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Space systems — Programme management — Breakdown of project management structures

Systèmes spatiaux — Management de programme — Éléments de structures de gestion de projet

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 27026:2011), which has been technically revised.

The main changes are as follows:

— updated the normative references in Clause 2;

— updated the terms and definitions references in Clause 3.

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

Space programmes, and the space systems developed by them, are complex, incorporate many different technologies, and can last for many years progressing through several different stages from conception to disposal or other disposition. When a space programme advances from one stage to another, substantial changes in the breakdown of project management structures, hereinafter collectively called project breakdown structures, of the programme and the type and amount of resources required can occur; a programme is often composed of one or more projects. In addition, there can be attendant risks to either the success of the project or to the well-being of project equipment or to personnel. Well-regulated project breakdown structures can be an important factor in ensuring that all factors are ready for these changes through controlled changes to the project breakdown structures that form a framework for the project in each of the several different stages, and assist in ensuring that the risks are well understood and accepted. Use of this document as a basis for the framework of activities comprising the project, the necessary resources, controls, inputs, outputs, and results is intended to enhance communications between different organizations that participate in a project, and can assist in reducing costs and schedule of performing the project in each stage.

This document is intended to complement and supplement similar project breakdown structure processes, requirements and recommendations contained within ISO 14300-1, which serves as a higher-tier International Standard for this document and for such other space systems and operations International Standards that require formal project breakdown structures.

Space systems — Programme management — Breakdown of project management structures

1 Scopes

This document specifies processes, requirements and recommendations for the breakdown of project management structures, collectively called project breakdown structures, in terms of the various specification (i.e. requirements), functional, product, work, cost, business and organizational breakdown structures that are established and implemented to contribute to the success of a space programme, which is often composed of one or more projects. It specifies the various types of project breakdown structures and gives processes, requirements and guidance concerning the composition of these breakdown structures.

This document is applicable to project breakdown structures for a project, including at the top level of a programme, i.e. level 0, as indicated in ISO 14300-1. It is intended to be used either by an independent developer as a partial basis for programme processes or as a basis for an agreement between a supplier and a customer.

This document also provides descriptions of the kinds of project breakdown structures that are commonly useful in contributing to the success of a space project. Other project breakdown structures not described in this document also often contribute to the success of a space project.

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 10795, *Space systems — Programme management and quality — Vocabulary*

ISO 14300-1, *Space systems — Programme management — Part 1: Structuring of a project*

ISO 23462, *Space systems — Guidelines to define the management framework for a space project*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10795 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/

3.1.1
breakdown structure
framework for efficiently controlling some aspect of the activities of a *programme* (3.1.2) or *project* (3.1.3)

3.1.2
programme
group of *projects* (3.1.3) managed in a coordinated way to obtain benefits not available from managing them individually

3.1.3
project
unique process consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources

[SOURCE: ISO 9000:2015, 3.4.2, modified — The notes to entry have been removed.]

3.2 Abbreviated terms

CBS cost breakdown structure

OBS organizational breakdown structure

WBS work breakdown structure

WP work package

4 Overview of project breakdown structures

4.1 General

4.1.1 There are generally several types of project breakdown structures that are generated to provide a framework for efficiently controlling the programme, or its projects, and producing the product agreed to between the customer and the supplier. The project breakdown structures shall have the organizational framework of a tree in accordance with ISO 23462.

4.1.2 A project breakdown structures tree as used in this document is an arrangement of related items or elements characterized by having a top-level node, or summit, that is broken down into lower-level elements or nodes until the lowest-level elements are determined; the lowest level is usually based upon some degree of reasonableness or of diminishing returns of further breakdown. A tree is generally constructed for project breakdown structures because the lower-level elements are more easily managed. In a project breakdown structures tree, a hierarchical relationship exists between elements at the same level of breakdown to the next higher related node element above; in addition, elements at the same level of breakdown often have interfaces with other items at the same level.

4.1.3 The project breakdown structures described in this clause and in Clause 5 are expressed in terms of a business agreement or contract between a supplier and a customer, where the project breakdown structures are based upon the supplier's workshare. However, the same principles, processes and requirements for project breakdown structures can be used by an independent developer, in which case the project breakdown structures are for the complete system product that can be developed entirely by the independent developer, or by the independent developer and subcontracted suppliers.

