

Modeling of the Information System for Processing of a Large Distilled Data for the Investigation of Competitiveness of Enterprises

Nataliya Boyko^[0000-0002-6962-9363], Lesia Mochurad^[0000-0002-4957-1512],

Iryna Stetsiv^[0000-0003-4982-1355], Yurko Kryvenchuk^[0000-0002-2504-5833]

Lviv Polytechnic National University, Lviv79013, Ukraine
nataliya.i.boyko@lpnu.ua, lesia.i.mochurad@lpnu.ua,
irina.s.stetsiv@lpnu.ua, yurkokryvenchuk@gmail.com

Abstract. The technology of data analysis is offered for finding competitiveness of the enterprises. To determine the competitiveness of enterprises, a methodology based on the theory of effective competition is used. This method is proposed by economists Joseph Schumpeter and Friedrich Hayek and is one of the most widely used methods. According to this theory, the most competitive enterprises are those, where there is the best organized work of all units and services as a system. An example of using the Microsoft Excel Power Pivot technology to download large volumes of data, their processing and analysis of unstructured information and its organization into an ordered database is given. Examples of methods for working with non-structured data arrays are given. Scientific directions for the analysis of cumbersome data are determined. The principles of work of unstructured data in distributed information systems are formulated. The work of the Microsoft Office Excel spreadsheet process is presented to achieve goals. Its properties and highlights of advantages and disadvantages of finding and comparing the competitiveness of enterprises were analyzed. An analysis of the ease of connection to the database, the data transfer from the model, the formation of tables, conducting complex data calculations, updating information in tables, grouping data and outputting totals is made.

The experiments conducted have proven the feasibility of using the Microsoft Office Excel spreadsheet to process large volumes of data presented in text files, modeling and grouping data with poor quality information representation. This work analyzes the data structure in order to determine the state of the enterprises in the Ukrainian export market and develop algorithms for the research of competitiveness. Further research may consist in the widespread use of information systems that would provide an easy-to-understand and effective set of technologies to determine the company's competitiveness and make recommendations for its improvement.

Keywords: system, technology, information, technique, database, competitiveness, OLAP-cube, modeling, processing, analysis.

Copyright © 2020 for this paper by its authors.
Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

1 Introduction

In recent years, the promising area of scientific research is the application of IT in various fields: economics, management, education, medicine, etc. To date, most of the novelties in the field of information technology are used to solve managerial problems. Information technologies are being improved in the following key areas: a significant increase in the efficiency of technology; simplification access and expanding the potential of software tools and widespread use of "open technologies"; creating a user friendly interface; significant improvement in the quality and function of information technology and the reduction of their value [1-3].

For example, the use of spreadsheets is particularly useful in financial control of enterprises, as well as in analysing of their work. In order for the company to grow up, it is necessary to watch after its position on the world stage. For this, it is necessary to regularly evaluate its competitiveness. By doing this, the owner of the enterprise has the opportunity to assess the strengths and weaknesses of the enterprise, to identify its hidden potential and, accordingly, to maximize its working strategy [7-9]. Only the company with the competitive advantage in a certain place, at a certain time, as well as the ability to obtain and maintain this advantage can compete in the market. Consequently, the competitiveness of enterprises is a process where each market participant, striving to realize its goals, tries to represent more advantageous than other offers of prices, quality or other features that affect the process of entering into a transaction; the ability to increase the company's internal efficiency of functioning through the strengthening and improvement of the market position; the ability to design, manufacture and sell goods whose prices, quality and other features are more attractive than the corresponding features of goods offered to consumers. For this analysis, Microsoft Excel spreadsheet is suited for a convenient and understandable graphical user interface. Thus, the process of constructing an OLAP - cube for the study of the competitiveness of the enterprise through Microsoft Excel 2013 is the subject of this study [12-15].

The subject of the study is methods and tools for downloading, transmitting, modeling and processing data in Microsoft Excel 2013.

The purpose of the work is to investigate the feasibility of using Microsoft Excel 2013 to build an OLAP cube, to determine the competitiveness of the enterprise.

2 Setting the Task

The research objective is to provide IT the development of the Microsoft Office Excel 2013 table processor information system for processing large volumes of unstructured data to examine the competitiveness of enterprises. To achieve this, the following tasks must be solved [10-12]:

- look through the methods and principles for working with cumbersome data in the Microsoft Office Excel 2013 table processor;
- take a look at the capabilities of the Microsoft Office Excel Power Pivot add-in for analyzing and modeling data that is presented in text files;

- become familiar with the concept of OLAP - cube in the Excel 2007 spreadsheet;
- analyze TEC technology to determine the competitiveness of the enterprise;
- make a summary analysis of the efficiency of using the Microsoft Office Excel 2013 table processor;
- sum up the comparative competitiveness of the enterprise data.

