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## IMPLEMENTATION OF BUSINESS INTELLIGENCE PERFORMANCE DASHBOARD FOR THE KNOWLEDGE MANAGEMENT IN ORGANIZATION

**Summary.** Nowadays, knowledge management in organization is a big challenge and an important task for managers at all levels. The effectiveness and efficiency in a decision-making process – to a high extent – depends on the availability of reliable and comprehensive knowledge. There are many IT tools that were created to meet an organization's needs related to the access to the best quality of knowledge. This publication concerns the theme of knowledge management in organization and the tools supporting this sphere. The authors focus on the characterization of the management dashboard within the architecture of the Business Intelligence system. Moreover, the implementation process of dashboards within the Business Intelligence system is defined and presented.

**Słowa kluczowe:** Business Intelligence, performance dashboard, knowledge management.

## WDRAŻANIE KOKPITU MENEDŻERSKIEGO W CELU ZARZĄDZANIA WIEDZĄ W ORGANIZACJI

**Streszczenie.** Zarządzanie wiedzą w organizacji obecnie stanowi duże wyzwanie i ważne zadanie dla menedżerów wszystkich szczebli. Skuteczność i efektywność w procesie podejmowania decyzji są w dużej mierze uzależnione od dostępności wiarygodnej i pełnej wiedzy. Istnieje wiele narzędzi informatycznych, które powstały w celu zaspokojenia potrzeb organizacji dotyczących dostępu do jak najlepszej jakościowo wiedzy. Niniejszy artykuł podejmuje tematykę zarządzania wiedzą w organizacji i narzędzi wspierających ten obszar. Autorzy skupili się na scharakteryzowaniu kokpitu menedżerskiego w ramach architektury systemu Business Intelligence. Ponadto, zdefiniowano i przedstawiono proces wdrażania kokpitu menedżerskiego w ramach systemu Business Intelligence.

**Keywords:** Business Intelligence, kokpit menedżerski, zarządzanie wiedzą.

## 1. Knowledge management in organizations

Knowledge management in organizations constitutes an example of a dynamic organization management concept, which is related to the rise of the knowledge-based economy [1]. The knowledge-based economy refers to the process of production, distribution and use of knowledge and information [2]. One of the aims of this trend is pursuing chances of success of the organization in the knowledge and experience of employees. Therefore, knowledge plays a primary role in determining the competitive advantage of the organization [3]. Thus, there is a need for a formalized knowledge management, (which exists in a material form, e.g. documents, manuals, training materials), as well as for a tacit knowledge management (which is stored only in the minds of workers) [4].

The literature defines knowledge management in various ways. According to the USA Ministry of Defence, the knowledge management can be defined as a systematic and integrated approach to the process of identifying, managing, and sharing the holistic enterprise's information resources, including documents, databases, policies and procedures, taking into account the expertise and experience of the particular employees [5]. In interdisciplinary terms, the knowledge management means an efficient learning process, related to searching, exploitation and dissemination of knowledge (formal and tacit), which uses the appropriate technologies and cultural environment, whose objective is to increase the intellectual capital and the efficiency of the company [6]. The aspects of knowledge management are presented in Figure 1.

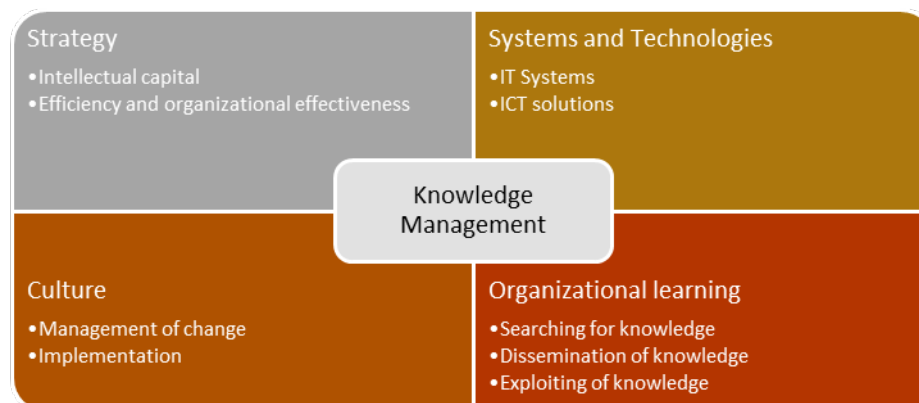


Fig. 1. The aspects of knowledge management

Rys. 1. Aspekty zarządzania wiedzą

Source: own elaboration based on [6].

