
**Space systems — Programme
management —**

**Part 1:
Structuring of a programme**

Systèmes spatiaux — Management de programme —

Partie 1: Structuration d'un programme



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 14300 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14300-1 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 14300 consists of the following parts, under the general title *Space systems — Programme management*:

- *Part 1: Structuring of a programme*
- *Part 2: Product assurance*

Introduction

This part of ISO 14300 provides an overview and requirements of space programme management with the overall objective of optimizing performance, costs and schedules and of minimizing the risks.

Programme management is an integral element of any programme, but, in space, it is particularly important due to the following:

- specific environmental conditions in space;
- need for a high level of performance;
- limited number of models;
- limited access to the product during operations;
- quasi-impossibility of repairing in the case of failure during flight;
- often high complexity of the organization;
- associated high costs involved.

The deployment of this standardized common set of programme management requirements should encourage and facilitate international space co-operation.

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Space systems — Programme management —

Part 1: Structuring of a programme

1 Scope

This part of ISO 14300 addresses the space programme management requirements, applicable through a top-down approach in a contractual relationship between customers and suppliers. The applicable requirements for product assurance are given in ISO 14300-2.

This part of ISO 14300 is intended to be used as a basis when establishing and negotiating customer programme management requirements, and guiding the supplier's responses.

It permits:

- a clear definition of the roles, responsibilities and authorities of the different customers and suppliers;
- coherence between their activities;
- communication capability between them;
- stable and rigorous programme organization;
- and, as far as possible, standardization of the rules applicable to various programmes.

It still allows for supplier flexibility in its implementation and tailoring.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 14300. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 14300 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9000:2000, *Quality management systems — Fundamentals and vocabulary*.

ISO 9001:2000, *Quality management systems — Requirements*.

ISO 10007:1995, *Quality management — Guidelines for configuration management*.

ISO 14300-2:—¹⁾, *Space systems — Programme management — Part 2: Product assurance*.

1) To be published.

3 Terms and definitions

For the purposes of this part of ISO 14300, the terms and definitions given in ISO 9000 apply.

4 Abbreviated terms

CCB	Configuration control board
CDR	Critical design review
CI	Configuration item
CM	Configuration management
DF	Design data file
EIDP	End item data package
FS	Functional specification
ILS	Integrated logistic support
LSA	Logistic support analysis
PDR	Preliminary design review
PRR	Preliminary requirements review
QR	Qualification review
TS	Technical specification
WBS	Work breakdown structure
WPD	Work package description

5 Programme management specification and plan

5.1 General

The attainment of quality throughout programme execution is the overall goal of management.

The requirements stated in ISO 9001 shall be taken into account by any company involved in a space programme.

When a level 0 customer (the first level in the contractual line issuing a contract) intends to make this part of ISO 14300 a condition of a contract, this customer shall include in the solicitation (request for proposal, invitation to tender, request for quotation, etc.) a dedicated programme management specification for its application by lower level customers and suppliers.

The application of the management requirements from the level 0 customer to the lowest level of suppliers in the contract chain shall be consistent with the criticality, complexity and cost of the product to be supplied. Thus, suppliers of less critical products may seek to have fewer requirements. Nonetheless, the continuity and the coherence of the programme requirements shall be maintained. Selection and tailoring of this part of ISO 14300 is needed at the customer level. Any adaptation of this part of ISO 14300 shall be based on specific objectives and constraints.

At a given level, the supplier shall adapt the management requirements contracted with his own customer to his own suppliers. The customer can consequently fulfil his own obligations towards the next higher level (see Figure 1).

The suppliers shall prepare a management plan in order to comply with the dedicated management specification, received from their customer.

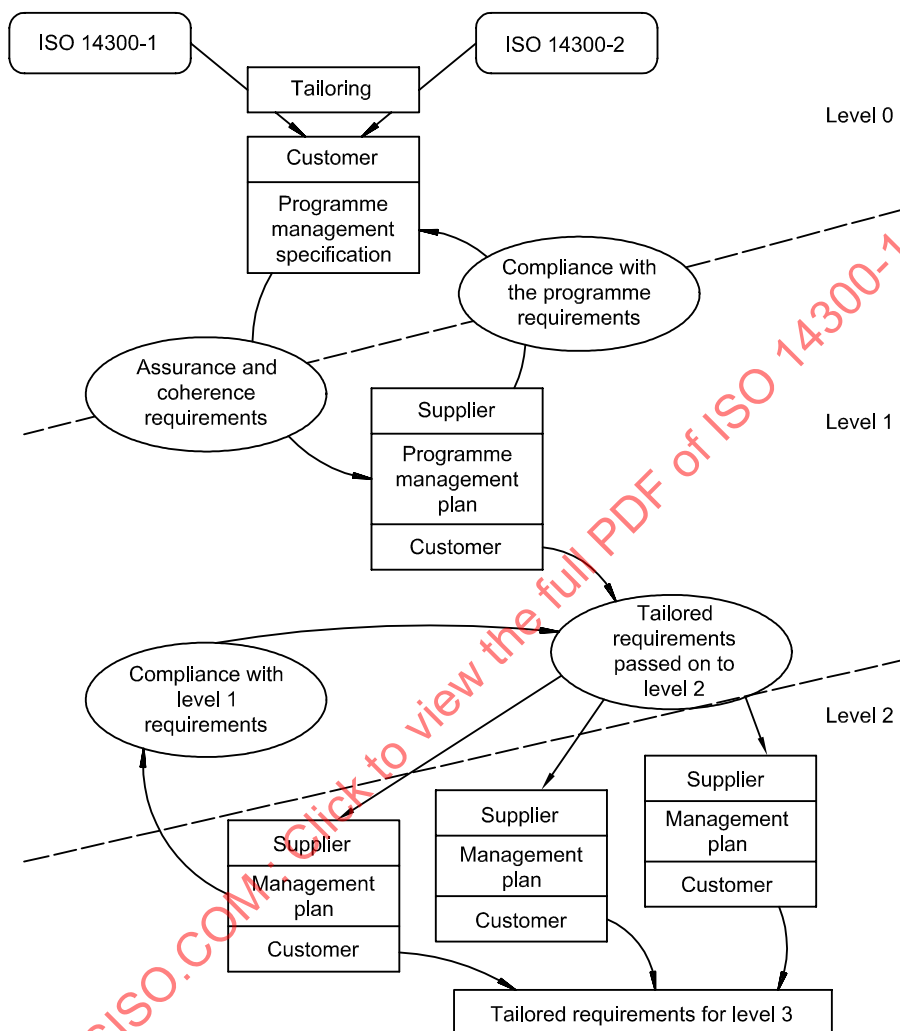


Figure 1 — Establishing programme management rules

5.2 Programme management specification

Depending on the nature of the programme or the programme phase, the programme management specification shall be issued by the level 0 customer and may include additional requirements or, on the contrary, certain elements which may be deleted with regards to this part of ISO 14300.

