Business Intelligence HRIS Monitoring Dashboard to Increase User Interaction Using Power BI

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ABSTRACT
PT Samudra Dyan Praga is a company operating in the exhibition contracting industry with national and international reach, which has several branches throughout Indonesia. The implementation of exhibition events which often take place simultaneously, as well as the dynamic movement of the workforce, creates its own challenges in terms of reporting employee data. The process of updating data to reporting still relies heavily on separate spreadsheets, thus hampering data recapitulation, analysis and management decision-making processes related to human resources. The main goal of this research is to improve dashboard visualization to support decision making, Business Intelligence (BI) analysis, as well as ensure wider accessibility for users. We identify the latest trends and implement visualization dashboard practices in the BI domain. With a user-focused design approach, we provide improvements and solutions. Specifically, we addressed several challenges, such as creating dashboard controls that are easily accessible to novice users in visualization, improving annotation capabilities to support BI analysts in the analysis process, and adding storytelling functionality to dashboards to facilitate communication between analysts and decision makers. We specifically focused on new aspects of annotation, such as multi-target annotation, annotation transparency across charts, and the ability to share annotations between multiple data sources and BI applications. Through interviews with BI analytics experts and gathering requirements related to BI visual storytelling, we designed and implemented a storytelling tool prototype integrated in the dashboard analytics tool. This allows for a seamless transition from analysis to story creation and sharing. Our system was previously identified by experts as having great potential for training other analysts. Furthermore, it helps BI analysts compile and convey their findings more quickly to decision makers, as well as enabling them to reach a wider audience because the results of data analysis are presented in an easy-to-understand format without the need for special training.

Keywords: Business Intelligence, Dashboard

1. INTRODUCTION
The explosion of data presents challenges in the analysis of large data sets (Al-Zahrani, 2022). Among the various BI systems available to support big data analysis, there is the BI dashboard (Da Cunha, 2023) BI dashboards provide BI analysts with advanced visual analytics capabilities. However, business users often experience difficulties because they have to spend a lot of time in the process of creating dashboards, analyzing data, and compiling findings to share with others (Gathani, 2021). Our main motivation is to increase the efficiency of the process. In this chapter, we present the broad context of this work spanning the fields of Human-Computer Interaction (HCI), Business Intelligence (BI), and Data visualization, with particular emphasis on dashboards which are the main focus of this research.
The amount of digital data in the world continues to grow rapidly, according to International Data Corporation (IDC) research (Jiang, 2022), and the increasing volume and detail of information collected by companies will fuel exponential data growth in the future (Pau, 2022). Therefore, big data analysis has become a major focus in the business world (Batko, 2022). Extraction of predictive information from large databases helps companies to forecast future trends and behavior, and make decisions (Kayya, 2022). This encourages more people in every business to understand and utilize big data, not just managers who were previously the main target of Business Intelligence systems (Maja, 2022). This emphasizes the importance of reducing costs in information search and obtaining relevant answers to complex questions efficiently. Business Intelligence (BI) involves a set of processes and software that supports organizations in understanding large business data sets, analyzing information, and making decisions. The value of data visualization was recognized early in this domain, often through dashboards, interfaces similar to mobile dashboards that organize and present information in an easy-to-understand manner (Lingwall, 2023). BI visual dashboards integrate various visual components, such as graphs, in a single view so that information can be monitored quickly (Terrado, 2022).

Today's BI dashboard lifecycle involves many stakeholders (Bany, 2022), including end users and business analysts. In a user-focused BI approach (Cardoso, 2022), end users are actively involved and provide feedback to business analysts who design custom dashboards according to their needs. This feedback is provided at various stages of dashboard design and setup, involving intense communication between business analysts and end users. As a result, there is an intrinsic delay in any changes to end-user requirements or customization requests. Once end user needs are understood, business analysts perform data analysis and compile their findings to present to end users or other analysts.

In this research, we focused on improving user interactions with BI dashboards at different stages of the dashboard lifecycle. Our work is carried out in the field of Human-Computer Interaction (HCI), which aims to improve interactions between users and computers by making computers more useful and responsive to user needs. Following popular HCI methodologies, we adopt a user-centered design approach to understand the requirements for dashboard creation and analysis, and propose solutions for each step in the dashboard lifecycle.

