

Real - Time Business Intelligence: Enabling Agile Decision - Making

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Abstract: *In the year 2001, agile methods were first introduced. In the period since then, practitioners have used Agile approaches across a wide variety of delivery disciplines. An examination of the ways in which Agile methodology and principles can be used to the delivery of business intelligence is presented in this article. Additionally, the study delves into the ways in which Agile has developed alongside the development of capabilities related to business intelligence. The exponential expansion in the amount of data generated by technologies such as the internet and smart devices has resulted in the development of business intelligence. This growth has modified the way in which individuals and businesses utilize information, which has led to the development of business intelligence. Despite the fact that the application of Agile principles and practices has evolved as a result of the development of business intelligence, the practice of delivering business intelligence using an Agile methodology has reached a mature development level. The phenomenon known as "Big Data," which refers to the volume, diversity, and velocity of data, has had an impact on different aspects of business intelligence as well as the application of information. A number of novel concepts, such as data science and fast analytics, have recently come into existence within the realm of business intelligence. This article discusses the ways in which Agile concepts and practices have developed in conjunction with business intelligence, as well as the issues that it faces and the paths it will take in the future.*

Keywords: Agile methodologies; business intelligence (BI); analytics and Big Data; lifecycle for BI and Big Data.

1. Introduction

The method focuses a priority on the proactive roles that the Leader and the IT team play. This is due to the fact that it was specified that the Leader is the one who first gives treatment once the development need has arrived. The leader received the first notice of a desire for progress, processed it, and then made the first selections and criticisms that were necessary. Thanks to this, methods and pathways can be put in place to satisfy the demand solution according to the initial request made by the client area. A number of factors, including the title, purpose, assumptions, business process summary, and need description, were shaped by this request. Smart decision - support system development required thinking about software engineering in general and agile methodology in particular [1]. Using an intelligent decision support system, it was decided whether to sign a product import contract (like one for gasoline) at that specific moment. Particularly, the head of the IT department distilled the raw data into a more technical manner for his staff. I did this to help bring the original goal in line with the current requirement and the best technology course of action. The method takes us back to the first stage, where we had a conference call with everyone involved and two internal meetings where the software engineers refined the business process using question cards or created their own to bolster the research. The method suggests that meetings be fifteen minutes long, similar to the sessions in recognized agile methodologies [2]. At this first step, the leaders of information technology convened a meeting with all the participants, splitting them into smaller groups to collect needs using cards. Whenever the head of the IT department started a new group, an IT team was there as well. An IT staff member stepped in to help with the meeting's logistics, the assembly of the intricate 3D graph, and the listing of needs. Only members of the IT team were present at the other two meetings that occurred during the first phase.

The head of the IT team presided over these two meetings in order to provide direction to the team about the organization

of the requirements and the packaging of the packages. Following this, the requirements for creating an intelligent decision support system were uniformly laid down. For example, the specific type of import needed for the specified business operation was decided upon by the IT team. Furthermore, in order to deliver a more precise decision - support component, the group identified factors that require stock market access.

Meetings within the phases followed the PMBoK process group format, which involves the usage of input and output artifacts. Both the requirements evolution process and package definition relied on these artifacts. At the end of the first phase, layers and important people generated a requirements board and a complexity chart, which were similar to but served a different purpose: to assist with the planning and defining of the first packages. Prioritizing matters involving a key individual helped build trust among the development team from the start, as they knew they could always rely on that individual.

The board will largely aid in prioritizing the prepared packages. Each stakeholder group and the IT department got together for a meeting during the planning and analysis phase. The IT manager had to address the concerns of his staff while also satisfying the requirements of the client area during the meeting with everyone concerned. The IT team leader relied heavily on the 3D complexity graph and a board outlining needs by layers and important individuals to accomplish this. Their use of these artifacts allowed the IT manager and his team to validate the first packages. One example of a package would be one that facilitates ecosystem creation in order to negotiate an import contract. An additional option would be one that reports commodity statistics via an interface with the stock market. To better conceptualize the delivery of tiny products, we were able to see the initial system size in the 3D complexity graph.

