Digital engineering in Japan: Sharing of purpose, concepts, architecture, and process through models

Hidekazu Nishimura, Ph. D, Professor
Keio University, Graduate School of System Design and Management
JCOSE (INCOSE Japan Chapter) Representative

JCOSE activities (https://www.jcose.org/)

Conference, Workshop, Training Course

- JS 2020, 2022, 2024 inviting SE experts from INCOSE.
- The next conference named Japan Systems Conference 2025.
- Online Seminar/Workshops focusing on specific topics.
- Collaboration with JSAE (Society of Automotive Engineers of Japan)
  - SE beginner and intermediate courses from 2022.
  - SE Symposium in JSAE autumn event in 2023.

AWG

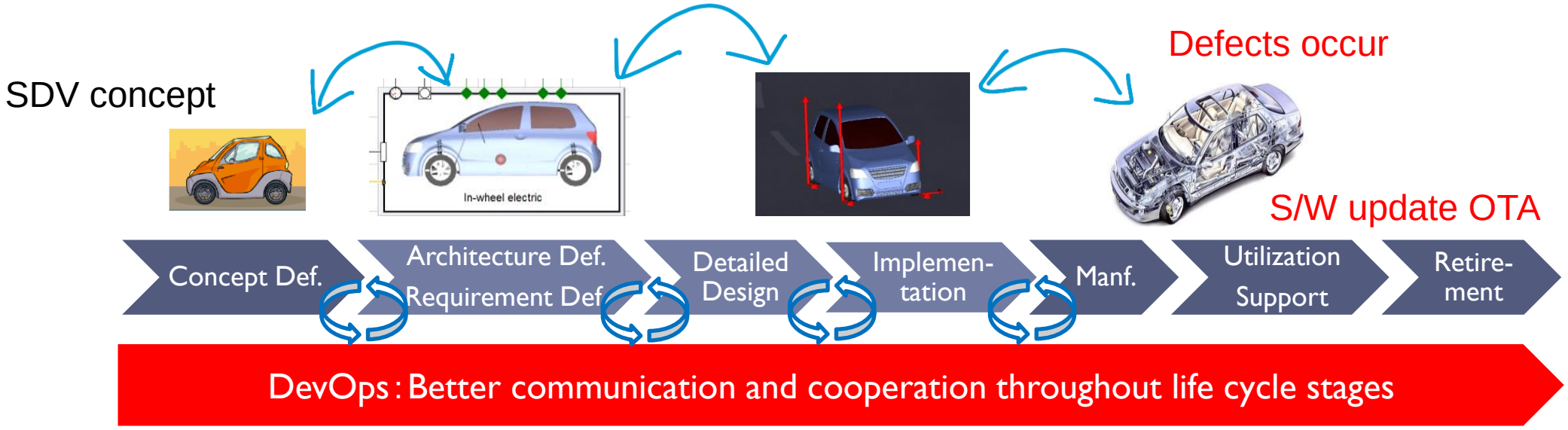
- Automotive WG (AWG) in JCOSE started in Aug. 2024 in collaboration with INCOSE AWG.

Future SE in Automotive (planned)

- Supporting JSAE project of Mobility DX Platform received from METI (Ministry of Economy, Trade and Industry in Japan) https://www.jsae.or.jp/press/detail/2387/
- DE & MBSE for SDV (software defined vehicle) context

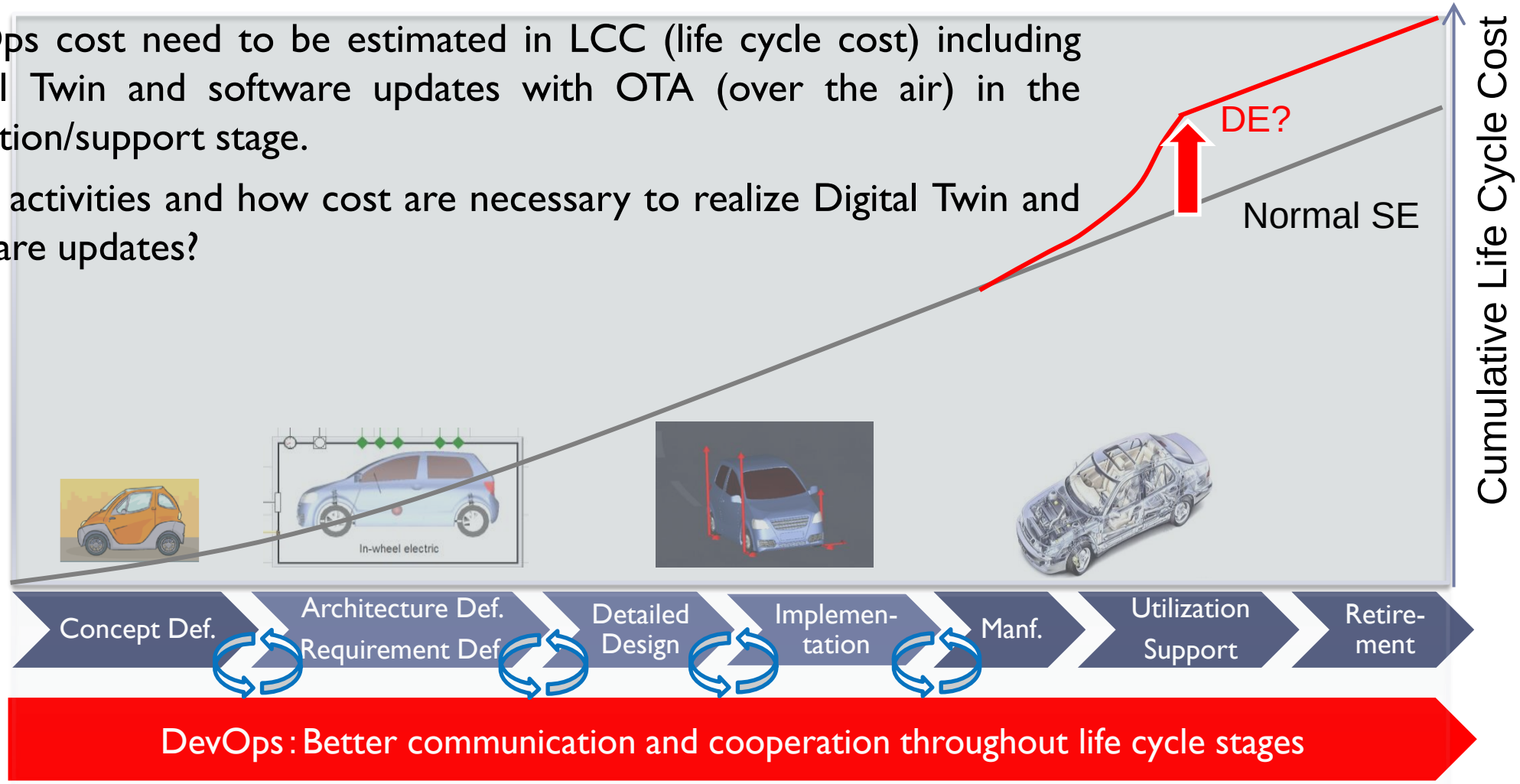
Why digital engineering? Why model?

