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Additive manufacturing — Data — Data packages for AM parts

Fabrication additive — Données — Paquets de données pour pièces de FA

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Foreword

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This document was prepared by Technical Committee ISO/TC 261, *Additive manufacturing*, in cooperation with ASTM Committee F42, *Additive Manufacturing Technologies*, on the basis of a partnership agreement between ISO and ASTM International with the aim to create a common set of ISO/ASTM standards on additive manufacturing, and in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 438, *Additive manufacturing,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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Introduction

Additive Manufacturing (AM) processes follow many of the same manufacturing steps observed in more "traditional" manufacturing processes, from design to manufacture to inspection. As an advanced manufacturing process, AM introduces additional complexities to those steps within an AM workflow (illustrated in Figure 1). AM-specific information is necessary to specify, verify, and archive data related to parts that are manufactured using AM technologies. Key information associated with those steps includes relevant facility, operator, machine, process, material, postprocess, inspection and other information (see ASTM F3490).

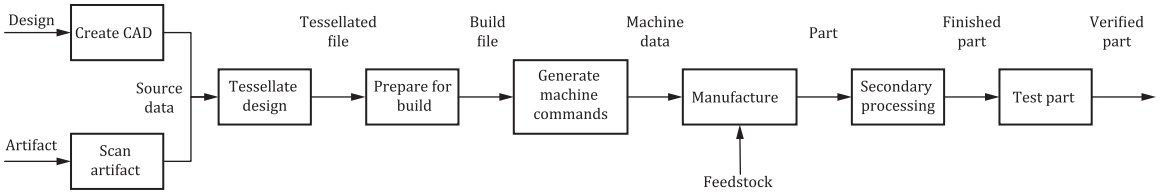


Figure 1 — Illustrative additive manufacturing workflow[1]

This document is developed on the premise that an overarching digital thread can represent the workflow of a part fabricated using an AM process, such as shown in Figure 1. This digital thread is comprised of the information requirements derived from various stages of fabrication, including design, manufacture, and inspection. By identifying and selecting specific information requirements from the digital thread (see Figure 2), a data package for a specific part can be developed for a specific application or scenario associated with each individual stage of the workflow. Data packages serve to provide an organization with a means to specify and organize part information requirements specific to a given application or scenario.

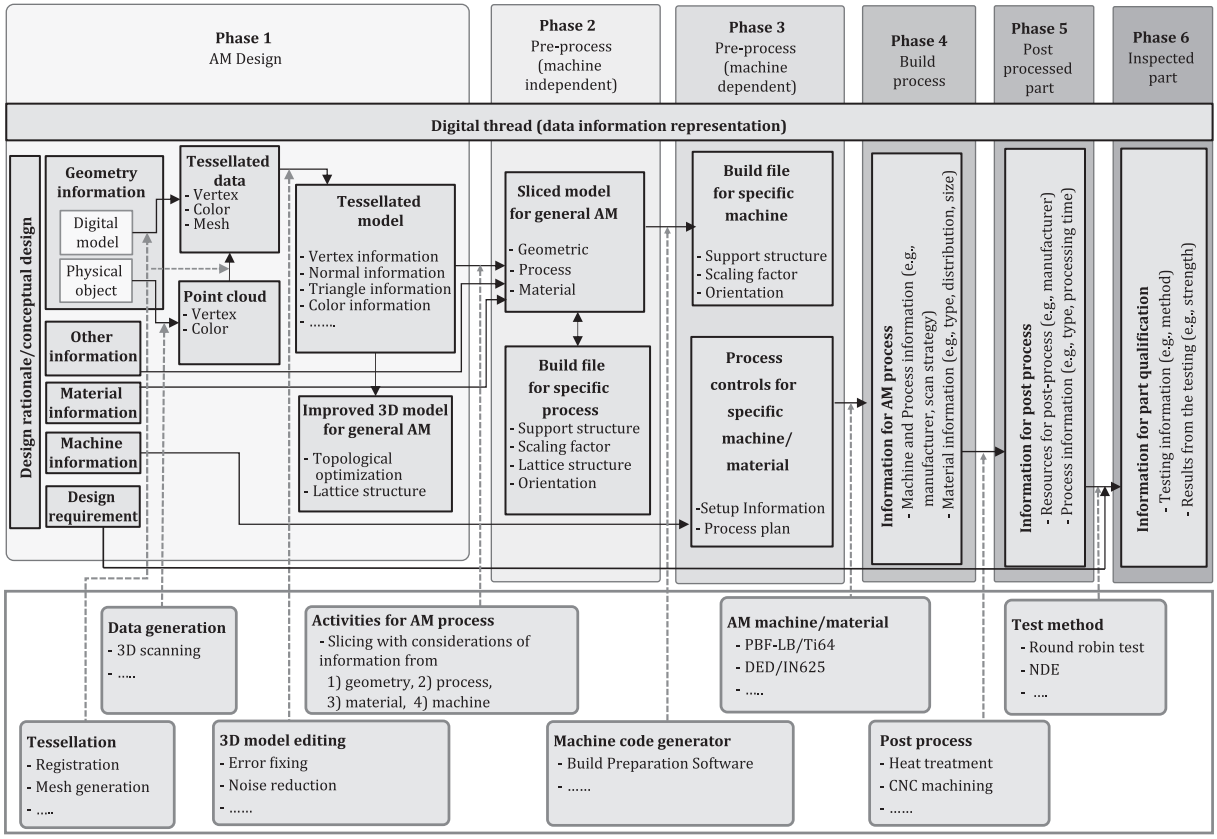


Figure 2 — Illustrative information requirements associated with data package development[1]

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This document establishes a system to maximize an organization's flexibility when determining its data package requirements for various scenarios. The modularization of information requirements and their level of specificity supports the general, broad adoption of this document while also supporting specific organization needs and scenario requirements. In this sense, this document establishes principles for modular, multi-tiered information requirements to support the development of data packages for various scenarios with varying levels of control. Configuration management practices are used to identify acceptable representations, including file formats and file types, for given data package requirements.

