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USING BI CLASS SYSTEM IN MANAGING SCIENTIFIC AND TECHNICAL INFORMATION. THE EXAMPLE OF SYNAT PROJECT

Abstract: This article is devoted to the subject of SYNAT project as an element of building national scientific and technical information system. The article presents an analysis of necessary solutions. Among others, it concentrates on the issue of choosing BI class system as a tool which supports designing the system. Possible solutions were presented in this regard and on the basis of a comparative analysis proper recommendations were given. It was stressed that one needs to use those BI solutions that include in their construction a management dashboard.

Keywords: Business Intelligence, information system, data warehouse, management dashboard, virtual workspace, documents management, KPI – key performance indicators.

1. Introduction

The role of the development of Poland is visible in the currently running strategic project to build an interdisciplinary interactive system of scientific information and scientific technical information. The project called SYNAT (Scientific and Technical Information System) aims to "create universal, open, repositories hosting and communication platform for network resources of knowledge for science, education and open society of knowledge" [http://www.synat.pl/opis-projektuv]. It is funded by the National Center for Research and Development. The program involves seventeen research institutions led by Marek Niezgódka from Warsaw University ICM. The authors of this article work on the construction of a long-term financial model ensuring a long-term existence of the scientific and technical information system. The position of Poland on the map of the world is defined by both material and intellectual resources of Poland (National Intellectual Capital – NIC). Often it is

criticized that not enough resources are spent on research and education in Poland [Galwas 2010]. It is especially important now when we are "catching up" old European Union member states, which are constantly moving forward. However, one can ask at the same time: Do we use our intellectual resources in the right way? Do we know how to gain knowledge from existing global resources of knowledge? What actions should be taken to ensure position of Poland corresponding with our aspirations? How was transfer of science influenced by the possibilities which were obtained as a result of global networks or cyberspace? Obviously, many more questions can be asked here. This article is an attempt to respond to the opportunity of using BI solutions, including management dashboard, to manage SYNAT project.

Project SYNAT reminds a project realized in 1970s on governmental system called in short SINTO (System of Scientific and Technical Information and Organizational Information) [Kisielnicki 1972]. However in 1980s all works on this kind of system were abandoned. The resources were used to realize another national IT system for registering citizens (PESEL), which was a priority for the authorities. The good thing is that achievements in improving the system of popularizing science and technical information have been already resumed in new conditions and with new technical and technological solutions. Now we have completely different needs and new possibilities, given by modern IT technology and functioning system of scientific technological information in cyberspace including the use of cloud computing technology [Kisielnicki 2009].

2. SYNAT in the national scientific and technological information system

The national scientific technological information system does not work as an actual system in the commercial practice. It reminds a direction of actions whose aim is to create a dedicated IT system within a communication system of a country regarding scientific and technological information. It is correlated with other systems of this type functioning for the first time in the European Union countries and then in other countries in the world. Using a computer network, the system combines elements of scientific and technical information and their usage into one unit.

The main task of SYNAT is to create a system of scientific and technical information exchange in Poland. What are the relations between the KSINT (National Scientific and Technical Information System) and SYNAT? SYNAT can be the core of the KSINT. Regarding SYNAT, people follow the scope and define resources assigned to different tasks within it. Obviously, some elements of national scientific and technical information system are in operation, for example, scientific and public libraries, systems of universities and research institutions, etc. Is it a coherent system, though? Here we can have some doubts. A national system which SINTO is supposed to be in the target layer should give users an efficient tool to make deliberate actions

both in the area of scientific policy and its applications. Its result should be an increase in scientific quality of our works and modernization of the Polish economy. To evaluate the level of Polish publications, we may use the Impact Factor (IF) [Garfield 2011]. This factor allows defining prestige and impact of the scientific journals in which Polish scientists publish. The problem of the position of the Polish science is only mentioned here and is not a subject of this article, the same as the analysis of the impact of science on the economic development of Poland. We may also define such a target scientific and technical information system as a multilevel structure [Kisielnicki 2010]. This system allows its users to transform information linked to science, and scientific and technical progress into desired information output using proper procedures and models. Obtaining this information, it results in both scientific and economic decisions.