- What effectiveness models bring throughout life cycle stages?
  - Rigorous traceability among deliverables from each stages can be held.
  - Configuration or change management can be easily implemented.
  - When finding defects, appropriate measures can be easily preformed.
- For the realization, each digital model needs to have right and consistent information.



Cost issues in digital engineering

- DevOps cost need to be estimated in LCC (life cycle cost) including Digital Twin and software updates with OTA (over the air) in the utilization/support stage.
- What activities and how cost are necessary to realize Digital Twin and software updates?



ISO/IEC/IEEE 32675-2022(E) Information Technology – DevOps – Building reliable and secure systems including application build, package, and deployment

DevOps needed in digital engineering throughout LC

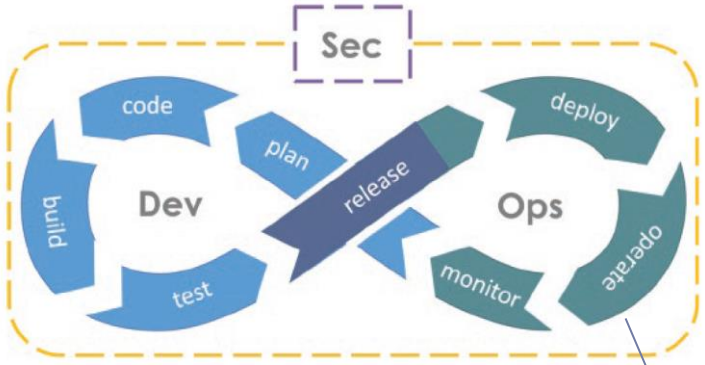
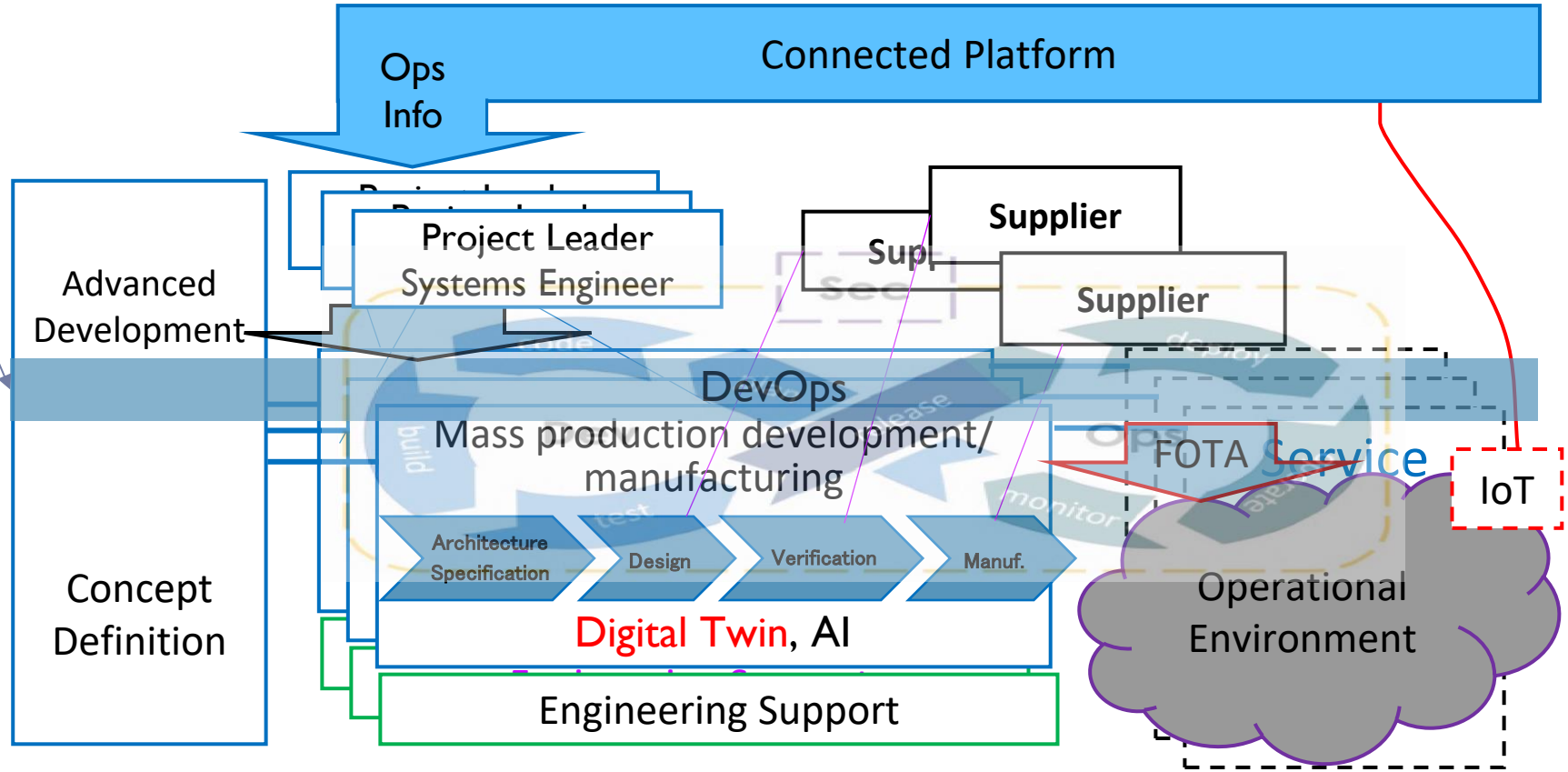


