Power BI as an Advanced Alternative to Microsoft Excel

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This article explores Business Intelligence (BI) systems, focusing on a comparative analysis of Microsoft Excel and Power BI. Power BI is an extension of Excel because it utilizes its add-ons: Power Query, Power Pivot, and Power View. Both Excel and Power BI allow data transformation and visualization, but Power BI is more appropriate for advanced analysis. Its tools are designed for business-oriented analysis through dashboards, while Excel remains well suited for simpler calculations using summarized data. A practical example was developed using Power BI to highlight the power of this program to transform and visualize data. Comparisons with Excel were made to see how Power BI is an extension of the program, not a completely different program. The main purpose of this paper is to inform data analysts, data scientists, and BI enthusiasts about the appropriate contexts for using each tool and to identify when one may be more suitable than the other.
Keywords: *Business Intelligence, Excel, Power BI, Data Analysis*

1 Introduction

Business Intelligence (BI) systems are essential for supporting data-driven decision-making in modern organizations, particularly as data continues to increase in volume and complexity. Microsoft Excel is a common and widespread tool for data analysis due to its flexibility and simplicity; however, analytical requirements have evolved and spreadsheet-based approaches have their limitations, especially for large datasets and complex dashboards with various types of graphs. In response, Microsoft Power BI was introduced as a modern BI platform that enhances Excel's capabilities by integrating three of its significant add-ons into a unified, business-focused environment. Excel and Power BI each have their specific applications, depending on the requirements and needs of users and organizations. However, for generating insights about a company and supporting decision-making to improve business processes, Power BI is generally recommended. It enables more advanced calculations and produces more informative and visually compelling charts and graphs, making it particularly suitable for complex analytical requirements. By examining their functional capabilities, historical evolution, and use cases within BI systems, this study investigates the link between Excel and Power BI.

2 Business Intelligence Systems Overview

"Business intelligence (BI) is a set of technological processes for collecting, managing and analyzing organizational data to yield insights that inform business strategies and operations" [1]. Data warehouses are usually the primary source of information for BI platforms, with data from multiple sources aggregated into a central system. However, other data sources are equally important, including data lakes, cloud platforms, Hadoop systems, industry statistics, and similar resources.

The typical BI workflow involves identifying the data required for analysis, collecting and cleaning the data, analyzing it, visualiz-

ing the results, and developing insights to streamline various organizational processes within companies. This information is utilized by organizations to measure key performance indicators (KPIs) and to report on them [2].

Data collection and cleaning can be performed using extract, transform and load (ETL) or extract, load and transform (ELT) tools or spreadsheet programs such as Microsoft Excel. The data analysis stage includes data discovery, data mining, data modeling, machine learning (ML), natural language processing (NLP), Online Analytical Processing (OLAP), and predictive and prescriptive analytics.

From a historical perspective, the term "business intelligence" was first utilized in 1865 to describe a banker who gathered market information before his competitors did. BI grew in popularity in the 1990s; however, it usually required IT support due to the technology being still complex at that time. This led to delayed reports and technical problems, and even without IT the BI analysts and users needed training which would have taken a lot of time.

The benefits of BI include clearer reporting, consolidation of data from multiple sources, fixing or improving business operations, faster decision making, and increased customer and employee satisfaction. On the other hand, BI also presents several challenges: different research teams may reach contradictory conclusions, data integration can be difficult due to technological limitations, and the initial costs of developing a modern BI system can be high. Nevertheless, these investments often prove worthwhile, as BI analyses can help reduce overall costs over time.

Business Intelligence is beneficial across a wide range of industries, including customer service, banking and finance, healthcare, retail, sales and marketing, security and compliance, statistical analysis, and supply chain management. The advantages of using BI include faster customer support, identification of opportunities for improvement or investment, increased sales or customer satisfaction, and the detection and correction of inefficiencies in business processes.

