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**Article**

## Effectiveness of agile compared to waterfall implementation methods in it projects: Analysis based on business intelligence projects

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## EFFECTIVENESS OF AGILE COMPARED TO WATERFALL IMPLEMENTATION METHODS IN IT PROJECTS: ANALYSIS BASED ON BUSINESS INTELLIGENCE PROJECTS

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**Abstract:** The global Business Intelligence (BI) market grew by 7.3% in 2016 according to the Gartner report (2017). Today, organizations require better use of data and analytics to support their business decisions. Internet power and business trend changes have provided a broad term for data analytics – Big Data. To be able to handle it and leverage a value of having access to Big Data, organizations have no other choice than to get proper systems implemented and working. However, traditional methods are not efficient for changing business needs. Long time between project start and go-live causes a gap between initial solution blueprint and actual user requirements at the end of the project. This article presents the latest market trends in BI systems implementation by comparing agile with traditional methods. It presents a case study provided in a large telecommunications company (350 BI users) and the results of a pilot research provided in the three large companies: media, digital, and insurance. Both studies prove that agile methods might be more effective in BI projects from an end-user perspective and give first results and added value in a much shorter time compared to a traditional approach.

**Keywords:** agile, waterfall, business intelligence, analytics, big data, end-users requirements, sprint.

### 1 Introduction

Business Intelligence (BI) complexity and changing requirements represent the most difficult challenges facing applications. During the process of BI implementation, multiple components must be considered from the very start such as data integration, cleansing, modeling, warehousing, metrics creation and management, reports, dashboards, queries, alerts, and many more (Cerqueira, 2015).

This requires a clear vision of a future needs and a very well-defined strategy from project sponsors and end-users. Projects take a long time to implement and their effects can be visible sometimes only after a few years (Kernochan, 2013).

Today, organizations require BI solutions more than they needed in previous years and decade. Owing to the rapid market changes, organizations need to adopt their strategies to the new environment properly if they do not want to stay behind their competitors.

This situation impacts user's requirements for data and reports. Thus BI projects final products are often

found useless because of the organizational needs that would have changed during the time of project design and implementation (Eckerson, 2007; Marjanovic, 2011). Business cannot longer afford empty investments and needs to have quick benefits and an acceptable payback on the selected BI technology (BARC, 2017).

Traditional methods of BI implementation are no longer efficient. An overly lengthy timeline, the inability to request timely changes that usually occur only at the end of the project, and overly complex approaches do not allow meeting customer targets (Digital Megatrends, 2015).

Agile methods brought a new view to a project delivery. It approves that success can be achieved more quickly by delivery of actual product in iteration.

In this article, effectiveness is measured from the added value brought by BI in a short time, namely, return on investment (ROI) achieved after the first BI benefits appear, and by meeting end-users' requirements.

This article presents some initial research in order to answer the question: Is Agile more efficient in BI implementation compared to traditional methods?

## 2 Agile versus Traditional Implementation Approach

For a better understanding of agile method for BI system implementation projects, it is worth to compare agile with the traditional/waterfall approach first. Agile methods of implementation require a change of thinking and a different approach compared to traditional waterfall methods.

Traditional methods concentrate on project scope, using them to determine cost and time schedule. Agile concentrates on business values, using them to determine quality levels and possible technology constraints. Where waterfall methods are suitable for well-arranged and predictable environment, agile seems to be more appropriate for a somewhat chaotic and unstable environment, lacking a clear vision. All traditional models adopt the Rational Agent Model (Cobb, 2015). Agile relies primarily on the so-called approach of shared values. Table 1 shows a comparison of agile to the traditional waterfall method.

Table 1. Comparison of Agile to Waterfall methods  
(source: Awad, 2012; Project Management & Agile Methodologies, 2012)

Approach	Agile	Waterfall
Emphasis	People	Process
Domain	Unpredictability / exploratory	Predictable
Documentation	Minimal-only as required	Comprehensive
Approach	Agile	Waterfall
Quality	Customer centric	Process centric
Process style	Iterative	Linear
Organization	Self-organized	Managed
Upfront planning	Low	High
Perspective toward change	Adaptable	Sustainable
Prioritization of requirements	Based on business value and regularly updated	Fixed in the project plan
Management style	Decentralized	Autocratic
Leadership	Collaborative, servant leadership	Command and control
Performance measurement	Business value	Plan conformity
Return of investment	Early/throughout project life	End of project life

Projects managed with agile methods are provided in a progressive way in iterations. As a result, products of a specific project are the actual functionalities of the system that may be already used by a user and an organization. First, the project delivers products that bring the most value for the business. Several teams work on different elements of the solution at the same time, so they can provide planned “sprint/iteration” in a short time (Project Manage-

ment & Agile Methodologies, 2012). As a result, the number of unsupplied functionalities yet is reduced with the time of supplied iterations. Often with the traditional approach, the number of not ready functionalities is high until the end of the project. This means that every sprint represents a completed product (working functionality) delivered by a project team.

