TRANSLATION OF PART MARKING CODES IN DIFFERENT SYSTEMS

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Abstract:

Marking of products using defined codes is common practice. Products are designated by producers, traders and consumers. In the case when there is a need for the supply or exchange of products between two different systems, there is a problem of mutual communication. The problem can be solved on a case-by-case basis or systematically, by introducing a new labeling system. Any introduction of new labeling systems is a costly and lengthy process. Thanks to modern software tools, the problem can be overcome in real time, which is an affordable solution, economically and logistically. This paper considers a possibility of the translation of labeling of spare parts in different marking systems.

Key words: *part marking, interoperability, codification.*

Introduction

Marking products and services in accordance with standardized conventions is a requirement for easy and effective communication between manufacturers, traders, companies and organizations. The purpose of product codification systems is to efficiently manage inventory and business processes, define required procurement and contracting, as well as offer the overall logistical support.

When there is a need to identify products or services between two or more different codification systems, there is a problem of finding a fast and efficient response, especially when dealing with a large number of different products. Depending on needs, we can talk about recognizing a class of

related products of the same type or about unique identification of specific products.

For the purpose of maintenance of technical systems, a codification system should respond to the most important customer requirements such as: what are the relations between all parts and the supplies, their components or larger systems to which they are incorporated; whether there is interchangeability of parts; whether there are national or international customers and, if yes, who they are; and where required parts can be purchased.

Specific issues of the maintenance function in the Serbian Army regarding product codification have grown in numbers recently, primarily due to the absence of former manufacturers of various technical systems, due to the inability to procure some products caused by the abandonment of certain technologies, and due to the introduction of small series of a wide range of different imported equipment which requires spare parts for its maintenance. A particular problem in product codification has occurred because of the engagement of our forces in multinational operations when it is necessary to procure spare parts in the local market. In Serbia only, there are different marking systems, so, for example, in the system of the Army of Serbia, the numerical group code for paint is 6820 (out of 12 digits), it is 2420 (out of 8 digits) according to the general vocabulary of public procurement of the Public Procurement Office, and according to the customs regulations it is 3208 (out of 10 digits).

Therefore, the question is: do we really need a new codification system and, if yes, for which existing equipment? We are convinced we do, for products that are active, used not only in the Army of Serbia but also in other armies, and which are completely or partly compatible with other systems. This paper presents an approach to the introduction of interoperability between different codification systems.

Part marking in different systems

When a spare part is needed and cannot be found in the stock, it is necessary to procure it in the market, local or international, or to obtain it from some other storage system which has stocks. Every time it is necessary to describe the part in a manner that clearly defines the required product.

The Serbian Army logistics system uses 12-digit codes for any product description and cataloging, including spare parts. This code is a short description of the product. The attributes connected to the code are:

name, manufacturer, original equipment manufacturer (OEM) code, and others. This code is structured. The first four digits indicate a broader context of the product. This system of marking is suitable only in Serbia. Only few mentioned attributes may be useful for international exchange. When spare part purchases are made, a problem arises: some products cannot be identified, so products are described by technical drawings, schemes, photos, etc. instead of using a simple numerical code.

The fact is that these products are sooner or later fully identified. With a good recording system, databases or simple table records, it is possible to link the national marking system and almost any other "external" one.

Methods of product marking

Codification is a method for product marking by using a well-defined marking structure. It is regulated by rules and conventions. The goal of codification is a precise communication between different subjects (United Nations Standard Products and Services Code, 2001).

Generally speaking, there are identification and classification codes for product marking. An identification code is a unique mark of some product. A classification code marks a group or class of similar products.

Any marking system, numerical or numerical combined with letters, is based on human needs. It should be user-friendly, easy and simple to use on a daily basis in communication by voice or by machines. Research works (Maheut, et al, 2013), based on world-wide experiences, indicate that numerical characters are universal, language independent and the best solution for product marking.

Manufacturers and organizational systems typically use two product marking/labeling schemes. The first one, the "not intelligent" or "non-significant" scheme is such a scheme where a numerical designation does not provide any information about the product. Such labels typically grow in series, within the limits of the available number of characters. In the "intelligent" or "significant" scheme, however, labels provide important information about products. The numerical label contains descriptive and informative details about the product.