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At this point, the approach is banking on the fact that the inputs will help build the overall goals, package goals, and important outcomes. It is the method's goal that these artifacts will allow it to go to the next level. During the negotiating process, we were able to clarify the structural sets employed in the system's development. These sets include things like paradigms, architecture, data integration, and algorithms. Meeting with the IT team at this negotiating round intended

to connect plans with potential technological solutions. For this, the head of IT made use of the method's structural set. As an example, there was a debate on which paradigm would be most useful for expanding the negotiation ecosystem. Here, the head of IT took the helm and chipped in where it was needed, prompting a conversation about whether or not the trading ecosystem's representation really reflected actual user actions [3].

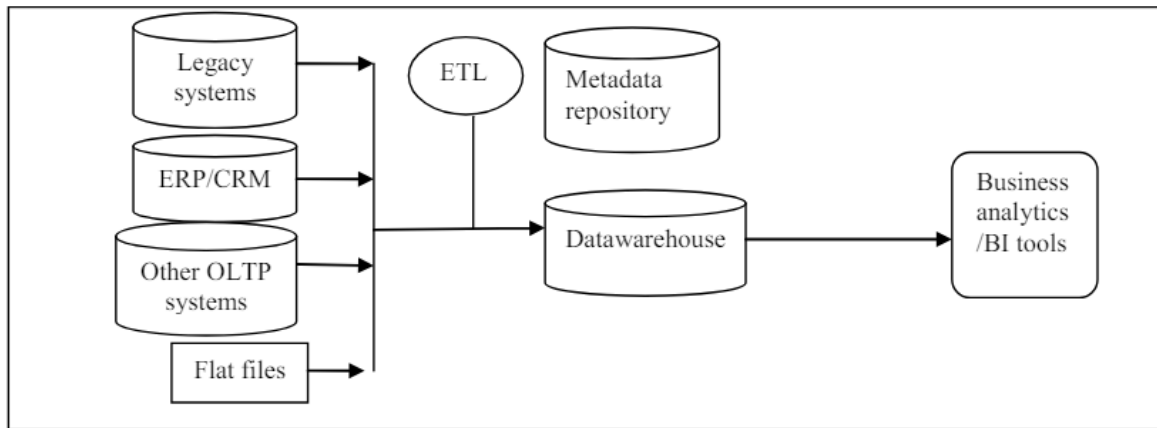


Figure 1: A traditional BI architecture

Conventional BI tools only make use of a subset of the total data set. Also, structured data is the sole source used by conventional BI systems. Enterprise data warehouse (EDW) tools, business analytics, and metadata repositories are the mainstays of conventional business intelligence (BI) architectures (Figure 1). Building on the foundation of iterative meetings, it also details an agile process for developing intelligent decision support systems. This approach walks you through the steps of starting, analyzing and planning, negotiating, controlling, and intelligent decision support. The completion of a phase indicates that all the planned meetings were held, whereas a cycle represents going through all the steps of the method.

Artifacts that aided in the development of each meeting made up the input and output during each fifteen - minute session. At the outset, we gathered everyone with their cards to conduct a needs assessment and build a 3D graph to show the scale. In IT meetings, artifacts, forms, and tables were used to define the initial packages. Throughout the analysis and planning phases, we made use of the objectives by key results form. We negotiate using the structured sets form. The configuration artefact and associated control graph are part of the control phase [4].

2. Literature Review

With its wide range of features, business intelligence (BI) offers a great opportunity to connect massive data stores with actionable insights. This expressed the idea, which posits that the efficacy of one's decision - making is directly related to the clarity and quality of one's available information. Using business intelligence, leaders can uncover valuable insights that help them make informed decisions. These decisions can enhance operations and boost the company's competitive position. Business intelligence is shrouded in mystery for reasons having to do with both its potential and its

actualization. The increasing interest in business intelligence among corporate personnel is a clear indication that it may drive operational efficiency, service quality, and new paradigms for decision - making.

However, the journey that Business Intelligence (BI) is taking to reach its full potential is not devoid of complexities [5]. By increasing operational efficiency across a wide range of industries, business information tools have become more important assets. It is clear that they have had a significant impact on the process of streamlining processes, particularly in the fields of engineering and banking. One major advantage of business intelligence in the banking industry is the depth to which it can probe operations, allowing banks to enhance their activities. They evaluate their operational data frequently, which helps them find bottlenecks, redundancies, or areas that may be adjusted for better output.

