INTERNATIONAL STANDARD

ISO 16192

Second edition
2017-04

Space systems — Experience gained in space projects (lessons learned) — Principles and guidelines

Systèmes spatiaux — Évaluation de la connaissance pratique — Principes et lignes directrices

Reference number
ISO 16192:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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.

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: 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 16192:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— information previously in Clause 2 (role of lessons learned) and Clause 4 (the lessons learned process) has been reorganised and rewritten to eliminate duplication and inconsistent text; and

— information describing the lessons learned process which was previously in Annex A has been removed and combined with similar information in Clause 4 to further simplify the text in Clause 4.

Introduction

In order to improve the quality of products and to work efficiently, it is important to consider past experiences and how the knowledge of those experiences is transmitted. The aim is to decrease errors (in terms of both quantity and gravity), improve working methods and decrease risks of nonconformity to specified objectives (management, technical, quality, costs and schedules).

In the process of lessons learned, future space projects or programmes are intended to draw benefit from past experience, by capturing and communicating knowledge from the past through recording, classifying and making the information available.

An efficient processing of lessons learned is considered essential for:

— ongoing efficiency and quality improvement inside any organization;

— successful project management.

Space systems — Experience gained in space projects (lessons learned) — Principles and guidelines

1 Scope

This document outlines lessons learned principles and guidelines that are applicable in all space project activities (management, technical, quality, cost and schedule).

The application of this document is intended to be included in the supplier quality management system, but can be tailored in individual contracts as agreed by the customer and supplier, depending on:

— the content of each project (size, technological level and novelty, particular organization, participants, etc.);

— the interest and usefulness of the related information.

The lessons learned information can result from any situation which might be encountered in similar contexts for future projects, i.e.:

— undesirable experiences that need to be avoided;

— strategies, rules, principles of design, validation, tests and operations that proved to be successful or necessary.

This document neither endorses nor recommends the transmission of company proprietary information to external entities as part of a lessons learned process.

Implementing a formal lessons learned process as outlined in this document makes it possible to capture and benefit from this information.

The lessons learned activity is an important contribution to the processing of the preventive and corrective actions specified in ISO 9001 and ISO 17666.

This document also provides lessons learned processes and suggested lessons learned forms.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 The role of a lessons learned activity

4.1 Role

The role of a lessons learned activity is to ensure that projects benefit from the experiences – good and bad – of previous projects. The main activities involved in the process are:

a) to identify and collect relevant information;

b) to analyse information, classify lessons learned and issue recommendations;

c) to document the process;

d) to make information available.

The outputs of the activity are:

— root event background;

— lessons learned;

— recommendations.

The steps involved in the lessons learned process are described in detail in Clause 6.

4.2 Information availability

Information should be made available, as necessary, by referring to a collection of data and by consulting a shared database. External provision of data should be in accordance with agreements between the customer and supplier. This database should include any information considered by the participants to be useful for ongoing or future project activities.

The database should be searchable by domain, type of project, period and type of anomaly.

Information may also be made available by means of more "active" ways of knowledge transfer, such as a debriefing or presentation of lessons learned to interested personnel (e.g. within the company) or the presentation of lessons learned to relevant project teams (e.g. within the company).

5 Lessons learned management

5.1 The main applications of the lessons learned

Lessons learned should be systematically applied in the following situations:

a) before the start of a space project;

EXAMPLE Information about costs and duration, technical performance and quality of previous projects are made available to a new project.

b) transition from one phase to another phase;

EXAMPLE The lesson learned during phase B (definition phase) or phase C (development phase) is that a qualification of an advanced technology is followed by specific inspection during manufacturing.

c) when the results from one project could benefit another coexisting project;

EXAMPLE The lessons learned from analysis of a component in a given project is directly beneficial to another project.

d) when the knowledge of one field can benefit another.

EXAMPLE The lessons learned from analysis of defects or failures during integration and test results in improvement of the specifications of a contract.

5.2 Information sources for the lessons learned

The search for useful information is an essential step to developing lessons learned.

Suggested sources of useful information include the following:

— opinions of specialists and experts;

— documented conclusions of specialists and experts;

— technical reports, actions and recommendations resulting from reviews;

— non-conformance reports;

— failure analysis reports;

— assessments of success in meeting project objectives (at the end of a project);

— documented results of operation of models of space engineering, or results of space mission, or both;

— feedback from customers;

— alerts;

— accidents, mishaps, incidents and close calls; and

— risk assessments.

