A COMPUTER DATABASE SYSTEM SUPPORTING THE MANAGEMENT OF PUBLIC TENDERS

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Abstract: In the paper we lay out a novel computer database system called *SzukajCPV,* which supports the management of public tenders. We state the purpose and the design principles of the system. We describe the employed software tools. We present the structure of our database and the functionality of the application built to use it. Finally we describe tests carried out on the *SzukajCPV* system to determine its usefulness in a practical setting.

Keywords: databases, information technologies, public tenders, CPV.

1. Introduction

Proper and efficient operation of manufacturing enterprises is more and more dependent on the selection of appropriate management support systems. There are variety production activities. In many cases a production enterprise needs to get new orders to continue their business. For this reason, some companies are forced to operate in the public procurement sector.

Every country utilizes some means of public procurement for the purpose of obtaining goods and services necessary for the functioning of national and local authorities as well as other public entities. The process involves the adherence to certain procedures, set out by the Public Procurement Act (Polish: Ustawa – Prawo zamówień publicznych – PZP) approved on 29 January 2004. It is complex and time-consuming and the obligation to carry it out rests on the procurer.

An accurate description of what is being ordered prevents the waste of time associated with providing additional explanations or the consideration of protests. For this reason the description has to include names and codes outlined in the *Common Procurement Vocabulary*, or CPV [1]. CPV is a kind of a taxonomy, where every kind of goods or services is associated with a special nine-digit code. The taxonomy includes divisions, groups, classes and categories. The procurer has to identify the most possibly detailed code which describes the order well [2]. The official list of codes is contained in the commission regulation (EC) No. 213/2008 of 28 November 2007.

The vocabulary is useful for production enterprises looking for orders. Because the main dictionary currently consists of about 9500 names for goods, works and services universally used in procurement, locating the right one can be tedious. This can be sped up by using software providing the right code. There are two kinds of systems existing on the market: simple CPV look-up applications based only on the official classification and dedicated systems for managing tenders (e.g. *ProPublico*), which, in an enterprise setting, require deployment and appropriate user skills. Therefore there exists a need for simple and functional applications, which do not have a large financial or time investment, but which will nonetheless provide appropriate tools for the management of public tenders. The computer program *SzukajCPV* described in this paper is such an application.

The application is useful not just for the procuring entities but also for small and medium production enterprises, for which the knowledge of the makeup of the CPV code opens up the procurement market of the whole European Union. Knowing the CPV code of a given service or product, the user can use the Tenders Electronic Daily, containing tenders published in the Official Journal of the EU to find open tenders and join them.

The *SzukajCPV* software is a system that assists entities performing public utility activity, like companies providing public services in the power generation and the water extraction sectors. The system gives them support in the management of public tenders, including the effective preparation of tenders. What is more it assists small and medium production enterprises in the effective exploration of these offers.

2. The purpose and design principles of the SzukajCPV system

The *SzukajCPV* application was built in such a way as to make it simple and intuitive to use and to make its deployment in a company setting. In particular our application supports quick searches for the CPV code.

It offers two ways of conducting the search:

- the user can find the right code by navigating the code tree, which represents subsequent levels of the hierarchy,
- the user can also find the code by typing in the name of some part of the order.

In the database designed for our application it is possible to add names provided by the user and associate the appropriate codes with them. This way regular use of the database leads to enriching the database with additional descriptions of CPV codes for the delivered goods and services. In addition, one can create and print out a specification of the order, which includes all important aspects of the order.

In order to secure the data stored in the system, some application settings are only available for the administrator, whose most important task is the management of the additional dictionary of the CPV codes containing delivered products and services. The administrator decides whether the code descriptions entered into the application are correct and should be included in the search. In our manual, we describe the design of our system, in a way which allows for its further enhancement.

The following fundamental design choices were made for *SzukajCPV*:

- the application is to be implemented in a windowing system,
- the application uses the *InterBase* database system available for the Microsoft Windows, Solaris and Linux environments, which has modest system requirements and limited consumption of the operating system resources,
- full access to the application is only possible for administrators after the provision of a username and password,
- the creation of the additional CPV code database occurs in the background without user input, which improves later searches,
- the provision of a specification of the order, which includes basic information such as the name and address of the procurer, the mode of procurement, the description of the order and the delivery deadline.