3 Origins and Evolution of Microsoft Excel

Microsoft Excel was introduced in 1985 as one of the first spreadsheet applications [3]. However, the first widely adopted version of Excel debuted in 1992, when Excel 4 was released. Its subsequent version, Excel 5, introduced Visual Basic for Applications (VBA), a programming language that allows users to create macros. These are sets of recorded instructions utilized to manipulate data, automate tasks, and standardize documents [4]. Macros can be applied for data cleaning, enabling users to easily identify and remove duplicates, reformat numbers and dates, and eliminate empty cells.

The most recent features were introduced in the 2019 update and included map charts, funnel charts, new keyboard shortcuts, and enhanced calculation functions. Excel has thus evolved from a basic spreadsheet tool into a complex business intelligence and data analytics platform, offering a wide range of functions, features, and tools.

Excel is primarily utilized for numerical calculations, being widely utilized across various fields. It is also employed for non-numeric tasks, such as text manipulation or organizing lists [5]. For numeric data, Excel is commonly used for analyzing survey results, performing financial analysis, and creating charts, diagrams, and graphical dashboards. Its macros further simplify repetitive tasks, enabling users to perform complex operations with a single click.

4 Overview of Power BI

Power BI was initially released in 2013 as Power BI for Office [6]. The first general public release occurred on July 24, 2015, introducing the main components of the

Power BI ecosystem: Power BI Desktop, Power BI Service, and Power BI Mobile. Power BI Desktop provides tools for data analysis and visualization, including custom calculations beyond standard descriptive statistics. Power BI Service, built on Microsoft Azure, allows users to perform basic analysis and visualization and to publish desktop reports to the cloud for sharing. Power BI Mobile enables users to view and interact with reports on iPhones, iPads, Android phones and tablets, and Windows mobile devices, although it does not allow report creation.

Power BI is widely used for data analysis and sharing reports and dashboards among users [7]. These reports can either be created manually or automatically using the Quick Insights feature. After their publication, they can be included in dashboards as a whole or only extract certain elements from them. Reports and dashboards can then be shared in various forms: on a website or blog, or within the organization or certain groups, where sharing rules will be applied.

5 Continuity Between Excel and Power BI

Self-Service Business Intelligence (BI) was introduced by Microsoft in 2009 with the announcement of Power Pivot for Microsoft Excel 2010 [8]. Initially, the only method for sharing reports within a team was via SharePoint, which limited usability. Based on user feedback, Microsoft developed Power BI to address these limitations. Offering enhanced functionality, simplified workflows, new visualizations, and mobile support, Power BI builds upon existing Excel add-ins: Power Query, Power Pivot, and Power View. Data can be loaded into Power BI not only from Excel files but also from various cloud sources.

Power Query provides tools to access tabular data in multiple formats, ranging from large-scale databases to simple text files [9]. The resulting tables can be concatenated, reformatted, and loaded into Excel for further manipulation or visualization. Power Pivot adds computational capacity and supports interactive visualizations based on complex calculations, while Power View serves as the visualization engine of Power BI. Compared to Excel, Power BI allows users to create and share reports and dashboards with significantly less time and effort, offering a more user-friendly and efficient development environment. Key differences between Excel and Power BI are summarized in Table 1 [10].

Table 1. Differences between Excel and Power BI

Feature	Microsoft Excel	Microsoft Power BI
Data analysis	- basic to intermediate analysis - utilizes formulas and functions	- advanced data modelling - complex calculations
Data visualization	- standard charts and graphs - limited interactivity	- interactive and highly customizable visuals - dynamic dashboards and reports
Data integration	- performance might decline with large datasets - imports data from files and databases	- handles large volumes of data from a wide range of sources
Sharing	- file sharing via email or cloud storage	- cloud-based with Power BI service - simple report sharing
User interface and ease of use	- user-friendly for basic tasks	- modern interface - advanced features have a steeper learning curve

6 Data Transformation and Visualization in Power BI

Data transformation is the process by which data is subjected to certain changes in order to be cleaned and prepared for the analysis needed for certain business requirements. This can be performed with the Power Query Editor window, in which the user can rename queries, assign appropriate data types, add new columns, replace values, and remove certain columns. Moreover, users can create hierarchies to be able to navigate through data easily. M query is commonly used to query data sources, load and clean data, and create custom columns when importing data [11].