Multifacetedness of knowledge management is extremely important from the point of view for building a competitive advantage of a company as well as for the development of this management discipline. One should emphasize that knowledge management should be focused on both the computer systems and information technology, as well as on the human aspect of the generating and transferring the knowledge basing on informal contacts between workers [7].

NASA scientists have defined knowledge management as a provision of the right knowledge to the right people at the right time and an assistance in the creation of knowledge, sharing it and making decisions based on it, so that measurably improve the operations of NASA and its partners [8]. This definition clearly indicates the function the knowledge and its management play in the organization. Knowledge management should support the decision maker as the relevant knowledge is essential in the decision-making process.

Knowledge management can be supported by a variety of ICT tools using both technical solutions (e.g. the Internet) and software (IT systems). One can distinguish a variety of tools supporting knowledge management, as presented in Figure 2.



Fig. 2. Exemplary knowledge management tools

Rys. 2. Przykładowe narzędzia wykorzystywane w zarządzaniu wiedzą w organizacji

Source: own elaboration based on [9].

Knowledge management tool generally can be defined as a tool that supports the application performance, tasks or actions such as knowledge generation, knowledge codification, or knowledge transfer [10].

In the literature, one can find the classification of tools supporting knowledge management in the following categories [11]:

- Content management tools – tools enabling integration, classification, and codification of knowledge from different sources;
- Tools to share knowledge – tools supporting the sharing of knowledge between people or other entities;
- Systems to search for knowledge – systems to find and acquire the desired knowledge; they also have a capacity to discover knowledge
- General Knowledge Management Systems – systems that offer a general solution to the needs of organizations for knowledge management.

The examples of tools assigned to the above-mentioned categories are presented in Figure 3.

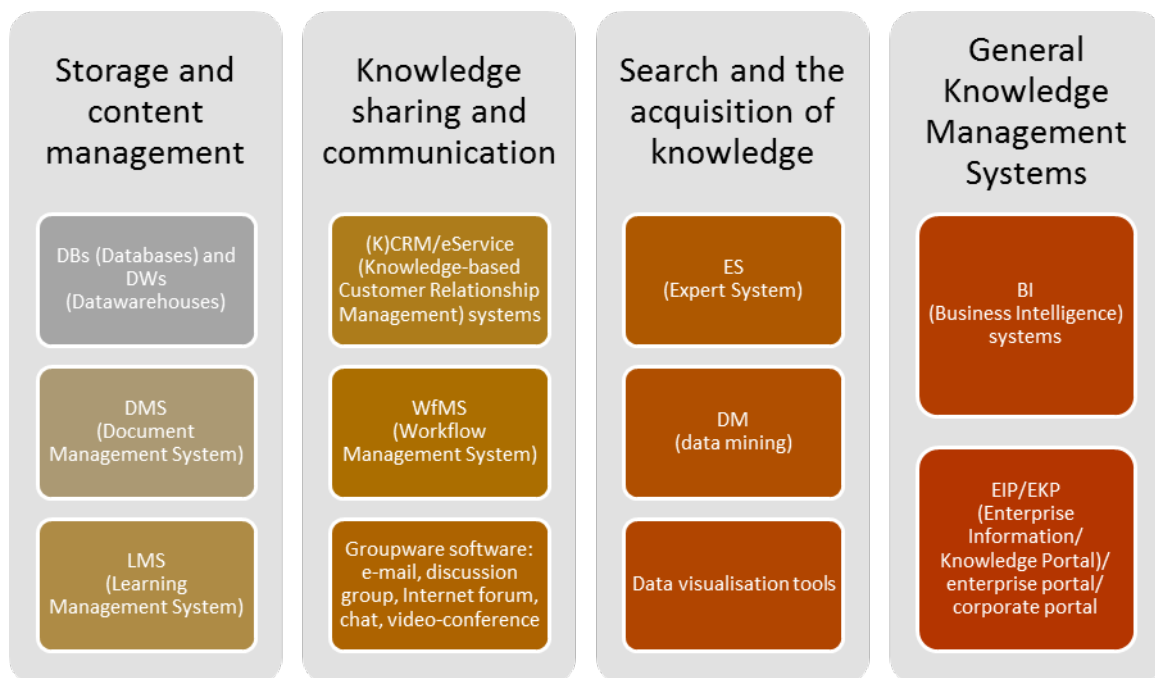


Fig. 3. Categorized examples of IT tools used in knowledge management in an organization

