PD ISO/TR 8344:2024

BSI Standards Publication

Information and documentation — Issues and considerations for managing records in structured data environments

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Full document details: PD ISO/TR 8344:2024

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The UK participation in its preparation was entrusted to Technical Committee IDT/2/17, Archives/records management.

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

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Published by BSI Standards Limited 2024

ISBN 978 0 539 25956 8

ICS 01.140.20

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This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 April 2024.

Amendments/corrigenda issued since publication

Date	Text affected

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Technical Report

ISO/TR 8344

First edition
2024-04

Information and documentation — Issues and considerations for managing records in structured data environments

Information et documentation — Enjeux et considerations pour la gestion des documents d'activité dans les environnements de données structurées

Reference number
ISO/TR 8344:2024(en)

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Foreword

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Introduction

With the digital transformation of government, business, and society, records are increasingly being created in structured data formats in databases, or in business systems that are underpinned by databases. Whilst this has been occurring for several decades, there has been an increase in the volume of data created, stored and analysed with widespread use of sensors and a focus on data driven decision-making. Data structures are also changing, developing from the well-known relational database into new forms which include distributed data systems that are not controlled by a single organization and which may exist across jurisdictions. There is also a significant number of legacy databases that have been decommissioned from active use, but which require ongoing management.

These changes mean that evidence and memory of government, business and society are increasingly represented in structured data formats. This raises issues if structured data is to be trusted as an authoritative source of information, or record, that meets business, legal, and regulatory requirements. As the basis for decision making and operations, structured data becomes the evidence that is subject to e-discovery requirements. If not properly managed, the business, legal, evidential, and information value of structured data can diminish and adversely impact the organization's productivity, compliance, trustworthiness, transparency, accountability and reputation.

Building the capability to manage records in structured data environments has become essential to the governance and management of organizations and communities. There is a growing business need for guidance and recommendations around the design and implementation of adequate policies and procedures to help ensure that records in structured data environments have the attributes of authenticity, reliability, integrity and usability.

Whilst management systems for records as specified in ISO 30301 can be used to ensure that there is appropriate leadership, planning, support, improvement and evaluation with respect to records in structured data environments, there are also specific records control, process and system issues to be considered.

This document provides a landscape review of records management in structured data environments, and identifies issues and considerations for managing records in these environments.

The primary audiences for this document are data policy makers, systems designers, business system owners, data management professionals, database professionals, and the records management professionals working together to ensure the application of appropriate records management approaches, processes, controls and systems in structured data environments.

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Information and documentation — Issues and considerations for managing records in structured data environments

1 Scope

This document identifies issues and considerations for managing records in structured data environments.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 30300, *Information and documentation — Records management — Core concepts and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 30300 apply.

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

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

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

3.1
attribute
characteristic of an object or entity

[SOURCE: ISO/IEC 2382-36:2019, 3.9.2]

3.2
data
set of characters or symbols to which meaning is or could be assigned

Note 1 to entry: From an ICT perspective, ISO/IEC 2382:2015, 2121272 and ISO 8000-8:2015, 3.1 define data as "reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing". In an ICT environment, data is a digital representation of information. It is considered to be the result of how information has been recorded and consists of bits, bytes, characters and pixels.

[SOURCE: ISO 30300:2020, 3.2.4, modified — Note 1 has been added.]

3.3
database
collection of data organized according to a conceptual structure describing the characteristics of these data and the relationships among their corresponding entities, supporting one or more application areas

Note 1 to entry: database: Term and definition standardized by ISO/IEC 2382-1:1993; ISO/IEC 2382-17:1999.

[SOURCE: ISO/IEC 2382:2015, 2121413, modified — Note 2 has been deleted]

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3.4
database management system
system, based on hardware and software, for defining, creating, manipulating, controlling, managing, and using databases

Note 1 to entry: The software for using a database may be part of the database management system or may be stand-alone.

Note 2 to entry: database management system; DBMS: term, abbreviation and definition standardized by ISO/IEC 2382-17:1999.

[SOURCE: ISO/IEC 2382:2015, 2121417, modified — Note 3 has been deleted]

3.5
data element
unit of data for which the definition, identification, representation and permissible values are specified by means of a set of attributes

[SOURCE: ISO/IEC 2382-36:2019, 3.8.21]

3.6
entity
any concrete or abstract thing that exists, did exist, or might exist, including associations among these things

EXAMPLE Person, object, event, idea, process, etc.