4.2 Relationship of project breakdown structures

4.2.1 In the context of ISO 14300-1, the various project breakdown structures within a programme or project originate with the level 0 customer's set of requirements. Based upon the business agreement and from the customer's requirements, a level 1 supplier develops a set of specifications, each containing requirements, that satisfies the level 0 customer's requirements. The specifications are organized in a hierarchical specification tree, with lower-level specifications containing requirements that flow down from higher-level specifications.

4.2.2 From the requirements contained in the specification tree, a function tree shall be generally generated. The functions determine what shall be performed by the level 1 supplier's workshare portion of the system, which can be the complete system; the functional requirements in the specification tree specify how well the requirements shall be performed. The specification and functional trees shall be used to generate the design elements of the system product, which is arranged as a product tree. The development of the specification, and hence requirements, tree, is an iterative process with the development of the function tree and the product tree to develop lower levels of each of the trees. Depending upon the situation, the requirements within the specification tree may often contain the functions expressed as functional requirements in sufficient manner that a function tree may not need to be separately generated, in which case only a specification tree may be generated.

4.2.3 The tasks needed to develop the trees resulting in the system product are arranged in a work breakdown structure (WBS), which is a hierarchical tree with lower-level tasks providing more detail related to the node task above. The WBS serves as a reference for the identification of cost elements arranged into a cost breakdown structure (CBS), which is a hierarchical tree of lower cost elements related to the next higher node cost element above.

4.2.4 The WBS and CBS, along with the overall management organization of the level 1 supplier, result in a programme or project organizational breakdown structure (OBS) for the level 1 supplier's workshare, which is arranged as a hierarchical tree of lower organizational elements reporting, or related, to the next higher-level node organization.

4.2.5 In the context of ISO 14300-1, when the level 1 supplier subcontracts part of the product development to one or more level 2 suppliers, each level 2 supplier develops a similar set of lower-level project breakdown structures based upon the requirements contained in the sub-contractual agreement with the level 1 supplier, which in effect becomes the customer for the level 2 suppliers. This process of generating further lower-level project breakdown structures is similarly repeated for each successively lower level of supplier relationships. If a level 1 supplier initiates subcontracts with a level 2 supplier or other lower level suppliers, the supplier generates a business agreement breakdown structure that hierarchically depicts these subcontract relationships.

4.3 Purpose of project breakdown structures

The purpose of generating and maintaining a set of project breakdown structures is to provide:

a) a framework for ensuring that all requirements, functions and products of the system design are identified and arranged in a logical relationship that can be traced to, and satisfy, the customer's requirements;

b) an identification of all tasks and resources needed to generate the system product;

c) a cost relationship to the tasks being performed;

d) an organizational context for the programme, or project, to perform the tasks needed to generate the system product;

e) an identification, by name, within the organization of the responsible person for performing each task element within the WBS;

f) a basis for configuration control once a particular project breakdown structure is baselined;

g) a framework for identifying risks and subsequent risk management;

h) a basis for effective management of changes;

i) a basis for financial control and interface responsibilities resulting from business agreements.

4.4 Tailoring

The requirements and other provisions contained within this document may be tailored to conform to the specific circumstances of a particular business arrangement. Tailoring involves examining the requirements and other provisions contained in this document for a specific programme or project and potentially:

a) selecting only a subset of the requirements and other provisions;

b) modifying selected requirements and other provisions;

c) adding new requirements and other provisions;

d) some combination of a), b) and c).

5 Processes and requirements of project breakdown structures

5.1 General

5.1.1 For simplicity, the term “customer” shall hereinafter refer to the level 0 customer that has a contractual relationship with the level 1 supplier as specified in ISO 14300-1.

5.1.2 For simplicity, the term “supplier” shall hereinafter refer to the level 1 supplier as specified in ISO 14300-1.

5.1.3 For simplicity, the term “lower tier supplier” shall hereinafter refer to a level 2 supplier as specified in ISO 14300-1, and may be extended to mean suppliers at even lower levels.

5.2 Specification tree

5.2.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a specification tree for the portion of the system product that is the supplier's workshare.

