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The myth of the digital twin

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There are numerous myths surrounding real-life twins. But their digital counterparts are also the stuff of legend. And what does the research have to say about the potential they offer – for example the implementation of new business models on the basis of digital twins? Is the intelligence of the digital twin down to "genetics", in other words the corporate culture, or rather the result of the (PLM) environment? Karsten Theis, a member of the executive board of PROSTEP AG (Darmstadt, Germany), talks about the background to the creation of digital twins and the added value they bring to a new business experience.

Castor (bright light source on the left) and Pollux (significantly larger, on the bottom left) are the two brightest stars in the constellation of Gemini. Not only are Castor and Pollux close in brightness, but the line of stars trailing them have similar brightnesses as well and are also similarly positioned. So, it's pretty easy to understand how this constellation was named Gemini, or "the Twins". Castor, a conspicuous white star, is actually part of a multiple star system, some 52 light years from Earth. Pollux, an orange giant, is slightly brighter than Castor and about 34 light years away. Though they appear near each other in the sky and are nearly equally bright, they have no mutual influence on each other – which is not the case with a digital twin and its physical counterpart.

Source: epod.usra.edu/blog/2016/12/castor-and-pollux-in-gemini.html

Dr. Theis, has the lively debate about the digital twin benefited our understanding of PLM?

It is indeed the case that our customers have a lot to say about the digital twin and the various ways in which it can be interpreted. When we are talking, they often focus on the simulation aspect of the digital twin as a factor that contributes particularly to value added. But one thing I have noticed when it comes to the digital twin is that our customers are quick to talk about the Internet of Things and about IoT connectivity, but it doesn't occur to them that the digital twin might have anything to do with PLM. Customers have specific use cases in mind when it comes to the digital twin and are operating their own PLM infrastructures, but they fail to see that the digital twin could be a PLM use case.

That's really surprising. And how do the PLM system vendors see it?

Of course, the PLM system vendors have an entirely different opinion. Some of them don't mince their words when they try to market the digital twin as their domain. But I'm not seeing any successful reference projects.

What portfolio can PROSTEP bring to bear in supporting the development of an infrastructure for the intelligent digital twin?

The digital twin feeds on a multitude of data sources that all need to be interconnected. This is why we've converted our OpenPDM product to microservices. The individual services in OpenPDM are now encapsulated in the form of independent processes. This means that OpenPDM can be installed close to a backend on the intranet, or its services can be used for cloud applications. OpenPDM has been fully cloud-enabled since version 9.

Congratulations! Speaking of the cloud, what importance do you attach to this kind of data center utilization?

Very considerable importance. All the major carmakers, for example, have formulated their own cloud strategy. Some of them even intend to migrate legacy systems to the cloud over the medium term. The fundamental principle is that new solutions are installed in such a way as to permit cloud operation. OpenPDM is ideally suited for this because it can be implemented "close" to the system in a wide variety of architectures. This guarantees low latency for function calls. The associated services, on the other hand, are able to run in the cloud.

If I understand you correctly, a connection layer of OpenPDM takes over the task of providing access to the legacy databases in order to provide data for the digital twin.

That's right. Our connector encapsulates the legacy system and a typical HTTPS protocol then allows access to the data.

OpenPDM thus provides "soft" integration that allows seamless use of the IT infrastructure and applications. The problem lies in the fact that cloud applications from different providers run in separate data centers and these applications, such as PLM and ERP, cannot be easily linked.

Technically, this is all feasible: Going from one cloud to another is no more complicated than going from a cloud to a legacy system running on an intranet.

So your message is that people should implement OpenPDM as it opens up any scenario ...

That's good! Can I quote you?

Thank you! Cloud providers like to claim that an operation of this kind requires little investment in hardware infrastructure. But is that really true? After all, if you want to share CAD data with others via a cloud, you still need an expensive CAD workstation to visualize the 3D models. What does the future hold in this respect?

One plus for the major cloud providers is that they offer very powerful data replication mechanisms that guarantee the global availability of data. Particularly in the case of very large volumes of data, a cloud infrastructure can greatly facilitate data exchange, complete with security concepts, reliable backup and the management of access permissions. On the other hand, it is also clear that a local CAD workstation is needed if Catia models are to be opened; but a tablet PC is entirely adequate as a frontend when using SAP. In principle, there are very few local hardware requirements for the majority of cloud applications.

