CHANGES IN THE IT INDUSTRY IN THE PERIOD 2006-2012 WITH PARTICULAR EMPHASIS ON ANALYTICAL TOOLS TO SUPPORT MANAGEMENT OF LARGE CORPORATIONS

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This paper presents the changes in the global IT market over the last 6 years. The main purpose of the research is to establish (using multidimensional data analysis tools) a ranking of worldwide providers of advanced analytical tools used to support complex management processes in large corporations.

Keywords: IT market, advanced analytics software, analytic application, data warehouse, business intelligence

1. Introduction

Using of IT tools in the management processes began in the second half of the twentieth century. Initially, these were separate products for each department in the company. The evolution of management information systems is described in many publications (e.g. [4], [5], [9], [10]). Already in 1960, under the cooperation of the Case and IBM companies, the first system of MRP (Material Requirements Planning) was designed, and since 1972 such systems have become the primary support in many manufacturing companies. In 1972, five German engineers established SAP company, and in the second half of the seventies, Oracle Corporation and SAS Institute were created, which currently together with IBM and SAP, are the main global suppliers of software supported management process. Starting from

the year 2000, after the emergence of the concept of EAS (Enterprise Application Suite) i.e. integrated packages for businesses, the rapid development of the business process management software market has taken place. This acceleration can be illustrated (see Figure 1) by changes in annual revenues of the SAS Institute (a company specializing in creating software for data storing and decision making based on its own system SAS) proudly presented on its website: http://www.sas.com/company/about/statistics.html. Revenue from the Business Analytics area, as defined by IDC (International Data Corporation), represent over 80% of the company's revenues in the recent years.

In the period 2000-2007, the majority of large companies with foreign capital in Poland implemented or were well advanced with the implementation of MIS systems together with Business Intelligence (BI) type of tools. In the case of banks, it has had a visible impact on the achieved results. More information on this can be read in the papers [4], [5] and [14]. Thus, it can be assumed that from 2007 onwards there is already a mature software-supported management market with experienced and stable suppliers.
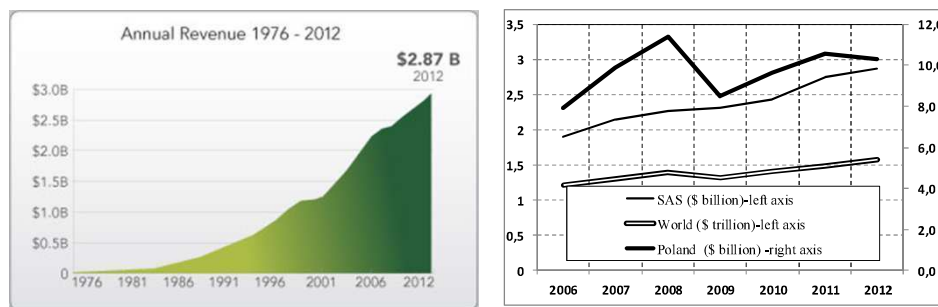

Figure 1. (Left) SAS Company annual revenues beginning from the establishment of the company. (Right) SAS revenues in 2006-2012 against annual expenditures on information technology (excluding expenditure on telecommunications) in Poland and the world. Source: http://www.sas.com/company/about/statistics.html and own calculations on the base of [3], [7] i [8]

World information technology expenditures have grown an average of 3.1% annually since 2006. Figure 1 clearly shows that they exceed the 2008 level while in Poland they are still below this level. The growth is not uniform and the structure of expenditures is changing.

Table 1 (the left part) shows the world information technology expenditures in 2006-2012 broken by type of products (Hardware – H, Services – Serv, Software – S) and year. In the middle part of Table 1, expenditure structure in each year and throughout the period is shown. The right part contains respectively: the expenditure structure in the period 2006 - 2012 broken down by type of products (the last

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line); the expenditure structure broken down by year (the last column) and the overrepresentation ratios (inside).

