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Information technology — 3D printing and scanning — Framework for an Additive Manufacturing Service Platform (AMSP)

Technologies de l'information — Impression et balayage 3D — Cadre conceptuel pour une Plateforme de services de fabrication additive (AMSP)

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

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 and www.iec.ch/national-committees.

Introduction

Additive manufacturing (AM) has been used for rapid prototyping for many years and is increasingly being applied to volume production, mass customization and spare parts production among other use cases. It is possible that low volume prototyping can tolerate simplified, ad hoc or informal interfaces between parts customers and AM service providers. As additive manufacturing capabilities have increased and as demand for additively manufactured parts has increased these informal interfaces are no longer sufficient. Additionally, AM workflows can require the contributions of several service providers in order to achieve the desired outcome. These workflows can need to nimbly adapt to needs specific to that outcome. To do so, a flexible and transparent interface structure is required.

Without interface standards, information exchanges between parts customers and AM service providers, and among collaborating AM service providers, often require ad hoc and expensive manual intervention. Inconsistent descriptions of the characteristics of the services provided can also create confusion, misunderstanding and rework.

The framework for an Additive Manufacturing Service Platform (AMSP) identifies interfaces and their key characteristics where standards can make a beneficial contribution to formalizing the interface for parts submission, design and creation. The Framework for an AMSP also identifies the qualities of an AM service provider that require a standard-consistent specification. The framework for an AMSP does not include these standards; they need to be developed separately. However, it does provide a landscape that clarifies how these standards relate to other elements of the AM ecosystem.

It is hoped that the adoption of this framework and the standards that it calls for will streamline and accelerate the adoption of AM technologies in the manufacturing ecosystem at large, enabling increasingly more complex use cases and richer collaboration between parts customers and a variety of AM service providers.

Information technology — 3D printing and scanning — Framework for an Additive Manufacturing Service Platform (AMSP)

1 Scope

This document specifies the framework for an Additive Manufacturing Service Platform (AMSP). The following elements are within the scope of this document:

— Overview introducing the stakeholders and workflow of an AMSP.

— Requirements specifying various prerequisite conditions from different aspects.

— Framework defining a general functional architecture based on the identified requirements.

— Use cases showing typical work modes of an AMSP.

This document is applicable when individuals or organizations (e.g. commercial enterprises, government agencies and non-profit organizations) build an AMSP or improve existing ones to provide 3D printing and other services specific to the submission, design and creation of AM parts.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/ASTM 52900, *Additive Manufacturing — General Principles — Fundamentals and vocabulary*

ISO/ASTM 52901, *Additive manufacturing — General principles — Requirements for purchased AM parts*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/ASTM 52900 and the following 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
additive manufacturing service platform
AMSP
platform that uses additive manufacturing technology and information technology to provide services according to users' requirements

Note 1 to entry: Examples of services provided include objects/parts manufactured by AM technology, 3D model designs and other services specific to the submission, design and creation of AM parts.

Note 2 to entry: A typical AMSP usually consists of an online platform to gather requirements of users, a group of skilled staff to deal with users' requirements, 3D scanning equipment, AM machines and different kinds of feedstock.

Note 3 to entry: A typical AMSP can sometimes cooperate with individuals or organizations professionalized in specific industries (e.g. aerospace, medicine, etc.).

3.2
user
individual or organization that needs parts manufactured by AM technology and would like to turn to an AMSP for service

3.3
designer
individual or organization that performs 3D modelling and 3D scanning assigned by agreement between user and AMSP

3.4
infrastructure as a service
IaaS
cloud service category in which the cloud capabilities type provided to the cloud service user is an infrastructure capabilities type

[SOURCE: ISO/IEC 17788:2014 3.2.24, modified — term "cloud service customer" replaced with "cloud service user".]

3.5
software as a service
SaaS
cloud service category in which the cloud capabilities type provided to the cloud service user is an application capabilities type

[SOURCE: ISO/IEC 17788:2014 3.2.36, modified — term "cloud service customer" replaced with "cloud service user".]

3.6
additive manufacturing centre
AM centre
place where AM parts are manufactured according to the user's requirement

Note 1 to entry: An AM centre may consist of several kinds of AM systems and corresponding feedstock.

Note 2 to entry: An AM centre can be operated by organizations that manage the AMSP or by organizations/individuals who operate AM systems qualified to be registered on the AMSP.

3.7
3-dimensional design model
3D design model
3D model
data set that contains 3-dimensional geometric elements representing the object/part to be manufactured

3.8
technical data package
data set that contains necessary information and can be exchanged or transformed to provide a format that can be used by an AMSP

Note 1 to entry: Examples of "necessary information" in this context include 3D model, colours, materials, lattices, textures, etc.