Is there already a widespread understanding of the pros and cons of cloud infrastructures in the market?

Certainly. IT managers know what they are talking about and have already been operating initial pilot applications in the cloud. But within top management, the term "cloud" undoubtedly tends to be bandied about as a buzzword. The extent to which the concept is really understood in such circles depends very much on how familiar people already are with the whole subject.

On the one hand, it is obvious that providers of publicly accessible clouds such as AWS or Microsoft Azure will significantly expand the range of functions they offer over time and thus increasingly compete with the cloud offerings of PLM providers. On the other hand, a fee is charged for each transaction, which can drive up the costs of the applications enormously. So what do you recommend when it comes to investing in the cloud?

The price difference between SaaS (Software as a Service) and on-premises operation is typically a factor of 3 to 5 in favor of on-premises operation. But the additional cost of SaaS is offset by the increase in flexibility, for example by varying the number of workstations according to workload. Especially in times such as these, with the coronavirus crisis, this translates to hard cash. An engineering service provider, for example, can quickly reduce the number of licenses used ...

... but it is not so easy to deactivate and reactivate a PLM infrastructure. The core team must be able to keep working.

This is undoubtedly true for product development, but the number of staff involved in large projects in particular varies considerably. It's a great advantage to be able to reflect staffing fluctuations within a license model. And the same applies to computing power, which can be scaled up and down as required.

The digital twin is seen by many as a business enabler for new business models, for example when it comes to implementing an Asset as Service (AaS). This involves remuneration for the output of a machine or system. However, this requires the expertise of component suppliers to be integrated, ideally via the cloud, in order to be able to guarantee high availability of the asset ...

... but before that can happen, there are still many open issues that need to be clarified. This is because traditional business models involve a transfer of ownership from the manufacturer to the machine operator. The operator is given technical drawings, but certainly not confidential development data, simulation models and so on. This is where the real added value lies, and manufacturers can exploit this when they take over operation of their own product. This data can provide the basis for guaranteeing optimized operation. Far more intensive comparison of development data and real operational data is possible, indeed necessary, because in this scenario there is a considerable interest in keeping the maintenance outlay as low as possible.

What does your experience tell you? Is the market ready to take up this gauntlet?

Certainly. There are quite a few machine manufacturers who are trying to do just that. However, their clients are still rather reluctant to go along with them.

What solutions can PROSTEP offer for the infrastructure needed for availability-oriented business models and the intelligent digital twins they require?

As I indicated earlier, we support such scenarios with OpenPDM and our new lightweight product OpenCLM. OpenCLM enables users to build an end-to-end digital twin, from requirements management to concept development all the way through to validation in the field. This makes not only traceability and true end-to-end development paradigms possible but also reliable operational concepts.

Tell us a little more about OpenCLM.
OpenCLM is an easily configured web application. The basic idea is to implement cross-domain data integration via links to address issues such as which requirement refers to which electronic component, or which test validates which requirement. This preserves the context of meaning throughout the entire development process. This operates as an extremely lean layer above the familiar PLM, ALM and test systems.

This sounds like support for systems engineering approaches. Is OpenCLM the ideal way of achieving the digital twin?
Systems engineering is a methodological approach to product engineering, and the digital twin is the merging of product and operational data across domains. To begin with, the two topics should be considered separately. But the digital twin can support systems engineering.

After all, the goal of systems engineering is to create transparency without media discontinuity. This is precisely what the digital twin requires and is a goal shared by OpenCLM.
That's right, and OpenCLM is the technical realization of this transparency, which barely exists at present. On the other hand, the existence of the digital twin makes systems engineering easier. For example, during test cycles in particular, it is important to draw conclusions about the original requirements. If a change is made, for example, you need to ask what impact does it have in the test and how consistent are these results with the requirements? OpenCLM provides the answers to such questions and enables systems engineering without discontinuities between systems.

Thank you for sharing your thoughts with us.
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