

Driving Automotive Innovation

Cloud-Powered SDV Infrastructure for the Future of Mobility

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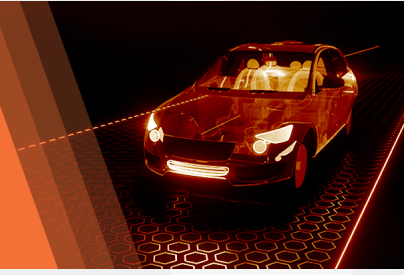
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1 Mobility: Transformation at all levels

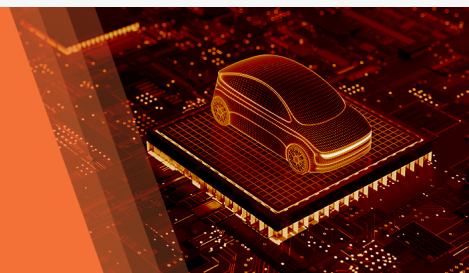


We find ourselves at the crossroads of innovation, sustainability, and social progress, calling for a fundamental shift in how we conceptualize and navigate the movement of people and goods. The industry is going through the transformation of a century and is reimagining mobility as more than just a means of getting from point A to point B. It is a complex ecosystem, intricately intertwined with our daily lives, economies, and the very health of our planet. By embracing a holistic perspective, we can unlock a future that seamlessly integrates cutting-edge technologies & sustainable practices, leading to enhanced accessibility, improved efficiency, and a higher quality of life for all.

The accompanying changes are so significant for our future mobility that OEMs and Tier 1s worldwide are facing massive challenges and are forced to rethink their business models and ways of working. The vehicle manufacturers are looking at means to enhance the overall experience for the user. They are moving from a 'sell it and forget it' model to a more 'continuous engagement & enrichment' model.

Digital technologies are helping vehicle manufacturers to create the 'Software Defined Vehicle', which can help them to **continuously enrich & engage with the customer**. With the SDV, the vehicle is considered more of a digital platform with experiences & services to help engage customers better.

2 The Software Defined Vehicle is the future



Software Defined Vehicle is a broadly used term. An SDV comprises mechatronics components, sensors, compute units, zone and functional controllers supported by a high speed and safety-critical network backbone, and a unified and integrated software system with multiple components, supported by a cloud-based digital ecosystem capable of complete lifecycle management of the SDV as a product.

This transformed vehicle will provide the foundation for OEMs to provide competitive and differentiable user experience with an always up-to-date and upgradeable feature set throughout its usable life, as expected by customers in today's age. It also enables various streams of revenue from value added content and services throughout the life of the vehicle.

An extremely lucrative billion-dollar market has emerged with the SDV, with the OEMs expanding into new services and features in areas such as mobile entertainment, healthcare, smart home, digital working, and much more. In the coming years, many new offerings and innovative solutions will be added, but the foundation platform is being created today in the form of service-oriented architectures and scalable automotive platforms, etc. For this new market, OEMs & Tier 1s are looking for partners with chip to cloud expertise and experience in SW services business models. They need experienced software specialists who are willing and able to react as quickly as possible and break new ground with a great deal of foresight, courage, and creativity, but sometimes also with perseverance. By focusing on integrated edge (in-vehicle), cloud & data offerings, and leveraging expertise in SW service business models from other industries, GlobalLogic is helping OEMs and Tier 1s with this once in a century transformation of the mobility industry.

3 The challenge of software integration at scale in the automotive industry

Software and Mechatronics are the basic building blocks of an SDV, with even the basic functions being controlled by software. This transformation has created a completely new challenge in terms of development, integration, and lifecycle management of numerous software components for an industry that is, traditionally, proficient in managing and assembling thousands of hardware components. New, efficient methods must be devised to tackle this challenge. Some of the underlying challenges are listed below.

