Initiatives towards value provision through software (ALM, Software BOM)

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Mazda Motor Corporation/Engineering Systems Dept.
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COMPANY OUTLINE

Headquarters ：Fuchu-cho, Aki-gun, Hiroshima

Founded ：1920

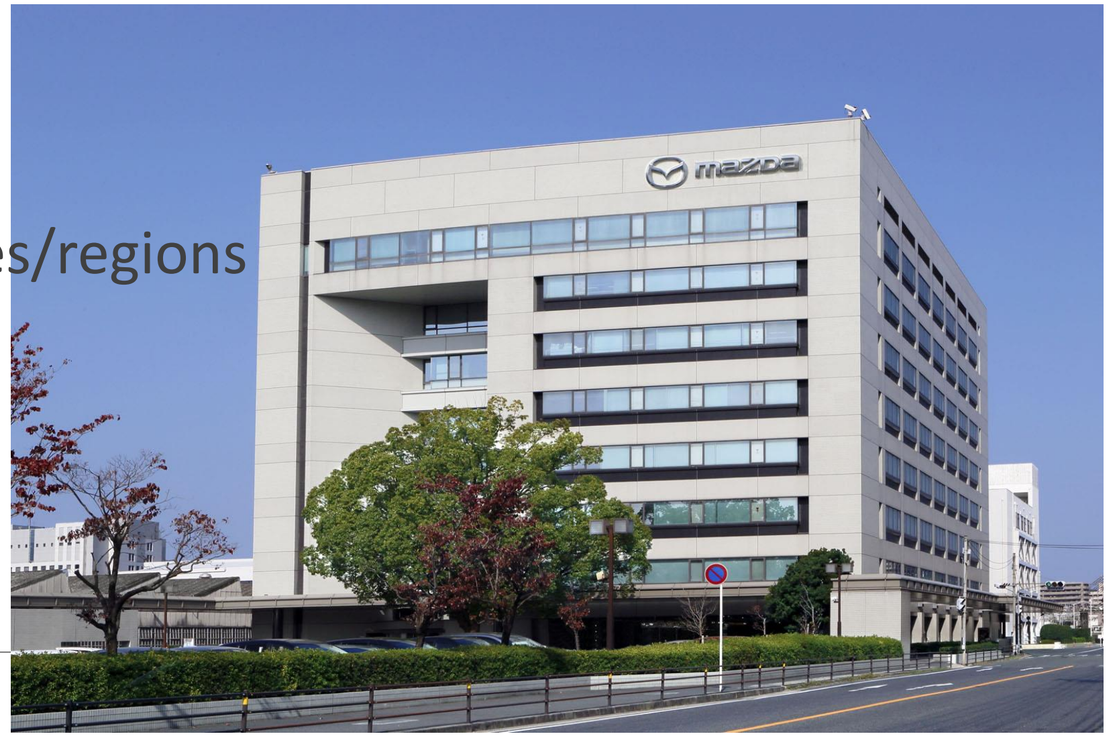
Employees ： 23,144(Unconsolidated)　48,481(Consolidated)

Global sales volume ：1,110,019

Sales (Consolidated) ： 3,826,800 mil. yen

Countries/Regions of sale ：Over 130 countries/regions

(As of March 2023)



CORPORATE PHILOSOHY / 2030 VISION

CORPORATE PHILOSOHY / 2030 VISION

Japan Mobility Show

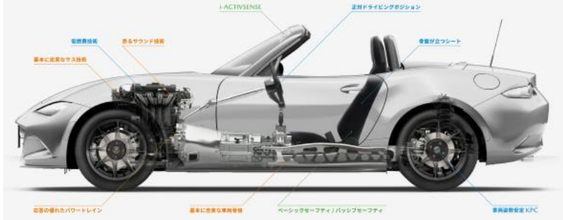
FUTURE CRAFTED BY THE ‘LOVE OF CARS’

The origin of the ‘ n

"This car brings joy and happiness to all those who are courageous
choose this model."
As Mazda's brand icon, the MAZDA ROADSTER has won hearts o
customers. This model was designed and developed so that when
down, feeling the wind through driver's hair becomes a revitalizing
Mazda also hoped that driving the ROADSTER would lead the driv
new friends with the shared passion.
Mazda's legacy, origin and DNA are all rooted in the first-generati
ROADSTER. This model is exhibited on the Mazda stand for visitor
look and learn about the epoch-making model.

Revitalizati customer
“Joy ”

ADSTER
rment Driving Vehicle



to serve people. Monotsukuri (= manufacturing in Japanese) is about mindfulness and empowerment of the drivers and passengers alike.

That is why Mazda is embracing "human-centric" engineering philosophy. Our technologies were developed by paying full attention to people and their behavior, and thinking about people by putting ourselves in their shoes. In short, Mazda's technologies are aimed at delivering the spirited joy to people's heart and body. We have coined ActivSync as a collective name for our engineering philosophy; Activ, to activate the human body, mind and spirit. Sync, to synchronize with people.

Mazda is committed to delivering the "Joy of Driving" to all Mazda customers and drivers.

Our SeDV development is driven by a desire to help physically-disabled people to discover the Joy of Driving a vehicle, and by doing so, making vehicles more than just a means of getting from A to B.
That is why Mazda worked on its ROADSTER, an iconic model that offers a direct, pure "Jinba Ittai" driving experience, to realize manual driving operation.
Discover Mazda's pursuit of the "Joy of Driving" on the Mazda stand.

