Information Engineering

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Abstract. The International Standard ISO 10303 provides the technology to achieve the computer-interpretable representation of scientific and technical data for stability and accessibility in the long term. A new application of ISO 10303, Part 235, has been developed specifically for the representation of property data and to ensure its long term value. ISO 10303-235 provides a specification, in the form of an information model, to describe the processes and the conditions used to derive a property, with the supporting information to ensure that the processes were valid. The information model can be used for any property measured by any method. The names of processes and their associated properties are defined in computer-processable dictionaries to which the ISO 10303-235 can make reference. The sequence of processes to produce scientific and technical data is shown and the scope of the information model is described.

1 Introduction

The communication of information, by whatever means, depends on the use of an information model to provide the structure for the data items that represent the information and on the use of a dictionary to define the meaning of the data items. In order to achieve understandable communication it is essential that the same information model and the same dictionary are used by all parties in the communication chain. A sentence in a natural language, whose structure conforms to the specification of the grammatical rules of the language, is an example of an information model and many instances of this sentence structure can be used to convey different collections of information.

ISO 10303 standards[1] and their applications define information models for the computer representation of product data that is independent from any proprietary computer system. ISO 13584[2] provides the resources to develop computer-processable dictionaries of terms that are also independent of any computer system and that can be referenced from an information model. ISO 10303 and ISO 13584 have been developed by the ISO Committee TC184/SC4[3] in an international collaboration extending over 20 years between all of the world's manufacturing nations and most of the industrial sectors. SC4 Standards are written in the EXPRESS[4] language.

ISO 10303-235 'Engineering properties for product design and validation'[5] is a new application of ISO 10303 for the computer representation of scientific and engi-

neering property data. The meaning of a scientific or engineering property depends on the process used in its measurement and the magnitude of the value of the property depends on the conditions used in that process[6]. ISO 10303-235 provides an information model for the representation of: the processes used in a measurement, the values of the property and the supporting information that ensures that these values were valid. The use of referenceable dictionaries, conforming to ISO 13584, for defining the measurement methods and their properties, ensures that instances of the information model in ISO 10303-235 can be used for the values of any property measured by any method.

2 Measurement of property values

The chain of processes required for the measurement and validation of a property value is shown in Figure 1. Each process requires an input and an output and sometimes these are physical objects, such as a test specimen, and sometimes they are data. The processes on the left side are true for any property. The processes on the right side of the diagram are needed when the data is to be used for critical engineering design, such as for the components of an aircraft or automobile. Figure 1 represents the planning model for the development of ISO 10303-235 and is an indication of its scope.

3 Scope of ISO 10303-235

The modeling of an application of ISO 10303 is developed by using formal processes in three stages:

- Application Activity Model (AAM) – defines the information flows associated with the technical problem;
- Application Reference Model (ARM) – defines the information objects and their relationships that will specify what information is required to satisfy the requirements in the AAM;
- Application Interpreted Model (AIM) – defines the standardized information constructs from the ISO 10303 Integrated Resources that will be used in order to meet the requirements of the ARM and AAM. This is the normative part of the standard.

The use of standard data constructs in the AIM ensures a high degree of consistency for ISO 10303 models across a wide range of applications. Other advantages are the re-use of software code for interfaces and the potential for sharing data across different domains.

The ARM is divided into sections, called Units of Functionality (UoF), that group together model constructs of associated concepts. This makes it easier to appreciate the scope of the model and to evaluate the details of how the model meets the re-

quirements of the technical domain. The titles of the UoF in the ARM of ISO 10303-235, and some indication of their contents, are shown in Table 1.

Table 1. Indication of the contents of the UoF of the ARM of ISO 10303-235

activity – activities planned and realised, activity relationships, resources	**administration** – date, time, event, event relationship, contract, project, specification
approval - approval, certificate, security classification	**condition** – condition, condition assignment, condition relationship
document management - document, document relationship, digital record, file, file location, hardcopy	**effectivity** – effectivity, effectivity relationship, dated, lot, serial, time-interval effectivity
engineering property – engineering property, property representation, property value, property environment	**geometry** – axis placement, cartesian point, curve, Cartesian transformation, shape, shape dimension, shape element
geometric tolerance – angularity, coaxiality, concentricity, flatness parallelism, straightness, symmetry	**location** – address, global location, organization location product location
measure – numerical measure, unit, unit conversion, maths value, maths function, qualifiers, uncertainties	**person organization** – person, organisation, qualification, address
product – product type and individual, planned and realised, product relationship	**quality assurance** – class defined by evaluated condition, class defined by requirement
requirement – required resource, resource assignment, resource relationship, requirement source	**state** – derived state, process state, property state, state type, state type relationship
substance – chemical element, element amount, composition, structure, structure element, structure element relationship	**tolerance datum** – target area, circle, point, rectangle, straight line

4 Discussion

ISO 10303 and ISO 13584 are designed for the long-term archiving of technical data and overcome the problem that the life time of data is longer than the lifetime of proprietary computer systems and software. The use of applications of ISO 10303 for this purpose is now well established. The application of this technology to the representation of property data became possible with the recognition that the meaning of a property depends on the processes used in the measurement and the value of a property depends on the conditions of the process. The dependence of a data value on the conditions of a measurement method was first standardized in ISO 10303-45[7] and the

ISO 10303-235 now completes the requirements by specifying the processes that were used.

