BRITISH STANDARD

BS ISO/IEC 19796-3:2009

Information technology - Learning, education and training - Quality management, assurances and metrics

ICS 03.100.30; 35.240.99

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

Full document details: BS ISO/IEC 19796-3:2009

National foreword

This British Standard is the UK implementation of .

The UK participation in its preparation was entrusted to Technical Committee IST/43, Information technology for learning, education and training.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2009

© BSI 2009

ISBN 978 0 580 58482 4

Amendments/corrigenda issued since publication

Date	Comments

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 19796-3:2009

INTERNATIONAL STANDARD

ISO/IEC 19796-3

First edition
2009-02-01

Information technology — Learning, education and training — Quality management, assurance and metrics —

Part 3:
Reference methods and metrics

Technologies de l'information — Apprentissage, éducation et formation — Management, assurance et métrologie de la qualité —

Partie 3: Méthodes de référence et métrologie

Reference number
ISO/IEC 19796-3:2009(E)

Documents
Document Sharing Hub
© ISO/IEC 2009

Full document details: BS ISO/IEC 19796-3:2009

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2009

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 19796-3:2009

Contents

Page

Foreword iv

Introduction v

1 Scope 1

2 Conformance 2

3 Normative references 2

4 Terms and definitions 2

5 Mapping quality approaches 4
5.1 Quality approaches and ISO/IEC 19796 series 4
5.2 Practical guideline for quality approaches 6

6 Quality management / assurance activity model 6

7 Reference model for quality methods 8
7.1 Categories 8
7.2 Elements 10

8 Reference model for quality metrics 14
8.1 Categories 14
8.2 Elements 16

9 Collection of methods and metrics 19
9.1 Collection of methods 19
9.2 Collection of metrics 22

Annex A (informative) **Description format examples of methods reference model** 30

Annex B (informative) **Description format examples of metrics reference model** 34

Bibliography 38

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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

ISO/IEC 19796-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training*.

ISO/IEC 19796 consists of the following parts, under the general title *Information technology — Learning, education and training — Quality management, assurance and metrics*:

— *Part 1: General approach*

— *Part 3: Reference methods and metrics*

The following parts are under preparation:

— *Part 2: Harmonized quality model*

— *Part 4: Best practice and implementation guide* [Technical Report]

— *Part 5: How to use ISO/IEC 19796-1* [Technical Report]

© ISO/IEC 2009 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

Introduction

Quality in the field of distance education and e-learning has become an issue of increasing importance in academia, institutions, and industry. A variety of approaches have been developed and implemented successfully. Generic standards, such as ISO 9000:2005 and/or ISO 14000 have been used also in the educational community. In addition to generic standards related to quality, there are specific quality guidelines that have been developed and used for e-Learning or distance education (such as the ASTD criteria for e-Learning, the BLA Quality Mark, Quality Platform Learning by D-ELAN, or Quality elements by Sloan-consortium). It has become clear that quality management can contribute to improve the performance of organizations in the field of learning, education, and training (LET).

Numerous approaches to quality management and assurance and their different scopes and objectives lead to confusion within communities that depend on information technologies to support and facilitate learning, education, and training. Therefore, a harmonized quality standard, the ISO/IEC 19796 series, has been developed.

ISO/IEC 19796 has five parts as a series. ISO/IEC 19796-1 is the basic framework for quality development in organizations within the field of learning, education, and training (LET). It serves as a framework to describe, compare, and analyze quality management and quality assurance approaches. In addition to providing a descriptive model that can be used to compare and analyze quality approaches, ISO/IEC 19796-1 identifies the components of a seven-part process model within the lifecycle of information and communication systems for learning, education, and training. As a framework it may be used to compare different quality assurance and quality management processes. This part of ISO/IEC 19796 provides reference methods and metrics used in the lifecycle process. It also provides examples of how methods and metrics can be generically described, compared, and used for specific contexts. For each process in the e-learning lifecycle, a set of potential methods and metrics should be specified. This set of methods and metrics can be used during the development of an individual quality approach that is based on defined quality objectives.