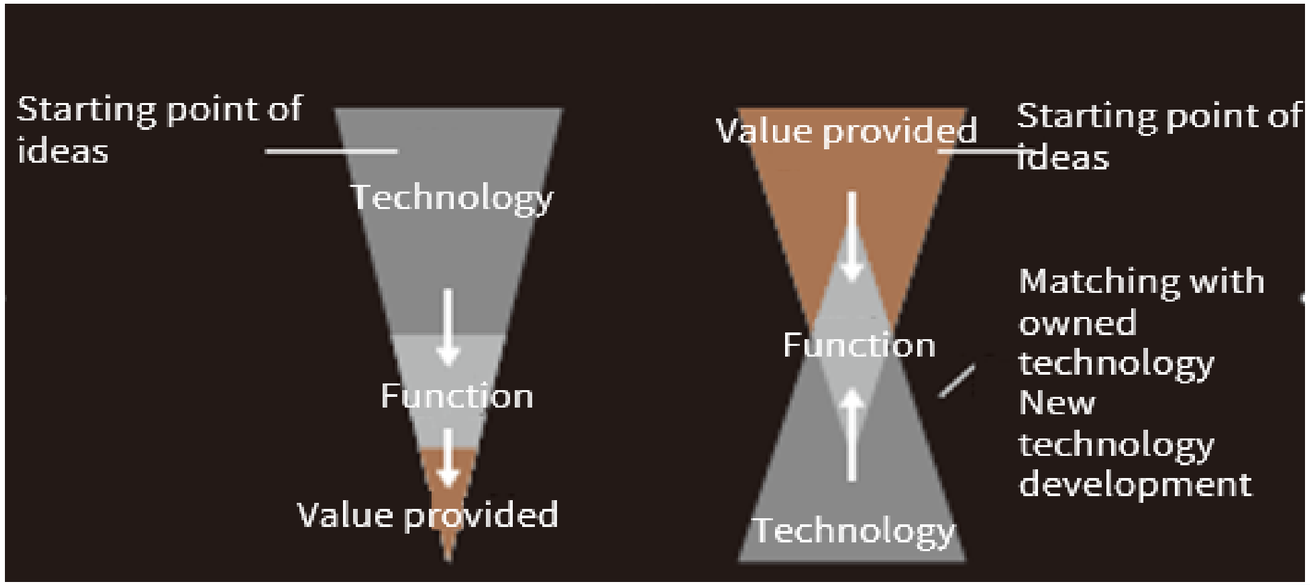
MID-TERM MANAGEMENT PLAN　Electrification

PHASE1（2022–2024）
Development enhancement for the era of electrification

PHASE2（2025–2027）
Transition to electrification

PHASE3（2028–2030）
Full-scale introduction of BEV

Product value, Value provided



Existing assets
KODO Design,SKYACTIV etc,

Business value

Customer value

Existing assets
KODO Design,SKYACTIV etc,

Utilizing existing unique assets to compete with 'Product + Service’

BEV, ｘEV, Sports、・・・

×

Vibrant experience, SDV, MaaS、・・・

Mazda's efforts in software development.

7 G software development L/L
（problem）

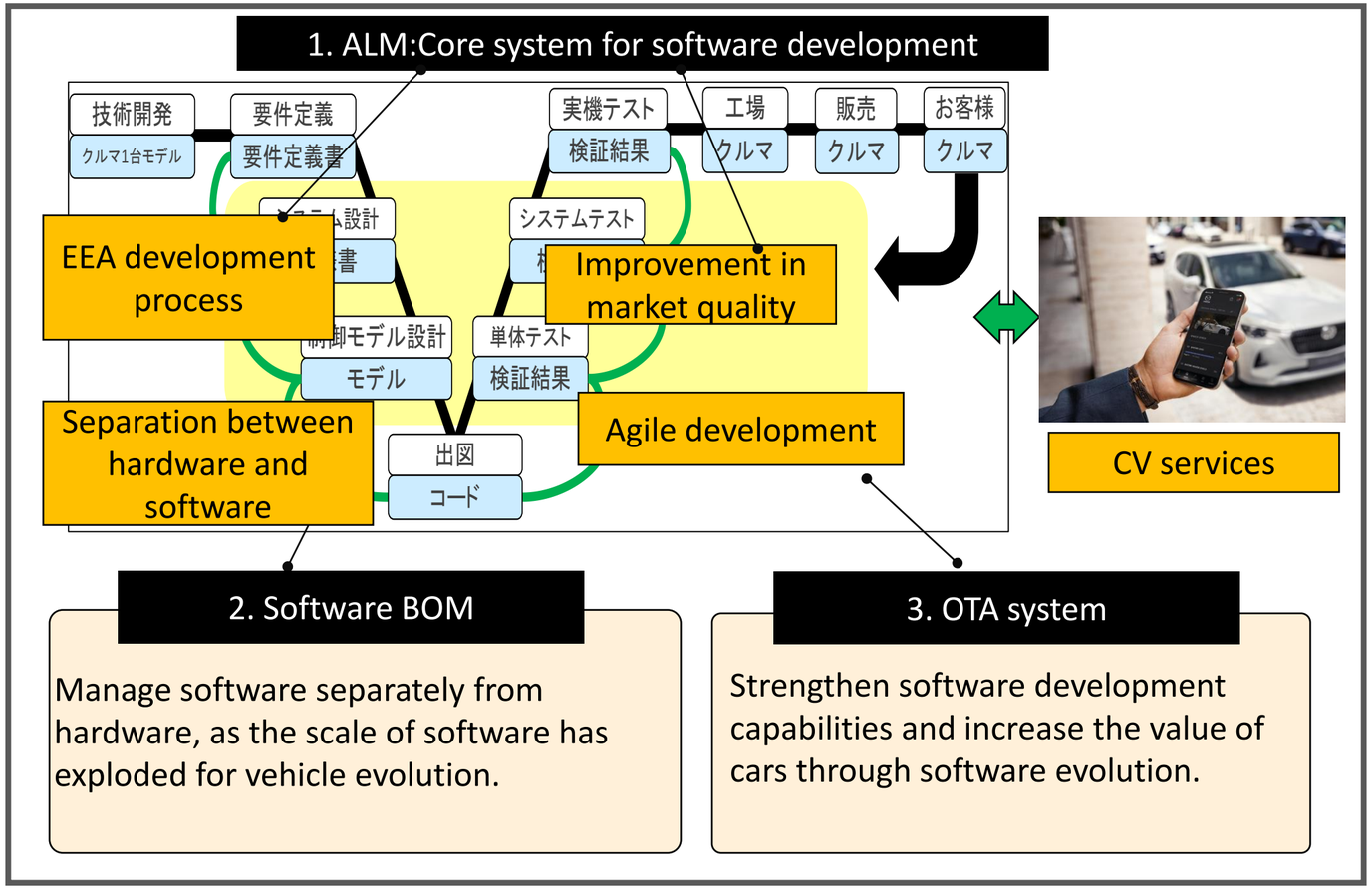
Software development process
EEA development
（logic design⇒physical design）

