A Compilation Procedure of ISO Conforming Dictionary for Constructing Product Database

Saburo Tanatsugu[1] Mamoru Kawanobe[2] Isao Shirakawa[1] Cong Yan[3] and Yukihiro Ano[1,3]
[1]Graduate School of Applied Informatics, University of Hyogo,
1-3-3 HigasiKawasaki-cho, Chuo-ku, Kobe, 650-0044 Japan
[2] Benic Solution Corp., 35 NishiMachi, Chuo-ku, Kobe, 650-0038 Japan
[3]SmartTips Inc., 1-12-4 NihonbashiHama-cho, Chuo-ku, Tokyo, 103-0007 Japan
E-mail: [1]sub@p-lib.com

Abstract: This paper devises a compilation procedure of a dictionary conforming to ISO standards, the so-called PLIB dictionary, dedicatedly for a mechanical element of 'chain'. First, a standardized identification hierarchy of the chains is constructed on the basis of ISO 13584-42, and then a new compilation procedure of the PLIB dictionary is described, which consists of (i) assigning BSU (Basic Semantic Unit) codes to each family and each property of of chains as well as to each incidence of property to family, and (ii) constructing a physical file on the basis of ISO 10303-21 by means of a mapping system developed originally by the authors.

1. Introduction

WTO (World Trade Organization) insists that in accordance with the agreement on TBT (Technical Barriers to Trade) the Central Government Bodies of every ratifier should enforce technical regulations on the basis of international standards. This implies that the standards drafted by ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) should be legally enforceable not only for product databases but also for international commerce and procurement, production specifications, etc., and therefore it is of urgent necessity for Japan as an industry/trade-oriented nation to construct product databases conforming to ISO standards.

The work of preparing international standards for industrial product databases is now carried out through an ISO technical working group of TC184/SC4/WG2 in such a way that the compilation of the PLIB dictionaries, i.e. the 'parts library' dictionaries conforming to ISO 13584, has been progressing in several countries. For example, China is now conducting the compilation of a PLIB dictionary dedicatedly for fasteners by official approval of ISO 13584-511, and Sweden is also compiling a PLIB dictionary for cutting tools by ISO 13399-100. However, such a work of compiling PLIB dictionaries has not yet been initiated in Japan for any of those mechanical elements which constitute national principal exports.

To cope with this situation, the present paper attempts to compile a PLIB dictionary dedicatedly for a mechanical element of 'chain'.

2. Mechanical element of 'chain'

First, seek all parts and properties of chains dealt with in ISO standards. Then Tables 1 and 2 are obtained, which show the list of all parts and properties, respectively. Especially as for class C in Table 1, there is another class of 'Drive chains' which has the same set of properties with the class of 'Motor cycle chains', and hence let class C be divided into two classes of C1(Drive chains) and C2(Motor cycle chains).

In order to construct a standardized identification hierarchy of the chains on the basis of ISO 13584-42 [1], define a

Table 1 List of classes of chains dealt with in ISO

A: Chains, sprockets and accessories-List of equivalent terms [2]
B: Flat-top chains and associated chain wheels for conveyors [3]
C: Motor cycle chains [4]
D: Bicycles chains [5]
E: Heavy duty cranked-link transmission chains [6]
F: Conveyor chains, attachments and sprockets [7]
G: Short-pitch transmission precision roller and bush chains, and attachments and associated chain sprockets [8]
H: Double-pitch precision roller chains and sprockets for transmission and conveyors [9]
I: Welded steel type cranked link drag chains and chain sprockets[10]
J: Steel roller chains, types S and C, attachments and sprockets[11]

Table 2 List of properties of chains dealt with in ISO

No.	Name of property
1	Chain Number
2	Pitch
3	Maximum bearing pin body diameter
4	Maximum width over bearing pins
5	Maximum roller diameter (small)
6	Minimum width between inner plates
7	Minimum bush bore
8	(Maximum width over bearing pins) / 2 +Maximum additional width for joint fastener
9	Maximum width over inner link
10	Minimum width between outer plates
11	Maximum inner plate depth
12	Maximum outer or intermediate plate depth
13	Transverse pitch
14	Plate width
15	Minimum cranked link dimension L1
16	Minimum cranked link dimension L2
17	Maximum plate depth
18	Maximum roller diameter (large)
19	Width over attachment
20	Maximum additional width for joint fastener

matrix of Table 3 such that each row and each column correspond distinctly to a property of Table 2 and a class of Table 1, respectively, and the (i,j)-entry is '○' if and only if property i is indispensable for class j, in accordance with ISO standards[3-11]. Using this matrix, an ISO 13584 conforming hierarchy is constructed as follows.