It is intended, as far as possible, that the wording of clauses 5 to 13 and the content of ISO 14300-2 be integrated directly into any programme management specification, i.e. for harmonization or depending on the negotiated applicability.

Each supplier of a given level acts as a customer towards his own suppliers and has to specify the management requirements in the relevant contracts through a specific document or through the statement of work itself.

5.3 Programme management plan

In response to this programme management specification, each supplier concerned prepares a programme management plan which contains descriptions of main activities, implementation methods and general procedures with respect to its organization.

Existing supplier policies, procedures and other management controls should be used, where appropriate, and in this case should be made available to his direct customer.

The supplier is encouraged to tailor any specified requirement that may provide more effective scheduling or reduce costs without loss in compliance to the intent of the requirement. Such tailored requirements should be individually identified within the supplier's programme management plan to facilitate review by the customer.

The programme management plan shall be submitted to the customer for acceptance. The plan, as accepted by the customer, becomes the basis for determining compliance with the customer programme management requirements.

6 Work breakdown structure

6.1 General

The programme work breakdown structure (WBS) is the reference system for programme management data which:

- ensures the coherence between technical, documentary, administrative and financial activities of the whole programme;
- identifies the responsibilities and authorities of each supplier.

The rules to be observed when producing, modifying and using the programme WBS are specified hereafter.

6.2 Objectives

The programme WBS is the structured and comprehensive breakdown of the whole programme. On the basis of the product tree (see 6.4.3) or the function tree (see 6.4.2), it identifies the tasks and principal resources²⁾ required to complete products intended to satisfy the expressed requirements.

This breakdown is achieved in a consistent way at different levels of responsibility and authority.

The programme WBS is used as a common reference for the level 0 customer and the suppliers so as to identify all tasks required to entirely complete the programme, regardless if these tasks are:

- on the programme budget or not;
- under the responsibility and authority of the suppliers or other organizations.

The programme WBS ensures management, planning, performance and control of all tasks implied by the programme.

2) Principal resources include the development of all hardware and software (e.g. test benches, tools) necessary for the programme and also the resources required for the adaptation or the reuse of existing means, that means all those whose unavailability may be a constraint for the programme.

6.3 Responsibility and authority for development

Each supplier shall:

- develop the product tree for his own supplies and limit it to interfaces with his own customer and suppliers;
- express his requirements concerning the establishment of the WBS to his suppliers.

These requirements are in particular associated with the programme organization (see clause 7) and the configuration items, CIs (see clause 10).

6.4 Rules for defining the WBS

6.4.1 Main aspects

The coding of tasks, resources and products (and possibly, functions) shall be unique and constant in time.

The tasks to be performed have to be linked to each level of the product tree (see 6.4.3).

As long as the system's product tree has not been defined, it is possible to associate tasks with functions of the function tree (see 6.4.2).

The principal resources to be used to accomplish each task shall be clearly identified.

When the resources involved in the programme have to be developed (specific resources), they shall be considered in the same way as the products to be provided.

6.4.2 Function tree

The function tree gives the framework of system performance by breaking it down into functions. Each function can be decomposed into subfunctions, independent of the products involved.

It is possible to link tasks to functions at the early stages of the programme, i.e. at least up to the system definition phase (phases 0, A and B, see 8.2).

At the system level, the function tree assures coherence of the whole system and the configuration control.

6.4.3 Product tree

The product tree gives the top-down framework of the product by breaking down the system into elements, i.e. from the system, to subsystem, to equipment, to component level where appropriate.

All product tree elements are under configuration control, the identifiers have to be consistent with all related work packages and documentation.

The product approach is based on a *priori* knowledge or knowledge gained since the programme started concerning the products to be provided.

The product tree has to be established at the end of phase B (see 8.2.4) at the latest.

Products indicated in the product tree shall include, as a minimum, each product having a TS.

6.4.4 Tasks

The tasks can be described in work package description (WPD).

NOTE A WPD is the information associated with tasks and work packages.

Each task is mainly characterized by:

- a) the customer/supplier relationship;
- b) a unique and identified person or organization in charge;
- c) its content, including:
 - a title,
 - an objective (e.g. qualification test),
 - a description with excluded tasks, if necessary,
 - a task type (design, production, product assurance, management, tests, etc.);
- d) its link to an element (product or function);
- e) its planning constraints, including:
 - a planned duration,
 - one (or several) input event(s) and data,
 - one (or several) output event(s) and data,
 - possibly, intermediate events (key events for the task);
- f) its conditions of performance;
- g) the resources required for its performance.

The resources used shall be associated with the task which implement them.

6.5 Management rules for changes

Changes in the WBS shall not modify its organization, so as not to disrupt programme management.

Each added product, function, resource or task shall be given a new identification (re-use of identifiers having already been used at any other stage shall not be allowed).

The changes take into account the modifications of mandatory services and/or requirements which shall be accomplished in compliance with the contractual specifications (modification of clauses, riders, etc.).

7 Programme organization

7.1 General

The implementation of a programme organization is required to ensure consistent programme performance and to control programme execution.

This clause defines the organizational principles (organization at customer and industrial levels for programme management) and specifies the organizational requirements concerning information circuits, internal and external to the programme and its environment.

On the basis of contractual data, this clause is used by the different programme suppliers as a definition model and for implementation of the respective organization at each level.

7.2 Principles

The organization to be implemented shall take into account the programme phases concerned, the nature of the tasks to be performed and the associated responsibility and authority levels.