The ability to analyze data also enables financial institutions to tailor their strategy to the specific needs of individual branches. Given that each bank branch is unique, it's feasible to tailor decisions to each department's needs by learning about their cash flow, personnel dynamics, and unique circumstances.

Also, the constantly shifting landscape of the financial sector necessitates a high level of adaptability [6]. Banks are able to quickly respond to changing market conditions or profit on newly discovered opportunities thanks to business intelligence (BI), which offers them this very nimbleness. This kind of agility is very necessary in order to keep a competitive edge in the banking industry.

During the process of shifting our focus to manufacturing, we have discovered that the deployment of Business Intelligence Software (BIS) offers companies with a comprehensive toolkit that considerably boosts their ability to make

decisions. There is no possible way to overestimate the significance of such tools when it comes to improving responsiveness and honing competitive competencies. Furthermore, the role of business intelligence becomes incredibly advantageous in scenarios such as computer - integrated manufacturing (CIM) [7]. It is necessary for CIM systems to have this uninterrupted integration of information systems in order for them to work correctly. Whenever this occurs, business intelligence (BI) comes into play by ensuring that information from a range of sources is consolidated, assessed, and presented for executive decision - making in a consistent manner. It does this by filling in any data gaps that may exist. The merging of organizational data structures and an information delivery system (IDS) is a further step toward improved industrial management. This is made possible through the application of business intelligence (BI). One of the benefits of using such a centralized approach to data flow is that it makes it easier to translate operational figures into insights that can be put into action.

In the manufacturing industry, the existence of user - friendly interfaces is an additional benefit of business intelligence solutions. Especially in contexts that make use of linear programming, these user - friendly interfaces make the decision - making process more straightforward. Those in charge of making decisions are able to traverse with ease, choosing visual suggestions rather than navigating a maze of commands, which guarantees a smooth and efficient procedure [8].

Agile Methodology Usage in Business Intelligence Projects

The need of business intelligence (BI) in today's highly competitive business world is a well - known fact that is widely acknowledged. By meticulously collecting data on competitors, consumers, and markets, it enables educated decision - making to take place. For the purpose of preserving their competitive advantage and effectively reacting to shifts in market conditions, businesses rely on convenient resources such as business intelligence (BI) tools. By analyzing massive datasets in order to identify patterns and make suggestions, these systems provide measurable data that may be used for an informed decision - making process [9].

Because of the increasingly complex and dynamic nature of organizational contexts, there is a growing demand for business intelligence (BI) systems that are able to adjust to demands that are either unexpected or change over a predetermined period of time. Automating the delivery of high - quality technological solutions on a constant basis is something that information technology (IT) departments should do in order to guarantee that they will continue to have an advantage over their rivals. On the other side, conventional procedures are typically inflexible and stringent, which makes it difficult to adjust to changing business demands. However, there are certain exceptions to this rule. Additionally, the implementation phase is time - consuming, which leads to a mismatch between the initial solution design and the final user needs once the project is completed [10]. This discrepancy between the two is a result of the implementation process. The agile technique has the ability to boost business intelligence projects by delivering initial results and growing value at a more quick pace. This is in comparison to more

conventional methodologies, which have the potential to be more time - consuming by comparison.

As with corporate or infrastructure initiatives, the complexity of business intelligence (BI) systems comprises the hardware, software, and resources that are utilized during the course of their lifetime. For this reason, the complexity of the infrastructure will increase as the breadth of the business intelligence system expands.

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In addition to this, it offers a comprehensive comprehension of the advantages of utilizing Agile for business intelligence, which enables stakeholders to make decisions that are well - informed. The findings of this study have measured the most influential variables of implementing a business intelligence system using Agile methodology. These findings have provided stakeholders with insights that assist informed decision - making.