Rys. 3. Skategoryzowane przykładowe narzędzia IT wykorzystywane w zarządzaniu wiedzą w organizacji

Source: own elaboration based on: [12].

Business Intelligence systems, which have become more and more popular within large companies, can be assigned to the group named General Knowledge Management Systems. And in the knowledge search and retrieval sphere, a management dashboard is one of the visualization tools [12]. Firstly, in the hereinafter publication, the implementation process of

Business Intelligence in the organization is presented. Then, the authors discuss the management dashboard and the process of its implementation.

## 2. Implementation of Business Intelligence system

Construction of a Business Intelligence system is a combination of three functionality and technology layers that correspond to the various stages of data processing. The aim of the data processing is its analysis and information provision to the decision-makers [13]. This construction is presented in Figure 4.

It can be stated that the core architecture of Business Intelligence systems are data warehousing, analysis tools and presentation techniques [14].

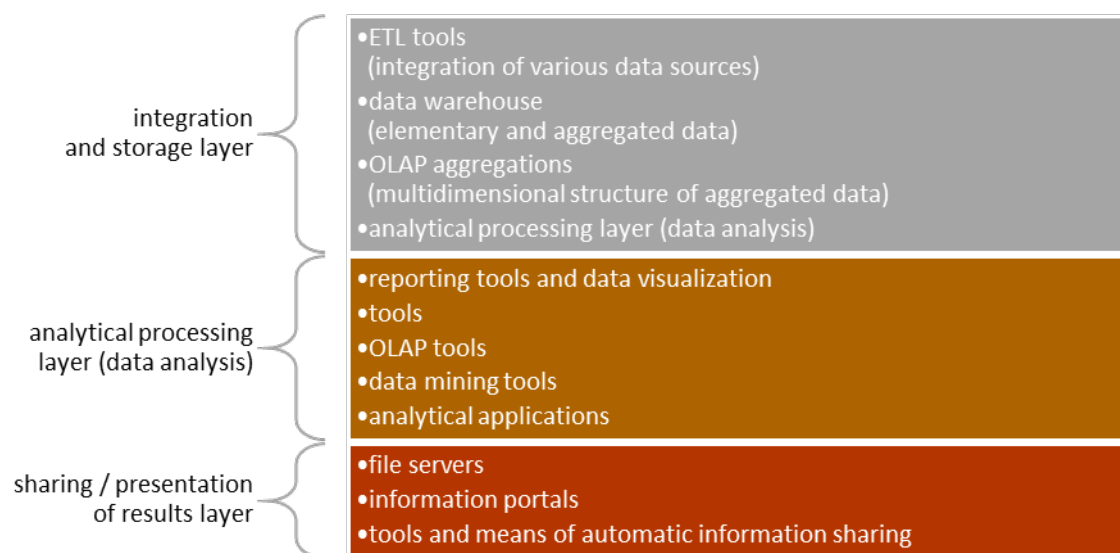


Fig. 4. Architecture of Business Intelligence System

Rys. 4. Architektura systemów Business Intelligence

Source: own elaboration based on [13], [15].

The presentation layer of Business Intelligence system, which directly interacts with the data warehouse layer, is represented by a management dashboard. [16]. The purpose of the presentation layer of the Business Intelligence system is to provide information to users in a convenient and accessible way, using all kinds of applications, containing graphics and multimedia interfaces [17].

Dashboard is a synthetic form of presentation of largely simplified information. Dashboard uses the advantages offered by the visualization of information using various graphic elements. Visualization enables to summarize and present extensive data sets in a transparent manner, to notice their interdependence, to explain the relationships that exist

between different kinds of information and even to complement them [18]. Dashboard allows monitoring the situation of the organization, warns it against the negative phenomena, and improves the decision-making process.

