TECHNICAL REPORT

IEC TR 61908

First edition
2004-11

The technology roadmap for industry data dictionary structure, utilization and implementation

Reference number
IEC/TR 61908:2004(E)

Publication numbering

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International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE X

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

THE TECHNOLOGY ROADMAP FOR INDUSTRY DATA DICTIONARY STRUCTURE, UTILIZATION AND IMPLEMENTATION

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 61908, which is a technical report, has been prepared by IEC technical committee 93: Design Automation.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
93/195+195A/DTR	93/205/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

In order for a standard to be effective, there need to be utilization and implementation. In today's global economy the leading edge companies forge ahead with their agenda and many times produce what are known as pseudo-standards. Whether driven by an individual company (i.e. Microsoft®) or a consortia group, the ability to satisfy a customer need is their main focus and goal. This, in many instances, puts the groups developing standards in a "catch-up" mode while they make sure that industry has accepted the new concept, domain or technology. Unfortunately, although there may be better ideas developed during the standardization process or the playing field be levelled by the standard requirement, there is a "reluctance to change" by those organizations or individuals that have invested a good number of resources in developing or implementing the new concept.

If the standard defines physical performance requirements or conformance details, the contractual agreements between members of the supply chain handle these according to an implemented revision level. Many engineering hours are spent in determining the variation between an existing version and a new change proposal, to ascertain whether the change is compatible with the implemented processes, or whether the change would require a major process overhaul. The effort to change, many times, impacts business relationships and thus support of the next revision of the standard.

When it comes to software these issues become more complex, and take on market share, technical competence, business process, and competitive rhetoric significance. Instead of working together to help the industry, many times the players work to enhance their own position. This is counter productive to helping the electronic industry make sound decisions and continue to follow along the path of outsourcing much of the supply chain transactions, whether purchasing, fabrication, assembly or testing of electronic hardware.

In order to clearly define the difference between a dictionary and a library; a dictionary contains only meta data (data about data supported by an Information model of such entries). So the definition according to a certain methodology is given of a specific characteristic, for instance "terminal diameter" For such a characteristic, the identification, description and value representation shall be defined. What is not given in the dictionary is the actual value(s) of diameters of something.

A library is like a catalogue. It uses dictionary entries to be built into the database. In a library you find the characteristics with their values, so you can compare components of different manufacturers on their characteristics.

THE TECHNOLOGY ROADMAP FOR INDUSTRY DATA DICTIONARY STRUCTURE, UTILIZATION AND IMPLEMENTATION

1 Scope

This Technical Report is applicable to the technology roadmap for industry data dictionary structure, utilization and implementation.

This report covers one aspect of industry relationships; that of data dictionaries. A data dictionary is made up of information about products. The products can be electronic components, base material, clothing, chemicals or any product that can be described in terms of an industry understood descriptive name (element) and the characteristics that make up that part (attributes). Another item that helps data dictionaries become very efficient is to reuse the characteristics (attributes) in more than one element. Reuse of information is desirable in any implementation strategy in order to reduce search time for the implementation software. The topic of discussion, therefore, in this report is the status, completeness, implementer goals, and standardization efforts related to electric components.

2 Normative references

The following referenced documents are indispensable for the application 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.

IEC 61360-1, *Standard data element types with associated classification scheme for electric components – Part 1: Definitions – Principles and methods*

IEC 61360-2, *Standard data element types with associated classification scheme for electric components – Part 2: EXPRESS dictionary schema*

IEC 61360-4, *Standard data element types with associated classification scheme for electric components – Part 4: IEC reference collection of standard data element types, component classes and terms*

ISO 13584-26, *Industrial automation systems and integration – Parts library – Part 26: Logical resource: Information supplier identification*

ISO 13584-42, *Industrial automation systems and integration – Parts library – Part 42: Description methodology: Methodology for structuring part families*

3 Overview

3.1 Dictionaries and Libraries

The ultimate goal is the transfer of product data in a **library** which can be interpreted by computer systems. For this reason, the structure and meaning of elements in the libraries have to be defined. In addition to a basic information model, which defines, for instance, that each product has to have a unique attribute Product ID, and that it contains a list of properties, the structure and meaning is defined by dictionary.

