	90%
Axis 3 (Z)	+/- 40" 100"	90%	90%	90%
Axis 4 (W)	+/- 100"	100%	100%	100%
Axis 5 (V)	+/- 100"	100%	100%	100%
Axis 6 (U)	+/- 100"	100%	100%	100%



5 advantages of having early DT



Risk



Cost



Productivity



Ready to
use DT



Better
integration



Conclusion

- A generic method to create digital twin in early stage of design was proposed.
- We showed the effectiveness of this method through the HyperHub

Future work

- We are working on proposed platform and case study.