Research on Digital Process Design of Display and Control Equipment Based on Teamcenter

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Abstract. To enhance the guidance of 3D models for actual production and realize the process digitalization of display and control equipment, a digital design architecture of display and control equipment based on Teamcenter is proposed to analyze process design planning and BOM construction, which can effectively ensure the consistency of product physical objects and design drawings and enhance the stability of product process quality. In display control equipment processing, assembly example verification aims to improve the process of production practice guidance ability.

Keywords: Teamcenter; Digital process design; Display and control equipment; BOM

1 Introduction

The display and control equipment can realize the needs of information processing, operation, control, and human-computer interaction. It has rich functions, strong integration, and many wiring harness connection points, and the overall hardware platform is more complex. The equipment consists of a large number of parts, complex modeling, specifications, and models, cumbersome processing, heavy processing technology design, subject to external space restrictions and product size requirements, complex assembly relations, and limited wiring harness space layout, so assembly process design is more difficult. At present, the process design of display and control equipment is still mainly based on two-dimensional engineering drawings and combined with technical requirements and other text descriptions, the degree of digitization is low, the intuitiveness is poor, and the manufacturing intention of the drawing itself cannot be quickly conveyed, and the technical level of the operator is high, which is easy to cause rework and modification in the later period, directly affecting the production schedule of the product and increasing the production cost. With the development of technology, digital design based on 3D models has become the development trend in the manufacturing industry. Aerospace enterprises are relatively advanced in digital construction and can realize 3D digital design and management of flight products to a certain extent [1-3]. However, the digital development of display and control equipment in the shipping industry started late and has not yet realized the digital process design of the whole

process. Compared with the production of fine management, short cycle delivery requirements are far away, and cannot meet the needs of use. Therefore, this paper optimizes and improves the digital process design of a certain display and control equipment based on Teamcenter, which can effectively ensure the consistency of product physical objects and design drawings, enhance the stability of product process quality, strengthen the guiding role of technology in the manufacturing process, and improve batch production efficiency.

2 Digital Process Design Data Integration Based on Teamcenter

The PLM (Product Lifecycle Management) system used now is the Siemens Teamcenter system, which has been deeply used in various design processes and production links. The system can effectively realize the design model, process information, flow information, and other product design and production process data, through the integrated interface, to realize the digital design and manufacturing of products.

