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Research Article

Empowering Users: The Role Of AI In Enhancing Self-Service BI For Data-Driven Decision Making

Shakir Syed[1*], Rama Chandra Rao Nampalli[2]

[1] Senior Solution Architect & SSBI Leader, shakir.syed.microsoft@gmail.com
[2] Oracle EBS and Workday Consultant, nampalli.ramachandrarao.erp@gmail.com

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ABSTRACT

In today's data-driven landscape, empowering users through self-service Business Intelligence (BI) is crucial for informed decision-making. This paper explores the transformative role of Artificial Intelligence (AI) in enhancing self-service BI capabilities. We examine how AI technologies, such as natural language processing, machine learning, and predictive analytics, democratize data access, enabling non-technical users to derive insights with ease. By analyzing case studies and user experiences, we highlight the benefits of AI-driven tools in improving data literacy, accelerating analysis, and fostering a culture of data-driven decision-making within organizations. Our findings suggest that integrating AI into self-service BI not only streamlines data exploration but also enhances collaboration, leading to more effective and timely decisions. The implications of this research underscore the need for organizations to invest in AI-enhanced self-service BI solutions to fully leverage their data assets and empower users at all levels.

Keywords: AI in Business Intelligence,Self-Service BI,Data-Driven Decision Making,User, Empowerment,Analytics Accessibility,Data Visualization Tools,Machine Learning,User-Centric Analytics,BI Tools,Data Literacy,Automation in BI,Decision Support Systems,Predictive Analytics,Data Democratization,Performance Metrics,Real-Time Analytics,Interactive Dashboards,Business Insights,Cloud-Based BI Solutions,User Engagement in BI.

1. Introduction

Empowering users is key to organizational growth and decision-making, while the role of AI in business intelligence is becoming increasingly important. Research shows that this has been largely done in the realms of performance, usability, analysis, and exploration, rather than in decision-making and data-driven insights. Indeed, for AI to support data-informed decision-making, it is critical to understand users and their use of resources in a data-driven environment. This electronic format is relevant in orchestrating effective decision-making that should use AI, machine learning, and statistical techniques for predictive and prescriptive decision-making. Thus, this paper targets the right balance of the end user in a data-driven environment to use BI outputs with confidence. We also believe that aiding the user to better interact with data can provide the technological advances that can be used in self-service BI.

Business intelligence is no longer just a support function but also seeks to make a success of almost all processes in an organization. As BI now moves into predictive and prescriptive analytics, machine learning and AI have empowered data-driven strategies. Herewith, we should strive to harness AI and ML experts to empower organizational stakeholders in a self-service BI environment to provide a mix of descriptive, predictive, and prescriptive analytics. This research explores the requirements necessary for developing an AI-powered self-service BI element to build informed organizations.Empowering users within organizations is essential for fostering growth and enhancing decision-making processes, particularly as the role of AI in business intelligence (BI) becomes more pronounced. Research indicates that while progress has been made in performance, usability, analysis, and exploration, there remains a significant gap in leveraging AI for informed decision-making and actionable insights. To bridge this gap, it is crucial to understand how users interact with data in a data-driven environment. This paper advocates for a balanced approach that enhances user

confidence in utilizing BI outputs, integrating AI, machine learning, and statistical techniques for predictive and prescriptive analytics. As BI evolves from a support function to a central component of organizational strategy, harnessing AI and ML expertise is vital to empower stakeholders in a self-service BI setting. By focusing on the necessary requirements for developing AI-powered self-service BI tools, this research aims to facilitate informed decision-making, enabling organizations to thrive in an increasingly complex data landscape.

Fig 1: Self-Service Business Intelligence

1.1. Background and Significance

Business intelligence (BI) refers to methods and technologies used by enterprises for the data analysis of business information, supporting managers in the process of making decisions. The importance of management-supported decisions for the survival and prosperity of enterprises is not only generally accepted but also rooted in economic theory. In the course of the availability and access to more and more data, the exponential growth of data further propels the demand for data analysts. In light of the increasingly important role that data-driven decision-making plays in the modern economy, a large number of enterprises have adopted traditional BI methods and tools to provide them with the data and insights they need to adapt and keep up in the fast-moving, data-rich landscape. The requirement for offering larger amounts of data, resulting from a growing reputation for making well-informed business choices, has driven the advancement of BI from an expert-driven area into mainstream development.

Therefore, the timeliness and accuracy in the provision of information have gained more attention. With the increasing growth in data volume, diverse data sources, and a rapidly changing business environment and needs, BI is also transformed. In the last few years, one of the popular types of BI is self-service BI, allowing users, often without any technical background, to directly generate visualizations, reports, and dashboards. In recent years, the realization of the growing and cumulative demand for organizational success has initiated a wave of interest in supporting distributed, self-service reporting and analytics, giving end users the capability of preprocessing and analyzing enterprise data warehouses to produce actionable insights in almost real-time. Self-service BI has become a significant imperative for competitive analytics, as well as a major consideration for enterprise investments in analytics capabilities. Web-based reporting capabilities integrated within systems of record are widely used, and within our use cases, the growing use and emphasis on dashboards and advanced exploration in particular are noted. Self-service skills, such as standard data exploration, adapting reports, and developing dashboards, can empower frontline managers and decision-makers in organizations to apply new analytic capabilities to improve care and manage resources more efficiently.