Implementation of the system is one of the stages distinguished in the life cycle of the IT system. The implementation process is considered to be one of the most complex tasks, due to the fear of changes perceived by the organization's employees [19]. Implementation of IT system is a complex process involving the installation and configuration of the system in a user's target environment, testing and starting using test data, transferring of the data (in the case the data was earlier gathered), user and administrator training, and finally – transference of the system to users [20].

Implementation of Business Intelligence system in an organization is a laborious process, involving many phases, which may vary depending on the methodology adopted for implementation. The phases may follow one another or may become intertwined. The choice of approach depends on the specifics of the company. However, most often, it is assumed that the implementation of Business Intelligence in the organization comprises the stages presented in Figure 5 [12].

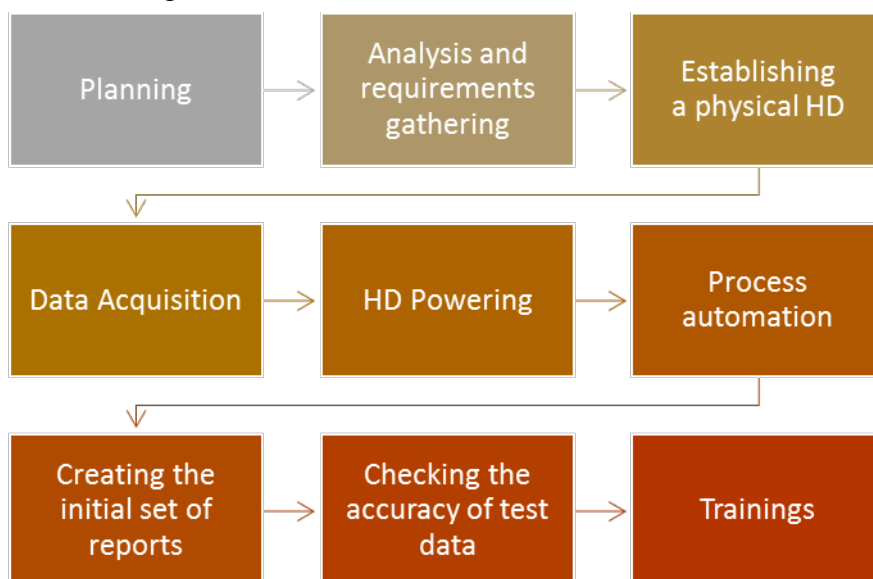


Fig. 5. Stages of Business Intelligence implementation in organization

Rys. 5. Etapy wdrażania Business Intelligence w organizacji

Source: own elaboration based on [21].

During the planning phase, the project's execution plan is created, the data warehouse architecture is determined, the technical tools are specified, as well as the tasks are defined.

While analysing the implementation, it is essential to understand business needs and requirements of the Business Intelligence systems' users-to-be. The third phase is constituted by a physical data warehouse creation, i.e. tables of dimensions and facts. Finding data sources and analysis of its structure is the next step in the implementation of the Business

Intelligence system. At this stage, it is also necessary to define all the essential operations, e.g. transformation or data clearing in order to ensure the consistency and integrity of data supplying the warehouse. Subsequently, the cleared data supplies the data warehouse. Automation and scheduling of the data supply is the next stage. After data supply to the warehouse, the templates and report drafts, that will be available to users after the system implementation, are prepared. Then, the correctness of the data warehouse functioning is checked with the use of the created reports. The latter phase is constituted by training for both end users and administrators of the system [21].

In addition, before the implementation of Business Intelligence system in the organization, it is recommended to determine the so-called Key Performance Indicators, KPIs [22]. The analysis of these indicators is designed to assist managers in decision-making process and technical employees to use in a more efficient way the equipment and infrastructure of the system [23]. Mostly, these indicators are presented in graphic forms, e.g. directed arrows, thus allowing for efficient interpretation of the results, which in turn enables a faster response to emerging issues (e.g. production efficiency loss, decrease in sales) [23].

Successful implementation of the Business Intelligence system is closely connected to the use of its functionality by individual end users. In practice, this means that the success of the implementation of the Business Intelligence system is determined by its correspondence with the organization's expectations [24].

