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Research on Problems and Progress of Digital Twin Models

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Abstract: Various tools and technologies in the Digital Twin model are diverse, and the research object is not determined according to the project, but according to the object of use, and the controlled elements of the model are effectively controlled to complete the sorting of logical relationships. This determines that there will be various problems in the Digital Twin model. However, Digital Twin model is one of the core contents of Digital Twin research, and it is also the focus of future research. The author summarizes the theoretical research of the Digital Twin model, sorts out the criteria and problems, and finally summarizes its progress for peer exchange.

1. Introduction

Digital Twin has shown great potential in recent years, mainly because it can be used as a new method in many fields, such as measurement and control projects involved in traditional manufacturing, biomedical projects, petroleum engineering, etc. However, Digital Twin is a relatively new concept, and the definition of its connotation, scope and model concept are not clear enough [1-2]. Thus it is of great guiding significance to study various problems in the Digital Twin model and summarize the research progress.

2. Theoretical Research on Digital Twin model

The Digital Twin model shows its own advantages during its development, and its research is growth from the development of the concept to the determination of the research object. There is no clear definition of the concept of Digital Twin model. From a conceptual perspective, Digital Twin can probably express a certain relationship between a virtual thing in the digital virtual space and a thing in the physical space. This relationship is derived from multiple dimensions, including behavior, material, and even shape. And there are many key technologies in the corresponding model, such as information exchange, information storage and information processing. In the development stage of the whole concept, various diversified models have been proposed by scholars, but the specific content has not been fully defined yet. Digital Twin model can be well understood by comparing, analyzing and deeply studying various models. The first choice for scientific research of Digital Twin is to determine the research object. However, the research object of Digital Twinmodel is not a specific project. It is more to define the controlled elements of the model as a group of objects, exploration of the internal relations between multiple objects, and analysis of

management and communication of various elements in different environments [3-4]. The classification of Digital Twin models can be divided into two categories, namely the study of concepts and the study of general models. At present, more and more researchers study these two models. The study of concepts is to study items from a macro perspective. It can analyze the life cycle of products and its management, describe the system behavior of products, and also research from the perspective of workflow, including general system behavior, reconfiguration problems, methods, product management, system manufacturing and process analysis. The whole research content has a high degree of dispersion, and there is no special situation in the current research. And the study of general models is to develop and explore language construction, model development, tool use, concept implantation and model algorithm. Digital Twin model is at the core of the whole research, and the key point of future research is still to select the twin analysis with large differences, and sort it into a new model that is integrated, interactive and expandable according to the external characteristics and internal attributes. Only in this way can the entire information be circulated between the physical and digital worlds, and finally can Digital Twin be formed.

Experts and scholars also analyze or summarize a specific problem, which involves many aspects such as aviation, satellite assembly, digital manufacturing, fault diagnosis and prediction, aircraft predictive maintenance, etc. Various models also include general models and special models, which can be used for life cycle management of products, crack initiation, system behavior, data exchange in heterogeneous space, remote information processing, modular workshop management, simulation of manufacturing building models, product development with physical and performance characteristics, brake health detection system, automatic continuous assessment of assets, damage control of parts, biomedical engineering applications, remote 3D printing technology, numerical control machine tool modeling application, simulation ofcoronary artery of the heart, transportation process simulation in the drilling platform [5]. From these detailed application scenarios, we can conclude that the theoretical research of the entire Digital Twin model can be applied in many aspects of life, involving all walks of life, and these research have made some progress.