To support part acceptance, this document establishes general principles for data package requirements, that, working in concert with data structure and configuration management, can be used to create a digital representation, or a "digital twin" of an additively manufactured part. A digital twin (see Figure 3) is developed by addressing the requirements of this document for a specific part and application scenario.

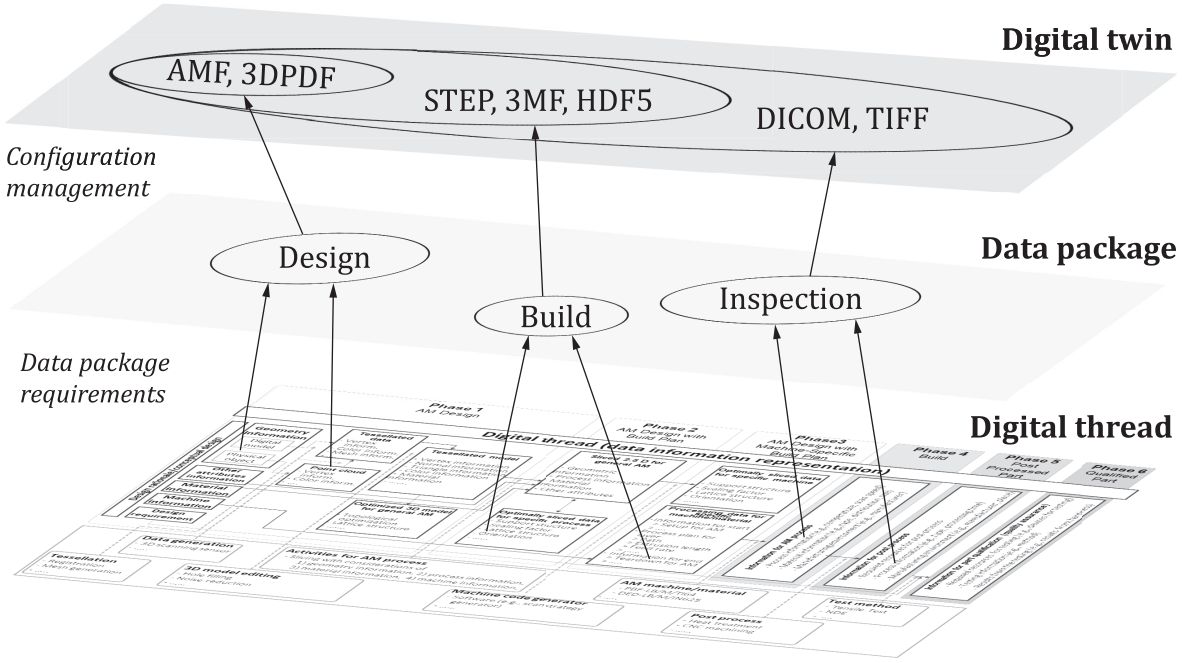


Figure 3 — The data package concept is central to the curation of additive manufacturing information

In transitioning from a design to a manufactured part, the AM digital thread progresses through many digital representations including: CAD design, simulation, tessellated geometry, sliced geometry, build file, part with build data and part with evaluation data. At each of these stages, the digital provenance of the part is evolving, with its digital twin maturing from the generation of new data at every stage. As a digital representation of the intended physical counterpart, the digital twin provides important insight into the state of the part through its design to product transformation. When accepting a final part, it is important to have confidence in the processes used in the fabrication of the part, since differences in implementation can mean different parts. The digital twin provides an important resource from which confidence can be gained but can create its own uncertainty if not well-defined and well-understood, with the requirements identified in the data package.

Clause 4 outlines the general procedure to be followed for an organization to develop a customized data package, from identifying information requirements to adopting configuration management practices. Clauses 5 to 10 outline the data requirements across the AM workflow. Clause 11 provides the specific configurations to meet specified organizational requirements.

Key concepts used and discussed in this document include data package, data package requirement, digital thread, digital twin, modular components, configurability, configuration management, capability (e.g. software, equipment, facility, operator) and criticality (part or application).

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Additive manufacturing — Data — Data packages for AM parts

1 Scope

This document specifies the methods, parameter sets and models to develop and utilize a data package for a part created using AM technologies (AM part). This document is applicable to the information requirements associated with workflow of the fabrication of an AM part, from design to acceptance. Peripheral information related to entities such as organization, facility, operator, security, and others is addressed for sake of completeness; but is not the focus of this document and can be defined elsewhere. This document provides the means to develop an organizational or application-specific data package for the communication between and amongst the designer, the manufacturer, and all acceptance authorities, among other potential stakeholders.

This document does not impose a plan of execution to produce an AM part, though a digital thread is provided to establish a referenceable information workflow.

The requirements set forth in this document are based on the fabrication of a part using the PBF-LB/M (powder bed fusion-laser based/metal) process. While specific details directly relate to PBF-LB/M, generalized workflow requirements can be related to any AM process.

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*

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
AM data package, noun
set of information associated with an AM part, instantiated data package requirements that should confirm established configuration management practices

3.2
AM digital thread, noun
digital component of the design to product transformation workflow of an AM part

3.3
AM workflow, noun
process applied to realize the design to product transformation of an AM part, including any acceptance procedures

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