The overrepresentation ratios are defined by the following formula:

$$h_{ij} = \frac{s_{ij}}{s_{+j}}, \quad i = 1,...,k, \, j = 1,...,n, \tag{1}$$

where s_{ij} and s_{+j} mean, respectively, the j-th coordinate of the structure stored in the i-th and the last line of the middle part of Table 1. It is easy to see that the ratios h_{ij} have the identical interpretation in relation to the vertical parts of this table. It follows from the following equality:

$$h_{ij} = \frac{s_{ij}}{s_{+j}} = \frac{r_{ij}/r_{i+}}{r_{+j}/r_{++}} = \frac{r_{ij} \times r_{++}}{r_{+j} \times r_{i+}} = \frac{r_{ij}/r_{+j}}{r_{i+}/r_{++}}, \quad i = 1,...,k, \, j = 1,...,n, \tag{2}$$

where r_{ij} means revenues from the sale of the j-th group of products in the i-th year, and r_{+j} revenues from the sale of the j-th group of products over the entire period and r_{i+} sale revenues in the i-th year, r_{++} total sale revenues.

Table 1. (Left) World information technology expenditures in 2006-2012. (Middle) The expenditure structures in each year and for the whole period 2006-2012. (Right) Over-representation rates of expenditure structures in the subsequent years in relation to the structure of the whole period 2006-2012

$ B	H	Serv	S	Total		H	Serv	S	Total		H	Serv	S	Structure
2006	289	686	186	1162	2006	0,249	0,590	0,160	1,00	2006	0,975	1,023	0,958	0,120
2007	318	761	209	1288	2007	0,247	0,591	0,162	1,00	2007	0,967	1,024	0,967	0,133
2008	350	814	223	1388	2008	0,252	0,587	0,161	1,00	2008	0,987	1,017	0,960	0,143
2009	336	782	219	1337	2009	0,251	0,585	0,164	1,00	2009	0,984	1,014	0,977	0,138
2010	353	821	232	1406	2010	0,251	0,584	0,165	1,00	2010	0,982	1,012	0,985	0,145
2011	404	848	268	1520	2011	0,266	0,558	0,176	1,00	2011	1,040	0,967	1,052	0,157
2012	424	874	285	1583	2012	0,268	0,552	0,180	1,00	2012	1,048	0,957	1,075	0,163
Total	2475	5586	1622	9684	Total	0,256	0,577	0,168	1,00	Structure	0,256	0,577	0,168	1,000

Source: own preparation on the basis of [3], [7] and [8]

Figure 2 presents the overrepresentation maps illustrating the expenditure structure in the world and in Poland. An overrepresentation map is a rectangle, divided by the lines parallel to its sides, into n horizontal and k vertical parts, giving a total of n × k rectangles, shaded with the intensity of the shade determined by the overrepresentation ratio values (Formula 1). More about the over-representation maps one can read, for example, in the works [15], [16].

The map in the middle part of Figure 2 is the graphical presentation of Table 1. The width of the columns is determined by the structure in the last line of the Table 1, so the width of the columns indicates the 2006-2012 expenditure structure broken by type of products. The width of the lines is determined by the expenditure structure broken by year.

The overrepresention map in the left part of Figure 2 is the graphical presentation of the world IT expenditures structure (including telecommunication), and the map in the right part of Figure 2 represents the IT expenditures structure in Poland.
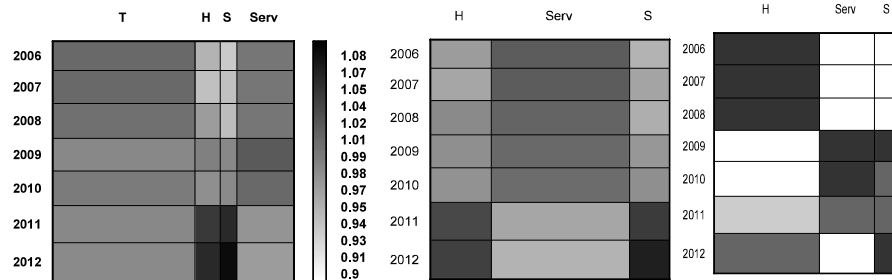

Figure 2. Over-representation maps illustrating the structure of information technology expenditures in the world, including the telecommunication expenditure T (Left) and excluding the telecommunication expenditures (Middle) and in Poland (Right)
Source: own preparation based on [3], [7] and [8] using the application GradeStat
(http://gradestat.ipipan.waw.pl/)

In sum, Figure 2 shows that the telecommunication spending constitutes more than half of a global spending on IT, but it's share is decreasing in favor of spending on software and hardware. In contrast, the annual expenditures in nominal terms, excluding the year 2009, are increasing. Comparing the maps in the middle and the right of Figure 2, it can be seen that the expenditure structure in Poland is very different from the world expenditure structure. In Poland, more than half of the expenditure in the considered period is spent on hardware. This means that a significant change in the expenditure structure can be expected in the coming years.