3. Software tools employed to carry out the task

DBDesigner 4 was used for the visual design of the database. It provides a graphic representation for tables, fields, indexes and relations in the database. DBDesigner 4 allows

the user to generate SQL scripts (SQL is the language used for database queries), which are then used to build the application.

To create a physical data model, we used the *Interbase* relational database management system, which uses a client-server architecture. The *Interbase* system is integrated into the development environments developed by Borland (now the owner of this product is Embarcadero Technologies). *Interbase* implements SQL syntax according to SQL92[3]. *InterBase* is very well suited for applications that support multiple users. Easy installation, high efficiency, low hardware requirements and event alerting mechanisms contribute to the reduction of costs related to the implementation, maintenance and management of the database in this environment.

The tool which was used to build our application is *Borland Developer Studio 2006* (BDS). Like Interbase, it is now owned by Embarcadero Technologies. BDS is actually a package of four powerful programming tools. It contains the environments: Delphi for Win32, Delphi .NET, C# Builder and C++ Builder, which can be run separately or used together. To accomplish the task we used the Delphi environment.

Delphi is a continuation of Turbo Pascal adapted to the Windows environment and uses a programming language known as Object Pascal. Delphi is a Rapid Application Development, or RAD-type tool, i.e. it is meant to be used for building applications quickly. The system automatically generates a window form containing the interface of the application being build, into which the programmer puts objects (labels, edit boxes, buttons) using VCL (Visual Component Library) [4]. The designer then builds the application by programming events for the selected components of the form.

The *Rave Reports* reporting system was used to create the document containing order specifications. It allows for attaching the reports to executables. With *Rave Reports* objects and the corresponding interface components in Delphi, one can create reports for viewing or printing directly in the Delphi environment, without running additional programs.

4. The Database used by SzukajCPV

The database used by our system is designed in such a way as to cover the basic functionality of the application, i.e. searching for the most detailed CPV code for what is being ordered.

We show the entity diagram designed for the *SzukajCPV* application in figure 1. Our database model consists of 15 tables and the corresponding relations. There are three logical groups in the figure.

- The general specification of pertinent terms of the order.
- The structure of CPV codes.
- Additional description of CPV codes.

The makeup of CPV codes shaped the design of the group “The structure of CPV codes”, which consists of 5 tables connected to one another using one-to-many relations, thus reflecting the hierarchy of CPV codes. In addition, this leads to data consistency and partial validation of the entered data.

As in the structure of CPV codes, the root of the tree is the table *CPV_dzial* consisting of the two fields: *Id_dzial* and *Opis*. The field *Id_dzial* contains two first digits of the CPV code and is simultaneously the main key of the table. Then we have a branch from the root to the table *CPV_grupa*. This table inherits the field *Id_dzial,* which becomes its foreign key and simultaneously is a part of its main key (the other part is the field *Id_grupa*). Similarly, the table *CPV_klasa* inherits the fields of the table *CPV_grupa*, and its main key

consists of three fields. The last table in this hierarchy is the table *CPV_podkategorie,* in which the main key consists of six fields, the combination of which identifies the full CPV code for a given product. Thanks to this implementation of the code hierarchy the application can search very fast.

The group "Additional description" was introduced to enable the application to save additional descriptions of CPV codes, provided by the users. It consists of additional tables subordinate to the corresponding tables from the group „The structure of CPV code", which contain additional fields *Opis* and *Poprawnosc.*

The third group is „General Specification". It contains the tables *Zamawiajacy*, *Tryby*, *Zamowienia* and *Specyfikacja_zamowienia.* These tables contain general information concerning the particular public procurement. The most important one of them is the table *Specyfikacja_zamowienia*, which contains information about the codes used in the order. This enables the user to look up the orders which used a particular code in the past while he is working on the specification of his order.