4 Overview

4.1 General

An Additive Manufacturing Service Platform (AMSP) provides an access interface (website, app, etc.) where stakeholders, including users, designers and AM centres, can have connections based on their own requirements. With the help of an AMSP, users can purchase specific AM objects/parts and relevant services as they are required rather than AM equipment and feedstock, without the need to have skilled staff trained in AM. There are no up-front costs or investments when turning to AMSP.

4.2 Stakeholders

Figure 1 describes the relationship and interaction among stakeholders including an AMSP, users, designers and AM centres.

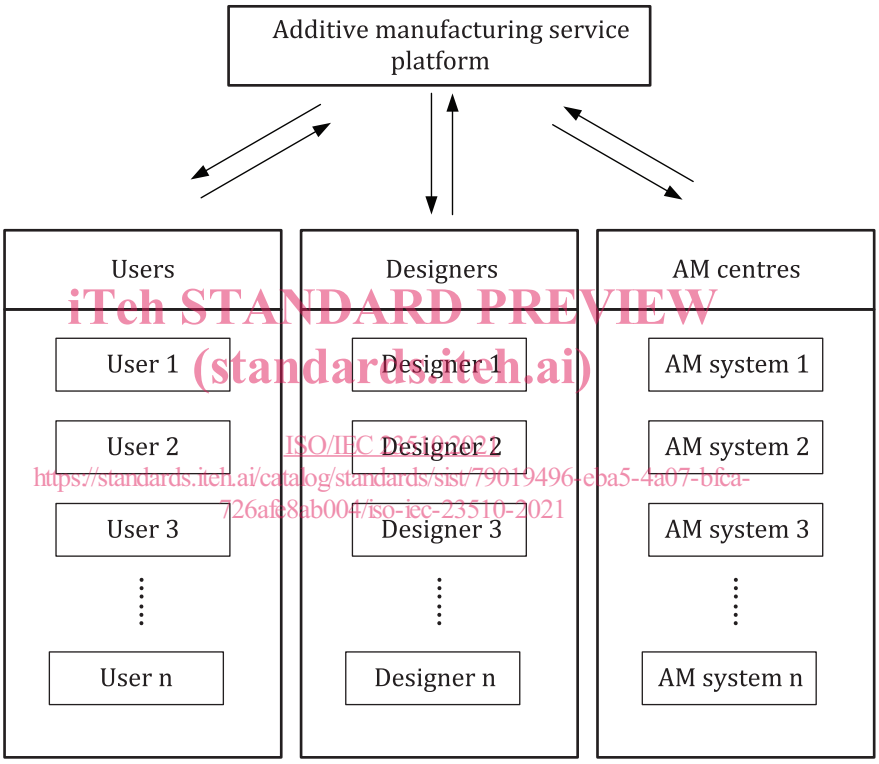

Figure 1 — Interaction among AMSP, users, designers and AM centres

4.3 Workflow

4.3.1 Introduction

Figure 2 describes a typical AMSP workflow.

