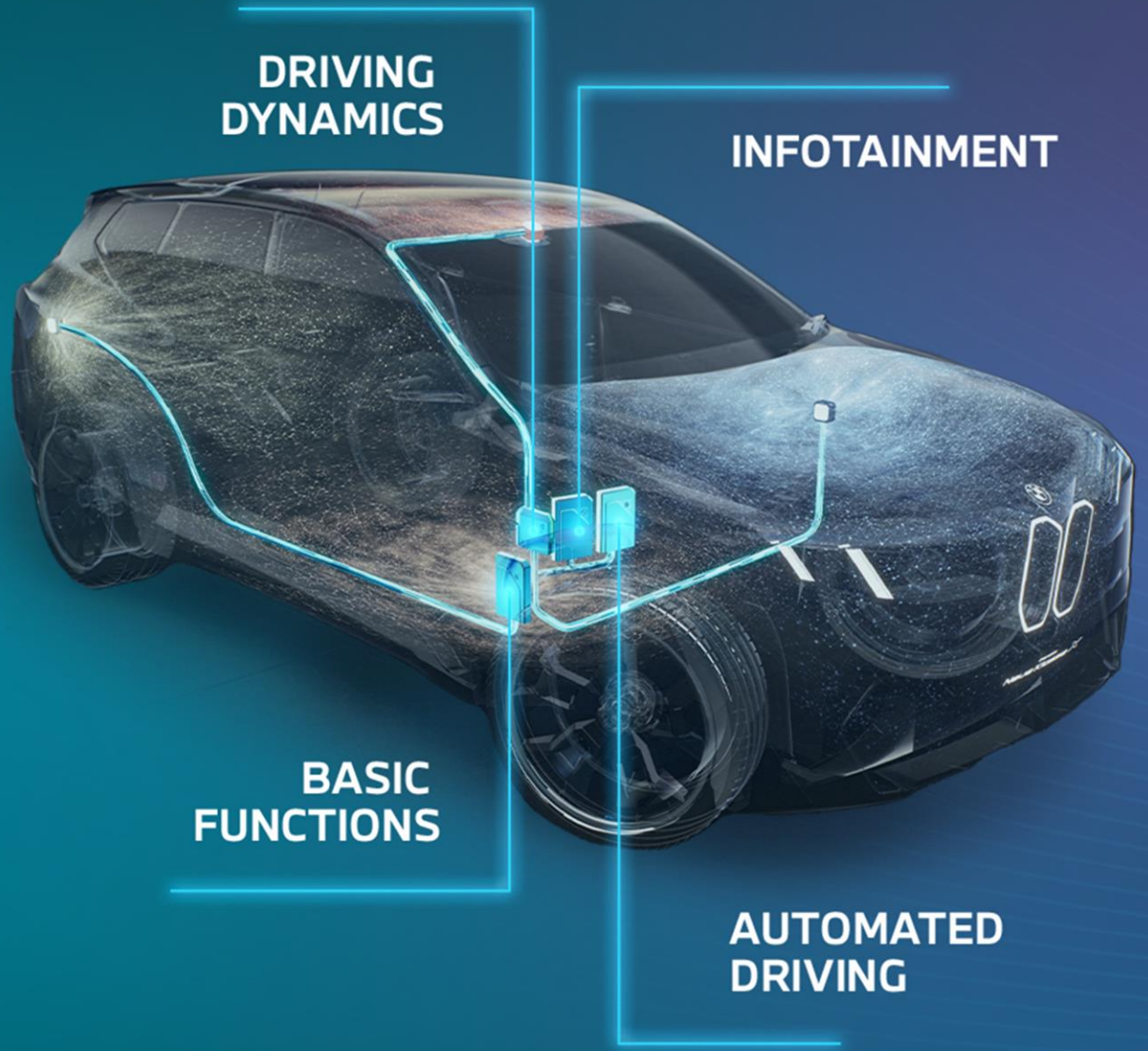
BMW GROUP

BRIDGING THE GAP BETWEEN TRADITIONAL OSS AND AUTOMOTIVE SERIES PROJECTS.