The preparation, definition and implementation of the programme organization shall be planned in compliance with programme phasing (see 8.2).

The choice of the simplest and most effective management programme as well as contractual relationships shall be made taking into account the specific programme aspects, whether it be a national or an international one.

The person in charge of the definition and implementation of the programme organization shall be identified.

The responsibilities and authorities for programme management and contracting shall be identified so as to anticipate contractual and legal incidences.

Each programme organization shall be coherent in contractual and technical terms.

If the programme is associated with other programmes, responsibilities and authorities regarding interface definition and management shall be specified and taken into account when implementing the programme organization.

7.3 Organizational requirements

7.3.1 General

The programme phases requiring an effective implementation of programme organization (feasibility, definition, development, production, utilization) shall be specified. The programme change may lead to modifications of the implemented organization during programme execution.

When several suppliers jointly play a common role, the responsibilities and authorities of each of them shall be defined. When a supplier simultaneously plays several roles in the same programme, they shall be clearly defined and carried out separately. For effectiveness, however, one single authority may supervise them.

Each supplier shall identify and assign the main responsibilities and authorities for the programme and implement the internal organization in order to satisfy the contractual requirements.

Each customer and supplier are bound to play the roles both has been assigned for throughout the programme. When several external organizations and/or internal departments are involved, the responsibilities and authorities of each of them and their interfaces shall be clearly documented and the appropriate measures shall be taken to ensure their co-ordination. These measures shall in particular define the nature of the information to be exchanged between customers and suppliers.

7.3.2 Requirements

The roles of the programme suppliers shall be explicitly defined and, in particular, the programme organization shall indicate who is in charge of each activity, required by the specific programme management specification, i.e.:

- programme management;
- contract management;
- cost and schedule control;
- engineering;

- procurement;
- ILS;
- product assurance;
- configuration and documentation management.

The interfaces and relationships with company management should be indicated. The application of the management rules and their effectiveness for the performed or subcontracted programme activities shall be verified according to planned and documented audits, analysis of indicators and/or reviews, as contractually defined.

7.4 Information and communication

7.4.1 Information circuits

Rules governing the organization of information circuits shall:

- define the list and role of the programme customers and suppliers;
- specify the information to be exchanged between customers and suppliers and the schedule of exchanges.

The mode of establishment, of change and application shall be stated.

7.4.2 Progress reports

For the supplier(s) and customer, the purpose of these reports consists in evaluating the work progress regarding technical, performance, commercial, schedule aspects.

The content and periodicity of these reports shall be contractually defined. Progress meetings should be held only if necessary.

7.4.3 Customer's prerogatives

When this part of ISO 14300 is made part of an agreement between a customer and a supplier, the agreement should establish the appropriate degree to which the customer will:

- monitor the application of the management requirements by the supplier;
- conduct or participate in audits or reviews of the supplier;
- be informed of the progress made by the supplier in design, manufacturing, inspection, and test.

The prerogatives needed by the customer in order to accomplish these tasks should be established by provisions of the agreement. These provisions should cover:

- customer visits to the premises of the direct supplier;
- provisions that should be included in the direct supplier's agreements with lower level suppliers regarding visits of higher level customers;
- the designation of permanent or non-permanent representatives, resident at the supplier's premises;
- the delegation of all or parts of these prerogatives to national surveillance organizations, or to other specified organizations.

7.4.4 Action items management

Throughout the programme activities, the actions resulting from relations with the customer (e.g. meetings, exchange of mail, key events, reviews) and/or those determined by the supplier as part of the application of the management rules shall be controlled. Each action is defined by a form of identification, a clear and unambiguous wording, an applicant, a person responsible for its completion and the corresponding deadlines (fixed date or programme event).

The final status shall be formally expressed and accepted by the applicant on presentation of the applicable justifications.

7.4.5 Technical and management indicators

From the start of the programme onwards, technical and management indicators, in particular highlighting developments in product quality and the organizational functioning shall be formally defined, implemented, put to use and updated throughout the programme activities. In case of significant unfavourable developments, measures shall be taken according to the analysis of results.

These indicators are defined between the customer and the supplier and shall remain confidential.

8 Programme phasing and planning

8.1 General

The objective of programme phasing and planning is to minimize the technical, scheduling and economical risk of the programme by introducing phases of which the ends are marked by formal milestones³⁾. By implementing this objective, the progress of the programme can be controlled with respect to cost, schedule and technical objectives.

This objective is achieved by breaking the product life cycle into distinct phases which are interlinked. The objectives and work content of each phase shall be clearly defined.

Each milestone consists of a formal review process interrelated with technical baselines subject to configuration management (CM). The results of this process are formalized by appropriate documentation.

The number of phases and their objectives should be defined at the start of the programme. They should also be tailored to minimize risks from cost, scheduling and technical problems that can compromise the success of the programme.

The composition and content of the phases shall be determined by the level 0 customer using the programme management specification based on this part of ISO 14300 and shall be appended to the contract.

8.2 Programme phasing

8.2.1 Principles

The phasing may be broken down into seven phases. The start of a phase coincides with crossing a milestone, at which time a decision is taken by the level 0 customer (or his highest authority) at a given system level. This usually occurs after a specific review assessing the work results of the current phase, the provisions for the next phase and the identified risks.

The crossing of milestones at lower levels shall be decided by the relevant customers, after the relevant reviews.

3) A milestone is a significant event or stage marking the end of a phase of development in the programme.

The purpose of a review is to perform a critical evaluation by a team not directly involved in the activities and with the aim of helping to:

- assess the validity of the technical elements in relation to the predictions and the contractual requirements;
- enable corrective and/or preventive actions to be carried out in the case of drift or inadequacy;
- mark the transition to the following stage;
- decide to cross the concerned milestone.

8.2.2 Mission analysis phase (phase 0 or pre-phase A)

This phase consists of an initial definition of the mission and of a preliminary assessment of the concepts needed for consideration in the feasibility phase.

