"Virtualization should be considered a business case with a clear return on investment"

Steve Hubbert, IPG Automotive GmbH

Virtualization has long moved beyond being a technical tool – it is a strategic success factor for efficiency and quality. In this interview, Steve Hubbert, Lead Consultant at IPG Automotive, explains how companies can integrate virtualization into their processes in a holistic way, and why long-term success depends on a clear business case.

This interview was conducted by Henning Kemper, Senior Specialist Editor, IPG Automotive GmbH

Could you briefly introduce yourself and your area of work?

Hubbert: Of course. I have been working in the automotive industry for 20 years, focusing on embedded systems, driver assistance systems, vehicle dynamics control and virtualization.

As Lead Consultant at IPG Automotive, it is my task to establish virtualization as a strategic element across the entire V-model process, rather than just as a tool. In other words, I support companies in establishing and utilizing simulation in a holistic and effective way.

What are the key trends and challenges facing vehicle manufacturers and suppliers in connection with virtualization, and why are these topics particularly relevant today?

Hubbert: Trends such as the growing diversification of vehicle architectures lead to more sophisticated methods, models and infrastructure while simulation applications are becoming more complex as they increasingly cover the overall vehicle with its interconnected functions. The issue is not a lack of competence or infrastructure, but a misalignment in how existing capabilities are used.

That's where our consulting services come in. We help companies drive their virtualization strategy, for example with a clear digital development roadmap. We shorten development times for them by enabling early, quick simulation and creating a seamless infrastructure, and ensure that they use the full capabilities of simulation through holistic testing strategies and efficient virtual validation. Finally, we maximize the coverage of applications by setting up virtual prototypes, supporting the transition to virtual development and expanding test coverage.

What, would you say, are the main reasons why in many companies virtualization is not being established as fast and efficiently as it could?

Hubbert: The reason why the establishment of virtualization is often sluggish is that basic requirements are not met. Many companies primarily see simulation as a way to cut costs, rather than a strategic investment. In reality, however, simulation initially requires effort and resources, such as infrastructure, tools, know-how and clear processes. Without detailed planning and precisely specified requirements, the utilization of simulation remains uncoordinated and does not yield the desired results.

Another reason for the slow adoption of simulation lies in the not yet fully attuned mindset: Virtualization must be an intrinsic part of an organization and its projects rather than a technical afterthought. Scattered skills, silos and a lack of central coordination lead to the creation of inefficient special solutions that are unsuitable for scaling. Doubts about feasibility and a lack of trust in the results add to this.

In your experience, what organizational and methodological adjustments are most important to successfully implement virtualization?

Hubbert: Apart from having the right organizational conditions, focusing the mindset on virtualization is key, which requires a consistent focus by the management: Virtualization must be part of the company's vision, backed up by quantifiable objectives, down to a working level. It must be seen as an operative goal, not just a technical element, covering all the processes, roles and structures that you have in traditional development.

This includes developing teams with experience in virtualization, interdisciplinary project teams, training and up-skilling strategies, standardized virtual process and tools with a low entry threshold. Virtualization must be the only way of ensuring a project's success because fallback levels jeopardize the success of the transformation. This also includes a continuous appraisal and development – after all, technologies and requirements are ever-changing.

What you need is a holistic organizational approach with a clear roadmap that takes into consideration both technical and human factors. Building a virtual development approach is a disruptive process, which is why it is mainly a leadership task.

Do the requirements and strategies vary between different markets – for example between China and Europe, or between the passenger car and the heavy-duty vehicle markets?

Hubbert: Yes, we do have to make distinctions here. Long-established companies have a great deal of experience and skill, but they also struggle with high costs, complex structures and slow change processes. Young companies, particularly in Asia, start with low costs, high resource availability and the possibility to build structures from scratch. They adopt best practices, combine these with their own ideas and act with impressive speed – based on a mindset that allows trial and error. Established companies often err on the side of caution. They think that consistently playing to their strengths and investing into the future are key, rather than focusing on cutting costs above all else.

