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Information technology — Reference Model of Data Management

Technologies de l'information — Modèle de référence pour la gestion de données

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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

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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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

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Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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 TR 10032, which is a Technical Report of type 3, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

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Introduction

ISO, in specifying a Reference Model of Data Management, recognizes that there are many implementors of data management systems. It is inevitable that different implementors use different terms to specify or refer to similar data management functions. Furthermore, the use of the same term to describe different functions is also common. There is a clear need to standardize the data management functions. This Technical Report fulfils that role by presenting a Reference Model of Data Management and defining the areas of this model which lend themselves to standardization.

This Technical Report defines the Reference Model of Data Management. It provides a common basis for the coordination of standards development for the purpose of data management, while allowing existing and emerging standards to be placed into perspective.

The term “data management” includes the description, creation, modification, use and control of data in information systems. Such data management functions may be performed as a common service for information systems applications. Alternatively, each application may define and control the data relevant to it. In the case in which data management functions are performed as a common service, it is desirable to provide standardized facilities for data access and control in order to permit the sharing of data by a number of users. Such standardization requires the determination of a number of interfaces for which individual standards may be developed.

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The objectives of this Technical Report are to provide a framework allowing, within the scope specified in Clause 1, for the following:

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a) identification of interfaces;

b) positioning all such interfaces relative to each other;

c) identification of facilities provided at each interface;

d) identification of the process which supports each interface and, where appropriate, of the data required for such support;

e) positioning the use of the interfaces in terms of an information systems life cycle; and

f) identification of the binding alternatives associated with each appropriate identified interface.

There are three major objectives which are applied in this Technical Report to data management standardization. These are as follows:

a) Shareability of resources;

b) Minimize cost of supporting an information system over its life cycle;

c) Optimum use of standardization effort.

The shareability of resources objective applies to both information resources as represented by data in databases and to processor resources of the kind described in Clause 6. There is particular emphasis on the shareability of information resources located at different places and developed using different hardware and software. All shareability of resources is subject to access control.

The objective of minimizing the cost of supporting an information system applies to all phases of the information system life cycle, including design, development, operation and maintenance costs.

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The objective associated with the optimum use of standardization effort refers to reducing the number of standards required and to simplifying the content of such standards.

This Technical Report identifies areas for developing or improving standards, and provides a common framework for maintaining consistency of all related standards.

This Technical Report provides a framework which allows teams of experts to work productively and independently on the development of standards for different components of information systems.

This Technical Report has sufficient generality to accommodate the development of new standards in response to advances in technology.

The description of the Reference Model of Data Management given in this Technical Report is presented as follows:

— Clause 4 introduces data management and the requirements based on information systems;

— Clause 5 explains the data concepts that are required for the Reference Model and how they relate to each other and the process concepts;

— Clause 6 provides an architectural model within which different data and processing components relevant to data management can be placed;

— Clause 7 describes the objectives and principles for data management standardization;

— Annex A is a list of related International Standards;

— Annex B shows how the existing and future SC 21/WG3 standards relate to the architectural model described in Clause 6;

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This Technical Report specifies the classes of services that are expected to be provided by data management, and it provides a framework which describes the way in which they are related to each other. However, data management does not exist in isolation but within an environment providing other services such as data storage and communication, as is described in Clause 4.

Prior to completion of work on this Technical Report, data management standards were developed within ISO/IEC as indicated in Annex A of this document. The positioning of such International Standards using this Reference Model of Data Management is described in Annex B.

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Information technology — Reference Model of Data Management

1 Scope

This Technical Report defines the ISO Reference Model of Data Management. It establishes a framework for coordinating the development of existing and future standards for the management of persistent data in information systems. See Annex A for references to existing data management standards.

This Technical Report defines common terminology and concepts pertinent to all data held within information systems. Such concepts are used to define more specifically the services provided by particular data management components, such as database management systems or data dictionary systems. The definition of such related services identifies interfaces which may be the subject of future standardization.

This Technical Report does not specify services and protocols for data management. This Technical Report is neither an implementation specification for systems, nor a basis for appraising the conformance of implementations.