Success in analyzing large data sets offers significant benefits to companies and organizations (in the form of competitive advantages over competitors), as well as to individual users in planning better investments. Because of this, we have seen increasing interest in user-friendly visualization platforms. Researchers are currently focused on understanding the practices of novice users. However, dashboards are still often created by experts due to the complex and lengthy creation process, which is often inaccessible to end users. This lengthy creation process, which involves a lot of communication between business analysts and end users, makes dashboards less popular among novice users and less accessible to a wider audience. In our work, we strive to create dashboards that are easy to create and customize by beginners in data visualization. We also identified the need for annotation and organization of findings as being of particular interest, as in other visual analysis domains. Although research on annotations for visual data analysis is growing in popularity, research related to BI dashboards and other complex multi-chart visualization environments (such as coordinated views) has not advanced evenly. Through user interviews, we found that users needed a more sophisticated solution for annotating dashboards. These requirements were implemented in a dashboard prototype with context-specific annotation features, which were evaluated by BI experts.

At the end of the dashboard, insights, knowledge, and analysis from experts need to be captured to be more efficiently conveyed to others (such as end users), and made available for future analysts to study. This step is important because often data analysts and decision makers are two different entities. Based on the requirements of the analysts, we designed and implemented a storytelling tool integrated within the analytics dashboard, enabling a seamless transition from analysis to story creation and information sharing. In the next section, we explore each area of research related to this topic.

2. LITERATUR REVIEW

a. Business Intelligence

Business Intelligence or what is usually abbreviated as BI is a collection of tools for analyzing business data or information that is stored, integrated and processed on a very large or massive scale, with the aim of providing access to business processes to produce decisions and actions that are in line with company goals, to improve business performance. This concept has also been researched previously (Lanza-Cruz, 2024).
Business Intelligence is a combination of mathematical models and analytical methodologies designed systematically to form data so as to produce information and knowledge that is useful in supporting complex decision-making processes (Mohammed, 2024).

Power BI functions in a simple way for users to analyze data, so it is often referred to as one of the business intelligence software that is easy to use (Quoc, 2024). With its ability to model and display data in real-time, Power BI is able to generate insights from simple data. This makes it ideal software for report creation and visualization (Quoc, 2024).

Power BI offers a number of features (Ruvolo, 2024), including:

1) Power Query: This tool allows users to perform ETL (Extract, Transform, Load) independently by receiving data, manipulating it, and loading it into Excel.
2) Power Pivot: This Power BI component enables fast data modeling and calculations.
3) Power View: This feature provides drag-and-drop visualization to build interfaces with efficiency.
4) Power Map: This feature creates data visualization in three dimensions.
5) Power Q&A: This feature allows users to create questions or statements directly on a visual dashboard.
6) Power BI Desktop: This desktop application is equipped with a Drag-and-Drop feature that makes it easier for users to quickly create visual displays.

b. Data, Information and Knowledge

In the context of Business Intelligence (BI), we often encounter the terms data, information, and knowledge, which can sometimes cause confusion regarding their usage and implications. The following is the concept of data. (Pedersen, 2024):

- **Data**: This term refers to the structured codification of individual primary entities, as well as transactions involving two or more primary entities. BI is widely embraced by companies primarily for the analysis of data in various forms, enabling the formulation of strategies accordingly. Data is typically categorized into three types: structured data, semi-structured data, and unstructured data.
  - Structured data refers to information that is presented in a fixed format. This data could include various forms from websites, as well as detailed addresses, and is readily interpretable by computers due to its standardized nature.
  - Unstructured data, on the other hand, comprises information that computers find difficult to interpret. This may include text, documents, video recordings, websites, images (Jermol et al., 2003), or any other type of information that lacks clear organization into rows and columns. Company data often span across different platforms and locations, such as Customer Relationship Management (CRM) programs, marketing automation systems, and social media platforms.
- **Information**: Arises from extraction and processing activities performed on data, rendering it meaningful within a specific domain.
- **Knowledge**: Meanwhile, evolves from information and is utilized to make decisions and inform corresponding actions. Therefore, knowledge encompasses information applied within a specific domain, enriched by the experience and expertise of decision-makers in addressing and resolving complex issues.

c. Business Intelligence Architectures

This following pyramid to illustrate the construction of a business intelligence system (Pedersen, 2024):

- **Data sources**: These sources primarily comprise data from operational systems, but they may also include unstructured data such as emails and data acquired from external providers.
- **Data warehouse/Data mart**: Data warehouses serve to consolidate various types of data into a central repository using the Extract, Transform, Load (ETL) process, standardizing these results across systems eligible for querying. Data marts are typically smaller repositories that concentrate on information related to a single department, rather than gathering data across an entire company. They reduce database complexity and are less expensive to implement compared to full-scale warehouses.
- **Data exploration**: This phase of BI analysis involves passive exploration, encompassing query and reporting systems, as well as statistical methods.
- **Data mining**: Data mining constitutes active BI methodologies aimed at extracting information and knowledge from data.
- **Optimization**: Optimization models enable the determination of the optimal solution from a range of alternative actions, which can often be extensive and sometimes even infinite.
Decisions: With available and successfully adopted business intelligence methodologies, the decision-making process rests with decision-makers. They may also utilize informal and unstructured information to adapt and refine recommendations and conclusions derived from mathematical models.

