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Aeronavtika - Vodenje programov - Splošne smernice za nabavo in dobavo/oskrbo odprtih sistemov

Aerospace series - Programme Management - General guidelines for acquisition and supply of open systems

Luft- und Raumfahrt - Programm-Management - Allgemeiner Leitfaden für Erwerb und Lieferung von offenen Systemen

Série aérospatiale - Management de Programme - Recommandations générales pour l'acquisition et la fourniture de systèmes ouverts

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Contents

Page

Foreword

This document (EN 9320:2014) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2015, and conflicting national standards shall be withdrawn at the latest by June 2015.

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1 Scope

These general guidelines cover the open system acquisition and supply processes.

There is an increasing requirement for systems designed and produced by industry, particularly in the aeronautic, space and defence fields, to be used with other systems designed, produced, acquired and operated independently.

The concept of open systems is touched upon in many systems engineering documents. This document deals specifically with this subject. To this end, through the various processes applied, it provides information to stakeholders (buyers, suppliers, designers, subcontractors, supervisors, etc.) on the best practice to be adopted.

The specific nature of openness for a system is defined by all the following properties:

— Interchangeability,

— Interoperability,

— Upgradability,

— Reusability,

— Reversibility,

— Flexibility,

— Affordability.

These properties are defined in the glossary for these general guidelines.

These general guidelines are largely based on the structure and system life cycle processes described in standard ISO/IEC 15288:2008.

The characteristics of openness also relate to:

— The products or services offered by the company (target systems resulting from use of company processes).

— The company's processes (project systems). Several stakeholders, with their own assignments, cultures, jobs and geographical locations, different working methods, modelling frameworks, standards, tools and aids, etc. are involved in the activities, which are sometimes multidisciplinary, of the internal and external processes of a company. These diverse elements are not necessarily all suited to working together without causing certain risks, a loss of autonomy, effectiveness and/or efficiency, etc. A company must, for example, develop its ability and capacity in terms of interoperability both internally (between the systems of which it is made) and externally (with other partners), including, by way of an example:

    — Ability of each stakeholder and each department involved to maintain efficient and trusting relationships with other stakeholders, taking into account deadline, cost and quality objectives,

    — Ability to exchange, communicate and use the necessary flows (data, information, knowledge, materials, energy) autonomously, without error and dynamically throughout the life cycle of the target system,

    — Ability to coordinate, synchronise and manage common tasks and share and use resources (human, machine or application) and services efficiently and appropriately.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9001:2008, *Quality management systems — Requirements*

ISO 9241-210:2010, *Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems*

ISO 10007:2003, *Quality management systems — Guidelines for configuration management*

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*

ISO/IEC 15288:2008, *Systems and software engineering — System life cycle processes*

ISO/IEC 9126-1:2001, *Software engineering — Product quality — Part 1: Quality model*

IEEE 830:1998, *IEEE Recommended Practice for Software Requirements Specifications*

IEEE 1471:2000, *IEEE Recommended Practice for Architectural Description for Software — Intensive Systems*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
affordability
ability of a system to have acceptable operational performance for an acceptable cost of ownership, resulting from a compromise after negotiation between the Parties

[SOURCE: IEEE 1471:2000]

3.1.2
architecture
fundamental organisation of a system described by its components, the relationship between these components and with the environment, and the principles guiding its representation and its development. The relationships between the components are described in the interfaces

3.1.3
capacity
capacity is represented by the consistent integration of a Policy, an Organisation, human resources, training, Support and Equipment

3.1.4
component
product that cannot be broken down from the point of view of a specific application

[SOURCE: ISO 10303-1:1994]

3.1.5
flexibility
ability of a system to continue to fulfil its mission by dynamically or statically adapting to anticipated or foreseeable changes that may occur in its environment

3.1.6
interchangeability
ability of a hardware or software component to be replaced, with no change to the components connected to it, by another that meets the same requirements

3.1.7
interface
an interface is the part of a system or piece of equipment that communicates with another system or piece of equipment

3.1.8
interoperability
interoperability can be defined as the ability of systems to exchange, with no loss or ambiguity, various object flows (data, information, knowledge, materials, energy, etc.), then to be capable of using these objects independently to fulfil their own assignments or to fulfil a shared assignment for a given purpose with no change to their structure, behaviour or operation

3.1.9
key interface
the interface of a module that needs to be interoperable, easy to change, replaced or isolated due to its complexity, obsolescence or the costs involved

3.1.10
operational assignment
operational assignments are the parts of department activities that may be repetitive, planned and of limited duration

3.1.11
product life cycle
this covers all the situations the product goes through during its life from statement of requirement to withdrawal from whatever service is provided

[SOURCE: NF X 50-100:1996]

3.1.12
reusability
for a hardware or software component, ability to be used, unchanged, in a system or subsystem other than the one for which it was originally developed