7 G software quality improvement

Strengthening MBD
（electronic/software/hardware）

Responding to CSSU regulation
（OTA, etc.）

Separation between hardware and software（Construction of software BOM）

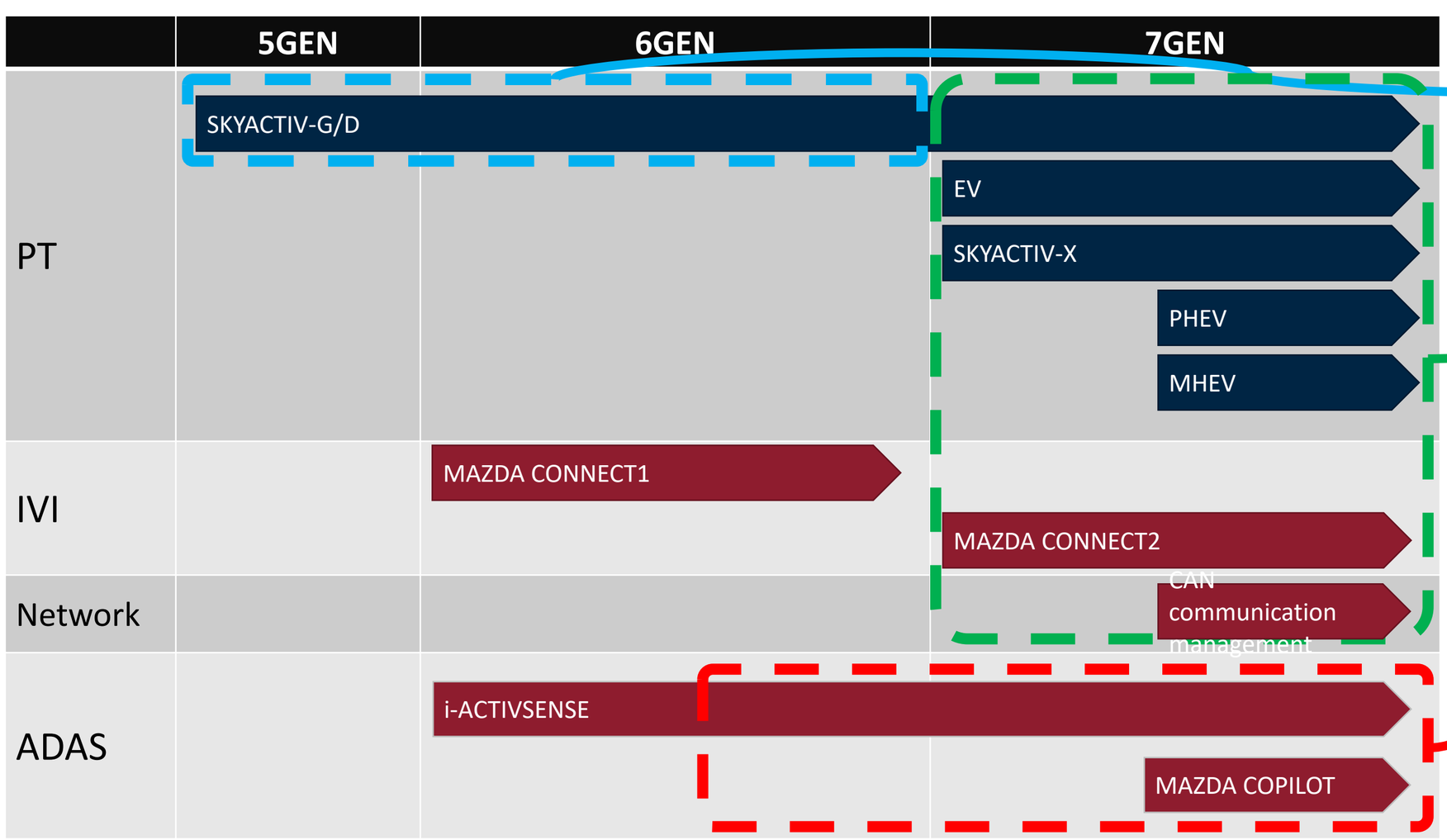


Promote software development innovation that integrates process/method/enabler for SDV

ALM:Core system for software development

Current status of Mazda's control development and IT system (software management)

In accordance with the control development evolution, deploy optimal IT systems into each unit.