Note 1 to entry: An entity exists whether data about it are available or not.

[SOURCE: ISO/IEC 2382-36:2019, 3.9.5]

3.7
information
data (3.2) in context with a particular meaning

Note 1 to entry: ISO/IEC 2382:2015, 21212 2 and ISO 8000-8:2015, 3.3 define information as "knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts, that within a certain context has a particular meaning".

[SOURCE: ISO 30300:2020, 3.2.7, modified — Note 1 to entry has been added]

3.8
knowledge
maintained, processed and interpreted *information* (3.7)

Note 1 to entry: From ICT and artificial intelligence domain perspectives, ISO/IEC 2382:2015, 2123771 defines knowledge as a "collection of facts, events, beliefs, and rules, organized for systematic use".

Note 2 to entry: Knowledge is data that is meaningful to particular context.

[SOURCE: ISO 5127:2017, 3.1.1.17, modified — Note 1 to entry and Note 2 to entry have been added.]

3.9
metadata
data about other data, documents, or records <set of data> that describes their content, context, structure, data format, provenance, and/or rights attached to them

Note 1 to entry: See also ISO/TR 14873:2013, 2.29.

[SOURCE: ISO 5127:2017, 3.1.10.26.01]

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3.10
metadata for records
structured or semi-structured information, which enables the records processes through time and within and across organizations

[SOURCE: ISO 30300:2020, 3.2.9]

3.11
record
information created or received and maintained as evidence and as an asset by an organization, in pursuit of legal obligations or in the course of conducting business

Note 1 to entry: Records are normally used in plural.

Note 2 to entry: In a management system standard (MSS) implementation, the records created to conduct and direct the management system and to document its implementation are called documented information.

[SOURCE: ISO 30300:2020, 3.2.10]

3.12
records control
instrument for helping in the conduct of records processes

Note 1 to entry: Example of records control include metadata schemas for records, business classification schemes, access and permission rules, and disposition authorities.

[SOURCE: ISO 30300:2020, 3.5.6]

3.13
records management by design
approach in which records management is implemented in the initial design stage and throughout the complete lifecycle of products, processes or services that involve handling record

[SOURCE: Records management by design – Some considerations[47]]

3.14
relational database
database in which the data are organized according to a relational model

Note 1 to entry: relational database: term and definition standardized by ISO/IEC 2382-17:1999.

[SOURCE: ISO/IEC 2382:2015, 17.04.05, modified — Note 2 to entry has been deleted]

3.15
relational database management system
database management system designed for relational databases

Note 1 to entry: In order to use relational data base management systems (RDBMS), it is necessary to represent relational model of data that organizes data (see 4.5) with specific characteristics (tables or relations, unique key, etc.) (see ISO/IEC 25024:2015, Table C.1).

[SOURCE: ISO/IEC 25024:2015, 4.34]

3.16
semi-structured data
aggregate datatype whose components' datatypes and their labels are not predetermined

Note 1 to entry: Semi-structured data are forms of structured data that do not follow structure of data models related to relational databases or other forms of databases.

Note 2 to entry: Examples of semi-structured data include the data that contain HTML tags or other markers to separate semantic elements and to represent hierarchies of records and fields within the data.

[SOURCE: ISO/IEC TS 38505-3:2021, 3.14]

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3.17
structured data
data which are organized based on a pre-defined (applicable) set of rules

Note 1 to entry: The predefined set of rules governing the basis on which the data is structured needs to be clearly stated and made known.

Note 2 to entry: A pre-defined data model is often used to govern the structuring of data.

Note 3 to entry: Example of structured data are data contained in relational databases.

[SOURCE: ISO/IEC TS 38505-3:2021, 3.15]

3.18
unstructured data
data which are characterized by not having any structure apart from that record or file level

Note 1 to entry: On the whole unstructured data is not composed of data elements.

EXAMPLE An example of unstructured data is free text.

[SOURCE: ISO/IEC 20546:2019, 3.1.37]

4 Basic concepts

4.1 Understanding relationships among data, information, records and knowledge

The concepts of data, information, records and knowledge are abstract and have different meanings depending on professional perspectives.

