**Administrative Metadata:**

Administrative Metadata is among the key categories of metadata which describes the digital assets that are required for management, organizational and stewardship purposes. While descriptive metadata is used for finding and defining the contents of a resource, administrative metadata is focused in its management and use, particularly from the technical, legal and preservation perspectives. Besides, it has multiple uses including material and document organization, retrievability, and preservation which makes use indispensable in modern resource centers including digital libraries, archives or repositories.

**Subtypes of Administrative Metadata**

Administrative metadata can be divided into several subtypes, each serving a distinct role in the lifecycle of a resource:

1. **Technical Metadata:** This kind of metadata gives details regarding the characteristics of a given resource such as format, resolution, compression etc., the software requirements etc. For instance: the format of the image file, either Jpeg or Png; the resolution, for example 300 DPI; and whether or not the image has been compressed in any way. This information is crucial for the ability of software systems to process the resource, display and render it at some future period of time when technologies may have advanced significantly. At the same time, it is used to preserve the integrity of the resource, as it passes through a system or a format change and assists in its utilization in different systems.
2. **Rights Metadata:** Rights metadata is therefore concerned with legal information of a resource which includes among other things ownership, licensing and usage rights. For instance, it can set flags like the resource being copyrighted, a public domain, or a Creative Commons license. This information is critical for controlling entrée to resources and for aiding in decisions over the uses of those resources in terms of their being legal or not. Rights metadata also assists in the monitoring of the permission for sharing, reproducing or using a resource in any way this is important in preventing legal complications that may arise by using the privileges granted to one a resource.
3. **Preservation Metadata:** The maintenance type of this subtype is more focused on the efficient and sustainable management of resources. It consists of data that has to be employed with a view to making sure that a resource stays optimize for its use over time as technology evolves. Descriptive metadata generally records data about the resource format, status, conversion if done to a different format, and preservation activities applied such as file format standardization and duplication across storage media. Such metadata is crucial for websites that provide data to individuals and institutions with the goal to make them available to the next generation of computers and technologies.

**Standards for Administrative Metadata**

Several standards have been set around the world to help in the documentation of administrative metadata when creating, and using the resources involved. Some of the most notable standards include:

* **ISO 8183:** The management of metadata for digital resources, when placed in an archive, is defined by this standard. It provides guidelines for the technical, preservation, and accessibility aspects of the resources, to make them as easily to preserve, retrieve, and reuse as possible. ISO 8183 would be most useful in organizations that are in charge of very large information stores and that require a common way to register metadata.
* **ISO 17572:** This standard is pointed toward metadata that enables the administration of digital content throughout systems and repositories. The application of its guidance pertains to the organisation of metadata concerning preservation, access and rights of digital objects, according to ISO 17572. It fosters an instance-level common metadata model that sets out the basis of interoperability across several systems and platforms.
* **ISO 14033:** This standard initiates coordination of digital record and information. Preservation Metadata is a field that identifies the general context, structure and management of the digital resources within the specific preservation context. According to ISO 14033 it is possible to define steps to be followed in documenting the life cycle of a given resource, the process of creating it, the steps involved in storing it and the steps that may be taken in order to preserve it in its original state.

**Use Case for Administrative Metadata**

The aim of the administrative metadata is thus to promote inventory, ushers resources for use, and sustain them. Functionalistically, administrative metadata is one of the main tools offering exhaustive control over digital objects’ life cycle: from the moment they are created to the moment when they are placed into long-term preservation. For example, in a digital archive, technical metadata ensures that the files remain accessible as formats change; rights metadata are a method to manage access to the resources and its legal use; preservation metadata would help ensure that the resource can remain usable for decades into the future.

For example, an organization’s digital collections, such as a digital archive from a university may utilize administrative metadata in documenting a collection of historical papers. Technical metadata would make sure that the images of the documents captured where in the correct format and at the right size. It means rights metadata would trace the owner of the document and the guidelines on how the document can be used were it to be used in research without breaching intellectual property rights. The preservation metadata would work to make sure that the archive had a strategy for how the documents would be transitioned to new formats down the road if and when needed to save the documents for future purposes due to changes in software and computer technology.

**Descriptive Metadata**

Descriptive Metadata is very helpful when it comes to the identification, discovery and placing into context of resources. Mainly it is used to specify the subject matter and scope of a given resource and help its identification in catalogues, databases, and search systems. This metadata type includes main descriptive data about the resource, title, author, keywords, abstract, creation date. These elements enable people to find where a particular resource is and what the resource is all about.