FIGURE 2.8 DevSecOps INCOSE SEH original figure created by D'Souza derived from Banach (2019) and Anx (2021). Usage per the INCOSE Notices page. All other rights reserved.

SEH v5 Figure 2.8,
2.2.3 Evolutionary methods



DevOps: Better communication and cooperation throughout life cycle stages

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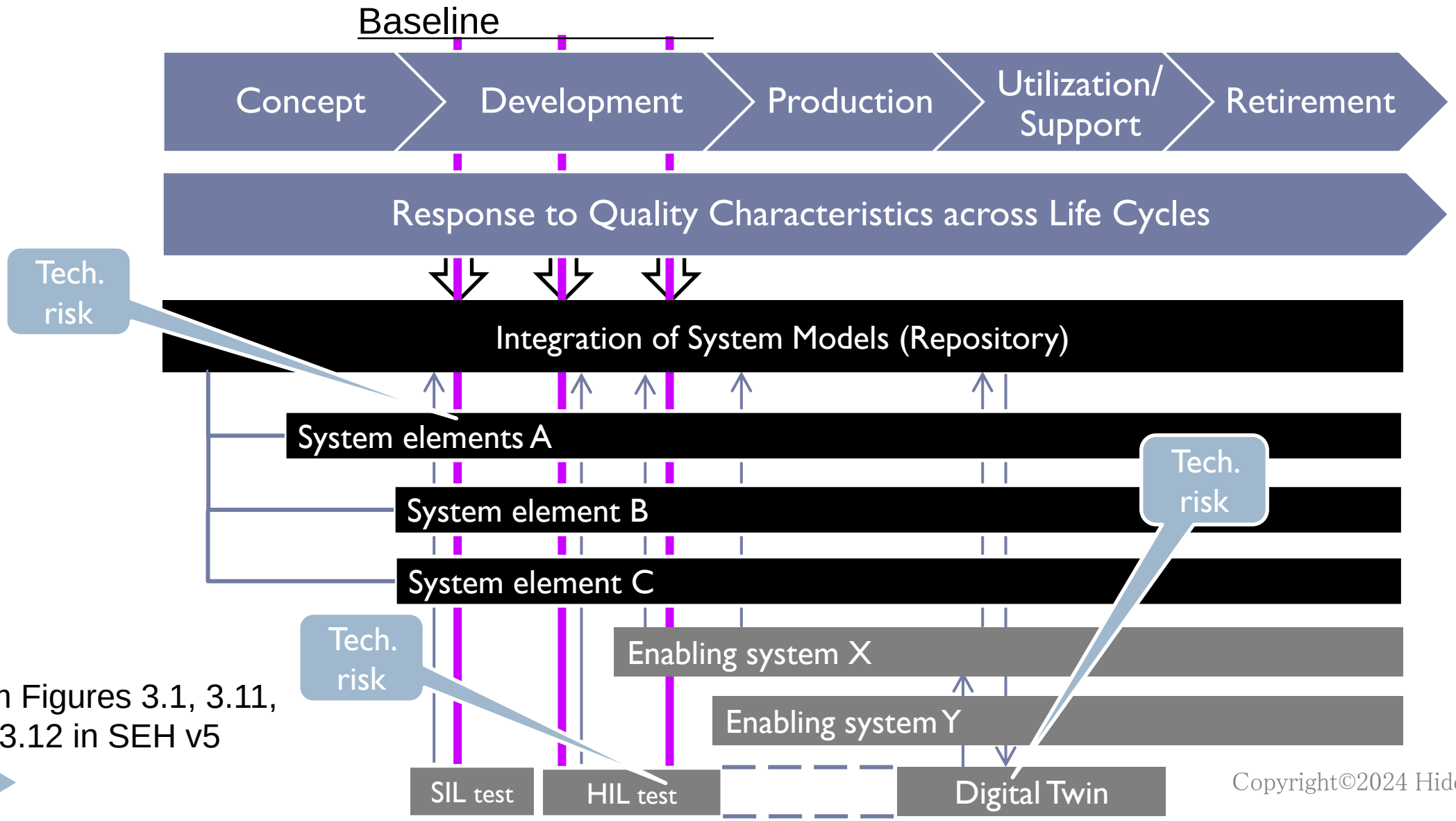
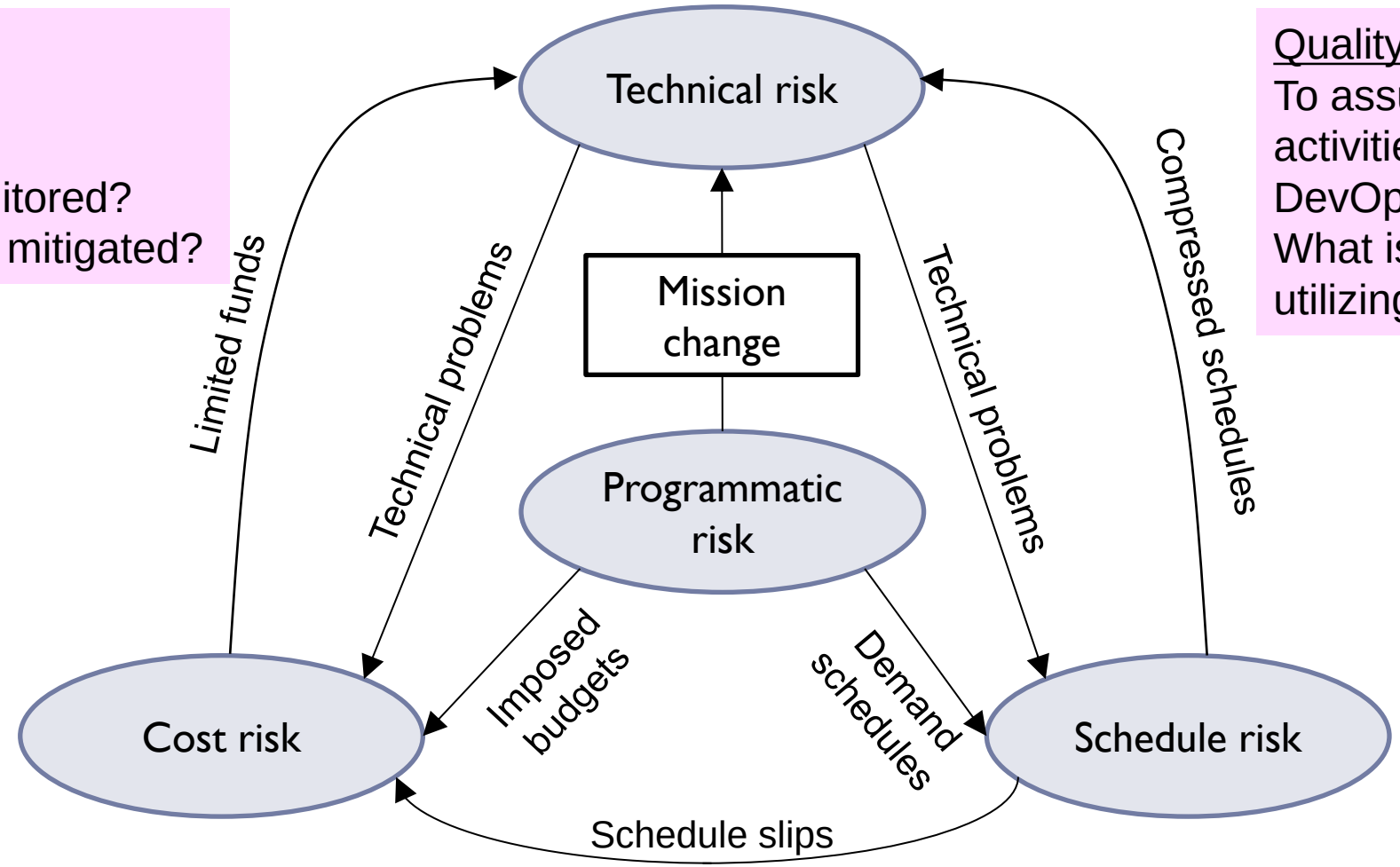
Utilization of system models throughout LCs