Traditional methods do not have those kinds of control points. In a waterfall scenario, often, teams spend a long time on critical tasks leading the project progress to lag behind (because of the lengthening of project phases leading to the launching of the project) and end up with a long list of unfinished tasks at the end of the project.

Because of agile team's iterations on successive versions of the product, they regularly engage the customers in the project and allow them to test additional versions of the product(s)/functionalities already being used in their daily work (Scott, 2012).

Moreover, agile methods focus on delivering value and quality within the project development process. Traditional methods focus on the scope of the project and its schedule in order to remain within the determined project's budgeted cost and planned duration. Agile methods are constant in time, cost, and quality – scope may not only change but also is expected to change. In the case of traditional methods, scope is the constant factor of the project with the variables being time, cost, and, partially, the quality of the delivered product. This is presented very well in Fig. 1.

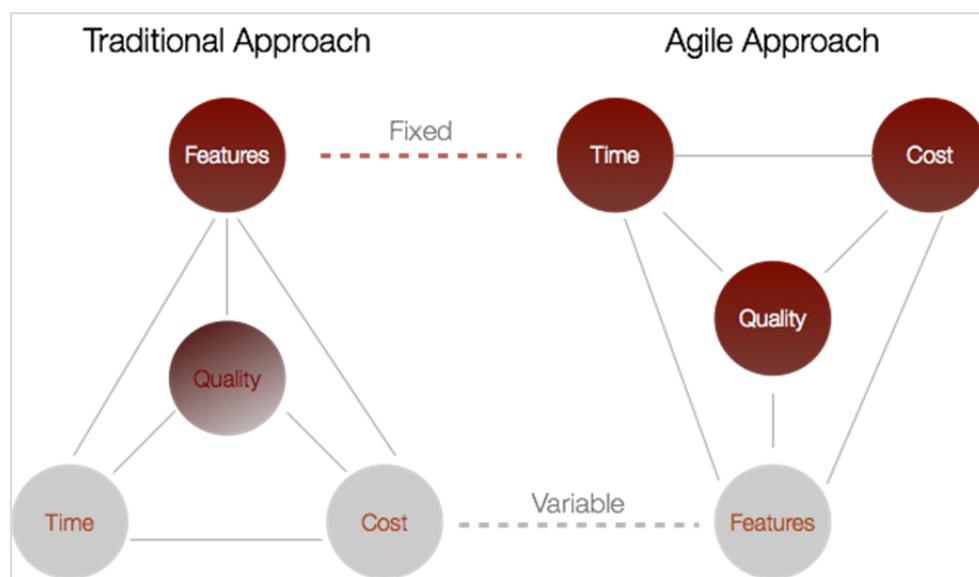


Figure 1. Comparison of the project triangles for traditional and Agile approaches  
(source: Awad, 2012; Beck et al., 2001)

In conclusion, it is important to indicate the main differences between traditional and agile project implementation management methods:

- in agile methods, cooperation with the customer takes place during the entire project on a regular basis, whereas in the Traditional ones, it is performed only at selected stages of the project,
- in the agile approach, changes are taken into account regardless of the stage of the project, whereas in the traditional approach, changes are made only after the final acceptance of the solution concept,
- the agile project is divided into parts. Each section is treated as a final distinct product that can be used by customer, and it can deliver ROI already.

Agile methods require a change in approach and habits that are the result of running most BI projects in a waterfall model. In traditional project management methods, the cost and schedule of a project determines its scope. Agile tunes into business values and uses them to determine the quality of the BI system being implemented.

Traditional methodologies are appropriate for a structured and predictable environment, and agile methodologies work perfectly in a frequent, uncertain, and unpredictable environment. For BI projects, information requirements may change during the project, and often this information that was very important becomes useless at the end of the project.