From a records management perspective records are information created or received and maintained as evidence and as an asset by an organization, in pursuit of legal obligations or in the course of conducting business.

Records, therefore, are a specific form of information, which require particular management approaches, processes, controls, and systems to ensure they have integrity and provide authentic, reliable and usable evidence.

In the digital environment, records may be in the form of documents or emails, sometimes referred to as files or unstructured data, that are created or communicated as part of business transactions. They are often captured in records systems along with metadata for records.

Records may also be in the form of structured or semi-structured data, captured in business systems that are used to support business processes. Often, these business systems are not designed to capture and manage records. Nevertheless, the organizational need for authoritative evidence of the business processes remains.

Records may form part of the knowledge assets within organizations, especially as documented information.

Figure 1 shows one perspective on the relationship between data, information, and knowledge with respect to meaning. In this perspective, there is an abundance of data which often by itself may not have much meaning. Information then is meaningful data. Meaningful data refers to data which has contributed to achieve purposes or solving tasks. Knowledge is what humans know, understand, and can apply, based on what one has perceived, discovered, and learned from processed, organized, contextualized and meaningful data.

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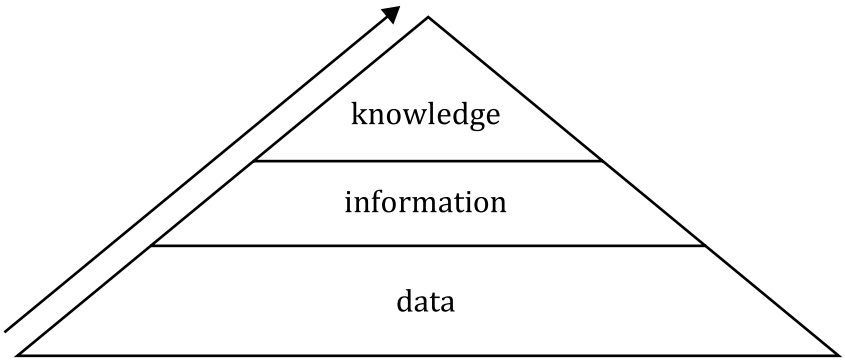

Figure 1 — Relationships of data, information and knowledge

4.2 Concept of structured data

4.2.1 Physical records and structured data

Records managers have always managed records comprised of structured data. In the physical world, these records included:

— registers;

— financial records including ledgers, journals and cash books;

— outputs of instruments, such as seismographs;

— completed forms and charts.

Most of these record forms were replaced by databases as computers were developed to process, organize and record information in digital formats.

4.2.2 Business systems

Initially, data was entered directly into databases. Over time, databases came to underpin business systems where data is entered and processed via a software application and stored in a database. Examples of business systems include human resource management systems, financial systems, contract management systems, case management systems and other transactional systems.

Records managers understand that business systems used to support business purposes often generate data that is needed to serve as evidence of business activity.

However, these systems are usually not specifically designed to manage records.

As outlined in ISO 16175, many business systems generate and store data that can be subject to constant updating (dynamic), are able to be transformed (manipulable), and only contain current data (non-redundant). While business requirements for dynamic, manipulable, and non-redundant data can be entirely legitimate, if records are to serve as reliable evidence of business functions and processes, they need to be fixed and inviolable. Because of the dynamic and manipulable nature of business systems, the capture of records and the ongoing management of their fixity, authenticity, reliability, usability and integrity can be challenging.

4.2.3 Databases

4.2.3.1 General

A database is a collection of data organized according to a conceptual structure describing the characteristics of these data and the relationships among their corresponding entities, supporting one or more application areas.

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Databases are typically comprised fields or data items, usually organized in tables.

The content of every field in a row of a table is a data value and conforms to a data type such as string, date, number, etc.

The set of fields or data items treated as a unit is known as a data record or tuple[15].

4.2.3.2 Relational databases

Relational databases have been a common database type for many years. A relational database is a database in which the data are organized according to a relational model.

For example, Bo Wang from Rotterdam owns a house in Gouda, Netherlands, and wants to sell the house using John Johnson's housing broker services.