5.2.2 A specification tree is the breakdown into successively lower levels of detail of the requirements to which the portion of the system product shall comply, which, depending upon the business agreement, can be the complete system or some subset of the system. The specification tree is a hierarchical arrangement of specifications, which contain the requirements at each hierarchical level. Starting at the top or summit level, each requirement is broken down into more detailed requirements at the next lower hierarchical level; the same process can then be performed to arrive at successively lower, hierarchal levels of requirements. This process generates a tree of requirements; the requirements are contained in a tree of specifications. The requirements at each hierarchical level are traceable to requirements at the next higher hierarchical level. The requirements at the top, or summit, level conform to the customer's requirements that are contained within the contract or are normatively referenced to by the contract. Annex A provides an example of a specification tree.

5.2.3 The development of the specification, and hence requirements, tree, is an iterative process with the development of the function tree and the product tree to develop lower levels of each of the trees.

5.2.4 The requirements in the specification tree shall contain all the requirements needed to develop and produce the portion of the system product that is the supplier's workshare. If a supplier subcontracts part of the workshare to another supplier, a specification tree shall be developed by the lower-tier supplier and be incorporated as part the higher-tier supplier's specification tree.

5.2.5 The specification tree, and the requirements therein, shall be subject to customer approval and subsequently placed under configuration control. Changes to the requirements in the specification tree shall be approved by the customer.

5.3 Function tree

5.3.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a function tree for the portion of the system product that is the supplier's workshare.

5.3.2 The function tree is the breakdown into successively lower levels of detail of the functions that shall be performed by the supplier's portion of the system product. The top-level functions are derived from, or specified by, the customer's requirements that result in the top-level specification in the specification tree. Starting at the top or summit level, each function is decomposed into more detailed functions, or subfunctions, at the next lower hierarchical level; the same process can then be performed to arrive at successively lower, hierarchal levels of functions. This process generates a tree of functions and provides the framework of the performance of the supplier's portion of the system performance. The functions at each level are independent of the product involved. The functions determine what shall be performed by the supplier's workshare portion of the system, which depending upon the business agreement can be the complete system or some subset of the system; the functional requirements in the specification tree specify how well the requirements shall be performed. The functions at each hierarchical level are traceable to functions at the next higher hierarchical level. The functions at the top, or summit, level conform to the customer's functional requirements that are contained within the contract or are normatively referenced to by the contract. Annex B provides an example of a function tree.

5.3.3 The development of the function tree is an iterative process with the development of the specification, hence requirements, tree, and the product tree to develop lower levels of each of the trees.

5.3.4 At each level, the requirements and functions shall result in specifications for specific hardware and software products that become a part of the specification tree.

5.3.5 The function tree shall contain all the functions required to be performed by the portion of the system product that is the supplier's workshare. If a supplier subcontracts part of the workshare to another supplier, a function tree shall be developed by the lower-tier supplier and be incorporated as part of the higher-tier supplier's function tree.

5.3.6 The function tree shall be subject to customer approval and subsequently placed under configuration control. Changes to the function tree shall be approved by the customer.

5.4 Product tree

5.4.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a product tree for the portion of the system product that is the supplier's workshare.

5.4.2 The product tree is the breakdown into successively lower levels of detail of the products that shall be produced for the supplier's portion of the system product. The products at each level of the tree can be hardware, software or a combination of both. The product tree defines the breakdown structure of the portion of the system product that is the supplier's workshare in terms of its elements, which depending upon the business agreement can be the complete system or some subset of the system, such as subsystems, assemblies, equipment, components, down to individual deliverable end items. Annex C provides an example of a product tree.

5.4.3 The development of the product tree is an iterative process with the development of the specification, hence requirements, tree, and function tree to develop lower levels of each of the trees.

5.4.4 Each product at a particular hierarchical level of the product tree shall comply with the requirements and functions contained in the applicable specification of the specification tree.

5.4.5 The product tree shall contain all the products needed for the portion of the system product that is the supplier's workshare. If a supplier subcontracts part of the workshare to another supplier, a product tree shall be developed by the lower-tier supplier and be incorporated as part of the higher-tier supplier's product tree.