Table 1 – Example of product marking
Таблица 1 – Практические примеры маркировки
Табела 1 – Пимер означавања из праксе

Producer/organization	Mark example	Characters	Area
Siemens	49D36098001	11	automation
Siemens	6ES7315-2AH14-0AB0	14	automation
ALLEN-BRADLEY	1747-L532	8	automation
Robert Bosch	0 986 424 797	10	automotive
Mahle	219-1006	7	automotive
SKF	6205-2RSJ	8	industry
SKF	MU 1207-TV	8	industry
Volvo	CH 271092	8	vehicles
KAMAZ	5320-1001171-00	13	vehicles
NATO (NSN)	3139-00-121-6210	13	organization
EAN	3286340244312	13	organization
UNSPSC	20184514	8	organization

The intelligent scheme provides the most important attributes of a particular product and leaves the place for its unique identification. As an illustration, Table 1 gives the examples of product labeling of some manufacturers and organizations.

In practice, codification should serve logistics. Processes such as procurement, warehouse and inventory management, production orders making, work orders making, etc. need to be supported by a codification system. Industry and manufacturers impose their systems of codification to consumers. There is no common marking system or convention. Any implementation of a new marking system is an expensive and time consuming process (Lima, 2011).

However, modern information technologies can overcome these problems and ensure that labeling systems not only coexist, but are interoperable and cooperate in the current environment (Karray, et al, 2009).

Interoperability

As a multi-dimensional concept, interoperability can be viewed from multiple angles. One of the often-cited definitions is: "Interoperability is the ability of two or more systems or elements to exchange information and to

use the information exchanged" (Rezaei, et al, 2014, p.2). The levels of interoperability can be technical, syntactic, semantic and organizational.

Cooperation between two or more labeling systems, if there is such a goal, is possible if information exchange is coordinated regardless of the differences. When a system is able to use the information from some other system or to perform an operation on behalf of another system, this process is called interoperation (Yahia, et al, 2012, pp.443-457).

The marking translator

There is undoubtedly a need for a marking label translator. The paper describes the current non-existence of such a translator and gives a theoretical possibility to solve the problem.

Methods of product labeling are determined by organizations or manufacturers. The first problem of communication is that the existing classification schemes do not have sufficient semantic precision. Another important property of the existing schemes is that they are only valid in a well predefined context (Zdravković, Trajanović, 2009).

A neutral solution is a good starting point for solving the translation problem. If all relevant part attributes are entered into a database owing to PLM (product lifecycle management) systems of producers, then a marking system can be created only as a reference to this data. A new marking system should have 5 to 7 digits, which is enough for inventory. A new mark or index is a link to the existing product data. In maintenance management, tools like CMMS or EAM have modules for inventory control and may be used for parts referencing.

The first step is to decompose marking systems to their basic meaning. We have to understand marking systems for which we want to achieve a translation goal. Also, we should connect semantic meanings of product names in different systems. More importantly, we should find any attribute of marking data common in both systems if it exists. One example is the OEM number.

The second step is to create a system based on knowledge (KBS - knowledge based system), which is able to emulate the work of experts with specific knowledge. The most important KBSs are (Kendal, et al, 2007): expert systems, artificial neuron networks, case based reasoning, genetic algorithms, Data Mining and Intelligent agents. Creating one KBS is an extremely demanding task. A much easier way is to use an already existing solution, for example a specific type of software. With well-defined rules, such a KBS will be able to compare product marking attributes in

different systems. The task of this activity is to identify the same attributes in different systems if they exist.

The third and final step is to propose a convenient way for storing records of the items identified in two or more different systems for later usage.

Concept and model

If it is necessary to harmonize two or more marking systems in short time, it is convenient to apply the "Data mining" technique which implies that the labeling rules are already known. Data mining is (Aghdaiea, et al, 2014, pp.767-776) a term that means study of knowledge by identifying previously unknown relations between data. Data mining is an interdisciplinary field, and combines artificial intelligence, databases, mathematical algorithms and statistics. Technology asks for a new technique for analyzing, understanding and visualization of large amount of data collected in business processes and scientific research (Tsai, 2012, pp.8172-8181). General knowledge about the product is defined first, as illustrated in Figure 1.

A product has two general types of characteristics, physical and descriptive ones. The physical properties are the form, the function and the ability to connect with a higher level, e.g. a bearing with a shaft. The descriptive characteristics are called attributes and they include the marking number, the name, the OEM mark, etc. In this way, the product is fully described. A very important thing for further development of the concept is a precise definition of the meaning of attributes.