3 Review of the Literature

Today, information systems are widely evolving in different areas and simplify their lives. One of the examples is the economics, an integral part of which is the new technology that helps to improve and accelerate its development. The work of foreign scientists [1-2] will help you choose the environment to create OLAP - cube that will help you calculate the necessary data. As the chosen theme was based on the research of the competitiveness of enterprises, the following works help to get acquainted with this subject [3-6]. In these works, attention is focused on the competitiveness of enterprises in general and individual factors also. After all, each stage of production and export of products plays an important role in assessing the competitiveness. Using such electronic resources [7-9], you can familiarize yourself with creating an OLAP - cube using Microsoft Office Excel tools. These articles describe the sequence of creation and execution.

After analyzing it was found that there is no single specific and common methodology and technology for calculating the competitiveness of enterprises. Therefore, working with a detailed description of the development of OLAP - cube for determining the competitiveness of enterprises is relevant [11, 14].

4 Methods of Solving

Probably everyone who connects their field of activities with computers knows what databases are. But unlike the usual relational DBMS, the concept of OLAP is not so well known. So let's dash what it represents On-Line Analytical Processing. This is a technology for operational and analytical (online) data processing. The basic principle of OLAP is the multidimensional representation of the data. Some measurements are made highlighting the factors that influence the activity of the multidimensional model, and receive a hypercube, which is filled with performance indicators. Data can be real or predicted based on data accumulated over time. Indicators can be collected from different sources, cleared, merged and compiled into a relational repository. Moreover, they are available for analysis.

In 1993, E.F. Codd have formulated OLAP criteria. He identified 12 rules that the OLAP class software product should meet [12]:

1. Multidimensional Conceptual View (Multi-Dimensional Conceptual View). Analysts should be able to perform such operations as "longitudinal and longitudinal analysis", rotation and placement of data.
2. Transparency

3. Accessibility. OLAP must perform all the transformations that are necessary to provide a holistic view of the user to the information.
4. Sustainable Performance (Consistent Reporting Performance).
5. Client-server architecture (Client-Server Architecture).
6. Generic Dimensionality. Baza data structure, report formats should not be based on one dimension.
7. Dynamic Sparse Matrix Handling (Dynamic Sparse Matrix Handling).
8. Multi-User Support.
9. Unrestricted Cross-Dimensional Operations. Work with data from any number of measurements can not be prohibited.
10. Intuitive Data Manipulation. Manipulations inherent in the structure of the hierarchy must be executed in a convenient interface.
11. Flexible Reporting (Flexible Reporting).
12. An unlimited number of measurements and levels of aggregation (Ed Dimensions and Aggregation Levels).

Subsequently, these requirements were transformed into the FASMI test. This test also defines the requirements for OLAP products. The decipherment of this abbreviation is [5]:

- Fast. On average, access to data should take about 5 seconds.
- Analysis. The user should be given the opportunity to perform a static and numerical analysis.
- Shared (Access is divided). Ability to work for multiple users at a time.
- Multidimensional. Hierarchy support, multidimensional conceptual representation of data.
- Information. The user should be able to receive the necessary information in whatever electronic storage it was located.

Intelligent data analysis allows you to automatically generate hypotheses based on a large amount of accumulated data, which can be verified by other analysis tools, such as OLAP. On-Line Analytical Processing (OLAP) is a promising service in terms of the subject field, which provides a flexible view of the information, obtaining an arbitrary cut of data and performing analytical operations of detail, convolution, through-distribution, comparison of the document circulation of communicative structures in time. OLAP does not in fact mean specific software products, but multidimensional data analysis technology. The basis of OLAP technology lies in the conception of the hypercube of the data model. In this regard, depending on the answers to the questions on whether there is a hypercube as a separate physical structure, or it is only a virtual data model, there are two main types of analytical data processing: MOLAP and ROLAP [10].

The data in the OLAP model are presented as measures, each of which is defined in a certain set of dimensions.

Working with OLAP - cube in the Microsoft Office Excel spreadsheet using the Power add-in that can be used to perform powerful data analysis and creation of complex data models. With Power Pivot, you can blur large volumes of data from a variety of sources, quickly analyze information and easily share information. In Excel and Power Pivot you can create a data model, a set of relations tables.

The data you work with Excel and Power Pivot is stored in an analytical database in the Excel workbook, and a powerful local engine loads, performs queries, and up-

dates the data in this database. Because the data in Excel, they are immediately available for PivotTables, PivotCharts, PowerView and other Excel functions that you use to aggregate and interact with the data. Power Pivot supports files up to 2GB and allows you to work with up to 4GB of data [4].

Our goal is to find the most competitive company with OLAP cube.

For this example, determining the company's competitiveness will use a method based on TEC. According to this theory, the most competitive enterprises have the best organized work of all units and services as a system. There are many factors that affect the performance of each service. Evaluating the effectiveness of each unit involves assessing the effectiveness of the use of resources provided to them. The method defines the main economic indicators, which are divided into 4 groups [9]:

- Indicators of economic efficiency of activity.
- Indicators of the financial position of products.
- Indicators of sales of products.
- Product Quality Indicators.