The main benefits associated with a successful implementation of Business Intelligence systems in the organization are [25]:

- Reliable and consistent information from all business areas;
- Organization's data transformed into useful knowledge;
- Efficient making of predictions for the company;
- Rapid response to market trends, detection of threats and opportunities in the business sphere;
- On-going tracking of budget deviations;
- Fewer people involved in the decision-making processes;
- Increased number of correct decisions;
- A higher rate of return on investment.

### **3. Definition of a management dashboard**

As a starting point for a reflection upon the management dashboard, the authors have worked out a list of definitions of the dashboard presented by the producers of Business Intelligence software. Table 1 presents the definitions chosen. The definitions have been found on the websites of companies that are listed in the so-called Magic Quadrant. Gartner's

Magic Quadrants represent market in its mid-life cycle. The use of a two-dimensional matrix helps to measure the vendors' effectiveness based on their completeness of vision and how they are able to execute them [26].

Magic Quadrant for Business Intelligence and Analytics Platforms by Gartner as of February 2014 is presented in Figure 6.



Fig. 6. Magic Quadrant for Business Intelligence and Analytics Platforms by Gartner  
Rys. 6. Magiczny Kwadrant Gartnera dla platform analitycznych i Business Intelligence  
Source: [26].

Out of 27 companies, 10 were randomly selected and their websites were analysed. It turned out that the companies' information about the products, supporting pages or knowledge bases provided a definition or indicated characteristics of a management dashboard. Usually, one definition was quoted from one subpage of a given company.



Table 1

## Business Intelligence performance dashboard definitions

No.	Performance dashboard	
	Company	Definiton or description
1	Infor	Business dashboards present a unified graphical display incorporating key business status information in a format that's easy to read.
2	Logi Analytics	Dashboards—sometimes called IT dashboards or corporate dashboards—are single screens in which various critical pieces of information are placed in the form of panels. Like dashboards in a car, they allow the end-user to have a unified view of the data and information that matters to “drive” the business forward.
3	Microsoft	A dashboard is a related group of interactive scorecard and report views that are organized together. Dashboards have capabilities like advanced filtering, guided navigation, interactive analytics, and visualizations. It contains a collection of indicators, data, or graphics.
4	Micro-Strategy	A dashboard is a display of related sets of data on one screen. A dashboard is commonly used to assess company or personal performance, to take a quick status check of the company, or to monitor personal work or work group contributions to overall goals of the business. Dashboards summarize key business indicators by presenting them in visually intuitive, easy-to-read, interactive form.
5	Oracle	Dashboards provide personalized views of corporate and external information. A dashboard consists of one or more pages. BI dashboards bring together reports and graphs from several data sources and present information to users in a simple-to-understand, unified manner.
6	Pentaho	Interactive dashboards offer business users key performance indicators in a highly graphical visual interface to improve organizational performance.
7	SAP	Dashboards contain various components, such as charts, graphs, and buttons, which are bound to data sources. These components display the data in a compact and visual manner, which can then help the dashboard consumer see trends and make informed business decisions.
8	SAS	Dashboards provide quick access to key performance information that business professionals need to make effective decisions.
9	Tableau	Designed properly, a good business dashboard is an indispensable tool that informs with a glance. Good dashboard software should provide: Interactivity: Filtering, highlighting, and other dashboard tools; The ability to combine multiple data sources; Fast creation by a business user; Easy sharing with support for existing security; Visual analysis best practices
10	TIBCO	Dashboards attempt to give decision-makers a complete overview of their business operations, and should allow follow-up on important business decisions without a complicated interface. This is achieved by using charts that are relatively simple compared to some of the graphical displays that are often applied in more sophisticated analytic applications.

Source: own elaboration based on: [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39].

A management dashboard can be defined as a visualization of the most important information presented on one screen required to achieve one or more goals. Dashboard should allow for a quick and easy monitoring: the most important information should be seen at glance [40]. The objectives of the management dashboard are effective measurement, monitoring and management of the achievements of the specific unit. One could say that dashboards are multi-level applications based on the infrastructure that integrates data from a variety of economic data collection systems [41].