From Figures 3.1, 3.11, and 3.12 in SEH v5

Share risks through models

Technical Risk
What is the risk?
Where is the risk?
Can the risk be monitored?
How the risk can be mitigated?



Quality Assurance
To assure qualities, what activities are necessary in DevOps?
What is the issue in the test utilizing Digital Twin?

Systems Engineering Handbook v5
Figure 2.30 in P. 86 of risk management process

Moving to DE: What is the wall? and What shall we do?

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Japan Council on Systems Engineering

What is the wall?

- DX in business, or business transformation, is not progressing well, especially in Japan.
- The organization with silo structure resisting to realize DX
- Difficulties in building a complex DE mechanism including personnel assignment and supplier cooperation
- Many engineers say: Why do we have to change what we've been doing up until now?
- If they are in the DE, in turn possibly will engineers totally tend to rely on it?
  - I heard from an automotive company that some engineers said "SE will help us".

Another perspective (but, negative for SE)

- Simulation freaks are exciting to Digital Twin itself.

We need to share the purpose and concepts to transform SE with stakeholders.

Engineers need to understand a system needed in the context.

34th Annual INCOSE international symposium

hybrid event

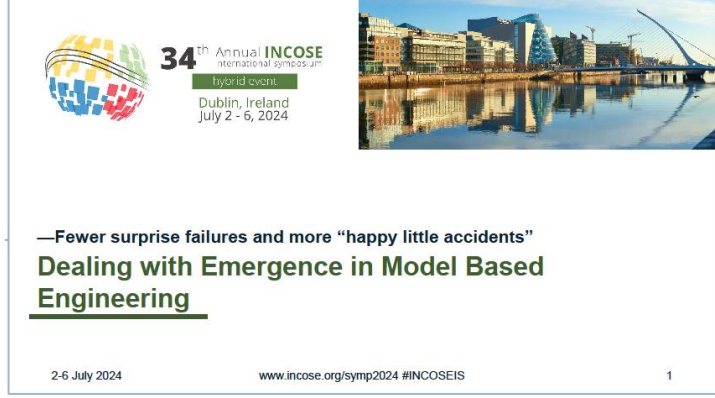
Dublin, Ireland
July 2 - 6, 2024

Steve Holt (Boeing)