2.1 System Architecture Design

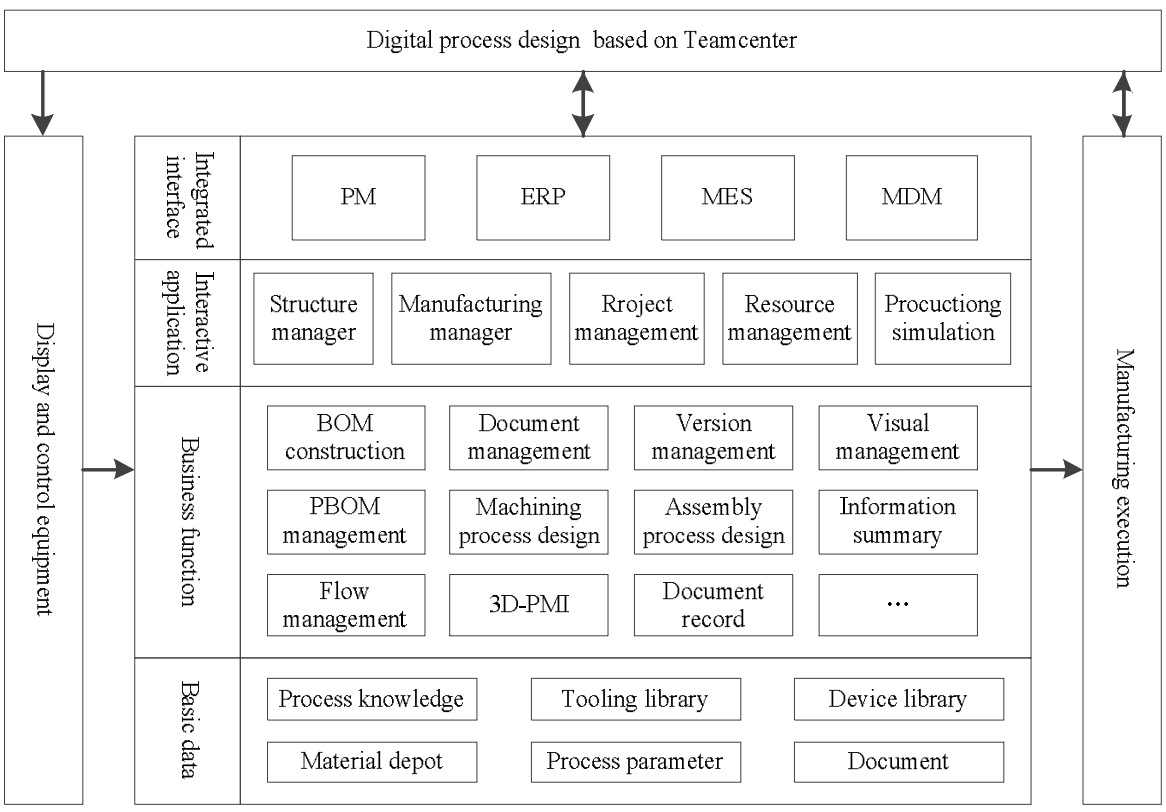


Fig. 1. Digital process design framework based on Teamcenter.

To improve the quality of product process design, a digital process design framework based on Teamcenter is proposed, as shown in Figure 1, including an integrated interface, interactive application, business function, and basic data. Through the Teamcenter system framework, we achieve digital design and process comprehensive control, to

achieve integration with NX/CAD and other software, MDM/MES/ERP, and other systems. The interactive application provides users with a visual operation window to complete process design and simulation. A business function is the business component that realizes the system function, including BOM construction, process design, three-dimensional annotation, document management, information summary, etc. Basic data includes tooling, equipment, and material information, including process knowledge, process parameters, etc., to facilitate the implementation of process invocation [4].

2.2 Process Resource Database

Process resource library is an important part of digital process design, which is used to store and call process resources uniformly. Based on the classification management of Teamcenter, a classification library of materials, equipment, tooling, tools, instruments, measuring instruments, typical processes, process templates, process parameters, etc., has been constructed. These resources are stored in each classification database and have corresponding unique codes, which can be selected by classification query or search in the resource database.

3 Digital Process Design Process of Display and Control Equipment

The digital process design of display and control equipment is based on the three-dimensional model of the product and its dependency relationship as the path to carry out the process work planning, parts processing, and assembly design while combining the process simulation and simulation to verify the production process.

3.1 Product Process Planning

Process BOM (PBOM) is the core of product manufacturing and data integration, the basis of process preparation, and the link between design BOM (EBPM) and manufacturing BOM (MBOM). EBOM is the database of PBOM, and PBOM is the derivation and extension of EBOM data.

After product design approval is completed, EBOM is released as the data basis. EBOM contains components, parts, components, standard parts, etc. Components and components directly enter the procurement supporting process, and components and parts enter the process design stage of the subsequent production process. In this link, based on the structure tree of EBOM, process personnel add process parts, standard parts, and borrowed parts to EBOM in the “BOM Structure Manager”, divide manufacturing modules, assign process tasks, complete the top-level planning of process design, and form the top-level PBOM of process planning. With PBOM as input, we prepare the process procedures for components and parts, add the tooling, fixtures, tools, equipment, instruments, and processing parameters required in the construction process, form the process route, material quota, material demand list, and release it after approval, and finally form the product process baseline to complete the construction of

MBOM in the manufacturing process. The BOM construction and transformation process is shown in Figure 2 [5].