6 The lessons learned process

6.1 General

The lessons learned process is depicted in Figure 1. It comprises three phases with related outputs:

a) the **background** of the experience, in which the following are described in detail:

   — the report of the fact;

   — the analyses which comprise the identification of the causes (possible, probable and proven) and the consequences (immediate, future and potential);

   — the resulting actions;

b) **lessons learned**, which are lessons drawn from the experience;

c) **recommendations** which are applicable to new projects (impact on documentation, impact on product).

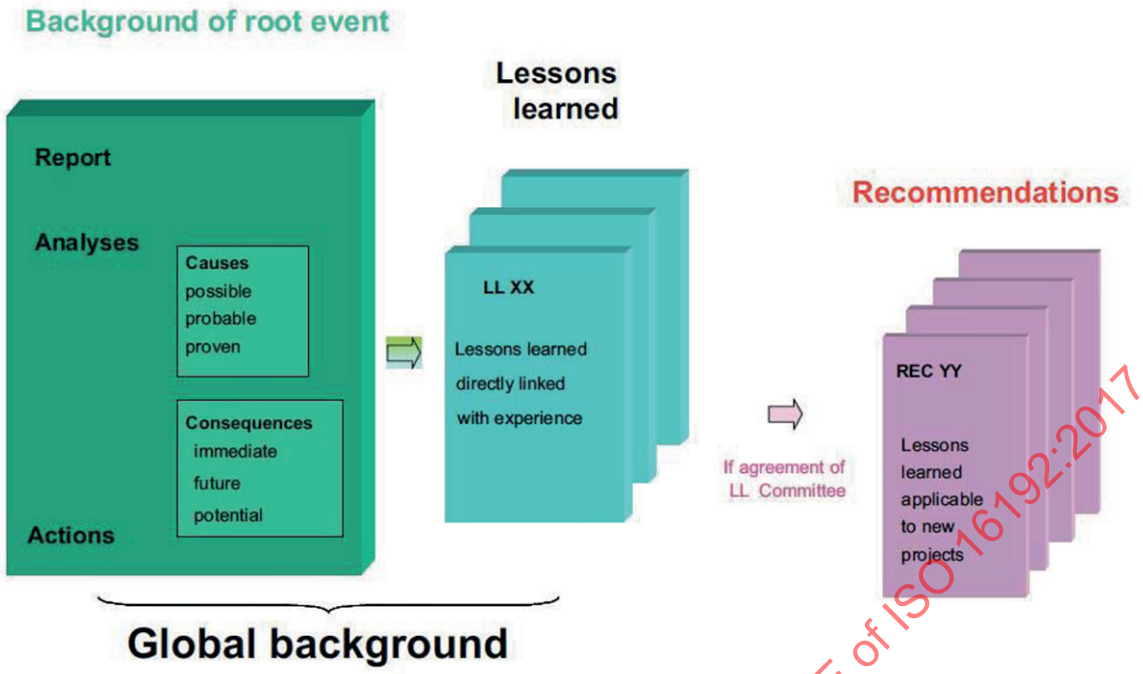

Figure 1 — Lessons learned process

6.2 Process steps

The lessons learned process is optimized by implementing a common methodology of definition, classification, description and registration.

The three phases in the process each comprise one or more steps. These steps are depicted in Figure 2 and described in 6.3.1 to 6.3.7.

It should be noted that, whilst the process in Figure 2 is shown as a simple sequence, only steps 3 to 5 describe a totally sequential flow. Steps 1 and 2 are performed continuously throughout the life of a project and will trigger the steps that follow. Step 6 is event triggered, and step 7 is scheduled or periodic.