The advancement of AI opens up new opportunities to enhance the technologies and methodologies traditionally used in self-service BI. Future research should bring users and human team members into the loop of understanding and interaction to maximize impact and accentuate the strengths of AI systems. AI can not only detect and predict data insights but also become a natural language query interface to find these in data lakes, retrieve information, and aid AI models. Relevant trends in these spaces that have driven expanding interest in the enhanced awareness of AI and machine learning with self-service BI practices include the rise of big data, in particular, the usage of data lakes, the increasing incorporation of cloud platforms and vendors in various areas of analytics, as well as the usability and user interface enhancements that have resulted from a range of efforts, including exploratory analytics, data preparation, data science, and self-service. The ascent of open-source technologies and tools, as well as new big-query engines that span new cloud technologies, support in-memory processing, and transition support between on-premises and cloud capabilities, have been driving self-service BI's expansion.

Equ 1: Sparse inference and active learning of stochastic differential equations from data

$$\mathbf{Z} = [\mathbf{z}_1^{\mathrm{T}},\ \mathbf{z}_2^{\mathrm{T}},\ \ldots,\ \mathbf{z}_M^{\mathrm{T}}] = \begin{array}{c} \text{state} \\ \downarrow \end{array} \begin{bmatrix} z_{1,t_1} & z_{1,t_2} & \cdots & z_{1,t_N} \\ z_{2,t_1} & z_{2,t_2} & \cdots & z_{2,t_N} \\ \vdots & \vdots & \ddots & \vdots \\ z_{M,t_1} & z_{M,t_2} & \cdots & z_{M,t_N} \end{bmatrix}, \quad \text{time} \longrightarrow$$

1.2. Research Aim and Objectives

Research Aim The research aim is to explore the role of AI technologies that might be utilized to enhance self-service business intelligence (BI) regarding the benefits and opportunities, as well as challenges and risks for organizations. Overall, the research aim is to tackle the question: What is the role of AI technologies in enhancing self-service BI in organizations, and what are the key implications for organizations? To guide the research aim, the following objectives have been created: Objective 1: To explore which AI technologies are expected to enhance self-service BI. To pursue this objective, missing links in the literature between self-service BI and AI were identified and reviewed. Moreover, AI technologies were explored that addressed previously identified challenges of self-service BI. Objective 2: To explore the implications of integrating AI technologies in BI frameworks. To achieve the second objective, prior research on self-service BI and its benefits for organizations overcame challenges through an empowered end user, which was reviewed to engage in that exploration. Our exploration initially indicated potential capabilities that AI technologies may contribute to identified self-service BI frameworks. This research aims to disentangle the linkages between self-service BI and AI, in particular, to guide and inform organizations about the relevant technologies that may enhance self-service BI. While deep-diving into the implications of AI technologies for the requirements definition phase of a BI system, literature confirmed the likelihood of AI technologies addressing specific challenges of self-service BI. Nonetheless, new challenges were also found as brought into organizations by AI-integrated self-service BI. Therefore, the objective of this research shifts to the exploration of AI technologies and implications contained within BI frameworks designed to enhance self-service for organizations. Our research seeks to investigate the potential benefits and opportunities organizational stakeholders could gain from the adoption of AI technologies within BI systems. Specifically, the research analyzes individuals, via the asset-based approach, at both the individual and group levels, and with stakeholders. Research gaps and motivations for our research are presented in the final two sections. The primary aim of business intelligence (BI) projects is to empower the intended users of the deployed BI system with access to the right information and analytical tools to foster and enhance their abilities to make decisions with data.

2. Understanding Self-Service Business Intelligence (BI)

"Self-service BI" does not have a standard, universally accepted definition, but for businesses and organizations involved in data-related activity, it often signifies the following combination of features and functionalities. A shift of focus from analyst-centered traditional BI that allows processing data to the more user-centric approach enables wider categories of users to enter into data processing. Tools and technologies enabling data processing are designed for end users and ease of use. Data processing is often conducted through data access, data integration, data transformation, data analysis, and information consumption capabilities. These tools include technologies ranging from stand-alone analysis software like spreadsheets, statistical analysis, visual analytics, etc., to web-based access to analytic tools. End users have greater control over the manipulation of their data and analysis, often including the ability to conduct statistical analysis, sophisticated reporting, and the development of predictive and prescriptive models.

The rise of "self-service BI" was accelerated by the sophistication of the tools available for enabling users to tap into ever larger sources of data. This level of activity suggests that people are interested and able to "work with the work" of using and analyzing data so that they are solution-ready. With the advent, usage, and impact of business intelligence today, organization executives have become aware of the importance of data and how it can be stored, processed, and analyzed to reveal valuable information and support important decisions. Given the vast volumes of data now collected by organizations, BI has had a marked effect on how to assess data relevance and analyze and mine for hidden useful information that serves the recall needs of various systems accessed by a network. Self-service BI applications, including on-prem and cloud-based applications, have become market-ready commodities. From an end-user standpoint, there are several characteristics of self-service BI. First, self-service BI features wide data availability. One of the key components of a decision-driven BI architecture in a changing world is reducing the latency of the data stream visibility by bringing the data holdings into operation. Self-service BI allows users to be self-sufficient in retrieving data from different places and to be in control of the end.