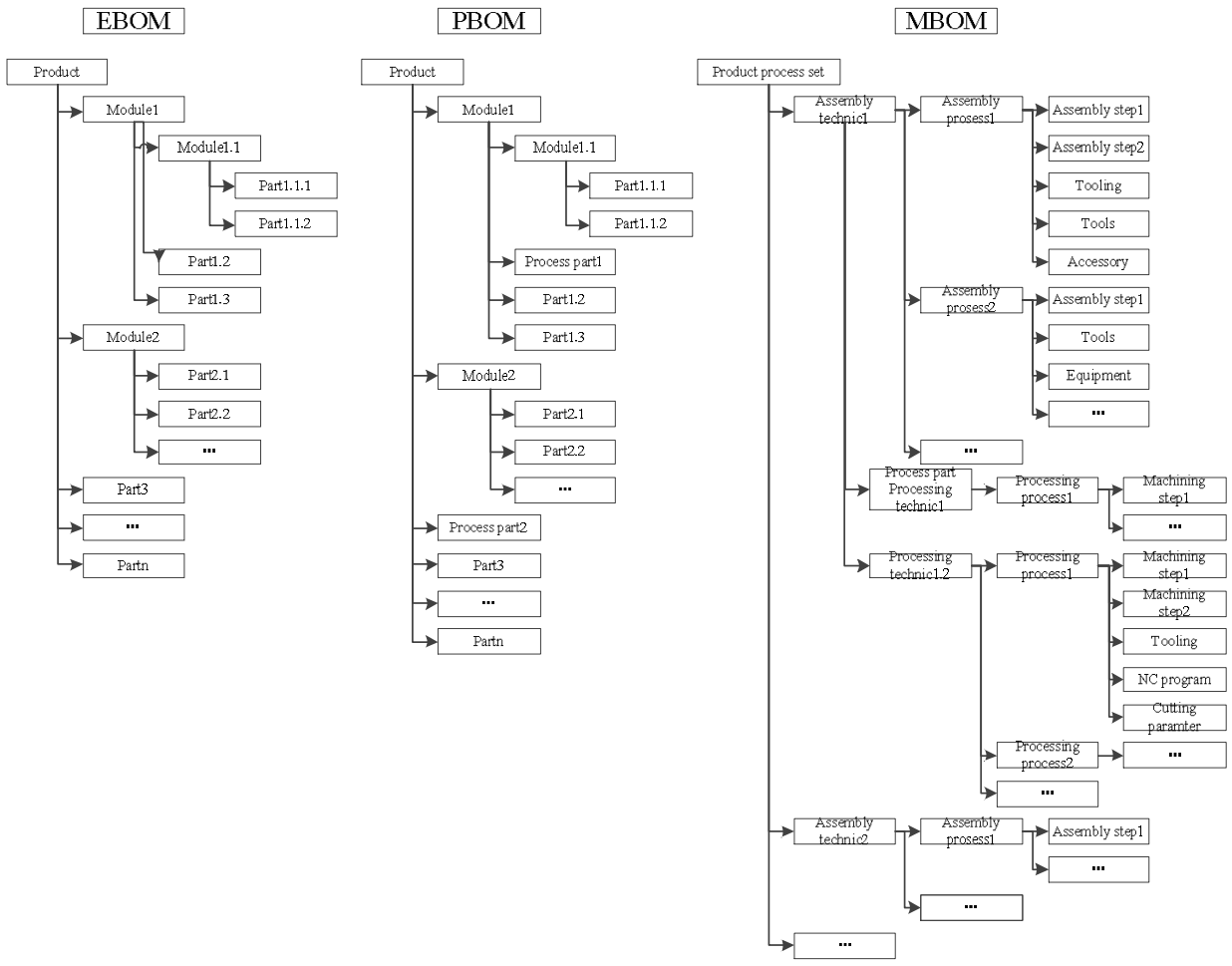


Fig. 2. BOM construction and transformation.

