SLOVENSKI STANDARD
SIST EN 14514:2005

01-januar-2005

Standardi v vesoljski tehniki – Analiza funkcij sistema

Space engineering standards - Functional analysis

Raumfahrttechnik Normen - Funktionenanalyse

Normes d'ingénierie spatiale - Analyse fonctionnelle

Ta slovenski standard je istoveten z: **EN 14514:2004**

ICS:

49.140	Vesoljski sistemi in operacije	Space systems and operations

SIST EN 14514:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14514

August 2004

ICS 49.140

English version

Space engineering standards - Functional analysis

Normes d'ingénierie spatiale - Analyse fonctionnelle

Raumfahrttechnik Normen - Funktionenanalyse

This European Standard was approved by CEN on 21 February 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Ref. No. EN 14514:2004: E

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Foreword

This document (EN 14514:2004) has been prepared by CMC.

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of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

It is based on a previous version[1)] prepared by the ECSS Engineering Standard Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. The European Cooperation for Space Standardization (ECSS) is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

This document is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications.

Requirements in this document are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this document takes into account the existing ISO 9000 family of documents.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1) ECSS-E-10-05A

1 Scope

This document defines the requirements to perform functional analysis and the information output of that analysis. It applies to all types and combinations of space systems, projects and products. It also applies to project phases 0, A, B and C and at all levels.

When viewed from the perspective of a specific project context, the requirements defined in this document should be tailored to match the genuine requirements of a particular profile and circumstances of a project.

NOTE Tailoring is a process by which individual requirements of specifications, standards and related documents are evaluated and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 13701:2001, *Space systems – Glossary of terms*

EN 13290-4, *Space project management – General requirements – Part 4: Project phasing and planning*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13701:2001 and following apply.

3.1.1
constraint
characteristic, result or design feature which is made compulsory or has been prohibited for any reason

NOTE 1 Constraints are generally restrictions on the choice of solutions in a system.

NOTE 2 Two kinds of constraints are considered, those which concern solutions, and those which concern the use of the system.

NOTE 3 For example constraints can come from environmental and operational conditions, law, standards, market demand, investments and means availability, organization’s policy.

NOTE 4 Adapted from EN 1325-1.

3.1.2
function
intended effect of a system, subsystem, product or part

NOTE 1 Adapted from EN 1325-1.

NOTE 2 Functions should have a single definite purpose. Function names should have a declarative structure (e.g. “Validate Telecommands”), and say “what” is to be done rather than “how”. Good naming allows design components with strong cohesion to be easily derived.

3.1.3
functional analysis
technique of identifying and describing all functions of a system

NOTE Adapted from EN 1325-1.

3.1.4
operational mode
manner or way of operating

NOTE The mode is realized by a group of related functions or tasks required to accomplish a specific operation.

3.1.5
operational scenario
summary of sequences of events and the environment for a specific operation

3.1.6
functional specification
document by which the customer establishes the intended purpose of a product, its associated constraints and environment, the operational and performances features, and the permissible flexibility

NOTE 1 This document contains a complete set of provisional technical requirements for a product.

NOTE 2 This term is equivalent to functional performance specification as defined in EN 1325-1.

3.1.7
technical specification
specification expressing technical requirements for designing and developing the solution to be implemented

NOTE The technical specification evolves from the functional specification and defines the technical requirements for the selected solution as part of a business agreement

3.2 Abbreviated terms

The following abbreviated terms are defined and used within this document.

Abbreviation	**Meaning**
FMECA	failure modes effects and criticality analysis
ROD	review of design
RAMS	reliability, availability, maintainability and safety

4 Principles and methods of functional analysis

4.1 Principles

In order to design, develop and prove any space engineering system, the mission and consequent functions, that the system shall perform, is clearly established. This functionality is distributed throughout the different design levels (e.g. systems, subsystems and units). This allocation of the system functions in a systematic way is an important step in establishing a design which meets all the design objectives.

4.2 Methods

Functional analysis is the technique of identifying and describing all the functions of a system. The purpose of the analysis is to identify and partition all the functions of any system required to perform the intended mission.

The analysis is performed to establish the system functions and to control the distribution and maintenance of these functions in a systematic and useful manner. Three techniques: function tree, functional matrix and functional block diagram are described, although it is recognized that other representations can also prove suitable.

At the top system level, the required functions are derived from the mission statement and are the basis of the system functional specifications. All these functions can be considered ”external” functions.

The solution to meet these functions can lead to new lower level functions to be identified which are a result of the chosen solution. These new functions are either serviced at the system level where they were derived, in which case the function is satisfied, or passed to a lower level. A function, which is passed to a lower level, is a higher level function for the recipient level.

As the detail of the design progresses, each tier of the design add additional functions necessary to support the higher level functions. Both types of functions can be either solved internally within the system or refined into requirements and functions to be met at some lower level engineering unit. Thus, some functions have different levels of importance associated with them depending on how and where they originated. Some functions are readily achievable, while others are complex and expensive to meet. Often at the lower levels, solutions are available which readily meet most of the functions or during development it is established that a particular function is only met under specific conditions. The knowledge of the origins of any function allows to establish the consequences and impact of not meeting a requirement or to allow a function to be renegotiated.

Changes to requirements can arise at top system level, in which case the ”sub”-derived functions, which are affected at the lower tier level, are readily identifiable. A realistic example of top system level changes occurs when the launch vehicle is changed and as a consequence, the vibration spectrum or human factors can alter.

