

INVESTOR & ANALYST DAYS 2024





DIGITAL PRODUCT STRATEGY

BMW GROUP

WHAT DO YOU EXPECT FROM A CAR?



140 200

50









Amazon Music

Horbucher

DIGITALIZATION ADDRESSES THE OVERALL COMPANY.

Consistent digitalization to exploit potentials in all business segments.

Business Processes



Smart logistics
 Innovative automation & assistance systems
 Virtualization
 Quantum computing

Catena-x automotive network



Focus today

Products



- Unique user experience
- Safe, comfortable and innovative driving experience
- Car as a best managed device

Central enablers: Stable

software platforms, SW/HW integration, safety & security, consistent partner integration

FOCUS ON CUSTOMER CENTRICITY

Customer Interaction



 Digital customer experience
 Digital aftersales upgrades
 Digital personalization of the vehicle
 Digital financing process at financial services

DIGITAL IS AN ESSENTIAL PART OF OUR BMW GROUP PRODUCT STRATEGY.



KEY ELEMENTS OF THE BMW DIGITAL STRATEGY ENABLE STATE-OF-THE-ART DIGITAL **EXPERIENCE.**



A SEAMLESS **USER INTERFACE**

20+ years of BMW iDrive BMW Operating System 8.5 (Linux) / 9 (AOSP)

PERFECTLY ASSISTED

features

40+ Driver Assistance

L2 hands-off up to 130km/h (DE/US/CAN)

3RD PARTY CONTENT

Alexa, Youtube, Bundesliga, XPERI, 3rd Party App Store, Amazon Fire TV, etc.

ALWAYS CONNECTED

5G, My BMW App, BMW Maps, Digital Key Plus

FULLY UPDATEABLE

Largest upgradeable fleet (> 8 million vehicles) >120 features & quality upgrades

All functional domains, all drivetrains

TARGET PICTURE DIGITAL CAR STRATEGY.

The inspiring **overall digital experience** blends seamlessly into every driving moment and combines them into the ultimate driving experience.

The vehicle becomes an intelligent, always up-to-date companion.

Driving dynamics are combined with assisted driving in a unique and consistent way.





FUTURE BECOMES PRESENT.

A joyful user experience by the BMW Group.

COMPRESS.



OFFEI	RING	
OUR (USTON	IERS
A SAF	E	
COMF	OŔTAB	
AND I	NNOVA	TIVE
DRIVI	NG	
EXPE	RIENCE	

	D 120 120 60 km/h Assist PLUS 445 km			² D	
LEVEL	MARKET AVAILABILITY			• • • • • • • • • • • • • • • • • • •	
Level 4				Automated Valet Parking	· · · · · · · · · · · · · · · · · · ·
Level 3	Offer in Germany since March 2024.	First L3 Offer @ BMW 7 Series		First OEM with L2* and L3	
Level 2 Extended Driver Monitoring	Offer in USA, Canada and Germany since October 2023.	First OEM with L2 * @ BMW 5 Series	L2* @ BMW 7, X5, X6, X7, XM, iX	@ BMW 7 Series in <u>ONE</u> vehicle	
Level 2	Worldwide offer.		 		
Level 1	First Active Cruise MORE THAN 40 FEATU Control @ BMW 7 Series Safety, Comfort, Parking	JRES: g		,	
	2000 [] 2019	2023	03 2024	07 2024 upwards	Z = = = = = = = = = = = = = = = = = = =

OUR DEVELOPMENT TEAMS WITHIN A GLOBAL NETWORK.









OUR DIGITAL CAR STRATEGY CLEARLY DEFINES OUR LONG-TERM DIRECTION AND PUTS US AHEAD OF THE COMPETITION.



Our overall digital experience blends seamlessly into every driving moment

Unique UI that connects the driver with the vehicle and the outside world naturally, intuitively and multimodally.



Our driving experience strategy is a distinctive combination of self-driving and being driven

Connecting sheer driving pleasure with the comfort of automated driving and keeping the driver in the flow.



Anchoring "Pick & Choose" strategy and maintaining control

Our ecosystem openness enables customers to access content in a variety of ways.