**Key Characteristics of Descriptive Metadata**

1. **Title:** The title merely is one of the simplest types of descriptive metadata common to any resource. They are employed in order to define a resource and more often than not would be the first piece of data that a user comes across when searching for or obtaining a resource.
2. **Author:** The author is the person that is mentioned by the author of the resource so that the users can see who is behind the given source and the information that they have provided. In academic use, this can especially be important in determining the reliability of the particular source being consulted.
3. **Keywords:** Descriptive words or phrases that state out the main content or area of interest of the resource are known as keywords. These assist the users in making their search regarding resources on given subjects or ideas. Keywords help make related beneficial changes in search engine optimization (SEO) which isused to locate the desired resources by using search functions.
4. **Abstract:** An abstract functions as a brief description of what the resource contains. This enables the user get an overview of the contents of the resource with relation to his research or interests without necessarily going through the entire content of the resource.
5. **Creation Date:** This indicates the date on which the resource was created or published for use by its consumers. The author believes that this is especially so in terms of identifying past history of the resource, its significance, and any subsequent modification and amendments.

**Descriptive Metadata Standards**

Two global codes exist that prescribe the structure of descriptive metadata and how they should be applied. These standards provide guidelines for consistent and interoperable metadata across different systems and contexts:

* **ISO 19115:** This standard gives guidelines on the geographic information metadata and descriptive metadata for resources like maps, geographic datasets as well as spatial data. This paper defines that in order to describe the spatial data, it is necessary to determine what elements are needed to describe content, quality or context of a certain type of spatial data so that such a resource can be easily found and effectively utilized in GIS systems.
* **ISO 24627:** Specifically, this standard is directed at the metadata of linguistic resources. It can serve as general principles for defining dictionaries, corpora or any other languages resources, called language resources hence such resources could be described in a way so that they can fit well to the linguistic and computational context in order to be catalogued, retrieved and utilized. It is especially useful for those, who deal with language data and natural language processing assets.
* **ISO 26162:** This standard relates with the metadata for educational resources with major concentration on the description and classification of educational material. It assists in making sure that whatever is in a particular medium – printed, television or software, assists in identification, selection and usage of educational aids such as books, videos or software. The standard enhances the teaching and learning resources to do with other ancillary learning materials.

**Descriptive Metadata over all is used in the following manner:**

Descriptive metadata is mostly useful in the following use case, that is in resource finding and organising resources. By creating descriptive metadata one is able to search for large material resources in collections. For example, a digital library may employ descriptive metadata format of a catalog wherein users may search for books by inputting the title or author or keywords or search for documents published on a given date. It also covers the ability to categorise the resources as per subject fields, or format or any other specifications which makes it easier for the users to filter out their search results and get hold of the necessary resources.

Descriptive metadata is also important in order to preserve the analysis of the context of a certain piece of resource. For instance, the title and creation date of an academic paper help the users understand the main issues and the significance of the paper; the author also guarantees the credibility of the information. For libraries and archives, proper and complete DC ensures availability and conservation of useful historical or academic contents.

When looking at IoT, descriptive metadata can be employed for structuring and differentiating devices or data sets created by IoT systems. This way, the users or systems can know what the data is about, the important keywords and when the data was created and thus can more easily handle it and integrate the IoT data into large systems for analysis or action.

**Provenance Metadata**

This type of metadata known as Provenance Metadata identifies the past and current history of a given resource. It offers the history of the resource, which was made, changed or updated, and helps to prove its credibility and auditability, which is crucial for the digital resources. In such cases preservation of integrity and history of a resource is essential and this is why provenance metadata is of outmost importance in cases of datasets, and other scientific documents, legal works as well as archival materials.

**Key Characteristics of Provenance Metadata**

* **Creator's Name:** It is a widely known fact that one of the most basic facets of any metadata concerning a resource’s history is defining its creator or originator. This can be the name of the person who created it, or the name of the organization that produced the given resource, which allows determining its source. Awareness of the creator gives users an insight of the environment in which the resource was developed, and therefore assess its reliability.
* **Modification History:** This metadata identifies the transformations that occur in a resource along the development of its life cycle. This also extends to information concerning the identities of the people, who made changes to the resource, time when the changes were made as well as details of the changes made. This is specifically true in shared spaces where a number of people have both created or modified content. Modification history tracking provides the possibility to analyze how the resource has been changing and which version is the most recent.
* **Versioning:** Provenance of the data involves metadata and version control is one among it. As investments are made in resources, these are bound to be updated several times and versions enable these changes to be managed well in a systematic way. The different versions of the resource are labelled with a version identifier and a time point, so that the user can tell which version is which. The technique is also critical in data control, research, or software where frequent updates and changes to a particular resource need to be documented.

**Standards for Provenance Metadata**

There are several standards which serve to set and describe the practice and utilization of the provenance metadata, aiming at creating a unified and coherent approach to the management of primary sources of the digital assets.