Equ 2: To calculate the standard deviation, use the following formula:

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}$$

2.1. Definition and Components

Self-service business intelligence (BI) enables business users to perform analysis and generate insights without extensive technical knowledge or the assistance of data analysts. Self-service BI consists of four components. Data visualization refers to organizing and representing data visually to gain insights and make data-driven decisions, whereas reporting is bound to disseminate information to help organizational decision-making entirely. Self-service BI also refers to the process of generating insights using data visualization. Thus, the front end here refers to ideally some kind of dashboard or visualization tool that allows regular users to explore the analysis on their own with little to no training or assistance from an analyst. User-friendly interfaces allow business users to easily interact with self-service tools and rely on AI to further enhance user experience by guiding the analytics process.

Self-service BI systems are designed to enable business users to generate insights through data visualization without the technical know-how needed to configure the tools and use them. As such, self-service BI is different from traditional BI, which requires businesses to rely on IT professionals to perform the necessary IT configuration to set up the BI system. Business users are also dependent on BI experts to create reports on their behalf. Data governance and data management are necessary components for ensuring that self-service analytics continue to produce accurate and reliable insights. These components are about managing the privacy and security of the underlying source data, as well as monitoring the data being ingested by the platform. For this work, user empowerment is conceptualized as the ability of business users to derive insights from data using self-service BI and is synonymous with the concept of data-driven decision-making.

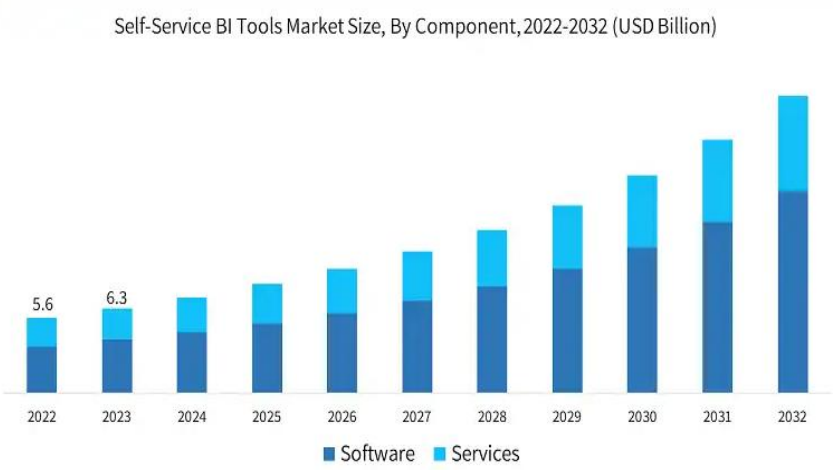

Fig : Self-Service Business Intelligence Tools Market Trends

2.2. Benefits and Challenges

Self-service BI is associated with several benefits. With self-service BI, speed and economic feasibility are high since end-users are provided with an intuitive interface to access and analyze data for decision-making. Moreover, self-service BI also improves the quality of decision-making by using data analytics. Real-time data distillation leads to speedier decisions. Employees have more faith in the quality of decisions that are data-driven as opposed to those that are made based on their intuition or informal data. The idea is that if data points them in that direction, they are more inclined to follow the decision. Furthermore, because they understand the process utilized to reach that conclusion, self-service data analytics leads to increased confidence among users. A data-driven society is in favor of democratizing data access across all hierarchy levels. AI and ML might improve and optimize processes and workflows where putting them into self-service is feasible.

Despite the numerous benefits that it offers, self-service BI also comes with many challenges. The most frequently stated obstacle lies in the lack of knowledge and know-how among employees when it comes to data science and BI. Certainly, business managers are often unaware of how to interpret complex data and identify

patterns. Misinterpretations of BI data can lead to poor decision-making. As a result, adequate training is required for employees to take advantage of these services. Proper guidance and support can overcome these challenges. The greatest weakness of almost all self-service BI tools is the lack of governance and control. Their usage could lead to data chaos. Data lineage and data integrity become gray areas as data enters organizations fast and in high ebbs. It can lead to duplicate databases and versions of the truth. AI technologies can be harnessed to create an advanced solution for these commonplace challenges. Facilitating the synergy and cohesiveness between end-users and IT departments is the basis for AI incorporation into self-service BI. Organizations can amplify the use cases and value connected to self-service BI and evolve into a data-driven entity.