CC/CQ
(1) Management of control model versions /changes

CC/CQ： Customize based on IBM products

PMIS（Jira）
(3) Task management + collaboration with suppliers

PMIS：Project Management Information System： Customize based on Atlasian products

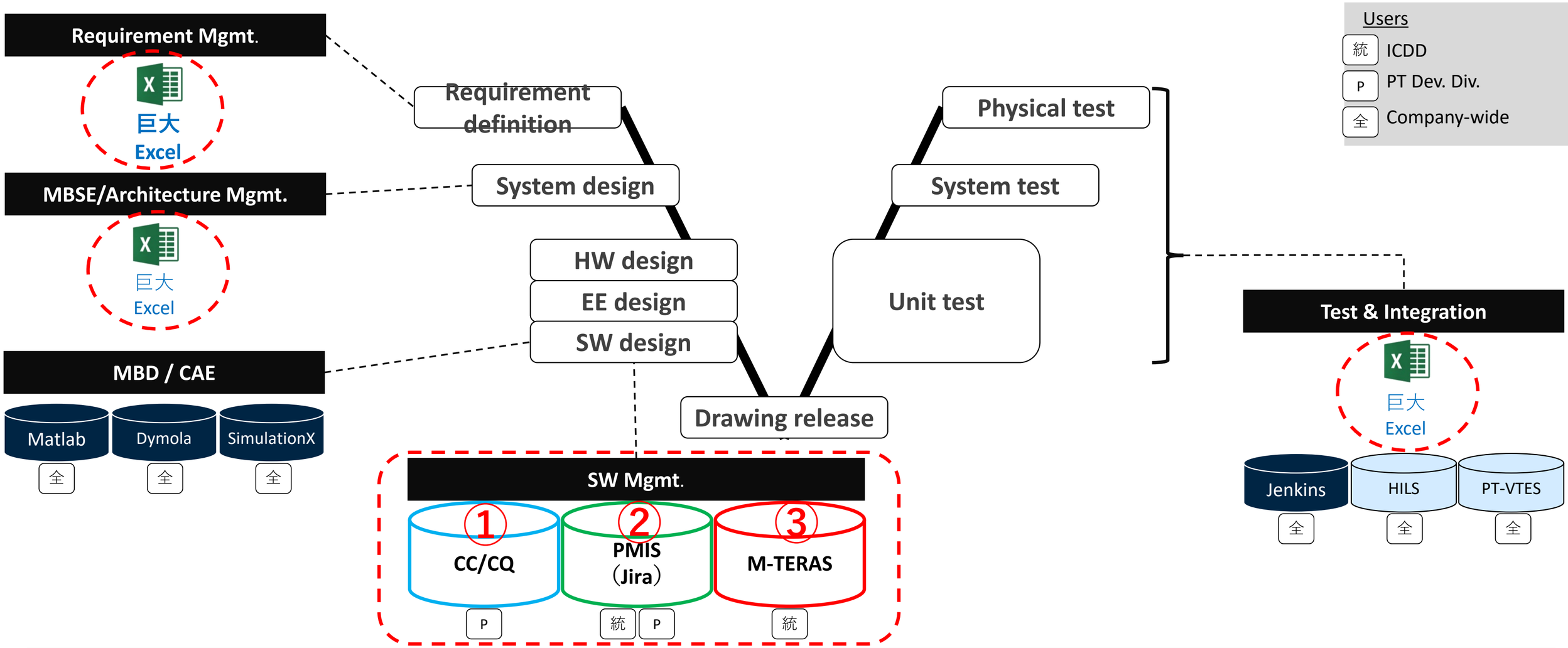
M-TERAS
(2) Compliance with ISO26262（Functional safety standard)

M-TERAS：Customize based on NTT-Data products

ALM:Core system for software development

Status quo: Different systems are used by individual domains/departments. Some of them are managed with Excel files.

Issue: Info. sharing among domains/departments and info. management from company-wide viewpoints are not sufficient.