—Fewer surprise failures and more “happy little accidents”

Dealing with Emergence in Model Based Engineering

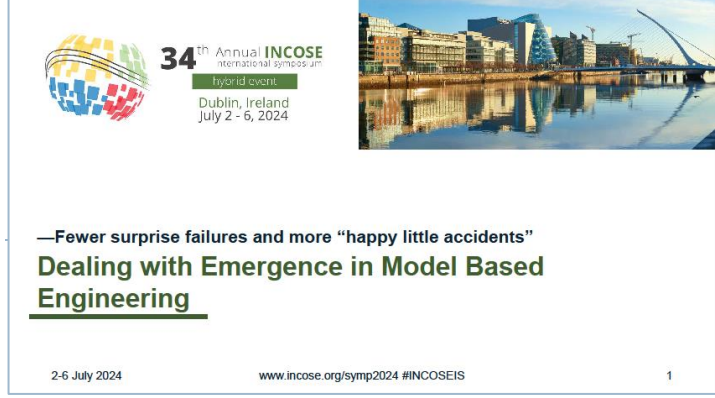
Improvement of Engineering Judgement



- **Make assumptions visible**
  - Clarify the tacit knowledge behind model
  - Hand drawings rather than tool drawings
  - Visualize sensitivity analysis results
  - Make a physical mockup by hand
- **Review what you're doing**
  - Explain it to someone else and yourself
- **Look for conflicts and weak signals**
  - Mental simulation = Simulation in you brain
  - Critical Thinking
- **Evaluate the results**
  - Always predict outcome in advance and compare the actual results to prediction
  - Maki predictions before running the test

- **Activate different neural pathway than reading or using a computer**

Being successful and avoiding failure



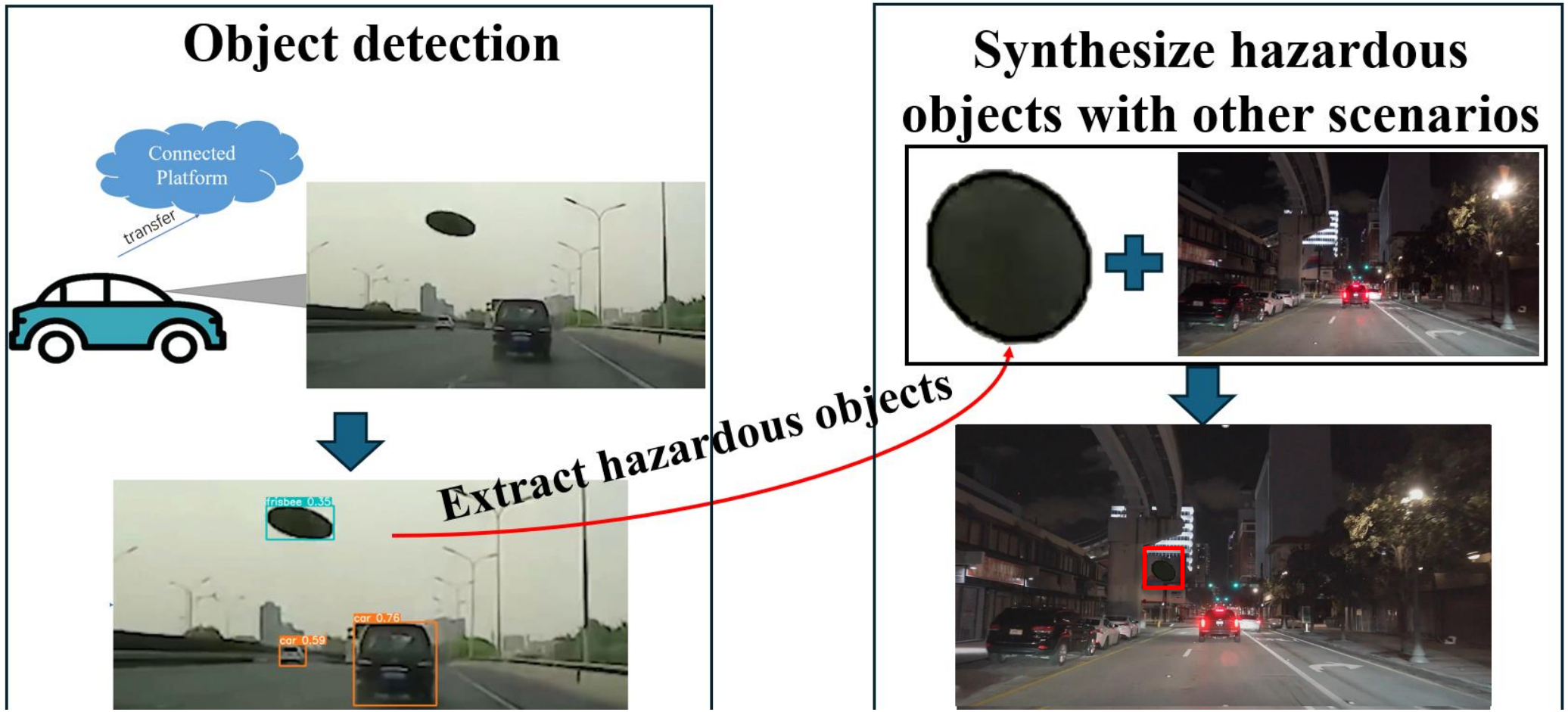
As promising and valuable as Model Based Engineering and AIs (Artificial Intelligence) are, they are not sufficient alone.

- Models based on reference environments and training sets such as a Digital Twin or LLMs cannot predict Strong Emergence because they can't model what they don't know (uncertainty).