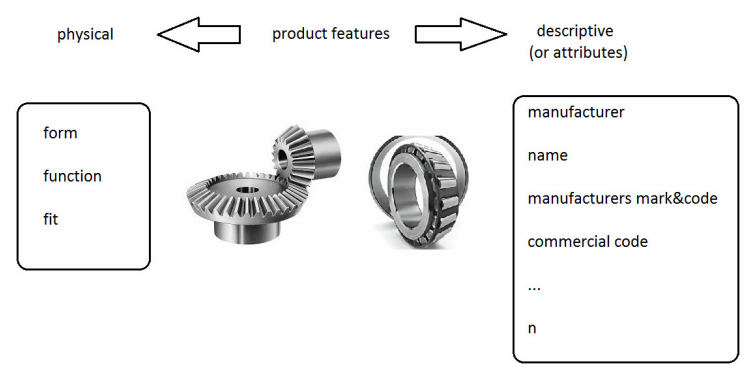

Figure 1 – Product characteristics
Рис. 1 – Характеристики продукции
Слика 1 – Особине производа

Also, it is assumed that the majority of attributes in the product label are created by the manufacturer (name, factory code, additional special mark, name of manufacturer, etc.), which is illustrated in Figure 2.

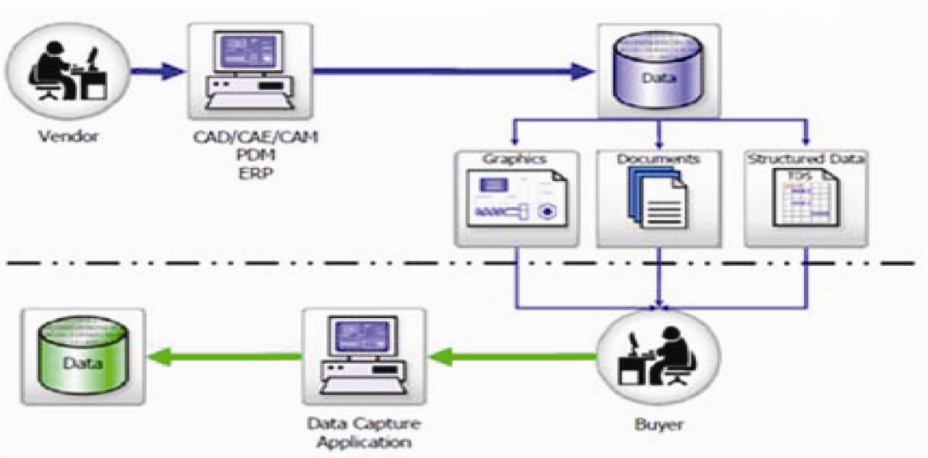

Figure 2 – Information about the product, (Benson, 2009)
Рис. 2 – База данных о продукции (Benson, 2009)
Слика 2 – База информација о производу (Benson, 2009)

The marking translator, modeled in the RapidMiner software package, is composed of dictionaries (one for every marking system), digit codes related to any word (name as word is one of the marking attributes), and tables which have a number of attributes for a number of products. These tables are different in marking systems. The mentioned tables are now a subject of analysis. We are looking for the same attributes in two or more marking systems. The goal is to find a proper value pair between the marking systems. The term 'proper' in this sense is a synonym for the attribute. If there is the same value of an attribute, the model will be efficiently and quickly discovered. The model can detect a unique matching or matching of groups or classes. A group/class implies similar products, e.g. rifles. Figure 3 is an illustration of the concept. English and Serbian terms are combined. The concept comprises the knowledge about the structure and the form of marking in two different labeling schemes.

Also, the method for temporary or permanent recording is defined.