3.1 Inefficient quality management of software products

The legacy quality management processes and infrastructure of software products do not measure up to the new requirements of an SDV and exponentially growing amount of software. In recent years, the efforts of OEMs and Tier 1s to develop suitable solutions themselves have led to a clearly fragmented patchwork of 'new-meets-old' solutions and have tended to hinder software development in the automotive industry as a whole instead of advancing it further. No wonder, then, that most OEMs today struggle with realizing the potential of software to create additional value to the clients, as they are battling with that complexity.

3.2 Problem identification in the later phases of software development

Issues discovered during the late stages of product development due to insufficient or inadequate requirements or software integration can lead to financial losses due to launch delays and reworks. The identification of issues later in the SW development lifecycle leads to a very expensive change management process, potential product launch delays, and lower customer satisfaction.

3.3 Expanding the domain-specific software development to include fully integrated software defined vehicles

In recent years, OEMs have increased in-house software development and integration for certain domains, largely in Digital Cockpit and partially in ADAS.

A true software defined, fully networked vehicle will provide distributed and redundant computing space for mission critical applications, requiring the complete vehicle software to be developed as a unified, integrated product of various software components with strict version control and change management process. In this journey, OEMs face significant challenges without comprehensive agile development methodologies & tools. Industry has some of the best-in-class agile solutions for specific domains, but the solutions almost always lack the potential for reusability

3.4 Globally distributed internal & third-party teams

The development of the SDV platform(s) needs expertise at a scale which cannot be supported by talent in a specific geography. Hence OEMs and Tier 1s are setting up global teams to support the development. Based on our recent conversations with OEMs, we foresee 85% of the SDV apps & services coming from the third-party ecosystem. Hence, the third-party ecosystem needs to be engaged at a scale never seen in the automotive ecosystem. At the same time, the supply chain constraints limit the number of actual hardware that can be shipped to remote teams for the development lifecycle. Hence, a quickly scalable, configurable, HW-agnostic development framework is needed to quickly engage & make global teams productive.

In summary, we foresee cloud-based frameworks playing a pivotal part in the development of complex SDV platforms. With the support of an experienced software partner like GlobalLogic, the transformation is not witchcraft, as GlobalLogic already has both rich Cloud Expertise and Partnerships and SDV Cloud Accelerators to help with that transformation. GlobalLogic is enabling such cloud-based platforms through multiple OEMs that leverage their know-how in cloud expertise and enable such development infrastructure for multiple industries.