Figure 1: The main components of a Business Intelligence System

3. RESEARCH METHOD

Appropriate visual representation in dashboards, with effective use of color, size, and shape, combined with interactive exploration features (Intelligenc, 2022). It aims to improve human cognition and deepen understanding of information (Haymond, 2022). Today’s BI dashboard lifecycle involves multiple parties (Samuel, 2022), including end users and business analysts. In a user-oriented BI approach (Saabith, 2022), end users are actively involved and provide feedback to business analysts who design custom dashboards according to their needs. This feedback occurs at various stages of dashboard design and setup, involving intense communication between business analysts and end users, to determine functional specifications and create a positive user experience.
Because there is an intrinsic delay that occurs every time there is a change or request from the end user's requirements. Customization request. Current market trends identify dashboards and data analysis as one of the increasingly popular driving forces in business. This represents an increase in the population of end users with diverse needs, who require quick access to customizable dashboard technology, which can ideally reduce communication costs associated with dashboard design. This development is reflected in the advancement of customizable dashboard visualization systems such as Spotfire (Lavanya, 2023) Tableau (Firat, 2023), and is also seen in related research in the InfoVis community (Chauvergne, 2023).

However, many questions remain about how novice users interact with actual visualization systems. To better understand how novice users interact and build their own visualizations (without the need for dashboard designers or other human mediators), we developed the Exploration View (EV) in collaboration with SAP engineers. EV is a prototype dashboard created specifically to empower end users, following guidelines from previous research on novice users in visualization. To evaluate its effectiveness, we compared expert responses of the dashboard with novice users' responses to EV when they performed real-world visualization tasks.

**Exploration View (EV) Prototype**

This section outlines the design basis of the Exploration Display (EV) and the function of features that support novice users, drawing on guidance from previous research. We will first explain the main purpose of EV: the ability to easily create, customize, and interact with various visual representations in a unified dashboard environment.

While dashboard users may have clear questions about their data, they may still be beginners when it comes to visualization and lack experience in how dashboard software can meet their needs. A simple creation process is essential for beginners to quickly experiment with dashboard designs. As seen in visualization novices, they have partial mental specifications for their visualization needs and tend to refine and change their designs (Chauvergne, 2023). To ensure the creation of a user-friendly dashboard, the steps need to be simple with continuous visual feedback regarding the end result of the user's choices. Additionally, because novice users may not be familiar with appropriate visual templates and representations for various types of data, EV should provide suggestions of diagrams and templates to choose from. Finally, EV should support commonly used data formats, and users should not be limited by data storage structures, but can use data from a variety of sources (for example, personal data in Excel and OLAP data from their company). When novice users create dashboards, they may need to explore and try alternative views.

Custom templates and representations allow users to customize dashboards according to their needs. Requirements and tasks may also change over time, requiring different data representation and data filtering mechanisms, or even new data sources. EV should support the iterative visualization specifications suggested by Grammel et al. (Rezaie, 2024), by being adaptable and adaptable. It is important for beginners to see

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firsthand the effects of their choices, which encourages exploration and experimentation with visualization. Therefore, in EV customization, it is important to ensure that the customization is integrated with the analytical process. EV also supports visual analytics processes with features such as storage and sharing, text search mechanisms, fully connected visualizations, visual queries, and other data exploration mechanisms. Finally, if EV design facilitates low-cost experimentation using visual templates and visual analytics processes, it can help novice users to better understand visualization creation and data analysis, promoting learning.

![Figure 3. Illustration includes an Exploration View consisting](image)

The illustration includes an Exploration View consisting of: (a) The main dashboard and its components. (b) Clipboard drawer widget containing templates for diagrams (top) and example data widgets (bottom) that the user has created as palettes. The drawer can be closed when not in use. (c) Visual representation of the global data filter currently active at any point. (d) As well as various other functions such as search, storage, sharing, and so on.

This research involves several process stages to produce output that can be used by users. The process includes dataset retrieval, data analysis, ETL (Extract, Transform, Load), and data visualization processes. Figure 1 depicts the flow of the work process carried out in this research.

