TECHNICAL REPORT

ISO/TR 19033

First edition
2000-07-01

Technical product documentation — Metadata for construction documentation

Documentation technique de produits — Métadonnées pour la documentation de construction

Reference number
ISO/TR 19033:2000(E)

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Printed in Switzerland

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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.

The main task of technical committees is to prepare International Standards. 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.

In exceptional circumstances, when a 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), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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

ISO/TR 19033 was prepared by Technical Committee ISO/TC 10, *Technical drawings, product definition and related documentation*, Subcommittee SC 8, *Construction documentation*.

Introduction

During the last two decades the construction industry has undergone a thorough transition from manual practice to computer support for the production and exchange of information. However, the manual practices and standards for handling construction documentation have not undergone a corresponding change. Instead, the well-documented manual methods for design cooperation and coordination, a system for process quality assurance common to the industry, are being replaced by procedures specific to projects and companies. The result is that, although every individual participant strives to assure the quality of his or her own products and services, the process may fail to improve overall product quality. In this situation, the information interfaces and networking become key factors.

Nevertheless, electronic document management technologies are well suited to handle the large numbers of documents used in the construction process, together with the associated reference information. Cost reductions and quality improvements are immediate incentives. The potential benefits include:

— efficient search and retrieval of specific documents;

— quick and direct propagation of changes;

— automatic workflow procedures;

— documentation of dependent information in document collections;

— reduced administration through integration of document production and management;

— retrieval of knowledge gained from previous projects and common industry sources.

As document management is by its nature an instrument for the exchange of information, the need for standardization is evident. Specific properties of the construction process, in particular the presence of many participants temporarily involved but over a long period of time, make it extremely difficult to arrive at specific agreements between the different parties and thus promote the importance of standards common to the entire industry. The lack of dominant actors who would be able to set de-facto standards, as well as the ongoing internationalization of the construction industry makes dejure standardization within ISO the natural choice for a successful strategy.

ISO/TC 10/SC 8 has identified metadata for technical documents as being a field where the construction industry would immediately benefit from standardization, and where no standards are presently available. The purpose of this Technical Report is to further investigate and describe those standardization needs, and to propose standardization activities within the ambit of ISO/TC 10/SC 8.

Technical product documentation — Metadata for construction documentation

1 Scope

This Technical Report gives guidelines for the electronic management of documents used in the construction industry. It pays particular attention to the transition from manual to computerized processes, and the use of metadata in document exchange.

2 Basic concepts

2.1 Documents and files

In common language, a document is of paper and contains written or drawn information for a particular purpose. In many cases, the term document also has a legal aspect, for example, as proof of a legally valid obligation.

In the digital environment, the paper is replaced by a computer-file stored on a digital medium. However, there is no one-to-one relationship between document and file. The document can be composed of several files, and a file could contain several documents. Mixed environments, with paper-based documents, also exist.

An extended definition of the term document is offered by ISO/IEC 8613-1. It is “a structured amount of information for human perception that can be interchanged as a unit between users and systems”. A document can be on paper or any other media, including computer files or parts thereof, and audio and videotapes.

In this Technical Report paper-based documents and computer files are both regarded as manageable units in the information-exchange process.

The term document is used to refer to all kinds of units of information that can be managed using an electronic document management system (EDMS), the normal term for a computer application that manages documents and files.

2.2 Compound documents and document sets

Documents can be combined in two conceptually distinctive ways:

— a compound document is a homogenous document, consisting of several parts or sections (e.g. a technical specification made up of sections or a drawing that contains several views);

— a document set is a collection of individual documents, grouped for a specific purpose (e.g. the drawings and specifications needed for the procurement of a subcontract).

Document management has to consider both combinations and their parts, regardless of whether or not they are stored as individual computer files. The term collection of documents is used when discussing a number of documents that are managed together, but not directly related.

2.3 Metadata

In the process of exchanging documents, additional information will need to be attached to each document, to document sets and to separate files that are parts of compound documents. Metadata is the term used for this “information about the information”. It includes information that is usually part of the document header as well as all other

kinds of information needed to organize and manage the documents. In manual practice, metadata is transferred using a number of media, such as letters, labels on envelopes or floppy disks, telephone calls or meetings.

2.4 Model

A model is the representation of real-world objects and their relationships.

A model is built, or instantiated, using a conceptual schema that defines the kinds of objects and relations that exist in the model. Two kinds of models are of particular interest.

— A building product model describes the physical parts of a building. The conceptual schema for this kind of model defines the properties of the parts and the relationships between them.

  EXAMPLE That a column has length, width, height and material properties, that it connects to floor and a ceiling, and that it is part of the load-bearing structure.

— A documentation model describes the documents. The conceptual schema for this kind of model defines the properties of a document and its relations with other documents.

  EXAMPLE A plan drawing has size, scale and creator properties, it refers to detail and section drawings and is part of a set of working drawings. Such properties and relations are metadata for the document.

In the subsequent clauses of this report, the model concept is further elaborated.