Table 3 Matrix of properties incident to classes

	B	C1	C2	D	E	F	G	H	I	J
1	○	○	○	○	○	○	○	○	○	○
2	○	○	○	○	○	○	○	○	○	○
3	○	○	○	○	○	○	○	○	○	○
4	○	○	○	○	○	○	○	○	○	○
5		○	○	○	○	○	○	○	○	○
6		○	○	○	○	○	○	○	○	○
7		○	○	○	○	○	○	○	○	○
8		○	○	○	○	○	○	○	○	○
9		○	○	○	○	○	○	○	○	○
10		○	○	○	○	○	○	○	○	○
11		○	○	○	○					
12		○	○	○	○					
13		○	○	○	○					
14		○	○	○	○			□		
15					○					
16					○					
17	○					○		○		
18						○		○		
19	○									
20				○						

(□ indicates that property 14 is necessary only for type A of double-pitch roller chain.)

3. Hierarchy of families of chains

According to ISO13584-42, the families of chains are classified hierarchically with the use of the matrix of Table 3 as follows.

① Rows 1 through 4 have ○' s in all columns, and hence a set X={B,C1,C2,D,E,F,G,H,I,J}of all classes constitutes a generic family of chains, which is designated as 'Chains'.

②Rows 5 through 10 have ○'s in columns of C1,C2, D,E,F,G,H,I, and J, and hence define Y={C1,C2,D,E, F,G,H,I,J}. Then Y constitutes a generic family of chains, which is designated as 'Roller & Bush chains'.

③ Rows 11 though 14 have ○'s in columns of C1,C2,D, and E, and hence define Z={C1,C2,D,E}. Then Z constitutes a generic family of chains, which is designated as 'Transmission chains'.

Considering that X=Y∪{B} and Y=Z∪{F,G,H,I,J}, and each element of X={B,C1,C2,D,E,F,G,H,I,J} constitutes a simple family of chains, the standardized identification hierarchy of chains is obtained by using the set inclusion relation, as shown in Fig. 1, where it should be noticed that the name of each vertex is abbreviated, each *leaf* (i.e. vertex without a child) indicates a simple family of chains, and each of the other vertices represents a generic family of chains.

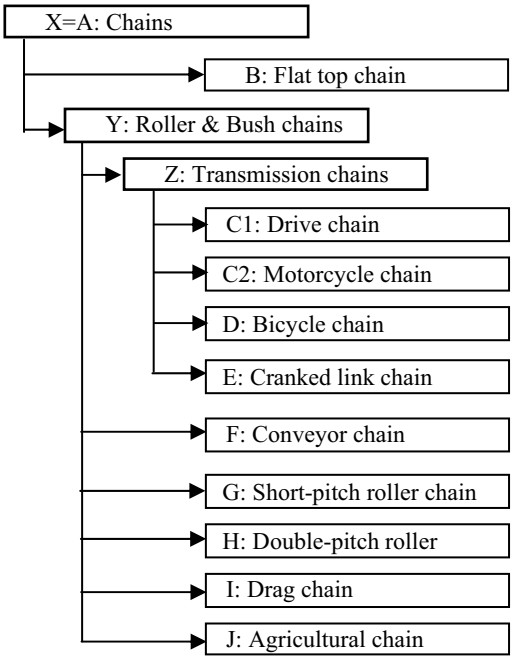

Fig. 1 ISO 13584 conforming hierarchy of chains

4. Compiling process of PLIB dictionary

The rest of the work of compiling a PLIB dictionary of the chains is (i) to assign a BSU (Basic Semantic Unit) code to each family in Fig. 1, each property of Table 2, and each incidence of property to family, and (ii) to construct a physical file on the basis of ISO 10303-21[12] by means of a mapping system developed originally by the authors.