ISO/IEC 19796-1 describes the processes for the e-Learning lifecycle. It is a reference model with a high level of abstraction which has to be adapted to a certain organization and to a certain situation. To facilitate the adaptation procedure, two reference models for quality management and quality assurance are described in this part of ISO/IEC 19796:

— reference model for methods;

— reference model for metrics.

To facilitate the adaptation of ISO/IEC 19796-1, as the first step, this part of ISO/IEC 19796 provides reference methods and metrics used in lifecycle processes with the reference models from ISO/IEC 19796-1. It also provides collections of methods and metrics which are generically described and can be used for specific contexts. For each process in the e-Learning lifecycle, a set of potential methods and metrics should be specified. This set of methods and metrics can be used during the development and definition of an individual quality approach based on certain quality objectives.

ISO/IEC 19796-1 provides a description format and a process framework as the reference framework for the description of quality approaches (RFDQ), for the description and development of quality approaches. The RFDQ framework is only a base for quality development – it does not provide specific methods and metrics for particular quality objectives, and also does not provide instruments or procedures.

ISO Guide 72 Guidelines mainly distinguish three types of management system standards; Type A — management systems requirements standards, Type B — management systems guidelines standards, and Type C — management systems related standards. The consensus is to use *ISO Guide 72 Guidelines for the justification and development of management system standards*. Accordingly, this International Standard is Type C, a management systems related standard, as neither requirements are defined nor guidelines are given.

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 19796-3:2009

Information technology — Learning, education and training — Quality management, assurance and metrics —

Part 3:
Reference methods and metrics

1 Scope

This part of ISO/IEC 19796 extends the “reference framework for the description of quality approaches” (RFDQ) defined in ISO/IEC 19796-1 by providing a harmonized description of the methods and metrics required to implement quality management and quality assurance systems for stakeholders designing, developing, or utilizing information technology systems used for learning, education, and training.

Activities such as quality planning, quality control, and quality improvement are important for quality management implementations. While these three activities are focused on products, processes and their development, quality assurance is focused more on confirmation and indication for internal and external stakeholders. It should be noted that the reference methods and metrics for this part of ISO/IEC 19796 include issues related to the implementation of quality management and assurance systems for information technologies that are used for learning, education, and training. This part of ISO/IEC 19796 is to be used to help identify methods and metrics to implement a quality assurance and management system of an IT system used for learning, education, and training. For example, it may be used for quality management systems that help to verify items such as IT system effectiveness, compliance with quality objectives including purposes, customer satisfaction, training in the use of the IT system, complaints handling, and auditing.

NOTE While not included in the normative references of this part of ISO/IEC 19796 it may be helpful for ITLET (Information Technology for Learning, Education, and Training) stakeholders interested in quality issues to refer to the related standards listed in the bibliography for further information regarding quality management and quality assurance.

During the implementation of quality management and quality assurance systems, using specific methods and metrics are indispensable for the exchange, purchase, management, and archiving of learning courses, systems, and/or services. Involving all stakeholders (e.g., developers, administrators, government, providers, teachers, and learners) within a framework that is open and inclusive will help to ensure that information technologies for learning, education, and training are both effective for and appropriate to learning and teaching needs.

This part of ISO/IEC 19796 has the following components, which are developed in order to indicate and communicate quality approaches.

- The reference model for methods — provides an interoperable formalized description of methods that can be easily implemented and adopted into a quality management system to realize and facilitate quality management.
- The reference model for metrics — provides an interoperable formalized description of metrics that can be easily implemented and adopted into a quality management system to measure quality in a comparable way.
- A collection of methods that can be used to manage and assure quality in different contexts. It supports stakeholders to implement concrete actions to achieve (a set of) quality objectives.