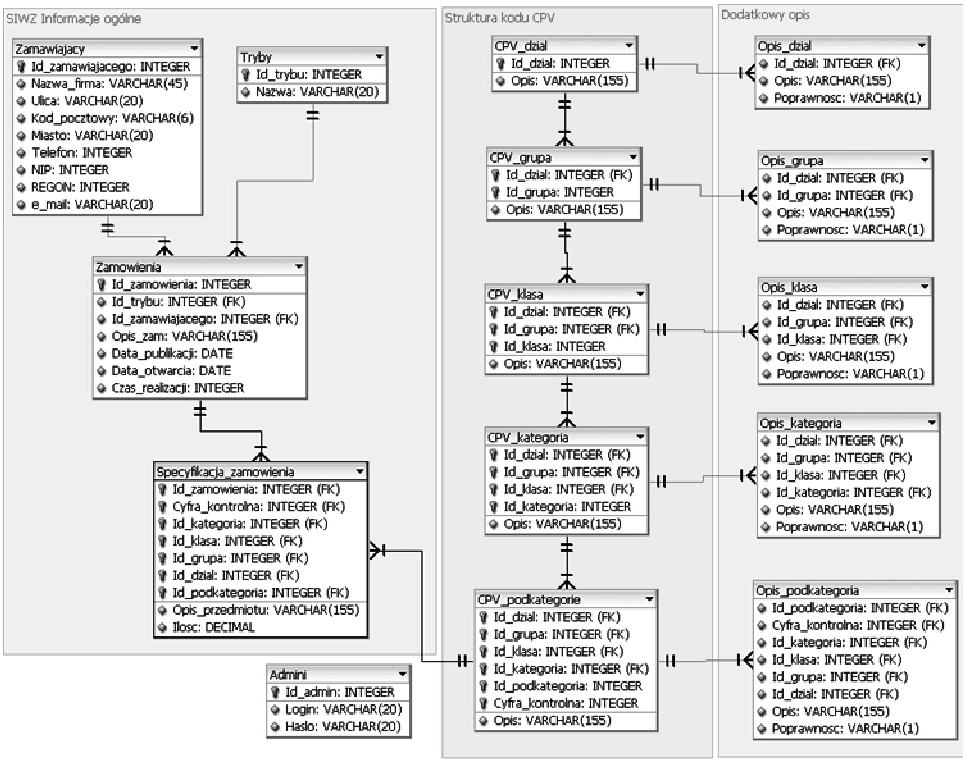

Fig.1. The entity relation graph for the application *SzukajCPV*. Source: own research.

To allow for the management of the application, we also added the table *Admini*, which contains data about administrator passwords. In order to fully use all features of the application, one needs to specify them on log-in.

We defined the appropriate perspectives, generators, triggers and stored procedures in the database of the *SzukajCPV* system, which meaningfully support the functioning of the application.

When creating the database for the *SzukajCPV* application, we used SQL scripts generated by the *DBDesigner 4* software, which allowed us to easily create the database structure in *InterBase*.

5. Application Setup

In order for the system to work properly, one has to have the Windows XP SP3/Vista/7 operating system as well an installed copy of *InterBase*. When these requirements are met one has to launch the *IBConsole* tool of the *InterBase* system. One should then add a local server by clicking on the *InterBase Servers* node and then log into it by giving the username *SYSDBA* and the password *masterkey,* which is shown in figure 2.

The *SzukajCPV* application does not need to be installed in the operating system. One only needs to have the exe file in the same directory as the files with the required libraries, as shown in picture 3. In order to start the application, one has to launch the exe file.