3. The Integration of AI in Self-Service BI

Self-service business intelligence (BI) refers to a software framework that allows end users to access and prepare their data to conduct analysis and report findings. By doing so, individuals can make data-driven decisions without the need for specialized data science expertise. Over the years, increasingly more advanced forms of AI have been integrated with self-service BI platforms. These include, but are not limited to, machine learning, natural language processing, deep learning, as well as non-statistical, rule-based AI systems. The benefits of such a technological partnership are bountiful. Machine learning, for example, allows for automatic, real-time insights generation, freeing up enough time to analyze those insights for the user. Natural language processing, meanwhile, drastically improves user experience by offering more intuitive ways of interacting with data. With both facets combined – machine learning, for generating automatic insights, and natural language processing, to enhance accessibility – end users can more effectively conduct faster, data-driven analysis towards making more effective, efficient, and economical decisions. Leveraging AI within self-service BI can offer a wide range of benefits to users. Insights can be generated from data faster than using traditional statistical techniques or by taking the time to learn how to run a new machine learning model for the first time. The AI elements overlay on top of BI tools to enhance one's user experience. These features should be built, not as a "cool feature," but rather as a means of accomplishing a higher-level task such as "increasing adoption," "reducing the number of actions to completion of a task," and many other associated metrics. Using AI in self-service BI can generate substantial benefits, for example, through generating real-time, automatic insights and improving the user experience through features such as natural language processing. These improvements can enable organizations and end users to be more effective, efficient, and economical in their data-driven decision-making. It is worth noting, however, that careful thought should be given when building solutions that make use of AI due to potential algorithm bias and complexity.

3.1. Overview of AI Technologies in BI

Overview of AI Technologies in BI Today, a plethora of AI technologies are making their debut within BI applications to equip business users with the competence of a data scientist. A few such technologies and capabilities are mentioned below. Machine Learning Algorithms: Self-service BI products linked with AI can perform automatic feature engineering for making predictions on data. Automated Data Processing: These systems utilize natural language translations to interpret user queries and, in less than a blink of an eye, process, cleanse, and transform data accordingly. Predictive Analytics: Here, the system in the background models data using a set of machine learning algorithms to forecast future events using historical and real-life data. For instance, one company with a connected fleet can leverage this feature to predict when their vehicles are about to fail or at which location a problem might occur. Insight Engines: Insight engines can tap into data until senses are made, finding trends, detecting sales patterns, and even suggesting visualizations.

To users, these are periodic facets of self-service BI that simplify and condense the user experience, allowing them to extract valuable insights promptly without the need to learn data science or forcing them to visit a data scientist. The utilization of AI technologies in this era of BI, thus, leads to contextual users, steering user engagement and organizational decision-making. Like several other applications, early intelligence BI systems focused more on the 'enterprise' and less on the user. Modern AI-driven BI tools cater to user-friendly needs by presenting them with data and encouraging self-service reporting and analytics. What more? They personalize data delivery, and the insights they present are natural and easy to understand. AI is gradually infiltrating business intelligence applications and tools in the form of human voice, text, and image recognition as the day progresses. With this increased acceptance, businesses no longer consider AI a mere technological blessing. They are now convinced that the AI structure within their self-service BI regime gives them the fertile ground to truly unearth insights and make insightful decisions.

Fig 2: Overview of Self-service BI and Its Business Benefits

3.2. Benefits and Challenges of AI Integration

The integration of artificial intelligence (AI) with self-service business intelligence (BI) provides various benefits to employees and organizations when making data-driven decisions more transparently and comprehensively. The findings suggest several benefits associated with the use of AI in self-service BI. For example, it can automate routine data analysis tasks, quickly uncover insights that were not readily apparent to humans, reduce noisy and low-quality data to improve insights and speed up the process of analyzing large datasets. Given that AI technology frees up experienced users to focus on strategic activities, many organizations are already adopting these AI technologies in their BI systems. However, simply integrating AI into self-service BI can be more advantageous than removing existing AI. Yet, the insights generated by AI are not accurate and fair in some cases due to algorithmic bias and poor governance. In addition, the integration of AI requires appropriate technical and skill capabilities to develop and work with AI teams.

The integration of AI into self-service BI is increasingly being discussed in fields such as threat identification and decision-making. It is crucial to keep these facts in mind when considering AI technologies in the BI system. On the one hand, the use of AI in BI-related tasks can greatly streamline activities and improve decision-making capabilities. On the other hand, AI can bring various challenges that require significant attention. Therefore, organizations need to sensibly assess AI technologies as an asset in the BI toolset to ensure that AI investments provide beneficial insights that can speed up strategic decision-making. Individual employees and the organization can use intuitive and interactive tools provided by BI to improve their capabilities.

Equ 3: Internal Rate of Return (IRR)

$$\text{Internal Rate of Return (\%)} = \frac{\text{Future Value (FV)}}{\text{Present Value (PV)}}^{\frac{1}{\text{Periods}}} - 1$$

4. Empowering Users through AI-Enhanced Self-Service BI

Self-service BI solutions empower users to access, analyze, and interpret data to execute data-driven decision-making daily. Through the application of AI, these solutions are being further enhanced to empower users in a way that was not previously possible with traditional BI. Through intuitive data exploration and interaction, AI-enhanced self-service BI disaggregates the typical waterfall requirements composition of the separate designer-consumer roles in any BI solution to allow consumers to act as designers of insights in an interactive BI system. Such AI-enhanced visualizations also have the potential to simplify the communication of very complex datasets faster than detailed reports and text, as users can learn to interpret these graphics quicker than the time it would take to read a lot of detailed reports or documentation. Furthermore, solutions that leverage the power of AI to provide users with personalized insights and recommendations are now appearing in the marketplace. These insight delivery solutions monitor user behavior and preferences, leverage available data, and apply machine learning techniques to personalize user experiences and the delivery of data, so that contextual and relevant data may be composed in an intuitive and consumable manner for expedited and improved decision-making. These personalized insights, coupled with other advanced features such as natural language query and generation of insights from unstructured data, have the potential to catalyze a radical shift away from the traditionally slow and deliberate BI operations of the past, and towards an era of self-service, rapid, and confident decision-making.