Dashboard is a form of data presentation, which uses simplified graphical elements [42]. Among management dashboard graphic elements, one can enumerate: statistical graphs (e.g. pie charts, column, bar, line, and radar charts, Chernoff faces, as well as dotted, surface, pictorial, and segment charts), statistical maps (e.g. cartograms, thematic maps, dot method, the method of contour lines), icons (e.g. traffic lights, arrows), speedometers and counters, thermometers, conditional formatting numbers, heat maps, and spark line charts or bullet graph specific to the dashboards [43]. Despite a diversity of graph forms, one should be aware of the fundamental principle of dashboards creation: the most important features in data presentation are simplicity and efficiency [44].

The main management dashboard's objective is to provide right information to the right users at a particular time, with the aim to optimize the decision-making process, and to improve the efficiency and performance of the company [41]. Management dashboards also provide analytical results. These results enable to acquire knowledge, which often is strategic from the decision-makers' point of view [45].

Dashboards are used, among others, in areas such as finance, marketing and production. They are also popular in monitoring ICT infrastructure [44]. However, one can also notice that they are used in e-health. For instance, they are applied in monitoring epidemiological phenomena [45], e.g. as a tool to track the incidence of influenza [46]. Dashboards have become so common that banks offer it to their retail customers as one of the tools in a running account. These tools enable users to track their expenditure and revenue and to assess their financial condition. For example, ING Bank Śląski named it Finansometr, which may be translated as Financemeter, a finance calculating device. Finansometr is a transparent system for managing the household budget, which automatically analyses the carried out transactions on customer accounts and assigns them to specific categories of expenditure and revenue such as Fundamental Spending, Health and Beauty, Entertainment and Traveling or more specific subcategories. This tool allows comparing expenditure in different periods of time, which enables to have a complete picture of finances and effective management of the household budget [47].

The information presented in a dashboard should be reliable, embedded in the appropriate context (giving the ability to compare it to desired value or historical data), current and – what is most important – clear and transparent. Key indicators should be exposed, and all information should be at an appropriate level of minuteness. When visualizing the data, one

should also be aware of the correct selection of forms of presentation, the level of precision and appropriate colours. The component placement is also extremely important [18].

The effective management dashboard consists of a reasonable number of elements and which does not evoke in users the effect of welter. Dashboard should be transparent and aesthetic, which can be achieved by use of charts, readable formatting numbers, right application of data labels and titles. A very significant rule is a limitation concerning the dashboard display on one screen (users should not scroll the screen to display all the elements of the dashboard) [48]. Construction of the dashboard should be preceded by careful design, in which users-to-be are involved. The project should reflect the needs expressed by specific users [49].

To summarize the previous discussion, the dashboards' characteristic features are listed below [50]. Management dashboards:

- Display the information needed to achieve specific goals;
- Display elements on one screen;
- Enable to track information at one glance;
- Are compact, concise, clear and intuitive presentation mechanisms;
- Enable personalization.

The first chapter of this publication touches upon the issue of knowledge and knowledge management, which are crucial in the decision-making process. Therefore, it seems important to determine the role the dashboard plays in the decision-making process, which was indicated by the authors as a tool for knowledge management. The decision-maker monitoring the selected sphere of the enterprise, basing on visualization of key performance indicators (KPIs), can identify the problem and take further action.

Referring to the decision-making process, an easy-to-read dashboard initiates a decision-making situation. Decision-maker at the stage of diagnosis tries to identify the problems and to find out their source. Dashboard is the first tool, whose objective is to clearly indicate the problem. If the dashboard is interactive and allows for an easy preliminary analysis, it is possible to use it also at the design stage in order to provide decision variants. The comparison of different variants requires the dashboard to simulate various scenarios. Hence, this leads to a conclusion that dashboard can support decision-makers throughout the decision-making process, provided it is interactive and sophisticated. It should therefore be assumed that there are two approaches to decision-making processes when using dashboards: holistic and partial. A partial approach means supporting the decision-making process only at the stage of diagnosis. Just signalling problem for experienced decision-makers may be sufficient, and this is the main goal of dashboards. A holistic approach stands for taking into account the issue of analysis and simulation at management dashboard [51].

#### 4. Implementation of a management dashboard in the organization

Dashboard implementation is a complicated process dependent on many factors. There is possible to distinguish three layers of developed project: data source layer, BI layer and data visualization layer. It is presented in Figure 7 [52].