We may define SYNAT as a subsystem of the national information system in which we have an organized set of people (creators and their co-workers), processing procedures, databases, models and knowledge and devices used to provide scientific information and its application for all the citizens interested in the topic. Oleński [2011] believes that the national system of scientific and technical information is a complex of scientific and technical information systems gathering scientific and technical information and sharing this information with domestic users and foreign users within defined range. Therefore, it is an integrated complex of scientific and technical information systems including all national systems and connected with them international systems and systems managed by foreign entities (see [Shah 2006; Suber 2007; Swan 2007]). Therefore, the construction of SYNAT requires coordination and standardization of the elements listed earlier, the aim of which is to ensure coherence of the system. IT tools such as BI help to manage such comprehensive projects efficiently.
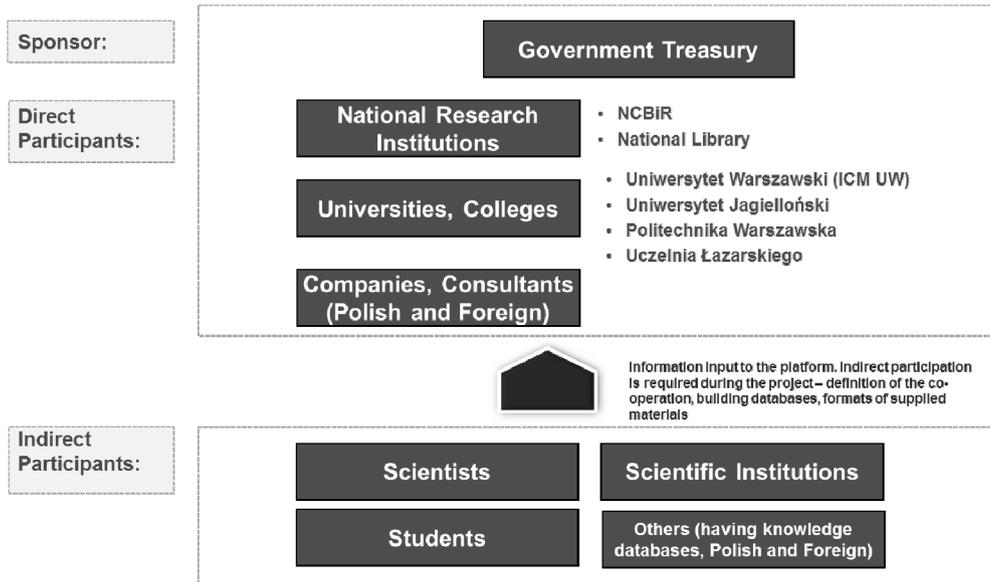
3. BI for the realization of SYNAT

Business Intelligence as a tool supporting building and exploitation of SYNAT is made of a few layers (see Figure 1):
*   tools of obtaining and transforming data (ETL – Extract, Transform, Load) from source systems,
*   databases in which the obtained data are stored – so-called data warehouses,
*   reporting and analytic applications including management dashboards.

Business Intelligence System is fed with data which may come from many sources (see Figure 1). Decisions on which data and from which sources should be collected should be made at the moment when the goal and result to be obtained from BI are already known. Then the scope of data to BI reports should be defined so that it is usually wider than the actual initial need. The scheme of functioning BI is shown in Figure 2.

Thanks to ETL tools, data are extracted from source systems, transformed and uploaded to data warehouses. The most difficult element in ETL tools is data transformation. This process is based on data cleansing (e.g., removing duplicates, etc.) and their modification – getting them to the same denominator in such a way that they can be freely combined, compared, etc. The construction of an ETL tool requires detailed knowledge of processes occurring in the source systems and understanding data participating in them.


Figure 1. Participants in the realization of SYNAT project

Source: authors' own work.

