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## **Metabase cockpits as a base for BI in Strategic management**

**Abstract:** *The data diversity, scope and volume have increased to unprecedented levels necessitating numerous tools, techniques and technologies that enable the collection, integration, storage, systematization and analysing of existing data. The potential for creating strategic values based on data has always existed. But today, given the availability and diversity of data as well as new managerial, technical and technological capabilities for their collection, storage, processing and analysing data is a key driver of innovation, competitiveness and company productivity. Data as a resource is considered “responsible” for the revolution in management, a resource equal to “oil and gold”. Today, information is a dynamic category, big data and a ‘living organism’ which changes by the second, is on top of the mind of every company and top management. So it is believed that the power of a company is in precision of facilitating the information flow. The starting point for creating information are data and information, as necessary contribution for knowledge creation once placed into context and relevant for the user’s orientation, situational awareness, sense making and decision making.*

*This paper addresses the information needs of managers at the strategic level using diverse software solutions in which Business Intelligence (BI) defines approaches for collecting, storing, processing, analyzing and presenting company and business ecosystem data. A special place in this paper is for the METABASE tool which can be used in Data Science and visualization of BI concepts and managerial approaches. Metabase cockpits/dashboards are designed to present, visualize, report, and monitor a company's long-term strategy using critical success factors that influence business operations. They can track efficiency performance against a company's strategic goals. Thus facilitating and speeding up a company's decision-making process. Metabase cockpits present company data to all levels of management, but ought to be designed with the principles of adaptability and responsiveness, in order to capture the dynamic complexity of the world. Metabase cockpits also support automated draft decisions that can be used in the decision-making processes. For the needs of this paper, Metabase cockpits are presented as functional concept for the needs of the company's management, while at the same time, combined with real data, gives relevant knowledge as a tool for Data Science and BI.*

**Keywords:** *Information systems requirements, Strategic management, Business Intelligence, Metabase cockpits, Management Information Systems*

### **1. Introduction**

With the increase in the use of the Internet, today we have huge amounts of ubiquitous data, so the amount of publicly available data is increasingly reaching large scale. The large amount of data that has so much power and potential is supposed to answer every question, but availability alone does not mean it has to provide a solution too. The information contained in the data can answer various questions and help solve the problems that various business systems face.

Data explosion is an inevitable trend. Thus considering the great technological achievements, people and organizations are more and more dependent on computer devices, technologies and tools which are used to work with data, collecting, storing, processing and displaying it. The biggest problem companies face is the lack of appropriate tools specialized in integrating all the technologies needed to carry out the data analysis process. A complete tool should include the whole

process of finding accurate data and requirements, data collection, processing, visualization as well as storage and display in accurate form.

One of the tools that enable accumulation of available data in real time is Metabase cockpits which is an open source and offers an easy way to present information, create them, organizing and sharing data collections for all employees in a company in accordance with their privileges. This paper identifies the main benefits of using this tool as well as the modern approach, modern methods and methodologies related to business intelligence and support systems in the decision-making process at a strategic level. One of the main reasons for creating, designing and using Metabase cockpits is their efficient use of information technologies in order to manage, facilitate and accelerate the decision-making processes for the management of the company.

The emphasis is on discovering knowledge in databases and their use in decision making management. By creating Metabase cockpits, data can be presented to companies and managers in a form that they can use in their decision-making processes.

Subject of research in this paper are the tools- Metabase cockpits as basic tools that can visually present information or data displayed literally on one page. This paper will also pay attention to managers at a strategic level and based on these indicators (which may be financial or non-financial) they can make appropriate conclusions and make their decisions. Data presentation can be performed with the help of these tools in order to facilitate the decision making process in a company or organization.

The research methodology used in this paper is an analysis of literature dedicated to research in this area, accessible data through synthesis and analysis, a model developed for the needs of this paper by using Metabase. Experiences that are available for analysis as well as the evaluations of the functionality of Metabase will be used in this section from obtainable sources.

The purpose of the research is to show certain tools for monitoring, processing and data analysis, where they visually display the data from which managers at the strategic level draw a variety of information that facilitate the decision-making process. To make it easier for managers to monitor the work and situation of the company they display the processed data in various ways, including Metabase cockpits from where they draw information and thus can more easily follow the critical success factors and the long-term or strategic goals of the company. The complexity of this issue is considerable because in addition to the objective informational needs each manager owns a unique style of work and subjective need for information organized in a way that is most understandable to him. Furthermore in this paper we will try to give some insight on how this can be achieved and overcome in the most optimal way.