A **dictionary** contains the definitions of the properties which are used in libraries to describe products. As such, a dictionary may define a property "supply current", specify its type and potential value restrictions, define its meaning, its unique identifier, who has specified it, etc. Normally, the properties are organised in classes which themselves are often organised in an inheritance hierarchy.

A **Dictionary Information Model** describes the way in which a Dictionary is built. Thus, this model specifies how classes are described (e.g. that they have a unique identifier, a preferred name, a code, a set of synonyms, a textual definition, etc.), how properties are described (e.g. that they have a unique identifier, a preferred name, a code, a set of synonyms, a textual definition, a type definition, etc.), which data types are allowed for properties, how classes can be related to each other, how properties can be related to classes, etc.

Examples of Dictionary Information Models are IEC 61360-1, IEC 61360-2 and ISO13584-42, the DTD (plus verbal specifications) of the RNTD, and the table structure of the ECALS dictionary (plus some verbal specifications). If a Dictionary Model is populated by classes and property definitions, then a dictionary is produced (e.g. the RNTD or the IEC61360-4 or the ECALS dictionary, i.e. the content of the tables). Of course, different dictionaries can be built with the same Dictionary Information Model. For instance, besides the IEC61360-4 quite a few other dictionaries have been defined and are under development on the basis of the model of IEC61360-2 and ISO13584-42. A dictionary contains meta data in the sense that this data describes other data, namely the meaning of product data in a library (or in an exchange file which can be regarded as a library). For this purpose, in a library all elements are related to a dictionary, i.e. all products belong to a product class and all values are defined in a corresponding property of that class.

Electric component dictionaries are the most essential architecture in forming the basis for shared understanding that makes product information exchanges possible. At the time of this report there are three major Dictionaries that describe electric components being used through out the global electronics industry. These dictionaries are supported by either IEC standard bodies or Groups of consortia formed to address the global needs of their supply chain members. It should be understood that there are several conditions for the data dictionary to be useful to a trading partner transaction. These are:

- the dictionary descriptions must be clear and unambiguous;
- the dictionary shall have the possibility to be linked to a transport mechanism that must be available to create, send and match responses to queries to libraries and/or dictionaries;
- the dictionary development must be flexible for quick update and approval of new characteristics of products. The dictionary itself does normally not contain products information;
- the implementation of the library/catalogue must have been populated by industry supply chain members or the dictionary may also be populated by other organisations/persons;
- a group must be responsible for the development, maintenance and update;
- mapping software between different descriptions must be available;
- data dictionaries must be available on-line in an electronic format;
- there must be a depth of coverage that is aimed at completeness of the user needs.

3.2 The IEC Dictionary

The IEC Reference collection (dictionary) is published in IEC 61360-4. It has software support through EXPRESS information modelling and other STEP tooling. MERCI an IST project Number 12238 technically managed by the University of Hagen, Germany is based on that IEC dictionary. Since approval for new entries in the dictionary would require consensus by the countries that participate in the IEC, and the associated development and approval process would take too much time special delegation has been made to a maintenance agency and a validation agency to overcome this problem. By doing so, the IEC, being sensitive to industry needs, is able to meet these requirements using the expertise available in the many Technical Committees.

Sector Boards review project relevance to industry needs. The Presidents Advisory Committee on Future Technology (PACT) evaluates visions for the future. Due to the late IEC implementation of an on-line database of the dictionary, the number of implementations using the IEC dictionary is only now starting. The initial population of the dictionary was created in 1997 and has been under constant development ever since.

3.3 The ECALS Dictionary

The Second dictionary is an expansion of the IEC effort. The dictionary is managed by JEITA (Japan Electronic and Information Technology Association) under the consortia membership known as ECALS. The ECALS format was built on the IEC standard and the members have developed several search engines to help identify component availability. JEITA has a Memorandum of Understanding (MOU) with the IEC in order to use the standard in order to build the enhancements into the ECALS dictionary descriptions. Several of the ECALS consortia users are also impatient to have new products defined in the Data Dictionary used by ECALS. Delegates from Japan participate in the IEC Technical committee responsible for the IEC data dictionary TC3/SC3D. Implementation is minimal and is used mostly by Japanese OEMs who also produce electronic parts. The descriptions in the ECALS dictionary provide different characteristics (attributes) from those that are available in the IEC. This is part of the agreement reached in the MOU.