It should be noticed that in the practice of compiling the PLIB dictionaries of fasteners and cutting tools in China and Sweden, respectively, the physical files are directly constructed, where a trmendous amount of complicated operations are involved, and hence only a very limited number of excellent professionals can take part in such construction. Thus, to make the whole compilation process be much easier and applicable widely to other mechanical elements, the present paper attempts to compile a PLIB dictionary of the chains by a much simpler way, as follows.

[Phase 1] On the basis of the hierarchy attained above, all the necessary information of families and properties as well as incidence of properties to families, together with the BSU codes assigned to them, are filled in four Excel Sheets.

[Phase 2] By means of a sophisticated mapping system which was developed originally by the authors, the contents of the Excel sheets are described in terms of the EXPRESS specification defined with the use of the EXPRESS language standardized in ISO 10303-11[13], and then to a STEP physical file format, formally called "Clear Text Encoding of the Exchange Structure" on the basis of ISO 10303-21[12].

4.1 Process of Phase 1

[A] Family Sheet: According to the chain hierarchy of Fig. 1, assign BSU codes to all families of chaines, and then let them be filled in the Family Sheet as shown in Table 4, where it should be remarked that

① the column of PREFNAME.EN contains family names expressed in English, and those in Japanese, Chinese, French, and German are also provided in this sheet, but omitted here due to limited space,

② the column of CODE includes the BSU code of each family, and the BSU code of its parent is filled in column PARENT at the same row, and

③ the column of DRAWING contains drawings of parts with 'jpg' indicating images compressed by JPEG.

Table 4 A part of Family Sheet

PARENT	CODE	HTTP DIR	DRAWING	VERSION	REVISION	PREFNAME.EN
$ROOT$	UOH001			1	1	Chains
UOH001	UOH002		Flat_top.jpg	1	1	Flat top chain
UOH001	UOH003		R_B_chains.jpg	1	1	Roller and Bush chain
UOH003	UOH004			1	1	Transmision chain
UOH004	UOH005		Drive_chain.jpg	1	1	Drive chain
UOH004	UOH006		Motorcycle.jpg	1	1	Motor cycle chain
UOH004	UOH007		Cycle_chain.jpg	1	1	Cycle chain
UOH004	UOH008		Cranked_link.jpg	1	1	Cranked link chain
UOH003	UOH009		Conveyor.jpg	1	1	Conveyer chain
UOH003	UOH010		Short_pitch.jpg	1	1	Short pitch roller chain
UOH003	UOH011		Double_pitch.jpg	1	1	Double pitch roller chain
UOH003	UOH012		Drag_chain.jpg	1	1	Drag chain
UOH003	UOH013		Agricultural.jpg	1	1	Agricultural chain

[B] Property Sheet: The BSU code assigned to each property is filled in Property Sheet, as shown in Table 5, where it should be remarked that

① as is similar to Table 4, the column of PREFNAME.EN contains property names expressed in English, and those in Japanese, Chinese, French, and German are omitted from here due to limited space,

② the column of CODE includes the BSU code of each property, and the code at each row in column FAMILY indicates the BSU code of the family, for which the property at this row is applicable, and

③ the column of FIGURE contains drawings which specify the details of properties.

[3] Property Incidence Sheet: The third Excel sheet, called Property Incidence Sheet, is given by Table 6, which is to indicate the incidence of each property to families, which can be extracted from the inci-dence matrix of Table 3. For example, consider properties 1 through 4 (UOHP001through UOH004) which are used for family X (UOH001), and hence UOHP001 through UOHP 004 are incident to UOH001. Now, consider property 14 (UOHP014) which is used for family Z (UOH004) as well as family H (UOH011). Thus UOHP014 is incident to both UOH004 and UOH011.