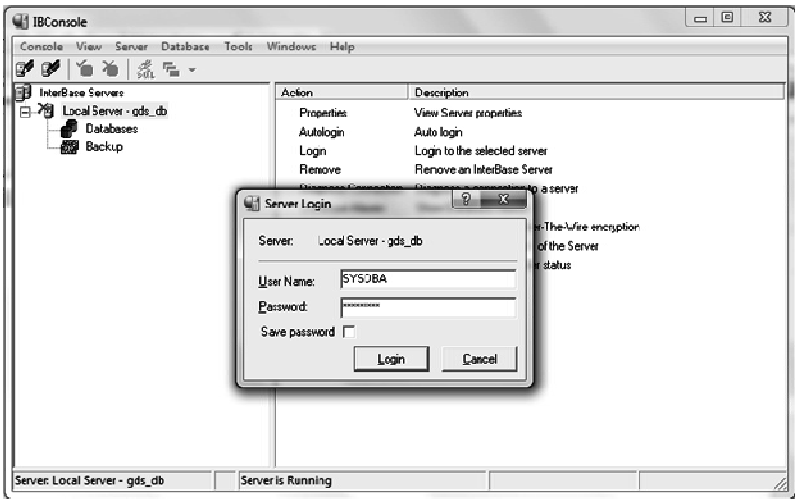

Fig.2. Log-in to the *InterBase* server. Source: own research.

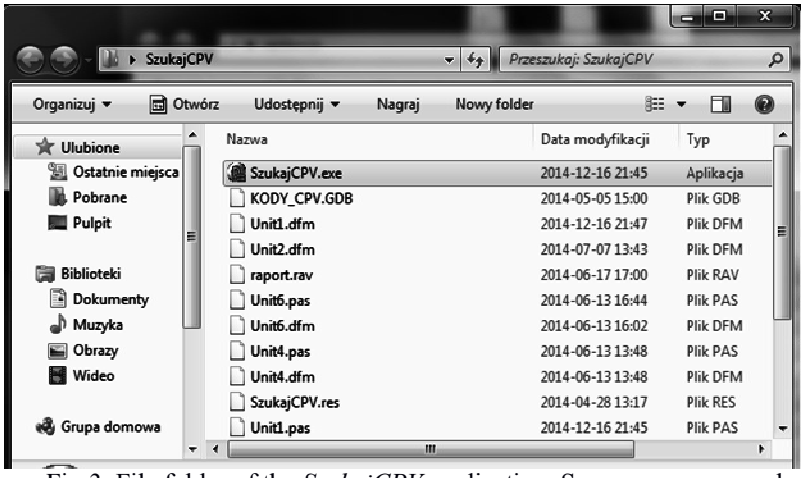

Fig.3. File folder of the *SzukajCPV* application. Source: own research.

6. Main application window

On startup, the application displays the main window shown in figure 4. The main pane contains three buttons corresponding to the three main features of the program. In the upper part of the window, one sees the main menu, which contains all the available features. In the lower part, there is the *StatusBar,* which is used to display messages to the user.

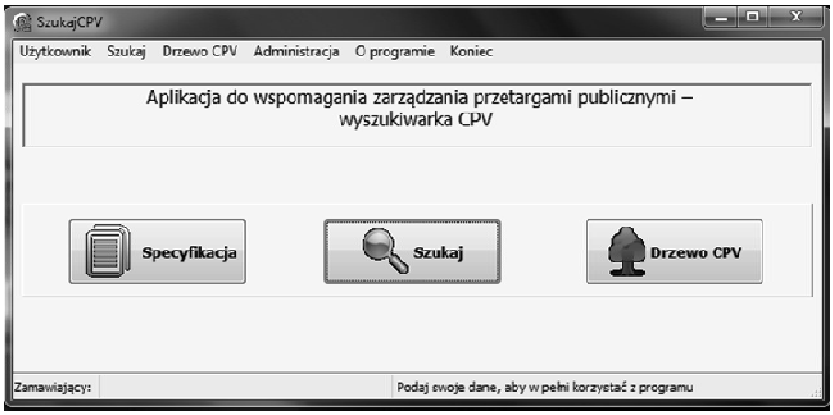

Fig.4. Main window of the *SzukajCPV* application. Source: own research.

6.1. The specification feature

Before using this feature one has to select the *Użytkownik* entry from the main menu and give data on the procurer and the order. This will make the specification feature (Polish: *Specyfikacja*) enabled. This feature allows the user to navigate the specification of the order being created and to delete individual entries. Another important feature is the capability to print the specification. On selecting the print command (Polish: *Drukuj)* one is presented with a document (made using *Rave Reports*) ready for printing.

6.2. The search feature

By using the Search feature (Polish: *Szukaj*), the user has the option to do the following.