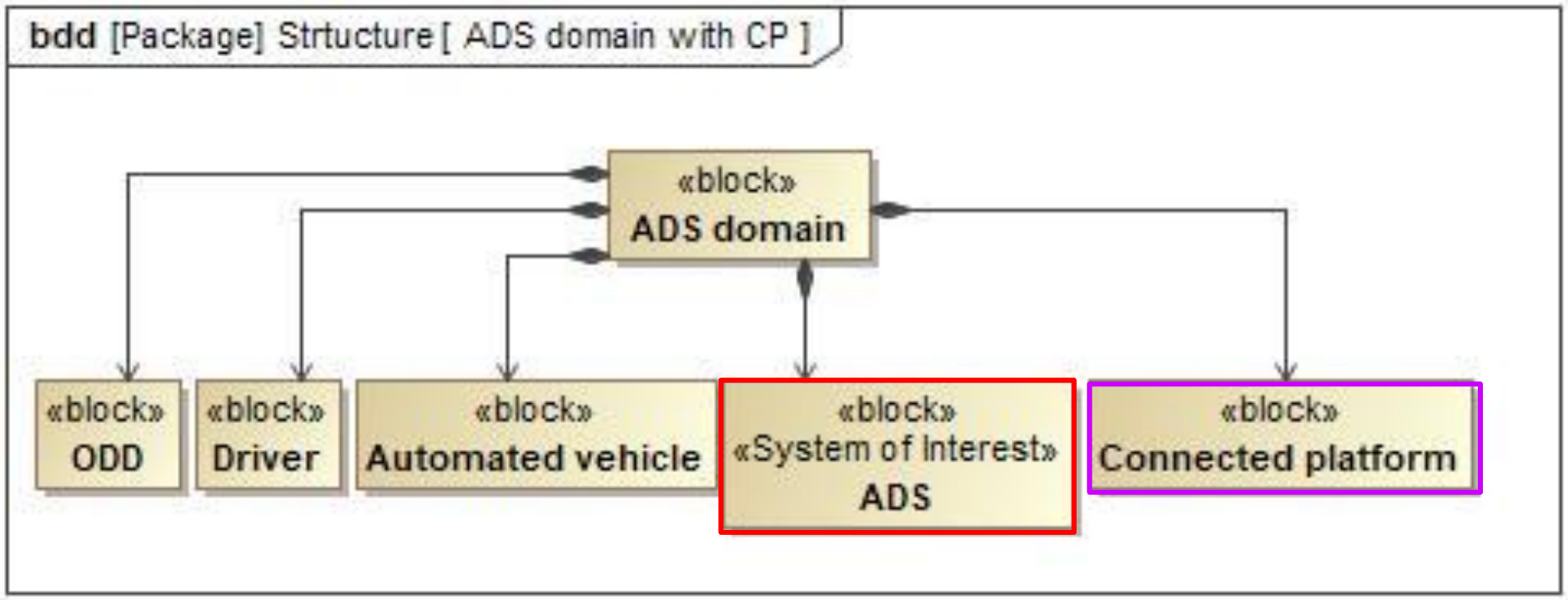
To successfully navigate an uncertain future, we must retain and enhance our Engineering Judgment skills

- Heuristics and Rules of Thumb
- First Principles
- If you understand the underlying theory, you can modify the details to fit the context.