[4] Enumerated Value Sheet: The fourth Excel sheet, called Enumerated Value Sheet, is given by Table 7, which is to add to each entry those enumerated values which indicate complementary information indispensable to specifying it accurately.

4.2 Process of Phase 2

First, with the use of the above four Excel sheets, the Component_Class of each family and each property is constructed in accordance with the EXPRESS specification, which is defined with the use of the EXPRESS language standardized in ISO 10303-11[13]. Then the contents of each

Table 5 A part of Property Sheet

FAMILY BSU	CODE	HTTP DIR	FIGURE	VERSION	REVISION	PREFNAME.EN
UOH001	UOHP001			1	1	Chain Number
UOH001	UOHP002		UOHP002.jpg	1	1	Pitch
UOH001	UOHP003		UOHP003.jpg	1	1	Maximum bering pin body diameter
UOH001	UOHP004		UOHP004.jpg	1	1	Maximum width over bering pins
UOH003	UOHP005			1	1	Maximum roller diameter(small)
UOH003	UOHP006			1	1	Minimum width between inner plates
UOH003	UOHP007			1	1	Minimum bush bore
UOH003	UOHP008			1	1	(Maximum width over bering pins)/2 +Maximum additional width for joint fastener
UOH003	UOHP009			1	1	Maximum width over inner link
UOH003	UOHP010			1	1	Minimum width between outer plates
UOH004	UOHP011			1	1	Maximum inner plate depth
UOH004	UOHP012			1	1	Maximum outer or intermediate plate depth
UOH004	UOHP013			1	1	Transverse pitch
UOH004	UOHP014			1	1	Plate width
UOH008	UOHP015			1	1	Minimum cranked link dimension L1
UOH008	UOHP016			1	1	Minimum cranked link dimension L2
UOH001	UOHP017			1	1	Maximum plate depth
UOH003	UOHP018			1	1	Maximum roller diameter(large)
UOH002	UOHP019			1	1	Width over atacchment
UOH007	UOHP020			1	1	Maximum additional width for joint fastener

Table 6 Property Incidence Sheet

FAMILYBSU	PROPERTYBSU
UOH001	UOHP001
UOH001	UOHP002
UOH001	UOHP003
UOH001	UOHP004
UOH003	UOHP005
UOH003	UOHP006
UOH003	UOHP007
UOH003	UOHP008
UOH003	UOHP009
UOH003	UOHP010
UOH004	UOHP011
UOH004	UOHP012
UOH004	UOHP013
UOH003	UOHP014
UOH011	UOHP014
UOH008	UOHP015
UOH008	UOHP016
UOH002	UOHP017
UOH009	UOHP017
UOH011	UOHP017
UOH009	UOHP018
UOH011	UOHP018
UOH002	UOHP019
UOH007	UOHP020

Table 7 Enumerated Value Sheet

PROPERTYBSU
VALUECODE
PREFMEANING.EN
PREFMEANING.JA
PREFMEANING.FR
PREFMEANING.DE
SHORTMEANING.EN
SHORTMEANING.JA
SHORTMEANING.FR
SHORTMEANING.DE
SHORTMEANING.ZH
DEFSOURCE
EOLN

Component_Class are transformed to the so-called STEP physical file format, formally called “Clear Text Encoding of the Exchange Structure” standardized in ISO 10303-21[12].

Fig. 2 shows an outline of a procedure of constructing a Component_Class for each family on the basisi of Family Sheet.

procedure COMPONENT_CLASS CONSTRUCTION FROM FAMILY SHEET
begin
  while there is an unprocessed row in Family Sheet **do**
    for each unprocessed row i **do**
      begin
        denote by K the family having the BSU code at (row i, column CODE)
        define a Component_Class for family K in terms of the EXPRESS specification for families
        insert the other contents of row i into the Component_Class of family K one by one in terms of the EXPRESS specification for families
        denote by J the family having the BSU code at (row i, column PARENT)
        add to the Component_Class of family J the information that family K is a child of family J in terms of the EXPRESS specification for families
      end
end

Fig. 2 Outline of constructing Component_Class from Family Sheet

By applying the similar procedure to Property Sheet, a Component_Class is constructed for each property in terms of the EXPRESS specification for properties. According to Property Incidence Sheet, the links between families and properties are constructed in accordance with the EXPRESS specification. Using Enumerated Value Sheet, enumerated values are added to properties. Due to limited space, these procedures are omitted.