- Find the description of a CPV code
- Locate a CPV code among the codes in the official list
- Locate a CPV code among the ones priorly used by the application for goods and services already delivered.

The search was implemented by exploiting the hierarchical structure of the CPV code. A CPV code lookup begins by searching the subcategories, which correspond to the codes which are the most detailed and the narrowest in scope and which should be used in the order description. If no code is found, the next step is to search among the categories, which correspond to less detailed codes. This is repeated analogously for classes, groups and divisions. The CPV codes representing divisions and groups should not be used to specify the order, because they are too general, but searching for such codes may still be useful by enabling the user to change his search query and thus obtain a better CPV code.

On selecting the search (Polish: *Szukaj*) feature, one sees the window seen in figure 5. In the edit box one has to input the search query, which should describe the order. On

accepting, one sees the search results window, which can be copied or added to the order specification. If the search query (consisting of several words) is not found, the application will search for descriptions containing just one of the words in the query, thus returning entries with similar meanings.

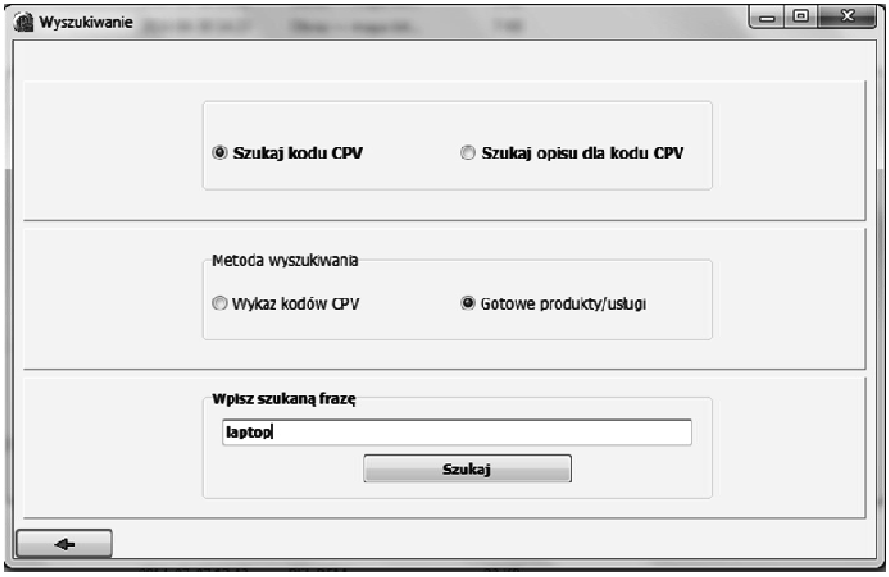

Fig. 5. Search window of the *SzukajCPV* application. Source: own research.

Moreover, the application saves the text input by the user during search, which enables it to produce an additional database containing descriptions of the CPV codes. This is done when one uses the copy-to-clipboard command (Polish: *Kopiuj do schowka*) or the add-to-specification command (Polish: *Dodaj do specyfikacji)*, which are available in the search results window.

6.3. The CPV tree feature

The CPV tree (Polish: *Drzewo CPV*) allows the user to find a code by defining the successive levels of its classification, which is shown in figure 6. The user selects a sequence of terms fitting his order from a drop-down list. When the user provides the successive elements of the specification, the choice for other options is narrowed down; for example, choosing the division limits the choice of groups and so on. When everything is filled in, one is presented with the option to show the code (Polish: *Pokaż kod*), which displays the looked-up CPV code and allows the user to copy it or add it to the order's specification. The CPV tree (Polish: *Drzewo CPV*) can be time-consuming, but it offers the best precision in selecting the code.

Fig. 6. Sequential search window of the *SzukajCPV* application. Source: own research.

7. Features for the application administrator

The system administrator has privileges to edit, add or delete all information on public procurement together with its full specification. The administrator mode (Polish: *Administracja*), found in the main menu, is available after providing the administrator login and password. On correct log-in one is presented with a window with six tabs, each dealing with one task.