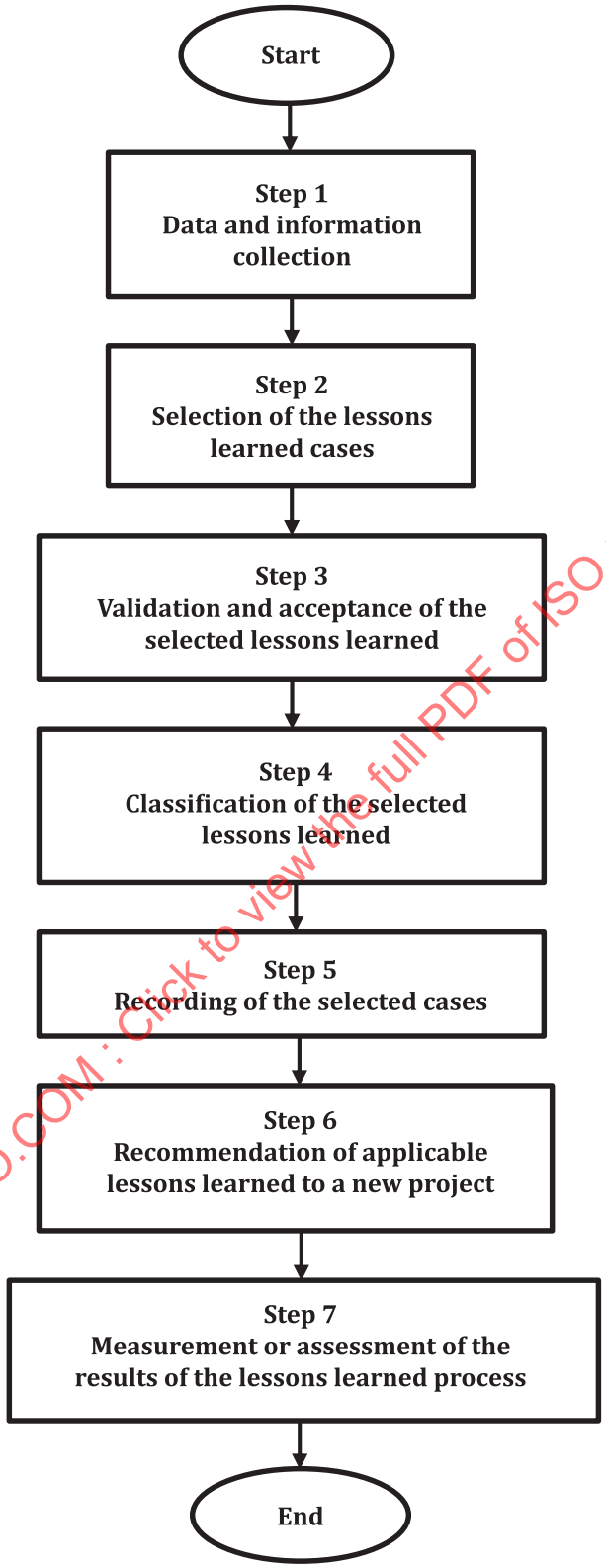

Figure 2 — Steps of lessons learned process

6.3 Description of lessons learned process steps

6.3.1 Data and information collection

The lessons learned are established by identifying pertinent information acquired directly from positive and negative experiences relative to the organization and management of the content of each project. Company proprietary information should be collected but should not be transmitted to external entities in a lessons learned process.

6.3.2 Selection of the lessons learned cases

Not all the technical experiences, occurrences, or events during a project have the same interest or importance. It is necessary to analyse the data collected and select the most significant occurrences, experiences or events, and to translate them into proposed lessons learned.

6.3.3 Validation and acceptance of the selected lessons learned

The lessons learned cases or events to be recorded in the database should be reviewed, validated and accepted (approved) by a defined method, i.e. by a "lessons learned committee" or any similar organization. An assessment should be made as to the acceptability of the proposed case or event, prior to ruling on the lessons to be drawn and describing the actions needed to decrease the risk of occurrence of the problems.

The responsibility for, and frequency of, examining potential lessons learned should be defined.

6.3.4 Classification of the selected lessons learned

After acceptance, selected lessons learned should be classified by type using key words or phases, e.g. management, safety, quality, engineering and programme phase.

6.3.5 Recording of the selected cases

Before recording the lessons learned outputs, the proposals should be checked. After validation, they should be recorded by the organization in a database, which should be updated as necessary.

The recorded output should include, as a minimum:

— facts;

— cause;

— consequence;

— recommendations for future action.

6.3.6 Recommendation of applicable lessons learned to a new project

The recommendations related to a lesson learned (e.g. causes of anomalies, rules of design) should be included in appropriate standards or reference documents.

6.3.7 Measurement or assessment of the results of the lessons learned process

Lessons learned results should be assessed in terms of costs, schedules and technical performance.