A. Business Intelligence

Business Intelligence (BI) is a suite of applications used to analyze a company's data. It encompasses data mining, OLAP, querying, and reporting tasks, among others. In order to make better decisions, save costs, and find new opportunities, businesses use business intelligence (BI). Business intelligence (BI) software commonly includes capabilities for collecting and analyzing data from a range of sources within an organization, including financial information, customer records, and sales figures. Aside from that, it provides businesses with data and insights that enhance decision - making, uncover untapped opportunities, and streamline processes [11]. In order to make the data easier to understand and analyze, many business intelligence (BI) systems incorporate features like dashboards, reporting, and data visualization. It finds use in many different industries, including retail, healthcare, manufacturing, and finance, to aid in decision - making at all levels of an organization.

B. Agile Methodology

The Agile methodology's ability to handle software development projects in a fluid and adaptive way has led to its massive popularity in recent years. Moreover, it is a strategy to software development based on incremental and iterative development. Collaborative efforts among self - organizing and cross - functional teams define needs and

solutions in this approach. The Agile methodology encourages continuous user participation and allows for frequent tweaks or alterations to requirements throughout the project. Because of this, it differs significantly from previous methods. The focus of this approach is on being flexible, interacting with clients, and consistently delivering software that meets operational requirements. For this reason, software development projects that adopt an Agile approach are better able to adapt to changing requirements and provide high-quality software that addresses stakeholder concerns.

C. BI Implementation Using Agile Methodology

Agile methodology's incorporation into BI systems is growing in importance as a means to meet the ever-changing demands of the corporate world. This approach allows for quicker value delivery to stakeholders, more cooperation, faster iteration, and more flexibility. Therefore, it is common practice in Agile projects to divide the whole project into smaller, more manageable chunks, with each chunk offering a distinct feature or piece of value. The team may avoid the frustration of having to wait until the project is complete to show stakeholders the outcomes by using this process. They can offer value consistently and predictably. Stakeholders can benefit from the team's efforts because of this. Furthermore, agile methodology emphasizes teamwork and open communication, which is crucial in business intelligence projects that may include several departments or roles. When a team works together incrementally and iteratively, members can share thoughts, get feedback, and make changes as needed. As a result of its greater adaptability, quicker value delivery, and enhanced teamwork, Agile can be an effective technique for business intelligence initiatives.

[12] Using terms like "business," "intelligence," and "implementation," we conducted a search for literature (SLR) on the factors that impact the effective deployment of business intelligence (BI), which led to a preliminary assessment of relevant articles. Furthermore, content analysis was employed to fully understand these previously identified components. We identified 10 criteria as the key influence for successful business intelligence deployment after compiling few publications from 11 databases that were published between 1998 and 2018. Management buy-in, data source systems, organizational resources, information technology (IT) infrastructure, a compelling vision, competent team members, effective project management, active user involvement, and effective change management are all part of the problem.

In addition, an SLR of business analytics implementation was carried out in with forty articles drawn from two databases and published during the years 2000 and 2018. In the research, an analysis of trends and patterns within the literature was included. This analysis was based on the bibliometric information of the publications that were ultimately chosen. MAXQDA, which is a quantitative analysis software, was used to inductively code key areas of the literature, which enabled systematic analysis and the organization of the data from the selected articles. Following this, the literature was evaluated. This research led to the discovery of four findings, including the rapid expansion of business analytics literature, the manner in which the deployment of business intelligence (BI) helps organizations

improve their performance, and applications in a variety of fields, including technical and business abilities. The research conducted by El-Adaileh and Yin did not use Agile approach in the process of developing business intelligence (BI). Instead, they merely conducted SLRs in broad terms without any model specification. Due to the expansive nature of the research issue, shown how data analytics, which includes software analytics, data analytics, machine learning, and artificial intelligence, may be utilized to support and enhance Agile software development (ASD) by employing systematic mapping (SM) rather than specific mapping (SLR). In order to pick few articles that were pertinent to the topic at hand, a rigorous manual search and snowballing process were applied to papers that were published in the IEEE database between the years 2011 and 2019. Initially, the research utilized a multi-stage selection method, which consisted of screening the titles and abstracts of the papers, followed by a brief reading of the papers to confirm that they were relevant. Following that, a full-text reading was performed for the purpose of further refining the documents, and a snowballing strategy for the first round was utilized by analyzing the references that were cited in the papers that were chosen. Over the course of the second round, both forward and backward snowballing were carried out, which ultimately resulted in the incorporation of new pertinent research into the study. According to the findings, there are three categories of Agile software development that are supported by data analytics. These categories are identified as Agile practices, engineering, and techniques.