Next, cleansed data are uploaded to a data repository (i.e., data warehouse). The data warehouse is a logically consolidated collection based on database technology. It is often said that the data warehouse is based on the construction of so-called "info cubes". It is connected with data integration. A BI element is the layer of a data presentation. It is an application level serviced by a user. Through users' questions, data coming from the data warehouse are properly presented in a desired form. The following group of tools belongs to this layer: reporting, OLAP (Online Analytical Processing) and data exploration tools, analytic applications and management dashboards.

The goal of SYNAT project is to build a publicly available e-platform of scientific knowledge operating on the basis of Open Access principle. This system aims at integrating:
- digitized resources available only in the Open Access system,
- databases made available by Polish scientific institutions,
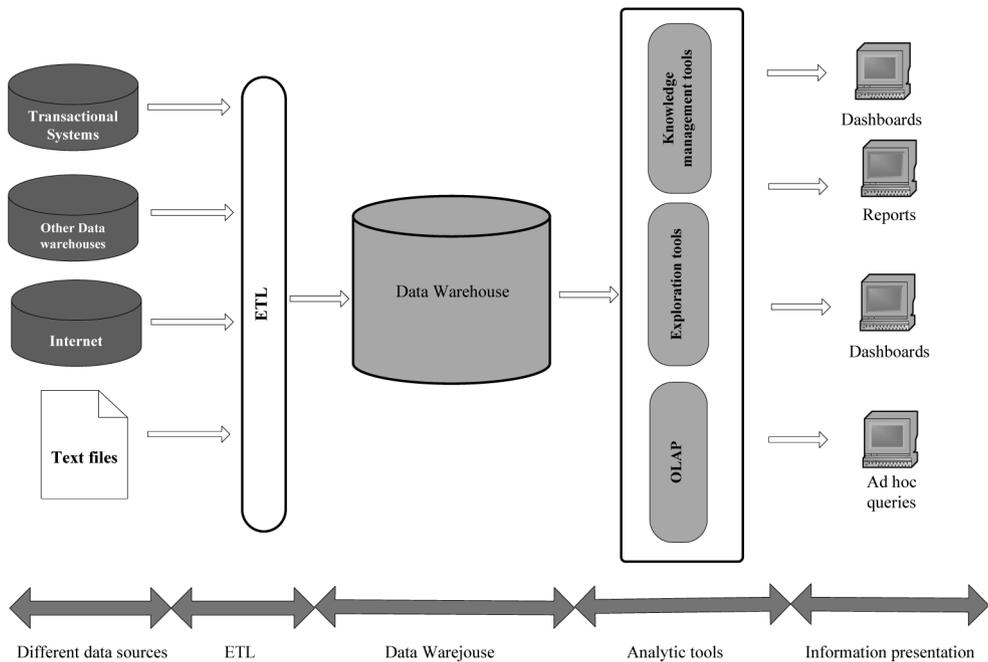
Figure 2. BI structure for SYNAT project

Source: authors' own work.

- databases of commercial publishers (provided on the basis of a license),
- development of own databases,
- maintaining hosting services for people interested in the organization and method of SYNAT platform operation,
- European scientific repositories (e.g., Europeana).

An overview of the goals of SYNAT platform shows the range of this operation, and therefore so many questions appear regarding aspects like: How will the platform earn money? How will the project be financed. How will the legal element be solved (especially, the tax aspect)? What is the strategy of managing the project organization?

The strategy analysis (see Table 1) shows that business models for SYNAT project have been created in line with the second strategy. The second strategy assumes that the state budget covers expenditures especially in the initial stage of the project, but the management system is decentralized. In the case of the decentralized management system, it is more difficult to monitor the progress of works. However, in Poland we do not have a centralized coordination system, and the state budget funds most scientific projects. Four strategies of the realization of SYNAT were considered as presented in Table 1:

Table 1. Strategies of SYNAT realization – possible strategies

Management system	**State budget funds functioning of SYNAT platform**	Fees for using SYNAT collected from all users
Centralized coordination system	Strategy 1	Strategy 3
Decentralized coordination system	**Strategy 2**	Strategy 4

Source: Kisielnicki [2011].