As indicators of the fourth group characterize the ability of the enterprise to meet the needs of consumers in accordance with its purpose, we do not take it into account, because our enterprises produce products of various purposes.

Consequently, $KCO = 0,15EO + 0,29FP + 0,23EZ$, where KCO is the coefficient of competitiveness of the organization; EO - the value of the criterion of the effectiveness of the organization's production activities; AF - value of the criterion of the financial position of the organization; EZ - value of the criterion of the effectiveness of the organization of sales and promotion of goods. All of these criteria are calculated as follows:

- $EO = 0,31V + 0,19F + 0,4Rp$ where B is the relative indicator of production costs per unit of output, which reflects the cost effectiveness of production. Rule of calculation of the indicator: $V = \frac{\text{Gross expenses}}{\text{The volume of product development}}$; F - relative indicator of return on capital, characterizing the efficiency of the use of fixed assets. Rule of calculation of the indicator: $F = \frac{\text{Production volume}}{\text{The cost of the main productive assets}}$; Pn - a relative indicator of profitability of a product, characterizing the degree of profitability of products. Rule of calculation of the indicator: $Pn = \frac{\text{Profit from sales} * 100}{\text{Full cost of production}}$; PP - relative indicator of labor productivity, reflects the degree of organization of production and use of labor. Rule of calculation of the indicator: $PP = \frac{\text{Production volume}}{\text{average annual number of employees}}$;
- $FP = 0,29Ka + 0,2Kp + 0,15Ko$, where Ka is the relative indicator of the autonomy of the organization, characterizes the enterprise's independence from external sources of financing. Rule of calculation of the indicator: $Ka = \frac{\text{Own funds}}{\text{Total amount of funding sources}}$; Kp - the relative indicator of solvency of the organization, reflects the ability of the enterprise to fulfill its financial obligations and determines the probability of bankruptcy. Rule of calculation of the indicator: $Kp = \frac{\text{Equity}}{\text{General obligations}}$; Ko - a relative indicator of turnover of

working capital, analyzes the efficiency of the use of working capital. Rule of calculation of the indicator: $Ko = \frac{Revenue\ from\ sales}{Average\ annual\ balance\ of\ working\ capital}$.

- $EZ = 0,37Rp + 0,29Kz + 0,2IKm + 0,14Kp$, where Rp - the relative indicator of profitability of sales, characterizes profitability of the enterprise on the market, correctness of the price setting. Rule of calculation of the indicator: $p = \frac{Profit\ from\ sales * 100}{Sales\ volume}$; Kz - a relative indicator of foraging in finished products, reflects the degree of forging in finished products. An increase in the indicator indicates a fall in demand. Rule of calculation of the indicator: $Kz = \frac{Volume\ of\ un\ realized\ products}{Sales\ volume}$; Km - a relative indicator of the loading of production capacity, shows the business activity of the enterprise, the efficiency of the sales service. Rule of calculation of the indicator: $Km = \frac{Volume\ of\ production}{production\ capacity}$.
- [11]

5 Experiments

The research is carried out for the enterprises of three branches, the products of which are in greatest demand abroad:

1. Honey (honey products):

- Bartnik LLC is a limited liability company based in Iziaslav, Khmelnytsky region.
- Agro Ist Trade LLC is a limited liability company based in the city of Mykolayiv.
- Ukrainian Honey Company - a Donetsk company for the selection, purchase and sale of honey products, located in the city of Volnovaha.

2. Butter (dairy products):

- PJSC "VMZ Roshen" - Public Joint-Stock Company is located in Vinnytsia.
- LLC "Radivilmoloko" - a limited liability company located in Krupets, Rivne region.
- PE "Alma-Vita" -private enterprise in village. Zolotniki, Ternopil region.

3. Sugar:

- PC "Podillya" - food company that is located in the village. Kryzhopil, Vinnytsia region.
- LLC "Novorozhitsky sugar factory" - a limited liability company is located in the village. Novorozhitsk, Poltava region.
- OJSC "Radekhiv Sugar Refinery" - Open Joint-Stock Company of the village of Pavlov, Lviv region.

These enterprises are presented in the form of test files with information about the work of the enterprise (data on production) and data on the export of goods. These files contain information separated by dates (business days of enterprises).

Data from files is downloaded using Power Pivot, a data modeling technology that allows you to create data models, establish relationships, and add computing. Also, text files are downloaded with a list of general information for all enterprises and the date (the time period for which the research will be conducted) (Fig. 1).