2. Software supporting management processes

Currently, it is difficult to imagine a large corporation, which does not use either basic systems recording operations with customers and company's own economy in the wide sense or advanced analytical software to support the widely understood management processes. Moreover, with high probability it can be assumed, that companies have comparatively good systems concerning the automatic registration of operations with customers and company's own economy. However, in the area of using Business Analytics (BA) software to support management processes there is still a large variation. This is particularly true in developing countries.

IDC company divides the market of BA software into the three primary segments:

- Performance Management and Analytic Applications (PM&AA): Financial performance applications, Supply chain analytic applications, Workforce analytic applications, CRM applications, Service operations analytic applications, Production planning analytic applications.
- Business Intelligence Tools (BI): Query, reporting, analysis tools, Advanced analytic tools, Contents analysis, Spatial information analytic tools.
- Data Warehouse Management Platform (DW): Data warehouse management, Data warehouse generation – processes data generation, transformation, loading, data quality.

Changes in the structure of BA software suppliers' 2005 – 2012 revenues according to the three categories mentioned above (PM&AA, BI, DW) are shown in Figure 3 in the form of the overrepresentation map. Analyzing Figure 3 one can see that the revenues from the sale of these products are growing quite quickly (in consecutive years lines become wider and wider). The structure of revenues broken by product is also changing (changes in gray color intensity of individual cells shows the overrepresentation of cells from a particular year relative to the average for the whole period).

As follows from Figure 3, the share of BI tools revenues is decreasing in relation to the other categories in the period 2005-2012. Business Intelligence tools appeared on the market quite a long time ago. Revenues of BI tools suppliers in the period 1994-2012 are presented in Figure 4, from which it can be seen that the sale of BI tools was growing at over 15% a year at the end of the last century.
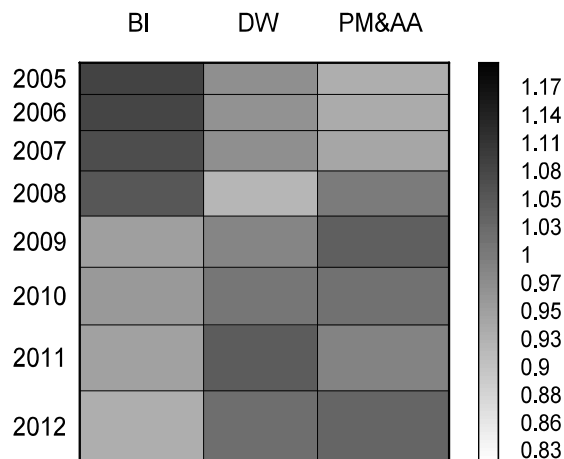

Figure 3. Overrepresentation map illustrating the structure of the revenues from the sale of BA tools in the period 2005-2012
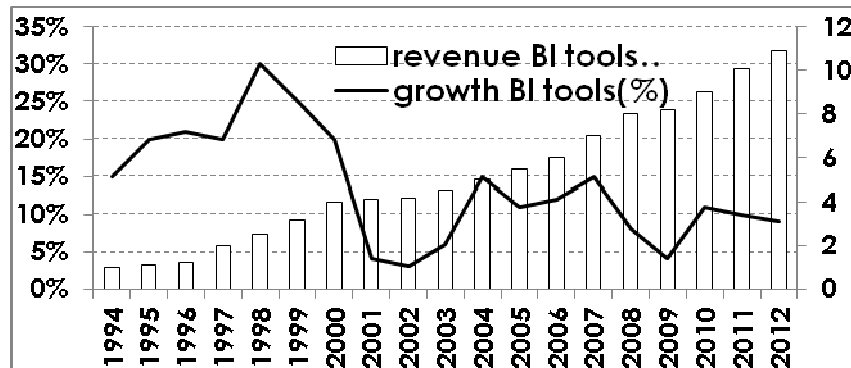Source: own preparation based on [17], [18] and [19] with using the application
GradeStat (http://gradestat.ipipan.waw.pl/)

Figure 4. Revenues of BI tools suppliers in the 1994-2012 period
Source: own preparation based on [18] and [19]

3. Business analytics tools market

The Business Analytics (BA) tools market is the market already operating for several years, and therefore it can be considered as the mature market. Some big players offering a wide range of products as well as many niche players offering single products operate in this market. It is worth to mention that large corporations choose as suppliers mainly the world-known players which are well assessed by product positioning global companies. One of the most known such companies is Gartner Inc. listed on the American Stock Exchange NYSE under the symbol IT. It operates also in Poland. Another no less –known company is the International Data Corporation (IDC), a leading global provider of market information and IT advisory services and solutions. Based on the reports of this type of companies, the global BA market picture can be easily submitted, in terms of both the software quality and the market share of the individual major players.