※ALM = Application Lifecycle Management

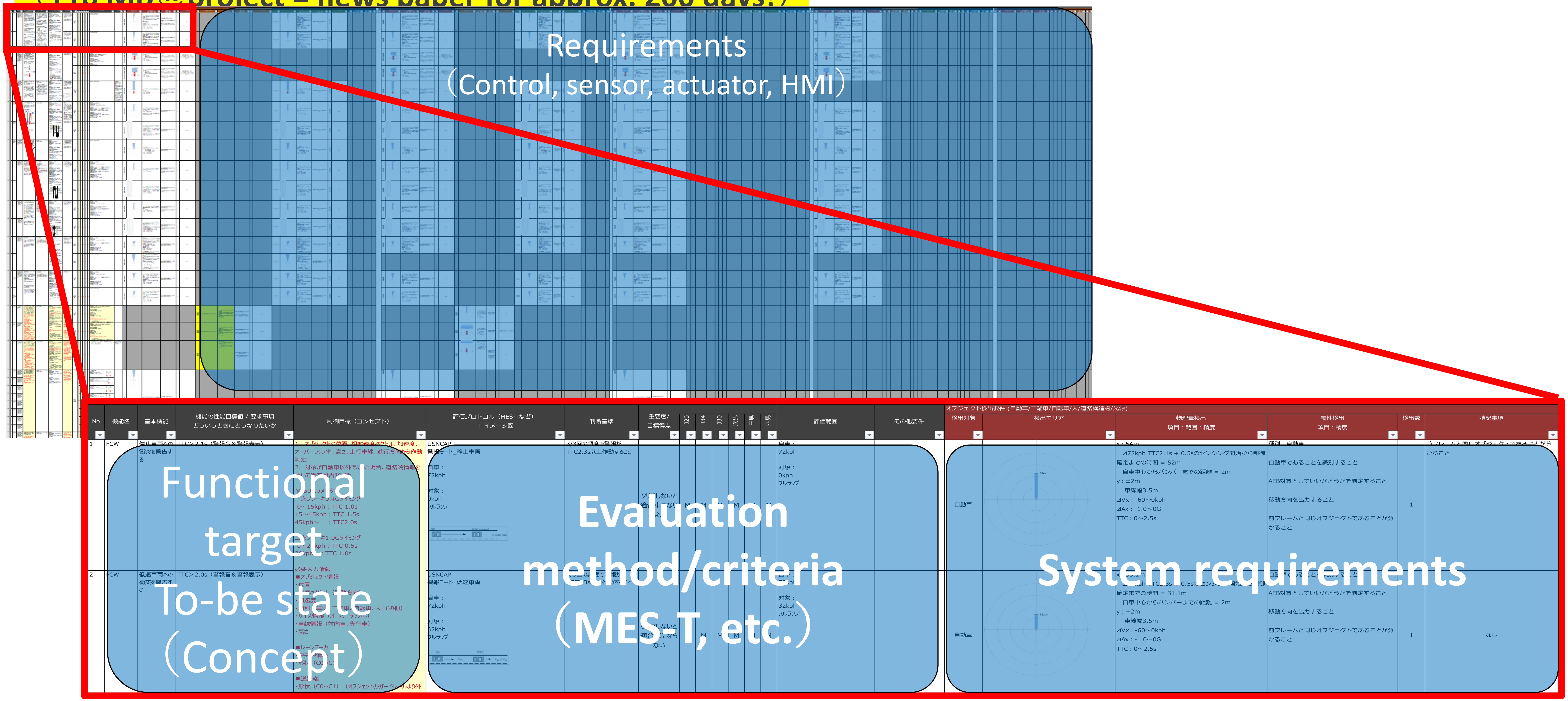
※PMIS = Project Management Information System。Jira/Confluence/Bitbucket等Atlassian製品を中心に構成。

※M-TERAS = Mazda版TERAS。Redmine/Subversion/TERAS（NTTデータアーク製品）で構成。

※CC/CQ：ClearCase/ClearQuest。IBM製品。

Example of gigantic Excel

Targets, requirements, and criteria for ADAS development are managed in a large-capacity Excel spread sheet.
（110 MB@project = news paper for approx. 200 days!）



Work problems

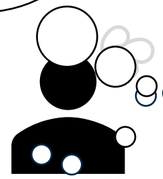
Conducted questionnaire survey with ICDD engineers. （Feb. through Mar. 2022, 30 responded with 69 comments.)

Process-related problems

- In cooperative control btw vehicle systems, the development is halted by misalignment btw ECU frequently.
- Develop schedules are not aligned btw vehicle and control （lead time for control development not considered.)
- W/o verification environment for specs, reworks occur on the right side of development process.
- No procedure established for quality assurance at the update of full-vehicle model.

IT system-related problems

- Control information to grasp the vehicle total concept is not centralized.
- Lessons/knowhow from forerunners scatter; cannot find what I want to know.
- Outcome and design process are manually connected;、input takes time and has risk of human error.
- Each engineer haphazardly collects information necessary for simulation analysis; it lacks accuracy, efficiency, and stability.



Work problems （questionnaire analysis results)

✓Questionnaire results revealed that **business process is not defined and information are not linked.**

✓Further analysis located the causes as follows:

Beyond human comprehension

Expanding scale of systems overwhelms human; even an evaluation of each system is difficult unless all systems are connected.

Complicated causal relationship

Software is indispensable to create new value and causal relationships are complicated; what are affected cannot be identified.

Shortened change cycle

Software's change cycle is too fast.
Its configuration is also changed; change points cannot be cross-checked.