This phase results in:

- the identification and the characterization of the mission;
- an initial evaluation of needed performance, risks, requirements, and objectives, e.g. dependability and safety;
- an initial assessment of the manufacturing and operational constraints, including environmental conditions;
- the identification of possible solutions with the associated critical issues, taking in account the lessons learned from current space programmes;
- an initial evaluation of the elements of the programme (organization, costs, schedules).

The results of these activities are summarized in a transition phase 0 to phase A document including a provisional functional specification (FS) which serves as the basis of the decision to initiate the feasibility phase.

8.2.3 Feasibility phase (phase A)

8.2.3.1 Objectives

This phase of the programme consists in exploring the various possible concepts so as to meet the defined objectives (performance, costs, schedules).

This phase results in:

- a) the function tree being issued;
- b) the user's objectives being formally defined in:
 - a reference FS,
 - a preliminary issue of the TS at the system level;
- c) the presentation of each concept examined in a pre-design associated with a financial proposal (costs and schedules) for the definition phase;
- d) the estimation of technical and manufacturing feasibility and the emphasis on the critical elements of each concept (performance, risks, costs, schedules, technical and support costs).

8.2.3.2 Documentation

This phase results in the drafting of a “transition phase A to phase B document” under the responsibility and authority of the level 1 customer.

These documents shall emphasize in particular:

- the feasibility of proposals to meet the anticipated requirements;
- the general description of these proposals, indicating the main elements for each one (performance, costs, schedules, risks) and the one recommended;
- the organization of subsequent phases (structures, resources, etc.) and in particular those elements allowing the start of the definition phase (WBS, costs, schedules, etc.).

The authority responsible for the milestone crossing may require that phase A results be examined in their entirety or at least partially during a review called the “preliminary requirements review”.

8.2.4 Definition phase (phase B)

8.2.4.1 Objectives

This phase consists of selecting one proposal for development among those proposed at the end of the feasibility phase and in specifying the necessary requirements.

This phase starts by crossing the milestone corresponding to the acceptance of phase A results.

This phase results in:

- the comparison of performance and risks (regarding technical/cost/schedule aspects) of the technical solutions previously selected to be studied;
- the establishment of the TS at the system level;
- the establishment of the TS at the first level and whenever possible in compliance with the function tree as inputs to all specifications;
- the evaluation of the dependability and the safety characteristics;
- the choice of the proposal for development, in particular taking into account the financial aspects of the proposal;
- the issue of the “transition phase B to phase C document”.

8.2.4.2 Documentation

8.2.4.2.1 General

The following documents, written under the responsibility and authority of the level 1 customer, shall be compiled with the TS and the documents drafted by the supplier:

- the management plan and the development plan;
- the WBS (see clause 6);
- the first level TS and, whenever possible, the associated technical clauses;
- the preliminary design data file (DF) and the justification for it.

8.2.4.2.2 Transition phase B to phase C documents

These documents in particular emphasize:

- a) all the necessary requirements listed in the TS. This TS shall be compared with anticipated requirements. The purpose of this comparison is to verify that there is no incoherence between anticipated requirements, defined by the user in the reference FS, and the technical and contractual requirements expressed in the TS;
- b) the proposed design of the solution, which has been sufficiently examined in compliance with the requirements. This design is, in general, described in a preliminary DF and defines the architecture of the main components. This design shall facilitate the identification of the various critical points in the product development and manufacturing;
- c) the organization of the development phase with:
 - the organization of the project,
 - the schedule for completion, including key events,
 - the methods allowing the various identified risks to be kept under control;
- d) the justification of the estimated cost of the development phase.

8.2.4.2.3 Development plan

At the end of phase B, the development plan shall be drafted by the level 1 customer, taking into account the requirements of his customer and with the elements of his own suppliers. This development plan shall describe the phasing rationale used to carry out satisfactorily the development of the products under his responsibility and authority and in particular:

- the task sequence of the project;
- the mandatory steps (key events);
- the significant stages in development progress and of the design verification (document issue, manufacturing of models, tests, reviews, etc.).

When approved by the level 0 customer, it becomes the document for management and follow-up of the work.

8.2.4.3 Reviews

8.2.4.3.1 System requirement review

During phase B, a system requirement review should be held in order to:

- examine the compatibility of the system framework and the allocation of performance to the lower level of the products;
- examine the compatibility of interfaces;
- review the system TS and allow the start of work on subsystems.

8.2.4.3.2 Preliminary design review

The authority responsible for the milestone crossing may request that the “transition phase B to phase C document” be examined during a review called “preliminary design review” (PDR). The purpose of this review is to approve the system TS, the frame of the system, the associated lower TSs and the development plan.

NOTE 1 Phase A and B activities are iterative and tend to clarify progressively requirements thus making possible solutions more evident.

NOTE 2 If there are several level 1 suppliers, then arrangements should be made to ensure the consolidation and coherency of level 0.

8.2.5 Development (phase C) and production (phase D) phases

8.2.5.1 Merger of phases C and D

Phases C and D may be merged into one unique C/D phase if the programme leads to the manufacturing of a single flight unit or of a very small quantity of product.

The choice shall be determined by the level 0 customer.

8.2.5.2 Integrated C/D phase

This programme phase consists of making a detailed study of the solution selected upon completion of the definition phase and subsequently manufacturing qualification model(s) and flight model(s). The purpose of this phase is to obtain a qualified design of the deliverable products required for system operation and support.

This integrated phase starts by the milestone crossing of the PDR and corresponds to the acceptance of “transition phase B to phase C documents” issued during the previous phase.

This phase shall include, as a minimum, the tasks necessary to complete the designed state of the system and of each of its components (critical design reviews, CDR).

On the basis of the verifications made during this phase and during qualification tests, the qualification process shall show that this design meets the specified requirements (qualification review, QR).

Product design qualification and flight model acceptance complete the C/D phase.

8.2.5.3 Separate development (phase C) and production (phase D) phases

8.2.5.3.1 Development phase (phase C)

This programme phase consists of making a detailed study of the proposal selected upon completion of the definition phase. The purpose of this phase is to obtain a qualified design for the mass production of deliverable products required for system operation and support.

Phase C starts by the milestone crossing of the PDR and corresponds to the acceptance of the “transition phase B to phase C documents” issued during the previous phase.

This phase shall include, as a minimum, the tasks necessary to complete the designed state of the system and of each of its components (CDRs).