If the information is stored in a relational database, a data element containing the string 'Gouda' may be the content of a data field of the field type named 'name_town' in a row about the entity Gouda in a table named 'towns'. This table may be part of a relational database named 'houses' owned and managed by John Johnson (or even an association of housing brokers). Such data about towns in a table of a relational database can be the result of a general process of gathering and storing data about towns.

In the same way, the data element 'Bo Wang' can be the content of a data field of the data type named 'name_client' in a row about Bo Wang in a table named 'clients' in another relational database. This kind of data can be the result of John Johnson's specific client intake process. Bo Wang's residential address details are in a table named 'addresses' with a reference from the table 'clients' to this table and another reference from the table 'addresses' to the table 'towns' which includes both 'Gouda' and 'Rotterdam'.

When Bo Wang's house is sold, the sale date and sale price can be added to another table called 'sales'. Thereafter, data already stored in the said tables and databases can be reused in a transaction document prepared by John Johnson and in another transaction document prepared by a notary public.

Annex B provides examples of relational databases for better understanding of their complexity in many and various different types of data models and the predefined set of rules.

4.2.3.3 Master data and transaction data

In some databases, there are two types of data tables: master tables and transaction tables.

Master data is data held by an organization to describe the entities that are both independent and fundamental for the organization and are referenced in transactions. Types of master data include records that describe customers, products, employees, services, etc.

Transaction data is data representing a business transaction. This data may be stored in a transaction table containing data about one type of transaction. Transactions are the result of processes performed which relate to entities recorded in the master data. Transaction data therefore often includes master data that can be used to identify the entities that are party to the transaction.

For example, a credit card transaction relates to entities represented by master data, such as the credit card account at the issuing bank (represented by a credit card number), and the merchant account at the accepting bank (represented by a merchant number)[2].

4.2.3.4 Other forms of databases

The world of data is rapidly changing as familiar relational databases are replaced with alternative data structures, such as graph databases. Graph databases are designed to depict relationships between data points.

The Internet of Things has also resulted in an increase in data being captured by sensors within everyday items. Often, this data is captured in time series databases which record values in simple tables organized by dates and times.

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4.3 Different interpretations of the concept of 'record'

Table C.1 shows there are different interpretations of the concept of "record". For database managers and administrators, a record is a set of related data items treated as a unit[14]. Typically, a data record is a tuple or row of data in a database table.

For records managers, a record comprises all of the information that is created or used in a business transaction, so in a database this might typically comprise related data items from multiple data records across multiple tables.

For example, a person submits an online application by entering information in a web-based form and attaches a scanned document. The form includes fields that require specific items of data, as well as fields that allow free text to be entered. The information is stored as structured, semi-structured and unstructured data. The record comprises the data that was submitted as part of the online application, as well as the metadata about the creation and submission of the application, such as the date and time of creation and the person or agent/actor which created the record.

It may be a complex task to identify which combinations of data elements in a database are considered as a specific record.

Because records managers focus on records as evidence, their aim is to ensure the information content of the record, which may be stored as structured, semi-structured, or unstructured data, can be trusted as authoritative proof of the business transaction.

However, records managers also recognize that records have value as information assets. As information assets, records may be used in subsequent business processes and transactions, generating new records.

4.4 Metadata for records as structured data

In the digital environment, authoritative records are those accompanied by metadata defining their critical characteristics (see ISO 23081-1:2017, Clause 4). According to ISO 15489-1, the metadata of a record itself should be managed as a record. However, it should be noted that the content of a metadata set associated with a given record, unlike the content of the record itself, is not fixed and new metadata are usually added to it over time.

Just like the data itself, the metadata also can be seen and managed both as a set of codes (e.g. when metadata-supporting IT infrastructure such as special databases within electronic document and records management system (EDRMS) systems or communication issues are considered) or as meaningful information that supports integrity, authenticity, usability and confidentiality of records and the operation of the relevant information infrastructure.

There are many kinds of the metadata, of which the "metadata for records" is a subset. In ISO 30300, the metadata for records are defined as "structured or semi-structured information, which enables the records processes through time and within and across organizations". There are numerous other metadata that are not directly related to the records processes (e.g. technical metadata associated with e-mail message and describing its path through the internet).