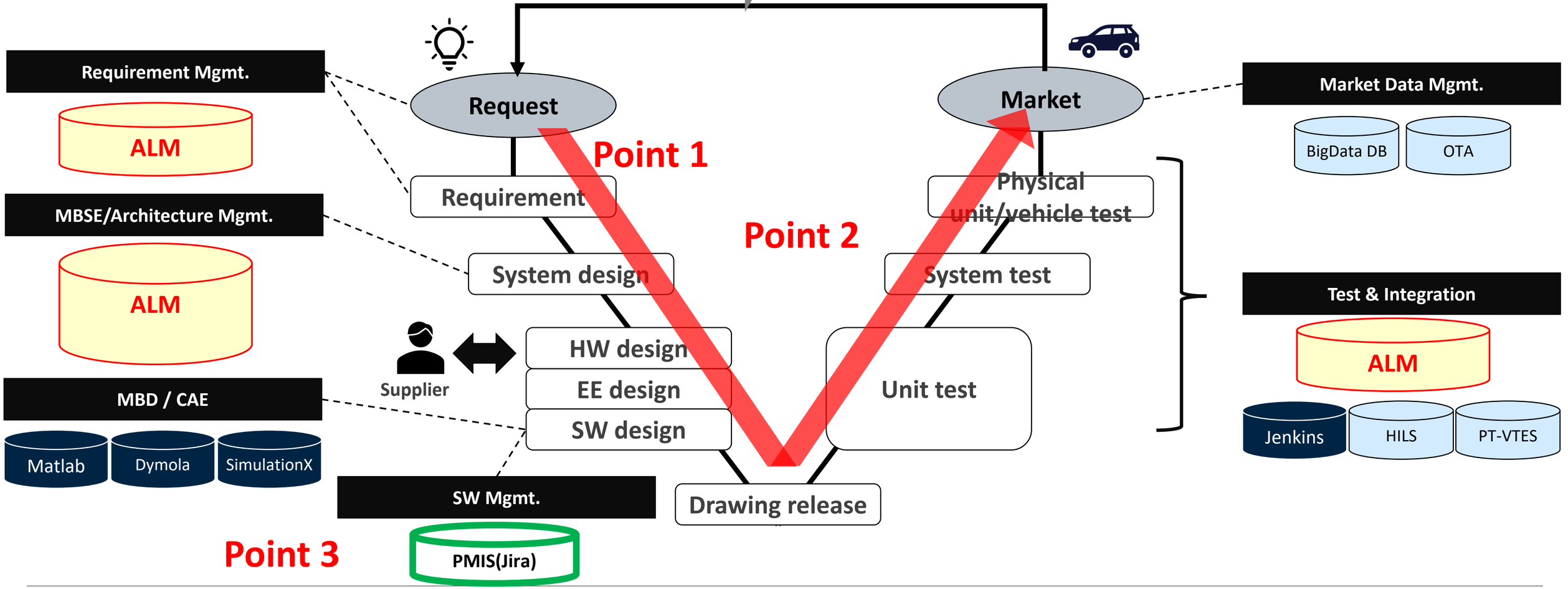
Rapid change in technical requirements

As electrification, AD/ADAS, and connected evolve quickly, technological elements change significantly; past knowledge cannot be utilized.

✓ Build a system to connect processes from start (requirements) to finish.

Point 1: Define total vehicle requirements + manage function allocation.
Point 2: Manage the linkage with tests.
Point 3: Utilize past assets.

ALM is expected to be the core.



Software BOM: Explosion of software combinations

We already face problems attributable to the explosion; need to solve it otherwise we have no future.

Current

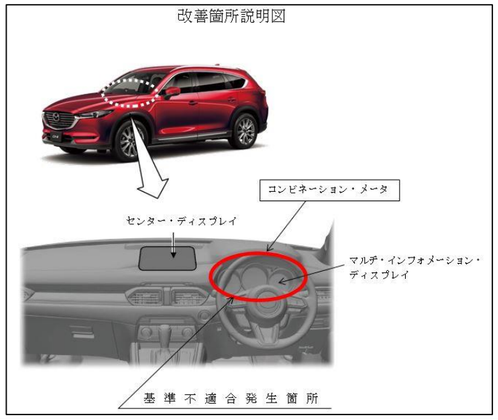
Combination has already explored due to CASE, CS/SU, etc.
Software are updated **to address defects** incl. omission of verification, etc.