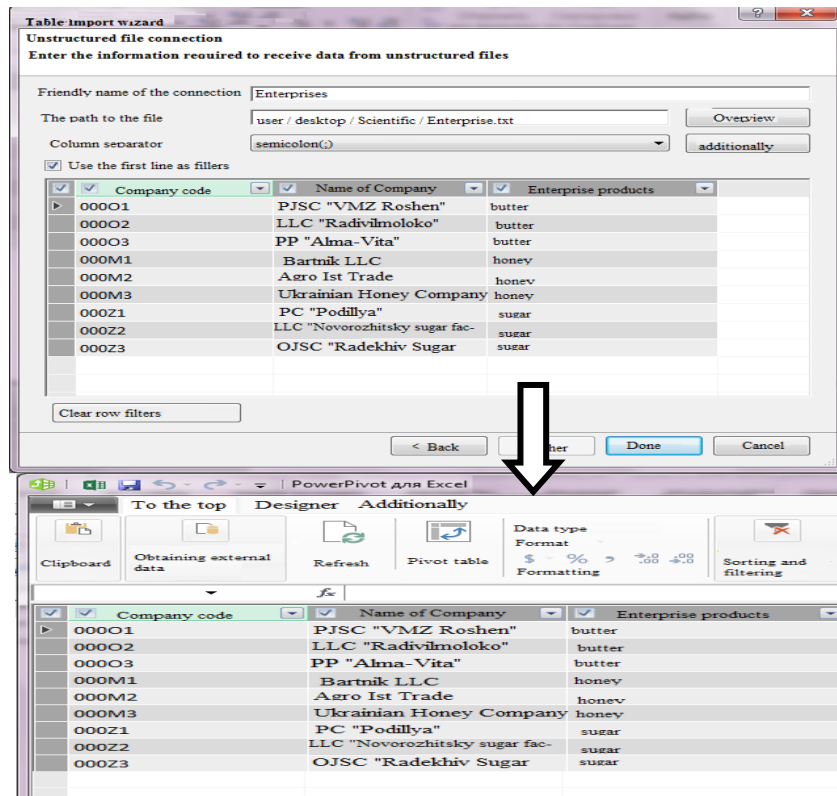


Fig. 1. An example of downloading and displaying data using Power Point

After downloading all the data, the links between the tables are established. To do this, the data is displayed in the form of diagrams (Start → Presentation in the form of a diagram). The corresponding "Date" fields of the business tables and the "Date" table are merged (the table of substitution will be the "Date" table). This connection will serve as a breakdown of time data in the OLAP- cube. Also, the connection of the corresponding fields "Enterprise Code" of the business tables to the Enterprise table is created (the table of substitution will be the "Enterprise" table). This connection collects information by displaying the product categories in OLAP - cubes. Another important link is the connection of the corresponding tables of the enterprise with the export of goods (Fig. 2).

