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Service-oriented manufacturing - Guideline - Part 3: Resource management

服务型制造 导则 第3部分：资源管理

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1 Scope

The document lays down the classification of the resources of service-oriented manufacturing and the requirements for managing them.

It applies to the planning, the establishment and the management of the resources of service-oriented manufacturing.

2 Normative references

The document referred to is GB/T 43879, Service-oriented manufacturing - General terminology.

Dated references apply in the dated version only; undated references apply in their latest version, amendments included.

3 Terms and definitions

The terms and definitions given in GB/T 43879 apply to this document.

4 Classification of resources

4.1 According to the part they play in the activities of the whole product life cycle and according to their service attributes, the resources of service-oriented manufacturing may be divided into eight classes: hardware resources, software resources, material resources, data resources, human resources, service resources, financial resources and other resources. The classification is shown in Figure 1.

4.2 Hardware resources: the various production and manufacturing equipment, production lines, tools and tooling and test equipment used to support the manufacturing of a manufacturing enterprise and to provide manufacturing resource services, together with land and plant and with the hardware infrastructure and computing power of computer

systems such as storage units, processors and servers.

4.3 Software resources: the various system software and application software used in the processes of product design, simulation, analysis, machining and management, which include computer aided design (CAD), computer aided engineering (CAE), computer aided manufacturing (CAM), product data management (PDM), enterprise resource planning (ERP), manufacturing execution systems (MES), data dictionaries and file management systems.

4.4 Material resources: the various raw materials, parts and components, process materials and semi-finished products used in the production and manufacturing of a product, which include the direct materials used directly to manufacture the product and the indirect materials that do not become part of the product but play an auxiliary and supporting part in the production process.

4.5 Data resources: the product manufacturing data, process data, empirical model data, marketing data, knowledge bases, customer data and logistics data accumulated during the manufacturing process, which provide the basis for assessing, discovering and applying resources.

4.6 Human resources: the teams or specialist technical staff who, during the whole product life cycle, are able to carry out a given class of operation, technical application and management activity, which include engineering and technical staff, management staff and marketing staff.

4.7 Service resources: the various product testing, trial, certification, training, consultancy, after-sales and personalized customization services provided to the customer.

4.8 Financial resources: the financial services of credit, guarantee, financial leasing and insurance provided for the production and manufacturing process of a product.

4.9 Other resources: the set of all the resources that do not belong to the classes above, such as user defined resources and resources that may be added in the future.

Figure 1 shows the eight classes hanging from the heading service-oriented manufacturing resources, with examples under each of them: manufacturing equipment, production sites and network facilities under hardware resources; production and manufacturing systems, auxiliary management systems, databases and file systems under software resources; raw materials, blanks and semi-finished products under material resources; user data, product data and market data under data resources; purchasing staff, design staff and sales staff under human resources; testing, certification and training resources under service resources; and financial leasing, insurance and credit resources under financial resources.

5 Resource management

5.1 The resources of service-oriented manufacturing shall be able to provide services

dynamically and flexibly according to the needs of the customer; the customer shall be able to use the various resource services dynamically and on demand, and the cooperative interaction of several parties shall be possible.

5.2 The resource management system of service-oriented manufacturing is shown in Figure 2 and covers five fields: the basic support of resources, the acquisition of resource information, the informatization of resources, the application of resources and the security of resources.

5.3 Resource information is obtained mainly through the industrial internet, the interfaces of application systems, sensors and other infrastructure, and the data are transmitted and processed uniformly. For different classes of resource, resource information is obtained in two ways: for manufacturing equipment resources, the information is sensed with techniques such as intelligent plant management and remote equipment operation and maintenance management, the dynamic and static attribute information of the manufacturing resources being sensed and the various sensed data processed through a communication adapter, so that the equipment information is monitored and controlled centrally; for software resources, human resources, data resources and the like, sensing is concentrated on their static attributes, such as the name of the resource and its description, and the resource information is obtained by calling the integration interfaces of the various business systems and processing the information.

5.4.1 Resource digitalization: by building a digital model of the resource, the attribute, state and capability information of the resource is described uniformly, so that the physical resources of service-oriented manufacturing are mapped into virtual resources. The requirements for resource digitalization are: the digital model of the resources of service-oriented manufacturing should be straightforward and easy to use, so that classification and retrieval are convenient; the digital model should be extensible; the application interface of a virtual resource should be uniform, so that it can be integrated and called by other systems, software and applications, which makes resource sharing and cooperative work easier; and dynamic management of the resources should be achievable through information technologies such as the internet of things and cloud services.

5.4.2 Resource servitization: service oriented technologies are used to encapsulate digitalized manufacturing resources so as to form service resources, and existing service resources may also be combined and encapsulated into new service resources. The requirements are: the encapsulation should be simple, automatic and standardized; the encapsulation standard should be of general application and open, so that software and hardware resources of different origins and different kinds can be connected and published under one specification; the use of resources on demand should be supported, aggregating services on demand and splitting them on demand included; the functional attributes of the resource should be well described; and the adjustment of the scale of the resource and the dynamic migration of the service should be supported.

5.4.3 Resource publication: the service resources are described and published uniformly so as to form a pool of service-oriented manufacturing resources, which allows the customer to query, match and use the service resources according to need.

5.5.1 Requirements for the application of resources: service-oriented manufacturing shall achieve the state management of the resources it already has, and shall be able, according to the demand for the use of resources, to establish a matching relationship between a task and the available service-oriented manufacturing resources and to obtain the resource matching results that meet the demand. The optimized combination of resources is the selection of the best among the several matching results obtained, according to the capability, the cost and the room for added value of the resources, so as to form combined resource service packages such as supply service packages, design service packages, manufacturing service packages and sales service packages, which are returned to the customer.

5.5.2.1 Application of hardware resources: the service ways of hardware resources cover three aspects. Hardware resources that lack interconnection functions or that do not lend themselves to online service are offered mainly through offline service, the manufacturing capability, the state of the resource and other information being supplied offline and the manufacturing task accepted, once the customer and the provider of the resource service have matched the service capability of the resource with the service demand. The online service of equipment resources is based on the interconnection of the hardware resources: once the necessary commercial process has been completed, the party that needs the resource may obtain the right to use the hardware resource online in a strictly controlled and operationally safe environment, typical application scenarios being remote control and remote fault diagnosis. The hardware resources of computing systems are the information system infrastructure of the service-oriented manufacturing process and provide the computing power for the software resources to run, with the feature of being available as soon as they are needed; computing power resources should not be offered as a service directly to the customer, but rather to the software resources that provide the service.

5.5.2.2 Application of software resources: in the service-oriented manufacturing process, software system resources act as the management platform, the agent tool and the execution environment of the other resources, and provide the customer with resource services such as cooperative design, manufacturing and management, through technical means such as interface technology, data sharing and remote control.

5.5.2.3 Application of data resources: in service-oriented manufacturing, information takes the form of data or documents; according to the provider of the data resource and to the information security policy, the customer is granted the right to use the data directly or to process it, and data resources are offered externally in a shared or an exclusive way.

5.5.2.4 Application of human resources: as the active subject of service-oriented manufacturing, human resources may use the various resources to carry out creative