## **2. Theoretical background**

### **2.1 Top management and information**

Top management, which deals with strategic decisions, needs additional information that are drawn from the business environment, laws, competition behavior, business partners etc. It requires a lot of information to be drawn from external sources to achieve this goal (Luckham, D. 2002). This can be done through data acquisition in many different ways. To collect statistics that are publicly available, statistics that are not publicly available and paid for, data that can be collected by web scrapping from competing sites, from media sites, surveys that you would organize yourself or done by independent houses, researches on social networks etc. When it comes to top management or the strategic level of companies it is difficult to be solved by aggregating analytical data that are in ERP software solutions and by using some BI packages (Beatty, R. C. & Williams, C. D., 2006). At this level a large amount of data, which are from the wider and narrower environment of the company's operation, is usually required. It also includes world trends and benefits and possible threats from them. At this level despite using internal and external data we would suggest hiring experts from certain fields who would independently analyze different scenarios for the operation of the company, competition, business environment etc. If all this includes different way of perception of people involved at a management level, the need for information and their presentation makes it the most complex.

Because managers at strategic level are characterized by their constant ambition to achieve something new, they need a plan which can be very simple or complex, short-term or long-term so that they can complete their vision and they need a strategy (Barone, D. & Mylopoulos, J. & Jiang L. & Amyot, D.,2010). A key challenge for managers at the strategic level is how to align the need for processing information with the capacity of companies to collect information, process, analyze and visualize them. Managers who understand the value of data and information and know how to manage it in the right way can greatly improve their business by better understanding the needs of customers, adapting to existing and introducing new services and products which will reduce costs and avoid risk (Liew, A., 2013). However, the process of creating value-based data is long and requires careful consideration. The starting point for creating information is data, while information is necessary to create knowledge. Knowledge contains information that have context and based on that certain actions can be taken. Recently, there have been numerous successful examples of using a computer and modern ICT tools for information processing and creating knowledge (Liew, A., 2013). Making decisions requires bigger intelligence because thanks to modern ICT it is possible to take into account all those data that previously could not have been observed and measured (Minelli, M. & Chambers, M.& Dhiraj, A.,2013). Therefore, the use of modern ICT facilitates the creation and transfer of knowledge, opens up new opportunities, generates new ideas and leads to a greater level of intelligence and wisdom, thus enabling managers at a strategic level to achieve the company's goals.

## 2.2 Dashboard and Data engines

### 2.2.1 Dashboards

Dashboard is a tool that can be used to report and track company's long-term strategy through critical factors of success. They are usually complex in creating, can affect business operations and can be used by managers at the highest level. In order to be functional in business operations Dashboards should be aligned with the company's strategic goals. They track efficiency performances as opposed to strategic goals of the entire company. These Dashboards tend to summarize the performances in terms of the set time frames compared to previous months, quarterly or annually. (Bounegru, L. & Milan, S. & Ciuccarelli.P.,2016). When a dashboard is properly developed, designed and implemented it can effectively reduce the time required to track the realization of company's strategic goals while reducing operating costs. In order to understand how a control dashboard is used in strategic planning and why it is important, it is essential to keep in mind that these dashboards can provide teams with a clear picture of strategic issues and therefore enable them to set certain course of action.

Although they can provide an opportunity to work in specific departments and perform analysis that would be used in future operations, strategic reports and dashboards are usually very highly aggregated. Team members that use dashboards can quickly identify strategic issues and provide extensive strategic reports with analyzed data. The importance is within the management processes, the use of common qualitative and quantitative language and identification of specific symbol to be inserted into the dashboard so that each decision maker understands the presented data (Hung, P. C. K. 2016). The presentation of data in some forms of reports is achieved by processing and systematization of data with an algorithm or method and aggregating them in an appropriate form. Data processing is done with so-called data processors or data engines.

If we take a closer look at each dashboard that is applied at a certain level of management, whether it is dashboards used by managers at a strategic, tactical or operational level, it can be seen that all mentioned dashboards despite being used at different levels of management have some common components and features such as:

- According to the needs of the company's management and of course according to the tasks that are performed all dashboards display certain metrics necessary for that level of management;
- Most frequently all dashboards display comparative data made with set goal (norm), or maybe a comparison with data from the past week achievements, monthly achievements compared to the previous month of the same year or the same month of the previous year;
- Dashboards are creation of authors with ability to adjust by users depending on how much they have opportunity to adjust and on the knowledge users have to do it;
- Metrics are often presented in absolute amounts, percentages and/or perhaps some coefficients that are calculated on different bases.