The tab containing additional description of the CPV codes (Polish: *Dodatkowy opis dla kodów CPV*) concerns a dictionary of additional terms for CPV codes, which is an enrichment of the tables containing the structure of the CPV code (Polish: „Struktura kodu CPV"). The administrator can browse all descriptions saved by the application and compare them with the official description of the code and change their status to `correct', which means they become available for search. The form has features for editing, adding and deleting additional descriptions.

The other tabs: *CPV codes, Procurer, Orders, Order specification* and *Account* allow the user to modify the data in every way.

8. Tests for our system

In order to test the application one was presented with the following problem. The Kielce Technological Park (Kielecki Park Technologiczny) seeks to procure equipment as a part of the official program „Expanding the IT Infrastructure of the Kielce Technological Park" as listed below.

- 50 laptops,
- 50 sets of software with licences permitting rental,
- 50 pieces of anti-virus software,
- 5 routers.

The procurer is obliged to give appropriate CPV codes specifying the order as early as on creating the procurement solicitation piece. For this purpose, he can use the application. On launching it, the user has to give data on the procurer and the order in order to create a preview of the specification created by the user.

The first search is a laptop computer. The user can quickly search the delivered orders. On inputting the query "laptop", the system returns no hits. The user therefore has to change the search criteria. This time he enters "computers" (Polish: *komputery*) and looks in the official code directory. He obtains six results containing the search terms, among them "personal computer". On selecting the "information" feature (Polish: *Informacje*), the user learns that, that the appropriate CPV code nesting level for a portable computer is the category and sees a selection of tenders in which this code was used. Thus the user can be certain that the code is right and add it to the specification. He is then asked to describe the ordered goods, where he inputs "laptop" and the quantity, where he inputs "50 pcs". The user searches for codes for other goods in a similar fashion. His results are shown in table 1.

Tab.1. Order descriptions input by the user.

CPV code	Code description	Description of the Ordered Goods
30213100-6	Portable Computers	Laptop
48620000-0	Operating Systems	Microsoft Windows 8.1 Operating System
48761000-0	Anti-virus software suites	Anti-virus software
32413100-2	Network routers	Router

The user found the appropriate codes and is certain that they are correct thanks to additional information. In addition, he can print out the order specification and close the application.

The user is not aware that he contributed to extending the database containing delivered goods and services and has thus improved the workflow of other users. An important role is played by the system administrator, who should manage the application regularly. In the administrator's panel he can accept the correctness of additional descriptions saved by the application in one click.

One can assume that the administrator accepted all descriptions added by the user in the described example. Thanks to this, the next quick search among delivered goods will return the pertinent code for the search query "laptop", which is the code for *portable computers*. Similarly, one will find the code for *operating systems* when searching for "Windows" and so on.

What is more, the application can be used by a production and trading company seeking to obtain orders from the public sector. By using the *Search* and *Tree* features of the *SzukajCPV* program, the user can find the codes appropriately describing his business and get to know their structure.

Other features of the administrator's panel and namely editing, adding and deleting any pieces of data concerning orders, specifications and procurers were also successfully tested. The tests have shown no problems and all data input during tests was saved in the database.

9. Concluding remarks

The system *SzukajCPV* was designed for entities organizing a public tender and obligated to apply the Public Procurement Act. The application supports the management of public tenders, in particular it speeds up the process of finding the right CPV codes specifying the order. The system can also be of use for production enterprises, which want to apply for such orders, because they can easily join a tender by knowing the right CPV codes. Minimal deployment costs, broad functionality, a simple and user-friendly user interface and modest system requirements make this application competitive among the solutions available on the market.

A major feature of the application is the capability to enrich the database containing CPV codes, which contains delivered goods and services. When the application is used often, it builds up its database, which makes the process of finding the right code less time-consuming thus facilitating easy preparation of order specifications.

The application has a number of built-in safety features, which protect the inexperienced user from making mistakes. Full access is only granted to the administrator, who has appropriate skills and experience.

The tests demonstrated that the application works. It is always possible to add additional functionality. To summarize, the application meets the requirements it was designed for and is moreover a practical and expandable system.

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