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The scope of this Technical Report includes processes which are concerned with handling persistent data and their interaction with processes particular to the requirements of a specific information system. This includes common data management services such as those required to define, store, retrieve, update, maintain, backup, restore, and communicate applications and dictionary data.

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The scope of this Technical Report includes consideration of standards for the management of data located on one or more computer systems, including services for distributed database management.

This Technical Report does not include within its scope common services normally provided by an operating system including those processes which are concerned with specific types of physical storage devices, specific techniques for storing data, and specific details of communications and human computer interfaces.

A data management standard defines services provided at an interface. It does not impose limitations on how processes are implemented.

2 Terms and definitions

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

The definitions provided in this clause aim to specify the most technical use of the terms in this Technical Report. The introduction to each term may be presented in a simpler informal description. Some of the terms are defined in other standards, but the following definitions are provided for use in the specific context of data management.

2.1
access control
the prevention of unauthorized use of a resource, including the prevention of use of a resource in an unauthorized manner. For data management purposes, access control relates to the enabling of authorized access to data and the prevention of unauthorized access. Access control determines the processes which a user may perform

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2.2
access control data
a collection of data associated with the definition or modification of access control privileges

2.3
access control mechanism
a mechanism which may be used to enforce a security policy

2.4
application
the data manipulation and processing operations that are related to specific requirements of an information system

2.5
application process
a process which is specific to the requirements of a particular information system

2.6
application system
a collection of application processes which utilizes the services provided by the human-computer interface, communications facility, and data management system to perform the processing necessary to meet the requirements of the information system

2.7
audit trail
a record of the activity taking place in an information system over a period of time

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2.8
authorization
a definition of privileges for a specific user identifier

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2.9
binding
a process which involves relating a process to specific data definitions

2.10
client
a role filled by a processor when it requests the services provided by another processor (i.e. a server)

2.11
client-server relationship
the relationship between a client and a server which is established at the moment that a client asks for a service to be performed by a server

2.12
communications linkage
a means for exchanging data between computer systems, or between a user and computer systems

2.13
computer system
a collection of hardware which is managed as a single unit by software such as an operating system which may also provide common services such as access control, interprocess communications, and a graphical user interface

2.14
configuration
a set of processes comprising an information system and the way in which the processes are interrelated

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2.15
configuration management
an activity of managing the configuration of an information system throughout its life cycle

2.16
constraining rule
a rule which is part of a Data Modelling Facility and which controls the specification of the constraints which may be expressed upon a collection of data

2.17
constraint
a restriction on the values permitted for a given collection of data

2.18
data content standard
a logical specification of a collection of data which is of sufficiently general applicability to be of use in many application systems

2.19
data definition
a description which determines the rules to which one or more collections of data instances must conform

2.20
data export
a data management service which retrieves a set of data from a database and creates a copy of that data organized according to a data interchange format

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2.21
data import
a data management service which inserts into a database a set of data organized according to a data interchange format

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2.22
data independence
the independence of processes from data such that the data definition may be changed without unnecessarily affecting the processes

2.23
data integrity
conformance of data values to a specified set of rules

2.24
data interchange format
a set of data structuring rules that determine a format for data to enable the export of data from one data management system and its import by another data management system

2.25
data interchange standard
a standard which defines a set of data according to a set of data structuring rules so that the set of data can be interchanged between one computer system and another

2.26
data management
the activities of defining, creating, storing, maintaining and providing access to data and associated processes in one or more information systems

2.27
data management environment
an abstract conceptualization of the data and associated processing elements involved in a computer system

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2.28
data management service
a service provided by a data management system

2.29
data management session
a period of time during which a set of data management services are being used by a client of a data management process

2.30
data management system
a system which is concerned with the organization and control of data

2.31
data manipulation process
a process the semantics of which are prescribed by the data manipulation rules of a Data Modelling Facility

2.32
data manipulation rule
a rule which either must be followed when specifying a process or else is automatically followed by a data management system when a process is executed

2.33
data modelling facility
rules for defining a schema and the data manipulation rules for operating on data stored in accordance with the schema