### 4. RESULTS AND ANALYSIS

![Figure 4. Flowmap Model](image)
a. Data sets
The data used in the implementation of Business Intelligence is the result of daily use of the ACCAbsence application by the development team. This data includes information about attendance and departures, the number of employees' daily activities, as well as employee details. This dataset is an example of data that represents the model being developed. Data is available in Excel format with CSV format, which contains tables of attendance, number of activities and employee details. Apart from that, the development team also provides the dataset in the form of a Python script which contains a database API that will be used in the data merging process.

b. Data Analysis
The data that has been connected will undergo an analysis process, taking into account the various rows and columns that can be processed into information. This aims to make it easier to understand the data and facilitate the future visualization process. Analysis is carried out to understand the data structure, relationships between data, and understand the limitations that exist in the data.

Analysis of the ACCAbsence dataset begins with identifying the data and ensuring compliance with a given data source. Next, analysis is carried out by reading the data and setting problem boundaries to focus on the desired business goals. By setting boundaries in the analysis, the process becomes more focused on the main problem that is the focus of the research (Maja, 2022). After gaining sufficient understanding of the data, prototyping is carried out using dummy data to provide an overview of the visualization process that will be carried out.

c. ETL
a) Extraction
Extraction is the process of retrieving data. Data can be extracted via various methods, including direct access to the database, file processing, the cloud, or using scripts. In this research, the extraction process is carried out through scripts to ensure direct connection with the database, making it easier to update data in the visualization.

The extraction process in this research uses a script via the data retrieval feature in Power BI. The Python script used contains an API and extracts several tables from various different application functions, which have been integrated with the presence application database.

b) Transformation
Data transformation is a stage that is carried out after the data has been successfully extracted and before the loading process is complete. The aim of this stage is to process raw data which may have various formats, so that it can be optimized for the visualization process.

The dataset used in this research requires data transformation because it has a format that is not suitable for direct visualization, such as the presence of null data and data in the form of boolean values (1 or 0). To overcome this, various transformation processes are carried out such as filtering, cleaning, merging, splitting and sorting data.

The transformation process is carried out using one of the tools available in Power BI, namely Power Query. By using Power Query, the transformation process can be carried out efficiently in the same environment, making implementation easier.

c) Loading
Loading is the process of entering data that has undergone transformation in the previous stage into the destination data warehouse. This data can be loaded into Power BI by applying a loading process, so that it is stored in the Power BI data warehouse and can be used to create visualization dashboards.

d. Data Visualization
The data visualization process using Power BI is carried out by selecting the appropriate type of graph and entering the data that will be used as a value. Each type of graph provides different information according to its function. In this research, a visualization dashboard was created using various types of graphs such as bar charts, donut charts, cards, and tables.
After completing all the necessary steps, the next step is to create a visual representation of the dashboard. A dashboard is a visual interface that presents information to stakeholders to assist monitoring and as a basis for analysis to support decision making. In this research, we produced two types of dashboards, namely sales dashboards and analytics dashboards.

**SALES DASHBOARD**

This dashboard contains information about target number and units with the realization of achieving the target number and units.

![Sales Dashboard](image)

**Figure 5. Sales Dashboard**

a) **Total Target by Number**
   In the visualization of target achievement based on the amount set by the company of Rp. 160,000,000,000,- was successfully achieved with a total realization of 180,717,995,360,-, an increase of 20,717,995,360,- (12.95%) from the set target.

b) **Total Target by Unit**
   In the visualization of the achievement of targets based on units that had been set by the company, 1,692 units were not achieved, with realization of 1,313 units, or still less than 379 units (-22.4%).

c) **Unit Target VS Unit Realization**
   In the visualization of unit targets versus unit realization, only 1 branch office succeeded in achieving the target set by the company, namely: Pontianak

d) **Data Table of Numbers and Units Based on Branch Offices**
   This visualization is used as a tool to compare the overall value between each branch office based on the target number and units with the actual targets and units.

**5. CONCLUSION**

Based on the research results, the following conclusions were obtained:

1. Utilizing Power BI can support data analysis and facilitate business decision making in companies, so that Power BI users can obtain useful data results and use them as a tool to solve problems.
2. By using Power BI, data can be generated with high accuracy and reduce human error when searching for data. With data visualization, existing information can be understood quickly and easily, as well as presenting comprehensive information to stakeholders.
3. Utilization of Power BI increases the effectiveness and efficiency of performance monitoring, so that the KPIs (Key Performance Indicators) that have been set by the company can be measured quickly and precisely through graphic visualization.

**System Testing**

The following table is the test results from business intelligence dashboard application.

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