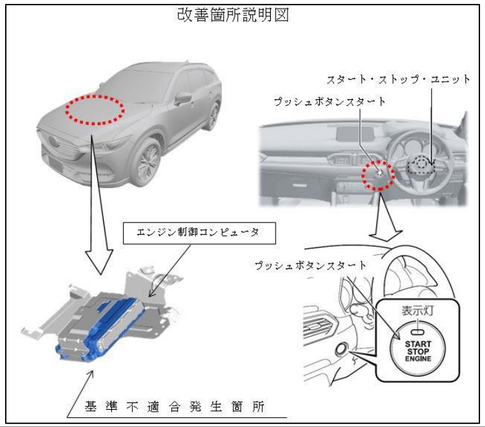
Electrification

ADAS/AD

Connected

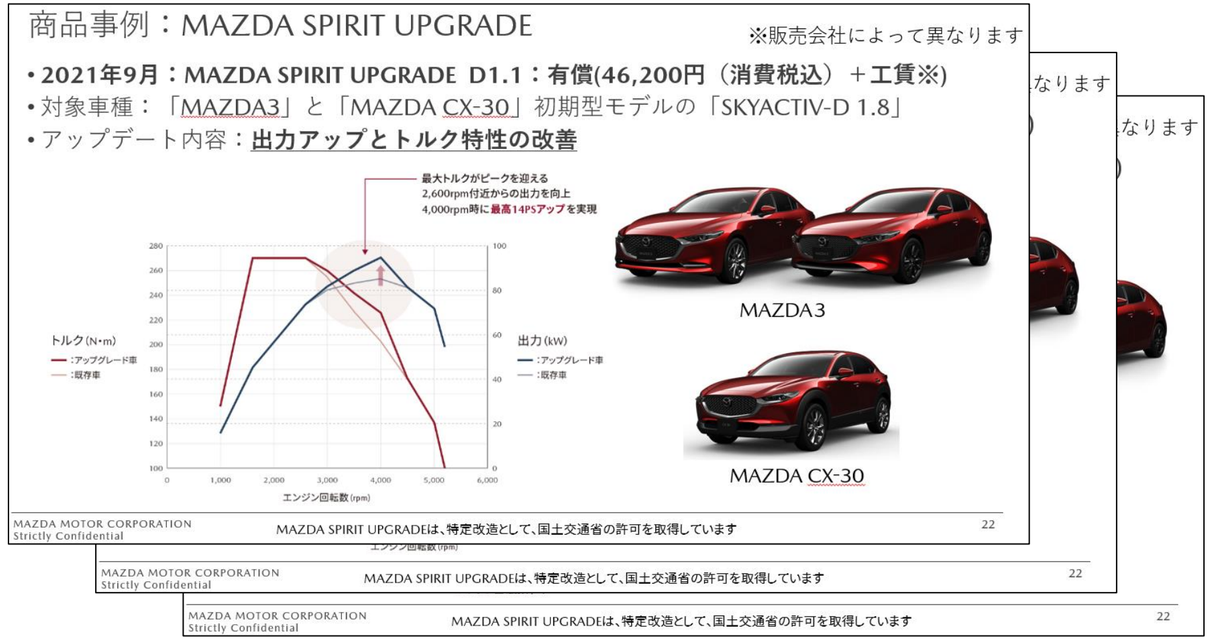
CS/SU reg.





Future

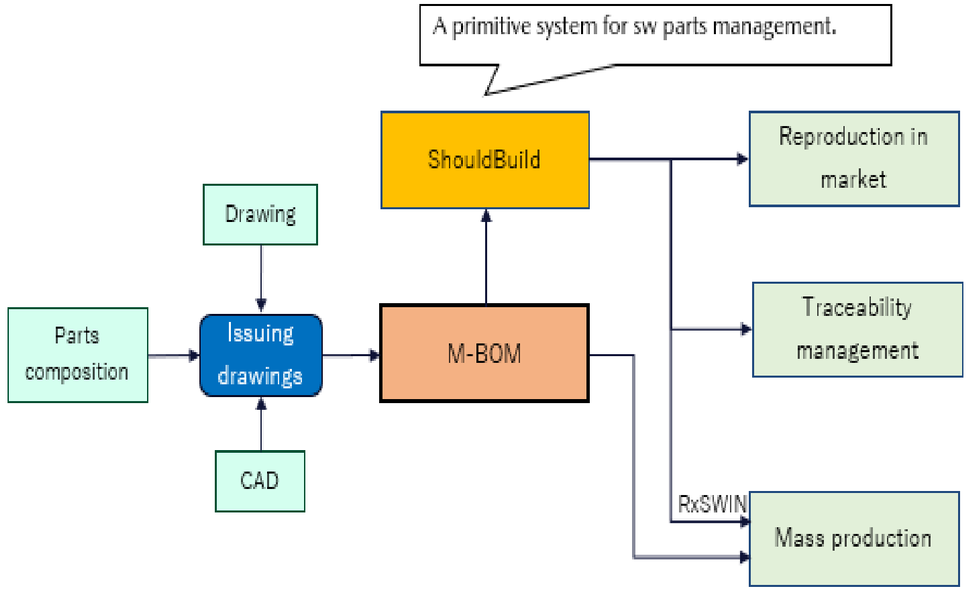
Software **update for value enhancement** further increases combinations.