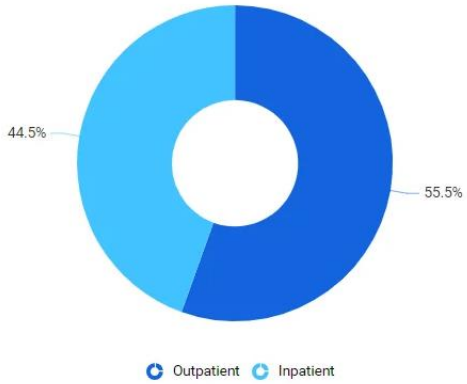

Fig : Unlocking the Power of Embedded Self-Service Business Intelligence

4.1. Improved Data Accessibility and Visualization

One major way in which artificial intelligence impacts self-service business intelligence is by making it more accessible. A characteristic of any self-service tool is that it presents analytics capabilities to the user in the most intuitive, familiar, and easy-to-understand way possible. While self-service encompasses a broad range of design features and functionality, its foundation is making data more accessible to users. The more engaging and easily accessible a self-service interface is, the more likely an end user will be to meaningfully engage with the analytics. AI-based advanced analytics do much of the challenging technical work behind the scenes, but interfaces provide an interface that can be naturally navigated in day-to-day usage.

A major component in the design of self-service business intelligence tools is advanced visualization. Advanced visualization techniques, including such innovations as the “sparking” of the x/y-axis with a color-flipping pulsing effect to show maximum and minimum points on a line or a scatter plot, make it possible for a non-technical user to not only understand but internalize complex information in just a few seconds. Real-time dashboards that are more interactive and updated in real-time are also common. Users have commonly had two choices in a dashboard: interactivity at the filter level, where data updates as the user changes filters, and interactivity at the chart level, where generally only the chart you click on displays its data in an underlying table. Real-time and AI technology allows for interaction at both levels simultaneously on the same chart. The outcome is that now nearly all users can explore their data without needing a cradle-to-grave training session every time, making these self-service solutions much more democratic enablers of intelligence. Offering this accessibility is fundamental to inspiring a broad-based data-driven culture and decision-making. While traditional BI applications tend to be data-centric, focusing primarily on underlying transactional systems, AI-enabled tools are business-centered. This places the needs of end users front and center and allows business workers at all levels of capabilities to get the insights they need at speed and in the flow of daily operations.

4.2. Personalized Insights and Recommendations

In the data-driven decision-making process, users draft a hypothesis about specific trends or contributing factors and validate them using existing data. Current BI tools support predefined visual reports and dashboards, leaving users the burden of figuring out how to draft these hypotheses and perform data analysis. Artificial intelligence algorithms can help address this challenge by learning user preferences based on their interactions with both the BI tool itself and the data. AI algorithms model these interactions to provide tailored insights and recommendations. Personalization is crucial for the self-service BI environment, as users already have insights about the likely outcomes for subpopulations relevant to themselves, which are not easily captured by generic reports and dashboards. Personalization helps enable several other factors relevant to user interaction with BI tools.

Personalized insights allow organizations to move from an emphasis on large amounts of data to making decisions in which data are a critical factor. As such, providing relevant insights based on the constituent's area of responsibility or interest enables timely action rather than further data mining or cleansing efforts. It has been widely documented that as the number of steps between insight and action increases, the likelihood of actionable items decreases. The long pipeline between insights and actionable items can occur when insights are not prioritized based on their relevance or need clarification. Assessing relevance with end users is important, but generally, irrelevant insights can delay effective action based on analysis. Providing business users with actionable insights aligns with their priorities, reducing the time required to go through the process and clarifying the steps forward. Providing recommendations along with actionable insights helps business users make timely decisions. The different types of recommendations are defined based on the context of the business user using relevant taxonomy and normalized data for item-to-item comparison in generating the recommendation. The business user's context and preferences can be recommended based on clusters or direct data sharing, ensuring a more accurate prediction. Providing personalized insights and recommendations is crucial in a BI environment because it enables end users to rely on available data for decision-making. The provider of the insights is perceived as being able to 'read the mind' of the recipient.

