Virtual product development in the Digital Engineering Center: Greater innovative capacity through interdisciplinary organization and automation

Christopher Woll, GNS Systems GmbH

Abstract

While the traditional development cycle of "design-build-test" often lasted several years, today it is imperative to bring innovations to market readiness with simulation-driven design and digital twin in shorter time spans. Virtual tests on vehicles make a significant impact in effectively reducing development times and costs. Companies must master two fundamental challenges for their efficient use: on the one hand, complex and time-intensive engineering tasks have to be mastered quickly. On the other hand, solutions are increasingly required that organise the complex product development across organizational units. The Digital Engineering Center, an engineering workplace in the cloud, meets these challenges.

HPC cloud solutions meet the demand for massive computing power quickly and reliably. However, on-demand access to "unlimited" resources in the cloud is often both a curse and a blessing. With cloud deployment, positive effects such as pay-per-use, reduced capital expenditure (CAPEX), greater business agility and higher quality results can be realised easily. Using efficient crash analysis tools like LS-DYNA in the cloud, on the other hand, is not trivial. Major bottlenecks are hidden in the planning as well as administrative activities - especially the lack of compatibility with existing IT structures and workflows.

Through its platform architecture, the Digital Engineering Center creates suitable interfaces to relevant applications in virtual product development such as LS-DYNA, pre- and post-processing tools and data management systems. As a continuous development environment, the engineering workplace ensures strong flexibility, low costs and high reliability in interdisciplinary product development. With the support of the platform, engineers collect simulation data, process it in a structured manner and evaluate it as required with the help of suitable AI tools. User-friendly workflows for each user group make simulation-based product development a reality in a few simple steps. This is possible through complete automation of the processes and the convenient integration of cloud-based or hybrid IT infrastructures into the entire development cycle. In the presentation, the experts from GNS Systems will show how the Engineering Workplace supports engineers with smart workflows and optimal computing performance to significantly accelerate simulation-based product development.

1 Introduction

Digitalization in industry and manufacturing is advancing steadily and changing market conditions, in some cases radically. In today's world of rapid technological innovations, customers are demanding products and integrated solutions that are always up-to-date and feature the latest designs and technologies - this is stated by PWC in its study "Digital Product Development 2025" [1]. As a result, the life cycles of established products are shortening. The traditional "design-build-test" development cycle, often over several years, is becoming obsolete. Companies are therefore responding to the desire for frequent product updates, incremental improvements and completely new developments with digitalized business processes and production environments.

This is also the case in digital engineering: digital tools, new agile development methods and automated processes play a major role in the increased efficiency and faster output of innovations in virtual product development. Simulation-based design and the digital twin, if used correctly, reduce costs and increase productivity. Key technologies such as the cloud, data analytics and AI-based solution design are already helping a wide range of companies to design products and integrated solutions that meet new market requirements. One of these solutions is the Digital Engineering Center from GNS Systems.

2 Digitalization of product development and design processes

The success of digitalized product development processes depends heavily on the ecosystem of the respective company. In a world of digital products, new skills are increasingly required from organizations: On the one hand, digital engineering must be able to solve time-intensive development tasks quickly and easily. This is often made possible by standardized processes and complete automation. Today's virtual product development applications have a high level of functionality and an enormous degree of maturity, but their capabilities are rarely exploited to the optimum: There is a lack of standards, rule-based systems and environments, and simply a lack of specific user expertise to establish automated processes. The basis for exploiting automation potential therefore lies both in the effective capture and reuse of existing processes and in the sustainable integration of engineering tools into the company's IT environment. Suitable methods then fulfill the goal of optimally integrating all systems into the product engineering process (PEP), interconnecting applications and thereby ensuring the necessary data consistency in product development.

In addition, skills that organize complex product development across corporate divisions are increasingly in demand. With advancing digitalization, the way of working in product development is changing. Collaboration is becoming increasingly relevant and includes internal cooperation as well as the joint development of products with external suppliers and customers. This development is also being promoted by agile methods such as DevOps and CI/CD. Particularly regarding the application of new technologies, this is hardly surprising: according to the IDC study from 2019 on the use of DevOps in Germany [2], the agile way of working is present in two-thirds of the companies surveyed. In particular, the increase in cloud-based applications in the development of new products makes DevOps the most important methodological framework for the rapid deployment of innovations.

The described change in digital engineering, and explicitly in virtual product development, therefore requires measures that successfully meet these challenges. It requires solutions that link tools and agile methods while fully standardizing underlying processes. As a powerful engineering workstation in the cloud, the Digital Engineering Center from GNS Systems meets these challenges.

3 High-Performance Computing in the cloud for highly complex analyses and simulations

Whether in the automotive industry, for weather forecasts or in medical research: more and more fields of application and development scenarios in almost every sector rely on high-performance computing (HPC). However, the demands on infrastructure, computing power and flexibility in high-performance computing have increased continuously in recent years. Big data analyses, machine learning and complex simulations, as well as the application of artificial intelligence, are drastically increasing the complexity of analysis, modelling and simulation. As a result, established HPC systems are processing ever larger volumes of data that can hardly be handled by on-prem solutions. Companies in all industries are therefore increasingly turning to HPC solutions in the cloud. In general, cloud computing has arrived in the industrial and manufacturing sector. According to the current Cloud Monitor 2021 by KPMG and Bitkom Research [3], four out of five of the companies surveyed already rely on the cloud. The focus here is on the advantages of performance, speed and flexibility. With the use of the cloud, positive effects such as pay-per-use, reduced capital expenditure (CAPEX), greater business flexibility and qualitatively better results can be realised easily. HPC in the cloud also does not require an in-house IT infrastructure; engineers benefit directly from the enormous computing power in the cloud.