MARTIN WAGNER, BMW AG

AOSS 2026

HIGH INTEGRATION ON **4 SUPERBRAINS.**



THE 4 SUPERBRAINS OF THE NEUE KLASSE

- Centralized and intelligent computing.
- Increased performance, reduced complexity.
- Future-proof with headroom for functional upgrades.
- Co-location for energy efficiency.

MOTIVATION | THE RACE TOWARDS THE SDV IS WON BY **MASTERING THE VERTICAL** TO ENSURE THE DELIVERY OF NEW DIGITAL FEATURES.

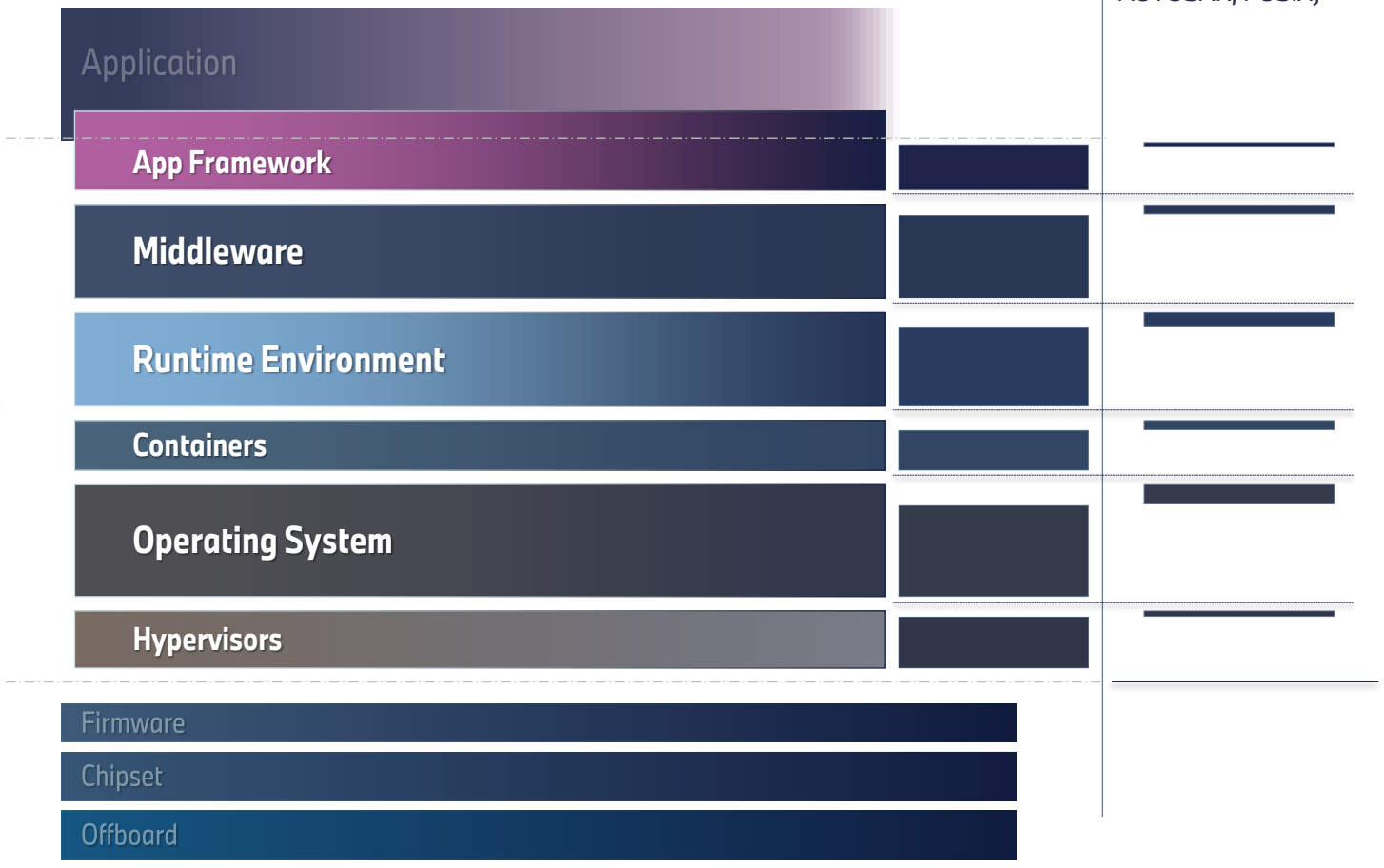
Customer-driven features

Vehicle functionality defined by SW and kept up-to-date

Focus of today

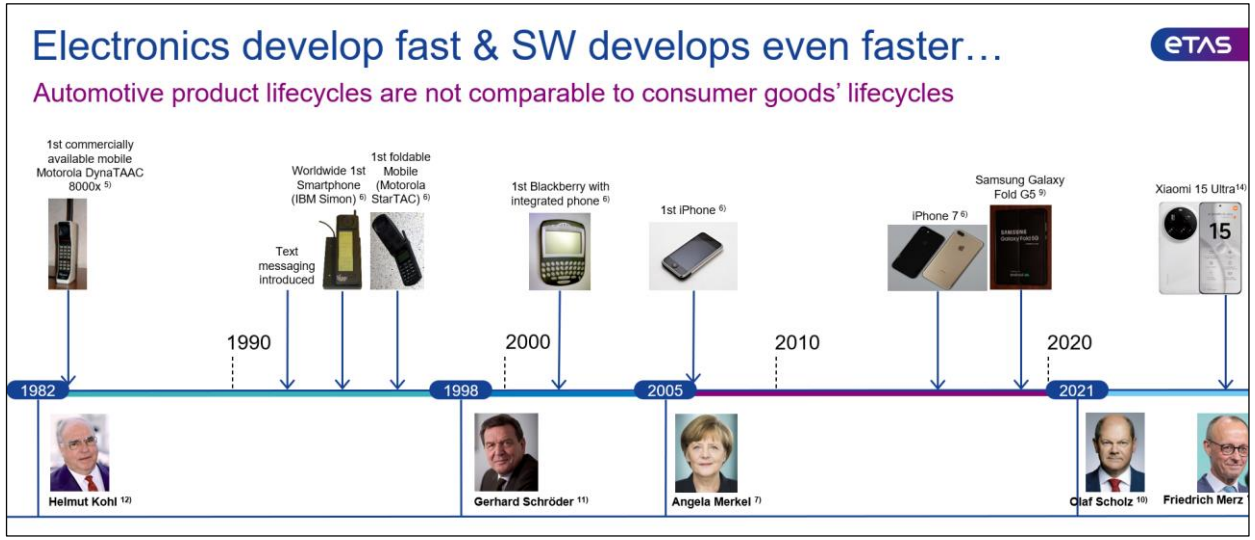