3.2 Product Process Design

According to the traditional two-dimensional engineering drawing process design mode, the two-three-dimensional hybrid digital design and manufacturing mode of two-dimensional engineering drawing + three-dimensional model is formed to realize the three-dimensional process design based on MBD. The realization method of "table + three-dimensional model" is adopted, which not only takes into account the production and application requirements of existing two-dimensional drawings but also realizes the three-dimensional numerical control machining. To adapt to the production status of multi-variety and small-batch product models, it can meet the production needs of short-cycle delivery [6-8].

For the process design of parts, the process personnel first confirm the raw material model and material quota according to the model data, and formulate the processing flow according to the characteristics of the parts, such as "heat treatment - number milling - electroplating – spraying", and add process parameters, tooling equipment, tools and measuring tools, operating requirements, precautions, inspection requirements, etc., according to the operational requirements of each process. NX interface is used to

call the design model for correction, and NXWave technology, synchronous modeling technology, and PMI 3D labeling technology are used to correct the model, forming the 3D process median difference model required by each corresponding process. Based on the process procedures and the middle difference model, the programmer uses the NX CAM module to prepare the CNC machining tool track file under the process, generates the NC code program, attaches it to the corresponding process, and simulates the processing program, and sends it to the corresponding machine tool after confirming that it is correct.

For the process design of components, the assembly steps are first divided and the assembly process procedures are designed, including the assembly method, assembly object (middleware and consumption materials), assembly tools and equipment, assembly order, and other information. If necessary, the process will be refined into work steps to further clarify the details of the work content[9].

3.3 Product Processing Simulation

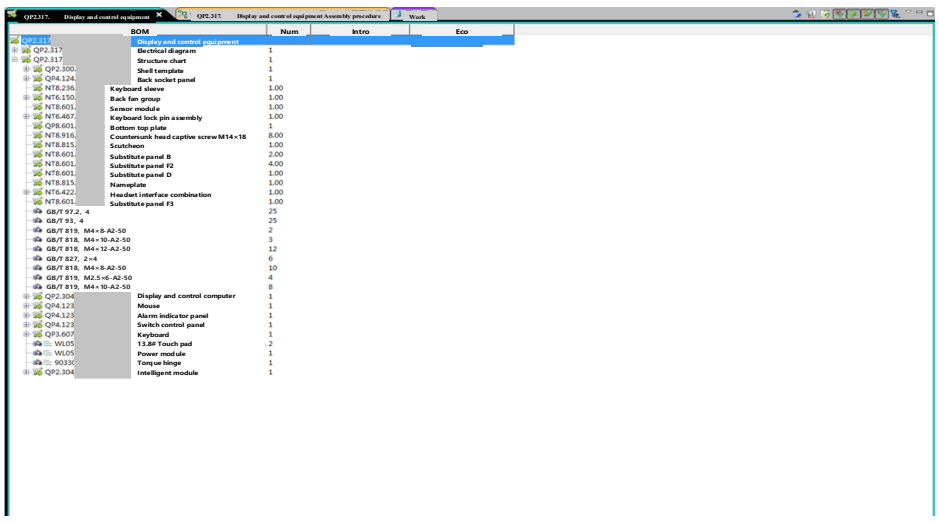
Part machining simulation and optimization is based on a virtual machining environment, CAM programming foundation, machine tool model library, tool model library, cutting parameter library, and other processing resources. We select the corresponding manufacturing model, tool type, cutting speed, feed rate, and other parameters, and generate the tool path. Through the simulation function, the machining process of the tool is simulated according to the generated path, and the tool movement trajectory, cutting state, and possible interference and collision are observed. According to the simulation results, the tool path and machining parameters are optimized and adjusted to improve machining efficiency and avoid interference and collision [10-11].

3.4 Product Process Document Generation and Release

Process procedures are guiding documents that directly guide production operations. Using the document template provided by the platform, a complete set of process documents is formed and signed after approval, including a process procedures card, process drawings card, process details card, process material card, etc. The integrated interface to ERP, MES, etc., directly guides the operator construction.