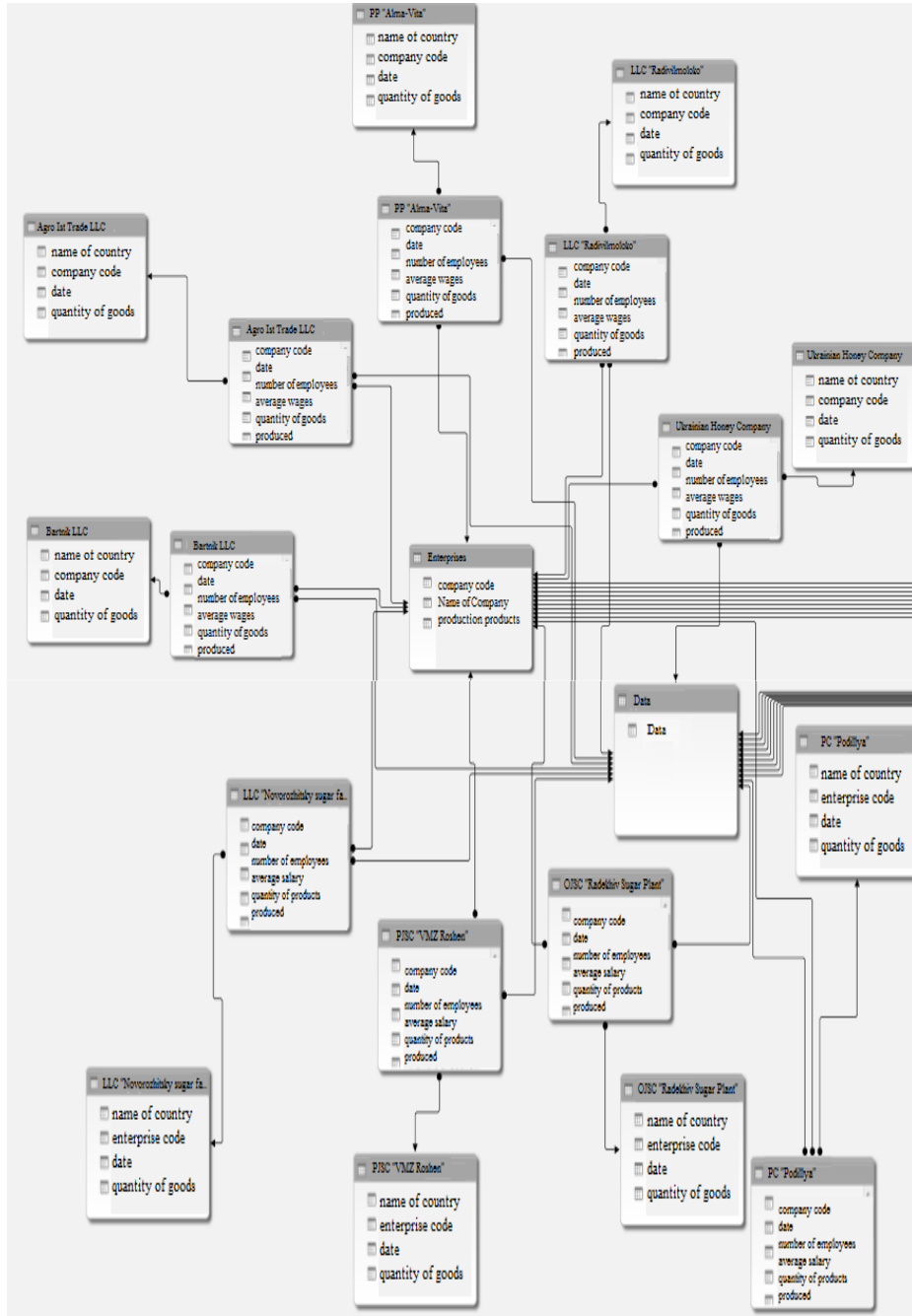


Fig. 2. Chart of links between tables

The next step is to export data from tables on the corresponding sheets, for their processing (Fig. 3).

Agro Ist Trade LLC production data for 2019								
Company code	Data	Number of employees	Average salary	Quantity of products produced	Cost	Tax	Lack of goods	Production capacity (quantity / hour)
000M2	02.01.2017	154	5900	12900	70,52	7,9	4	1044,67
000M2	06.01.2017	154	5900	12900	71,21	7,7	1	1066,67
000M2	14.01.2017	153	5750	12904	71,3	7,99	5	1079,33
000M2	02.02.2017	154	5750	12630	73	7,83	3	1052,50
000M2	10.02.2017	153	5750	13800	72,28	7,99	3	1150,00
000M2	27.02.2017	153	5750	14260	70,75	7,89	6	1188,33
000M2	02.03.2017	153	5750	14000	71,8	7,83	9	1166,67
000M2	18.03.2017	153	5750	13600	72,2	7,85	6	1133,33
000M2	29.03.2017	152	5900	13800	72,25	7,89	7	1150,00
000M2	04.04.2017	152	5650	14030	71	7,8	6	1169,17
000M2	14.04.2017	152	5650	14890	73,49	7,83	4	1240,00
000M2	30.04.2017	150	5600	13400	73,52	7,87	1	1116,67
000M2	04.05.2017	150	5660	12700	76,42	7,89	9	1058,33
000M2	19.05.2017	151	5660	14950	74,4	7,86	4	1245,83
000M2	26.05.2017	151	5660	15025	74,98	7,86	1	1252,08
000M2	07.06.2017	151	5660	14230	73	7,76	3	1185,83
000M2	08.06.2017	158	5700	14403	72,75	7,89	5	1200,25
000M2	20.06.2017	158	5700	14990	72,7	7,83	5	1249,17
000M2	09.07.2017	158	5400	14930	73	7,79	3	1239,83
000M2	11.07.2017	158	5400	15605	71,38	7,79	1	1300,42
000M2	23.07.2017	158	5450	14560	70,25	7,79	2	1213,33
000M2	09.08.2017	155	5400	15830	73,6	7,83	5	1319,17
000M2	17.08.2017	155	5340	15000	73,25	7,85	0	1230,00
000M2	23.08.2017	155	5340	15600	74,25	7,89	2	1300,00
000M2	09.09.2017	155	5340	14040	72	7,75	5	1170,00
000M2	13.09.2017	153	5340	14600	71,65	7,82	2	1216,67
000M2	30.09.2017	153	5340	13900	70,52	7,86	5	1150,00
000M2	07.10.2017	152	5400	14820	74,52	7,87	7	1235,00
000M2	12.10.2017	152	5400	15450	73,2	7,86	3	1287,50
000M2	23.10.2017	152	5400	15725	72,2	7,86	0	1310,42

Fig. 3. An example of the original form of the table with the data on the work of the enterprise

After that data from the tables on the export of goods by enterprises on the corresponding sheets is exported for processing (Fig. 4).