"Master the Vertical"

Be able to solve all in-generation and cross-generation integration challenges



MOTIVATION | **CARS** ARE OFTEN COMPARED TO **CELL PHONES**, YET LONG-TERM **MAINTENANCE MAKES A BIG DIFFERENCE** !

WHILE ONLY THE ELDERS REMEMBER CELL PHONES BEFORE THE IPHONE ERA…

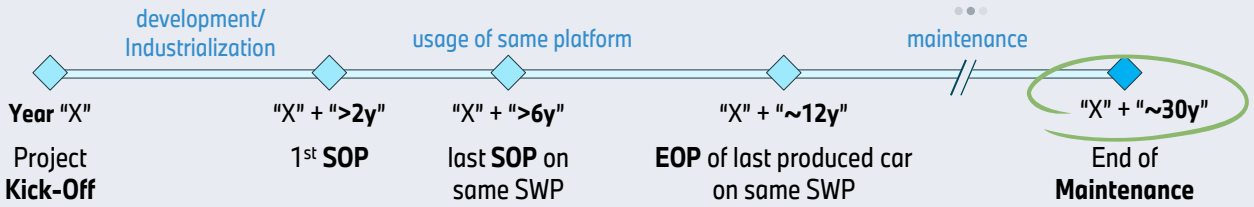


Source |
Detlef Zerfowski, ETAS

…THE **CARS FROM** THE SAME TIME PERIOD ARE STILL ON THE ROAD, AND **NEED TO BE MAINTAINED UNTIL TODAY.**

The overall **SW cycle** in automotive is **~30 years – long-term maintenance must be taken care of.**

Sharing the effort sounds promising.