For the visualization part, users can add card visualizations, map visuals, clustered column charts, and matrix visuals. They can add filters, set titles for them along with various text formats and options, change colors, set variables and their labels, add legends, and much more. Whenever having a hierarchy, Power BI offers us the option to drill down the data into a granular level by clicking the three-down arrow icons at the top right corner of a visual.

Data transformation and visualization processes are streamlined in Power BI, making it much easier to perform complex tasks on large volumes of data. M query is commonly used to query data sources, load and clean data, and create custom columns when importing data. Despite the fact that some functions are drag & drop or require only a few clicks, users can take full advantage of the program's functions by using Data Analysis eXpressions (DAX). Although it is based on Microsoft Excel formulas, it can only be used within Power BI and cannot be exported to other software. The DAX syntax allows users to define calculated columns, fields, and measures based on the given data source.

Compared to other BI solutions, data preparation in Power BI requires significantly less effort when using DAX. For instance, complex calculations that are time-consuming in Excel can be implemented more efficiently in Power BI through DAX formulas. Consequently, a dynamic solution using DAX can greatly reduce both the time and resources needed compared to performing equivalent calculations manually in Excel.

7 Coding in Excel and Power BI

As previously stated, Power BI utilizes DAX as its primary coding language, whereas Excel uses VBA. VBA is a programming language that includes several fundamental elements such as comments, variables, constants, data types, multidimensional arrays, dynamic arrays, and labels [12]. It operates similarly to other programming languages, supporting various data types including text, numbers and dates, as well as a variety of operators, including the Mod operator and those commonly found in worksheet formulas.

VBA enables working with Range objects, similar to selecting multiple fields in an Excel worksheet. These objects have various properties, such as the *value* property, which is used to read the contents of a cell or to read or modify the value of a range; the *text* property, which formats and displays information stored in a cell in a certain format; the *count* property, which returns the number of cells in a range; and the *HasFormula* property, which returns True if at least one cell in the range contains a formula. Range objects also include useful methods such as select, copy, paste, clear, and delete, which correspond to classic Excel operations.

VBA provides built-in functions that may accept optional parameters. The WorksheetFunction object makes it possible to combine Excel worksheet functions with VBA code, allowing the use of functions that are not directly available in VBA. Therefore, most computational tasks can be performed efficiently. Additionally, users can define custom functions, which represent the third category of functions used in VBA procedures.

The language is familiar to programmers, making Excel calculations more flexible and easier to implement.

DAX, previously mentioned in this paper, is the formula and query language used in Power BI, Microsoft Analysis Services, and Microsoft Power Pivot for Excel [13]. It is designed to compute business formulas over data models, which are sets of tables linked through relationships.

Another fundamental difference is represented by iteration. In Excel, calculations are typically performed one step at a time, whereas DAX supports iterator functions that allow the same operations to be executed within a single expression. Furthermore, DAX can also function as a query language, incorporating concepts similar to SQL while remaining more compact and accessible.

Therefore, DAX represents the native language of Power BI and enables more complex computations compared to VBA. However, its syntax and relational modeling concepts may make it more difficult to learn initially.

8 AI Integration in Excel and Power BI

Microsoft Excel supports numerous artificial intelligence (AI) tools, such as ChatGPT, Numerous AI, or GPT for Excel [14]. Additionally, Microsoft's 365 Copilot utilizes large language models to generate formulas, summaries, and visualizations, supporting users without advanced Excel expertise. Other Microsoft tools, such as SpreadsheetLLM, further enhance productivity by extracting relevant insights from complex spreadsheets.