Export for 2019			
Name of country	Company code	Data	Quantity of goods
Germany	00003	02.01.2017	28994
USA	00003	08.01.2017	29199
France	00003	22.01.2017	29302
Germany	00003	03.02.2017	29228
USA	00003	11.02.2017	29496
France	00003	16.02.2017	30098
Germany	00003	04.03.2017	30042
USA	00003	12.03.2017	30195
France	00003	30.03.2017	29072
Germany	00003	01.04.2017	29022
USA	00003	19.04.2017	28976
France	00003	20.04.2017	29198
Germany	00003	06.05.2017	28997
USA	00003	27.05.2017	28848
France	00003	29.05.2017	30623
Germany	00003	08.06.2017	30827
USA	00003	09.06.2017	30502
France	00003	20.06.2017	30986
Germany	00003	07.07.2017	31027
USA	00003	12.07.2017	31904
France	00003	25.07.2017	31058
Germany	00003	07.08.2017	31025
USA	00003	17.08.2017	31700
France	00003	27.08.2017	31779
Germany	00003	03.09.2017	31297
USA	00003	13.09.2017	31598
France	00003	21.09.2017	32093
Germany	00003	03.10.2017	32013
USA	00003	18.10.2017	32500
France	00003	29.10.2017	32422

Fig. 4. Example of the original form of the table with the data on the export of the enterprise

To the tables containing data about the export of goods, you need to add the column "Profit" = Amount of Exported _product × Price, where "Price" = Cost_product × Coefficient, where the Coefficient - the value of the margin on the product (different for each country).

To the tables that contain the company's work data following is attached:

Column "Total Costs" = Taxes on Production + Expenses on Payroll.

Column "Costs of production" = Quantity_product_product × Cost_production.

Column "Capital" = Initial_Capital - Mandatory_costs - Costs_production + Profit + Tenders:

Since, with Power Pivot, you can also create calculated columns, so the columns "Production Costs" and "Compulsory Expenses" are created in it.

The next step will be to calculate the indicators for computing the competition for a given date range. A diagram of the relationship between components is shown (Fig. 5), which highlights three components that affect the value of the "Competitiveness" object. Each of these components represents the component of the instance level that implements individual objects.

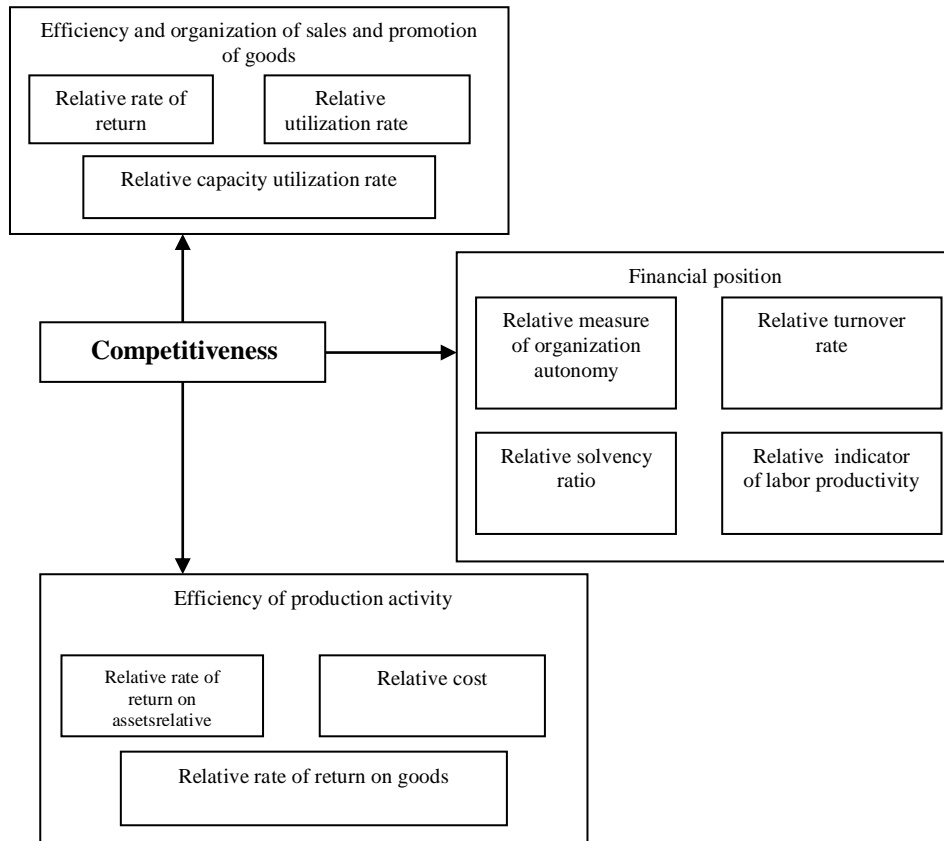


Fig. 5. Diagram of component ratio - indicators for calculating competitiveness.

The "Competitiveness" column is created and is calculated according to the given formula:

$$=0,15*(0,31*[@[relative cost]]+0,19*[@[relative rate of return on assets]]+0,4*[@[relative rate of return]]+0,1*[@[relative indicator of labor productivity]]+0,29*(0,29*[@[coefficient of autonomy]]+0,2*[@[solvency ratio]]+0,15*[@[turnover factor]])+0,23*(0,01*[@[profitability sale]]+0,29*[@[utilization rate]]+0,02/[@[utilization rate of own products]]+0,14*[@[solvency ratio2]])$$

Further, an OLAP cube is constructed to compare production volumes between enterprises over a certain period of time.