NOTE The product tree extends beyond the items directly necessary to perform the system functions from the function tree. It encompasses models, test facilities, ground support equipment, etc. so that these are identified and managed within the project as well and are covered in the work and cost breakdown structures.

5.4.6 The product tree shall be subject to customer approval and subsequently placed under configuration control. Changes to the product tree shall be approved by the customer.

5.5 Work breakdown structure

5.5.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a WBS for the portion of the system product that is the supplier's workshare.

5.5.2 The WBS is the systematic breakdown of the supplier's workshare into lower levels of detail that are arranged hierarchically like a tree. In the context of ISO 14300-1, the WBS shall identify all the tasks and resources needed to complete products intended to satisfy the requirements of the business agreement or contract agreed to between the customer and supplier. Annex D provides an example of a WBS.

5.5.3 Depending upon the phase of the programme or project as specified in ISO 14300-1, if the product tree is already developed, it shall serve as the basis for structuring the WBS. Otherwise, a mutually agreeable basis for the WBS shall be established between the customer and supplier.

5.5.4 The WBS shall define the complete scope of work that shall be performed by the supplier, thereby becoming one of the principal means of managing the programme or project. The WBS provides a basis for cost and schedule planning and control of the business agreement or contract.

5.5.5 Each of the hierarchical elements of the WBS is referred to as a work package (WP) and shall be defined by an associated WP description; the complete set of WP descriptions shall define the complete scope of work of the business agreement or contract between the customer and supplier. Each WP shall have:

a) a unique identifier, which preferably denotes its position in the WBS;

b) a title, for ease of reference;

c) an assigned WP manager responsible for accomplishing the WP description;

d) a description with a scope that is manageable and permits measurement of progress;

e) a planned duration, with specific start and end dates;

f) specific inputs needed to accomplish the WP, along with any WPs or sources from which the inputs originate;

g) resources (e.g. materials, personnel) identified necessary to accomplish the WP;

h) specific outputs identified resulting from performing the WP, along with the relationship of the outputs to other WPs and the product tree or some other breakdown structure, as specified in 5.5.4;

i) relationships identified to other WPs in the WBS.

5.5.6 Depending upon the business agreement or contract, a WP may be required to have other attributes in addition to those in 5.5.5.

5.5.7 If a supplier subcontracts part of the workshare to another supplier, a WBS shall be developed by the lower-tier supplier and be incorporated as part of the higher-tier supplier's WBS. The scope of work of the subcontracted business agreement or contract with the lower-tier supplier shall contain at least one WP of the supplier's WBS.

5.5.8 The WBS shall be subject to customer approval and subsequently placed under configuration control. Changes to the WBS shall be approved by the customer.

5.6 Cost breakdown structure

5.6.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a CBS for the portion of the system product that is the supplier's workshare.

5.6.2 The CBS is the systematic breakdown of the costs of the supplier's workshare into lower levels of detail that are arranged hierarchically like a tree; in addition, the CBS breakdown identifies cost elements by cost categories. The types of cost categories shall be based upon the business agreement or contract agreed to between the customer and supplier. Annex E provides an example of a CBS.

5.6.3 The CBS shall be structured similar to the WBS, use the WBS for cost summarization, and contain all the costs associated with the business agreement or contract.

5.6.4 If a supplier subcontracts part of the workshare to another supplier, then a CBS shall be developed by the lower-tier supplier and be incorporated as part of the higher-tier supplier's CBS.

5.6.5 The CBS shall be subject to customer approval and subsequently placed under configuration control. Changes to the CBS shall be approved by the customer.

5.7 Business agreement breakdown structure

5.7.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate a business agreement breakdown structure for the portion of the system product that is the supplier's workshare.

5.7.2 The business agreement breakdown structure is the hierarchical tree arrangement of lower-tier suppliers that the supplier has made subcontracts with in order to accomplish the portion of the system product that is the supplier's workshare.

5.7.3 The business agreement breakdown structure shall be related to the supplier's WBS as specified in 5.5 and to the CBS as specified in 5.6.

5.7.4 Additional requirements for a business agreement breakdown structure shall be based upon the business agreement or contract agreed to between the customer and supplier.

