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Mass customization value chain management —

Part 1: Framework

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Foreword

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This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 5, *Interoperability, integration, and architectures for enterprise systems and automation applications*.

A list of all parts in the ISO 24644 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Along with the generalization and popularization of Internet technologies, Internet of Things (IoT), flexible manufacturing technologies and modern logistics, individualized customization services have become embedded into all industrial and service sectors. Users can, by means of Internet platforms, determine and customize their own products upon their own demands. Mass customization is becoming a new mode in the manufacturing industry, and value chains will be ultimately driven by the users. Cooperation among enterprises is required by utilizing quick-response Internet platforms to provide a wide range of products and services in small lots to satisfy the users with various individualized demands.

From the user perspective, as the users directly interact with enterprises for customized products, they want to participate in the creation process of their individualized product and also to obtain or receive information about the progress of the product.

From the enterprise perspective, mass customization assists the enterprises in realizing the real-time and accurate understanding of the user's demands. Customized products increase the premium value of products for enterprises. Because of accurately estimated a priori information from customized product demand and requirements from the users, the enterprises can reduce or eliminate the inventory-related costs by appropriately conducting large-scale procurement or production.

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Mass customization value chain management —

Part 1: Framework

1 Scope

This document specifies a framework for mass customization value chain management, including the framework model, functions and information flow of mass customization.

This document does not describe interoperability at a system level or interoperability throughout the life cycle in detail.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1

domain

functional area

[SOURCE: ISO 24097-1:2017, 3.1.2, modified — “in a policy assertion” has been deleted from the definition. The EXAMPLE has been deleted.]

3.2

information flow

transfer of information from an information-source-object to an information-destination-object

[SOURCE: ISO/IEC 16500-1:1999, 3.30]

3.3

interaction

exchange of information between a user and a system via the human-system interface to achieve the intended goal

[SOURCE: ISO 11064-5:2008, 3.20, modified — term "dialogue" was removed.]

3.4

mass customization

production mode that provides customized products and services according to the individualized demands of users with the cost and efficiency in mass production

3.5
user experience

person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service

[SOURCE: ISO/IEC 30071-1:2019, 3.1.6, modified — Notes 1 and 2 to entry were removed.]

3.6
value-added service

service that is offered in addition to the core service in question thus creating additional value

[SOURCE: ISO/TS 17573-2:2020, 3.231]

3.7
value chain

range of activities or parties that create or receive value in the form of products or services

[SOURCE: ISO 22948:2020, 3.2.11]

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

APS	Advanced Planning and Scheduling
BOM	Bill of Material
B2B	Business to Business
CAX	Computer Aided X
CBL	Collaboration layer
CP	Configuration Partner
CRM	Customer Relationship Management
CTL	Control layer
CTO	Configure to Order
DTS	Delivery-to-Service
EML	Equipment layer
ENDO	Bare unit on which customization can be configured through assembly. Transceiver is set in working assembly form.
EPL	Enterprise layer
ERP	Enterprise Resource Planning
EVI	Early Vendor Involvement
FIFO	First-In-First-Out
IT&OT	Information technology and operational technology
M&S	Modelling and simulation

MES	Manufacturing Execution System
MRP	Material Requirements Planning
MTO	Mind-to-Order
OTD	Order-to-Delivery
PLM	Product Lifecycle Management
R&D	Research and Development
TMS	Transportation Management System
WMS	Warehouse Management System
WSL	Workshop layer

5 Mass customization value chain management overview

For mass customization value chain management, the value activities of mass customization can be divided into domains from the perspective of life cycle and system, and the contents of each activity and the information transmitted between activities should be clearly defined. The framework of mass customization value chain management consists of the framework model, functions and information flow of mass customization.

This document falls in the constructs of function view, according to the definition of enterprise activity and function view in ISO 19439.

According to ISO 19439:2006 5.3.2, the function view shall represent the business processes of the enterprise domain, their functionality, behaviour, inputs and outputs. The function view shall describe the assembly of single processing steps as a collection of processes (business processes and enterprise activities) structured as a network of activities reflecting their logical connection and interdependencies.