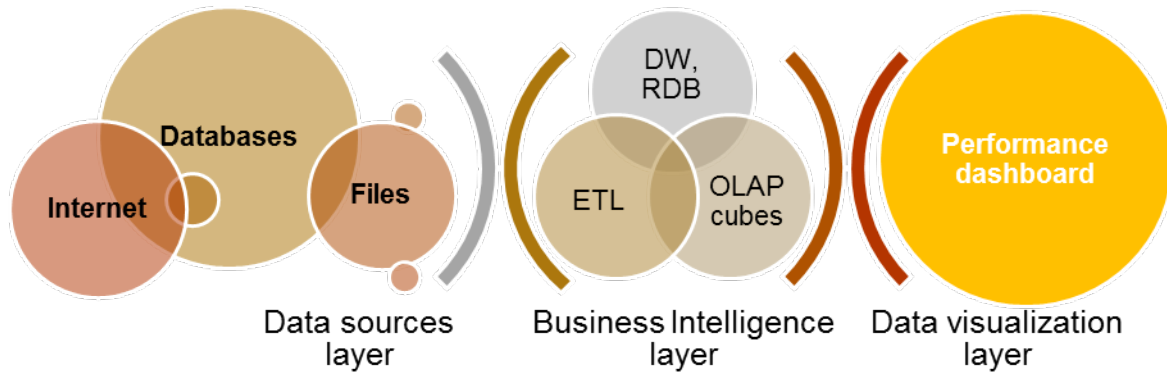


Fig. 7. Layered project structure of performance dashboard  
Rys. 7. Warstwowa struktura projektu kokpitu menedżerskiego  
Source: own elaboration based on [52].

As Figure 7 presents dashboard visualize data extracted, transformed from sources and loaded to database and to data warehouse.

For dashboard development could be suggested lifecycle approach. It is presented in Figure 8. Pre-phase of performance dashboard lifecycle consists defining and initiation of governance, resources and strategies. First phase is for designing technical and business solutions and KPIs.

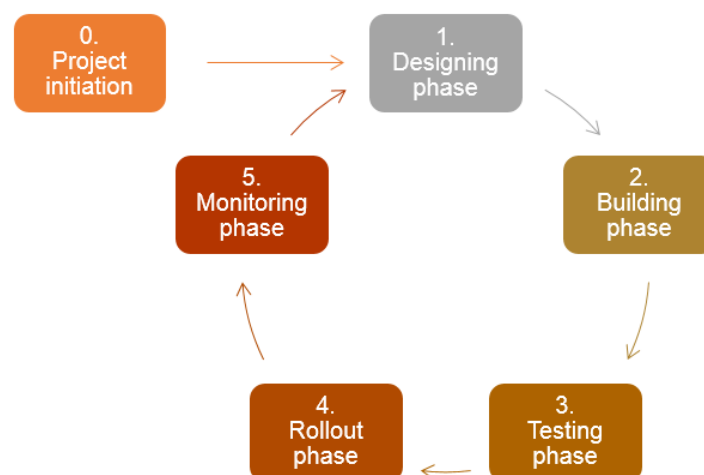


Fig. 8. Performance dashboard lifecycle  
Rys. 8. Cykl życia kokpitu menedżerskiego  
Source: [52].

During building phase data access is constructed and tools are chosen. After that, a testing phase starts. If project passed this phase users participate in conduct pilot. Last phase in cycle is for monitoring dashboard, evaluating feedback and prepare for next iteration [53]. Construction of the dashboard proceeds in stages. In literature, one can find such a construction's basic stages, which are presented in Figure 9.