The major task to be solved in SYNAT project is to find a way and procedures which will ensure the constant financing of the operating system. To achieve it, a long-term financing model has been built. This model will allow verifying the authors' proposition that concern financing SYNAT system. The application of the proposed strategy should ensure a long-term existence of the platform accessing the intellectual and technical information for SYNAT users.

The realization of SYNAT project is a decentralized and complex structure. The theme of this operation involves numerous differentiated users, and the management strategy has to have a decentralized structure, which requires proper monitoring and evaluation of works. Therefore, it seems to be a good solution to use a management dashboard, which is a BI element properly accessible to individual coordinators of SYNAT project.

The most important areas to be monitored in SYNAT project will be its budget (project expenses), legal decisions, rules of participation and financing individual participants of the project (resource control), project products (their value for the project and quality), timeliness of the realization of tasks, such as providing content, risks and dangers, including appearing problems which require making decisions.

Project products, i.e., so-called content (their value for the project and quality), are an area which has to be monitored. However, in order to achieve it, it is necessary to implement a few rules used in BI tools applications:

1) A virtual workspace for participants. Preferably it should be a dedicated application for virtual work where participants have the possibility of working on documents on-line or at least they can save their works in a dedicated virtual area. Such a system should ensure registering work time and the name of the user who operates on it. Other work conditions of such an application are:

a. The method of categorizing documents by adding attributes to them. It is based on saving documents in a set localization in an orderly way. Thanks to that, the documents can be viewed and searched in various perspectives. It will ensure the possibility of quickly getting the information about products.

b. A possibility of defining work-flow for a given product. In an operation like SYNAT, products will be a result of work of more than one person. They will be also approved by the succeeding levels of hierarchy. Thanks to the work-flow system, it

will be possible to quickly identify at which level of approval a given product is or whether it has already gone through the content, quality and other approvals.

c. Versioning of documents. It is necessary not to have to save following versions. Documents should be stored under one name. The system should save in the background following versions of documents, offering the possibility of returning to the previous versions at user's request.

d. Advanced management of the access to the chose products/documents/system areas. Individual users should have access only to chosen product libraries. The system should ensure such a possibility including the option of read only files. With such a vast project and so many participants, it seems dangerous to make everything available to everybody. Therefore, a system which would be only a file server with created folders may complicate managing the access.

2) Organization and education of participants. Implementing tools similar to those described earlier requires some project discipline. In this case, it is not enough to give access to users and ask them to register products in the system. Such system requires the following conditions:

a. Setting organizational rules such as decision on product attributes, a hierarchy of approval, a work-flow definition, access rules to the system, etc.

b. Educating users on organizational rules in such a system. Users must understand how the system works, how to describe their works using attributes, what the position in the work-flow hierarchy is, etc.

c. Introducing some natural requirements of using such a system. Users should not send their works to each other by e-mail. They should be obliged to work in the cyberspace.

The aforementioned points are the boundary conditions to use BI and implement management dashboard, which in turn allows monitoring provided products. A system that has such functionalities would significantly facilitate managing the project and organized work of its participants.

4. Analysis of BI solutions available on the market

The market of IT tools offers a range of Business Intelligence type solutions. A few guidelines have been made in this work to choose and compare the products which could fulfill as far as possible requirements of SYNAT projects:

• Building own tool vs. buying tool out-of-the-box. One of the first guidelines made for the purpose of this work will be considering tools available on the market. SYNAT operation is a consortium of many institutions. Building a tool that allows reporting is an investment (requiring identification of needs, decisiveness, software, etc.) which is rather expensive and lasts too long for the needs of project, which should end at a specified time. Currently available tools offer very advanced functionality out-of-the-box.