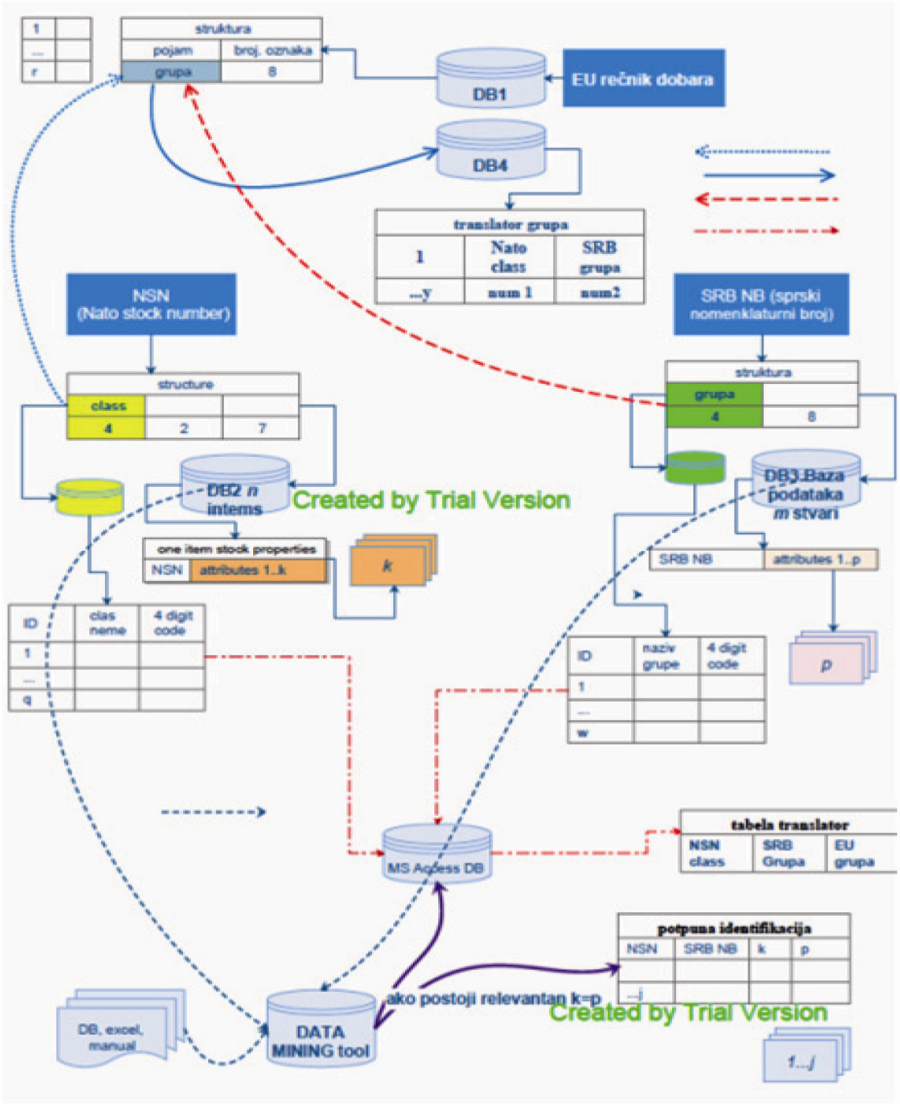

Figure 3 – The concept of the translator
Рис. 3 – Концепт транслятора
Слика 3 – Концепт транслатора

A simplified model of the translator is shown in Figure 4. Using the program for Data Mining, in this case RapidMiner®, the user defines which tables are initial for the analysis (collections of spare parts, each with its own attributes), defines the operators subjected to them as illustrated in

Figure 4, and searches for common characteristics i.e. the "Property-value" pair, or for the same attribute. If it is found, the solution is a new table that contains all products that have at least one common attribute. The same partial result is shown in Figure 5.

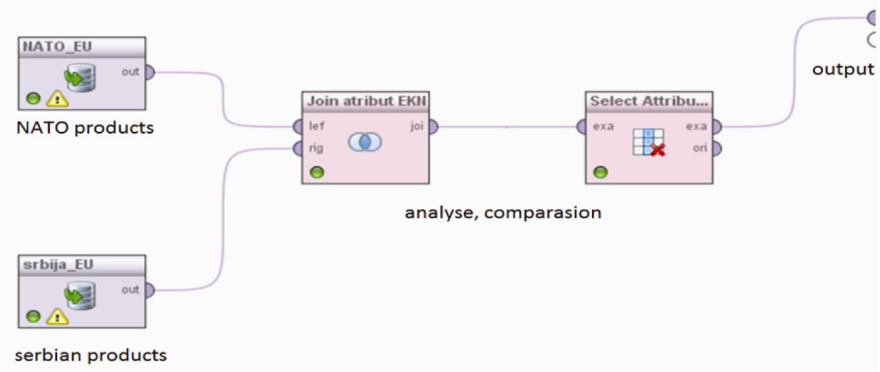

Figure 4 – Data analysis, finding commom features
Рис. 4 – Процесс анализа, поиск общего признака
Слика 4 – Процес анализе, тражења заједничког атрибута