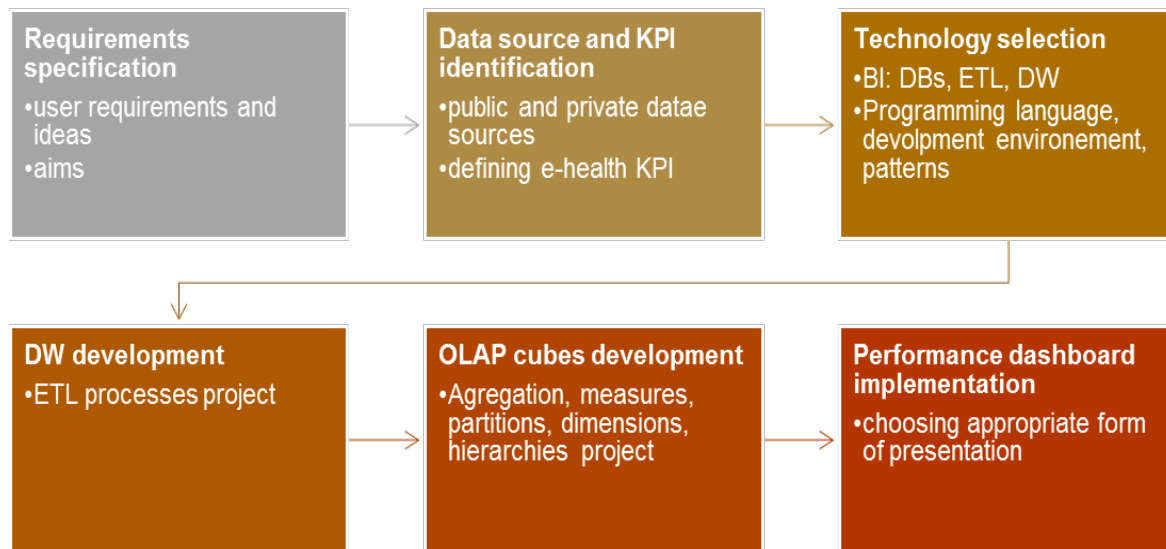


Fig. 9. Phases of development of the performance dashboard  
Rys. 9. Fazy budowy kokpitu menedżerskiego  
Source: [52].

The basis for the design of a dashboard should be accurate defining of the expectations and requirements of the end user of the dashboard. They should take into account [48]:

- KPIs corresponding to the initial objectives,
- Transfer meaning the objectives executed by dashboards,
- Users, which allows to specify more specific requirements,
- Dimensions (data clustering) and filters (data sorting),
- The type of mining data relevant to specific measures,
- The availability and quality of data sources,
- The data update schedule.

The KPIs selected in the design process should meet a number of objectives, i.e. [54]:

- Focus on a few critical instead of many trivial principles,
- Should lead to the implementation of the strategy,
- Could be associated with all organizational levels,
- Ensure the correctness of the data for the KPI,
- Should provide the ability to control.

## 5. Summary

In this publication a management dashboard is precisely discussed in the context of knowledge management. The authors define knowledge management in organization and present exemplary knowledge management tools divided into categories.

Implementation of Business Intelligence system in organization is characterized. Subsequently, a dashboard as an element of Business Intelligence system presentation layer is widely characterized. In order to highlight the most important features of the dashboard, the authors present both commercial software vendors' definitions as well as the definitions derived from the academic literature.

The authors describe the process of implementing dashboards within the Business Intelligence system in the organization, and depict its main stages. The key performance indicators (KPI) are described as an important element of dashboard and KPI objectives are detailed.

A properly implemented, effective management dashboard provides a convenient access to the required knowledge. Due to its visual, simple and interactive form, dashboard could be a perfect knowledge management tool for managers.

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## **Omówienie**

Organizacje dla osiągnięcia lepszej efektywności potrzebują dostępu do pełnej wiedzy o swoim funkcjonowaniu i kondycji. Potrzeba ta wyzwoliła wykształcenie się dyscypliny określanej mianem zarządzania wiedzą. Autorzy artykułu definiują zarządzanie wiedzą i przedstawiają wiele narzędzi informatycznych, które wspierają ten obszar organizacji. Artykuł porusza zagadnienia systemów klasy Business Intelligence, które umożliwiają integrację wiedzy w organizacji i oferują narzędzia analityczne, pozwalające na wydobycie wiedzy na podstawie danych. Uwaga autorów została skupiona na kokpitach menedżerskich zawierających się w warstwie prezentacji systemów Business Intelligence. Autorzy przybliżyli istotę kokpitu menedżerskiego na podstawie analizy literatury przedmiotu i definicji firm oferujących rozwiązania Business Intelligence. Ponadto, scharakteryzowano proces wdrożenia kokpitu w organizacji.