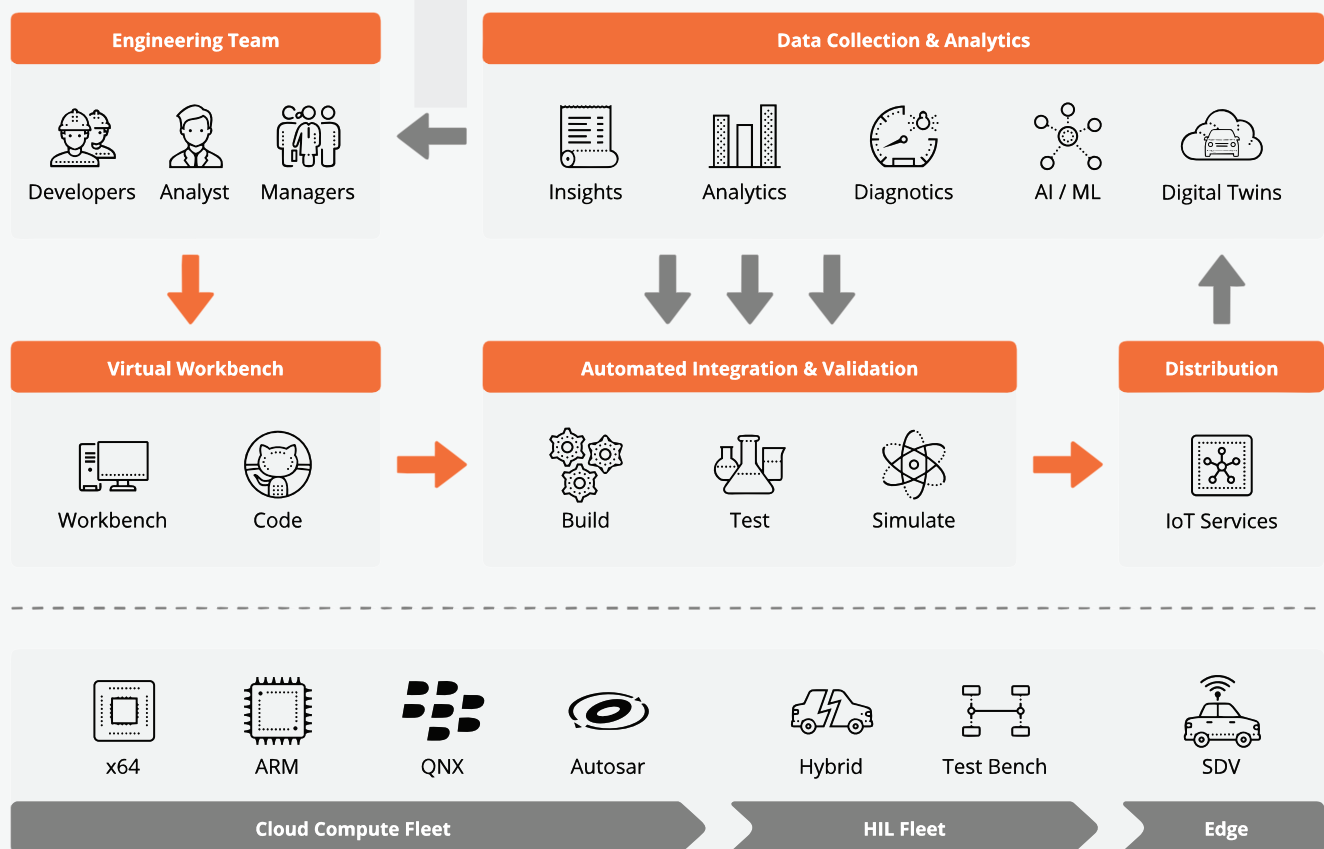
4 The SDV Cloud Framework: standardized software development and quality management



To address the challenges highlighted in the previous section, GlobalLogic has developed a cloud-based engineering workbench framework for the development of SDV applications.

GlobalLogic's SDV cloud framework is a highly flexible, scalable infrastructure with a broad pool of relevant tools and services. These are individually tailored to the needs of each user or a specific task, as this is the only way OEMs and Tier 1s can effectively use existing systems, sustainably streamline processes, and align their software development with the new SDV principles. To this end, GlobalLogic's SDV framework includes:

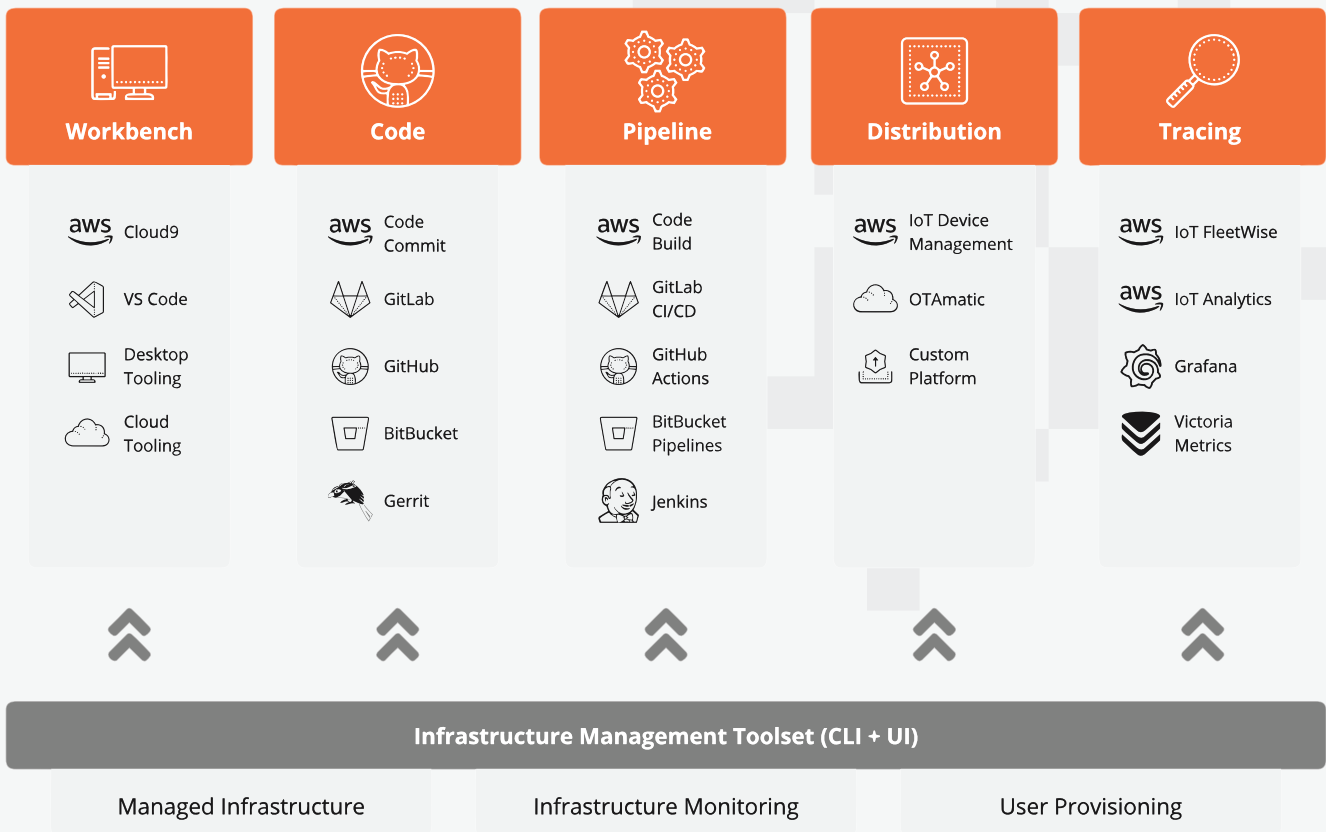
- Highly-modular Deployment Kit to build the Customer-Oriented Infrastructure
- Cloud Development Environment ready for automotive software development
- Quality Maintenance Services to cover ASPICE Software Integration and Qualification
- Integrated Data Lake to ingest and analyze IoT data collected from the ECUs



GlobalLogic works with individual customers to understand the specific product applicability, relevant processes, and existing toolsets. Subsequently, GlobalLogic leverages the SDV framework to design & develop a specific solution for the customer and then manages/maintains the solution going forward.

4.1 The Integration-enabled SDV infrastructure deployment

The individually configurable Deployment Kit forms the central backbone of GlobalLogic's SDV Cloud Framework. It was developed as a central orchestrator for the complex SDV development processes. The Kit allows us to build compatible to each other development environments on different levels of the end product creation process, ranging from drivetrain applications to infotainment and much more.



Furthermore, the Deployment Kit includes specific templates for various processes — from source code handling to complete integration with Autosar Adaptive or custom ecosystems. Thus, the framework can be easily integrated into legacy solutions, custom automotive ecosystems, systems of ECUs, and even into the development of individual ECUs. On this basis, automotive companies can build great-quality SDV software and enable traceability to requirements on all levels.