During this development phase, the “production plan” is established by the supplier and gives the general manufacturing schedule at the highest level of the WBS. It includes the elements provided by its own suppliers. The manufacturing plan shall be issued under the responsibility and authority of the level 1 customer and, once issued, marks the start of the following phase.

The production plan defines a production cycle of one element which is to be used as a reference. Consequently, any risks due to disturbances on the standard production line can be established.

This plan outlines the mass production scheme (see 9.3) and specifies the key events, as follows, that may be selected for stages of payment and follow-up scheduling:

- manufacturing preparation;
- procurement;
- manufacturing start;
- technical evaluations prior to acceptance tests;
- final acceptance.

The qualification process started during the development phase shall be based on verification made throughout the development phase as well as qualification tests. Results from the qualification process shall demonstrate that the product design meets the specified requirements and that it can be produced.

Qualification of the product design marks the end of the development phase (QR, qualification review).

8.2.5.3.2 Production phase (phase D)

This phase consists of manufacturing and delivering to the user the production ordered in compliance with the designed stage of the product.

It starts with the milestone crossing corresponding to the acceptance of the “production plan” issued during the previous phase.

Two processes may be identified within this production phase: the mass production process and the acceptance process for each finished product after a performance check by a pre-shipment review. This pre-shipment review authorizes the shipment of the product after checking its conformity with respect to the project objectives (performances, configuration and waivers) and the operational status of the system.

For reasons of scheduling, some procurements may be started prior to the production phase.

8.2.5.4 Utilization phase (phase E)

During this phase, the system and the resources required to fulfil its operational mission are put into service, used and supported.

The acknowledgement by the system user of its fitness for use conditions the beginning of its operational life.

8.2.5.5 Disposal phase (phase F)

This phase consists of the preparation and completion, in a co-ordinated way and in conformity with the applicable rules, of the complete or partial discontinuance of system operation and dismantling of the products and associated resources.

NOTE 1 This phase starts with a decision of complete or partial disposal.

NOTE 2 The dismantled products can be destroyed, stored, transformed or assigned to another utilization within the framework of other programmes.

NOTE 3 This phase may lead to establishing a historical record and an analysis of the programme (performances upon completion, life cycle cost, statistics, etc.).

8.3 Product stages — Associated processes and documents

8.3.1 General

The set of successive product stages is usually called the product “life cycle”. The different product stages, in relation to the phases of the programme, are indicated in Figure 2.

For a given intermediate level, the transition from the specified stage to the designed stage is a complex process or a number of processes progressively incorporating the design formulated at the lower level. The transition from a given stage to the following one is achieved by applying one or several processes as shown in Figure 3.

The different product stages are described in 8.3.2 to 8.3.6 and illustrated in Figure 2.

These stages shall be identified and recorded in the documentation system specified in clause 12.

As soon as a given product stage is attained, the CM procedure shall be implemented in accordance with clause 10.

8.3.2 Functional stage

This product stage defines and implements the service functions expected from the product.

This stage originates following the customer's request and is expressed in a FS or any other similar document.

The purpose of the FS, drafted under the customer's responsibility and authority, consists in expressing the customer's requirements in terms of the service functions expected from the product. Both the constraints of utilization, and flexibility, in the various phases shall also be explicitly expressed in this document.

The FS shall be drafted progressively and justified in respect to the initial customer request based on results from studies performed during the process of determining requirements.

The FS and its associated justifications are to be managed in accordance with the customer's in-house procedure.

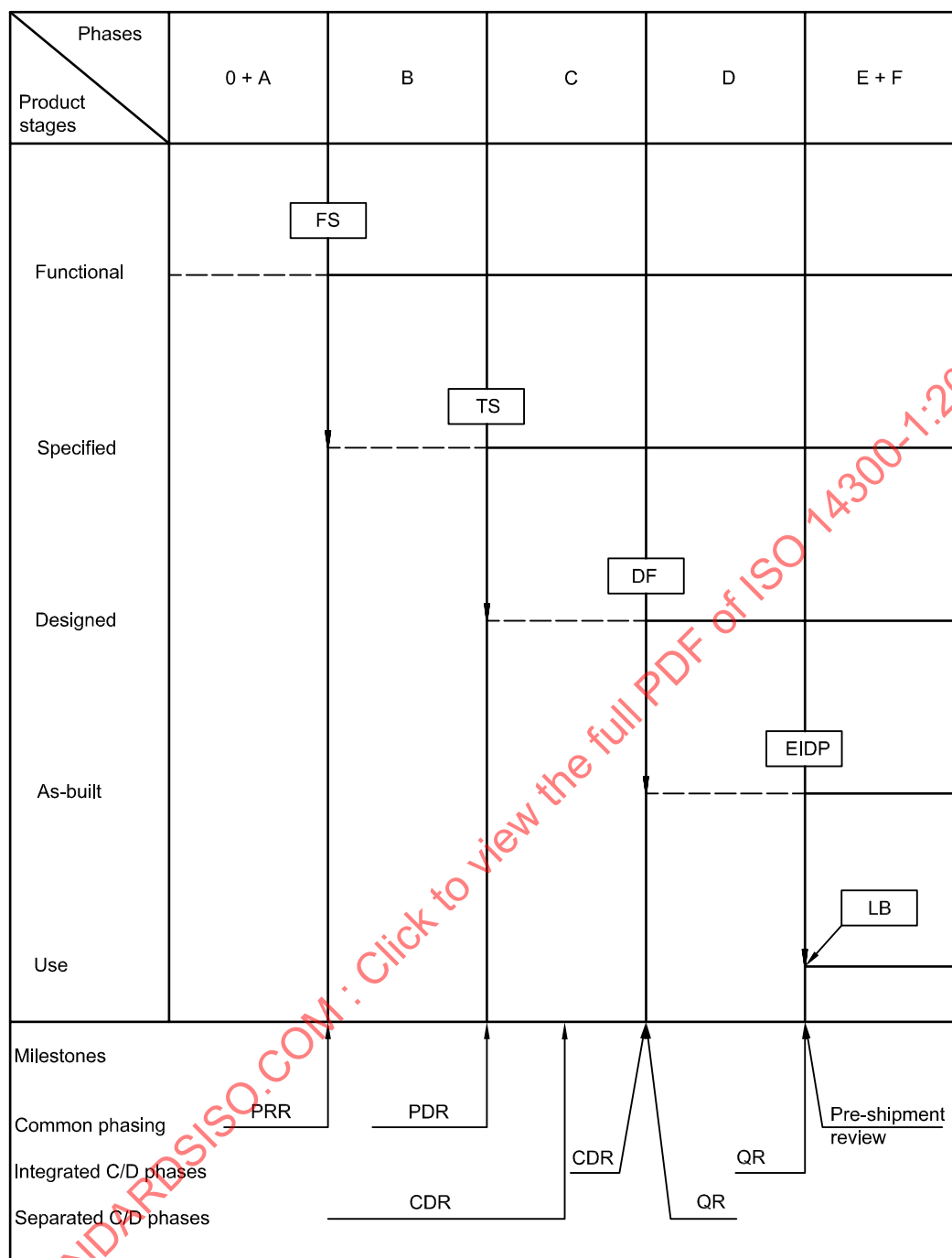
The functional stage is completed once the FS is issued. The FS becomes the reference FS at the end of phase A.