1. **ISO 19115:** This standard defines metadata frameworks exclusively for geographic information and datasets only. This also encompasses procedures concerning provenance about the originating source of the resource, prior alterations and the entire procedure of generation or transformation of data. This standard is relevant where, in the usage of geographic data, data origin is core in judging the value and credibility of the geometric details.
2. **ISO 14721 (OAIS):** The OAIS Reference Model is a common framework for digital preservation and states that preservation metadata should capture the provenance. OASIS pays special attention to why or how objects became digital and how they have been modified or migrated over time so as to preserve their integrity from genesis to delivery as a resource. This is especially so for digital preservation activities that will span long periods.
3. **ISO 16175:** This standard, devoted to metadata for records management, offers recommendations for consideration of the provenance information in records and documents. Covers how the beginning of a document or record creation, the process of its change and its history of usage and availability should be recorded. This is particularly important for organisations that must ensure that they demonstrate the transparency of the data and documentation processes.

**Use Case of Provenance Metadata**

The common application of provenance metadata regarded as a set of key elements is to check resources’ genuineness and trace their history in situations where data accuracy is more critical. For instance, in scientific research the provenance metadata is crucial in asserting the integrity of datasets and that they have not being spiked. The modification history and versioning information provide the necessary means for researchers to know the accuracy of the data they are using in the study.

For instance, a scientific dataset can undergo several versions of a particular dataset by different researchers at different years. The provenance metadata would record an author of a given din, another user that modified the set and the kind of alteration made. This makes it easy for future researchers interested in the dataset to know how it originated and what changes it underwent before they use it.

Provenance metadata is as important in legal contexts as well. A legal document or a contract for instance may be drafted, edited and reviewed for changes severally. Records of the different versions have to be captured in the metadata the capture of the changes done, the user who did them, the time of doing them and the type of changes done. This assist in helping the organization to verify the document thus making sure that every anybody involved has an easy time with the document and at the same time recognizes it as legal document.

**Structural Metadata:**

Structural Metadata on the other hand is a critical subcategory of metadata since it encompasses how various elements or parts of any source or resource are structured and connected. While descriptive metadata focuses on the identification of the resources’ contents, the major role of structural metadata is the description of relations and internal structure within the resource and most importantly simplifying the navigation, access, and overall comprehension of the structure of the resource.

**Key Characteristics of Structural Metadata**

* **Table of Contents:** Table of contents in a book, report or any other publication that is made up of many parts is a kind of structural metadata which shows how that particular parts. It demonstrates the order of chapters and sections and the sequential arrangement of subsections and assists readers to find what they need. This is particularly the case where large numbers of users are required to search for particular information within large, and often complicated, documents or files.
* **Data Schema:** In datasets, structural metadata can provide information about the schema of the dataset, or structure information of the data. That is, it may state how some structure, such as a relational database, is implemented at the table-field level and their mutual connection. This makes the users aware on how to analyze the data for instance in knowing which field is linked to which or even how to combine tables for analysis.
* **Relationships Between Chapters/Sections:** In a document that includes such components as sections or chapters in, for example, a report or an academic paper, structural metadata assist in determining relations between components. It shows how the subsequent chapters relate to each other; for example, the relation between Chapter 1, Problem formulation; Chapter 2, Literature review; and Chapter 3, Methodology. These relationships lay out a logical step by step process of going through the document as indicated by the reader.

**Standard for Structural Metadata**

Several international standards define how structural metadata should be managed and utilized, ensuring consistency and interoperability across different systems and applications:

1. **ISO 23081:** This standard covers the metadata best practices within an organisation and how to approach the documentation and management of metadata particular to record management. It covers guidelines for managing structural metadata so that resources structures and, in particular, record relationships are clear and processes are auditable. Applying this standard to organizations, allows for easier management and eventual accessibility of documents and records.
2. **ISO 13972:** Dealing with geographic and spatial data, the ISO 13972:2013 specifies the structure of structural metadata in the framework of geographic information systems (GIS). This comprises of the definition pertaining to the associations between layers of data and the different classifications of data with respect to spatial positions, administrative and hierarchical specifications of spatial features, and the connectivity of several data elements. This standard is a prerequisite to the use of complex geospatial resources and sufficient to manage spatial data to answer specifically the questions of what, where and how often.
3. **ISO 24289:** This standard focuses on enhancing metadata throughout multimedia qualities specifically targeting digital video, audio and image resources. In this respect, structural metadata assist in defining the structural link between elements of multimedia content, for instance scenes, shots, and segments. This makes it particularly helpful in arranging complex multimedia objects to allow their manipulation or analysis to be effected easily or not at all a problem.