Functional analysis includes different activities. The complexity of the analyses adapts considering the design maturity, the evolution of the design and the complexity of the mission. The ultimate aim is to achieve the simplest final design which meets all the system requirements and offers the best value by achieving that all the functions are met and also partitioned in a logical manner.

Functional analysis is performed in a systematic manner. Function are not passed from one system to another system of the same level, but are received from a higher level system and either serviced or further distributed (and divided if necessary) to lower level systems.

Functional analysis excludes the assessment of the criticality of the functions in terms of reliability and safety, but can serve as the basis of the functional failure analysis.

Functional analysis also excludes any consideration of the engineering solution required to service an identified function, until ”internal” functions are identified as part of the required solution. By considering a system in terms of functions (being the problem to solve) and not in terms of technology (a possible solution), alternative technologies are not excluded, duplication can be avoided and components standardization can be improved.

4.3 Objectives

The objectives of functional analysis are to:

a) identify or update the functional requirements;

b) ensure the functions are partitioned in an appropriate manner;

c) allow the traceability of the functions;

d) identify the interfaces between functions.

This allows a complex engineering system to be understood and realized.

4.4 Logic and implementation overview

4.4.1 Performance

Functional analysis is performed as part of the overall design development process.

4.4.2 Implementation

The following functional analysis steps are implemented to:

a) define the system and boundaries of the system under analysis by using the relevant requirements documents;

b) define the level of detail (depth of analysis);

c) identify the system functions, operational modes and operational scenarios;

d) represent the system by preparing the function tree(s), or functional matrix(ces), or functional block diagram(s).

The sequence of steps outlined above are valid for all uses, but the steps which are applied are determined on a case by case basis. The most common representation of the system is the function tree. The whole process is illustrated in Figure 1.

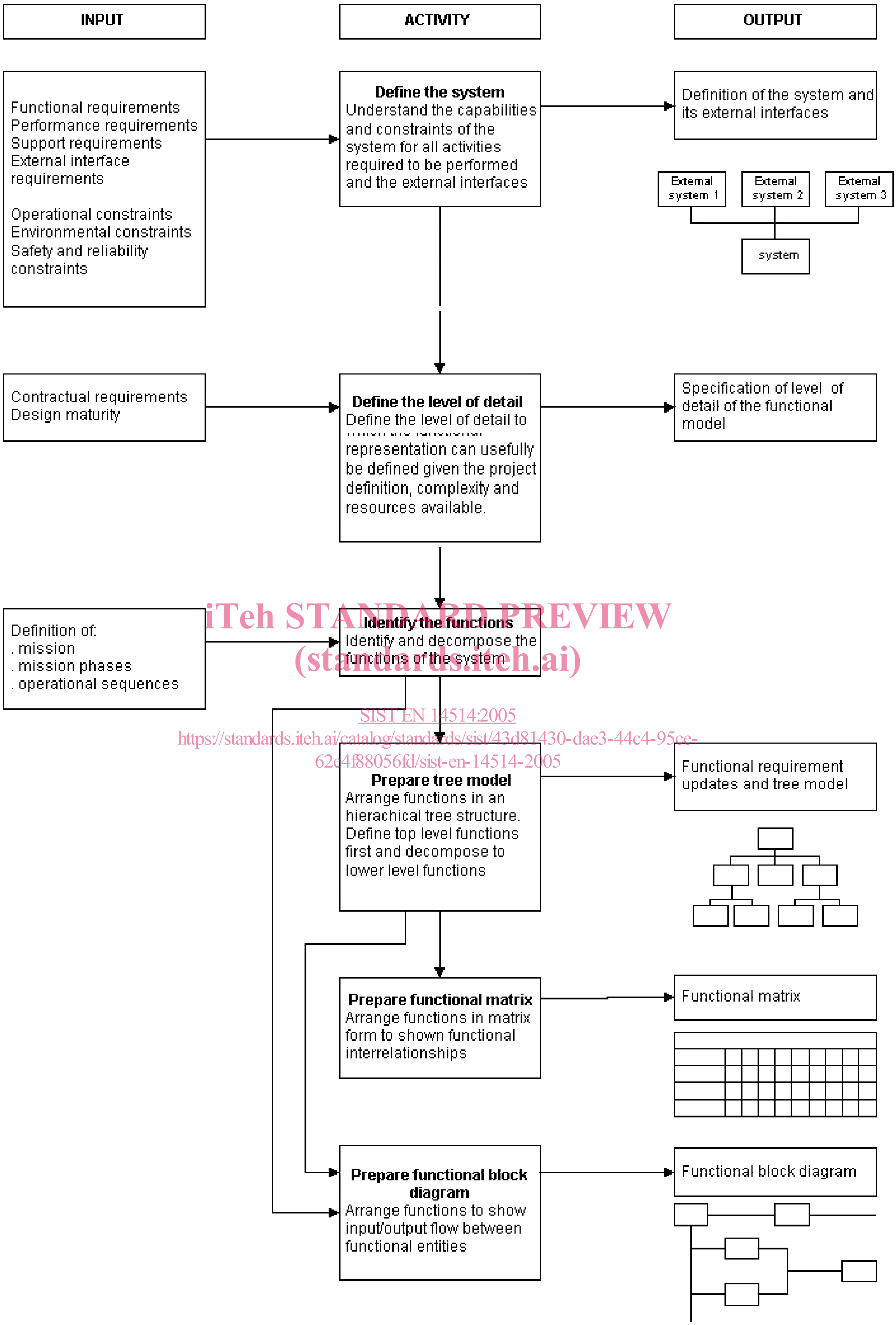

Figure 1 — Functional analysis implementation overview