RECENTLY, THERE ARE **TWO KINDS OF OEMS** IN TERMS OF **PROPRIETARY SW-PLATFORM** DEVELOPMENT.

#1 The ones who **tried to develop** a proprietary SW platform **and failed.**

#2 The others who **succeeded to deliver** a SW platform, …yet **are at risk to maintain** it.

SOLUTION SPACE | HOW TO DEAL WITH THE SDV COMPLEXITY?

MASTERING THE "VERTICAL" | ABILITY TO SOLVE ALL IN-GENERATION AND CROSS-GENERATION INTEGRATION CHALLENGES

Reduce Effort | Software can be **reused** across generations, yielding lower cost and increased velocity.

Enhance Quality | With reuse we can **stabilize our SW-platforms** over a long time period and **provide robust products**. (compare with tech industry, development of operating systems).

...

LONG-TERM MAINTENANCE | ENSURE LONG-TERM SW-PLATFORM READINESS

The overall **SW cycle** in automotive is **~30 years – long-term maintenance must be taken care of**. Sharing the effort sounds promising.

Lock-in with proprietary products |
Using specific vendor products may prevent reuse across generations (e.g., due to geo resilience, supplier cost, changes in supplier landscape).

...

OEMS ARE THE **"LAST LINE OF DEFENSE"** – INTEGRATING A COMPLEX STACK AND DELIVERING IT TO CUSTOMERS.

OEMs must be **responsible for SW-integration**

- To allow for the integration of **evolving tech stacks** from multiple players (also outside automotive)
- To **balance contradicting requirements of vertical stack** (buying full stack from supplier is not feasible in complex scenarios)

POTENTIAL **SOLUTION APPROACHES FOR STACK COMPONENTS** ARE LIMITED.

- Proprietary| **Make**
- Proprietary| **Buy**
- Specification | **Standardized**
- Implementation Standardized | **FOSS**

BENCHMARK | SOLUTION APPROACHES TO DEVELOP A SW-PLATFORM.

THE COMPARISON OF THE ESSENTIAL KPIS SHOWS THAT **DEVELOPMENT** OF NON-DIFFERENTIATING SW **IN OSS COOPERATION** IS THE BEST SOLUTION.

KPIs	PROPRIETARY| **BUY**	PROPRIETARY| **MAKE**	SPECIFICATION | **STANDARDIZED**	**FOSS IMPLEMENTATION STANDARDIZED** (Deep Dive)
KNOW-HOW/ SKILLSET OEM	☆☆☆ **None** (integration of combined HW/SW by supplier)	★★★ **State of the art.**	★☆☆ **Partly** inhouse (if OEM participates in standardization)	★★★ **State of the art.**
DEPENDENCY (REUSE, LOCK-IN)	☆☆☆ Complete **dependency** on supplier, no internal know-how/ skill set, high risk of **lock-in.**	★★☆ **No lock-in**, **reuse** depends on solution.	★☆☆ **Lock-in substantial,** since i**mplementation** proprietary.	★★☆ **No Lock-in** for code (choice between multiple distributions, yet ECU-specific work products proprietary).
EFFORT/ COSTS (OEM)	★★☆ **Less** effort | (black box ECU integration only, but risk of repeated supplier costs)	☆☆☆ **Very high effort** | Implementation, integration, maintenance.	★★☆ **Medium** effort | Specification and configuration may be reused.	★★★ **Shared** effort | SW-arch., detailed design, **code**, tests provided by community, ECU-specific work provided by distribution.

Cooperation is the best approach to deliver +
"FOSS standard" is the only way to collaborate on eyes' level.

VENDOR-DOMINATED VS. **NEUTRAL OSS COMMUNITY** IN THE AUTOMOTIVE DOMAIN.