In principle, there are six large suppliers of BA tools that can meet the needs of large corporations handling huge data volumes: IBM, SAP, Oracle Corporation, SAS Institute, Teradata, and Microsoft. However, this does not mean that it is the only option. A large number of niche players operate at the market. These are more flexible and can provide tools that are better adapted to the requirements of the purchaser. Currently, the market continues to grow strongly, being accompanied by market reshuffling: the new niche players appear at the market, and some other are absorbed by the global giants. These changes are well illustrated by two Gartner Magic Quadrants assessing BI software suppliers in 2007 and 2013 (see Figure 5). It is worth noting that earlier IBM was not found among the major providers of such tools, and it is not presented at 2007 Magic Quadrant. After the acquisitions

of very valuable niche players (Cognos and SPSS), IBM was assessed by a research group Gartner Inc. as one of the best companies.
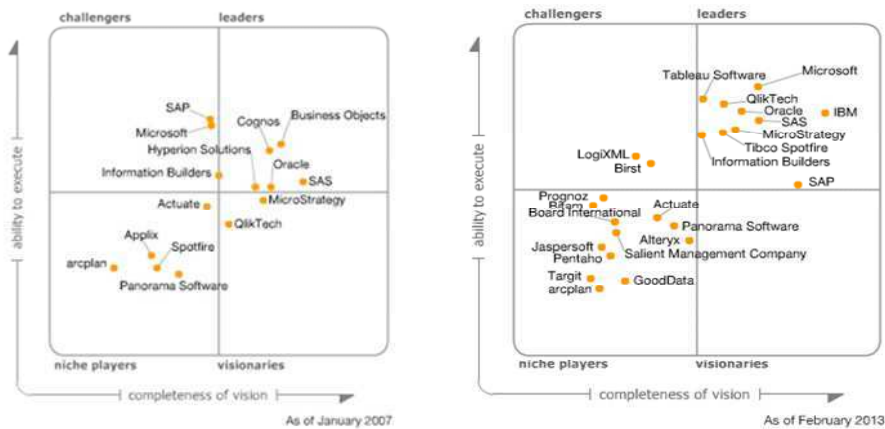

Figure 5. Gartner Magic Quadrants presented the assessment of BI software suppliers
Source: Gartner Reports [11] i [12]

In the case of Data Warehouse Management Platform tools, the situation is more stable. Changes in the assessment of DW tools suppliers were investigated on the base on Magic Quadrants assessing these suppliers. Five global giants (IBM, Microsoft, Teradata, Oracle, SAP) have appeared in the upper right quadrant during the whole period, wherein the corporation SAP is presented in a strategic partnership with the corporation Sysbase (SAP and Sysbase have signed an agreement on strategic partnership). For the period before 2009, the Sysbase assessment was taken as the assessment of the partnership. Since 2010, in the upper right quadrant of the Magic Quadrants has appeared EMC corporation, which took over the company Greenplum in that year. Earlier assessments of Greenplum placed it close to the upper right quarter. In addition, in 2010 disappeared the well assessed company Neteza, as a result of its acquisition by IBM.

Figure 6 illustrates changes in the assessment of major firms in the years 2006-2012. The assessment is based on Magic Quadrants. Namely, it is assumed that the point in Magic Quadrant is equivalent to the point in the square $[0,1] \times [0,1]$ and the assessment is defined as: $1 - d[(x, y), (1, 1)] / (2^{0.5})$, where d is the Euclidean distance. The information needed for positioning of individual firms was derived from reports published in the first quarters of each year. In sum, in the period 2006-2012 suppliers presented in Figure 6 were worth of recommending.
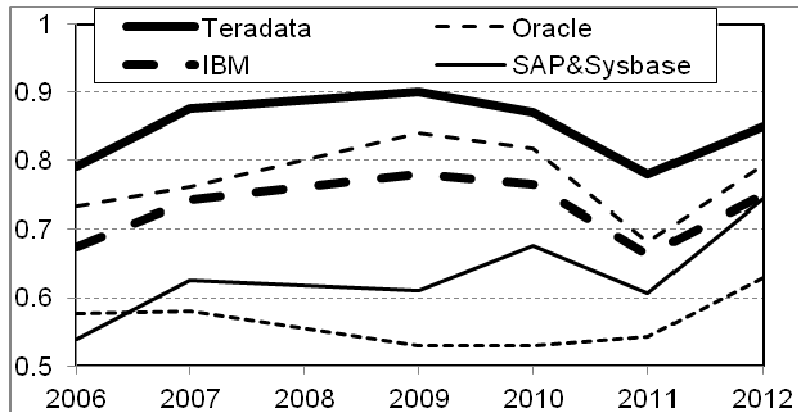
Figure 6. Chart of DW tools suppliers assessment in the period 2006-2012 according
to the achieved results published in reports of Gartner, Inc
Source: own calculations based on Gartner Inc. Reports ([1], [2], [3], etc)