4.5 Characteristics of structured data

Table A.1 in Annex A identifies characteristics of structured data from representative definitions mapping with ISO 704. There are four characteristics about structured data show in Figure 2:

1) use of a pre-defined set of rules;

2) specified data model;

3) structured in an organized manner or identifiable way;

4) stored in distinct fixed fields.

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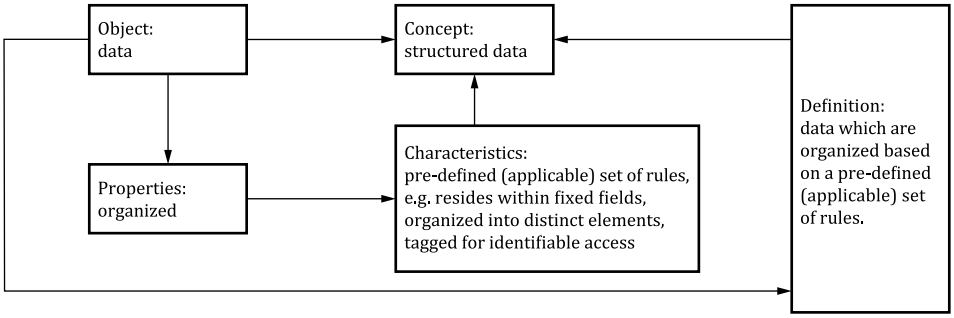

Figure 2 — Formation of structured data concept

Figure 3 illustrates the mapping between the specific characteristics of structured data and the characteristics of records defined in ISO 30300.

The first set of characteristics (e.g. authenticity, usability, reliability and integrity, as defined in ISO 30300) is essential for the categorization of certain data as records.

The second set of characteristics is related to the management of data as records in compliance with the principles and requirements defined in ISO 15489-1 and ISO 30301. These requirements are applicable to all kinds of data (structured, semi-structured, or non-structured) that are managed as records. Besides, managing non-structured data as records need extra work to ensure consistency of data processing and management and the traceability of the management process with adequate metadata for records.

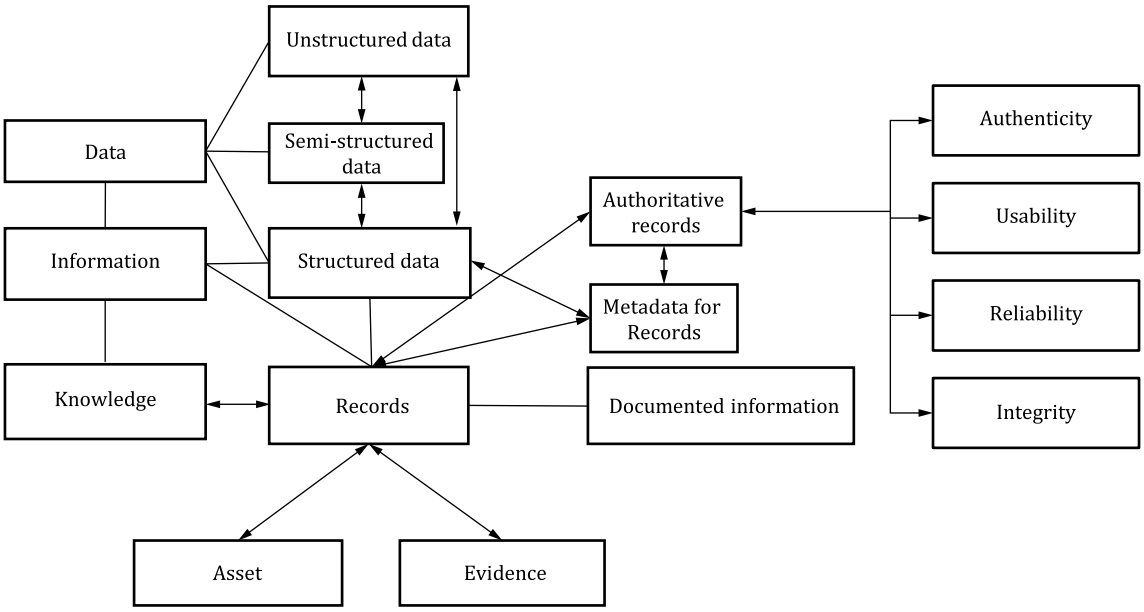

Figure 3 — Mapping concepts of structured data with ISO 30300

5 Issues for managing records in structured data environments

5.1 General

Annex D provides a template for identifying issues and concerns for managing records in structured data environment. The following issues have been validated by four use cases collected in Annex E, Annex F, Annex G, Annex H.