According to ISO 19439:2006 3.19, enterprise activity is all, or part, of process functionality that consists of elementary tasks performed in the enterprise that consume inputs and allocate time and resources to produce outputs.

With the definitions and concepts of enterprise activity and function view, the framework is generated referring to the enterprise modelling concepts defined in ISO 19439, which conforms with the requirement of ISO 15704. Specifically, the framework corresponds with the domain identification, concept definitions and requirements definition of the function view at the generic level as shown in the dash area of [Figure 1](#). The modelling concepts are reused in ISO 19440, which is built upon ISO 19439, to identify and specify constructs necessary for users that model enterprises.

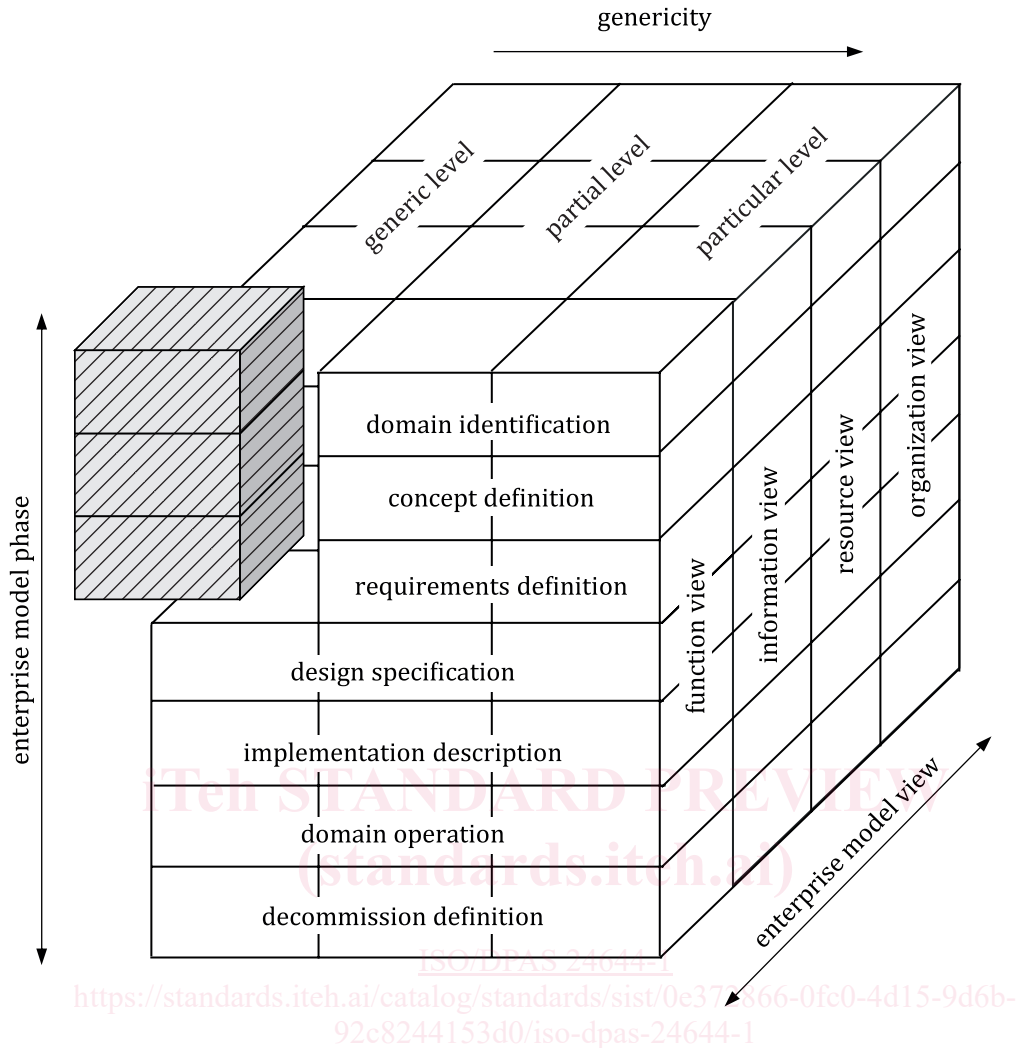


Figure 1 — Overview of the framework for enterprise modelling

NOTE Figure 1 is taken from ISO 19439:2006, Figure 5.