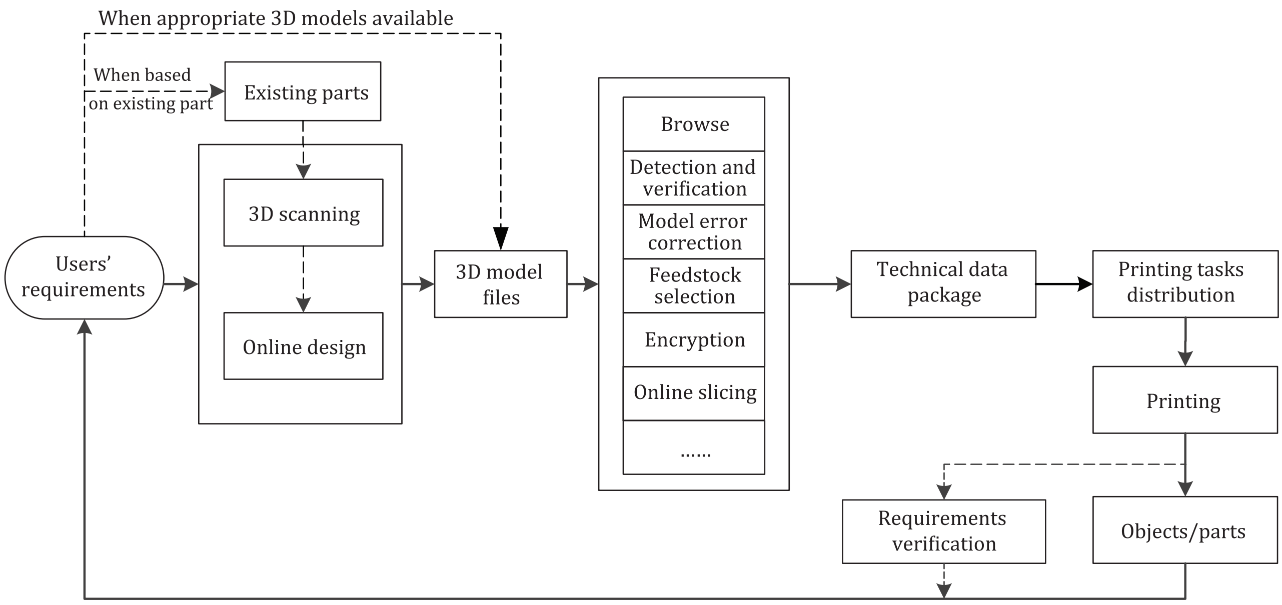

Figure 2 — Typical AMSP workflow

4.3.2 Release of users' requirements

Users are intended to be able to release their requirements on an AMSP in the following ways:

- — by creating 3D models using accessible design software provided on the platform,
- — by finding designers on an AMSP to help them achieve their ideas,
- — by using 3D scanning technology to generate 3D models, or
- — by selecting 3D models directly on an AMSP when there are already models that meet the users' requirements in the database.

Sometimes, after the release of users' requirements, designers will receive commissions distributed by an AMSP. Designers can communicate with the users to improve their ideas and modify the 3D models. More importantly, they can ensure that 3D models are suitable for printing.

When the 3D models are created, users can select colours, materials, lattices, textures, etc. according to their requirements.

4.3.3 Model processing

After receiving the users' requirements, an AMSP can finish several necessary model processing steps, such as model error detection and correction, slicing, data protection, etc. The AMSP then generates a corresponding technical data package and distributes the printing task to the AM centres.

Sometimes, model correction can be carried out by various automated, semi-automated and manual techniques.

Technical data packages can be large, and data compression may be necessary. Data compression should conform with, but is not limited to, ISO/IEC 21320-1. Data compression occurs prior to encryption, otherwise compression is not possible due to the pseudo-random nature of encryption results. In addition, it is recommended to limit the range of encryption to only sensitive or confidential portions of the data such as those requiring intellectual property protection. Excluding model metadata from encryption allows easier reference and access to that metadata and eliminates unnecessary decryption. Note that methodologies of encryption and decryption are out of scope of this document.

4.3.4 Printing and delivery

AM centres shall start printing services after receiving the printing task.

When necessary, an AMSP delivers the objects/parts to the users after the printing is finished.

For typical use cases of services an AMSP can provide, see Annex A.

5 Requirements

5.1 General

AMSPs should support the points in the following subclauses in order to meet the basic requirements of users, but it should be noted that not all points listed below are mandatory. An AMSP is built or improved according to its own purposes, or even expands functions such as logistic service, online shops, etc.

5.2 User management

AMSPs should manage user information registered on an AMSP. AMSPs should also be able to ensure consistent and secure user authentication and login. An AMSP can also provide users registered on the AMSP with access to the various kinds of service that the AMSP can offer.

5.3 Product design

Users can log on to AMSPs either to upload 3D models they already have or to create 3D models online (using online design apps or 3D scanning equipment to scan existing objects/parts), or even find designers on an AMSP to help with the design. Usually, users can choose materials and specify colours, due dates, etc. to suit their own requirements. In order to ensure printability, AMSPs should check the 3D models either automatically or manually.

EXAMPLE In order to facilitate online design, an AMSP can provide databases for typical 3D models, feedstock and post processes to choose from.

NOTE While using 3D scanning technology to generate 3D models, users usually need to deliver existing objects/parts to an AMSP or go to offline AMSP shops when necessary.

5.4 3D intelligent detection and correction

An AMSP should detect 3D model data errors and make corrections or suggestions accordingly and intelligently.

5.5 Order management

After receiving 3D data models with necessary information such as colour, material, etc., the AMSP should generate a price for users. When the price has been confirmed, the AMSP may generate an order. The AMSP tracks the whole process while the objects/parts are being manufactured (including printing and post-processing when necessary).

Sometimes, in order to promote the efficiency of manufacturing, the AMSP should be able to rearrange the orders containing different objects/parts according to the size, material, and process of the objects/parts (see Figure 1). In these circumstances the AMSP shall track the information about each object/part and be able to restore the original orders. Life-cycle tracking of the order is recommended.

NOTE It is sometimes possible for the AMSP to track the information after a user receives the finished objects/parts and to gather feedback from users' comments.