This is where IPG Automotive's consulting services come in: Thanks to our global network, we have our finger on the pulse of the markets and add value for all target groups. We combine our experience in conventional industry with an in-depth knowledge of emerging market strategies. Established companies can benefit from our ability to identify virtualization investment opportunities that boost efficiency and quality through tailored technologies, methodologies and process solutions. Young companies can benefit from our ability to identify a strategy to build competences and processes.

What would you describe as the key factors to ensure that virtualization not only saves costs, but also provides a noticeable added value in terms of development and product quality?

Hubbert: There is a common misconception, especially among senior management, that simulation will immediately cut costs. This seems plausible, but is oversimplified, and it's one of the reasons why virtualization is progressing more slowly than technology would allow. To start with, simulation is an investment into methods, tools, processes, qualification and licenses. Savings will not be generated until the infrastructure is consistently utilized, in other words once physical tests have been transferred into the virtual world, automated and scaled. Only then can the number of real-world prototypes and test drives be reduced, development cycles be accelerated and the software quality be improved through earlier, broader test coverage.

So virtualization should be considered a business case with a clear return on investment. Its added value consists in a realistic appraisal of cost structures and savings potential. External consulting services can help do that. Our consulting team is as familiar with the investment and cost aspects as with

business case analyses and ROI calculations – based on in-depth industry experience.

You just mentioned test coverage. How can this be maximized through virtualization?

Hubbert: Simulation offers varied use cases along the V-model: From faster function modeling and verification to tests at different integration levels down to system integration, application and homologation. In the top right hand part of the V-model, using real-world prototypes in physical tests is particularly expensive. That is why this is the area with the greatest potential for an efficiency increase by transferring tests to the virtual world.

Each use case requires a definition of an ideal test environment and an end-to-end solution. Two factors come into play here: The suitability of models and environments for the specific use case, and adequate methods for processing the results. Models have to simulate physical and logical behavior with suitable accuracy – in line with clearly

defined requirements. For all of this to come together, you need structured plans, measurement campaigns and automated analyses. Objectivization is also important as it replaces subjective feedback and ensures that the supreme discipline – fine-tuning – can complement the full vehicle simulation or support the preparation.

Automating test cases and analyzing them are the key for wide coverage and efficiency. Simulation is an investment that builds on scaling and repetition.

How can companies strike the right balance between cost control and quality in the face of fewer physical prototypes? And where can consulting services help here?

Hubbert: Many companies initiate their research and development activities in order to cut costs, with the focus generally lying on reducing the number of real-world prototypes. The management then often directly transfers these specifications to Tier 1 levels without having a clear roadmap for a joint virtual development, integration and validation. A lot of companies simply aren't prepared and lack central coordination. Limited budgets and new working methods are met with resistance – often because there is a lack of know-how and trust, or the fear of job cuts. But simulation, if employed properly, not only boosts efficiency, it also creates new job opportunities. It is clearly one of the most important tools for OEMs and tier 1 suppliers to counter cost pressure and competition from dynamic markets.

The challenge lies in reducing budgets while creating a foundation for a switch to virtual development in the long term. It is the only way of ensuring quality with fewer real-world prototypes – and even increasing quality. The costs of recalls and quality issues show that late physical integration costs more than investing in novel technologies. Subjective impressions from application and attribute development must be complemented with objective, virtual methods such as mathematical models, AI approaches and driving simulators, and even vehicle-in-the-loop systems. These solutions are less expensive, more flexible and more sustainable than real-world tests. Our consulting services have the necessary field experience to support this kind of transformation.

In your experience, what are the typical obstacles such projects face, and how do you help overcome them?

Hubbert: In addition to strategic success factors, it is important to implement projects in practice and to prepare a plan early on. Project teams need to define the scope and the objectives of a simulation application, commission models and tool chains, and to coordinate budgets. Ideally, this should be done across the disciplines. Missing this step means not creating the basis for efficient virtualization. Organizational and technical aspects are equally important: Roles, regular meetings, milestones, correlation and the verification of suitability must be planned, models must be integrated and test cases must be automated. Many companies

lack systematic approaches to connect conventional with virtual methods.