5.8 Organizational breakdown structure

5.8.1 Based upon the business agreement or contract agreed to between the customer and supplier, the supplier shall generate an OBS for the portion of the system product that is the supplier's workshare.

5.8.2 The OBS is the hierarchical tree arrangement of programme or project personnel responsible for managing the performance of the supplier's workshare. ISO 14300-1 contains provisions that a supplier may use in generating the OBS.

5.8.3 The OBS shall as a minimum contain the roles of the various elements of the OBS, names of persons performing the roles and the organizations from within the supplier that the persons belong to.

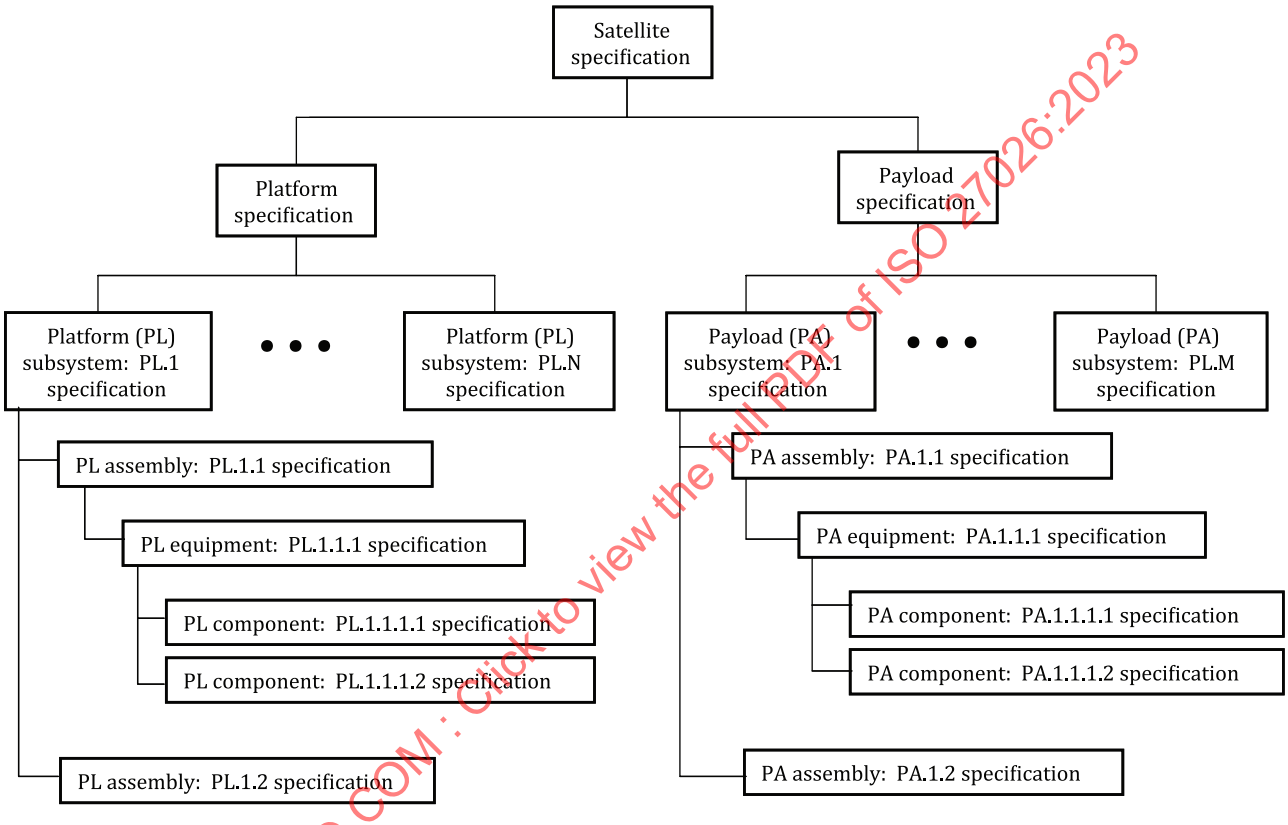
5.8.4 If a supplier subcontracts part of the workshare to another supplier, then an OBS shall be developed by the lower-tier supplier and be incorporated as part of the higher-tier supplier's OBS.