If we analyze dashboards separately at each level of management we can conclude that although different dashboards are used for each level of management, they still have several common features that can be summarized.

Strategic dashboards represent reporting tools used to track the success of the company in achieving strategic goals, often tracking global performances of the business or focusing on performance or processes of the individual. The data is updated periodically and it is best for managers to review it at least once a day so that they can more easily monitor the work of the company. Multiple data sources or a set of visualizations can be seen as components of dashboards at a strategic level of the management, which usually show analysis of a large amount of data originating from the finance sector or costs data made for marketing campaign and gaining new clients in a company. Data on the company's generated profit for a certain period of time are also displayed (Petrevska Nechkoska, R., 2020). On dashboards you can see components with data that are made comparatively with the costs incurred for a particular marketing campaign for the past month, or users of the products on a monthly basis compared to previous months. Dashboards at a strategic level enable managers to follow critical factors of success as well as the company's long-term and strategic goal at this level. Dashboards used by managers at mid-level (tactical) management are actually tools that show the processes that take place at this level of management and support the strategic goals of the company. At this level of management dashboards contain components that most often display comparative data with target groups. They also contain components that track the working process or goals achievement of a certain project, time frames etc. It also displays comparative data with target groups for specific marketing campaigns that track better how well a particular product or service is known or used by customers (Petrevska Nechkoska, R., 2020).

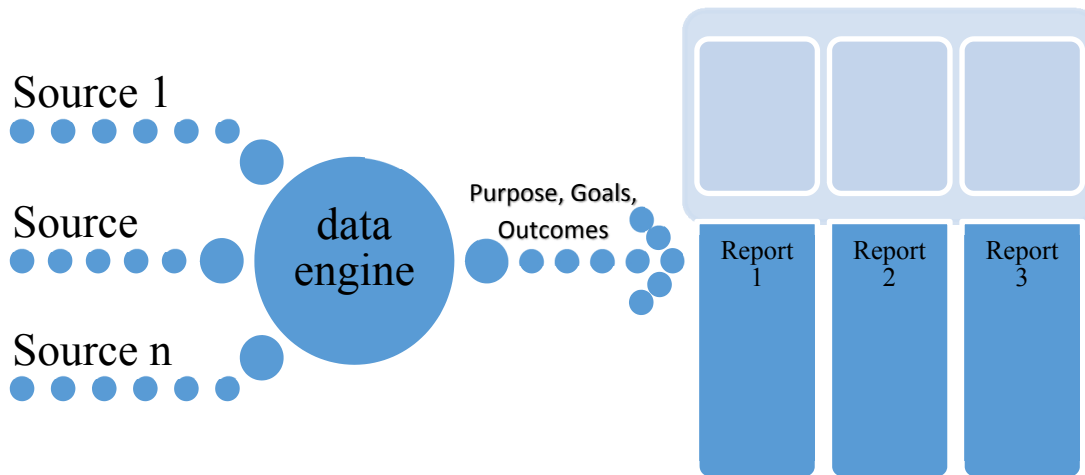
Operational dashboards are tools that display data about everyday business' processes in a company – frequently changed and current metrics of performance or key indicators of performance. These data that are displayed are usually "sensitive" to time because they are analyzed on a daily basis, produced daily by employees and they are changed or updated very often.

If you analyze dashboards used at the operational level of management it can be seen that they usually consist of components that display data for a shorter period of time, they present data summarized on a daily basis such as reviews of a particular campaign which is posted on social media, clicks on the add itself daily and weekly etc. It can be noticed that these dashboards lack the component for data comparison.

## 2.3 Data engines (data processors)

These are software tools that contain appropriate algorithms for data processing and their aggregation and appropriate display to the user.

The connection between the data sources, the data processor and the dashboard (i.e. the user GUI) is shown in Picture 1



**Picture 1.** Logical structure of data processing and their display

**Source:** Authors

Data engine is a software solution that draws data from various data collections. It is interesting to note that powerful data engines are able to draw data “in live” (stock exchanges, banks, weather forecasts etc.) from where they are located and from the company’s own data collections (Software solutions that are used within the company).

The logical structure of data processing and their display in the dashboard is the same for each level of management. The difference is in the data sources and the algorithms they are processed with.