Shift towards crossgeneration platform

Selectively deeper design of hardware is key to stabilizing and professionalizing our SW development.

We develop software globally integrated into the vehicle development

process

We are positioned worldwide and apply the best expertise wherever it is available.



HOLISTIC DIGITAL EXPERIENCE

BMW GROUP

TURNING CHALLENGES INTO OPPORTUNITIES.

We are constantly observing external factors for our digital Customer Experience.

Technology

Customers' Choice

Customer Experience

New Players

UNIQUE USER INTERFACE.

Connects driver with vehicle and outside world: naturally, intuitively and multi-modally for more than 20 years.



UI/UX -THE IMPORTANT DIFFERENTIATOR.

An outstanding digital experience will impact customer decisions.



CONTENT IS KEY.



Gaming - Airconsole

FEATURED GAME Who Wants to be a Millionaire? ★★★★☆ ペ 1-4 Play now

4 1+ Players

CONNECTED DRIVE STORE 3rd Party Apps – Faurecia Aptoide









CHINA-SPECIFIC ECOSYSTEM.

70% software code by China for China.

















Tencent 腾讯 — <u></u> WeChat 1260 m WeChat 1260 m.

Use the app





PICK THE BEST. OUR APPROACH ACROSS THE TECH STACK.



Make

State-of-the-art innovations

Fast iteration & re-use

Buy

Cost synergies (cross-industry re-use)

"Pick-the-best" approach

Open Source

"Standing on the shoulders of giants"

Leveraging existing ecosystems

Partner

Innovations by codevelopment

Shaping and establishing industry standards

BMW CHARGING OPTIMISED ROUTE -BEST IN CLASS.

Peace of mind on all-electric long-distance journeys.



BMW CONNECTIVITY. BEST MANAGED DEVICE.

THE DIGITAL EXPERIENCE REQUIRES CONNECTED CARS.



5G connectivity.

PERSÖNL. ASSISTENT

<u>:</u>!

22 M. VEHICLES CONNECTED TO BMW CLOUD WORLDWIDE.

 3×8 m. fully upgradeable over-the-air.

Setup your personal eSIM to improve your connectivity

) Setup eSIM



13 M.+ APP USERS.



Data security and privacy first.

THE CONNECTED VEHICLE IS BASED ON A POWERFUL CLOUD-BACKBONE.

A flexible data collection infrastructure and a future-proof Al platform.



Scalable, word-wide cloud platform

- World-wide 24/7 availability
- Boosts reliability, dynamic scalability and stability
- Focus on customer functions



Flexible, compliant data collection

- 100% compliant
- Flexible, standardized and efficient data collection platforms in the vehicle and in the cloud

Al platform in the cloud and vehicle

- Platform for model training / execution and GenAl
- Productive in the cloud since 2023; in the vehicle as of 2025
- Enabler for data-driven use cases (e.g. Proactive Customer Care)

ALL IS NOTHING WITHOUT DATA.

Connected Vehicle Platforms.

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THESE FIGURES ARE EXPECTED TO TRIPLE OVER THE NEXT TWO YEARS.

22M.+

Connected vehicles

12B+

Requests per day

8M.+

Fully upgradable vehicles

1.100+

Microservices

165TB

Data sent to fleet per day

99.95%

Reliability

We offer an interactive, integrated system for the ultimate UI/UX experience.

THE NEW

BMW iDRIVE.

BMW 3D Head-Up Display

BMW Panoramic

Vision

Connected Vehicle Backend & 24/7 Operations

Central Display

6

Multifunctional Steering Wheel

BROUP SOFTWARE-DEFINED VEHICLE AND ITS ELECTRONICS FOUNDATION

BMW's SOFTWARE-DEFINED VEHICLE IS THE DELIVERY PLATFORM TO OUR DIGITAL CUSTOMER PROMISE.



Scalability of hardware and software layers leverages development across segments.



Updateability keeps features and platforms fresh over generations.



Evolutionary code-base across generations ensures feature continuity and software re-use.



'Platformization' de-couples function development from fast-moving enablers.





Globalization of developer network effectively uses independent contributions.



THE EVOLUTION OF BMW's E/E ARCHITECTURE.