The final step is to transform the data in the EXPRESS specification to the so-called STEP physical file format. This work is executed according to the description rules prescribed in ISO 10303-21[12], which specifies HEADER, DICTIONARY DESCRIPTION, and LIBRALY DESCRIPTION.

In what follows, a part of PLIB dictionary compiled in the STEP physical file format is shown.

```
**********************
  HEADER;
  FILE_DESCRIPTION(('Dedicatedly for Mechanical Element of Chain by UNIVERSITY of HYOGO'),'2;1');
  FILE_NAME('CHAINS_DICTIONARY.P21','2007-12-25',('Cong YAN, Saburo TANATSUGU, Isao SHIRAKAWA and Hiroshi NINOMIYA'),('UNIVERSITY of HYOGO'),'Dictionary Tool 1.0','Dictionary Tool','Laboratory of SHIRAKAWA');
  FILE_SCHEMA(('ISO13584_IEC61360_DICTIONARY_SCHEMA'));
  ENDSEC;

  DATA;
    #1342=DATES('2007-12-25','2007-12-25','2007-12-25');
    #1008=PRESENT_TRANSLATIONS(('en','ja'));
    #1001=GLOBAL_LANGUAGE_ASSIGNMENT('ja');
    #1231=STRING_TYPE('M..64');
    #1006=REAL_MEASURE_TYPE('NR3..3.3ES2',#1005);
    #1005=DIC_UNIT(#1004,$);
    #1004=SI_UNIT(*,.MILLI.,.METRE.);
    #1348=SUPPLIER_BSU('9999/CODE',*);/
    #1347=SUPPLIER_ELEMENT(#1348,$,'001',#1345,#1346);
    #1345=ORGANIZATION('ID','Name','Description');
    #1346=ADDRESS('Internal Location','Street Number','Street','Postal Box','Town','Region','Postal Code','Country','Facsimile','Telephon','email','Telex');

  DICTIONARY
    #1343=CLASS_BSU('UOH001','001',#1348);
    #1344=COMPONENT_CLASS(#1343,#1342,'001',#1341,TEXT(''),$,$,$,$,(#1238,#1229,#1217,#1205),(),$,(),(),$);//
    #1341=ITEM_NAMES(#1340,(),#1338,$,$);
    #1340=TRANSLATED_LABEL(('Chains','\X2\30C130A730FC30F3\X0\'),#1008);
    #1338=TRANSLATED_LABEL(('Chains','\X2\30C130A730FC30F3\X0\'),#1008);
    #1049=PROPERTY_BSU('UOHP017','001',#1343);
    …….
    …….
**********************
```

References

[1] ISO 13584-42 : Technical corrigendum 1, 2003.
[2] ISO13203: Chains, sprockets and accessories - List of equivalent terms, 2005.
[3] ISO4348: Flat-top chains and associated chain wheels for conveyors, 1983.
[4] ISO10190: Motor cycle chains - Characteristics and test methods, 1992.
[5] ISO9633: Bicycles chains - Characteristics and test methods, 2001.
[6] ISO3512: Heavy duty cranked-link transmission chains, 1992.
[7] ISO1977: Conveyor chains, attachments and sprockets, 2006.
[8] ISO606: Short-pitch transmission precision roller and bush chains, and attachments and associated chain sprockets, 2004.
[9] ISO1275: Double-pitch precision roller chains and sprockets for transmission and conveyors, 2006.
[10 ISO6971: Welded steel type cranked link drag chains and chain sprockets, 2002.
[11] ISO487: Steel roller chains, types S and C, attachments and sprockets, 1998.
[12] ISO 10303-21: Clear text encoding of the exchange structure：2002.
[13] ISO 10303-11: The EXPRESS language reference manual, 2004.