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Smart manufacturing service platform – Service-oriented integration requirements of the manufacturing resource/capability

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SMART MANUFACTURING SERVICE PLATFORM – SERVICE-ORIENTED INTEGRATION REQUIREMENTS OF THE MANUFACTURING RESOURCE/CAPABILITY

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65E/578/DPAS	65E/585/RVDPAS

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SMART MANUFACTURING SERVICE PLATFORM – SERVICE-ORIENTED INTEGRATION REQUIREMENTS OF THE MANUFACTURING RESOURCE/CAPABILITY

1 Scope

This PAS provides the requirements of all relevant manufacturing resources integrated to the cloud manufacturing service platform, including integration of hard manufacturing resources, soft manufacturing resources and manufacturing capabilities.

This document is used for the integration of the relevant resources to the smart manufacturing service platform.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

2.1
soft manufacturing resource
manufacturing resources that are based on software, data, models, knowledge

2.2
hard manufacturing resource
manufacturing equipment, computing equipment, materials, etc. used in a product life cycle

2.3
manufacturing capability
ability to complete various activities during the product life cycle, featured by the organic combination of three main elements, human labour, management and technology

3 General requirements

The following requirements should be met:

a) Resource/capability integration to the smart manufacturing platform is generally divided into hard manufacturing resource integration, soft manufacturing resource integration and manufacturing capability integration.

b) Status data of soft/hard manufacturing resource and capability should be extracted, and integrated to smart manufacturing platform through a wired or wireless network.

c) Physical manufacturing resource/capability should be transformed to logical ones. Logical manufacturing resource/capability should be defined by unified description, which forms description document of virtual manufacturing resource/capability.

d) Virtual manufacturing resource/capability should be integrated to the smart manufacturing platform as a cloud service through a unified description of services and packaging method.

4 Integration requirements of hard manufacturing resources

4.1 Integrated content

According to the business requirements in a manufacturing life-cycle, integrated hard manufacturing resources typically include the following:

a) complete set of equipment, such as large-scale simulation test system and digital production line, etc.;

b) production equipment, including mechanical equipment, electrical equipment, environmental test equipment, etc.

4.2 Application requirements after integration

Integrated equipment/device should be applied in the following ways:

a) equipment/device status monitoring and resource utilization analysing;

b) equipment/device management;

c) equipment/device online renting and calling;

d) resource collaborative planning.

Integrated equipment/device should provide following information:

1) equipment/device general information;

2) equipment/device capability information;

3) equipment/device time information;

4) equipment/device status information;

5) equipment/device task information.

4.3 Integration mode

4.3.1 Complete set of equipment

4.3.1.1 Complete set of simulation test equipment

For the set of simulation test equipment which is well digitalized and has a complete set of control systems, a local server with dual DNC can be added to connect and convert real time network (reflective memory network) to research network, so that device is integrated and instrumentation is realized, as shown in Figure 1.

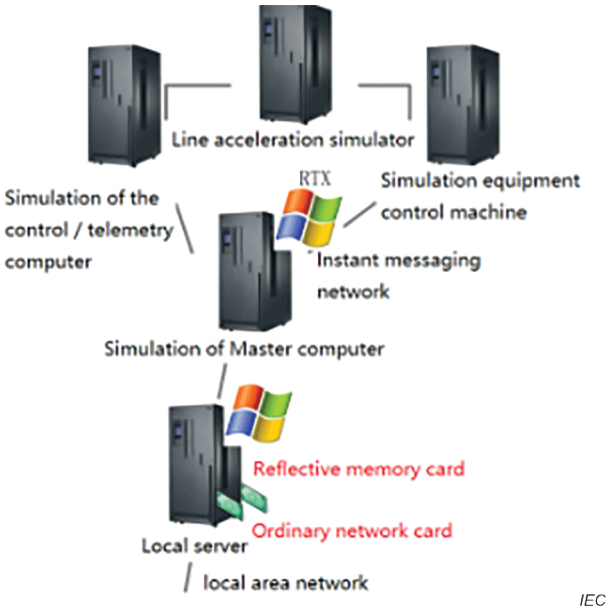

Figure 1 – Integration method for complete set of simulation equipment

4.3.1.2 Digital production line

For digital product line, there are generally two ways of integration:

- integrating distributed numerical control (DNC) centers, manufacturing execution systems (MES) and enterprise resource planning (ERP) systems to realize high-end integration and control of digital production line;
- integrating digital production line through digital manufacturing center database, which is generated by fully or semi-automatically collecting data of working status for equipment, which is realized by adding bar code labels to tools and materials and giving unified digital labels to all kinds of production resources.

4.3.2 Production equipment

Production equipment integration has the following two situations based on whether it has networking capabilities or not:

a) Install smart capture terminals and sensors or I/O signal capture devices on the production device which does not have the networking capacity, and then equipment should be integrated.

b) There are generally two types of integration for production equipment that has a networking capacity:

   1) integrated through deploying industrial data getaways which has a platform integration functionality;

   2) integrated through digital numerical control centers (DNC), manufacturing execution systems (MES) and enterprise resource planning systems (ERP).

5 Integration requirements of soft manufacturing resources

5.1 Integrated content

Integration of soft manufacturing resources should be able to implement the resource management and on-demand usage. Soft manufacturing resources which are integrated to the smart manufacturing cloud platform typically include the following:

a) enterprise information systems: including ERP, CRM, PLM, OA, etc.;

b) tooling software: including CAD, CAE, CAM, CAPP, EDA, etc.;

c) application integration platforms: including collaborative simulation platform, multidisciplinary optimization platform, etc.;

d) knowledge base: including public tooling libraries, parts libraries, fault diagnosis rule base, etc.

5.2 Requirements of application mode after integrated

5.2.1 Batch mode

Batch mode requirements of integrated soft manufacturing resources include the following:

Multi-agent users should be able to submit their compute-intensive analysis tasks (such as complex aerospace products pneumatic and thermal field analysis) or production tasks respectively in batch.

a) The cloud-based intelligent manufacturing platform should provide suitable problem-solving resources/capabilities to promote efficiency significantly for multi-agent users.

b) The cloud-based intelligent manufacturing platform should be able to prioritize tasks in a queue, so the user can focus on other tasks first.

c) It should show users the status, process and result of a task.

5.2.2 Virtual interactive mode

Virtual interactive mode requirements of integrated soft manufacturing resources include the following:

a) Multi-agent user should hand in their customized requirements on manufacturing resources/capabilities or environment of resources to cloud-based smart manufacturing platform.

b) Multi-agent users can easily get and operate cloud environment to finish the manufacturing tasks such as structural design, process design and even the semi-physical simulation test, etc.

c) The cloud-based smart manufacturing platform should be able to help create virtualized resource/ capability environment and transmit operating interface to user desktop.

d) The user doesn't have to understand where the environment of resources/capabilities locates and the ways to maintain the environment, so that he can focus on its expertized business area in the virtual interactive mode.

5.2.3 Collaborative interoperability mode

Collaborative interoperability mode requirements of integrated soft manufacturing resources include the following:

a) Multi-agent users should be able to collaborate on manufacturing tasks based on different manufacturing resources/capabilities (such as multidisciplinary design optimization for virtual prototyping, semi-physical simulation test, etc.)

b) The platform should be able to create a collaboration environment of same time/space automatically. In a wide-area distributed environment (or part of the high-performance computing cluster environment), interoperability can be automated, or business processes can be transferred, manufacturing resources/ability can be dynamically looked up, called and synchronized to finish certain tasks.

c) Users should be able to check the task status as well as to track the intermediate results of collaborative manufacturing job in the cloud through 3D visualization, etc. based on noted collaborative processes.