8.3.3 Specified stage

This product stage is initiated once the reference FS or the TS of the higher level is established. It consists of processes for establishing a preliminary design and in further defining requirements. The results shall be recorded in the TS.

The purpose of the TS drafted under the customer's responsibility and authority is to define requirements in terms compatible with the reference FS or the TS of the higher level and to describe the selected concept taking into account the performance, cost and schedule requirements. It shall therefore express:

- the functional requirements associated with the various features of the projects planned taking into account environmental conditions;
- the dependability and safety requirements;
- the requirements concerning interfaces;
- the requirements concerning design and production (prescribed or prohibited proposals, standards, etc.);
- the requirements concerning qualification and acceptance related to the verifications to be provided by the supplier.



FS Functional specification
 TS Technical specification
 DF Design data file
 EIDP End item data package
 LB Log book

PRR Preliminary requirements review
 PDR Preliminary design review
 CDR Critical design review
 QR Qualification review

Continuous lines correspond to product stages

Figure 2 — Relationships between programme phases and product stages

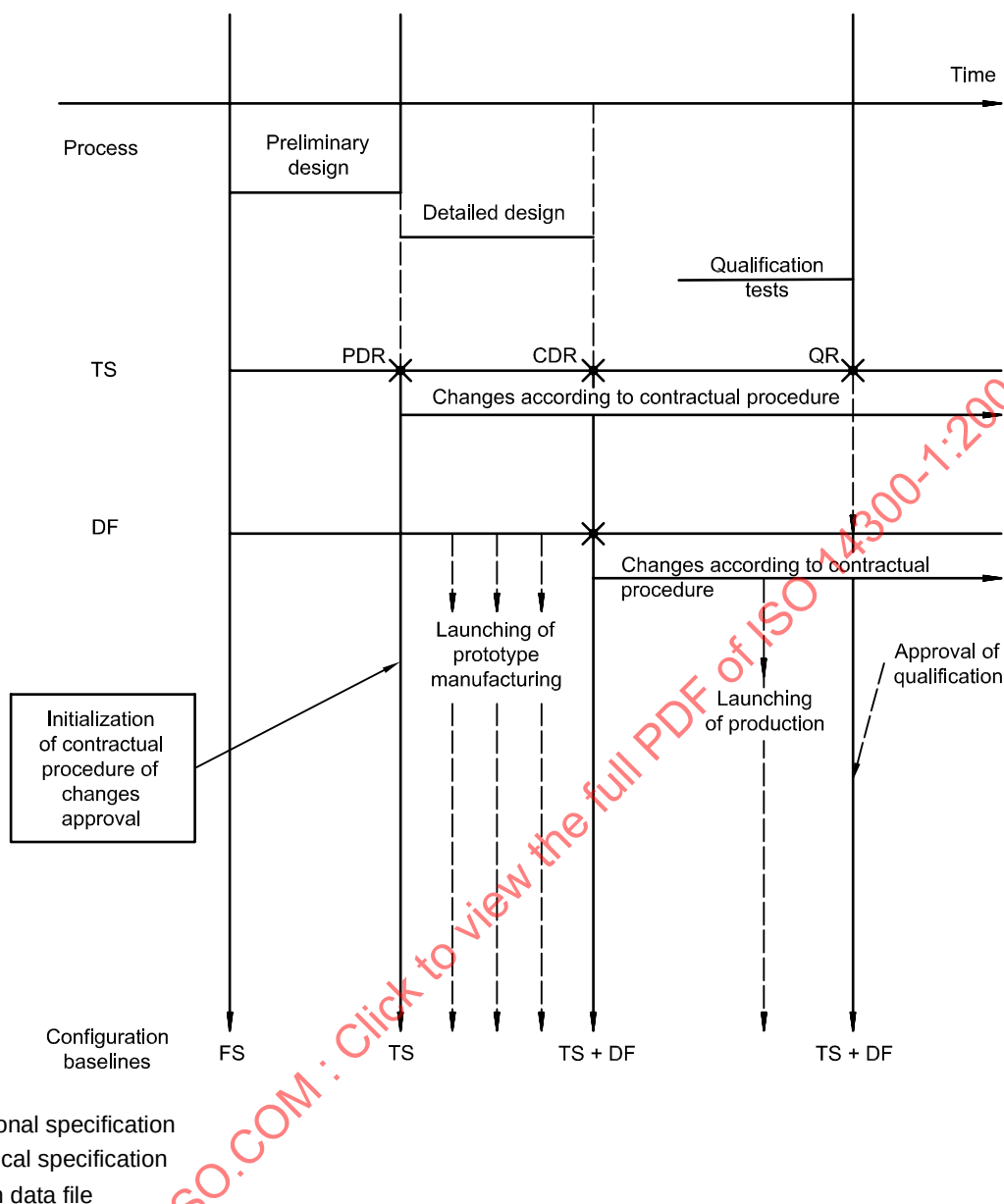


Figure 3 — Approved configurations

Results of the studies and tests performed when issuing the TS shall make it possible to compare the TS with the reference FS or the TS of the higher level.