Preparation of Digital Twin in DevOps

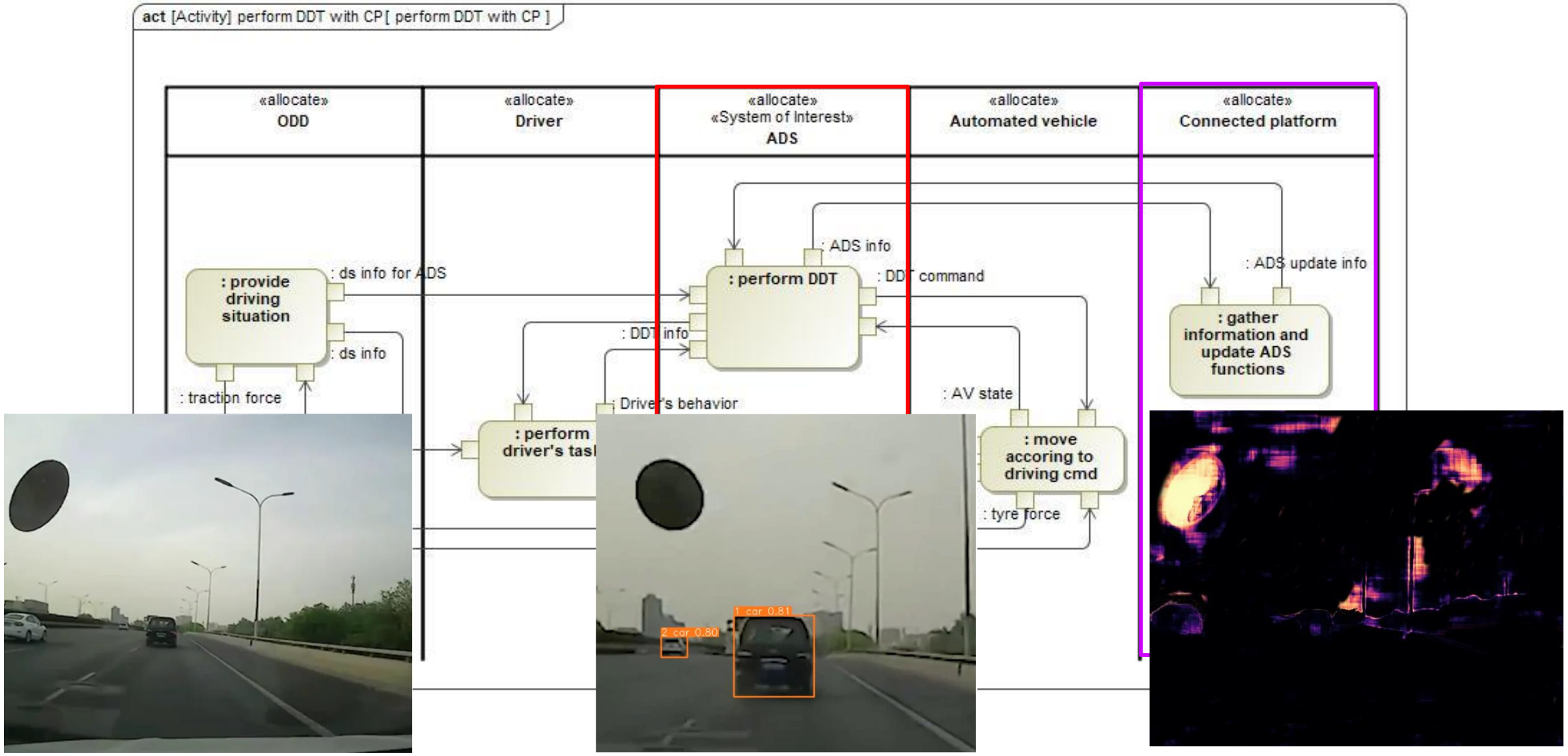


Definition of ADS domain with connected platform

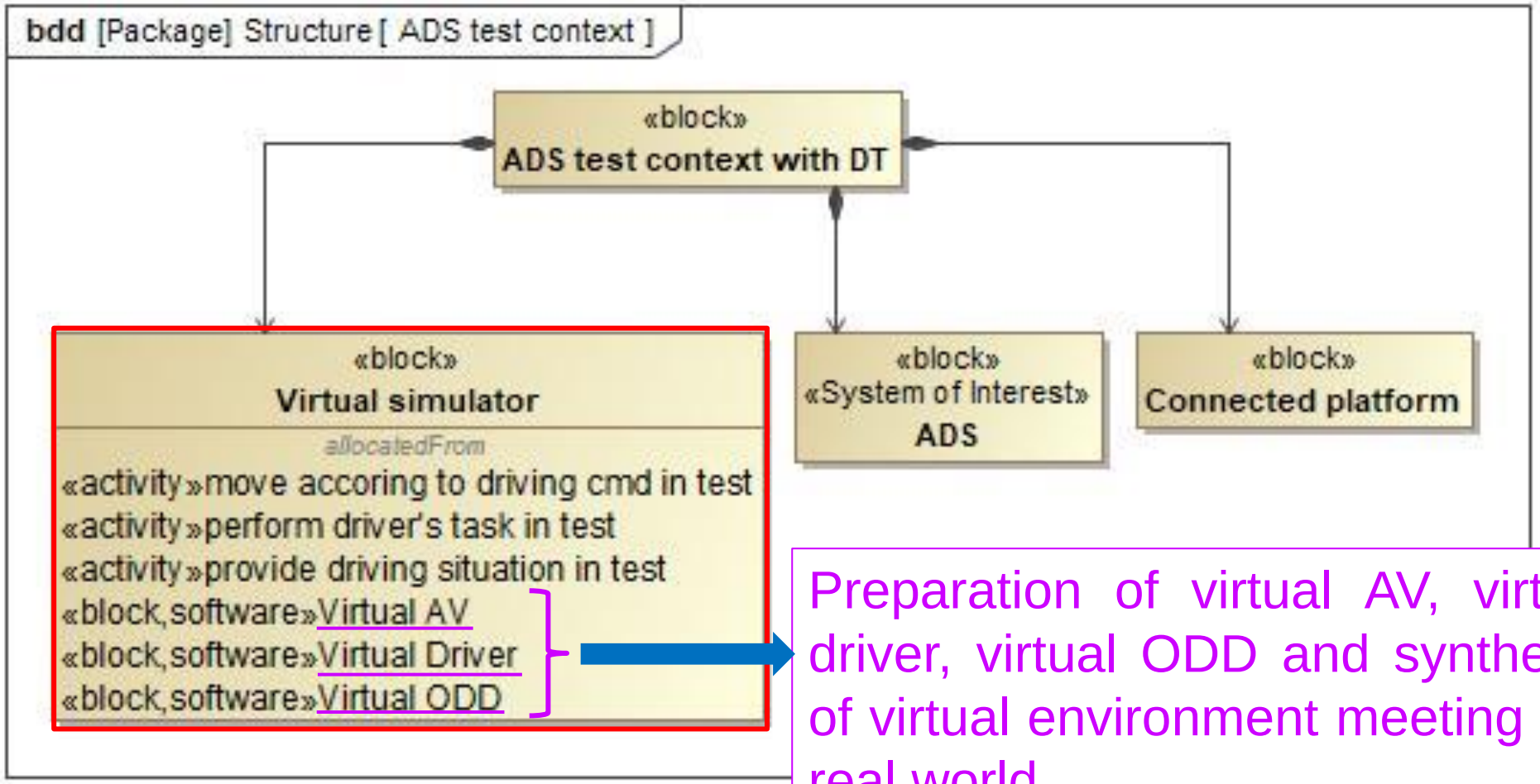


ADS: Automated Driving System, ODD: Operational Design Domain

Collection of an unknow scenario and related objects through connected platform from ODD