4 Application Cases

Taking a certain type of display and control equipment as an example, as shown in Figure 3, the digital process design is carried out based on the digital process design platform of display and control equipment.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QP2.317. Display and control equipment Assembly procedure
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BOM
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QP2.317
Display and control equipment
Electrical diagram 1
Structure chart 1
Shell template 1
Back socket panel 1
Keyboard sleeve 1.00
Back fan group 1.00
Sensor module 1.00
Keyboard lock pin assembly 1.00
Bottom top plate 1
Countersunk head captive screw M14×18 8.00
Scutcheon 1.00
Substitute panel B 2.00
Substitute panel F2 4.00
Substitute panel D 1.00
Nameplate 1.00
Headset interface combination 1.00
Substitute panel F3 1.00
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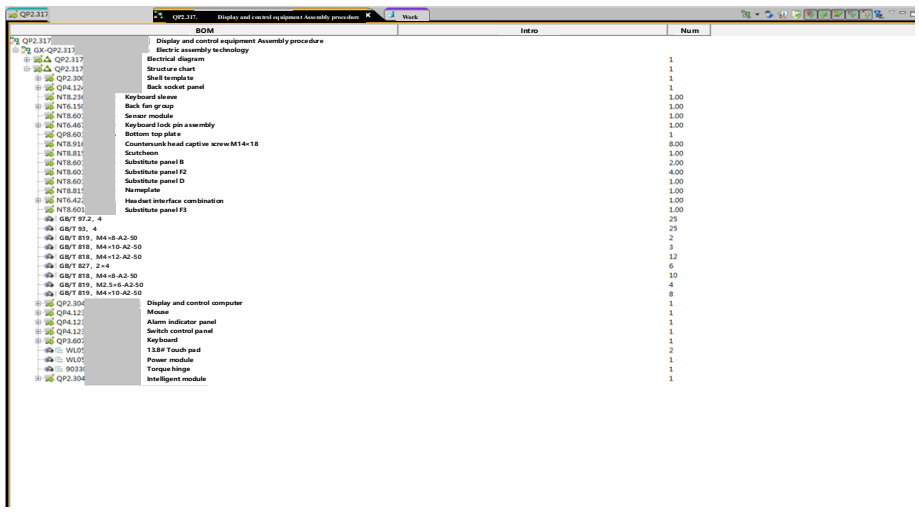
GB/T 819, M4×8-A2-50 2
GB/T 818, M4×10-A2-50 3
GB/T 818, M4×12-A2-50 12
GB/T 827, 2×4 6
GB/T 818, M4×8-A2-50 10
GB/T 819, M2.5×6-A2-50 4
GB/T 819, M4×10-A2-50 8
Display and control computer 1
Mouse 1
Alarm indicator panel 1
Switch control panel 1
Keyboard 1
13.8# Touch pad 2
Power module 1
Torque hinge 1
Intelligent module 1