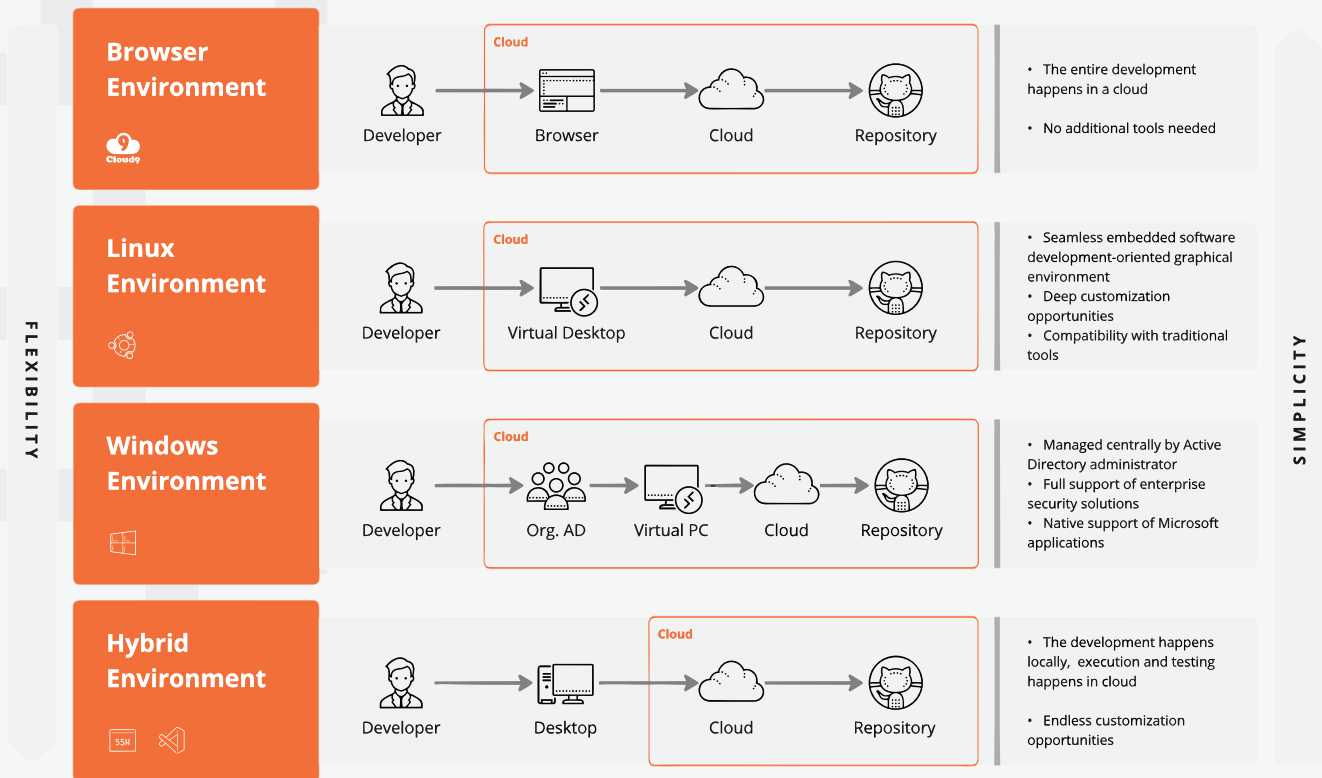
Because the Kit is based on Terraform, a popular open-source infrastructure-as-a-code software tool, it is particularly robust. As a result, automotive manufacturers and OEMs can effortlessly migrate from a domain-dependent approach to a product development process that includes both hardware and software components.

With the modular development kit, GlobalLogic also offers an optimized approach to managing changes and configurations. This significantly shortens development cycles and reduces the number of change requests. It also improves collaboration between component owners and departments across the enterprise, resulting in more transparent testing strategies and easier product certification.

4.2 Automotive software development-ready Virtual Workbench

Vehicle Software Platform development is multifaceted. Depending on the environment and stakeholders, various tools are essential. In the Foundation Platform software environment, the QNX Software Development Toolchain is prevalent. For safety-critical software, the environment leans towards the Autosar toolchain, while the Nvidia Cuda toolset is the go-to in the ADAS algorithms development environment, among others.