In the Business Analytics area, the increasing role begin to play advanced analytical technologies, which also allow to manage and exploit the large volumes of data. This means that the BA area begins to be more widely understood, namely in addition to the advanced analytical procedures it covers also the techniques for efficient processing of very large volumes of heterogeneous data: new area, called Big Data is arising. There is no uniform definition of the concept of Big Data. For many authors this term means exponential growth of data and issues connected with the collection and rapid access to the large and heterogeneous data sets (eg. non- relational data) in order to exploit the information contained therein. Some others place greater emphasis on advanced techniques for extracting infor-mation from a large set heterogeneous data. This is probably why many large cor-porations seek interdisciplinary specialists with:

• programming skills,

• knowledge of the technical platform for collecting and processing large hetero-geneous data

• specialized preparation in various fields with particular focus on the knowledge of the mathematical methods of information processing and statistical methods.

Suppliers have already responded and sell tools under the banner Big Data. In 2011, revenues under this heading received quite a lot of companies [13]. In 2011, total revenues of Big Data market achieved $ 5,2 billion. Table 2 presents the list of 15 companies with the greatest Big Data market share and the list of 15 niche suppliers who only sell products (or sell majority of products) under this heading. It is worth noting that the list of the 15 companies with the highest market

share does not include Microsoft and Oracle companies. More about Big Data market one can read in [6].

Table 2. (Left) Big Data revenues of companies with the greatest market share and (Right) companies with the greatest share of Big Data revenues in the total revenues

No	Company	Revenues ($ M) Big Data	Market Share (%) Big Data	Revenues ($ M) Total	Big Data Rev. Share in Total Rev.	No	Company	Revenues ($ M) Big Data	Market Share (%) Big Data	Revenues ($ M) Total	Big Data Rev. Share in Total Rev.
1	IBM	953	18,60%	106000	0,9%	1	OperaSol	76	1,48%	100	76,0%
2	Intel	765	14,93%	54000	1,4%	2	101Data	25	0,49%	30	83,3%
3	HP	513	10,01%	126000	0,4%	3	Couchbase	5	0,10%	6	83,3%
4	Fujitsu	285	5,56%	50700	0,6%	4	Musigma	55	1,07%	65	84,6%
5	Accenture	273	5,33%	21900	1,2%	5	Cloudera	18	0,35%	18	100,0%
6	CSC	160	3,12%	16200	1,0%	6	FractalAnal.	12	0,23%	12	100,0%
7	Dell	154	3,00%	61000	0,3%	7	Think Big An.	8	0,16%	8	100,0%
8	Seagate	149	2,91%	11600	1,3%	8	MapR	7	0,14%	7	100,0%
9	EMC	138	2,69%	19000	0,7%	9	DataStax	4,5	0,09%	4,5	100,0%
10	Teradata	120	2,34%	2200	5,5%	10	10gen	4,5	0,09%	4,5	100,0%
11	Amazon Web Serv.	116	2,26%	650	17,8%	11	Datameer	4	0,08%	4	100,0%
12	SAS Institute	115	2,24%	2700	4,3%	12	Hortonworks	3	0,06%	3	100,0%
13	Capgemini	111	2,17%	12100	0,9%	13	RainStor	2,5	0,05%	2,5	100,0%
14	Hitachi	110	2,15%	10000	1,1%	14	HPCC Systems	2	0,04%	2	100,0%
15	SAP	85	1,66%	17000	0,5%	15	Karmasphere	2	0,04%	2	100,0%

Source: own preparation on the base of [13]

4. Concentration of the business analytics software market

One of the key elements influencing the purchase of tools by a large corporation is the size and long term-market position of the supplier. Using IDC reports, the evaluation of concentration changes in business analytics software market in the past few years was performed. For this purpose, the simple indicator of CR4 (meaning the sum of the market shares of the top 4 brands in the industry) was used. Usually the following classification of the market (industry) is applied:

• competitive market – the concentration ratio CR4 <40%,

• oligopoly – the concentration ratio CR4 ≥ 40% (tight oligopoly when CR4> 60%, loose oligopoly when 40% ≤ CR4 ≤ 60%).