Software BOM: Explosion of software combinations

Current

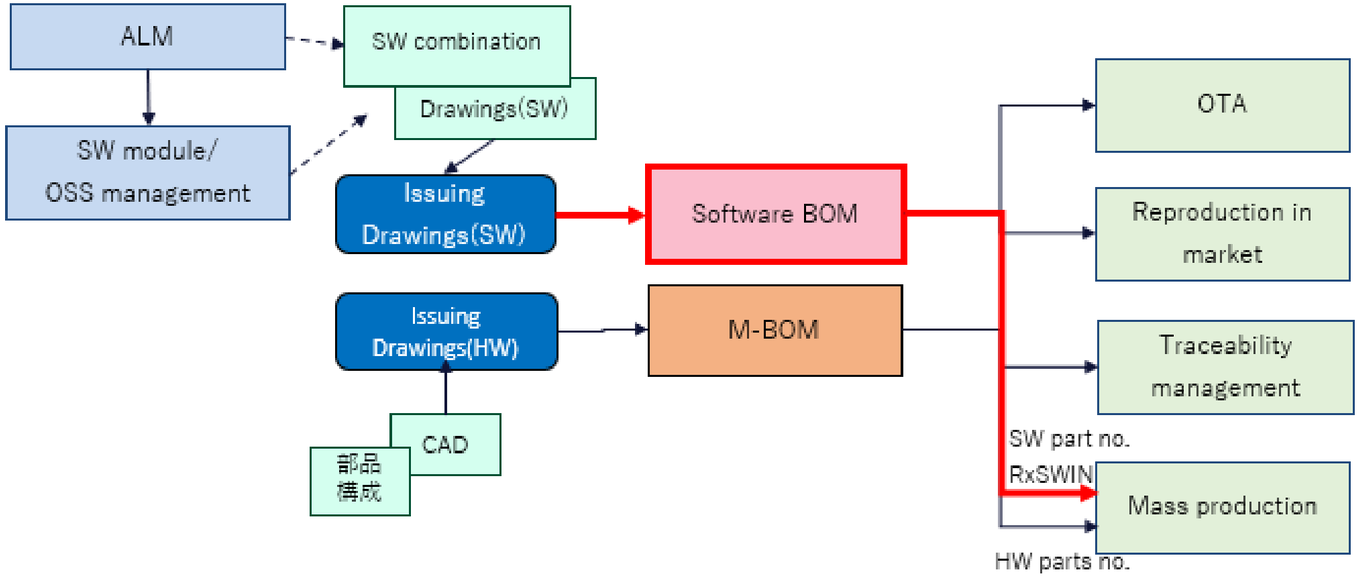
- Manage software as a component in the M- BOM for each car model.
- Generate software configurations (combinations) for each regulation/function using 'ShouldBuild’ system.



Future

Software BOM Construction: Separation of hardware and software management.

- ・ Fundamental measures to SU regulation (market combination), OTA support (SW differential update, paid reproduction).
- ・ Software is managed with the software BOM (software-centric, combination by function, module configuration)."
- ・Hardware is managed with the M-BOM (vehicle-centric, production configuration).



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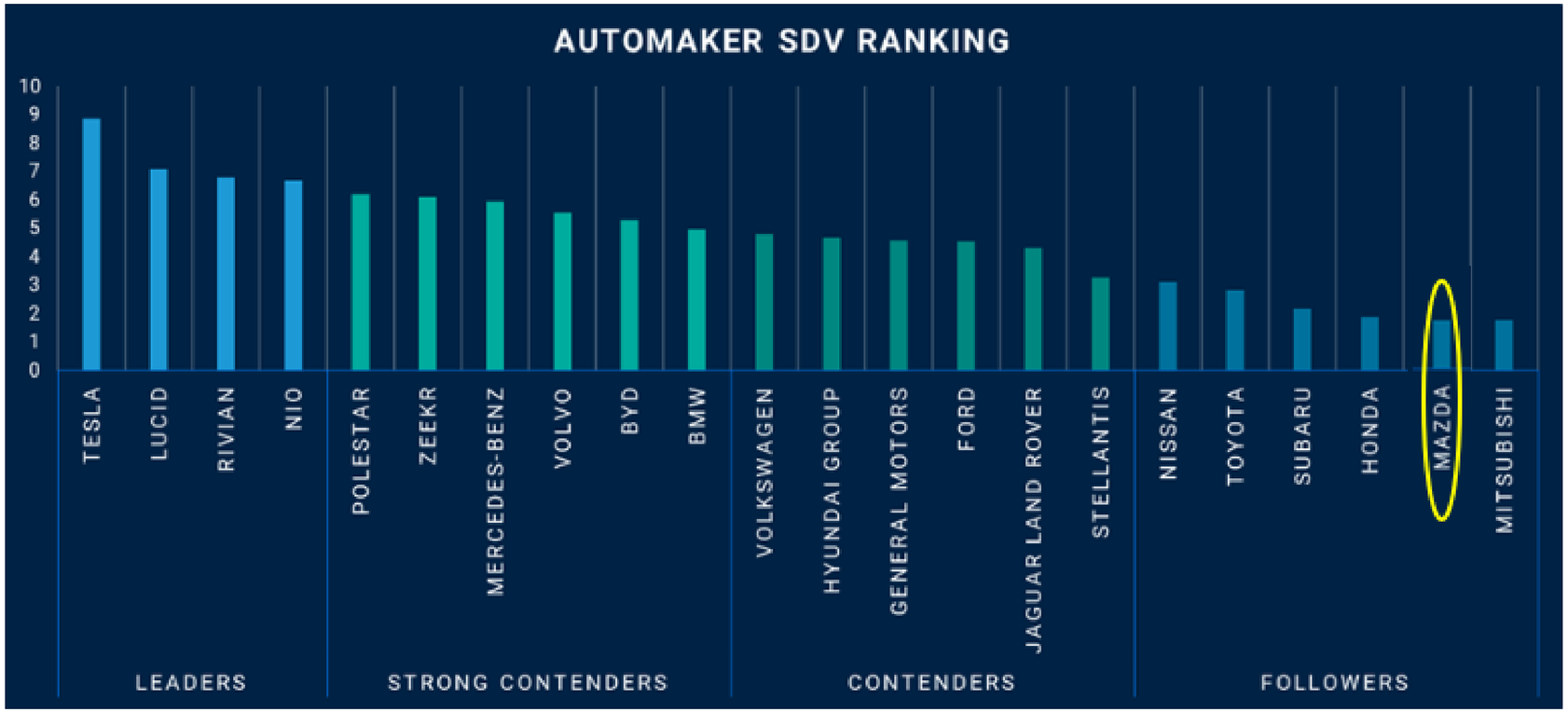

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