7 Content of the lessons learned record

7.1 General

The lessons learned record should contain at least four parts:

a) a brief description of the experience or event;

b) one or more lessons that may be taken from the experience or event;

c) for each lesson, one or more associated recommendations, in order to prevent a recurrence of the associated negative experience or to promote or enhance the recurrence of the associated positive experience;

d) for each recommendation accepted under 6.3.3, actions to be performed to implement the recommendation.

7.2 Detailed content

7.2.1 General

The detailed content in 7.2.2 to 7.2.4 is recommended for the lessons learned record.

7.2.2 Background of the root event

This part of the record should include:

— a heading intended for reference (fact);

— a synthesis of any investigations carried out;

— an analysis of the causes (possible, probable and proven) and the consequences (immediate, future and potential);

— the resulting actions directly taken.

7.2.3 The lessons learned

This part of the record documents the immediate knowledge drawn directly from the experiences associated with the causes or consequences of the root event.

NOTE Several lessons learned can be drawn from a root event.

7.2.4 Resulting recommendations and actions

This part of the record documents actions recommended to mitigate or eliminate the negative experiences or to promote or enhance the positive experiences of the root event. It may include more general or further-reaching recommendations to encompass a broader range of situations (e.g. changes to rules, standards or future contracts).

NOTE Several recommendations can be drawn from a lesson learned.

8 Lessons learned implementation

8.1 General

The lessons learned process can be implemented by using the formats provided in Annexes A and B. It can be initiated by any project member who identifies a lesson learned.

The generic form (see Annex A) is suitable for documenting multiple lessons learned from a single root event, which in turn lead to one or more recommendations.

The short form (see Annex B) is best suited for documenting a single lesson learned and recommendation leading from a root event.

8.2 Application

Lessons learned should be applied during the following programme or project activities:

a) processing of the successes, incidents and nonconformities;

b) processing of modifications;

c) design or other reviews.

The supplier should establish a schedule for lessons learned activities in the early project-planning stages.

8.3 Responsibility

Responsibility for the lessons learned process of a project should be clearly assigned.

9 Effectiveness of the lessons learned process

Participant surveys and project audits, as well as measured indicators (e.g. the number of queries of the database, the number of lessons learned cases originating in a project, and the number of applications of recommendations issued from the lessons learned process), help evaluate the effectiveness of a lessons learned process. The need for specific measured indicators should be considered in the initial design of a lessons learned database.

The assessment of the effectiveness of the lessons learned process in a given project should be part of the project evaluation after completion.

Annex A
(informative)

Generic lessons learned forms

The generic forms illustrated in Figures A.1, A.2 and A.3 are suitable for documenting multiple lessons learned from a single root event, which in turn lead to one or more recommendations.

1. NAME OF ORGANIZATION: Contact information:	2. ROOT EVENT N°: Approval date: Approval:
3. SUBJECT/TITLE/TOPIC(S):	
4. DESCRIPTION OF THE ROOT EVENT:	
5. ANALYSIS OF THE CAUSES: a) Possible causes: b) Probable causes: c) Proven causes:	
6. ANALYSIS OF THE CONSEQUENCES: a) Immediate consequences: b) Future consequences: c) Potential consequences:	
7. RESULTING ACTIONS:	

Figure A.1 — Root event background form

Instructions for completing the root event background form:

1. NAME OF ORGANIZATION: Contact information:	2. LESSONS LEARNED N°: ROOT EVENT N°: Approval date: Approval:
3. SUBJECT/TITLE/TOPIC(S):	
4. DESCRIPTION OF THE LESSONS LEARNED:	

Block 1: Enter the name and contact information of the submitting organization, company or agency.

Block 2: Enter the root event N°, the date of approval and approval name.

Block 3: Enter the name of the subject, title or topic of the lessons learned.

Block 4: Enter a complete description of the root event.

Block 5: Enter the results of analysis of causes (possible, probable and proven) of the root event.

Block 6: Enter the results of analysis of consequences (immediate, future and potential) of the root event.

Block 7: Enter the resulting actions.

Figure A.2 — Lessons learned form

Instructions for completing the lessons learned form:

1. NAME OF ORGANIZATION: Contact information:	2. RECOMMENDATION N°: LESSONS LEARNED N°: ROOT EVENT N°: Approval date: Approval:
3. SUBJECT/TITLE/TOPIC(S):	
4. RECOMMENDATIONS:	
5. ACTIONS: a) Impact on documentation: b) Impact on product/equipment:	