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5.2 Individual records are not self-contained

Records in structured data environments are usually part of an overall data structure designed to capture many records of the same type. Generally, all of the records of the same type will be aggregated as a set and cannot be managed individually.

This has implications for the application of records controls and processes as specified in ISO 15489-1.

5.3 Systems are not designed to capture records

In most cases, business systems are still not designed to capture records as records managers hoped by issuing ISO 16175.

Where systems require only current data values, then securing these values against unauthorized changes through authentication and authorization measures may be sufficient.

However, if historical values, such as previous addresses of citizens, have to be available as evidence, it may be challenging to create fixed-content records with data values linked to a point in time.

5.4 Data is often re-used

Once created and stored in a database, data that makes up specific records may be reused in other business processes or transactions, often combined with data from other records.

This re-use may create new records, although the data itself has not changed.

For example, documents or reports generated containing data may need to be saved as separate records, if these documents or reports are used in business processes.

Due to the high level of re-use of data elements, the same data elements can be part of multiple records each of which is subject to numerous retention or disposition requirements.

5.5 Records controls may not be able to be applied in business systems

Records controls may not be able to be applied or implemented in business systems. Nevertheless, some of these can be handled through the management system for records.

Business systems are rarely designed to include functionality that supports business classification schemes and disposition authorities. This might not be an issue where all of the records relate to a single business process and have the same retention or disposition requirements.

Metadata schemas and access and permissions rules are more likely to be able to be incorporated into business systems although the type of metadata and rules are likely to differ compared with records systems, as well as how these controls are implemented.

Metadata for records is different to the typical metadata that is part of structured data environments.

Business systems are unlikely to have all of the metadata for records. For example, business systems may not create explicit identifiers for individual records that are human readable. Also, format or storage metadata may not be explicit. However, this may not be an issue in active records system where records can be retrieved through system functions and the format and storage are known by system users.

The concepts of metadata in ISO 15489-1 seem to be mostly applicable to EDRMS type systems. In business systems, point of capture metadata that documents the circumstances of the creation of the records is typically the name of the agent creating the record and the date and time of record creation.

ISO 15489-1 clarifies that records controls may be designed and implemented in a variety of forms depending on the technological and business environment so these controls can be applied organisation-wide as part of a management system for records, rather than necessarily being applied within records systems.

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The management system for records can therefore be used to classify the records in a business system at an aggregate level. Therefore, classification may not occur through application of structured or semi-structured metadata to individual records but could occur through other documentation that shows how the business system relates to business, legal or social contexts.

5.6 Records processes may be different in business systems

Records processes applied to business systems may also be different to those applied in records systems.

In business systems, records are usually captured at the same time as they are created. There is often no significant distinction between creating and capturing records.

ISO 15489-1 seems to assume records are captured into systems that are different from where they are created, which is not the case for many business systems, nor was the case for physical records that preceded them such as financial ledgers.

In distributed ledger technology systems (DLT systems), for example (and like physical ledgers and registers or even diaries), records are created and captured simultaneously with minimal metadata applied to individual records, and no explicit identifier. Metadata was typically applied to the volume containing the individual records.

In business systems, indexing can also occur without explicitly capturing subjects, locations or personal names as indexing metadata. System indexing functions may index the data to enable retrieval of content.

Business systems are typically not designed to support execution of disposition actions, and unlikely to. And yet disposition of records in these systems can still be managed through the management system for records by applying disposition processes and actions at the time of system decommissioning or migration or upgrade.

5.7 Record meaning may depend on system documentation

Records in structured data environments may lose meaning unless codes and additional system documentation is retained, as records may not be meaningful in their own right. Sometimes, metadata for records may or may not serve this purpose.

For example, if an audit entry for a record only includes codes that reference the entities involved in the change event, this entry will be meaningless unless explicit system documentation is retained indicating what the codes referred to.