There is a composite table that will contain two dimensions: time (as the study priorities are certain intervals) and the measurement of the products of production and their respective enterprises. At crossroads will be displayed the sum of the number of manufactured goods. Conditional formatting shows enterprises with the largest volume of production by product category. A timeline is also added according to the "Date" table, to display the data at the required intervals (Fig. 6).

	Butter			Honey			Sugar		
	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced
	LLC "Radivimoloko"	PIBC "VMZ Rozbeke"	PP "Alma-Vita"	Ukrainian Honey Company	Agro Ist Trade LLC	Bartnik LLC	OJSC "Radekhiiv Sugar Plant"	PC "Podillya"	LLC "Novorozhynskyi sugar factory"
01.07.2017	28030	28030		11830					
03.07.2017							18030		13030
05.07.2017					14830	15830		15030	
07.07.2017			31030						
11.07.2017	27200	28905		11605	15605				
12.07.2017			31905					15965	
15.07.2017							18965		13965
21.07.2017						15560			
23.07.2017					14560				
24.07.2017	27060	27060		11560					
25.07.2017			31060						
26.07.2017							18677		13677
27.07.2017								15677	
Sum	82290	83995	93995	34995	44995	45995	55672	46672	40672

Fig. 6. Summary table "Work of enterprises".

For a better visual perception, a composite diagram is constructed (Fig. 7).

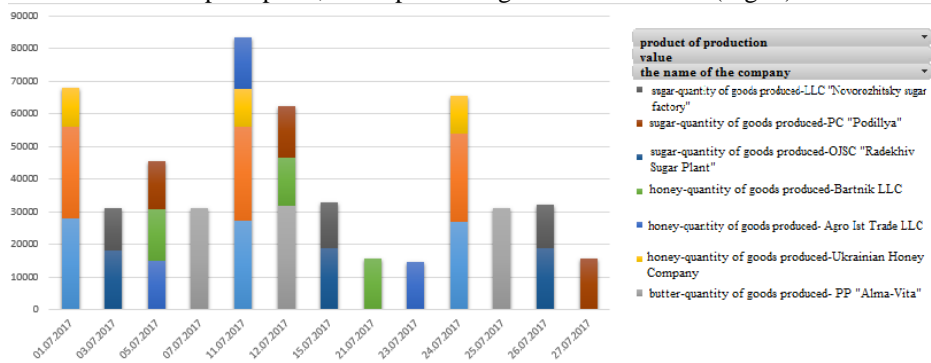


Fig. 7. Combined diagram "Work of enterprises"

6 Results

The final version of the experiment is the construction of OLAP - a cube for comparing the competitiveness of enterprises over a certain period of time.

There is a composite table that will contain two dimensions: time (as the study priority is at certain intervals) and the measurement of the products of production and their respective enterprises. At crossroads the value of competitiveness will be displayed, and the value of the totals will reflect the average competitiveness. Conditional formatting shows the most competitive companies in their industry and the most competitive enterprise among all enterprises. A timeline is also added to the "Date" table to display the data at the required intervals (Fig. 8).

	Butter			Honey			Sugar		
	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	Quantity of goods produced	
	LC "Radivimoloko"	PJSC "VMZ Roshen"	PP "Alma-Vita"	Ukrainian Honey Company	Agro In Trade LLC	Bartnik LLC	OJSC "Radekhir Sugar Plant"	PC "Podillya"	LLC "Novorozhitsky sugar factory"
01.04.2017		6,147							
04.04.2017	6,152		6,079	6,611	5,776	7,073	9,504	9,180	
07.04.2017								7,831	
10.04.2017									
13.04.2017					5,952				
14.04.2017				6,475			7,458	8,323	
15.04.2017						6,972			
16.04.2017							6,800		
18.04.2017	6,076		6,012						
19.04.2017		6,516							
20.04.2017		5,739							
28.04.2017							7,570		
29.04.2017								8,372	
30.04.2017	5,447		5,976	6,454	5,831	7,194	7,439		
Sum	5,892	6,134	6,022	6,514	5,853	7,080	8,134	7,850	
								8,176	

Fig. 8. Summary diagram "Competitiveness".

For a better visual perception, a composite diagram is constructed (Fig. 9).