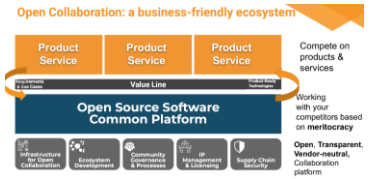
VENDOR-DOMINATED APPROACH		**NEUTRAL OSS COMMUNITY** APPROACH
Antitrust and compliance rules lead to complex collaboration setups.	COMPLIANCE & ANTITRUST	Community provides **trusted governance framework**. 
Other OEMs are extremely reluctant to become dependent on a competitor's solution (even if OSS)	VARYING REQUIREMENTS	 Contribution by many OEMs require collaboration to **prevent one-off solutions**.
	TRANSPARENT GOVERNANCE	Projects define maintainers, review rules, coding standards, and release processes. 
Only dominant players in a specific sector (e.g. Google AOSP) have enough capacity/energy to drive such a project, no such players exist in the automotive world.	GLOBAL ECOSYSTEM	 The international community ensures a global ecosystem w/ various contributors OEMs, Tier1s, SW-Tiers, ...).

Image Source | Eclipse Foundation

Eclipse Foundation provides a solution to most of the automotive OSS challenges.

VARYING PERSPECTIVES | OSS COMMUNITIES & AUTOMOTIVE INDUSTRY.

	OSS	AUTOMOTIVE	S-CORE SOLUTION
BUSINESS MODEL	**Established OSS Business Models** (Free OSS, Premium, Distributor, Services,…).	**Established Automotive Business Model** w/ standard players OEM/ Tier1 SW-Tier; all based on proprietary SW.	Community-Building via XCORE & MoU
SHARED CONTENT	Usually, **only code is shared** (not many other work products required).	Automotive processes require **work products beyond code** along the whole SW-development process.	Collaborate on all delivery artefacts, not just on code
REGULATION	Mostly **not regulated**/ non-safety critical	Highly regulated, e.g., safety/ security.	
TOOLCHAIN	OSS-based, usually quite simple	**Highly complex** tool environment used for whole vehicle development (expensive adaptation).	Set up audited OSS toolchain
COMMITMENT	**Voluntary**, no/ less adherence to deadlines	Strict **contractual milestones** (E/E and vehicle integration, plants, tooling, validation,…).	Community-based planning of S-CORE 1.0

The automotive industry explores OSS as a new collaboration model
– and the OSS community explores automotive as a novel field of application

ECLIPSE S-CORE | COMMUNITY-BUILDING AT THE CENTER OF ATTENTION.

S-CORE | FOSS-based cooperation for onboard SW-platform development **w/ inclusion** of all existing parties and new players **on eye level** on a **neutral common ground** Eclipse SDV Working Group.

COMMUNITY BUILD-UP

INITIAL SETUP

We´ve started with **5 initial members "Coalition of the willing".**

ETAS · BMW · Mercedes-Benz · accenture · QORIX

MoU

MoU aligned for OSS **cooperation on S-CORE**, to **ensure expanding** of the **community**.

1st batch of 11 signees (**AEK, 06/25**)

\+

2nd batch of 21 signees (CES, 01/2026)

X-CORE

We took care of **non-technical** issues, …to make sure our **developers** can **focus on delivery**!

X-CORE – takes care of…

- **Communication**
- **Funding** (Eclipse SDV + external)
- **Operations**
- Product **Branding**

ECLIPSE INFRASTRUCTURE

We´ve utilized existing **Eclipse SDV** Working Group **infrastructure**…

Eclipse Community Days: Rotterdam, Seoul, Detroit, Tokyo, Bonn, …

AOSS, OCX

TAC, SIG, Slack, Zoom

Linked-In channel

Website domain

COMMUNICATION CHANNELS

…as well as other channels, relevant for OSS and automotive industry.