Traditional methods use and create structures based on control; agile structures are flat, collaborative, and based on mutual inspections (Evelson, 2010; Project Management & Agile Methodologies, 2012; Vijaya, 2013). The choice of project management method will depend on many factors such as the organization's susceptibility to change, the type of BI project, as well as the size of the project.

This paper focuses on the usage of agile implementation methods in BI implementation projects. The main reason behind it is the organization's difficulty in having a clear view of the solution's shape and functionalities. This leads to many changes, often last minutes changes, required by users. This is not acceptable in traditional methods, while the agile philosophy is based on it.

### 3 Business Intelligence market

According to the Gartner report (2017), the global BI market grew by 7.3% in 2016 compared to 2015. Gartner (2017) anticipates even greater growth and doubling of market value of implemented BI until 2020. By 2018, BI tools will become self-service (self-service BI) and each manager/user will be able to build any analytics and reports based on large data volumes. In Poland, trends are very similar, according to the Research and Markets (2016) report; the average annual growth rate of the BI market in 2016–2020 will be 10.3%. As for BI revenue, they will double in 5 years.

According to a survey conducted by MIT Sloan Management on behalf of SAS, BI solutions as a source of competitive advantage in 2010 considered 37% of businesses; this proportion was 58% in 2011 and 67% in 2012 (Computerworld Report, Business Applications, 2013). According to IDG Enterprise Research, in 2016, 78% of the surveyed organizations said that data management solutions would be the basis for change and growth of their business. This demonstrates an increase in business awareness and, therefore, a forced need for a BI that analyzes the increasing amount of data.

Similar results were obtained by Oxford Economics Reports (2016), which confirmed the research of MIT Sloan Management. Their analysis showed that, currently, 68% of the surveyed executives be-

lieve that BI solutions provide growth and business development. Additional studies of Oxford Economics showed that by 2020, 75% of Polish companies would use BI tools, while business intelligence systems today are already used by 45% of companies. About 35% of the respondents claim that BI can definitely improve cost control processes. According to 34% of the respondents, implementing such tools would bring an opportunity to improve products or services. Additionally, 21% of the respondents believe that analytical software may increase the level of customer service.

The development of the BI market in the forecasts for 2017–2020 is presented in tandem with the development of the big data. Reports from 2017 indicate that big data is becoming an extension of traditional BI systems with new functionalities and the state-of-the-art technology to process large volumes of data (Business Intelligence Solutions Review, 2017). The Business Application Research Center (BARC, 2017) has released a report on BI development forecasts, specifying BI areas /functionalities identified as particularly important for 2017–2020. According to the report, the most significant changes compared to previous years in the rankings of the importance of BI trends are the following areas:

- data discovery and data visualization,
- self-service BI,
- maintenance of data quality and management of basic data (also called as reference data).

In 2012, The Economist highlighted few statements reflecting business situation:

- 1) a strong relationship between financial results and effective use of Big Data;
- 2) success can be achieved by those companies that focus on the priorities and strategy of their organizations by analyzing data;
- 3) technology can enrich an organization only when it successfully develops and adapts to changing environmental and business needs as fast as the rapidly changing market and data growth itself;
- 4) BI must bring a new dimension to data management. Social-media websites have become an essential source of data; internal data are no longer sufficient.

As results from different data analytics and BI studies consistently show, for the past few years, BI is a priority for decision-makers and managers of most businesses and institutions. Challenges for BI solutions are mainly with the pace of their development and that development will need to keep up with data growth, both inside and outside the organization. Both the technology and the way the adaptation of BI in business will have to be increasingly flexible and easy to adapt by analysts and controllers. It also leads to new considerations about an “agile” approach to implementing BI solutions.

#### 4 BI implementation from users perspective

Developing interactive software tools is all about people. This is not only about end-users but about the development teams as well. Most software developers and designers deliver some sort of enhanced support for end-users, and as such, their knowledge about the users is crucial to the outcome of the project (Blomkvist, 2010). Liam Bannon already stressed this importance in 1991:

*“... more attention needs to be paid to the process of design, to working with users in all stages of design, to see the iterative nature of design, and challenging conception of what one is designing as a result of the process itself. This is in contrast to a view of design that proceeds from a set of fixed requirements without iterations, and without involvement of the users”.*

BI implementation projects might be very similar to software development projects. However, unlike application development, BI is an integration and configuration of commercial tools with customization occurring in the underlying data models and data manipulation “code” (ETL /Extract, Transform and Load/, SQL /Structured Query Language/ - scripts, stored procedures, etc.). Instead of using object-oriented languages, BI requires stitching together many data sources and applications so that they work together seamlessly. However, in order to achieve this, proper technical designers and programmers must still be involved (Cerqueira, 2015; Parker, 2014).