3 Document management in manual practice

3.1 General

The tradition of managing documents in manual practice has produced a number of methods for organizing and exchanging information. Electronic document management has to consider the same basic needs, and provide a smooth transition path from manual methods. Each manual operation on a document, or one associated with a document, corresponds to a similar operation when using computer applications. What follows is a step-by-step description of the life cycle of technical documents, comparing manual practice with possible computer-aided equivalents.

3.2 Creation of documents

3.2.1 Manual practice

In most cases, before technical documents are created, documentation planning is performed. Preliminary document lists are made and boundaries for drawings defined. When the documents are created, document headers and title blocks are filled out with content that is standardized nationally or specified by the client.

3.2.2 Computer-aided equivalent

Here, the planning is done by registering the documents-to-be in a document-management database. Their identities and positions in the document-set structure and, where applicable, in a compound document, are defined. The metadata for each document can be registered when planning the documentation, or later, when the actual document is created, stored or otherwise managed.

3.3 Reuse of documents

3.3.1 Manual practice

New documents are often based on older ones. In its most systematic form, template documents or references to type documents are used. Old documents are used as copies or, when using minor parts thereof, rewritten or redrawn. The identity of the old document is sometimes preserved, in particular when there is a copyright requirement.

3.3.2 Computer-aided equivalent

Paper-based documents can be reused by capturing them by scanning and optical recognition of characters (OCR) or lines (vectorization). The existing documents can then be edited or portions of them can be included in new documents. Reusing digital documents is of course easier; either copies of, or links to, the documents can be created. In all cases, metadata that identify the origin of the document can be valuable.

3.4 Document distribution

3.4.1 Manual practice

For each version of a document, distribution is according to agreed distribution lists. A missive explaining the status of the document and the further particulars regarding the distribution may accompany the document. The receiver may also acknowledge the distribution.

3.4.2 Computer-aided equivalent

When using computer networks, distribution is easily accomplished automatically by data-communication. Distribution lists in electronic form can be applied to support the automated routines. Alternatively, no actual distribution is performed but documents are stored somewhere accessible to project members, and the existence of new versions is signalled by a message to all those on the distribution list. It is then the responsibility of each to open the document. Using appropriate supervision applications, all sending, receiving and reading of documents and messages can thus be logged.

3.5 Checking and approval of documents

3.5.1 Manual practice

Before a document is used for its final purpose, it is usually quality assured through an approval process that can contain several steps. In a typical document workflow, the document is first checked internally by the issuer, then in coordination with other specialists. After any necessary changes have been made, the client finally approves the document. In principle, the same procedure is applied to every subsequent revision of the document.

3.5.2 Computer-aided equivalent

Workflow applications allow the setting up of the workflow for approval processes, generally for a project or individually for a document, document category or set of documents.

3.6 Coordination of documents

3.6.1 Manual practice

Technical documents produced by different actors are usually checked against each other before final release. This applies in particular to drawings, but also to technical specifications, etc. In the coordination process, special atten-

tion is given to potential conflict points and zones, where several systems meet or intersect. Quite often, coordination is performed in steps, for example, technical installations are coordinated first, and then coordinated with the load-bearing and complementing structures.

3.6.2 Computer-aided equivalent

Analysis can be much enhanced by search and overlay techniques in computer applications. For example, all references to a section in a specification document or all occurrences of a specific term can be traced, and layers from computer-aided design (CAD) drawings showing the different technical systems can be overlaid to show collisions and other conflicts. The documentation of errors is possible, with links to the affected documents in a document management database.

3.7 Storage, search and retrieval of documents

3.7.1 Manual practice

Documents are stored in some structured order that facilitates finding and retrieving them. The usual storage systems in folders, binders and drawers are often standardized within companies, but seldom subject to formal standardization on a wider level. However, national classification systems for building elements, etc. are often used for the ordering of documents. In addition to the physical placement of the documents, document lists for each project, as well as project lists for the company, are used.

3.7.2 Computer-aided equivalent

At the basic level, all computer systems use file/directory structures that can be considered equivalent to binders and drawers in manual practice. Search and retrieval of documents is a basic function of document management systems. Search is based either on metadata or on the content of the documents (free text search).

For graphical documents, metadata is the most frequent search method (graphical pattern recognition is not yet a widely exploited technology). Many text documents can be found using free text search, although the existence of key words and other metadata can substantially improve the quality of searching. Retrieving the documents for viewing, printing or editing purposes requires knowledge of whether computer applications being used are able to read the data format, and often how the document is structured (in sections, layers, etc.).

3.8 Revision of documents

3.8.1 Manual practice

Changes prior to the official release of a document are often conducted informally. Revisions on a completed and released document have to be fully checked and approved, and every actor or party that will be affected has to be notified in accordance with routines established for the project or by standards.

3.8.2 Computer-aided equivalent

An important role of the EDMS is to assure that each document used is the correct version, and that revisions are correctly performed. Workflow functions can be used to manage revision activities. However, the need for more informal, but still sufficiently safe, procedures is seldom complied with by existing EDMSs.