These kinds of solutions can be found in different ways. The simplest approach (it does not mean it is of lower quality) would be with some of the software solutions for cross-tabular calculations. The most famous tools of this type are Excel, Google Docs, Open Office, Libre Office which have built-in capabilities to integrate with various databases and ability to load, process, aggregate and display data in real time. These tools can be connected to both internal and external data sources. This is a convenient tool for less technically oriented users (Bumblauskas, D. & Nold, H. & Bumblauskas, P., 2015).

Another approach would be when SQL is used for selecting, processing and structuring data and the display is done with a tool for preparing reports such as Cristal Report, Excel, Office 365 etc. This is a convenient tool for non-technical oriented users considering that very often large databases are stored in NoSQL databases. But for NoSQL it is developed SQL (SQL for NoSQL) with which data can be extracted in an identical way and further processed.

The third approach would be using some programming languages and their libraries: C++, C#, Java etc. This would be for technically oriented users. The development of such software solutions for data processing is the most expensive approach, both in terms of design and maintenance.

The fourth and most common way today is to use specialized programming languages for such analysis. Today the most famous, most used and most popular at the moment is Python. This is a very powerful JS programming language for data processing. This programming language is also used to process data with Big Data features.

All the previously mentioned software solutions have excellent features for extraction, analysis, processing, aggregation and display of the received reports.

Making decision by the management is a process based on a complex dynamic environment where managers’ demands are growing daily and they constantly need more challenging tasks. In accordance with increasing globalization and availability of information managers need to be provided with a tool that will allow them to navigate the data easily and quickly, which will serve as basis for their decisions (Hazen, B.T. & Boone, C.A. & Ezell, J.D. & Jones-Farmer, L.A., 2014). Every organization should focus on optimizing workflows while ensuring compliance with regulations and responding dynamically to market conditions and customer requirements. One of the options is for managers to use Metabase cockpits to visualize information and data used for various purposes, giving them opportunity to customize their reports so that everyone can see relevant information.

## 2.4 Metabase cockpits profile and potentials

Metabase cockpits use simple but effective graphic tools for visualization of data in order to provide short but precise answers to possible questions on topics on strategic level. But we can say that these dashboards also display clear data

that can be understood by all employees in a company. Data should always be updated so that decision can be made based on the latest facts and events (Huang, W. & Chen, S. & Liu, Z., 2016). Therefore the information displayed in Metabase cockpits must be based on well-integrated BI-solution that constantly has accurate data which are processed in real time because Metabase cockpits are shown as an interface to the stored data of the company and can not be a substitute for business intelligence. On the contrary, these dashboards require established database and for best efficiency they also require automatic processes for collecting data so that Metabase cockpits can present complex business data. The data necessary for analysis and displaying in Metabase cockpits should be available in the company's information systems. Data should also be collected and matched from multiple sources and result in useful information (Bumblauskas, D. & Nold, H. & Bumblauskas, P., 2015). Making decisions at a strategic level is always an important process because they should be clear and with a clear vision of where the business should head and why. The decision should be in accordance with the corporate strategy of the company and its goals (Michel, L., 2013). Metabase cockpits can visualize the company's strategy to the managers, which can help in the decision making process in order to ensure the success of the company itself.

Making important decisions always has a central place where participants can directly link their actions with the company's goals. In order to create a better presentation the business strategy should be well defined, clearly measured with key indicators of performance and visualized. All this should be done with the help of Metabase cockpits. This tool enables all data to be displayed visually so managers at strategic level can more easily and in detail explain to their employees how decisions were made and with what strategic goals they were measured (Waller, M. & Fawcett, S., 2013a). Metabase cockpits provide all the necessary information to managers at the strategic level to run their business unit and most often they are in accordance with the business strategy. In order to achieve this, Metabase cockpits is a holistic view of the company and includes information from different levels which makes it easier to discuss wide-ranging projects or decisions that affect different parts of the company, as the available information cover all aspects of business.

### 3. Simulation of Metabase Cockpits for Strategic Management

Collection, storage and processing of data is a basic imperative of modern companies. Although some companies do not seem to have an organized systematic approach to this process it certainly occurs on different grounds that happen consciously, intentionally or unconsciously:

- What was sold today?
- How much turnover was made?
- What has already been started needs to be done
- What has been done?
- What's going on?
- How much money is there on the bank account?
- How many liabilities are paid?
- How much is there to pay? etc.