For a system or subsystem, ability to use, unchanged, hardware or software components which were not originally developed for it

3.1.13
reversibility
ability of a system, subsystem or component to be modified and updated by a manufacturer other than the one that produced it

3.1.14
open system
assembly including software and hardware elements and operating procedures, designed by humans. These elements interact to satisfy the requirements (including interface requirements) defined, published and maintained by general consensus by a group

Modular construction created so that its modules are defined precisely and have public interfaces allowing independent suppliers to provide new capacities and innovative modules

[Modular Open System Architecture]

3.1.15
openness
the characteristic of openness for a system is defined by all the following properties:

— Interchangeability,

— Interoperability,

— Upgradability,

— Reusability,

— Reversibility,

— Flexibility,

— Affordability.

3.1.16
system of systems (SoS)
the characteristics of a system of systems are:

— Operational independence of the systems,

— Managerial independence of the systems,

— Emergence of new services,

— Upgradable configurations,

— Geographic distribution of the systems,

3.1.17
technical facts
key technical event, anticipated or unexpected, in the life cycle of a product

3.1.18
upgradability
potential ability of a system, subsystem or component to respond to changes in operational requirements and anticipated or foreseeable technical changes without affecting the basis of its structure

3.1.19
validation
comparative assessment to confirm that the requirements of stakeholders are properly satisfied. If discrepancies are found, they are recorded and lead to corrective action. Validation is ratified by the stakeholders

[SOURCE: ISO/IEC 15288:2008]

3.1.20
verification
demonstration, through assessment of the product, that the system has been designed correctly, i.e. that it complies with the specifications according to which the product was made

[SOURCE: ISO/IEC 15288:2008]

3.2 List of abbreviations

NCOIC	Network Centric Operations Industry Consortium
OTS	Off-The-Shelf
IADT	Inspection Analysis Demonstration Test
OS	Open System
MMI	Man Machine Interface
SoS	System of Systems
SMART	Specific, Measurable, Achievable, Realistic and Time-constrained.
STEP	Standard for the Exchange of Product model data
TRL	Technology Readiness Level
IRL	Integration Readiness Level
SCOPE	Systems Capabilities, Operations, Programmes and Enterprises
UML	Unified Modelling Language
SysML	System Modelling Language

4 Acquisition process

The organisations are producers and consumers of systems, which may make products or perform services. These systems are produced by some or implemented or consumed by others within the context of the relationship between buyers (those who purchase and consume or use) and suppliers (those who produce and sell). Buyer/supplier relations are maintained through contracts. Acquisition of an open system requires specific activities to be carried out to optimise signature of contracts to obtain a product/service that satisfies the openness requirements.

The purpose of the process described in this chapter is to characterise these activities. The level of detail of each activity depends on the complexity of the system to be acquired.

4.1 An acquisition strategy is established

4.1.1 Define an openness strategy

Define the openness level required depending on, for example, the maturity scale defined using the SCOPE model developed by the NCOIC. To establish this openness level, it is important to:

— Be aware of the operational environment into which the system to be acquired will be integrated, exhaustively and explicitly identify the systems of the operational environment with which the system to be acquired should interoperate, characterise the flows between these systems.

— List the rules and standards applied by the technical systems of this operational environment.

— Define the openness objectives.

— Rate these openness objectives for the system to be acquired in accordance with the environment.

4.1.2 Define an acquisition strategy

The way in which the system is acquired (related to the quantity and/or the complexity of the system in question) can have a direct effect on the system openness. A short-term acquisition for a system with a short life cycle may be unique. On the other hand, acquisition in stages or long-term acquisition for a system with a long life cycle entails requirements in terms of openness, including upgradability, and can cause openness problems linked to changes in the environment in which it is integrated, for example unplanned changes to the other systems in its environment. It is therefore necessary to establish an acquisition strategy depending on the system life cycle model and the changes anticipated in the system environment (regular upgrades, midlife upgrades, etc.).

It is necessary to:

— Define the life cycle model.

— The more important the openness characteristics, for example interoperability, the more complex the system's life cycle will be.

— Describe the acquisition increments leading to the solution.

— The acquisition increments must be organised depending on the openness requirements identified (for example planning the main changes anticipated taking into account the maturity of the technology implemented – TRL).

Contractual requirements specific to reversibility will be defined when the acquisition strategy is defined.

4.2 A supplier is selected and the selection justified

4.2.1 Define selection criteria

To facilitate the production of an open system, the prime contractor (supplier) should have experience in the design of open systems. The selection criteria proposed may be:

— the maturity of the supplier (according to SCOPE).

— a scale based on the supplier's experience:

— 0: no open system design listed,

  — 1: design of open systems in a different field,

  — 2: design of open systems in the field,

  — 3: recognised as an open system manufacturer (several references in several fields).