In addition, it may be useful to retain system documentation showing the data entry screens that were used to capture the records, so that relationships between data items can be understood. All changes to the system can be documented and this documentation retained to help people understand the records.

5.8 Ownership and control of records in shared systems may not be clear

Many business systems are designed to be used by people outside of the organization that established the system, such as systems jointly used by bodies belonging to different levels of government (local, regional, or federal), or systems used by organizations which are part of the same supply chain. Unless agreed up front, there can be a lack of clarity of who owns or is responsible for the records in these shared systems.

Increasingly, people using systems, in which they enter or submit data as part of a business transaction, may also have rights over the data which may be part of an organization's records.

It can be difficult to clearly isolate or separate one organization's records from those of another, each of which may be subject to different legal and regulatory requirements.

Additional challenges are also present in the case of records stored in third-party controlled storage (e.g. cloud) although in general this is not an issue, as usually records are kept separate for joint tenants of shared cloud infrastructure.

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Some distributed systems such as blockchain and distributed ledger systems are designed to not necessarily rely on the sole control of one organization, and copies of the ledger are deliberately distributed across the network nodes as part of the system design. This raises additional questions about which are the original records and which are copies.

5.9 Disposition of individual records is not feasible

Technical feasibility of the disposition of individual records is another issue.

Disposition is the range of records processes associated with implementing records retention, destruction or transfer decisions which are documented in disposition authorities or other instruments. Disposition includes both the transfer of records to another organization, permanently archiving records, and the destruction of records at the end of their retention period.

Disposition of records supports effective business, compliance and mitigation of security and privacy risks[12].

For records stored in a relational database, the disposition process requires the removal of specific records from the database.

Specific disposition issues in structured data environments include the following:

— **Identification of the data comprising the records**. Whilst appraisal may have determined the records required as evidence (see 6.3.1), the specific data comprising the records needs to be identified so that the required records to be retained are complete and meaningful. Metadata for records also needs to be identified and retained along with the records.

— **Technical feasibility of destruction.** Individual records in structured data environments cannot generally be disposed of without the risk to the integrity of remaining records in the same database. If the records to be deleted comprise data referring to foreign or secondary keys (see 5.10), this will violate the referential integrity rule for the database. Because individual records are usually part of an overall data structure, it may only be possible to dispose of the complete set of records at the same time. In many cases, the records can only be destroyed during the process of migration of the data or when decommissioning the database, especially when its architecture and design is intended to ensure the immutability of records, e.g. records in a blockchain or distributed ledger system. The disposition process may then be documented outside of the system, in a separate record, rather than being included in metadata for records.

— **Volume of data requiring disposition.** Due to the high volumes of data, manual disposition is not likely to be feasible. This is already problematic in traditional records systems. Policy-driven disposition, implemented by design automation, is even more crucial for structured data environments. Automation can also help in conducting disposition regularly in the course of normal business rather than as ad hoc projects, which is important for the trustworthiness of records management operations and to avoid legal risks in some jurisdictions.

— **Comprehensiveness of disposition.** From both legal and business standpoints, records are typically considered as destroyed or transferred when the controlled record is destroyed or transferred by the organization. However, as with other digital records there may be copies held by the organization (backup copies, paper printouts, etc.).

— **Assurance of the timely, complete and irreversible destruction of records**. In structured data environments that are complex, distributed, shared or controlled by third parties, it can be difficult to get assurance or attestations of the timely, complete, and irreversible destruction of the records. In some cases, this can be mitigated by internal governance and management measures or by inclusion of suitable clauses into contracts or service level agreements with relevant parties.

— **Making information inaccessible is not destruction.** Making information inaccessible by various means (e.g. by destroying corresponding cryptographic keys or cryptographic shredding, or destruction of indexes pointers and links) is not usually considered proper destruction as the information persists and could potentially be discovered with sufficient effort and expenditure. However, in certain situations, this can be the most feasible solution, after legal and information security risks are thoroughly analysed.

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If data has to be removed from a records management perspective but cannot be from the database perspective, alternative solutions may be sought such as masking content or shielding content from reading instead of removal. In such situations, one has to accept that such solutions have drawbacks and that sometimes one can only choose an approach of minimizing the risks by accepting the best possible (but not the perfect) solution.