a


QP2.317
QP2.317. Display and control equipment Assembly procedure
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Display and control equipment Assembly procedure
Electric assembly technology
Electrical diagram 1
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Substitute panel F2 4.00
Substitute panel D 1.00
Nameplate 1.00
Headset interface combination 1.00
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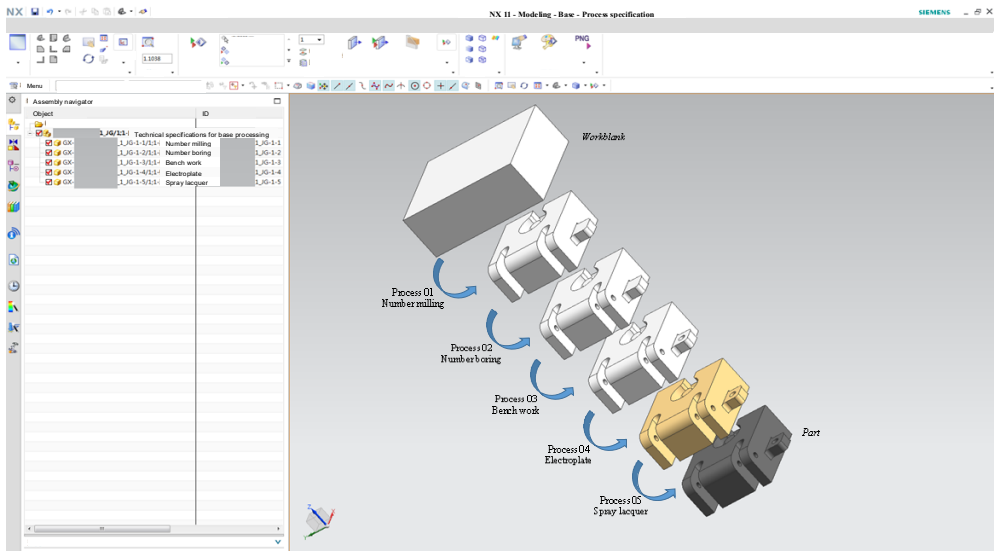
NX
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SIEMENS
Assembly navigator
Object
ID
Technical specifications for base processing
Number milling
Number boring
Bench work
Electroplate
Spray lacquer
Workblank
Process 01
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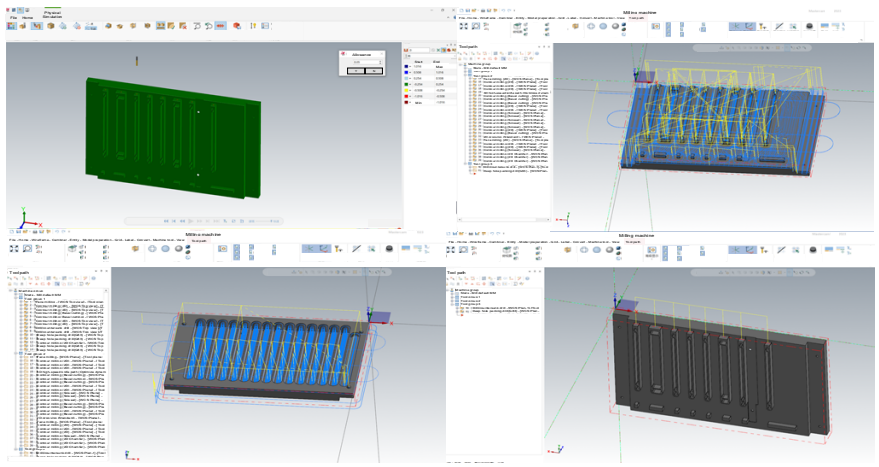
Process 02
Number boring
Process 03
Bench work
Process 04
Electroplate
Process 05
Spray lacquer
Part

c



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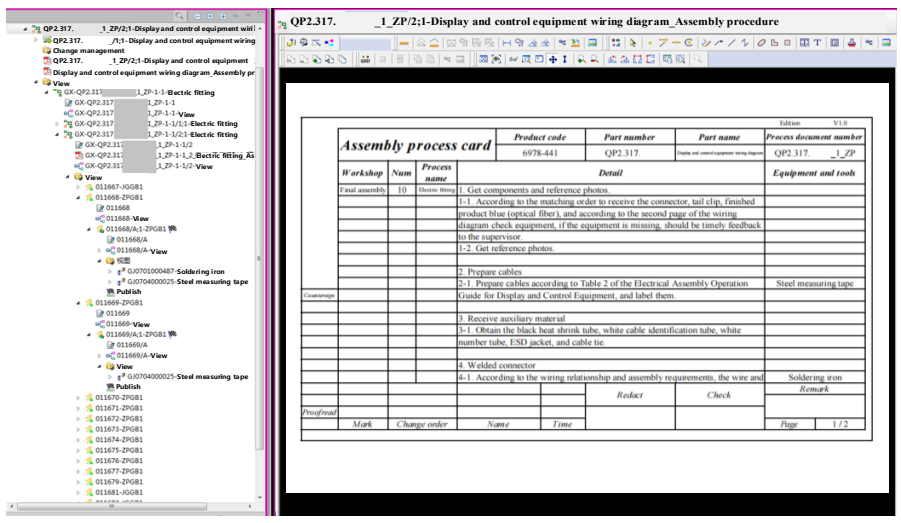