Although ChatGPT does not provide native integration within Microsoft Excel, it can be accessed through third-party add-ins such as *GPT for Sheets and Docs* (developed by Talarian), which requires an OpenAI API key, and *ChatGPT in Excel* (provided by Numerous AI), which is suitable for non-programers. Moreover, connection to the OpenAI API can be made directly within Excel using Power Query or VBA, enabling receiving responses directly into the spreadsheet.

After integrating AI into Excel, users can leverage its power through many functions, including content generation, grammar correction, text analysis, translation, language detection, formula writing or explanation, data cleaning, handling missing values, creating quizzes, generating data, or simplifying concepts for students. These capabilities can be enabled through installing certain add-ins and utilizing given functions, thereby improving workflow efficiency and reducing manual effort.

In contrast, Power BI incorporates AI capabilities through Microsoft-native models, rich visuals, and Azure Cognitive Services, which provide pre-trained machine learning models accessible through APIs [15]. Within the Azure ecosystem, models can be trained in parallel using *Automated Machine Learning*, while a single model can be created using *Azure Machine Learning Designer* or trained and deployed from scratch with *Azure Machine Learning workspace*, which requires data science knowledge. These approaches support different levels of technical expertise and enable advanced analytical functionality in Power BI environments.

AI integration can improve decision-making and operational efficiency by automating repetitive analytical tasks. However, it is associated with several limitations, including dependence on data quality, increased complexity of features, limited accessibility for non-technical users, high implementation costs, ethical concerns, challenges in integration of certain models, computational resource requirements, security and privacy risks, and limited customization options [16]. Moreover, effective use of AI systems requires specialized expertise, as non-technical users may face difficulties in model training, deployment, and configuration.

Although AI significantly improves analytical capabilities in both Excel and Power BI,

its implementation requires proper management and skilled personnel to ensure its effective and responsible use.

9 Practical Comparison of Excel and Power BI

In order to further examine how Power BI represents an improved extension of Microsoft Excel, a dataset requiring minimal data cleansing was selected, and a dashboard with graphical representations was developed. For this study, highly complex formulas and calculations were not employed; however, it is important to note that Power BI represents an enhancement of Excel and an optimal solution for large-scale datasets, particularly due to its ability to handle advanced calculations when required. Power BI Desktop was used for this analysis, as it provides more advanced and comprehensive analytical features.

The dataset used in this study is the Titanic Dataset available on Kaggle [17]. It contains 891 observations corresponding to passengers on the RMS Titanic and is typically utilized in survival prediction and binary classification tasks, as it allows one to estimate passenger's survival rate based on the target variable that indicates whether an individual survived the disaster (1) or died (0).

The dataset, excluding the identification number for each record, includes 11 variables that describe passenger attributes and information related to travel. These variables include survival status, passenger class (1st, 2nd, or 3rd class), passenger name, gender, age, number of siblings or spouses aboard (*SibSp*), number of parents or children onboard (*Parch*), ticket number, and passenger fare.

First, the dataset was imported into Power BI by creating a blank report and selecting the Text/CSV data source. The imported data is presented in Figure 1.

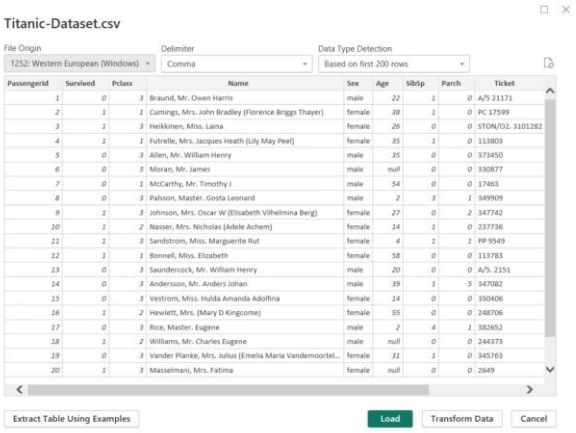

Fig. 1. Data Import Panel

Next, the Transform Data option was selected, which opened the Power Query Editor. This interface allows users to visualize the applied steps, modify or delete them, and insert intermediate steps in the data cleansing process. For the selected dataset, the variables *PassengerId*, *SibSp*, *Parch*, *Ticket*, *Fare*, and *Cabin* were removed, as shown in Figure 2. The data type of each remaining variable was automatically updated.