5. Case Studies and Examples

To complement our theoretical discussions and to explore the possible applications and implications of an AI-empowered self-service business intelligence approach, a collection of case studies and illustrative examples is now presented. For these examples, we have drawn on recent experiences and discussed projects with affiliate organizations consulting in the field of AI and data management and analytics. Examples of organizations now exploiting AI-empowered self-service business intelligence are drawn from the private and public sectors. Drawn from different sectors and organizational sizes/types, the following examples provide useful insight into actual industry best-practice applications of AI-empowered self-service business intelligence. Practical applications such as those provided here demonstrate the points made by theory by applying them in actual contexts and validating recent research in the field. This section provides a roadmap for organizations looking to integrate AI technologies with business intelligence for business decision applications across a range of application contexts. The key deliverable this research provides is a demonstration of AI-empowered self-service business intelligence and insights into how AI technologies can be used to enhance business intelligence capability.This section presents a curated collection of case studies illustrating the practical applications and implications of AI-empowered self-service business intelligence across various sectors and organizational types. By drawing on recent experiences and collaborations with affiliate organizations specializing in AI and data management, we showcase how both private and public entities are successfully leveraging these advanced technologies. These examples not only highlight industry best practices but also serve to bridge theoretical discussions with real-world applications, validating recent research in the field. The insights gained from these case studies provide a comprehensive roadmap for organizations seeking to integrate AI technologies into their business intelligence frameworks, ultimately enhancing decision-making capabilities and driving operational efficiency across diverse contexts. This research underscores the transformative potential of AI in empowering organizations to harness data more effectively, fostering a culture of informed decision-making and innovation.

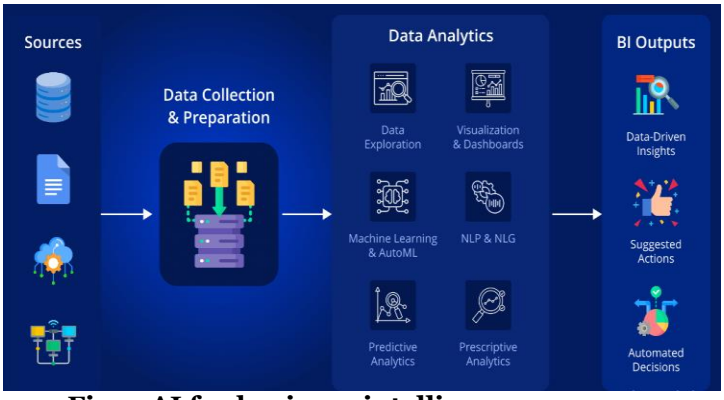

Fig 3: AI for business intelligence use cases

5.1. Successful Implementation Cases

The Empower Users survey confirms that AI can indeed transform the world of BI. In this section, we provide successful implementation cases from different customer companies, which serve as empirical evidence of how organizations are already reaping the benefits thanks to AI-enhanced self-service BI. By learning from the outlined cases, different organizations can adopt innovative approaches to reach important strategic outcomes. The cases are summarized in a table. For reasons of confidentiality, the names of the showcased organizations are pseudonyms. The detailed objective, the encountered challenges, and the successfully achieved outcomes are described in the following subsections.

1. Fast Snow's objective was to reduce the effort needed to analyze its data and increase the efficiency and proactivity of its employees with the help of an AI-enhanced self-service BI solution. 2. Since launching the digital platform, including the Embedded Analytics solution, North Juristic's customer success team has also reduced the time spent on customer emails by 80%. 3. JuraPoker's goal was to create a self-service BI tool suitable for the legal tech industry featuring voice control capabilities. Both JuraSoftware and JuraPoker are part of the wider Jura community. Their combined original and now reintegrated team consisted of nearly 40 people using a Digital Research and Development budget of over CHF 1 million. 4. The goal of creating a digital platform to analyze survey data is shared by Shapiro and Ocean Park. Ocean Park is a leading Swiss company with around 1,000 team members at 23 sites. Starting as a research project, the survey tool was established in 2014 and has been in production since 2015. Unique monthly users grew from roughly 50 to 1,702 in North Juristic and from roughly 20 to 25 users to 433 in Ocean Park.

5.2. Lessons Learned

From these four cases, a set of recommendations for implementing and embedding AI-driven self-service BI in an organization can be distilled. First, it is recommended that user adoption strategies are crucial for the successful embedding of a self-service BI tool. In this respect, it is important to continuously invest in training and support measures. Moreover, increasing user involvement in technology provides psychological safety for

user adoption and offers new insights hidden in large data sets. Second, it is advised to continuously ensure data quality and management. A data-driven organization needs reliable, high-quality data stored in data silos to ensure trustworthy, reliable, and continuously available information. Third, it is essential to embed AI-driven self-service BI capabilities in an organizational context and strategic setting. Only then can the potential benefits be reaped. Fourth, it is advised to invest in the soft side of AI in BI: organizational change management, culture, and behavior. Changing a culture is the most difficult part of stimulating BI self-service use in an organization. Encourage data-driven behavior and data quality improvements continuously. Providing access to reliable, high-quality data or excluding the use of data that is not in silos sets up rules and policies for the proper use of data. Fifth, it is advisable to invest in an easy-to-use BI tool with added embedded AI capabilities. It will stimulate usage and insight generation based on the large data sets of an organization. The self-service BI tool should not be a black-box configuration. Managers and content management of departments are responsible for the use of the insights and results generated by their teams. In addition, every user is responsible for using the insights with the utmost care and ethical behavior if needed.