The corresponding documents shall be compiled in a justification file of the TS.

The reference specified stage is achieved by the approval of the TS which takes into account the concept selected for development.

8.3.4 Designed stage

8.3.4.1 General

This stage is initiated once a set of data can be established to fully identify the design of the product for manufacturing, inspection, use and support processes. It is expressed in the DF drafted by the supplier.

The designed stage is established once the DF is approved after qualification (called qualified DF).

8.3.4.2 Design data file

The DF shall show the levels corresponding to the requirements associated with operation, maintenance and logistics and in particular identify:

- all supply items;
- all elements separable in use and/or deliverable as spares;
- the regrouping of products based on elements defined separately;
- the specific designs adapted to specific situations (situations concerning packaging, storing, delivery, standard or specific utilization, etc.) as well as changes allowing a switch from one situation to another.

8.3.4.3 Design justification data file

The purpose of the design justification data file is to make a synthesis of all the verifications proving that the designed state of the product satisfies the requirements of the TS. It should be drafted progressively under the supplier's responsibility and authority during the processes of design and qualification.

The design justification plan, drafted on the basis of the TS, shall constitute the framework of the design justification data file and shall explain how each TS requirement is to be verified. This plan should be part of the development strategy of the programme.

8.3.4.4 Qualification process

The QR concludes the qualification process with a verification that:

- the design satisfies the specified requirements (design justification data file);
- the design can be produced in accordance with the scheduled quantities and rates of production;
- the products complying with this design will be fit for the specified use.

The DF approved at the end of the qualification process and completed by the production master file, constitutes the point of entry of the production process. From this DF, the following shall be finalized:

- the tasks concerning the production and acceptance processes by the application of the production master file;
- the analyses and support tasks with the drafting of user documentation.

NOTE The verification that the design can be produced, can then be integrated in the design justification data file or can constitute a separate document.

8.3.4.5 Production master file

The purpose of the production master file is to manufacture units of the product in conformity with the DF. It shall contain:

- the part lists and process sheets;
- the list of specific or non specific tools;
- the purchase documents (procurement and manufacturing cycle);
- the inspection procedures and records,

and more generally all necessary data for production.

8.3.4.6 User documentation file

The purpose of user documentation file is to define the input data for the implementation conditions of the product's living state within the operational process, so as to develop later on:

- the operational documentation;
- the maintenance documentation;
- the procurement documentation;
- the training documentation concerning users, maintenance people and suppliers.

8.3.5 As-built stage

This stage corresponds to each product finished and ready for delivery to the user. It is initiated through the qualified DF.

This stage is complete by the implementation of the manufacturing process.

This process leads, for each of the deliverable products, to the implementation of the acceptance process.

The configuration of each deliverable product is given by its end item data package (EIDP) where the information specific to the current approved configuration (baseline configuration plus accepted changes) of the product and the approved waivers shall be recorded. The EIDP also includes the result of the acceptance and other data as requested by the customer.

The product and its accompanying documentation shall be transmitted to the customer for the ownership transfer in conformity with the contractual procedure and the acceptance requirements specified in the DF.

8.3.6 Use stage

This stage corresponds to each of the various units of the product put into service, operated and supported by the user.

The use stage shall be recorded in the logbook from the operational process onwards through to disposal, under the user's responsibility and authority.

9 Cost and schedule management

9.1 General

The objective of cost and schedule management is to provide a collective system of organized processes and actions in support of programme management aimed at establishing the optimum use of human resources, facilities materials and funds in order to achieve the successful completion of the space programme within its established goals:

- cost targets;
- timely completion;
- technical performances.

To this end, costs and tasks shall be planned and actively controlled, identifying those critical situations that can possibly lead to adverse impacts on the programme cost and schedule, together with the proposed recovery actions.

The work to be performed for every space programme shall be planned and controlled on the basis of the WBS to a level of detail commensurable with the achieved design maturity and adequate to the programme phase for which cost and tasks are planned.

Cost data specified in the contract shall serve as a reference for cost control agreed between the supplier and the customer.

Schedule planning and control are implemented by establishing and maintaining a schedule of programme activities in which external inputs and task outputs are linked and programme milestones are identified.

9.2 Cost management

9.2.1 Principles

The supplier shall perform cost management functions according to the contractually specified conditions as follows:

- cost estimate and calculation of costs at completion;
- evaluation adjustment;
- analysis of financial proposals made by his own suppliers;
- negotiation, formal expression and identification of technical or time-linked key events leading to payment;
- record and follow-up of actual costs and comparison with estimates;
- deviation identification;
- assessment of related consequences;
- taking or proposing corrective measures.

In this context, contractual requirements for a given phase imply a follow-up of expenses related to that phase in progress and preparation of subsequent phases regarding economic aspects: development cost, recurring cost, life cycle cost.

Contractually, cost monitoring by the customer and cost reporting to the customer are usually applicable only for cost-plus contracts, and not for fixed-price contracts.

9.2.2 Optimization

The level 1 customer (or his representative) shall provide the economic data required for optimization (elements of life cycle cost, schedules, performances) of the system with the support elements.

Furthermore, each supplier shall provide the economic data needed to optimize the supplied products to his own suppliers.

9.2.3 Cost estimates

For each proposal considered, an estimate and a cost proposal shall be made by the supplier indicating development, recurring production and operational costs. Key cost factors shall be specified.

These costs shall be broken down according to the known WBS and the types of expenses (engineering, purchases, etc.) specified in the contract or invitation to tender.

Each customer shall take into account all costs so as to obtain the global cost of the system.

9.2.4 Cost monitoring

The costs adjusted after negotiation at the end of the previous phase shall be taken into account and the change of the estimated costs for the following phases, especially within the framework of the CM, shall be permanently monitored.

The costs shall be monitored, by means of a schedule of commitments and an expense schedule until completion of the contract and by revision meetings concerning these schedules; the periodicity of these meetings is to be fixed by the contract.

Revision of the possible expense schedule shall be based on the tasks remaining to be completed at the date of the revision. The economic conditions of this revision shall be contractually specified.