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 19796-3:2009

- A collection of metrics and indicators that can be used to measure quality in processes, products, components, and services. It supports stakeholders to implement measures (e.g. indicators) for specific quality objectives.
- Annex A (informative) contains examples of how this part of ISO/IEC 19796 can be used and provides a suggested format to describe a quality method.
- Annex B (informative) contains examples of how this part of ISO/IEC 19796 can be used and provides a suggested format to describe a quality metric.

2 Conformance

The objective of this part of ISO/IEC 19796 is to extend the RFDQ (defined by ISO/IEC 19796-1) leading to a complete quality system that supports stakeholders to implement quality management and quality assurance systems.

For each quality management and assurance process a set of potential methods and metrics that can be used at the development of individual quality approaches needs to be specified. The harmonized description of these methods and metrics is needed to provide clear understanding, mutual communication and agreement. The collections of methods and metrics such as quality approaches should be extensible.

A method or metric is conformant if it uses the corresponding reference model (i.e. Clause 7 for methods and Clause 8 for metrics) or an instantiation in description format (as noted in Table 1 for methods and Table 2 for metrics). A conforming description may contain descriptions of processes or approaches in addition to what is included in this part of ISO/IEC 19796. In other words, it is intended to be extensible and may contain additional data elements. If it exists in the reference methods or metrics collection then a reference should be provided to facilitate verification that it is conformant.

3 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.

ISO/IEC TR 9126-2:2003, *Software engineering — Product quality — Part 2: External metrics*

ISO/IEC 19796-1:2005, *Information technology — Learning, education and training — Quality management, assurance and metrics — Part 1: General approach*

4 Terms and definitions

For the purposes of this document, the terms and definition given in ISO/IEC 19796-1:2005 and the following terms and definitions apply.

4.1
attribute
characteristic of an object or entity

[ISO/IEC 11179-3:2003, 3.1.3]

NOTE 1 An object or entity can have many attributes, only some of which may be of interest for measurement (and attribute can be distinguished object or entity quantitatively or qualitatively by human or automated means).

NOTE 2 Attribute is a measurable physical and abstract property of an entity. [ISO/IEC 14598-1:1999, 4.2]

© ISO/IEC 2009 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

4.2
measurement
set of operations to determine a value of a measure

NOTE 1 Measurement is a key activity in quality management and assurance. Especially, quality audit and assessment need measurement. Measurement implies a measurement procedure, based on a theoretical model. In practice, measurement presupposes a calibrated measuring system, which should be subsequently verified.

NOTE 2 Measurement is set of operations having the object of determining a value of a measure. [ISO/IEC 15939:2002, 3.17]

NOTE 3 Measurement is a process of experimentally obtaining information about the magnitude of a quantity. [ISO VIM: 2004, 2.1]

4.3
method
⟨quality approaches⟩
one or a set of instrument(s) or tool(s) to assure and/or to manage quality in processes

NOTE 1 Methods include physical methods and abstract or conceptual methods. There are various types of methods from the subjects of management science, pedagogy, psychology, engineering, statistics, biology etc.

NOTE 2 "Measurement method" is a generic description of a logical sequence of operations used in a measurement. [ISO VIM: 2004]

4.4
metric
⟨quality approaches⟩
material measure within some aspects of quality characteristics

NOTE 1 In other words, to determine a value, methods of measuring or testing are used in order to quantify a quality object from the standpoint of quality characteristics, such as scale, criterion, degree, weight, magnitude, interval, ratio, or standard rate.

NOTE 2 “Material measure” is defined as a device reproducing or supplying, in a permanent manner during its use, quantities of given kinds, each with an assigned value. [ISO VIM: 2004]

NOTE 3 In ISO/IEC 15939:2002, the metric is defined as "the defined measurement methods and the measurement scale". However metrics need to be clearly divided between the terms of method and scale because of implementation for audit and assessing.