Equ 4: Accessible Authentication

$$(1+a+b)G_\lambda(a,b) = 1 + \lambda \int_0^\infty dp \left(\frac{G_\lambda(p,b) - G_\lambda(a,b)}{p-a} + \frac{G_\lambda(a,b)}{1+p} \right) + \lambda \int_0^\infty dq \left(\frac{G_\lambda(a,q) - G_\lambda(a,b)}{q-b} + \frac{G_\lambda(a,b)}{1+q} \right) - \lambda^2 \int_0^\infty dp \int_0^\infty dq \, \frac{G_\lambda(a,b)G_\lambda(p,q) - G_\lambda(a,q)G_\lambda(p,b)}{(p-a)(q-b)}$$

6. Future Directions and Implications

By embodying decision-making rules, models, and recommendations directly into BI systems, organizations can significantly empower their users, as the need for data and tool proficiency diminishes. These capabilities will gain an additional advantage as digital assistance, cloud capabilities, and vendor capabilities around conversational interfaces mature. In the future, we also anticipate personalization and adaptation to user preferences, for instance, the choice of algorithms and features that have been proven to perform best in previous modeling scenarios. These are only a select few of the emerging trends and directions the integration of AI in self-service BI could take. Vast improvements in deep learning and automation are anticipated that will fundamentally change how BI can contribute to organizations and can be used by end users. These forthcoming changes are rather exciting since BI was for a long time focused on making the most of historical data until organizations could no longer keep up with the scrolling speed of data and the changing behavior of decision-makers. Therefore, we argue that future self-service BI strategies will change the nature of BI development itself by focusing no longer on getting users onto the 'bi-cycle,' and teaching employees to act on insights, but rather on building tools highly adaptive to their diverse needs, backgrounds, current expertise, and tasks, and minimizing the need for employees to learn any complex tools in the first place. Our perspective provides an outlook into future developments and will help organizations anticipate the technical and social challenges they face. Our study provides thought-provoking insights into the evolution of BI and proposes a paradigmatic shift to the status quo of BI that is essential for business organizations. Based on current research, we elucidate an emerging future trend in BI related to AI and quantitatively articulate the most anticipated technical advancements. Together, these insights help sketch the future landscape of BI in the age of AI.

6.1. Emerging Trends in AI and BI Integration

Emerging Trends in AI and Business Intelligence Integrations We are early in our exploration of the role of AI in BI, which is why it is difficult to predict future trends with a high level of certainty. Nonetheless, we can observe certain trends in the types of AI technologies that are currently adopted in BI environments. Firstly, there is a strong focus on voice-controlled user front ends, meaning a layer of the BI system that integrates with the end users. There is also a pronounced focus on advanced analytics and machine learning for data preprocessing and predicting required data outputs or the most relevant next steps for the users. Moreover, major technological vendors are focused on allowing BI tools to process larger sets of data in real-time. This includes the ability to establish temporary infrastructure for adjusting to the immense workloads or data size. Additionally, processing data in real-time means supporting the stream processing capabilities of systems. Lastly, major vendors have started focusing on better user journey mapping to learn or predict user behavior and proactively address its preferences. In BI environments, based on the combination of existing signals and derived projection patterns, e.g., valuable input from adjacent domains, historical signals in similar periods, or historical signals with cross-dimension relevance. The discussion is furthered by heralding the acceleration of technologies in the purview of augmented intelligence. In their continuous development, the market-leading BI platforms have introduced machine learning and artificial intelligence APIs to iteratively augment the capabilities of their third-party developers who can derive embedded AI/ML data integrations. That is to say that since BI is increasingly synonymous with decentralization and empowerment of the greater general workforce to gauge insights from company-wide data, developers are necessarily attempting to conjure an AI API ensemble capable of mass human data ingestion and cognitive reasoning support to answer questions on their behalf. As organizations increasingly adopt these technologies as part of their digital transformation

strategies, an increasingly profound cognitive natural language processing will accompany them for voice-activated user interfaces, personal chat interactors, and AI-augmented natural language, insight processing, and storytelling of their BI software offerings. This natural language processing will also leverage natural language queries and textual data to provide intelligent auto-semantic data extraction from holistic, unstructured company data, such as text-based knowledge bases. This involves the AI of BI researching existing data points across datasets for insightful consonance with the natural language data points from a user input query that tends to mean the same in a particular context. The AI that queries the holistic databases should understand the company vocabularies and also be capable of learning to improve its named entity recognition capabilities as new entity data is ingested from queries.

Equ 5: Benefit-Cost Ratio (BCR)

$$\text{Benefit-Cost Ratio} = \frac{\sum_{t=0}^{n} \frac{CF_t[\text{Benefits}]}{(1+i)^t}}{\sum_{t=0}^{n} \frac{CF_t[\text{Costs}]}{(1+i)^t}}$$

6.2. Impact on Decision-Making Processes

The reason for the ongoing interest in self-service BI and AI-driven enhancements is their impact on strategic and operational decision-making processes. Relevant insights can help decision-makers understand "the why" and groom them to ask "what if" type of questions (towards the decision options). AI-enhanced self-service BI can mitigate these concerns by providing insights that are timely, relevant, and accurate, thereby making the decision-making process effective. Due to the operational competencies, creating this story for managers is a supportive mechanism to help them "see" the connection between the recommended decision and the investment in monitoring data. The mutual understanding serves as part of the collaborative process. In short, integrating AI within the BI tools can result in insights that are aligned with the organizational strategy, culture, and stakeholders, and are capable of making an actual operational/strategic impact that goes beyond the reporting duties. This capability may propel organizations onto the data strategy maturity by actually reducing the decision latency. Where the decision-makers are looking at both the present and the future, AI can reduce the cognitive load on the BI users. Automation of insights will allow the BI user to question them (focus on decisions) with more clarity. Thus, the BI user can focus on "how to interpret the predicted data," "Is the result making sense to me," and "what to do next based on the insights." AI can answer these as well, but the distinction here has to be made in terms of "purpose." While AI can generate trends or happenings based on the data available, the decision-making process requires "clarity" to identify solutions for "what can or should be done." AI can also complement the BI users' perspective by using diverse data sources and creating a fertile ground for cooperation and collaboration. AI-driven insights can streamline the reporting. For example, ensuring there are no anomalies or providing explanations for the anomalies.