Neue Klasse: Zonal architecture with centralization of performance compute.



Until mid 90s

A zonal architecture with central performance compute platforms is key for SDV and an innovation driver for the semiconductor industry.



FUNCTIOANLITY

NAVIGATING ZONAL ARCHITECTURES: THREE TIERS OF ECUs.

Central performance compute, zonal compute and peripherals.

E/E SYSTEM BUILDING BLOCKS



	Central compute platforms with hundreds of kDMIPs per platform.
	Differentiated domain requirements: Safety vs. open POSIX systems.
	Regular hardware updates while maintaining software compatibility.
	Software integration and creation in BMW Group Make.
	Smart energy distribution and management for zones.
	Safe real-time OS computers with tens of kDMIPs per zone.
	Separation of Gigabit Ethernet from signal-based peripherals.
	Physical de-coupling of peripherals in separate zones (e.g. roof).

- **Sensors and actuators** with limited processing power.
- Safe **self-contained real-time** operations with single-digit kDMIPs.
- Industry standard components, spec based development.
- **No function logic** and typically limitation to single task.

BMW E/E ARCHITECTURE. FROM TODAY TO NEUE KLASSE.

Central performance compute, zonal compute and peripherals.



NEUE KLASSE WITH NEW HARDWARE FOUNDATION.

Consolidated, more efficient, and, at the same time, more powerful thanks to new technologies.



Increased performance and functionality. +20% energy efficiency .

Full zonalization of wiring harness.

- 30% weight reduction
- Variant reduction by factor 3.000
- Increased diagnostics capability and security
- Automated production of wiring harness
- Drastic cost reduction through zonal architecture and automation

Centralization and intelligent computing

- Two collocated central performance computers
- Increased performance, dec complexity
- Future-proof with headroom hardware upgrades
- Smart on-/offboard data pro
- Optimized energy consumpt

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SMART ENERGY MANAGEMENT WITH SMART eFUSES.

With our zonal architecture we also introduce Smart eFuses replacing traditional fuses.



A	dvantages of eFuses	
	Significantly faster power switching	
	Reduced need for maintenance and servicing (self-healing)	
	Saves raw materials and weight (as physical cables can be reduced)	
	Lower system energy consumption and increased safety	
D	Digitally designed power modes	
	Driving, Parking, Living, Charging	
	Diagnosis, Service, Production	
	Remote Software Upgrade	

LEADING THE PATH TO **NEXT GENERATION E/E ARCHITECTURE.**

BMW GROUP IS PUSHING FURTHER STANDARDIZATION.

Co-development and (setting) standards in the right technical fields is key.

IMEC ACP.

eFuse standardization			
(joint initiative by BMW Group an	d	Infir	າຍ

OPEN Alliance (initiated by BMW Group)

Automotive SerDes Alliance (initiated by BMW Group)

IEEE 802.3 TF for 10BASE-T1S (Initiated and supported by BMW employees)

UCle (BMW Group joined in March 2024)

PRE-COMPETITIVE COOPERATION ON AUTOMOTIVE CHIPLETS WITHIN

BMW and IMEC signed MoU for evaluation of BMW participation in IMEC ACP.

THE DIGITAL CAR TECH STACK.

We are in control over the tech stack across domains and layers – for several generations already.

Cloud and edge

GEN 3

OFFBOARD

Connected Platform

> Software applications. Functionality and features

> 22 million BMW Group vehi connected to BMW Cloud.

ONBOARD

Software platforms. Operating system and middleware

Shared Service Layer. Standardized functions, diagnosis, upd security, data management, etc.

¹ UI: User Interface. ² ADAS: Advanced Driver Assistance System.

³ CPU/GPU: Central Processing Unit / Graphics Processing Unit.

Hardware.

Infotainment	ADAS 27 100 74 14 12	Driving / Body
	BMW / M / MINI / RR UI ¹	GEN 6 3 3 3
Journey services GEN 3	Driving assistance GEN 3	Vehicle functions GEN 4
Infotainment OS GEN 6	ADAS OS ² GEN 3	Driving OS
	Al Core on the edge	
	Remote Software Upgrade	GEN 2
	Crowd Data Collector	en en la
	Automotive Security	GEN 3
		Miara Controllar

RAPID COVERAGE OF THE PRODUCT RANGE: REALITY = PLAN.