The emergence of the ISO 13584 to specify the processes and the meaning of the names of properties in a computer processable dictionary has been an important opportunity. For the first time, there is now the capability to have one information model, specified by ISO 10303-235, to represent the data values of any property determined by any method, with a series of associated dictionaries to describe the meaning of the information represented by the data items in the model. It is this powerful and unique combination that ensures the long term value of the data.

The production of data to a specification that will ensure its long term value allows the treatment of information as a product that can be tested to ensure that it meets the specification and provide an objective measure of its quality assurance. This is the same approach that is used by any manufactured product and so it is justified to describe the use of the ISO standards 10303 and 13584 as 'Information Engineering'[8].

5 Conclusions

The ISO 10303-235 is designed to meet the requirements for the long term stability and accessibility of property data. It uses a well established technology for the construction of an information model and its associated dictionaries to specify the data and ensure its accessibility independently of any proprietary computer system or software application. The complete specification of data in a formal information model with an associated dictionary applies the principles of Information Engineering and will therefore ensure its long term value.

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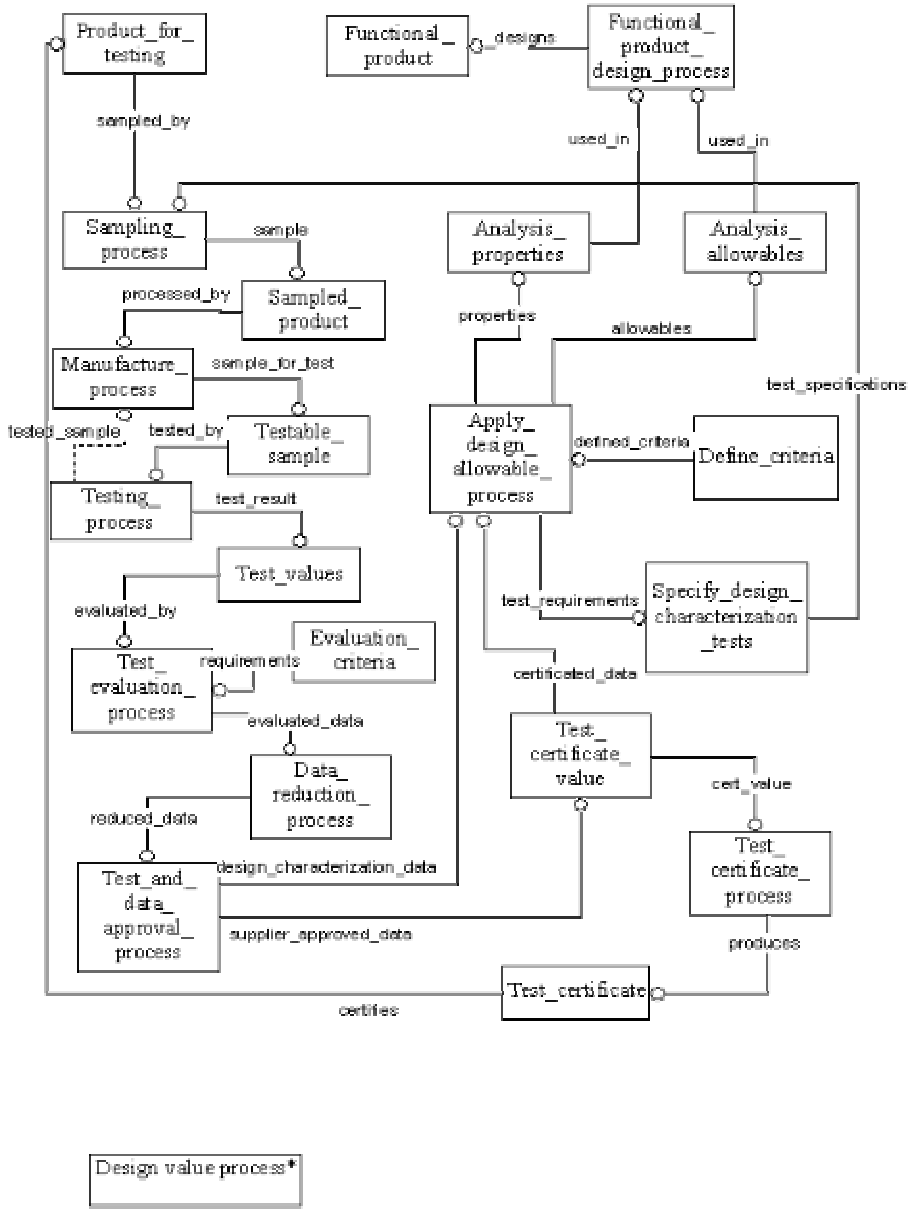

Fig.1. Sequence of processes to determine the value of a scientific or engineering property