To address it, the SDV Virtual Workbench is a highly scalable and customizable platform, which supports different software stacks, programming languages and development tools, enables automotive manufacturers and OEMs to develop their applications in a high-performance virtualized environment.



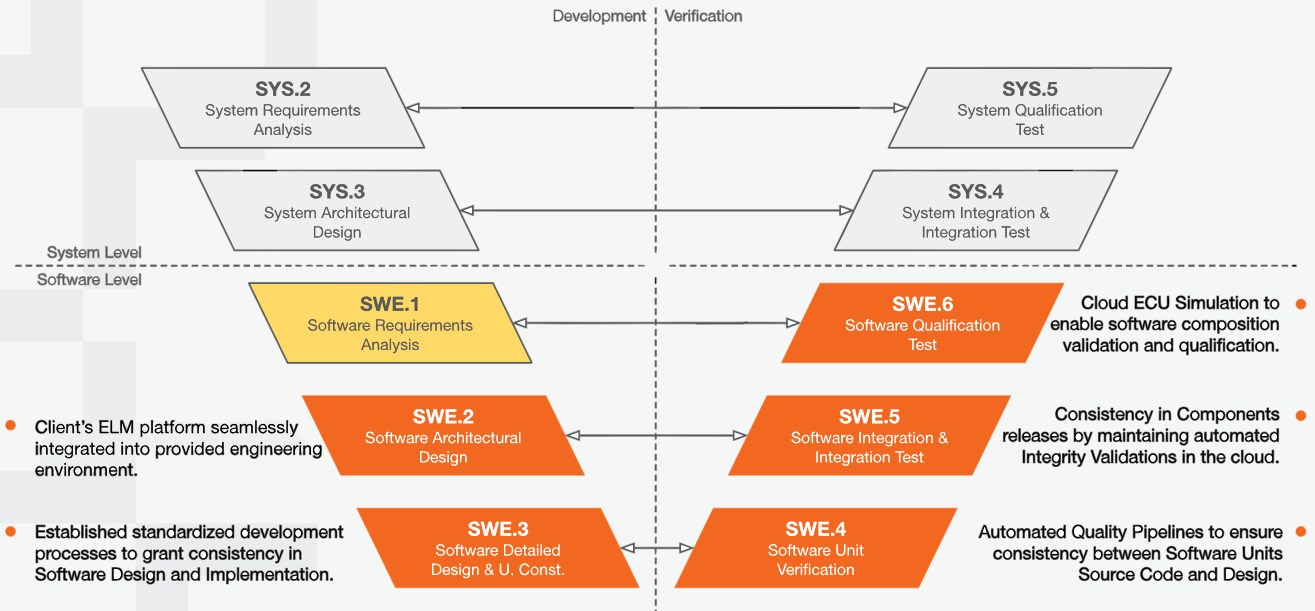
Developers are also provided with an intuitive user interface where they can collaborate, share code, and manage their projects. It means that, virtually any software application or services can be written, tested and integrated to an SDV system. This approach has a key advantage for automotive manufacturers: they can use the same executables for different test levels.

Besides that, developers' virtual environment may be pre-installed with all security protection software to correspond organization safety standards and enable seamless interaction with the private networks. It allows easy collaboration on proprietary source code, vehicle requirements and enables access to op-premise test-benches and HIL environments.

4.3 Integration & Validation services to enable ASPICE Software Integration and Qualification

As described at the outset, the increasing dominance of software functions has presented the automotive industry with enormous challenges. In fact, the quality management systems of many OEMs and Tier 1s are strained by the new technologies, as the actual software development processes were fragmented in many places and characterized by 'home-grown' isolated solutions.