We reliably deliver strong: Launching new products and developing the future simultaneously.







All-new MINIs All-new Rolls-Royce



BMW iX

OVER-THE-AIR (OTA) UPGRADE.

Upgradeability as essential enabler to keep the whole fleet up-to-date and secure.

LARGEST OTA FLEET

8+ M. and counting

45+ models **3** brands (BMW, MINI, RR)

ALWAYS FRESH (over-the-air)



20 min installation time 120+ upgrades: features and quality improvements (since 2019)

ALL FUNCTIONAL DOMAINS

ALL POWERTRAINS







SOFTWARE: GENERATIONS VS CONTINUITY.

Evolutionary, scalable platforms are essential to enable software continuity and re-use.





Increasing effort across generations with increasing code size ... New supplier constellations bring new hardware platforms with new semiconductors.

vs BMW GROUP TODAY



... continuity and reuse of software. ... evolution of hardware & semiconductors. Stronger reliance on de facto standards and open ecosystems.

MODULAR AND STABLE HARDWARE PLATFORMS ENABLE SOFTWARE CONTINUITY.

COMPACT

In hardware ...

Both are of utmost importance to allow for scalability across brand and product portfolio.

... and software

Image: Width of the second second



DIGITAL FOUNDATIONS. THREE ESSENTIAL ENABLERS FOR THE SOFTWARE DEFINED **VEHICLE.**

ONBOARD PLATFORM



SW Platforms for Infotainment, ADAS & **Body/Drive.**



OFFBOARD PLATFORM

DEVELOPER TOOLING



*= —





Connectivity backend, **3rd party** integration, **OTA** upgrades and operations, data-driven development.



Processes, methods & tools to enable state-ofthe-art SW development & maintenance.

Already today, these layers build the foundations for a stable ecosystem.

In future, we expect even more complex requirements, and need state-of-the-art software platforms and tooling in order to develop upcoming functionality more efficiently.

IT'S NOT JUST ONE AUTOMOTIVE **OPERATING SYSTEM.**

We are running three main software platforms for Infotainment, ADAS and Driving/Body.

Android Open Source Project

- **Performance**-functions with 3rd party ecosystems. Performance POSIX SW-Platform based on Linux / AOSP*.
- Open-source.



- Performance safety-functions for driving assistance.
- Safe POSIX SW-Platform based on QNX.
- Commercial modular solution.
- **Real-time-functions** for engine and chassis regulation. OSEK SW-Platform based on Classic Autosar.
- Cross-OEM standardization.

SOFTWARE PLATFORMS

DEVELOPER TOOLING: BMW SOFTWARE FACTORY PROVIDES GLOBAL DEVELOPER ENVIRONMENT.

Enabling independent contributions from our global developer network.

- Harmonized processes and methods for state-of-the-art software development across all BMW Group departments.
- Professionally operated software toolchain – stable and performant, operating on AWS.
- Growth from coverage of all onboard projects to include our offboard content.



CUSTOMIZED AND 'HANDCRAFTED' TOOLCHAIN GREW RAPIDLY.

Enables delivery of increasing and more complex software – across domains and regions.

CODECRAFT REALIZED A GLOBAL S DEVELOPMENT ENVIRONMENT FO

PR



SW DR B	MW.	<u> </u>	CODECRAFT DELIVERS SCA	LABILITY		
IECT	DEVOPS -	DEVOPS -		2015	2024	
MT.	AUTOMATION, MONITORING	BACKEND DEPL. & STATUS	# builds per day	~ 2.5k	~ 150k	
			# jobs per hour	~ 150	~ 14k	
	Ş	1	# CPUs in use	~ 1.0k	~ 75k (virtual)	
Amazon EKS			50-100x performance in 10 years, enabling	75% error r (SiL) via shift to Cl		
	C opens	stack.	20 min feedback cycles reliably, despite	200x SW platfor (previous se	m complexity ction).	