6 Framework model

6.1 General description of the framework model

The framework model of mass customization consists of two dimensions, namely system level and life cycle. The vertical axis in Figure 2 presents the system level, which includes equipment layer (EML), control layer (CTL), workshop layer (WSL), enterprise layer (EPL), and collaboration layer (CBL) as referenced in IEC 62264-1. The horizontal axis in Figure 2 covers the whole life cycle of a product, which includes seven activities, i.e. interaction, research and development (R&D), marketing and sales, sourcing and planning, production, logistics, and service.

System level in Figure 2 is divided into five layers according to the organizational structure related to enterprise production activities, in which:

- EML is applied by an enterprise to realize the actual physical process, and perceive and operate it by means of sensor, instrument, machine and device and others;
- CTL is used for handling information, and realizing the monitoring and controlling physical process within an enterprise;
- WSL is applicable for realizing production management within a factory or a workshop;

- EPL aims to realize enterprise-oriented business management;
- CBL is applied to realizing the interconnectivity and sharing of internal and external information in an enterprise and the business coordination between enterprises.

Mass customization domains include mind-to-order (MTO) domain, order-to-delivery (OTD) domain, and delivery-to-service (DTS) domain.

As shown in Figure 2, the MTO domain covers four activities from the life cycle, i.e. interaction, R&D, marketing and sales, and sourcing and planning, and it contains WSL and CBL from the system level.

The OTD domain includes the production activity and logistic activity. The production activity covers the EML, CTL, WSL and EPL. The logistics activity includes all five system layers.

The DTS domain covers the service activity from the life cycle and it contains the EPL and CBL from the system level.