4.5
scale
ordered set of values, continuous or discrete, or a set of categories to which the attribute is mapped

[ISO/IEC 15939:2002, 3.33]

NOTE 1 The type of scale depends on the nature of the relationship between values on the scale. Four types of scales are

— Nominal: the measurement values are categorical. For example, the classification of defects by their type.

— Ordinal: the measurement values are rankings. For example, the assignment of defects to a severity level.

— Interval: the measurement values have equal distances corresponding to equal quantities of the attribute.

— Ratio: the measurement values have equal distances corresponding to equal quantities of the attribute where the value of zero corresponds to none of the attribute. For example, the size of a software component in terms of lines on code (LOC).

The method of measurement usually affects the type of scale that can be used reliably with a given attribute. For example, subjective methods of measurement usually only support ordinal or nominal scales.

NOTE 2 Measurement scale is defined as "ordered set of values of quantities of a given kind, continuous or discrete, used in arranging quantities of the same kind by magnitude". [ISO VIM:2000, 2.8]

Documents
Document Sharing Hub

© ISO/IEC 2009 – All rights reserved

Full document details: BS ISO/IEC 19796-3:2009

4.6
validation
confirmation, through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled

[ISO 9000:2005, 3.8.5]

NOTE 1 Confirmation by examination and by resulting evidence that particular requirements for a specific intended use are fulfilled. [ISO 8402:1994]

NOTE 2 Confirmation through examination of a given item and provision of objective evidence that it fulfils the requirements for a stated intended use. [ISO VIM: 2004, 2.28]

4.7
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[ISO 9000:2005, 3.8.4]

NOTE 1 Confirmation by examination and by resulting evidence that specified requirements have been fulfilled. [ISO 8402:1994]

NOTE 2 Confirmation through examination of a given item and provision of objective evidence that it fulfils specified requirements. [ISO VIM:2004, 2.27]

5 Mapping quality approaches

5.1 Quality approaches and ISO/IEC 19796 series

ISO/IEC 19796-1 focuses on aspects of quality approaches and on a process-oriented framework in order to design, plan, understand, manage, and evaluate quality in an organization and within sectors or markets in which information technology systems are used for learning, education, and/or training. ISO/IEC 19796-3 provides ITLET stakeholders with more detailed reference information regarding methods and metrics that are aligned with ISO/IEC 19796-1, and may be used to help in the design, development, implementation, and evaluation of an ITLET quality management system. Together quality metrics and methods may be used to assure quality for stakeholders and to fulfill an organization's quality objectives.

ISO/IEC 19796 series consists of five parts. The relationship among these five parts is described in Figure 1. ISO/IEC 19796-1 provides perspective focuses on lifecycle processes for quality and it is located at the left of Figure 1.

Organizations and providers that produce, provide, and deliver information technologies for learning, education, and training, use quality approaches in order to provide assurance of quality and to continuously improve the quality of their products and services. The Reference Framework for the Description of Quality Approaches (RFDQ) outlined in ISO/IEC 19796-1 provides a framework that may be used to design and develop a quality management system. The flow of ISO/IEC19796-1 is represented by the "a" line in the figure. Quality information using ISO/IEC 19796-1 that is relevant to all stakeholders in the process is recorded and reported to stakeholders in order to assure and to improve quality (see the diagonally shaded area in the top of the figure).

There are many organizations/providers that use a variety of quality management and assurances approaches that may be sector or industry-based. ISO/IEC 19796-2 is being developed In order to harmonize the various aspects and types of quality approaches, (see line "b").

© ISO/IEC 2009 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

In cooperation with stakeholders, organizations/providers will identify how quality will be measured, the types of information that will be recorded, the methods that will be used, and how this information will be reported. ISO/IEC 19796-3 may be used by stakeholders, and organizations and providers to describe the methods and metrics that will be used for the quality management system. There are three flows related to ISO/IEC 19796-3, which are indicated by the “c”, "d" and "e" lines. The "c" line means that ISO/IEC 19796-1 notes that more detailed information regarding quality methods and metrics are provided in 19796-3. The "d" line means that the reference models of ISO/IEC 19796-3 can be used for quality management and assurance independently, depending on the needs of stakeholders. The "e" line indicates that a collection of ISO/IEC19796-3 methods and metrics can be searched and used as a reference to support the comparison and selection of quality methods and metrics.