3. Concept and Problem Analysis of Digital Twin model

Information technology is gradually improving, data processing is also faster and faster, and all kinds of information and physical materialization and other information in production are gradually digitalized. In this process, the concept of Digital Twin gradually has developed and formed. Decades of development have led to the blowout growth of Digital Twin, and Digital Twin model has gradually been more affirmed. In the process of modern development, smart city is the positioning of the future. As a key technology, Digital Twin shows great research value and social needs. Digital Twin model needs to follow certain rules when building. From the perspective of various general models, it can be described in terms of multiple scales, dimensions and fields. In detail, it can be developed from precision, standardization, lightweight, visualization and interactivity. As a basic and available model, precisionwith accurate and reliable characteristics can effectively meet various needs. Standardization is a universal criterion, which meets the needs of various universals and has the characteristics of compatibility and reuse. Lightweight is quick to be used, which can meet the needs of high efficiency and has the characteristics of fastness and lean. Visualization is easy and quick to be used, which can meet the needs of various intuitions and is vivid. Theses four criteria can help the whole Digital Twin model to be better constructed and more in line with current needs [6].Through in-depth study, it is found that, first of all, Digital Twin do not exist in isolation, but still need to be studied on the basis of the construction of network physical space and network physical production system. Therefore, it requires Digital Twin model to meet the corresponding model requirements. However, during the current research, it is found that the

specific framework requirements of the model are still not clear enough, and there are few research reports. Second, many scholars choose their own research methods during the research, so that the current Digital Twin model has no unified description method, and the conclusion shows isolation. In this context, it is more difficult to blend and expand various general models or special models. At the same time, the scalability, scalability, interoperability and fidelity of Digital Twin model itself are directly affected. While the system scale is expanded, the problem is more obvious. Third, in the comprehensive research, the research of Chinese Digital Twin model is not supported by more professional industrial software and modeling software that are key points[7].

4. Progress Analysis of Digital Twin Model

The change nodes of Digital Twin are concentrated in 2017. Before that, Digital Twin was a concept with less research, and a small number of researchers in European and American countries studied its concept and model. But after that, scholars all over the world have joined the research team, and concepts, models, and cases have been gradually proposed and verified, more application frameworks have been gradually formed, and the costs and application scenarios of Digital Twin have also been more studied and reflected. Dating back to 2003, professors at the University of Michigan initially proposed a description close to the concept of Digital Twin in their life cycle management courses. Two years later, the team carried out further research and described the mapping relationship of space. Subsequently, Digital Twin carried out various interpretations and applications with paradigms. In 2014, the concept of Digital Twin model was proposed, and then professors from the University of Michigan continued to revise and improve the model. With the efforts of experts and scholars, the implementation path of module-link-self-consistency-Digital Twin has been proposed. Then it is applied in the life cycle, including modeling, knowledge and various management work. Later, this model was used to simulate industrial equipment in the network physical space, and the virtual parts such as sensors and machines can access and read data on the basis of the Internet. Then, the exchange data model of automatic modeling further emerged. The interoperability between these two models has improved the exchange of data qualitatively [8].

After 2017, based on the previous architecture reference model, experts and scholars proposed new models and applied them to logistics smart factory, 3D printing technology and other scenarios, and achieved certain results. Later, scholars introduced it into Siemens' program development. This model can present the virtual world in front of designers in more real conditions in the design scheme, which has a good effect on product development and organization. As a developer, professors from the University of Michigan continue to develop scenarios for Digital Twin models, and the communication and coordination between employees and production systems can also be well realized. Because this concept and model itself is to place digital information in the physical system, which makes the whole system well linked with the system within a certain life cycle. It is like "identical twins" and the connection in the movie "Avatar", which can well reduce all kinds of unpredictable troubles and unwelcome emergencies in complex systems. On this basis, all kinds of complex problems in the model can also be changed in the way of block-chain, which simplifies complex problems and achieves better results. After memorial research, the current Digital Twin model has been able to be integrated in the horizontal and vertical levels. With the concept of Digital Twin, the control center is constructed, and cloud computing are added to connect various data to achieve better management.

5. Conclusion

China's computer software and industrial application software are indeed relatively backward, and software design processes such as industrial design, manufacturing, and key control also need

to be improved. The development of Digital Twin cannot be separated from modeling. Although there are problems in the Digital Twin model itself, the research process is still a big step forward. In the future, scholars can consider to carry out richer research from the perspectives of the integration of Digital Twin model and the reference architecture model, the construction of the unified description method of Digital Twin model, and the development of the modeling tool software and industrialized software of the Digital Twin model, so as to make the digital twin modeling in China have a better development.

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