AI can provide multiple future scenarios or improve the accuracy of the insights leading to collaborative discussions on what works best. All of these result in "CEOs and decision-makers in the highest-performing companies of all sizes leveraging analytics as part of their everyday activity." Providing insights can also strengthen a "culture of evidence-based decision-making" by embedding evidence-based insights during the decisions, thereby giving birth to the practice of 'data-oriented decision-making' in the organization. This phenomenon caters to making the organization more "in favor" of using technology for decision-making. By 75% of enterprises will shift from piloting pockets of AI applications to operationalizing AI as a core capability in their workforce and systems. Each step in the AI Ladder represents a move toward more sophisticated tools and processes, greater investment, and higher return on investment. Organizations are guided by aspects of AI, and they are working to embrace more sophisticated and innovative models that can automate and further streamline decision-making in the organization.

7. Conclusion

In summary, this paper has highlighted the transformative role AI can play in enhancing self-service business intelligence. Our findings explain how AI can vastly increase users' ease of access to data and help them derive independent insights from complex and scattered information. We also contribute by identifying both user and organization-centric benefits on top of the common themes in the literature.

AI not only empowers users by making data-driven decision-making more accessible; it also facilitates a data-driven culture within an organization. This is advantageous in an environment where speed and data-driven decisions are increasingly important. Organizations need to foster a sense of data awareness and preference for data. One way to do this is by empowering users through the utilization of AI. A recommendation for organizations is to roll out an overhauled BI strategy and potentially include AI-integrated self-service BI components. Not updating one's tools to the current standard means one has lagged in exploiting data and AI to reap maximum benefits. Hence, it is suggested that AI needs to be explored in tune with technological advancements, making systems and procedures intelligent as well as user-friendly. AI, if not, should be made

a part of the BI strategy. Also, it is imperative to undertake further research into AI in various other aspects of AI-integrated BI and at different stages. This will help in widening the practitioner's perspective.

7.2. Summary of Key Findings

Our research shows that AI is an enabler for engagement and improved decision-making and analytics capabilities through its functionality to simplify and empower users. We find that AI-personalized recommendation systems enable users to quickly get insights and features from data they might otherwise have overlooked. Our respondents believe that data democratization can turn a workforce into a data-driven organization, something that is critical for companies to remain competitive. The understanding by the front-line workforce of BI and the creation of human capital to use tools is key. Access to self-service BI content and system overviews is perceived as self-motivating: it can spark curiosity and generate new research questions. Understanding the near-efficacy of prospective actions is critical when working with data science advancements, and we have discovered that users not only use Business Intelligence for exploratory purposes but are also using data to validate their research.

By exploring BI system capabilities, we found a trend favoring decentralized algorithms with aggregated sentiment and further decentralization seen in breakthrough systems that do not require a centralized algorithm to compute results. Our research has highlighted the market need for BI capabilities extended by AI tools. Integration is key, and cutting-edge organizations will want these technologies combined. AI can create personalized KPI insights and provide self-service tools for unskilled users. We find a common excitement for AI and BI integration, with results suggesting that AI and consideration of data democratization initiatives are directly linked.

7.2. Future Trends

While we have observed a revolution in the relationship between AI and BI over the past, we anticipate a plethora of trends shortly. Based on predictions in the technological advancement of AI, we foresee machine and deep learning algorithms expanding in functionality, enabling more accurate predictions and broader analyses. In addition, natural language processing capabilities will continue to develop, allowing the users to ask more complex queries in multiple languages and receive spoken natural language responses. We also expect AI-augmented insights, forecasts, and simulations to be generated and presented to end users.

These innovations will lay the foundation for a novel class of predictive, goal-seeking, end-user-facing business intelligence, increasingly integrated with process automation and orchestration, enabled by enhancing technical capabilities and user experience. These trends will have consequences for the relationship between self-service BI and decision intelligence, the user experience of AI-augmented BI, and organizational decision-making. With these observations, we hope to begin to illuminate and anticipate the implications of technical change as the co-evolution of AI and BI reconfigures the field of organizational design strategies. We encourage future leaders and designers of organizations to remain alert to these potential shifts and develop their historical understanding and technical capabilities to address the business intelligence tools of the future. As AI continues to evolve, yet still embedded in BI tools and appropriately trained, there remains an opportunity to optimize the utility of these advanced BI systems. Organizations must future-proof their data analysts, scholars, and specialists by engaging in the continuous process of understanding, designing, and improving the AI-BI intersection.

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