5.3 Integration method

Integration requirements of soft manufacturing resources include the following:

a) Virtualized and service-oriented reform of the integrated soft manufacturing resources.

b) Use virtual application publishing or service-oriented (SOA, SaaS) packaging to integrate soft manufacturing resources.

c) Turn on premise software module into the cloud version before virtualized and service-oriented reform.

d) To EXE software or module programmed by VC++ in Windows system, automation technology can be used to expose the interface similar to DLL.

e) Integration can be realized by Jacob which uses COM called by Java, under the condition that the soft resources are packaged to Web Services through J2EE.

f) Reform the browser/server (B/S) structured software and module to user interface layer, business logic layer and data access layer to satisfy virtualized and service-oriented requirements from multiple tenants.

6 Integration requirements of manufacturing capabilities

6.1 Integration content

Manufacturing capabilities which are integrated to the smart manufacturing cloud platform typically include the following:

a) Human labour and relative business logic: such as approval process of warehouse manager, etc.

b) Enterprise internal information system: including integration between different ERP systems as well as integration between cloud manufacturing system and enterprise internal information systems.

c) Classification of manufacturing capabilities service (refer to Clause A.2).

Generally, there are two types of classification of manufacturing capabilities.

a) In accordance with the manufacturing life cycle activities, including research and development, supply, production, marketing, services, as shown in Figure 2.

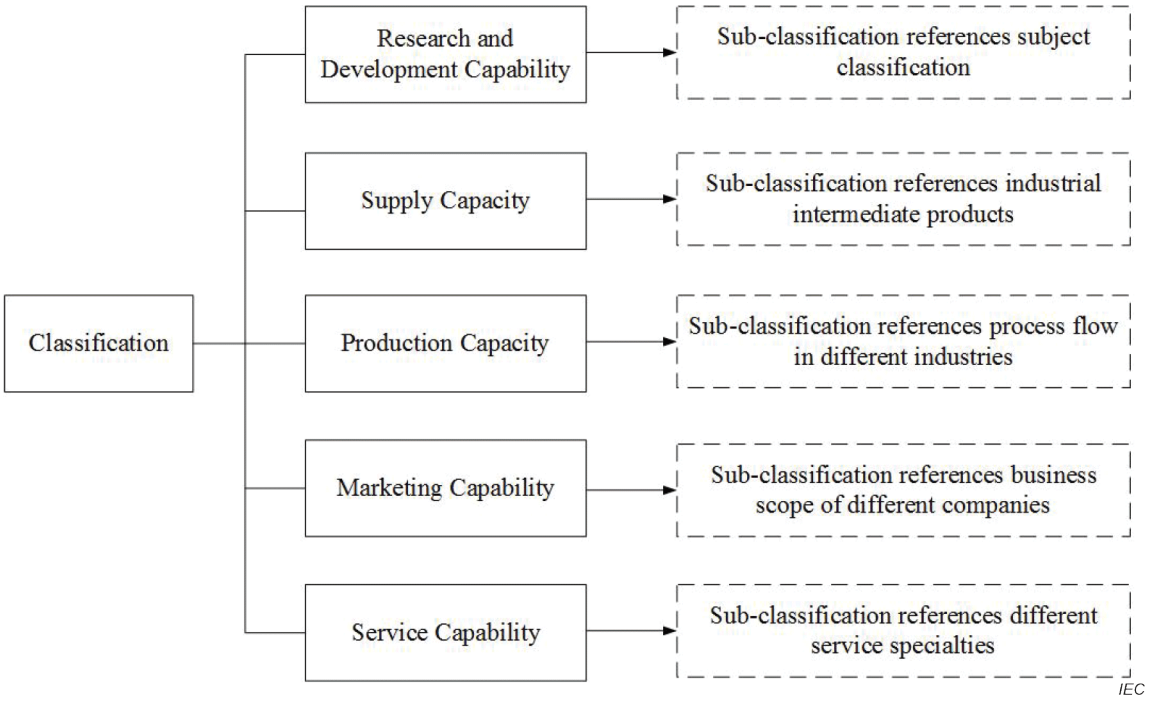

Figure 2 – Capability classification based on product life cycle