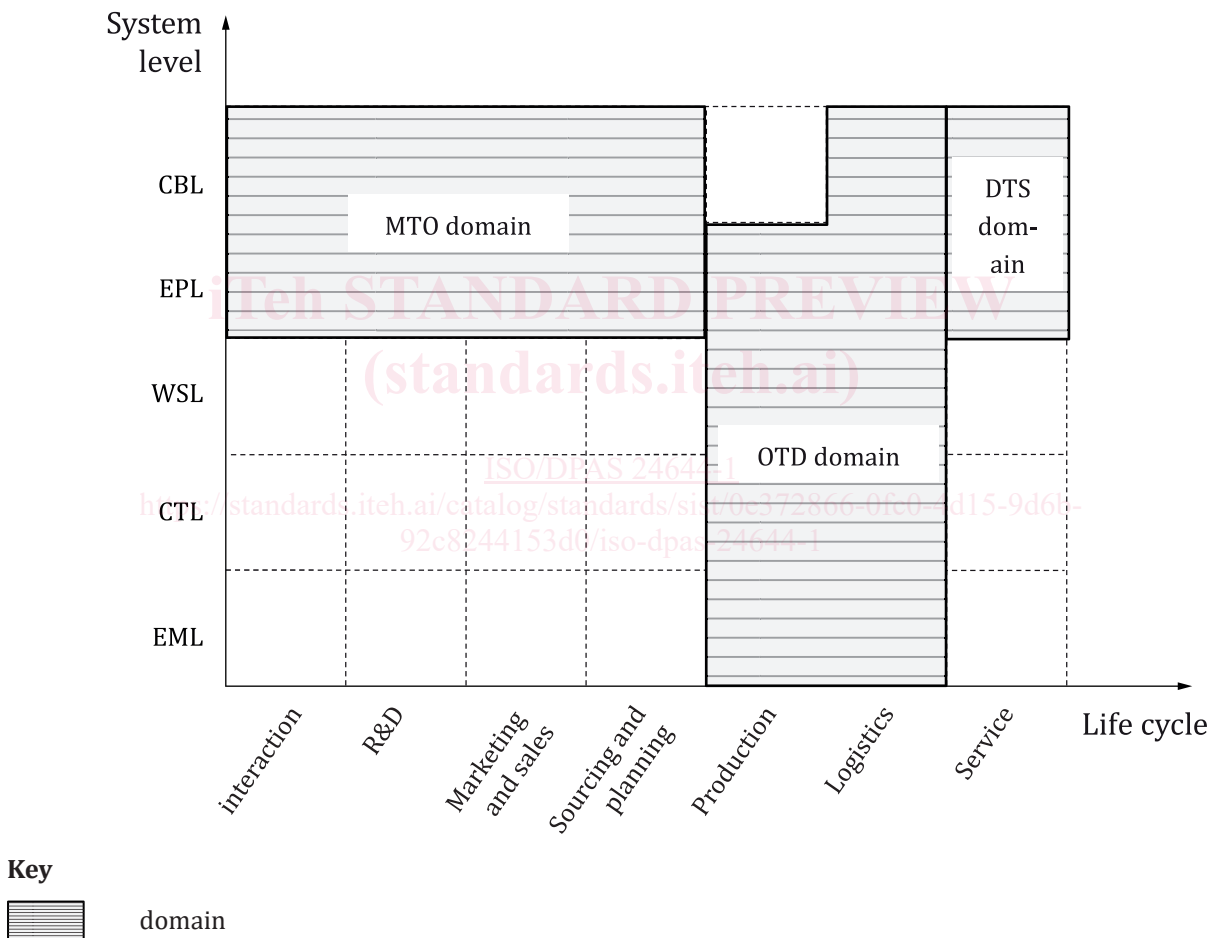


Figure 2 — Mass customization domains

6.2 Framework model domain

In the MTO domain, enterprises shall focus on user demands, output product schemes through the interaction and R&D activities. User orders are generated through the marketing and sales activity. Enterprises shall arrange a master production schedule according to the product scheme and the user orders and find suitable suppliers through the sourcing and planning activity to ensure commodity¹⁾

1) In this document, commodity includes raw material and purchasing parts from suppliers.

supply. The contents of a user order include, e.g. user basic information, customized information, expected delivery date and place, product model, payment information.

In the interaction activity, enterprises shall collect user demands, and interact with users and ecosystem partners, conduct user demands analysis and screening, and output customized demands. The interaction methods include user interfaces, networks (e.g. user interactions with enterprises by surfing the Internet using search engines), social networking (e.g. user interaction with enterprises through social media), web, apps, etc.

In the R&D activity, enterprises shall conduct customized demands classification, assessment, and transformation, and output product solutions after simulation verification.

In the marketing and sales activity, enterprises shall conduct product positioning and pricing, and this activity shall obtain user orders through precision marketing.

In the sourcing and planning activity, enterprises shall find suitable material suppliers for source searching demands and procurement demands.

In the OTD domain, factories shall conduct the production activity to produce customized products and deliver them to users through the logistics activity.

In the production activity, factories shall arrange a detailed production plan according to the master production schedule and material status (including material in stock or its expected arrival time), and this activity shall execute manufacturing according to the detailed production plan.

In the logistics activity, enterprises shall arrange a reasonable delivery route and deliver the customized products to the designated place at the appointed time through logistics management.

In the DTS domain, enterprises shall obtain user experience information through the service activity, conduct online or offline diagnosis to get the status information of products, and this activity shall provide after-sales and value-added services for users.

The user experience information and new demands obtained from the DTS domain shall be fed back to the MTO domain to promote product optimization and iteration.

[Figure 3](#) depicts mass customization domains, elements and functions, and information flow showing the interaction between the users and domains, pictorially summarizing the dynamics of the MTO, OTD, and DTS domains.