ISO/IEC 19796-4 provides guidelines with good practice implementations of ISO/IEC 19796-1. The flow of ISO/IEC 19796-4 indicating that this part may be used to support the implementation of 19796-1 is described by the “f” line and the diagonally shaded areas “record” and “report to assure and improve quality.

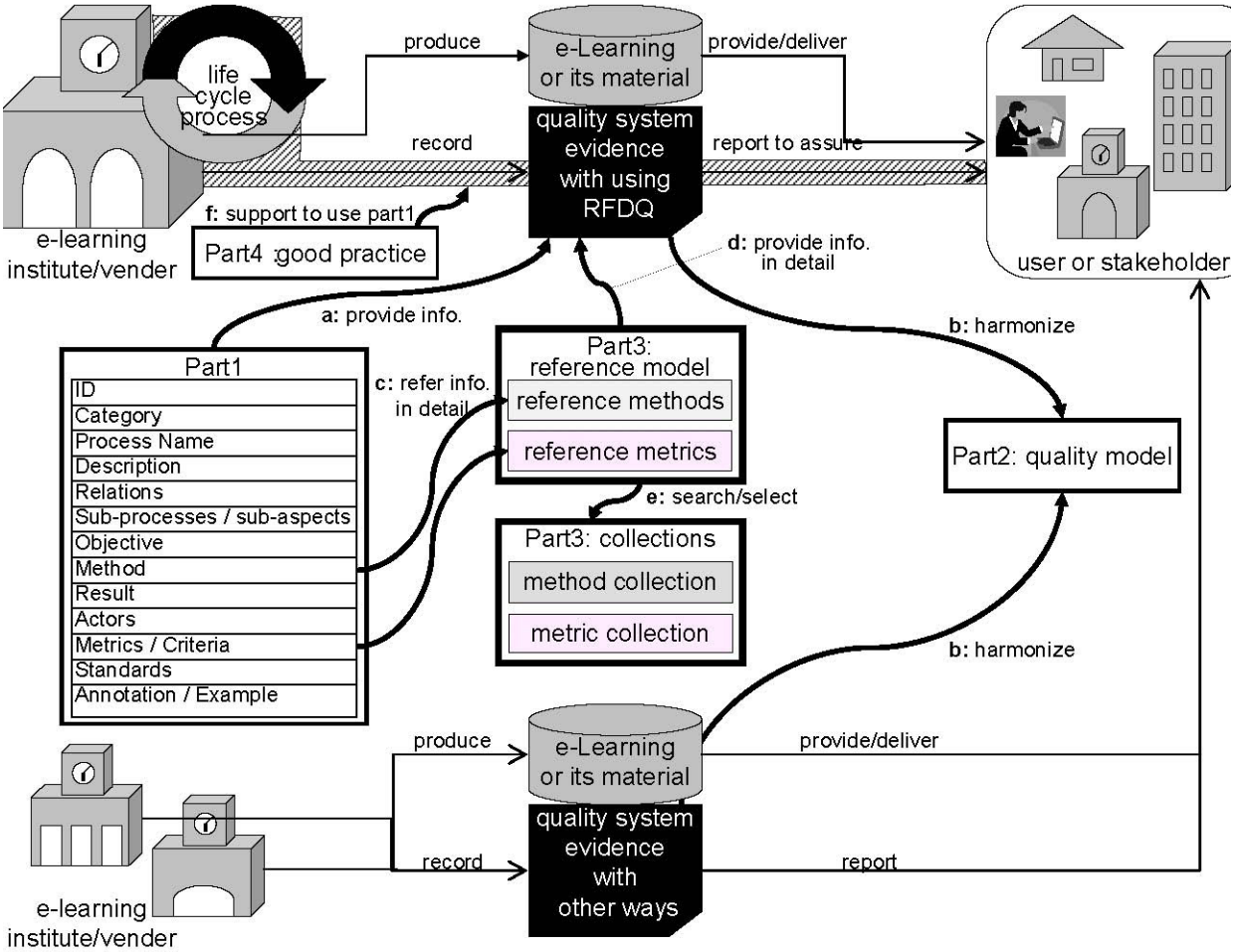

Figure 1 — Mapping quality approaches and ISO/IEC 19796 series

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

5.2 Practical guideline for quality approaches

In ISO/IEC 19796-1, the process-oriented model is divided into 7 processes. For validation and verification of quality approaches, it is important to identify what aspects should be measured and how value should be assessed. ISO/IEC 19796-1 defines the life cycle processes of quality approaches as non-sequential stages, and defines 13 items of RFDQ's attributes as a reference and descriptive model (see the left side of Figure 1). However, it does not focus on the characteristics of quality approaches.

The main purpose of this ISO/IEC 19796-3 is to facilitate the concrete implementation of quality approaches by providing implementation methods and metrics for measurement. Attributes and data elements are used to facilitate the documentation, analysis and comparison of different quality approaches for the development and use of information technology within learning, education, and training.

In addition to being useful for evaluating, auditing, goal setting and improving quality approaches in e-learning, quality methods and metrics can be used to define quality requirements to a detailed and substantial level. The communication and agreement on quality requirements and approaches beforehand using ISO/IEC 19796-3 could help to evaluate and ensure the effectiveness of information technologies in meeting the teaching and learning needs of ITLET stakeholders.

6 Quality management / assurance activity model

Products and services are defined as a result of one or more process(es). Information technology products and services that are developed and utilized for learning, education, and training are the result of one or more process(es). Data regarding the quality of these processes and their resultant products and services may be recorded and reported to stakeholders to assure and to improve quality. The ISO/IEC 19796 series provides a framework to guide the identification of quality data types, to harmonize different quality management systems, to identify quality metrics and methods, and to provide examples of best practice for quality e-learning.