3.9 Archiving and deletion of documents

3.9.1 Manual practice

When a construction project is completed, the documents produced and stored during the project are of varying interest for the future. Some can be directly disposed of, others contain knowledge that can be reused in other projects, while a third category is documents to be kept and used during the maintenance phase. Sorting can be done by tabs in the project binder or drawers for sketches and drawings. A similar structure for storing and classifying documents during the construction and maintenance phases, respectively, facilitates the management of documents during the entire lifecycle of a building.

3.9.2 Computer-aided equivalent

The sorting of documents can be done efficiently in much the same way, using file structures and metadata. Nevertheless, the long-term readability of documents poses a number of questions concerning the structure of document sets and compound documents, changing data formats and storage media.

4 Problems in document exchange

4.1 General

Document exchange is conducted frequently during the construction process, as well as during the lifecycle of the completed building. A number of information problems appear at each exchange stage. The manner in which these problems are approached often determines whether the document can be efficiently handled and properly used, in both the short and long term.

Four main problem areas for which information exchange solutions need to be provided can be identified:

— the reading and reproduction of documents (the presentation dimension);

— the identification of related documents (the organizational dimension);

— workflow and the archiving of the document (the life-cycle dimension);

— the connection between documents and parts of the building (the product dimension).

The exchange of metadata between users and systems is yet another problem area.

4.2 Reading and reproduction

A paper-based document can be read without tools other than the reader's senses, but reading a digital document requires a computer application. When exchanging documents, the receiver must have access to such an application, and he or she must also be informed in some way as to which application to use. Also, he or she needs to be familiar with the structure of the document or document set, as well as how and where it is stored. Metadata in a standardized format such as pure text is a way of providing such information. Some of these data can refer to national classification and other industry standards (e.g. document categories).

Furthermore, minor differences, such as application versions, screen and printer-driver software or installed typefaces can affect the appearance of documents, line breaks, page breaks, etc. If exact reproduction must be guaranteed, all such factors have to be controlled. In practice, this cannot be achieved without limiting potential errors, for example, by choosing a printing format that explicitly describes the exact page layout.

4.3 Organization and relating of documents

When organizing documents related to a project, all participants must agree on a structure for storing and managing the documents, with special attention given to compound documents and document sets. The structure can be used

directly by each of the participants, or form an “intermediate structure” used exclusively in a project network with common storage.

The simplest form of ordering documents for such purposes is the file/directory system. But as soon as there is more than one way of organizing documents, (e.g. one document is part of two or more document sets), additional information has to be provided. The file structure must also be preserved when linked documents are transferred from one storage place to another. Many communication methods, such as attachments to e-mail messages, do not provide such mechanisms, but the structure has to be recreated by the recipient.

Under current practice, several methods are combined, ad hoc, for controlling the document structures of digitally produced and stored documents. A part may be organized in a document management system, but project-specific manuals, especially for CAD, often play an important role, as do written or verbal agreements. One reason for this is the incompleteness of most EDMS applications for technical documents, while another is the lack of standards for the very complex information structures that are often used and the kind of information needed to describe the structures. The less coordinated the management, the greater the liklihood of errors.

Even more difficult to manage than compound documents consisting of linked files are documents extracted from databases using various kinds of filters for sorting information. Moreover, there is a need for various kinds of references and relationships between documents.

4.4 Quality assurance and workflow

Quality assurance within companies is normally subject to strict routines and is set down in manuals. In the project environment, however, coordinated routines for quality assurance are rare. Fundamental rules for the approval of documents exist at the national level, but the procedures for coordination of document sets are defined specifically for each project.

In order to perform a workflow, several pieces of metadata have to be exchanged. The access rights have also to be controlled, so that every participant can perform the authorized operations on the document, but nothing more. In many cases this will mean that only certain parts of a compound document ought to be accessible. When a document is approved, it should be locked to prevent changes.

4.5 Archiving

For long-term storage, information must be made independent of the person(s) who created it, as well as of the technical platform (software, hardware and storage medium) used in its creation. Retrieval must be guaranteed through the use of stable data formats and media. Often, the data will also have to be transformed to accommodate new technical platforms. The same applies for the information within documents and the metadata used for document management.

All information needed to search for and retrieve a document must be explicit to a degreee unnecessary during the project. Additionally, the long lifecycle of buildings often makes it necessary to adapt the information to the user’s existing storage systems.

4.6 Connection to product

In general, technical documents describe products. For production as well as maintenance purposes, a specific part or position in the building is a primary search path to documents. The document-management system must provide connections between specific parts of the building, as well as between product categories and other references.

4.7 Exchange of metadata

Most document-management systems use proprietary solutions for the structuring of metadata, and many also use them for the format for storing metadata. In a temporary organization such as a construction project, it is of vital importance that the information systems involved be able to exchange information. The demand for neutral formats and standardized definitions for metadata is obvious.