3.4 The RosettaNet Dictionary

The third dictionary is that of RosettaNet and its partners. RosettaNet has a dictionary that complements that of the IEC and ECALS also by adding other features. The attitude of RosettaNet members is that they must have a concept that is flexible, and has a fast approval cycle amongst the trading partners. Their goal is responsive turn-around time for new product descriptions or changes. Thus implementation and approval is measured in weeks as apposed to months or years, and implementations grow at a phenomenal rate. New parts, new members, new partners populating dictionaries have caused the need for high levels of implementation software, search engines, transport mechanisms and other tools to smooth the highway for B2B transactions. The energy level put into the RosettaNet consortia efforts has not gone unnoticed, thus other industries want to take advantage of the same strategies and goals. The RosettaNet dictionary has expanded outside electronic components descriptions, to IT, SM and soon TC. RosettaNet has no desire to become the standard developer; they do want to be the most robust implementation. To that end they have achieved their goal, however with that comes the problem of a different structure or description of the Data elements.

3.5 The Global Dictionary situation analysis

All three dictionaries use a number/naming scheme in order to keep track of their products, elements and attributes. As can be imagined, the alphanumeric descriptions are relatively different, although both ECALS and RosettaNet, at times, reuse each others main alphanumeric description. However, the attribute lists of an individual alphanumeric may be very different based on enhancements needed by ECALS or RosettaNet users. The IEC has a standard scheme for the IEC descriptions and will not adopt other schemes lest it upsets the significant organization of the information.

All three dictionary representatives, through their members, are active in the promotion of their approach. Most new features originate from the IEC SC3D working group 2, the EEC CIREP and MERCI projects and the close harmonisation work with ISO/TC184/SC4 PLIB. At that point the new information is part of the maintenance programme of the IEC and follows the natural process to update the standard on those items that are agreed to by the National Committees of participating countries following the relevant procedures as described in IEC 61360-3. The status of the three approaches is shown in Table 1.

Table 1 – Dictionary hierarchy and status (January 2003)

Dictionary	Characteristic description
IEC status	IEC has 483 class definitions IEC has 1354 property definitions (other IEC figures) IEC has 113 condition definitions
ECALS status	ECALS has 728 class definitions ECALS has 2688 EC characteristic instances (1316 unique characteristics) ECALS has 724 EC classes
RosettaNet status	RNTD has 915 EC classes RNTD has 44,279 characteristic instances (2774 unique characteristics) – 2708 instances for automotive (417 unique characteristics – 25121 instances for IT (907 unique characteristics) – 16450 instances for EC (1450 unique characteristics)

The IEC dictionary is published as IEC 61360-4: 1997. An amendment is in circulation that contains many additions to the IEC reference collection, mainly originating from IEC TC47 (geometries of electric components 50 %), the EEC 'Good-Die' project and TC47/PT62258 (DIE data 25 %) and JEITA/ECALS (connectors among others 25 %). The amendment has been accepted as a CDV and a consolidated version of Part 4 containing the new material is about to be circulated as an FDIS.

The IEC on-line database became operational in May 2003. It permits at present searching and browsing with simple download of class and property definitions. Besides this database, a CDROM database version has been produced by Dr. Radley; this contains, in addition to the IEC on-line database, a whole set of input tools, output generators and format converters for various data formats (tagged file, STEP physical file, XML and CSV formats) www.iec.ch.

The ECALS dictionary, ECDIC1.2J, dated January 2001, is available as Excel tables. It is implemented in several Japanese supplier and customers, however search engines and content are just evolving. http://www.e-parts.org