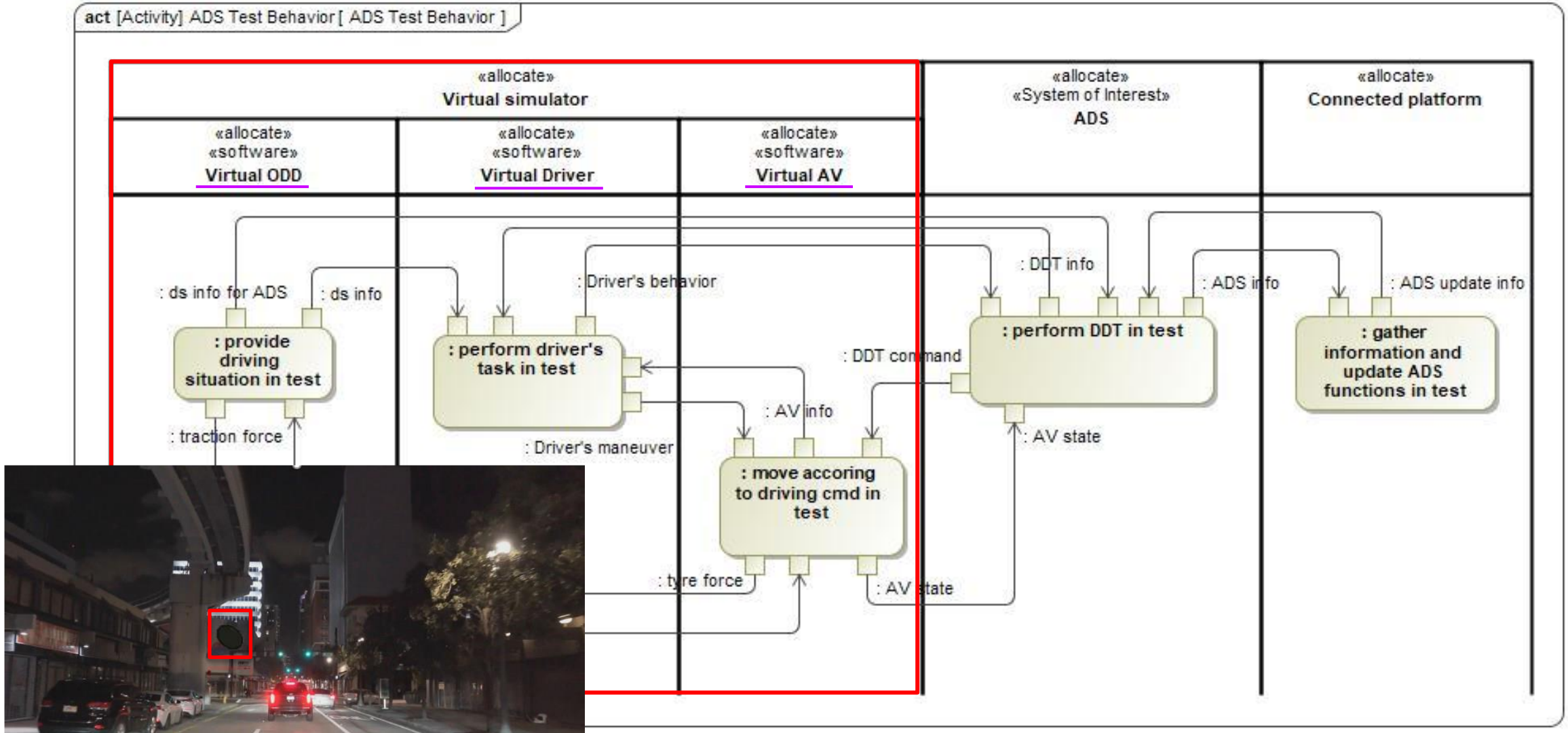


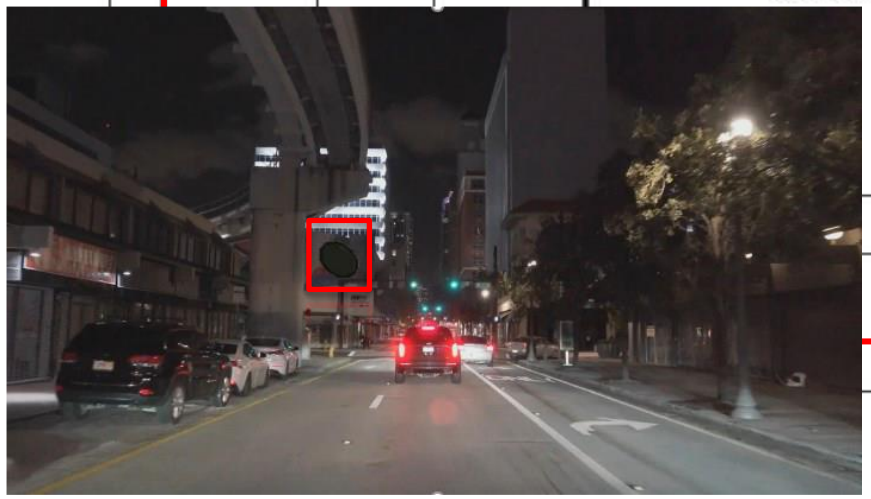
Digital Twin platform to test ADS



Preparation of virtual AV, virtual driver, virtual ODD and synthesis of virtual environment meeting the real world

ADS test in the virtual simulation





What to do in DE context in Japan

- Combination of engineers thinking with activating five senses and DE
- Improvement of engineering skills
- Lowering "mental" walls against DE by sharing a purpose and concepts with stakeholders
- Utilizing models for right communications among stakeholders to understand a system needed in the context

References

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- Systems Modeling Language (SysML®) v2, API and Services, Request For Proposal (RFP), OMG Document: ad/2018-06-03, available from < https://github.com/Systems-Modeling/SysML-v2-Release/blob/master/README.md>, (accessed on 23rd July 2021)
- ISO/IEC/IEEE 32675:2022（E) Information Technology – DevOps – Building reliable and secure systems including application build, package, and deployment
- ISO 21448:2022 (E) Road vehicles — Safety of the intended functionality