IAA

CES

AEK

ELIV

VDA QM

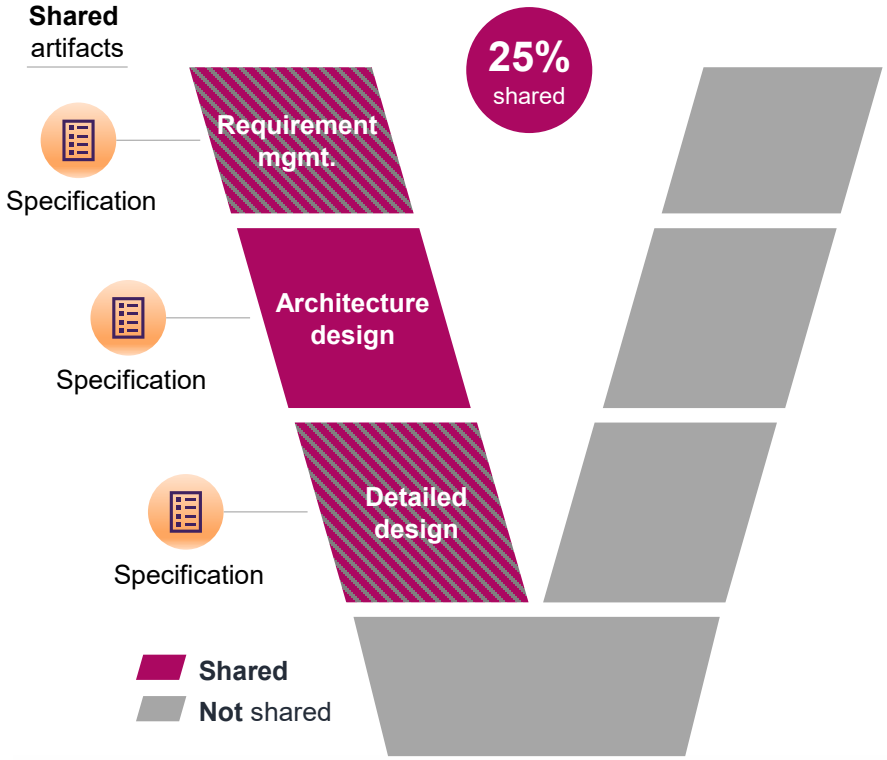
Ultimamedia

…

Growing international S-CORE community since 12/2024 via advertisement on multiple communication channels.

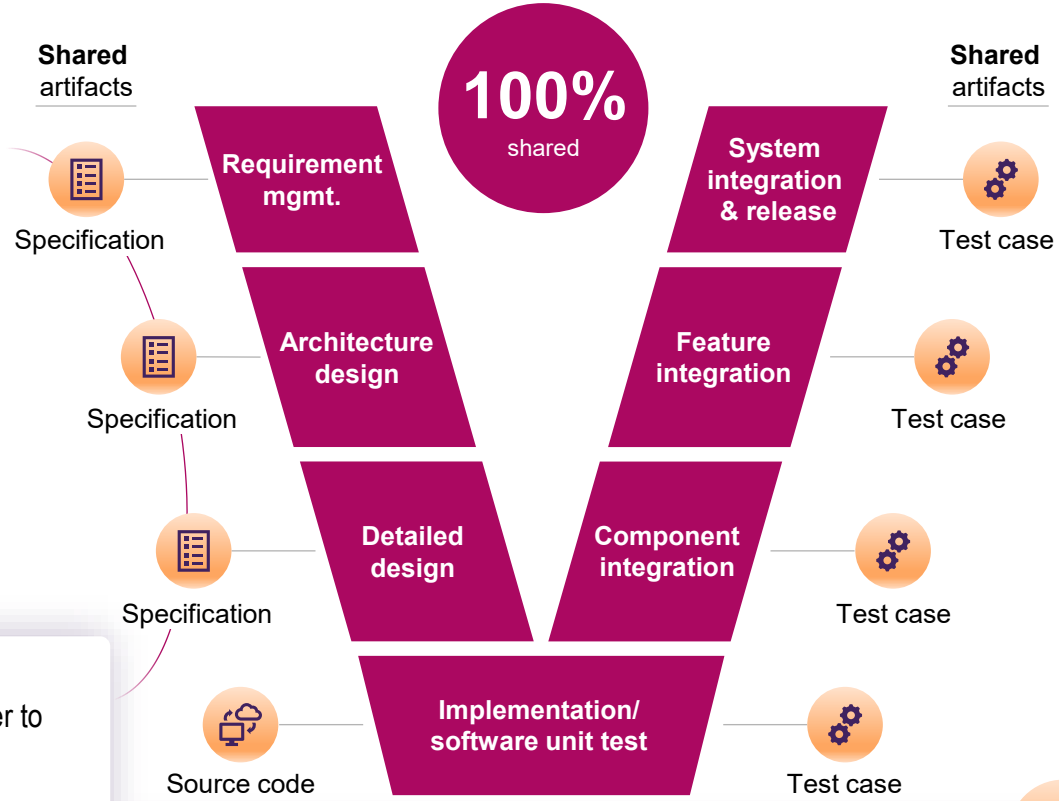
Reuse & efficiency | Collaborating on all artifacts increases efficiency