Expenses shall be apportioned by the supplier according to the accounting plan applicable in the supplier's organization and according to contract work units.

The revised expense schedule shall point out the deviations at the revision date and at programme completion due to:

- technical changes approved at revision date;
- cost updating and/or revision formula;
- other causes.

A report appended to the revised expense schedule shall:

- present new measures taken to reduce costs taking into account actual progress with respect to the work schedule;
- identify the source of deviations and the actions to be taken so as to reduce possible over-costs related to these deviations.

9.3 Schedule management

9.3.1 Principles

Schedule management aims at:

- evaluating the time required to perform different tasks and highlighting aspects that may be critical (tasks, resources);
- sequencing tasks, at all levels, in a structured and coherent way;
- supplying to the different levels of the organization the applicable data about the work progress (to the higher levels in the form of reporting, to the lower levels in the form of contract changes);
- detecting and pointing out the critical paths and especially situations likely to cause delays before leading to serious problems and affecting the programme target schedule;
- allowing a rapid response in the event of problem;
- studying and presenting the consequences of planned technical changes to the programme schedule;
- identifying and monitoring the programme key events, mainly those leading to payment, and the ordering dates of the different programme phases;
- preventing, as far as possible, or minimizing delays with respect to the agreed contractual schedule.

9.3.2 Task sequencing

9.3.2.1 General

For each element of the WBS, task sequencing should be produced and integrated in compliance with the chosen breakdown.

9.3.2.2 Work schedule

Each supplier responsible for an element of the WBS shall develop a work schedule and shall ensure that the schedules issued by his own suppliers are consistent; the supplier shall ensure that the breakdown and the target schedule fixed by his customer are met.

9.3.2.3 Key events

The supplier shall identify key events, i.e. events considered as representative of the programme's progress. These events shall be selected for:

- their start/finish character regarding outstanding tasks;
- their interface nature;
- their criticality (technical, economic, delay-related risks, etc.);
- their contractual aspect (event leading to payment).

Closure criteria shall be established for each key event.

9.3.3 Deviation analysis — Trend analysis

9.3.3.1 Deviation analysis

This analysis shall point out:

- the causes (traceability);
- the side effects on the general work schedule (schedule delays or anticipation);
- the changes concerning critical paths and associated risks;
- the basic elements allowing the determination of corrective actions;
- the measures proposed or taken to optimize cost, schedule and performances.

9.3.3.2 Trend analysis

On the basis of the data transmitted by his own suppliers, the supplier should conduct a trend analysis on reported deviations and variations in data concerning an event as well as assess any possible repercussions on the general schedule for project completion.

These analyses should briefly point out the most critical elements and, if possible, include suggestions for preventive actions.

9.3.3.3 Synthesis of work progress data

The supplier should periodically analyse all schedule data from his own suppliers and may report on the progress of the contractual tasks.

The report to be provided to the customer should include:

- identification of tasks that are critical or subcritical;
- comparison between the actual situation and objectives;
- trend analysis of identified key events.

This report forms part of the progress reports mentioned in 7.4.

9.4 Evaluation after completion

At the end of the programme or phase, an “evaluation after completion”, should be produced. This evaluation particularly should compile the effective costs and schedules at completion and the main causes of observed changes compared with the initial estimates. The supplier should specify as soon as possible the means implemented to record relevant information throughout the programme.

10 Configuration management

10.1 General

This clause defines the CM requirements together with ISO 10007 which is applicable to space systems.

10.2 Configuration identification

10.2.1 Product tree and selection of configuration items

The product tree should describe the relationship and the position of CIs in the system architecture.

Configuration items should be selected using the guidance criteria. The criteria used to select the CIs under customer control and the associated baseline reviews shall be negotiated between customers and suppliers and identified in management requirements and plans.

10.2.2 Documentation of configuration items

All the necessary functional and physical characteristics of a CI including interfaces shall be contained in the documents described in 8.2. These are normally categorized as configuration documents.

10.2.3 Establishment of configuration baselines

Configuration baselines should be developed upon formal agreement following clause 8 and used as starting points for the formal control of a configuration.

10.3 Configuration status accounting

Configuration status accounting provides visibility of the current approved configuration, traceability of changes to configuration baselines, and comparison with the configuration at completion.

10.4 Configuration control

10.4.1 General

Configuration control is applicable at the CI level. Any change, deviation or waiver applicable to a component shall be addressed to the next higher CI.

10.4.2 Configuration baselines

The configuration identification is established and maintained through four distinct increasing levels of detail, each one used for a specific configuration baseline:

- during phase B, the functional baseline (functional state) expresses the overall performances, interfaces and requirements, laid down by the customer;
- after a PDR, at the end of phase B, the development baseline consists of the TSs (specified stage), issued by the supplier for the product, and the lower level CIs;
- during phase C, after CDR, the baseline consists of the TS and DF status (designed stage), issued by the supplier for the product, and the corresponding documents for lower level CIs;
- after qualification, the production baseline (use stage) identifies the released detailed design for production and operation. It includes all the documents necessary to manufacture, assemble, test, accept and operate the product.

During operations, the configuration is identified by the incorporation of the approved changes (use stage).

10.4.3 Configuration control board

A CCB should exist in any organization with design responsibility and authority.

10.4.4 Change classification

Any proposed change should be put into two classes:

- Class 1: changes which have an impact on the contractual and/or technical requirements specified by the customer. These changes should be submitted to the customer for review and approval before implementation (CCB at customer level).
- Class 2: changes which are outside the class 1 definition, but are necessary for the supplier to meet for contractual and/or technical requirements and provisions.

Class 2 changes may be implemented after the supplier's CCB approval.

10.4.5 Change approval

After the change has been evaluated, the CCB should review the documented evaluations and decide upon classification, and approval or disapproval of the change.

The change procedure should identify the CCB responsibility and authority and mode of operation.

The authority for approval/disapproval may vary depending on the change classification.

All proposed changes should be reviewed and considered through the CCB structure until they reach the CCB with the appropriate authority for final decision.

11 Integrated logistics support

11.1 Objectives

The overall objective of the integrated logistic support (ILS) is to ensure the satisfaction of needs in terms of logistic support throughout the system life cycle.