The goal of conducting SLR in [13] was to examine how Agile approach was applied in different data science contexts. At the crossroads of Agile methodology and big data, fourteen articles were found to be pertinent. The ACM Digital Library, IEEE Xplore, Scopus, and ScienceDirect are some of the reliable sources from which these papers were sourced. Case studies published between 2012 and 2017 were part of the evaluation process. Keywords such as "Agile," "scrum," "kanban," "extreme programming," "large data," and "data science" were adopted. The study's results show that when compared to regular software engineering programs, big data projects have different dynamics in terms of the people engaged, the processes involved, and the technology used. On the flip side, new research shows that Agile approaches can be effective when applied to large data projects, suggesting that these methods are worth considering.

Implementation of Business Intelligence Using the Agile Manifesto An enormous amount of papers and research on Agile development have been produced as a result of the influence that the Agile Manifesto has had on the software community. The use of Agile principles, human interaction, and software advancement have all been topics of debate and discussion prompted by these articles and studies. Aside from other considerations, the Agile Manifesto was a crucial requirement for implementing business intelligence. Business intelligence implementation was addressed by eight of the twelve concepts listed in the document. Among these principles were the following: regular work delivery; a motivated team; continuous integration; deployment; common understanding among sponsors, developers, and users; team commitment; reflection; and, of course, favoring working software over thorough documentation. These

suggestions could make business intelligence creation more efficient and sustainable. A look at Table 6 shows how the Agile Manifesto affected the rollout of BI projects. If you

want your projects to be a success, you should follow the "deliver work frequently" philosophy.

Table 6: Agile Manifesto in BI Projects Assessed by Expert Judgment

Agile Manifesto	Validation Percentage
Deliver work frequently	83.3%
Continuous integration & deployment	66.7%
Shared understanding between sponsors, developers, and users	66.7%
Team commitment and reflection	66.7%
Motivated team	50%
Working software over comprehensive documentation	25%

B. Scrum: The Most Widely Used Agile Practice in BI Implementation

It was the Agile method that was employed the most frequently in both software development and business intelligence. User stories, sprints, product backlogs, and daily scrum were some of the fundamental ideas that were incorporated into it. With business intelligence (BI), needs were broken down into smaller stories and then combined into projects. A sprint is a time frame of one to two weeks during which each story goes through the design, development, testing, and delivery processes. Business intelligence (BI) development frequently adopted Scrum methods, Kanban, Xtreme Programming (XP), Custom Hybrid Multiple Programming, and Rational Unified Process (RUP), according to the report. The research used systematic mapping to find out which agile methods were most popular, and it turned out that various types of enterprises were involved. The introduction of more contemporary Agile approaches like SAFe and Disciplined Agile Delivery (DAD) has not diminished Scrum's hegemony in the field since its 1993 inception. Software development and the incorporation of BI into Scrum are two areas where the methodology is still extensively used [14].

This consistency demonstrated that the adoption of business intelligence matched the general trend in software development. When it came to the deployment of business intelligence, Scrum provided significant benefits, particularly in terms of fostering increased collaboration and information sharing among members of the team. The findings of this study demonstrated that Scrum has a beneficial effect on the scores for knowledge sharing and cooperation. These results were significant in business intelligence projects, which include the collaborative analysis of data by cross-functional teams in order to facilitate informed decision-making.

C. Significant Impact of Agile Manifesto

"Continuous integration" or change management, "user participation" or knowledge sharing among sponsors, developers, and users, and "motivated team" or organizational resources were among the many components uncovered by this study.

These factors were identified as being important. Taking into consideration the findings of El-Adaileh et al.'s survey, it appears that the influence of business intelligence implementation on the utilization of Agile manifesto methodology continues to be substantial. Due to its ability to facilitate the smooth consolidation of many components and

modules in BI systems, continuous integration is a key part of the Agile manifesto [15].

This is the reason why delivering work often and continuous integration are so prevalent in the Agile manifesto. Because it required integrating a plethora of data sources, analytical tools, and visualization components, this was a crucial stage in establishing business intelligence.