Past: High individual effort w/ spec-based standard



~75% of Software platform effort is **not shared**[1] **!**

S-CORE approach: **shared effort** across all artifacts



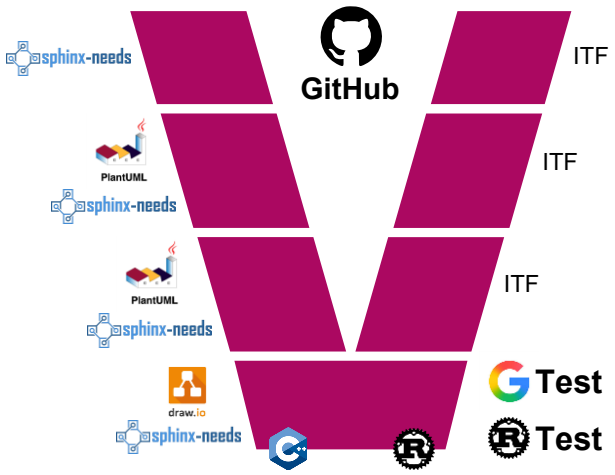
</> "Doc-as-code" format, in order to enable **AI-based evaluation**.

We can be **faster & more efficient** by sharing all artifacts

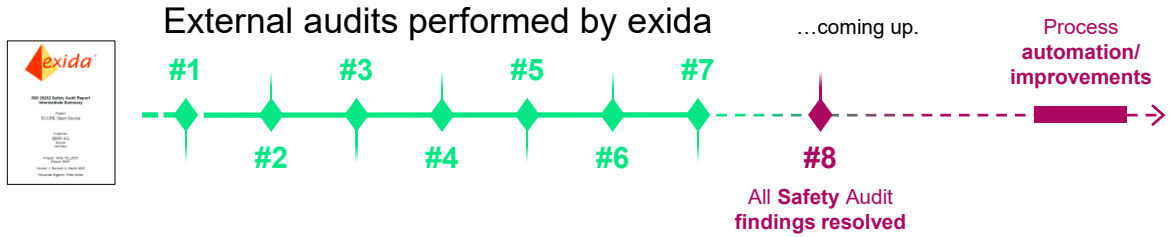
Source: 1) BMW estimation on effort distribution for ADAS safety SW platform development

Compatibility & qualification | We've established an integrated open source toolchain and perform continuous auditing of our process

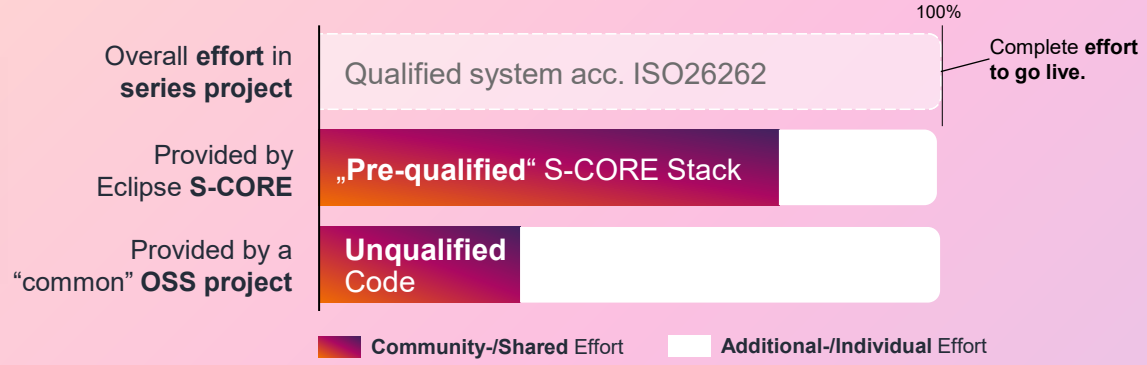
Full open-source toolchain established.



7 external process audits completed/ findings implemented,
1 more audit to go to cover **complete SW-development process**.