- Open-source tool vs. licensed tool. The next guideline is to compare available licensed tools. There are many open-source tools available. However, they still offer low efficiency regarding functionality or efficiency. SYNAT project requires cooperation of a large group of participants, quick and infallible tools which will be supported by their suppliers. Using freeware should be rather ruled out because as it is shown in many statistics the cost of using such software may be higher than buying proved licensed tool.
- Comparing costs of license. Offers of such solutions are submitted individually with proper discounts. Prices then may dramatically differ from these which are presented in the regular pricelists of suppliers. An analysis will be made of the best products available on the market belonging to the similar price group.

According to "BI Tool Survey 2012" report, this is the list of the most commonly used BI tools offered by the producers:

Table 2. List of the most commonly used BI solutions

Business Intelligence Tool	Most recent version	Supplier
Oracle Enterprise BI Server	11g1	Oracle
SAP Business Objects Enterprise XI	r4	SAP
Microsoft BI tools (integrated BI offering)	2008/2010	Microsoft
SAS Enterprise BI Server	9.2	SAS Institute
Microstrategy	9	Microstrategy
IBM Cognos Series 10	10.1	IBM
QlikView	11	QlikTech
Board Management IntelligenceToolkit	7.1	Board International
BizzScore Suite	7.3	EFM Software
WebFocus	8	Information Builders
Oracle Hyperion System	9	Oracle
SAP NetWeaver BI	7.3	SAP
JasperSoft (open source)	4.5	JasperSoft
Style Intelligence	11	InetSoft
Pentaho BI suite (open source)	4	Pentaho
Tableau Software	6.1	Tableau Software

Source: www.businessintelligencetoolbox.com.

The list consists of 16 positions. In order to choose the best system, first, a few BI systems will be chosen from the list above and they will be analyzed in detail in the next part of the article. Assumed criteria of selection (so-called MUST-BEs) are fulfilled when the system includes in its functionality a configurable management dashboard, is successfully implemented in the public/state/education sector, is

successfully implemented in Poland, offers the possibility of integrating with various data sources. On the basis of these criteria, the list has been narrowed down to the following positions: SAP Business Objects Enterprise XI, Microsoft BI tools (integrated BI offering), Oracle Enterprise BI Server and QlikView.

5. Comparative analysis of chosen BI products

To carry out comparison of BI products, criteria must be chosen specially for SYNAT project with properly assigned importance. The criteria including the results are presented in Table 3, where:

Importance level: 1 – very important, 2 – important, 3 – important but not obligatory. Respectively weights: 1 = 1, 2 = 0.5, 3 = 0.25.

Is the given criterion fulfilled by the product?: N = no, Y = yes.

Table 3. Classification criteria of BI products and their comparison

Criterion	Importance level (1, 2, 3)	SAP	MS	Qlick View	Oracle
1	2	3	4	5	6
Infrastructure and architecture					
Central installation on a server and a dashboard available through the web browser	1	Y	Y	Y	Y
Integration with any operating system including open-source	1	Y	Y	Y	Y
Administration: central management and support of the system from the console	2	Y	Y	Y	Y
Administration: possibility of generating audit reports (Audit Trail Report)	2	Y	Y	Y	Y
Administration: automatic function: Restart & Recovery	2	Y	Y	Y	Y
Administration: blocking and log-in function to the system	1	Y	Y	Y	Y
Administration: build-in helpdesk or a possibility of integrating with any helpdesk tool	3	N	Y	N	N
Access to user documentation/manual from the system level	3	Y	Y	Y	Y
Integration with any external system including data sources and other sources (e.g., external portals)	1	Y	Y	Y	Y
Data extract in any file format including Excel and PDF	1	Y	Y	Y	Y
Possibility to integrate with any e-mail system (including the domain)	1	Y	Y	Y	Y
Efficiency of a data warehouse: generating comprehensive reports within maximum 10 seconds	1	Y	Y	Y	Y
Increase in efficiency of actions through additional CPU and RAM actions on local servers	1	N	Y	N	Y