Often, obstacles are identified quite late in the process, but their causes go back to strategic framework conditions such as mindset or organization. When it comes to implementation, processes, communication and requirements management are essential. If results are not properly processed, documented and integrated into release processes, problems even arise when the preparation has been thorough. Typical root causes of problems include a lack of integration, insufficient communication or unclear expectations. Virtualization requires an end-to-end strategy and a holistic approach that also takes into account the human factor.

One of the greatest pain points of the automotive industry is the quality of software. How can methods and processes help optimize software quality early on while shortening development times?

Hubbert: To prevent high costs for subsequent performance issues or recalls, testing must be carried out early on, and it must be smart and automated. Concepts such as front-loading and shift left transfer testing to earlier phases and onto lower integration levels. There are two decisive factors: The first one is modular software with a clear architecture, interfaces and documentation as a basis for efficient tests. The second one is a well-thought-through testing strategy, where tests are assigned to the simplest environment which provides results

Steve Hubbert (left) in conversation with Henning Kemper

at an early stage. Approaches such as model-based development, systems engineering and targeted test environment management are essential here.

Test environments range from MIL, SIL and HIL to VIL. Especially when it comes to SDV architectures, virtual ECUs are becoming increasingly important, and coordination between OEMs and suppliers becomes essential. For each test, there is an ideal integration level at which costs and complexity are at a minimum. Robust processes and methods are vital for managing such complexity and to fully benefit from the potential that simulation has to offer.

What preconditions must be met to make simulation suitable for the full vehicle rather than just individual domains?

Hubbert: There are many different approaches to simulation in the automotive industry which vary depending on the domain, system and function in question. Most of them use commercial tools, but there are also many that use bespoke solutions. Each of these options has its own advantages and disadvantages when it comes to cost, effort and flexibility. Both options use strong specialization with models that are rarely compatible and high costs and complexity of changing test cases and models – especially between one company and another. In most cases, vehicles are not considered as full digital twins, but simply as integration platforms for individual domains.

The crucial step is building a powerful virtual full vehicle, which requires technical and organizational innovations, such as the standardization of environments, interfaces or infrastructure, and the adaptation of model complexity to the use case in question. It also takes cloud-based integration platforms, data and variant management, clear access rights and IP protection, automated model deployment and cloud-based simulation implementation for both internal and external users. This is the only way of replacing expensive individual local solutions with complete virtual prototypes.

When applied to models, this means improved architectures and quality and a broad range of applications from simple vehicle dynamics to closed-loop system integration for applications, release and homologation. It also includes real-time capable models, extensive test case libraries as well as tools and methods for proving correlation and credibility.

The credibility of simulation results for homologation is a controversial topic. How can this be ensured?

Hubbert: For OEMs, homologation is key because it ensures market approval. Legislators and test organizations work together with the industry on establishing virtual tests more firmly – this includes the drafting of specifications for correlation, model validation and data handling. Simulation can be applied in many different ways, but the regulatory processes are often slow, or only cover the smallest common denominator, which limits its potential.

Looking at it objectively, homologation is simply one use case among many. The preconditions – quality of the model, credibility, scenarios – are similar to those for virtual full vehicle development, meaning that OEMs and suppliers have to systematically develop methods and tools. IPG Automotive supports this process with solutions such as the UTAC Scoring Set, which covers various scenarios and evaluation methods. Even though there is no legal obligation to meet NCAP criteria, the method is similar to the UN regulation No. 171 on Driver Control Assistance Systems (DCAS). Based on tried-and-tested approaches, our consulting services also help with further homologation disciplines such as vehicle dynamics, emissions and endurance tests.

Finally, how can customers benefit from your experience with numerous projects involving different vehicle manufacturers and suppliers? And what distinguishes IPG Automotive's consulting services?

Hubbert: Thanks to a global customer network across all relevant virtualization domains, IPG Automotive is familiar with the industry's use cases and strategies. Our consulting team combines industry experience and technical expertise with methodological and strategic consulting, creating an interface between customers, sales and engineering. This allows us to provide effective support with introducing virtualization.

Thank you very much for taking the time for this interview.