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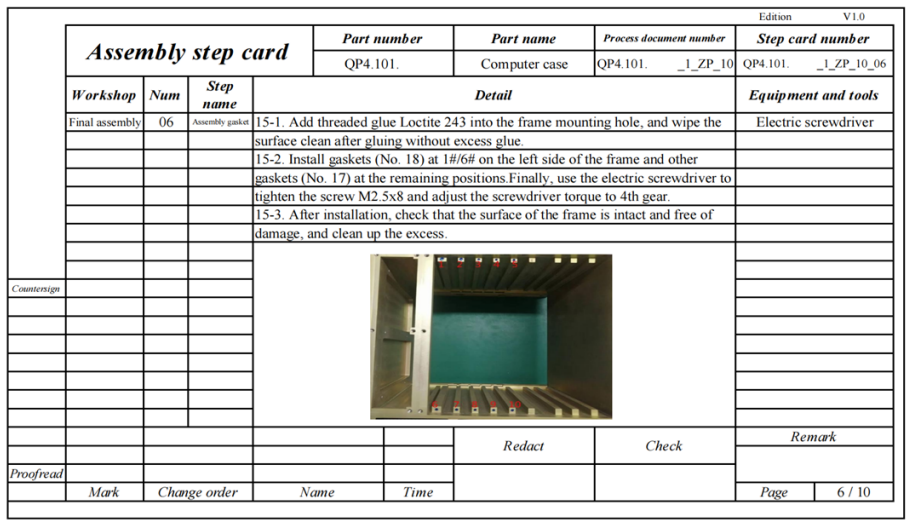

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Fig. 3. Digital process design process of a display and control equipment.

(a) EBOM of a display and control device, view the composition structure in the structure manager, and adjust the PBOM as needed; (b) Preparation of process procedures based on PBOM, completion of the process sequence, material quota, tooling and fixtures, and other resources, and construction of MBOM to guide production; (c) Addition of a three-dimensional mean difference model to the processing process and completion of PMI labeling; (d) Program and process program simulation based on NX CAM to verify program correctness; (e) Division of the assembly nodes and improvement of the assembly process and resource summary; (f) Fine chemical steps according to needs form a "table + three-dimensional model" process rules and issue to ERP and MES systems after publication.

Through statistical analysis, using a digital process design platform, the process design efficiency of display and control equipment has been greatly improved, the process documents are more standardized and more guiding, and the final assembly efficiency of equipment has been increased by 28%, and the time saving of some components is shown in Table 1.

Table 1. Production time comparison.

Category	Before/h	After/h	Time-saving rate
Front-panel	4	1.2	70.0%
Locking shaft	4.8	1.56	67.5%
Lock	0.9	0.4	55.6%
Case frame	24	12	50.0%
Printed board	24	13.6	43.3%
Transition plate	108	67.2	37.8%
Display mounting board	960	720	25.0%
Display bracket mounting seat	4, 224	3, 192	24.4%
Equipment assembly	522	408	21.8%

5 Conclusion

Digital process design and manufacturing of display and control equipment is an important way to develop high-quality products in the new era and an important means to achieve rapid delivery. Based on Teamcenter, this paper builds a digital process design platform for display and control equipment, analyzes the transformation from EBOM to PBOM to MBOM, analyzes the digital process design process of parts processing and whole machine assembly of display and control equipment, and takes parts and assembly of a display and control equipment as an example to illustrate its application. Through the application of a structured system, the digital level of process design is improved, which can better meet the needs of product design and manufacturing, and

has certain promotion significance in the Marine electronic equipment industry. In the future, based on the existing platform and combined with MBD, further engineering research can be carried out on assembly simulation, and product rationality review and operation process simulation can be realized through full factor simulation, to further guarantee product production quality.

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