5.10 Conflict between disposition and the referential integrity rule for relational databases

Research has been undertaken into the potential to undertaken disposition in relational databases, and the conclusions identified conflicts with maintaining the referential integrity of databases from the perspective of proper database management[24].

While disposition rules may dictate the deletion of records, referential integrity rules for relational databases may dictate the retention of the same records—potentially creating a conflict.

A relational database satisfies the referential integrity rule for it to be able to operate properly. In a relational database, foreign keys (also referred to as secondary keys) are values in predefined foreign key fields of rows in the tables of the database. These foreign key values refer to values of primary keys of rows in other tables. The primary keys are the identification (ID) codes of rows. The references from secondary keys to primary keys are essential to a relational database's operation. Therefore, each secondary key has to reference a primary key value that exists and a row that exists and contains that primary key value. The deletion of a row referenced by a secondary key damages a relational database, impedes its proper operation, and prevents access to content that are retained. Such a loss of relational database integrity has to be prevented. In practice, it is common that the application controls of a relational database management system (the application for the management of such a database) prevent the execution of commands that would damage the database in this way.

5.11 Preserving structured data records over the long-term

Preservation of document-based digital records (unstructured data) typically relies on conversion of files from proprietary file formats to open file formats or published file formats and there are format registries to assist with ongoing management of files. ISO/TR 22299 provides recommendations for digital file formats for long term storage but this excludes database formats.

There are examples of approaches for converting proprietary databases into standard formats, such as Software Independent Archival of Relational Databases (SIARD), which captures both the data values and the database structure or schema[25].

If data is not converted to non-proprietary formats, licensing policies can prevent the transfer of corresponding software and hardware to archival institutions. Also, archival institutions will be faced with extensive re-engineering efforts in order to ensure access to obsolete formats.

5.12 Data may be highly dynamic

In some technical or scientific environments, there are requirements for continuously changing data values.

Options in these scenarios may typically include:

— sampling the continuously changing values and capturing and storing the resulting sample values;

— determining averages of continuously changing values and capturing and storing the resulting average values;

— storing resulting values in a type of non-relational database that is more suitable for storing ranges of (measurement) values, for example a time-series database.

Recording current output values of smart device sensors in communication networks is a similar challenge.

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6 Concerns about managing records in structured data environments

6.1 General

Annex D provides a template for identifying issues and concerns for managing records in structured data environment. The following concerns have been validated by four use cases collected in Annex E, Annex F, Annex G, Annex H.

6.2 Approaches to managing records in structured data environments

Organizations have been creating and managing structured data for decades.

Records managers have largely continued to focus their attention on managing digital documents as records, in records systems designed to support records management processes and apply records controls.

For many years, strategies for managing records have comprised extracting records from databases as data sets or reports and managing them in records systems. This can be a feasible solution in some situations.

However, with the increasing focus on data management, and proliferation of structured data, records managers are increasingly looking to manage records in place within business systems.

For records to have integrity, the information content has to be complete and unaltered. This often contrasts with business systems that require data that is current and regularly updated. Therefore, strategies have to be implemented to ensure the information in the database at the time of the business transaction is available as a record.

Strategies for managing records in place within business systems include:

— design records controls and processes into business systems such as

  — recording the previous value in a field designed to capture historical data and the historical status at a point in time

  — logging changes to data values by using the logging facilities of the database

— apply records controls or policies from other applications to business systems

  — this might involve bringing together the data elements that make up a record to create a distinct digital object that is fixed and unalterable as described in ISO 16175-1

— implement a management system for records across business systems.

Implementation of these strategies can be considered in the design of records management solutions.

These strategies require records managers to work closely with application and database managers and administrators.

Where possible, the requirements for records are incorporated into the design of business systems upfront or when systems are being upgraded. It is more difficult to ensure records will be successfully captured and managed once the system has been built. As such, it is critical for records managers to undertake appraisal.

Once appraisal has been undertaken to determine what records need to be captured and the retention requirements for the records, records managers need to collaborate with system and database designers during the design stage.

6.3 Appraisal of records in structured data environments

6.3.1 Appraisal to determine what records need to be captured

In most cases, records will be required to be captured and retained whenever structured data is used to support an organization's business. The structured data may be needed as evidence for business purposes

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