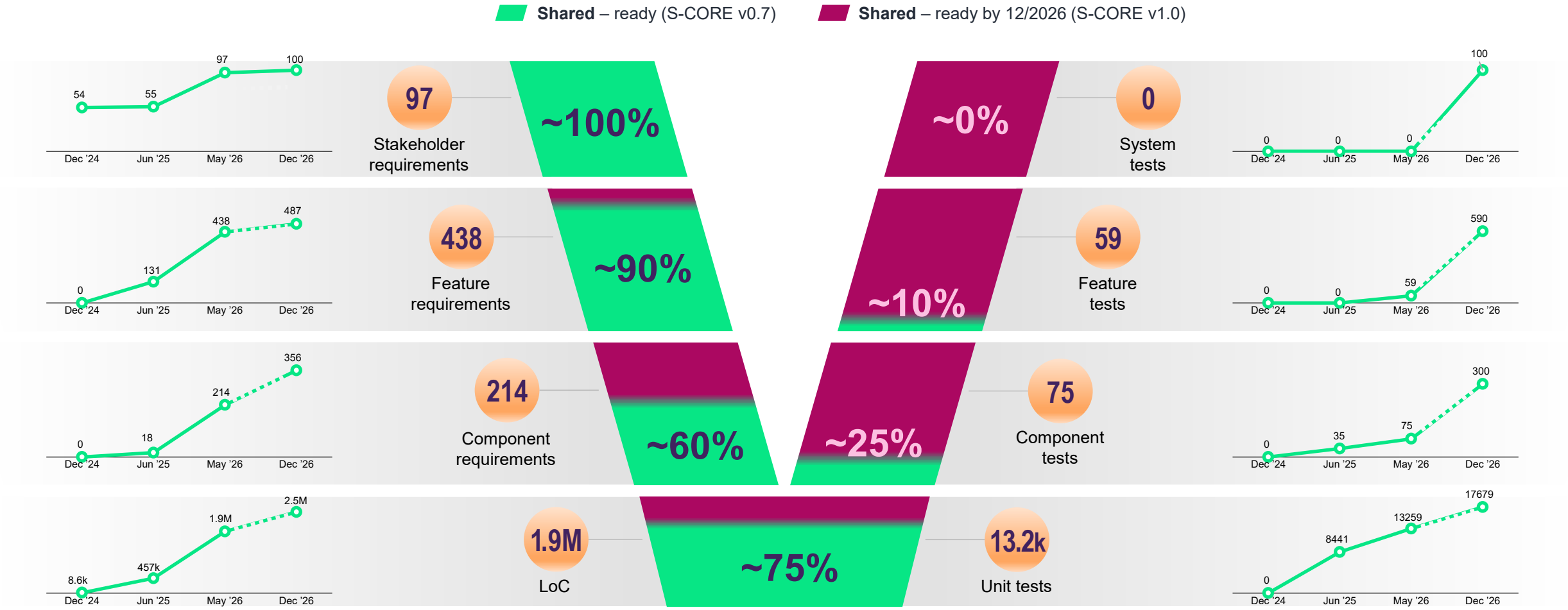
With S-CORE, the individual effort to qualify open source software decreases significantly.



*"With S-CORE, the **shared content** for the industry is **increased by far**,…*

*… nevertheless, **some effort** is still **needed** to reach a fully qualified system.*

Reuse & efficiency | We work at high speed to deliver all artefacts in v1.0



Source: Overall Status — REF_INT documentation

SUMMARY & OUTLOOK ECLIPSE S-CORE | **WHAT STILL NEEDS TO BE DONE.**

SUMMARY

- **Complexity of SDV** can be handled by controlling the vertical and solving long-term maintenance
- **Community-based OSS and automotive SW-development** are a pretty good match, and the best way to collaborate on eye-level.
- **S-CORE** is **addressing the challenges** arising from the combination of community OSS and automotive.

OUTLOOK/NEXT CHALLENGES

- Technological: **deliver S-CORE 1.0** and prove that the approach delivers on its promises.
- Organizational: Further **extend OSS community** with global players also from adjacent industries.
- Business: Define **viable business models** (e.g. distributions, services, ...).

Thank you.