Nato class	nato name	srbija vrsta	Srbija naziv
1005	Guns, through 30mm	1011	puške
1045	Launchers, Torpedo and Depth Charge	1055	lanseri i katapulti
1305	Ammunition, through 30mm	1305	municija za automate
1305	Ammunition, through 30mm	1307	municija za puške
1305	Ammunition, through 30mm	1305	municija za automate
1305	Ammunition, through 30mm	1307	municija za puške
1330	Grenades	1345	ručne bombe
1390	Fuzes	1356	upaljači
1560	Airframe Structural Components	1501	zmaj aviona
1540	Gliders	1526	jedrilice
1620	Aircraft Landing Gear Components	1610	stajni trap i kočnic
1620	Aircraft Landing Gear Components	1610	stajni trap i kočnic
1630	Aircraft Wheel and Brake Systems	1610	stajni trap i kočnic
1630	Aircraft Wheel and Brake Systems	1610	stajni trap i kočnic
2310	Passenger Motor Vehicles	2312	putnički automobili
2320	Trucks and Truck Tractors, Wheeled	2325	automobili teretni
2330	Trailers	2338	tegljači
2610	Tires and Tubes, Pneumatic, Except Aircraft	6605	gume za točkove
2815	Diesel Engines and Components	2815	motori dizel
2815	Diesel Engines and Components	2910	uređaji za napajanj
2815	Diesel Engines and Components	2920	električni uređaj
2910	Engine Fuel System Components,	2815	motori dizel
2910	Engine Fuel System Components,	2910	uređaji za napajanj
2910	Engine Fuel System Components,	2920	električni uređaj
2920	Engine Electrical System Components,	2815	motori dizel
2920	Engine Electrical System Components,	2910	uređaji za napajanj
2920	Engine Electrical System Components,	2920	električni uređaj
3110	Bearings, Antifriction, Unmounted	3105	ležaji kuglični

Figure 5 – Resulting table
Рис. 5 – Результаты
Слика 5 – Резултат

The RapidMiner Program can store the results of the analysis in the form of tables (Excel) or enter them into the table of leading databases.

Conclusion

Product marking or labeling systems co-exist with industrial production. They are created by producers for their internal purposes or for the market. On the other hand, organizations such as the military, military alliances and others have specific marking systems. The UN and the EU have developed their own systems. Today there is no "global" standard in the field of unification although there are efforts in this field such as the development of ISO 22745 Standard, the "eClassOWL" Project - The Web Ontology for Products and Services and the “ECCMA" Project - Electronic Commerce Code Management Association.

The problem is solved by dominant systems imposing their own marking systems. This is generally not a problem because they are based on good scientific and economic bases. Independent marking systems are in dilemma whether to migrate to new systems completely or to keep the current system and use it together with a new one. The transition to a new system is expensive and time-consuming.

However, logistics, i.e. providing parts in this case, has immediate and short-term needs and has no time for a complete harmonization of marking systems or a prolonged transition to a new marking system. In such cases, it is useful to have a model for defining relations between related groups of products between different marking systems. As this is not a definitive answer to the need for unambiguous identification of products between two or more systems, a solution for such cases is provided. The true value of this concept is not to repeat the identification procedures when procuring parts, but to do it once and permanently store the results. The process of translation can be repeated several times if necessary, and the bigger "input" bases-tables are, the more economical the process is.

In the end, if it is necessary to recommend the tool for this purpose, i.e. to choose between data mining or databases, the choice would be the first one. The recommendation is obvious because of its ease of use and the ability to create input for a real database.

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ТРАНСЛЯЦИЯ МАРКИРОВКИ ПРОДУКЦИИ В РАЗЛИЧНЫХ СИСТЕМАХ ОБОЗНАЧЕНИЯ

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Резюме:

Обозначение продукции определенными кодами является общепринятой практикой. Однако, так как продукцию обозначает не только производитель, но и продавцы и пользователи, представляющие различные системы, их обозначения могут отличаться. Различные обозначения продукции в рамках разных систем приводят к недопониманию при закупках или товарообмене. Данную проблему можно решать от случая к случаю, либо систематически, вводя новую систему обозначения. Каждое введение новой системы обозначения является длительным процессом, который к тому же дорого обходится. Благодаря современным программам обеспечения такую проблему можно решать в реальном времени, что с логистического и экономического аспекта является самым оптимальным решением. В данной работе представлены возможности трансляции маркировки запасных частей в различных системах обозначения.

Ключевые слова: *обозначение деталей, интероперабельность, кодификация.*

ТРАНСЛАЦИЈА ОЗНАКА ПРОИЗВОДА У РАЗЛИЧИТИМА СИСТЕМИМА ОЗНАЧАВАЊА

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Сажетак:

Означавање производа помоћу дефинисаних кодова је устаљена пракса. Производе означавају сами произвођачи, трговци и корисници. Када се јави потреба за набавкама или разменом производа између два различита система настаје проблем међусобног споразумевања, који се може решавати од случаја до случаја или систематски, увођењем у праксу новог система означавања. Свако увођење тог система је скуп и дуготрајан процес. Захваљујући савременим софтверским алатима проблем се може превазилазити у реалном времену, што је и економски и логистички повољно решење. У овом раду разматрају се могућности транслације означавања резервних делова у различитим системима означавања.

Кључне речи: *означавање делова, интероперабилност, кодификација.*

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