

# *The Connotation, Architecture and Development Trend of Product Digital Twin*

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**Keywords:** Product digital twin, product upgrading, network information technology, development trend

**Abstract:** The effective application of the technology of product digital twin can assist and influence the products' optimization, upgrading, physical control and traceability. The technology of product digital twin is a key technology after the rapid promotion and popularization of the network. The paper also focuses on the technology of product digital twin which is the core vocabulary of the paper, and mainly analyzes the connotation, architecture and corresponding development trend of product digital twin.

The rapid promotion and popularization of network technology has undoubtedly provided more references and help for people's work optimization and technology optimization at the present stage. The technology of product digital twin also came into being at this time, and achieved relatively good results in a relatively short period of time<sup>[1]</sup>. The technology of product digital twin can be traced back to NASA at the earliest. This kind of technology can assist and influence the innovation of various technologies and the optimization of products, and has a good development prospect. Taking this as the center, the paper briefly analyzes and discusses the technology of product digital twin.

## **1. The Connotation of Product Digital Twin**

At the initial stage of the application, product digital twin mainly acted on the product design and product operation and maintenance. However, with the changes of the times and the rapid development of network technology and communication technology, the role and influence of product digital twin have changed at the present stage except for traditional product design and product operation and maintenance. At the present stage, product digital twin can also transform physical entities into virtual models through corresponding digital simulation technology, simulate the performance and behavior of corresponding products in the process of practical application, so as to better develop and predict the unknown world, stimulate people's innovation ability, and promote the development, innovation, optimization and upgrading of manufacturing industry better and faster<sup>[2]</sup>.

Of course, at the present stage, the technology of product digital twin is still in the exploration stage, and still has a high development space, but the definition of product digital twin is relatively clear. The so-called product digital twin refers to the virtualized digital image based on physical entities, forming a multi-physical, multi-scale, hyper-realistic, dynamic probabilistic simulation

model, which is further used for simulation, detection, diagnosis, prediction and control to make effective analysis and treatment of physical entities, and control the behavior of physical entities.

The product digital twin can provide more assistance and guarantee for the creation, optimization and upgrading of physical products, and can also be applied to subsequent product services. The product digital twin has the corresponding characteristics such as virtuality, uniqueness, multi-physics, multi-scale, hierarchy, integration and dynamics, which can provide more services and references for the whole life cycle of products<sup>[3]</sup>.

## **2. The Architecture of Product Digital Twin**

Firstly, from the perspective of data composition, the data composition of the product digital twin includes the relevant data involved in the various processes from product production, product application to product scrapping, and these data are not fixed, but realize the dynamic simulation with the change of products.

Secondly, from the perspective of the realization mode of product digital twin, in general, the realization mode of product digital twin is basically the same as that of physical products. The realization mode of product digital twin can be analyzed and studied from the whole life cycle of physical products, specifically from the five stages of product design, process design, manufacturing, product service and scrap recycling. The product digital twin is oriented to the whole process of product from production to scrap. Through the two-way connection of physical information and virtual information, it can better trace and find the corresponding data and the technical status of physical products. At the same time, through the connection with physical products, it can effectively monitor the behavior of physical products, and can also provide more references for the tracking, management and maintenance of physical products.

Thirdly, from the perspective of the role of the twin, the role of product digital twin is relatively large. The product digital twin can effectively analyze the state and behavior of different physical products in the process of practical application through virtual simulation, judge whether the products can complete the corresponding work tasks, monitor the operating parameters, and analyze the feasibility, scientificity and effectiveness of the product application. The effective optimization of the production value of products can improve the quality of products. When the product is put into use, the product digital twin can be used to better understand the use status of the product and whether the product has a fault, trace the cause of the fault according to the corresponding data, and analyze the corresponding solutions. At the same time, in order to ensure the scientific, effective and targeted problem-solving, the application of product digital twin can also be used to predict the fault method through and choose the best solution after dynamic simulation. This method can also be applied to product innovation, optimization and upgrading to better develop new products and improve the comprehensive performance of products.

Finally, from the perspective of the application target of product digital twin, the emergence of product digital twin can take advantage of the convenience of virtual space to digitally copy the products in physical space, and then use information technology to effectively control. On the one hand, it can achieve the effect of controlling reality with virtuality, effectively analyze the actual situation of physical products, and dynamically control the situation. On the other hand, it can achieve the effect of promoting reality with virtuality, and effectively optimize and upgrade physical products through digital simulation.

## **3. The Development Trend of Product Digital Twins**

The product digital twin is a relatively new concept, which has been applied and developed only after the network has been widely popularized. However, at the present stage, the application of the

technology of product digital twin is still not mature, and there is still a large space for its development and growth. In the future, the foundation of product digital twin will be developed in three directions, namely, simulation, full life cycle and integration.

Firstly, from the perspective of virtual reality, the technology of product digital twin can make a virtual impression of physical products, then make an effective analysis of the corresponding data and the working conditions of products, find the corresponding optimization path, find problems in time, and solve problems effectively. The effectiveness of this technology will be greatly affected by the degree of virtual reality of digital modeling. Therefore, in the coming period of future, the virtual characteristics of product digital twin technology will be significantly improved and getting closer to physical entities.

Secondly, from the perspective of full life cycle, the technology of product digital twin can provide more references and assistance for product design, manufacturing, service, scrap and other links. In the future, the technology of product digital twin can more comprehensively cover the product life cycle, make effective control and research from more dimensions and angles, and provide more assistance and guarantee for the optimization and upgrading of products and the improvement of service quality.

Finally, from the perspective of integration, the product digital twin has a high development space in the future. It can integrate more emerging technologies, achieve efficient collaboration through the integration and interaction of various technologies, and exert its greater role and value.

(3) Digital twin of a product is a data center of the whole product lifecycle and the whole value chain. Digital twin of a product takes the product as the carrier and involves the whole life cycle of the product, from conceptual design to Detailed design, process design, manufacturing and subsequent use, maintenance and scrap/recycling phases. One party Face, the product digital twin is the product lifecycle of the data center, its essential enhancement is to achieve single A data source and all stages of the whole life cycle information connection; On the other hand, the product digital twin is also full In the data center of the value chain, the essence of the improvement lies in seamless collaboration, not only sharing information, this is A synergy across the value chain. Such as cross-regional cross-time zone manufacturers collaborative design and development, and upstream and downstream into Simulation of line assembly, testing/improving products in the customer's "virtual" usage environment, etc.

(4) Product digital twinning is an extension and extension of product lifecycle management

Product life cycle management PLM emphasizes on the product bill of material (including design BOM, engineering)Art BOM, manufacturing BOM, sales BOM, etc., and the correlation between each other) to achieve full production of products Management of lifecycle data. Product digital twinning not only emphasizes the integration of products through a single product model Life cycle information for product development, product manufacturing, product use and maintenance, engineering changes And collaborate with vendors to provide a single data source. Another product digital twin will be the product manufacturing data and production Product and service data are associated with product model, so that enterprises can not only use product data more efficiently Optimize and improve the product design, while also using the product digital twin to predict and control product reality Body in the real environment of the formation process and state, so as to truly form the whole value chain data unified management and Therefore, it can be said that the product digital twin is an extension and extension of PLM.

## 4. Conclusion

The technology of product digital twin is a new type of technology, and its application scope in China is still relatively narrow, but its development space and advantages can not be ignored. It will

be widely promoted and effectively applied in the future, providing more assistance and guarantee for China's scientific and technological optimization, product upgrading and economic development.

## References

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