**Use Case of Structural Metadata**

One of the most important application of structural metadata is its utilization in different ways to navigate through the hierarchy of the materials in digital or physical formats. For instance, in digital library where there is academic papers or books, structural metadata will enable the user know the structure of the papers or books by their chapters, sections or subsection. It allows the generation of active contents that let the reader get to certain sections of the doc depending on the structure used in the work.

In a dataset, structural metadata helps a user to define the correlation between tables or fields in data hence making it easier to use when querying data. For instance, a dataset that contains records of customer transactions may include a Customers table and Transactions table, as recognized by structural metadata indicating that these posture is connected by trace number called CustomerID. Without this structural metadata, the clients would find it very hard to interact with this data.

For organizing huge video or developer collection, structural metadata plays an imperative role in multimedia repositories. For example, in a video archive, structural metadata may point to various video clips within the documentaries or explain how frames in a video are related to scenes and chapters so that the users can search for momentary events in the videos.

**Statistical/Analytical Metadata**

Analytical metadata is a kind of metadata that has a heavy importance in the data analysis process to understand the data. It provides information about the kind of data, how different datasets are connected, as well as the results produced by evaluative data. This specific type of metadata is particularly useful in any research and analytical processes, for the context, approach and format of the data may greatly influence the resulting conclusions derived from the data.

**Key Characteristics of Statistical/Analytical Metadata**

* **Variables:** In statistical or analytical datasets, therefore, variables are the aspects of data that are measured during a study. Statistical metadata accompanying a variable defines what the specific variable is, what format it comes in, the unit of measurement and where it fits within the table. For instance, in a survey, the variables could be years of age, income and level of education as the respondents.
* **Data Definitions:** The other important metadata in statistics is the specification of the content of the data elements. This will helps users to know the meaning of each variable in a dataset. For instance, in medical data set variable ‘age’ can be described as the age of the participant at the time of the study, which is in years.
* **Methodologies:** This pertains to the techniques of getting, transforming and interpreting the data. Common examples of statistical metadata main areas are: information about the sample structure and sampling method, data collection method, and statistical treatments made on the collected data. Thus, if a dataset was collected from a sample of population, the metadata may contain information on the procedure of sampling employed to enroll people.
* **Derived Metrics:** In some cases, the datasets contain derived measures, which are numbers that were derived from other numbers in the dataset. If it quantifies something, then statistical metadata details these actualities including average, percentage, or regression coefficients showing how each of the above has been arrived at and specifically what it stands for. For instance, the dataset can contain a ‘mean income’ obtained from the values of income of the people.

**Standards for Statistical/Analytical Metadata**

Many standards exist to promote the organization of statistical and analytical metadata that can be processed, interpreted, and shared appropriately between various systems.

1. **ISO 11179:** This standard has aspects on the metadata registries in particular, concerning the definitions of data elements and connections between them. That way it guarantees that along the systems the data definition will be interpreted in a similar manner thus increasing its usage. ISO 11179 is applied mainly in statistical and analytical fields for documentation of variables, definitions of variables and the links between them.
2. **ISO 19115:** Although focused on geographic data, ISO 19115 also considers statistical metadata in terms of spatial data. It assists in recording the techniques employed for data gathering and accrual of spatial data as well as the parameters embedded in geographical research. The standard is significant for spatial data is to organize the data correctly and the structured metadata of the data enables the correct understanding it.
3. **ISO 2709:** This standard concerns the exchange of bibliographic data but it also Entails provisions for describing analytical data & and statistical models commonly used in research. Metadata makes sense to allow the various data depositories and organisations that share data to have a general format when sharing collected data.
4. **ISO 9241:** Although this is a norm mainly for ergonomics and user-oriented design, it has impacts on statistical metadata in human-oriented research. It covers advice on how to develop surveys and experiments that yield useful data and the metadata needed to document such a data set.

**Use Case of Statistical/Analytical Metadata**

Interpretation and analysis or the data being produced is one of the most common application of statistical metadata. For instance, in research studies, statistical metadata enables the researcher to appreciate the nature of the data and the environment in which the data was collected before one can conduct the right analysis to arrive at the correct conclusion. Through metadata, the researchers are able to know which variables are relevant, their definition or measurement and methods of data collection used hence will not misinterpret.

In a healthcare research which might be a quasi-experimental design investigating the efficacy of a new drug, statistical metadata would serve to describe the variables involved; age, gender, medical history, sample selection criteria; random sampling, and statistical analysis techniques; regression analysis. This way, this metadata helps others to replicate the study, understand the data and assess the findings as explained below.

In business analytics, the statistical metadata can be applied to relay information on some of the factors that correlate customer characteristics with purchasing habits. This paper is important because by knowing how these variables are defined and measured, analysts can then make much better decisions when it comes to arriving at the right decisions after analyzing relevant sales data and formulating strategies.

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