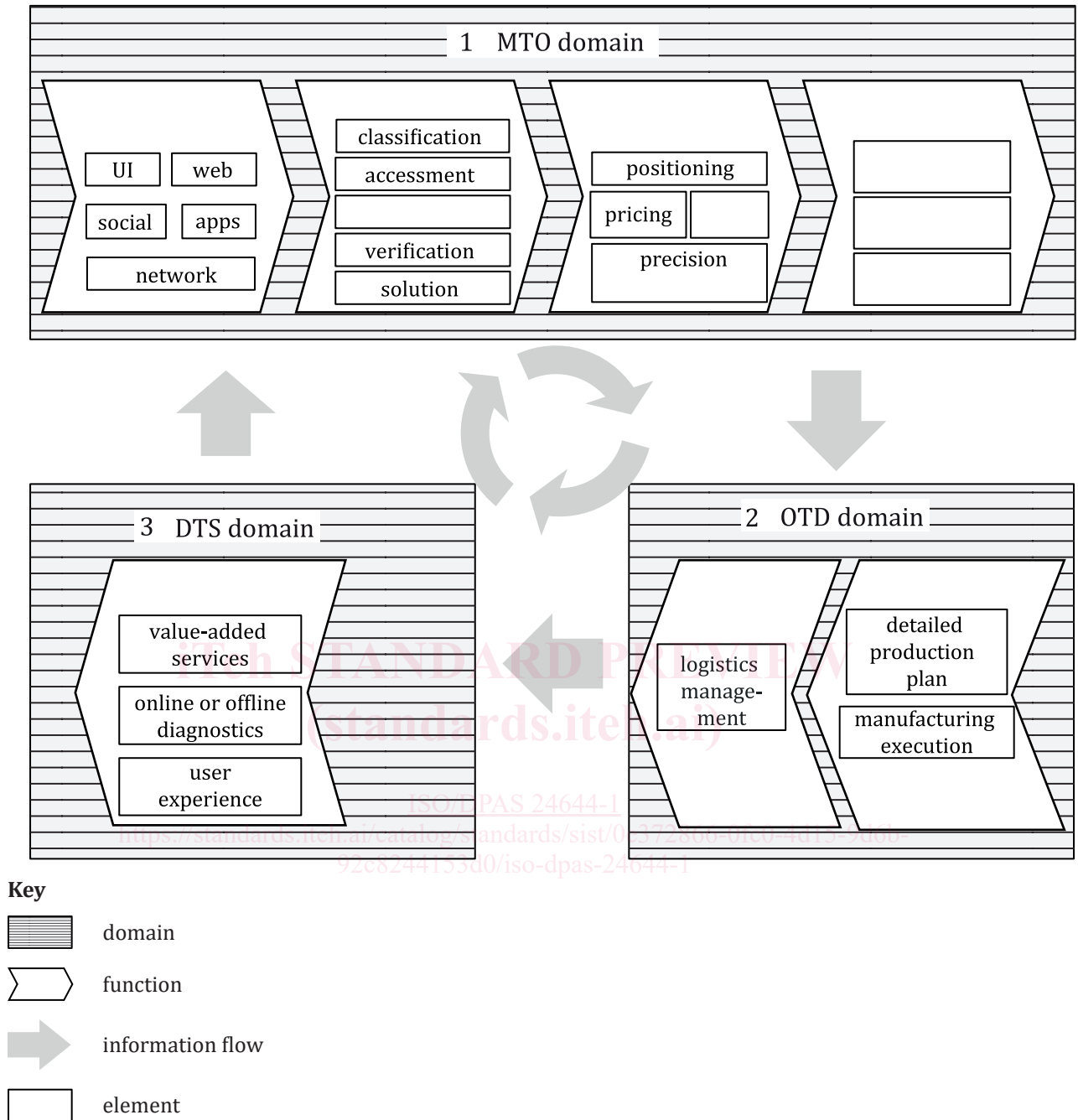


Figure 3 — Mass customization domains and functions

7 Functional model

7.1 Functional model notation

The notations used in the mass customization functional model shown in [Figure 4](#) and the interaction workflow of seven activities, i.e. interaction, R&D, marketing and sales, sourcing and planning, production, logistics and service, shown in [Figure 5](#) are described in [Table 1](#).