BMW TOGETHER WITH PARTNERS HAS INITIATED A PUSH WITHIN ECLIPSE SDV TO JOINTLY DEVELOP AN AUTOMOTIVE GRADE SDV CORE STACK.

THREE JOINT WORKSTREAMS WERE SET UP.

01

Technology

Experts discuss technology of the full stack in workshops and create a map of modules and contents of the full stack.



02

Process

Expert and lower mgmt. create an alignment on how to do safety in the open source space (incl. tools, formats and methods).

03

Business

Business and series development meet to ensure a valid business model for the full stack.

DEVOPS HUBS PLAY PIVOTAL ROLE IN OUR AUTOMOTIVE SW DEVELOPMENT NETWORK.



O Mountain View

SW hubs set up as JVs with local partners designed to enable speed, productivity, and SW tech culture.

And to leverage the best talent.

EOY 2024 figures



2018 Critical Software

- Portugal: Lisbon, Porto, Braga
- \sim 2,850 employees¹
- Automotive SW for global, Digital Company DevOps



2021 **ISA BATechWorks**

- China: Nanjing
- $\sim 640 \text{ employees}^1$
- Automotive SW for China & global

2024 BMW TECHWORKS INDIA

- India: Pune, Bangalore, Chennai
- JV announced in 04/24 in build-up
- Automotive SW for global, Digital Company DevOps

CRITICAL TECHWORKS HAS BECOME THE LARGEST SOFTWARE **COMPANY IN PORTUGAL.**

Furthermore, Critical TechWorks acts as blueprint catalyzing our China & India hubs.

Source: Teamlyzer







THE WORKING MODEL BETWEEN OEM AND TIER-1 CHANGES.

From 'contracting entity' to 'owner and integrator': OEMs need to embrace their new role, since a fundamental change takes place in the automotive ecosystem.

Classical ecosystem with ,traditional' roles



ECU Supply / Integration

2nd Tier Semiconductor

Fully colored: always involved
 Lined: partially involved



CONSUMPTION AND EMISSION DATA.

BMW i5 M60 xDrive.

Energy consumption in kWh/100km WLTP (combined): 20.5 CO₂-emissions in g/km: 0

CO₂-Class: A

BMW X3 m50 xDrive.

Energy consumption in I/100km WLTP (combined): 8.3 CO₂-emissions in g/km: 189

CO₂-Class: G

MINI Cooper Countryman.

Fuel consumption in I/100km WLTP (combined): 9.8 - 9.6CO₂-emissions in g/km: 223 - 218

CO₂-Class: G

BMW X2.

Fuel consumption in I/100km WLTP (combined): 8.3 – 7.7 CO2-emissions in g/km: 189 – 175

CO₂-Class: G – F

BMW XM.

Fuel consumption in I/100km WMTC: 4.9 CO₂-emissions in g/km: 113

BMW iX1. Fuel consumption in I/100km WMTC: 4.9 CO₂-emissions in g/km: 113

BMW iX xDrive40. Energy consumption in kWh/100km WMTC: 20.2 CO₂-emissions in g/km: 0 CO₂-Class: A

CONSUMPTION AND EMISSION DATA.

BMW i5 eDrive40.

Energy consumption in kWh/100km WLTP (combined): 16.3 CO₂-emissions in g/km: 0

CO₂-Class: A

BMW 530e xDrive Limousine.

Energy consumption in kWh/100km WLTP (combined): 15.4 – 14.1 CO₂-emissions in g/km: 49 - 46

BMW i5 M60 xDrive.

Energy consumption in kWh/100km WLTP (combined): 20.5

CO2-emissions in g/km: 0

CO₂-Class: A

CONSUMPTION AND EMISSION DATA.

MINI Countryman SE ALL4 Essential Trim.

Energy consumption in kWh/100km WLTP (combined): 18.5 CO₂-emissions in g/km WLTP (combined): 0

CO₂-Class: A

BMW R 1300 GS Trophy.

Fuel consumption in I/100km WMTC (combined): 4.8 CO₂-emissions in g/km: 110

Rolls-Royce Spectre.

Energy consumption in kWh/100km WLTP (combined): 21.5

CO2-emissions in g/km: 0



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