5.8.5 Additional requirements for the OBS shall be based upon the business agreement or contract agreed to between the customer and supplier.

Annex A
(informative)

Specification tree

Figure A.1 is an example of a specification tree for a satellite.



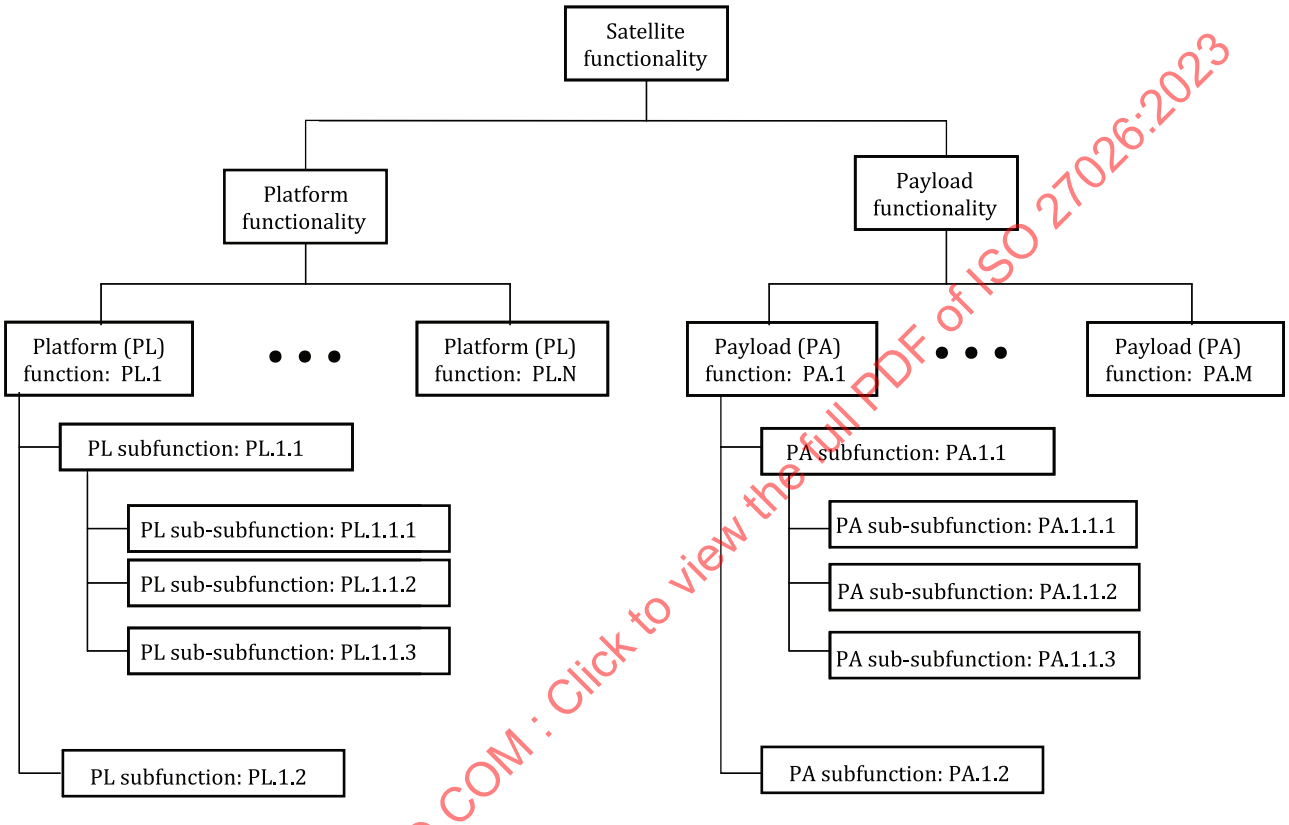
NOTE Generally, a specification tree is developed for each part of the product tree breakdown structure for a satellite. Depending upon the business agreement or contract, the number of subsystems, assemblies, pieces of equipment and components varies.

Figure A.1 — Example of a specification tree

Annex B
(informative)

Function tree

Figure B.1 is an example of a function tree for a satellite.



NOTE Depending upon the business agreement or contract, the number of functions and their level of decomposition vary.

Figure B.1 — Example of a function tree