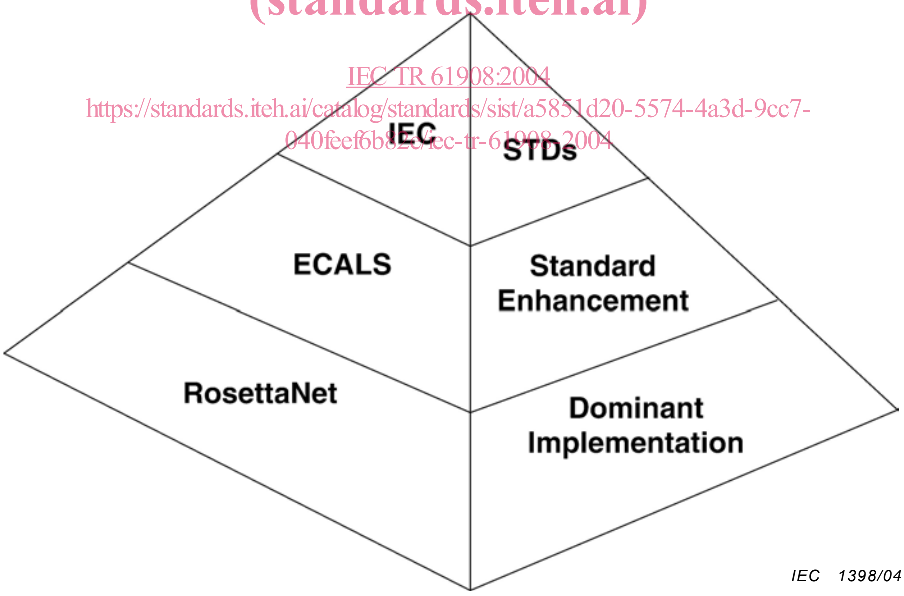
JEITA formed the ECALS steering committee in May 2000. In order to continue the efforts toward commercial application of the achievements of ECALS, the national project aimed at standardization and digitalization of catalogue data for semiconductor and electronic components. The committee commenced action in August 2000, and disclosed to the public version 1 of the ECALS dictionary developed in compliance with IEC standards. The dictionary concepts are used by e-Pianet /EIAK in Korea and some RosettaNet members. As a result of establishing guidelines for data distribution, improving software for such services, recruiting companies for business start-up, and other commercialization activities, the dictionary is spreading widely with disclosed data exceeding 310,000 as of July 2002. Dictionary standards and member data is managed centrally at JEITA and distributed to the members of the consortia. Parts data are kept in distributed storage by information suppliers and joint servers.

The RosettaNet dictionary RNTD1_3, dated August 2001, is available as an Excel table and an XML file. All versions of the dictionary include the same package of XML files and spreadsheet documents, and can be viewed with the RosettaNet viewer. The official release is the parsable XML file.

It is still a huge problem for non-XML users to read/study the RosettaNet results. The Excel files are almost unreadable for a human, while forcing companies to use an XML environment is in the author's view still a bad proposition

Version RNTD1_4 is now also available as an XML file. It is clear that the RN dictionary was based on ECALS and many of the identifiers are the same in the two dictionaries. There are a number of cases where the two dictionaries use different identifiers for the same property probably due to RosettaNet modifying the entity at some level. There is some overlap between both classes and properties in the three dictionaries. However, the classification philosophy and the end user goals vary dramatically. The philosophy used in the IEC is to develop a standard that is bound by rigid rules; the philosophy of RosettaNet is to serve the industry in the quickest manner possible and that the transport and search engines are efficient in what they are supposed to do. Thus software implementation philosophy varies and each software expert has his preference for the code and practice used in the queries and response mechanisms. There are quite a few implementations and a good amount of content in the data dictionary supply chain hierarchy.

Each dictionary and each organization has a focus and a goal. The purpose of the IEC harmonization experiment was to explore the differences and the similarities between their respective approaches to data element dictionaries. The world is changing, as are the needs of the supply chain and the companies involved. In an ideal world everyone would use the same procedures. If the world can manage to work around different power and voltage extremes and different wall sockets, by exploring the conditions of interoperability and granularity of the data elements, software can accomplish some of the needed bridging of the gaps. The rule should be that all must work together. All must make a commitment that no one gets left behind. Figure 1 shows the data element pyramid where each domain in their specific focus needs to continue to serve the industry in their own way. RosettaNet has the broader view and in many instances represents the leading edge. They have a responsibility to work with ECALS enhancement. ECALS works to help populate RosettaNet dictionary descriptions, and then influences the IEC standardization process catch-up.



IEC 1398/04

Figure 1 – Data element pyramid

3.6 The interoperability experiment

The intent of the "Electronic Component Description Interoperability Experiment" was to verify the ability of one system’s query about electronic component information to be handled correctly by another. As long as the software search engines are able to understand the communiqué and manage the information without ambiguity, certification tools can be developed that ensure that new techniques deal with the back and forward transfers are compatible without data loss.