Table 3, continuation

1	2	3	4	5	6
Access and security					
Safe logging-in (user, password)	1	Y	Y	Y	Y
Possibility of giving authorizations at the table level	1	Y	Y	Y	Y
Possibility of giving authorizations at the column level	1	N	Y	N	Y
Following history of changes (history file logs)	1	Y	Y	Y	Y
Main functionality					
Alert System	1	Y	Y	Y	Y
Functionality OLAP (On-Line Analytical Processing)	2	Y	N	Y	Y
Possibility of reporting AD-HOC	1	Y	Y	Y	Y
Reporting PUSH and PULL	2	Y	N	N	Y
"Drill-down" functions	1	Y	Y	Y	Y
Possibility of searching data in text formats and files	1	N	Y	N	N
Possibility of presenting data in any range including historical data	1	Y	Y	Y	Y
Possibility of setting own input parameters without the need to know SQL or other request language	1	N	Y	N	N
Possibility of making any aggregation of data, calculations, etc.	1	Y	Y	Y	Y
Possibility of presenting data graphically, e.g., in the form of charts	1	Y	Y	Y	Y
Possibility of formatting presentation elements	2	Y	Y	Y	N
Possibility of saving templates of formatted reports/ dashboards	2	Y	Y	Y	Y
Possibility of creating own dashboards without a need for programming (built-in function)	1	N	Y	Y	N
Interactive dashboards	2	Y	Y	Y	Y
Possibility of creating and changing KPIs at user/user group level without influencing globally defined KPIs	1	Y	Y	Y	Y
WHAT-IF analyses	2	Y	N	Y	Y
Scheduling report generations functionality	2	Y	Y	Y	Y
Automatically sending generated dashboards by e-mail	1	Y	Y	Y	Y
Servicing many localizations and creating dashboards depending on localization	1	Y	Y	Y	Y
ETL functionality					
ETL: Metadata central functions	1	Y	Y	Y	Y
ETL: Transformation of any data formats	1	Y	Y	Y	Y
ETL: Creating business rules	1	Y	Y	Y	Y
ETL: Functions of data cleansing and aggregation	1	Y	Y	Y	Y
ETL: Error management	1	Y	Y	Y	Y
ETL: Scheduling ETL works	1	Y	Y	Y	Y
Functions of managing data quality	1	Y	Y	Y	Y

1	2	3	4	5	6
Additional functionality for project management purposes					
Functionality: planning (connections with the calendar and alert system)	1	N	Y	N	N
Functionality: managing data resources	1	N	Y	N	N
Functionality: managing other resources for project organization needs	1	N	Y	N	N
Functionality: work-flow, including approval hierarchy	1	N	Y	N	N
Functionality: check-in and check-out	1	N	Y	N	N
Creating own tasks-tracking templates (tasks within the plans)	1	N	Y	N	N
System of managing access authorizations to individual resources	1	N	Y	N	N
Additional criteria					
The tool has been used in a project similar to SYNAT	1	N	Y	N	N
High availability of implementation consultants on the Polish market	2	Y	Y	N	N
The tool may be administered by internal resources	2	N	Y	N	N
Implementation of the tool lasting up to 6 months (whole implementation cycle, including trainings and organizational changes)	1	N	Y	Y	N
Product integrity (i.e., if the delivered product is one, integrated product or it has a multi-module construction which has an influence on the license price)	1	Y	N	Y	N

Source: authors' own work.

Principles:

1) The criteria have been chosen with respect to the needs of SYNAT project.

2) The level of the importance of individual criteria has been assigned on the basis of the knowledge of SYNAT project and possible needs/requirements.

3) Product comparison (Y = yes, N = no) has been done on the basis of available materials from solution suppliers.

The results of the comparison have been calculated on the basis of the sum of the multiplication of fulfillment of the condition and the weight assigned to the importance of the criterion. Table 4 presents the results.

Table 4. Results of the comparison of the products.