— The quality of presentation of the response to the call for tenders (structured presentation promoting a systems engineering strategy, etc.)

— The open systems of the suppliers are certified (for example by the NCOIC).

4.2.2 Justify the choice of supplier

Each supplier is assessed/graded in accordance with predefined criteria. Within the context of an open system, as well as the cost/performance aspects, the supplier's experience must also be taken into consideration.

4.3 Communication with the supplier is maintained

Continuously discuss the open system requirements and its interfaces (external and internal).

The needs of the Client in terms of the requirements for the system openness aspects that the Industrial Contractor must satisfy and apply during production and industrialisation of the system should therefore be stipulated in detail in the contract. This may relate to current and future operational changes to be taken into account, predicted technical developments and changes to OTS components.

4.4 A contract is drawn up

4.4.1 State the acceptance criteria for openness

The open system level, in terms of interoperability, upgradability, interchangeability, reusability, flexibility, reversibility and affordability, must be clearly defined in the form of requirements and acceptance criteria must be formulated for each of these requirements. The contract must refer to these requirements associated with openness, in line with the predefined acquisition strategy. A requirement must be Measurable, Useful, Simple and Traceable (MUST). To define these requirements, a detailed description of the system's operational environment will be used (current operational environment and probable future operational environment). To encourage interoperability, the system's interfaces with its environment must be precisely characterised from an operational and functional point of view. If rules, standards or OTS components need to be used, they need to be characterised:

— Either define a catalogue of rules, standards and OTS components to be used and keep it up-to-date,

— Or draw up the requirements relating to the use of rules, standards and OTS components with an associated priority: critical, essential, important, useful, optional, etc. (see essential, important, desirable or IEEE 830:1998 essential, conditional and optional).

4.4.2 Stipulate the legal conditions

From an architectural point of view, the openness is characterised by the use of product rules and standards and OTS components. To ensure that the openness requirements expressed by the Client comply with Industrial Contractor and third party intellectual property rights, a strategy on the choice of these rules, standards and OTS components must be defined in close collaboration with legal experts: rules, public or proprietary standards, free of charge or chargeable, etc.

For a SoS, every effort will be made to ensure a certain level of consistency between the various contracts. This means that the systems to be integrated into the SoS must comply with the interoperability rules and that the partners (Client and Prime Contractor) of the different SoS must exchange both technical and non-technical information (coordination between programmes, agreement between partners) and follow standardised systems engineering processes and activities when they are called upon to collaborate.

Of the various openness characteristics, reversibility is not a technical characteristic but a contractual and legal aspect. The guidelines present reversibility within the framework of French law. They will need to be adapted for other jurisdictions.

The contractual clauses relating to reversibility will be negotiated. Reversibility may be dealt with in a conditional part of contracts.

Particular attention will be paid to determining the elements of contracts specific to reversibility:

— a duration,

— advance notification of enforcement of the reversibility clause,

— a **reversibility plan** set up as soon as service provision commences and which must be updated regularly (similar to the service continuity plan in the banking field),

— the transfer of **intellectual property rights** (patents, drawings, models, etc.), copyright for software,

— the scope of the actions in relation to reversibility,

— gradual stoppage of services,

— maintenance or gradual reduction of performance commitments,

— transfer of information and data on maintenance history (reliability, failure rate),

— transfer of spare parts management: parts inventory, list of orders in progress, stock rotation management rules,

— expertise (know-how, etc.).

— skills transfer,

— transmission of written procedures, condition of installations,

— Staff re-employment,

— Training.

— Reversibility acceptance phase,

— Contractual guarantees,

— Payment of price.

4.4.3 Define the means for checking openness characteristics

The requirements of the openness tests to be performed must be laid down in a contract and their results produced in the presence of both parties. The following methods can be used:

— The development of scenarios by simulation and/or experimentation,

— The assessment methods based on inspection, analysis, demonstrations and tests (IADT),

— Operational acceptance tests and verification of service rendered.

These methods are cross-functional and apply to models, prototypes, demonstration models, first-offs and so on. Resources, such as test benches, simulation environments and scenarios, must be specified.

4.5 A product or service conforming to the contract terms is accepted

If the openness characteristics have been demonstrated and validated (performance of the activities defined in 4.4.3) and the product/service delivered satisfies all the requirements laid down in the contract, it can be contractually accepted.

The penalties associated with the non-conformity of an openness characteristic are dealt with in the same way as the other penalties. Depending on the ranking of the openness objectives laid down by the buyer, the penalties will be defined in the contract.

It is worth noting that defining guarantee criteria for system openness is not necessarily easy as the openness characteristics of a product/service depend on the products/services with which it interacts. Thus, the interoperability of a system is closely linked to the technological stability of the operational environment. Alternatively, it needs to be looked at in terms of risk. The instability of the environment will be managed by change requests and addenda to the original contract.