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2.34
data structuring rule
a rule specifying how a collection of data may be structured

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2.35
data type
a named, formal specification which governs the common static and dynamic properties of all instances of that data type

2.36
database
a collection of data stored according to a schema and manipulated according to the rules set out in one Data Modelling Facility

2.37
database controller
an abstract representation for the collection of services which conform to and implement a Data Modelling Facility

2.38
database environment
a database and its associated schema and database controller

2.39
database language
a language with a formal syntax to be used for defining, creating, accessing and maintaining databases

2.40
database management
creating, using and maintaining databases

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2.41
database management system
DBMS
a collection of integrated services which support database management and together support and control the creation, use and maintenance of a database

2.42
dictionary system
an information system containing information about an enterprise, its operations, activities, processes and data that are related to one or more application systems

2.43
distributed database
a collection of data which is distributed across two or more database environments

2.44
distributed information system
an information system, the data and associated processes of which are distributed across two or more database environments

2.45
distribution data
the data which defines location, replication and fragmentation information about data objects in a distributed database system

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2.46
fragmentation
a partitioning across more than one database environment of the data values for the instances of one data type in a distributed database

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2.47
functional standard
a standard which consists of an assembly of other standards showing how they fit together

2.48
horizontal fragmentation
a fragmentation where the partitions are formed from all data values for a subset of instances

2.49
information system
a system which organizes the storage and manipulation of information about a universe of discourse

2.50
interchange data modelling facility
a data modelling facility that supports the interchange of data between data management systems

2.51
interface standard
a standard which defines the services available at an interface to a process

2.52
level pair
a modelling concept which groups a schema with its associated database. There are two adjacent data levels. The upper level will always contain the definition of data stored on the lower level

2.53
management domain
a domain encompassing a set of two or more information systems, any of which may be distributed, which have been designed and constructed to interchange data and processes

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2.54
persistent data
data which is retained in the information system for more than one data management session

2.55
privilege
the authorization given to an identified user to allow the use of a particular data management service to access specific data or processes

2.56
process
a process is an active component of an information system

2.57
processing linkage
a representation of a possible interaction between processors

2.58
processor
a modelling concept that represents some combination of hardware and software that can provide services either to one or more other processors or to a human user

2.59
schema
a description of the content, structure, and constraints used to construct and maintain a database

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2.60
server
role filled by a processor when it provides services to another processor

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2.61
service
a capability provided by a processor to other processors, or by a process to other processes

2.62
services interface
a defined set of services made available by a process or processor

2.63
session
a period of time during which a client may have many interactions with a server and both the client and server maintain data about each other

2.64
source schema
a data definition or set of data definitions prior to transformation to a schema

2.65
transaction
a set of related operations characterized by four properties: atomicity, consistency, isolation and durability. A transaction is uniquely identified by a transaction identifier

2.66
transient data
data which is either flowing into and out of an information system, or, in the case of a distributed system, between two computer systems

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2.67
user processor
a processor which provides services to a human user and which is a client (directly or indirectly) of a database controller

2.68
variant
a configuration of all or part of an information system which coexists with another having a different configuration but providing the same facilities

2.69
version
a configuration of all or part of an information system at a specific point in time

2.70
vertical fragmentation
a fragmentation where the partitions are formed from the same type of data values for all instances

3 Symbols and abbreviations

The purpose of this clause is to identify the symbols and abbreviations used in this Technical Report.

3.1 Symbols

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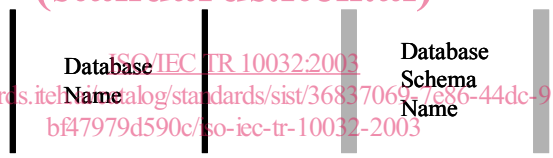
3.1.1 Persistent data



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3.1.2 Communications linkage

3.1.3 Processing linkage

3.1.4 Process class

A process class symbol is used to indicate a data manipulation process. A processing linkage at the left edge indicates input, at the right edge indicates output, and at the top indicates constraint.

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