Figure 7 shows the oligopoly character of the business analytics software market. Moreover, the BA concentration ratio is slowly growing over the reporting period. Only in the case of Data warehouse management platforms, the concentration ratio is decreasing. Taking into account the increasing use of the data processing centers services by small and middle-sized companies, the concentration may be even deeper.
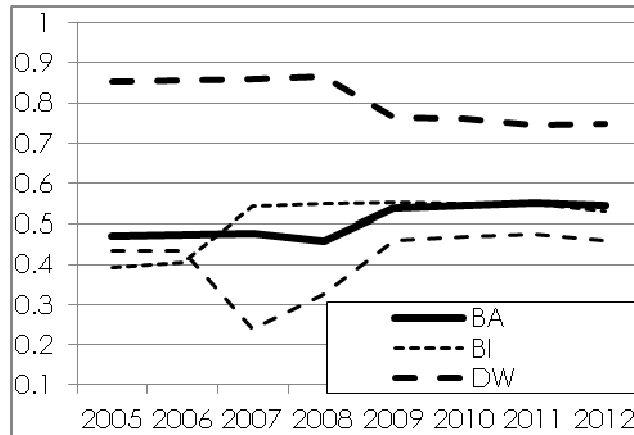
Figure 7. Chart of concentration ratios CR4 for BA software market
in the period 2005-2012
Source: own preparation based on [17, 18, 19]

5. Ranking of the business analytics tools suppliers

Nearly every large company has used the software supporting management for several years. The biggest diversity is in the BA tools area. Some companies are associated with a single supplier and another part uses the tools from different suppliers. Using standard methods of multidimensional comparative analysis the ranking of six major suppliers of this software was established taking into consideration 13 variables:
✓ the average positioning of Gartner Inc. from the years 2006, 2009 and 2012 concerning BI, DW and Advance Analytics Software - the average of the sum of the coordinates in three Magic Quadrant identified with a square [0,1] x [0,1] - weight = 1,
✓ the percentage change in 2012 position compared with to 2006 position in Magic Quadrant identified with a square [0,1] x [0,1] for BI, DW and Advance Analytics - weight = 0,5
✓ the current (from 2013) positioning of Gartner Inc. concerning Integrated Marketing Management and Data Quality Tools Software – weight = 1,
✓ the average market share in the years 2006, 2009 and 2012 for PM&AA, BI, DW and Advance Analytics tools according to IDC reports - weight = 1
✓ the 2011 revenues from the Big Data tools sale (according to [13]) - weight = 1
As a result of calculation the ranking of six leading companies was obtained. It is presented in Table 3 – the value of the synthetic index W indicates the big advantage of IBM.

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Table 3. Ranking of the six largest BA tools suppliers according to the value of the synthetic index W that uses 13 variables

Company	W	Ranking
IBM	0,6479	1
SAS	0,4831	2
Oracle	0,4593	3
SAP	0,4356	4
Microsoft	0,3153	5
Teradata	0,2266	6

Source: own preparation based on Gartner and IDC companies reports

6. Summary

Today, practically every large company, especially financial institutions, use widely understood MIS tools that have been implemented for several years and that are continually developed and improved.

On the basis of available on the Internet materials from local conferences for users of software provided by the international scale companies, one can find out that starting from 2000, the majority of banks and other financial institutions began gradually implement software supported management system (virtually in all areas of the corporation), including the BA tools.

The conducted analysis shows that only in the case of IBM, company may rely on one supplier. In other cases, individual business areas require the use of tools from different suppliers.

If the corporation has the appropriate specialists (i.e. having (i) the ability of programming, (ii) knowledge of the technical platform for the collection and processing of large heterogeneous (non-relational) data and (iii) the various fields of knowledge with particular focus on the mathematical methods of information processing and statistical methods), it can implement solutions using niche suppliers which is certainly a cheaper and more flexible option.

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