The SDV framework now fundamentally changes this situation, as GlobalLogic develops specific templates that set up QA processes according to the industry best practices and enforce relationships between individual product parts. As a result, the CI/CD process no longer depends on the development, manufacturing, or integration of the hardware platform, because software development and testing can now be performed in a fully virtual environment. This gives users a comprehensive understanding of their system architecture and removes rigid dependencies on the development and manufacture of the hardware platform, as well as its integration in the CI/CD process.




The mentioned GlobalLogic Framework component was specifically designed to support ASPICE SWE.4, SWE.5 and SWE.6 Software Quality Assurance processes which result in a much faster and easier audition and certification process for OEMs and Tier 1s.

4.4 Integrated Data Lake to ingest and analyze IoT Data


For SDV software development, GlobalLogic relies on automotive-specific analytics and distribution services that enable manufacturers and OEMs to collect and analyze both vehicle and user data from myriad interfaces and sensors. Based on this, intelligent IoT decisions can be made and cloud-based vehicle diagnostics can be used to perform fault analysis that can accelerate problem identification and even predict market trends. It will also be possible to update and customize each vehicle with the latest applications over-the-air using dedicated configuration management.

Think of the solution as a special, secure bridge. Just like how a bridge enables cars to travel back and forth between two points, our solution allows data to travel between your car and a cloud. Similarly, if there are important software updates that your car needs, the cloud sends this information back over the bridge to your car. This two-way communication ensures that your car stays up-to-date and performs optimally while also sending useful data back for analysis.




The SDV Framework

Technical Features




Over-the-Air Updates Made Easy

Seamlessly update and improve vehicle software with over-the-air technology. Stay innovative.




Unlock Cloud-Powered Fleet Management

Efficiently reuse software across different models.



Experience Rapid Transformation

Swiftly develop vehicle applications with GlobalLogic's integration and infrastructure services.



Customizable Infrastructure, Infinite Scalability

Tailor-made infrastructure with Workbench, CI/CD mechanisms, and Analytics & Distribution services. Utilize user information to improve your products.

5

GlobalLogic's SDV Cloud Framework redefines automotive software development



In summary, GlobalLogic's SDV Cloud Framework helps address some of the challenges in the development of an SDV platform & associated applications.

The template-based development environment provides OEMs & Tier 1 suppliers with the ability to create a development environment tailored to individual company's processes and toolsets. In addition, the integration of data cycles provides early feedback to the development team to improve the product. This enables **holistic quality management** of the SDV products since organizations align the framework to their existing tools and there is minimal resistance to change and holistic adoption of the SDV development principles helps with this.

The SDV workbench on the cloud and the virtualized development environment enables all component teams of the SDV product to be in the same development environment, enabling **early identification of issues** in validation cycles which are not completely dependent on vehicle/integration benches to uncover issues.

The development cycles of all component teams (including third parties) are completely aligned, which results in a true scaled agile product development and moves the automotive development lifecycle from a domain-based approach to a **truly SW defined development approach**.

The easily configurable template-based approach & HW agnostic cloud-based environment helps creation of customized user groups to quickly on-board global teams and make them productive in an accelerated manner.



The SDV Framework

Business Values

Shorter time to market

- Standardized development processes reduce errors and rework.
- Cloud-based collaboration enables early problem identification and rapid response to market changes.
- Virtual development environments enable faster iterations and testing.

Improved quality and lower costs

- Feature pipelines in cloud frameworks ensure timely product quality.
- Shared quality pipelines improve collaboration and communication and reduce costs.
- Complex testing on virtualized ECU simulation clusters reduces costs and simplifies change management.

More business opportunities

- Modular and flexible architecture enables tailored SDV solutions for customer needs.
- Support for fast and easy scaling of SDV infrastructure.
- Adaptability to changing market conditions and automotive industry requirements.

Contact us

Would you like to learn more about GlobalLogic's SDV framework or are you looking for a competent partner in the field of automotive software? Our SDV experts will be happy to provide you with advice and assistance at: <https://www.globallogic.com/de/contact/>