Missing values in the Age column were replaced with the average age calculated using DAX. The code corresponding to each transformation step is displayed in the formula bar at the top of the table. To replace null values, the following DAX code fragment was written when adding a new column to the dataset:

```
AVG_Age = IF (
   ISBLANK('Titanic-Dataset'[Age]),
   ROUND(CALCULATE(
     AVERAGE('Titanic-Dataset'[Age]),
          ALL('Titanic-Dataset')
     ), 0), 'Titanic-Dataset'[Age])
```

The null values in the Age column were replaced with the values computed in the AVG_Age column, code displayed previously.

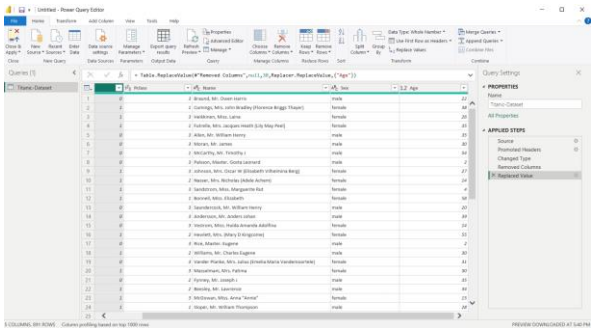

Fig. 2. Processed Dataset

Following the data preparation stage, a comprehensive dashboard presenting statistical insights from the Titanic dataset was created. Power BI offers a user-friendly interface that enables dashboard development on a single page using drag-and-drop functionality, where values are selected from the data pane and visualizations are customized as needed. The dashboard includes a table displaying passenger information, a card visualization showing the computed survival rate which was formatted as a percentage with 1 decimal place from the Measure tools tab, and two charts illustrating the number of survivors based on sex and passenger class by bought ticket. The resulting dashboard is presented in Figure 3.

Fig. 3. Power BI Dashboard for the Titanic Dataset

Unlike Excel, Power BI reports are inherently interactive, enabling users to filter and explore data dynamically across all visual elements. For example, selecting the female category in the Survival by Sex chart automatically updates all other visuals on the dashboard, including the Survival by Class chart, to display the number of female passengers who survived in each passenger class, as illustrated in Figure 4.

Fig. 4. Interactive Dashboard Results

The mobile layout can be generated automatically by selecting the "Auto-create mobile layout" option within the Mobile Layout view. Additionally, the file can be uploaded to the cloud and accessed through the browser-based version of Power BI, allowing it to be viewed from any location.

10 Conclusions

Power BI can be considered an extension of Excel, not only because it inherits and enhances certain Excel features, but also because it allows users to import spreadsheets and manipulate data more comprehensively. Additionally, Power BI dashboards can be shared among users more easily, which is particularly valuable for analysts who need to distribute insights to clients or team members.

Both Excel and Power BI have distinct strengths. Excel is better suited for smaller datasets, users with limited analytical experience, and scenarios requiring flexibility with minimal automation. In contrast, Power BI is more appropriate for larger datasets, users with advanced analytical skills, and situations where interactive visualizations, scalability, and streamlined sharing are priorities [18].

For future work, this topic can further be extended by exploring Microsoft Fabric as a

unified analytics platform delivered as a software-as-a-service (SaaS), designed to support data engineers, data scientists, business analysts, and database administrators within a single environment [19]. It incorporates Microsoft 365, includes Copilot for AI support in coding tasks, and offers integrated tools for end-to-end data processing. Power BI is included as a core workload, enabling quick access to various data sources and the creation of interactive charts and dashboards. Thus, Fabric provides the possibility to utilize multiple workloads within the same environment without duplicating data when processing or sharing it, thanks to OneLake storage.

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