If we focus on companies that do it in an organized and systematic way, analysis can result in an interesting concept of organizing data, processing them, extraction of relevant information and distribution to the appropriate levels of management.

**Top level of management** is in direct need of conceptual skills. This means that the manager is able to see the organization as a whole, to recognize the interdependence and relations of separate organizational units, able to improve the welfare of the organization and to make the most complex decisions.

**Simulation of Metabase cockpits' functionality for the needs of strategic management was made for the Green Telecommunications company:**

A dashboard has been created in Metabase for a virtual mobile operator for the needs of this paper. The main structure of a dashboard is shown in **Picture 2**.



**Picture 2.** Main dashboard for Green Telecommunications.  
**Source:** Authors

All diagrams can be seen on the main dashboard at the same time. However, more diagrams can be presented and there may be more dashboards with different diagrams.

But if we look Picture 2 diagram A we can see graphical presentation with a trend line for the number of subscribers per week where the number of telephone lines that connect weekly is shown. This diagram also shows that in the first week of May there is a subscriber which is not possible (because that date is later on). This data reveals an anomaly that needs to be checked how it happened (and this information is also useful for the management). This diagrams also shows the trend which is drawn by Metabase as part of the BI process implemented in Metabase.

Picture 2, diagram B shows the total number of subscribers in the last five days which can be an indicator whether then number of new users is increasing or decreasing and thus managers can have insight into the operation of their own company. Furthermore Picture 2 diagram C is a graphic presentation of the number of monthly subscribers. Diagram D shows a graphic presentation of the number of subscribers per partner. Diagram E shows graphic presentation of the number of subscribers per employee (client).

Picture 2 diagram F visually shows the number of subscribers per employee (client). The anomaly of 224 subscriber lines per employee is immediately noticeable. From the analysis of the database it can be seen that with one of the partners all operators work under the same account which reduces the analytics of data and the possibility of rewarding the employees (agents /operators) for their successful work. Diagram G shows graphic presentation of the turnover made by days while diagram H gives a graphic presentation of realized turnover by days with a set goal. This is a very simple and successful presentation of Metabase. Achieving the goal can result in sending e-mails, text messages to the management and some activity can be automatically forwarded for the achieved goal which belongs to the concept of BI and Data Science. Also such activities can be some automated processes in the background.

Managers at strategic level use Metabase cockpits as tools for reporting and monitoring company's success in achieving strategic goals, often tracking global performance of the business or focus on individual's processes and performances. The data is updated periodically and it is best for managers to review it at least once a day so that they can more easily monitor the work of the company.

Multiple data sources or a set of visualizations can be seen as components of dashboards at a strategic level of management, which usually present analysis of large amount of data originating from the finance sector data costs made for marketing campaigns and gaining new clients in a company (Petrevska Nechkoska, R., 2020). They also show data on company's generated profit for a certain period of time. On dashboards themselves you can see components with data that are comparatively made with the costs incurred for a particular marketing campaign for the previous month, or users of products on a monthly basis compared to previous months (Schoenherr, T. & Speier-Pero, C. 2015). Simply put, these dashboards give managers at strategic level the opportunity to follow the critical factors of success as well as the long-term or strategic goals of the company.

## Conclusion

In today's digital era of modern economy, almost all types of services have digital presence and most of them are data oriented. Companies communicate with their customers through various channels. For example, users can connect and

communicate with companies (for instance airline, hotel, restaurant or other type of company) through their website, application designed for mobile devices, telephone service, profiles on social media etc. For most companies it is important to collect more data from different sources, whether it is data collected from a marketing campaign conducted by the company or an agency that the company hired or it is data from financial reports, warehouse operating, material procurement cost etc. It is a challenge for every company to transform the data into appropriate information that will help the managers at the appropriate level of management in a company and thus will help to achieve short-term and long-term goals because they have a great impact on its management. The received information can and should be presented in different ways. Metabase cockpits are used for its presentation and visualization. These tools are used to report and monitor the long-term strategy of the company with the help of critical factors of success. They affect business operations, monitor performance for efficiency as opposed to the strategic goal of the company. As a result, Metabase cockpits tend to summarize performances considering the set time frames compared to previous months, quarterly or annually. Based on these tools, managers can run the company more easily and thus achieve its strategic goals, because decision based on data are better and thus managers can make decisions more easily based on evidence rather than intuition because powerful information can be hidden in the data.

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