Nevertheless, many companies still fail to set up the internal processes and integrate their workloads in the cloud. A 2019 study [4] by Vanson Bourne for Avanade confirms this "money-losing technology gap": companies often lack maturity in the cloud environment. Major bottlenecks are hidden in planning and administrative activities - especially in the lack of compatibility with existing IT structures and workflows. Consequently, the simulation time increases, innovations and market introduction times slow down considerably. In order for companies to nevertheless meet the new demands on the infrastructure for virtual product development, they need a reliable environment that, on the one hand, allows direct access to high-end resources in a technical ecosystem such as the cloud and, on the other hand, integrates all engineering functions and processes in a fully automated manner.

4 Constant environment for virtual product development

With the Digital Engineering Center in the Cloud - DEC for short - GNS Systems has created a development environment for CPU-intensive tasks in simulation and analysis that meets all engineering requirements. The architecture in Microsoft Azure also offers a valid solution for today's challenges of virtual product development.

Cloud-based simulation with DEC becomes an efficient and powerful element for engineers in their daily business. The hosted platform architecture provides on-demand central access to the services and data needed for complex simulations. Suitable interfaces provide the connection to relevant virtual product development applications such as LS-DYNA, pre- and post-processing tools and data management systems. Connection to an AI-based solution design also becomes a practical reality with DEC. DEC is accessed via secure remote access on a virtual desktop. The fully integrated development environment therefore optimally coordinates all systems in the product development process (PEP): it connects applications with each other and thus ensures the necessary data consistency in product development. At the same time, the connection to the cloud makes companies independent of limiting computing capacities, low bandwidths and expensive waiting times. The simple access to HPC resources in the cloud not only reduces the complexity of analysis, modelling and simulation, but also raises engineering as a whole to a sustainable level. Processes and workflows in virtual product development run without interruptions and much more efficiently with cloud HPC - an important plus in terms of greater productivity and faster results.

5 Manage engineering activities in a fully automated manner

Time-intensive tasks in product development often slow down the progress of innovations unnecessarily. The Digital Engineering Center can solve tasks quickly and easily. Repeatable IT processes and routine tasks in the cloud achieve a high degree of automation with the establishment of standards, rule-based systems and environments. This is made possible by the consistent use of Infrastructure as Code (IaC) and CI/CD principles. This enables the configuration of networks and virtual machines in the cloud to be deployed more quickly according to computing resource needs and project requirements. An integrated CI/CD pipeline then ensures a seamless continuous development flow in the areas of integration, testing, deployment and implementation.

This level of automation significantly eases the workload for developers by speeding up the infrastructure deployment process and increasing its consistency. This allows companies to make their production capacities more efficient and accelerate the entire development process. The DEC therefore allows workflows to be planned and managed efficiently with its fully automated environment in the cloud. Appropriately automated and standardised processes in turn reduce standby times and significantly shorten turnaround times.

6 Conclusion: Future-proof project handling in collaborative CAE processes - in a single place and for all workloads

The Engineering Workplace supports engineers with intelligent workflows and optimal computing power to significantly speed up simulation-based product development. DEC even creates ideal conditions for joint use in globally distributed collaboration teams. The joint development of products with suppliers and customers as well as cross-functional collaboration within a company is possible at any time via the connection of a virtual desktop. The cooperation and coordination of resources within a central architecture and platform creates synergies and thus accelerates complex simulation processes. The barrier-free access to projects and data drives innovation and helps companies in all sectors to shorten their time to market. The high flexibility and scalability of the required HPC resources in the cloud are essential for today's complex calculations in analysis and simulation.

The interdisciplinary organisation of a shared development environment in the cloud benefits from a high degree of automation of repeatable IT processes and routine tasks. For the rapid deployment of innovations, DEC integrates agile working methods such as DevOps. They not only enable more efficient and effective collaboration. Rather, this framework delivers high-quality results while shortening release cycles. The Engineering Workplace in the Cloud easily implements increasingly demanded agile methods and thus paves the way in the creation of innovative products for the ever-faster requirements of volatile markets.

7 Literature

[1] PWC: “Digital Product Development 2025 - Agile, Collaborative, AI driven and Customer Centric”, 2019

[2] IDC: „25 Prozent deutscher Unternehmen wollen bis 2022 die Hälfte ihrer Anwendungen mit cloudnativen Tools entwickeln“, Press release from February 17, 2020

[3] KPMG: „Cloud-Monitor 2021 – Die goldenen Zwanziger für die Cloud“, 2021, Page 5

[4] Avanade: „Drei Viertel aller Unternehmen mit Technologie und Cloud überfordert“, Press release from April 2, 2020