Quality management and assurance activities should be performed not only for quality management purposes, but as an integrated part of product and service development process and sub-process. Developers select and use methods and metrics during the development processes and sub-processes. While from the viewpoint of quality management and assurance, these activities can be recognized as quality related activities. As an example, the project manager of an e-Learning project should define requirements and evidence criteria for quality of products and services within the project. This will allow organizations/providers to plan, use, evaluate, and improve quality processes and sub-processes to assure stakeholders regarding the quality of their product(s) and/or service(s).

Each stakeholder may have a different perspective for the same activities. For example, a developer might select a specific method or metric for use in his/her developmental activities, whereas a project manager might use the entire reference model to ensure that the project process and/or outcome meet the desired quality.

A variety of specific implementations are already in place in industry, academia, and government. A combination of methods and metrics are purposefully combined to achieve a certain quality objective. Examples are 1) a mobile phone company using metrics for early fault detection for their e-learning software; 2) a public institution using methods to assure and measure customer satisfaction or 3) an academic institution using software quality metrics to evaluate the quality of student portfolio software. These methods and metrics have different functions, such as quality control, quality assurance, or both. For example, the methods “workshop”, "interview", and “fishbone analysis” might be selected for development, and executed and used by developers. While these methods are effective and adequate to identify specific educational requirements and to define concrete educational objectives or outcomes in the needs analysis process and in the framework analysis process (right side of Figure 2), these methods are meaningful to assure their processes and outcomes using its statistical data or diagram. Of course, workshop and interview can be used in the framework analysis, and fishbone analysis can be effective in the needs analysis. Developers will select some methods for each process for their suitability.