D. Iteration Method

According to the findings of [16], the Iteration Method is the gold standard. Crucial within the framework of Agile methodology, this approach allowed for constant input and customization as the project progressed. The requirements and data sources involved in business intelligence projects are often intricate and ever-changing, necessitating regular tweaks and improvements. Iteratively dividing projects into smaller ones allows businesses to regularly gather feedback from stakeholders and users. Since BI deployment usually results in value, organizations can prioritize and deliver the most important and helpful elements first.

Thanks to this method's ability to find difficulties, encourage collaboration, engage team members, and stakeholders, organizations can address possible risks and challenges early on. Teams were able to work closely together, share information, and focus their efforts towards common goals by working in short iterations. Because they show the current state of work visually, Kanban boards were an integral part of the Agile technique, which was crucial for keeping everyone on the same page regarding the many tasks that needed doing at any given time. Increased efficiency and output were the results of the team's increased openness and cooperation fostered by the visual presentation.

E. Failure and Agile Issue

One of the main reasons BI implementations fail is when team morale drops. Decreased motivation may result from a lack of teamwork. Without management buy-in and an explicit goal, team members may lose sight of the project's objective. The demotivating effect can be exacerbated by insufficient training and abilities, together with an absence of recognition and incentives. As previously indicated, a lack of extrinsic motivation variables might exacerbate already low levels of intrinsic drive. It was critical to address these factors in order to keep the team motivated and increase the likelihood of a successful BI implementation. While developing the system, there are a number of variables that can make it difficult to successfully implement BI projects. Problems and

uncertainties in business intelligence (BI) deployment might arise from the unanticipated complexity and hidden complexities of system development. Data loss and other technical difficulties are examples of system failures that can have a major impact on the implementation's overall success [17].

The small number of key success factors (CSFs) impacting the results of business intelligence (BI) deployment was another important consideration. Problems with BI system implementation can arise from a lack of understanding of the CSFs, which comprised management buy - in, integrated resources, and sufficient training. In essence, these varied obstacles demonstrated the importance of careful preparation for the successful launch of BI projects. G. Methods for Fixing Agile Problems The most effective ways to tackle agile challenges in business intelligence (BI) adoption were team communication and collaboration, dynamic product design, effort estimation, and management dimension. Consistent with the results of [18], the expert opinions show that good communication and cooperation are critical for BI deployment success. The results were better because people worked together to solve problems, share information, and make decisions. At the same time, everyone in the team had a crystal - clear awareness of the project's objectives, requirements, and status because to the open lines of communication that helped keep everyone on the same page. When implementing business intelligence (BI), a dynamic approach to product definition is essential because both needs and data sources might change over time. By incorporating new insights and data sources, this strategy allowed for the product scope to be defined and refined in response to changing business demands. This ensured that the BI solution remained to be relevant and valuable.

3. Conclusions

In conclusion, this study has evaluated and assessed numerous facets of business intelligence (BI) deployment inside the Agile methodology framework. Twelve seasoned project managers from various Indonesian sectors contributed insightful feedback. The findings added to the field's knowledge of business intelligence (BI) tools, Agile practices, methodologies, benefits, problems, and solutions, and they revealed the critical components necessary for BI initiatives to prosper. Improved responsiveness to changes, increased success rates, value addition, decreased costs, and a shortened project timetable were all positive outcomes of using Agile methodology in business intelligence initiatives. The experts' favorite strategy was Scrum, an agile practice that promotes efficient business intelligence development through its iterative and collaborative nature. The importance of continuous delivery, engaged teams, and common knowledge across stakeholders was highlighted in the 12 principles of the Agile Manifesto, especially those that pertain to business intelligence (BI) deployment. When put into practice as a whole, these guidelines greatly improved the longevity and effectiveness of BI development groups. Agile methodology had its fair share of difficulties when used to business intelligence projects, including issues with management and technology, a general lack of discipline, and the handling of requirements that were both vague and difficult to verify. Demotivated teams and ineffective system

development could result from these difficulties. Cycle time calculations, code ownership maps, management buy - in, and user participation are just a few of the Agile solutions uncovered by this study. Important factors in resolving Agile challenges during BI adoption include team - based communication and collaboration, flexible product definition, and support from upper management.

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