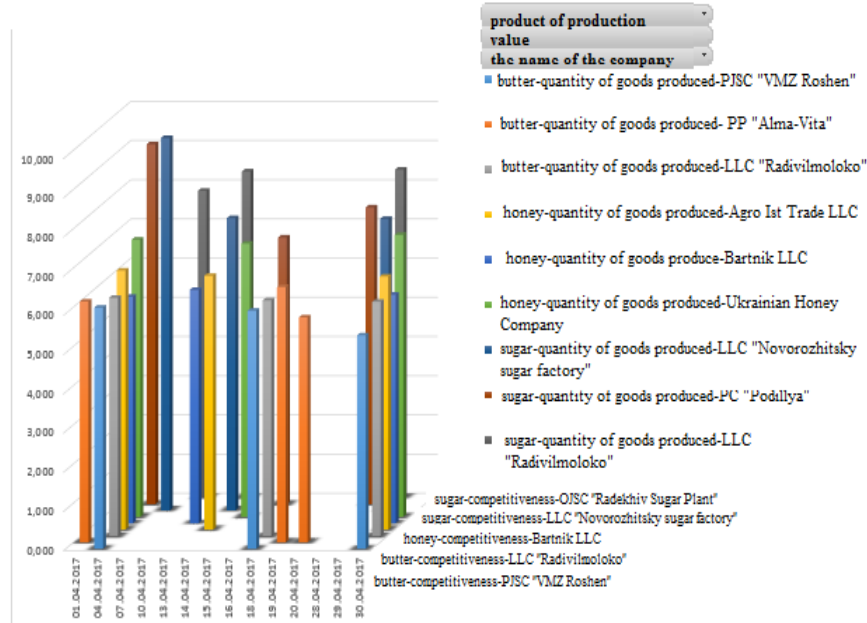


Fig. 9. Combined Diagram "Competitive Capacity".

7 Discussion

The given research has shown, that the leader-exporter in Ukraine in the field of production of butter from the enterprises of our choice is PP "Alma-Vita", for the production of honey - Ukrainian Honey Company; in the sugar production industry - OJSC "Radekhiv Sugar Plant". This calculation of the level of competitiveness accumulates all the important assessments in the enterprise, avoids the duplication of indicators, provides an opportunity to quickly find out the state of the enterprise in the sectoral market. The method used is convenient for use, for researches about the competitiveness of the enterprise, covers all the main activities of such organization. Also, this experiment shows us that sugar is the most competitive among the selected export goods, and OJSC "Radekhiv Sugar Refinery" is the largest exporter.

8 Conclusion

Today, the basis of increasing competitiveness is the use of a systematic approach that allows us to use a full set of strategic capabilities, to prioritize the development of certain departments of the enterprise in accordance with the goals set. With the help of the developed OLAP cube, you can easily compare the competitiveness of different enterprises from different industries, and determine the best in a particular industry, under certain conditions.

References

1. Thomsen, E.: OLAP Solutions: Building Multidimensional Information Systems, p. 460, Wiley Computer Publishing (2002)
2. Celko's, J.: Analytics and OLAP in SQL, p. 156 1st Edition (2006)
3. Storper, M.: The Regional World: Territorial Development in Global Economy, p. 338, N.Y.: Guilford Press (1997)
4. Kunanets N., Vasiuta O., Boiko N.: Advanced technologies of big data research in distributed information systems, Proceedings of the 14th International conference "Computer sciences and Information technologies" (CSIT 2019), pp. 71-76, Lviv, Ukraine (2019)
5. Dolzhansky, I., Zagorna, T.: Competitiveness of the enterprise: textbook. reference book, p. 384, Kyiv: Center for Educational Literature (2006)
6. Tregub, G.: Improving methodological approaches to Business Competitiveness, The mechanism of regulation of the economy, № 3-4, pp. 252-258, Lviv, Ukraine (2002).
7. Bukrinskiy, B., Lazareva, E., Ageeva, I.: Competitive capacity of production and enterprise, p.131, Odessa: IPREEI NAS, Ukraine (2002)
8. Boiko, N.: Advanced technologies of big data research in distributed information systems, Radio Electronics, Computer Science, Control, № 4, pp. 66-77, Zaporizhzhia, Ukraine (2017)
9. Analyzing Data from OLAP Service Manager with Excel Support [Online Resource] - <https://docs.microsoft.com/en-us/system-center/scsm/olap-cube-excel?view=sc-sm-1711>
10. OLAP and Excel [Online Resource] - <http://olap.com/olap-and-excel>

11. Using Microsoft Excel With OLAP Cubes [Online Resource] - http://www.oracle.com/webfolder/technetwork/tutorials/obe/db/12c/r1/olap/olap_excel/olap_excel.htm
12. OLAP data analysis systems [Online Resource] - <http://ukrbukva.net/988-Sistemy-operativnogo-analiza-dannyh-OLAP.html>
13. Kaflevskaya, S., Ganzha, T.: Competitiveness assessment of enterprises by the methodology of efficient competition theory [Online Resource] - <http://econjournal.vsau.org/files/pdfa/831.pdf>
14. Shakhovska, N., Boyko, N., Zasoba, Y., Benova, E.: Big data processing technologies in distributed information systems. *Procedia Computer Science*, 10th International conference on emerging ubiquitous systems and pervasive networks (EUSPN-2019), 9th International conference on current and future trends of information and communication technologies in healthcare (ICTH-2019), Vol. 160, pp. 561–566, Lviv, Ukraine (2019)