© ISO/IEC 2009 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009

Methods and metrics are needed to identify how to utilize quality management and assurance to improve development processes and sub-processes for information technologies for learning, education, and training. The left side of Figure 2 indicates the process that can be used to ensure that quality management and assessment is applied during the development and implementation of information technologies for learning, education, and training.

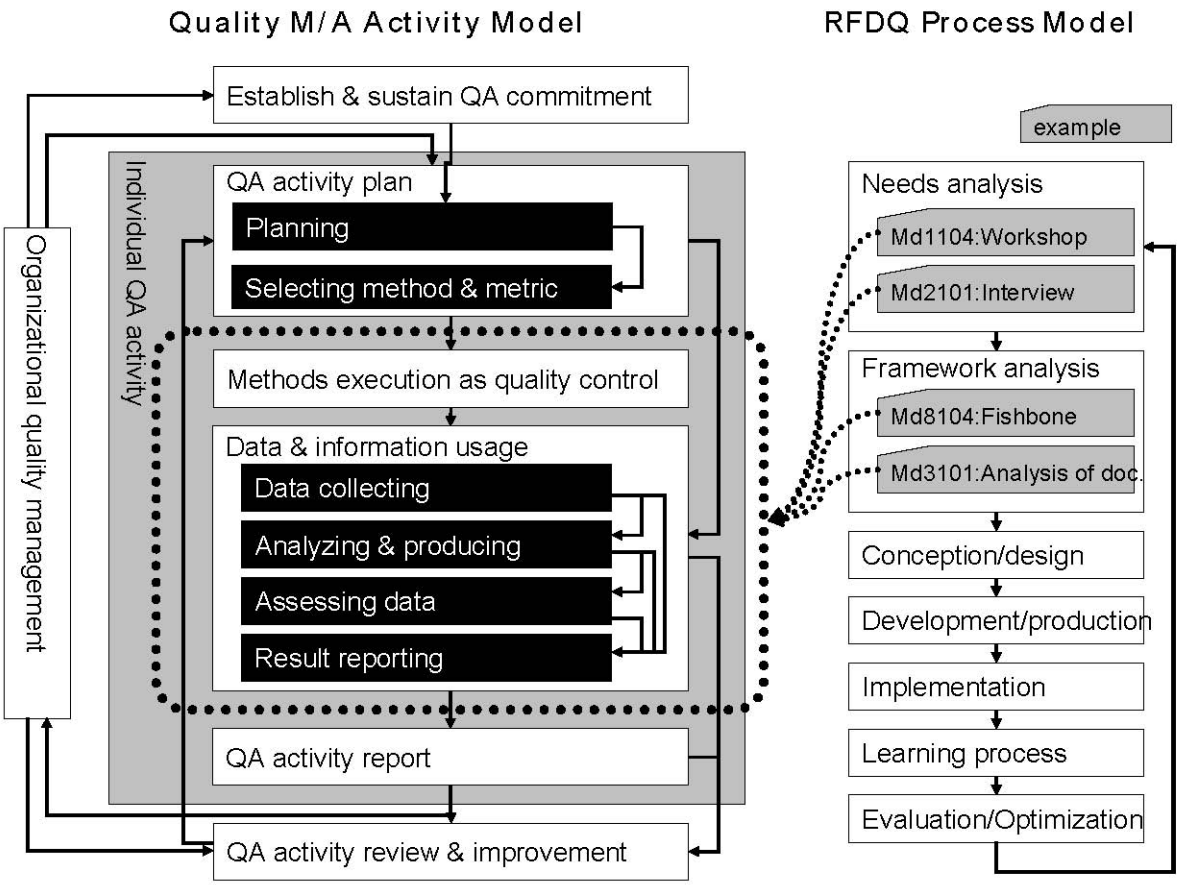

Figure 2 — Quality management/assurance activity model and relationship with RFDQ

© ISO/IEC 2009 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 19796-3:2009