SAP	$27 + (11 \cdot 0.5) + (1 \cdot 0.25) = 32.75$
MS	**$40 + (9 \cdot 0.5) + (2 \cdot 0.25) = 45$**
QlickView	$32 + (6 \cdot 0.5) + (1 \cdot 0.25) = 35.25$
Oracle	$28 + (9 \cdot 0.5) + (1 \cdot 0.25) = 32.75$

Source: authors' own work.

The obtained results of the assessment of the solutions are quite similar. Microsoft BI solution fulfills the highest number of the required criteria according to the conducted analysis. All the compared solutions are products that offer high-class management dashboards, including cutting edge functionalities and attractive graphics. However, the actual needs of SYNAT project should be stressed here because they will be slightly different from the requirements typical for a commercial enterprise. These may include:

- A functionality of an additional module dedicated for project management. MS has such a product called SharePoint. It is somehow part of MS BI. It simple in implementation and has high efficiency. In SYNAT project conditions, where the management platform for project documents is not fully operating, such a solution seems to be the perfect one.
- A possibility of integrating with the system storing project documents. As mentioned earlier, there is integration with SharePoint. MS offers integration with other dedicated systems to store documents including file servers. Thanks to the search functionality for text files, in MS dashboards KPIs characteristic for project management may be configured.
- Using the product in other similar operations. MS BI, including SharePoint, is a product which is often used for project management. The simplicity of the implementation of ETL Layer, data warehouses and dashboards and therefore common knowledge of MS products make the participants of the project willing to use this solution.
- Swiftness of implementation and product scalability. SYNAT project has its deadline. Therefore, a long-term implementation of a tool cannot be allowed. In the case of implementing the management dashboard, the implementation process does not involve exclusively parameterization of the dashboard, but implementation of other layers of Business Intelligence as well. It is usually a long process requiring significant interactivity on the customer's side. MS solutions will also require customer's participation. However, due to the common usage of MS products, time frames of some implementation phases (e.g., configuration of the solution, tests and trainings) will be shorter comparing to SAP or Oracle solutions.
- Using the tool after finishing SYNAT project. Undoubtedly, SYNAT will evolve and develop after the official GO-Live. Therefore, BI should include a flexible functionality and a possibility of quick re-parameterization of each of its layers. Such possibilities have been taken into consideration while analyzing the tool. Most probably, MS is the tool which may be reconfigured by local administrators without a need for external consultants. All MS tools assume implementation options through internal resources. This is an important element which should be considered while choosing BI product.

The conducted analysis suggests using Microsoft solutions, which are based on Microsoft BI tools.

6. Final remarks

The limited size of this article allows presenting only chosen problems regarding using tools such as BI and management dashboard connected with it. The works on SYNAT project are in progress. We hope that as a result of the realization of the project the communication between teams of scientists will be more efficient and money spent on science will be more effective than before.

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UŻYCIE SYSTEMU KLASY BI
W ZARZĄDZANIU INFORMACJĄ NAUKOWO-TECHNICZNĄ
NA PRZYKŁADZIE PROJEKTU SYNAT

Streszczenie: Artykuł poświęcony jest tematyce projektu SYNAT jako przykładowi dla budowy naukowych i technicznych systemów informacyjnych. W artykule przedstawiono analizę niezbędnych oraz potencjalnych rozwiązań, między innymi koncentruje się na kwestii wyboru systemu klasy BI jako narzędzia, które wspomaga projektowanie przyszłej platformy naukowej. Zostały zaprezentowane i porównane możliwe rozwiązania BI. Po przeprowadzonej analizie przedstawiono rekomendacje. W artykule zwrócono uwagę na to, iż rozwiązanie BI powinno zawierać w swoich funkcjonalnościach możliwość budowy kokpitu menedżerskiego.

Słowa kluczowe: *Business Intelligence*, system informacyjny, hurtownia danych, kokpit menadżerski, wirtualna przestrzeń pracy, zarządzanie dokumentacją, KPI – kluczowe wskaźniki wydajności.