A study by the Aberdeen Group (White, 2011) showed that “this style of BI is predominantly controlled, driven and delivered by corporate IT.

Often, only static views of data are available and any changes or enhancements must be made by the IT-organization.” This is no longer acceptable by today’s organizations. Frequently changing business and big data market force companies to a quick response; this can be achieved by having timely and reliable information.

According to a Gartner Study on critical capabilities for BI (2017), several problems appear during BI implementation:

- 1) a long development lifecycle and less visibility to user;
- 2) users are not involved in the development cycles;
- 3) after the design phase, there is no possibility to modify analytical requirements;
- 4) testing is performed at the end of the development cycle, again without a possibility for change requests;
- 5) a different language: the developers think in terms of code, the business thinks in terms of business value, and solution designers think in terms of customer experience.

A possible solution to these problems could be the use of agile methods. One agile method is called Active Stakeholder Participation (ASP), an expansion of eXtreme Programming (XP)'s On-Site Customer. It describes the need to have on-site access to people, typically users or their representatives, who have the authority and ability to provide information pertaining to the system being built and to make pertinent and timely decisions regarding the requirements, and prioritization. This approach seems to be very suitable for BI implementation projects.

People are not very good at defining, particularly in detail, what they want, especially when it comes to reports or dashboards. However, people are good at indicating what they think they want and then when a particular option is presented to them, what they like and do not like about it. That means that daily work with end-users would help to identify what they think and what they want, produce something that reflects that understanding, obtain feedback from them, and then update the solution to reflect an improved understanding.

Traditional approaches to software development that are based on defining a detailed requirements' specification early in the project, referred to as "big requirements up front (BRUF)" strategies, prove to be very risky in practice.

Traditional project teams, even "successful" ones, typically produce less than ideal results when they strive to produce a solution, which reflects the specification (Awad, 2012; Project Management & Agile Methodologies, 2012; Scott, 2012). Traditional project team may produce something to specification, but it likely will not be what the users actually want, but rather something what they thought they needed at some point in the past.

The goal of a disciplined agile delivery project team should be to provide their end-users with a solution that fulfils their current understanding of the intent

of their users as effectively as possible, given the constraints of the situation.

## 5 Case Study in a Telecommunications Company

BI systems can consist of different tools and components, depending on the level and purpose of usage. Thus, there are many ways of BI systems' classification that can be found in the professional literature. Chen et al. (2012) classified BI based on the type of data processed (see Table 2).

Depending on the type of BI, methods of BI implementation might vary. In the following case study and survey, the BI belongs to BI&A 2.0, web-based technology, according to the classification of Chen et al. (2012).

Table 2. BI&A (Business Intelligence and Analytics) evolution: Key Characteristics and Capabilities  
(source: Chen et al., 2012)

	Characteristic	Feature
BI&A 1.0	Data-centric approach	<ul style="list-style-type: none"> <li>• DBMS – data based on columns,</li> <li>• In-memory DBMS,</li> <li>• Real-time decisions,</li> <li>• Data mining workbenches.</li> </ul>
BI&A 2.0	Web-based technology	<ul style="list-style-type: none"> <li>• Opinion mining,</li> <li>• Answers to questions with normal language,</li> <li>• Web analytics and web intelligence,</li> <li>• Social media analytics,</li> <li>• Incorporation of unstructured data into its analyses.</li> </ul>
BI&A 3.02	Mobile and sensor technology BI	<ul style="list-style-type: none"> <li>• Location-aware analysis,</li> <li>• Person-centered analysis,</li> <li>• Context-relevant analysis,</li> <li>• Mobile visualization and Human-Computer Interaction (HCI)</li> </ul>

This research has been conducted in a telecommunication company. Method of research has been based on interviews with seven users and five project's participants and some internal company's documentation study. The company has 12,000 employees and is one of the major players, in the fixed and mobile services, in both the local and global market. For the last couple of years, the company merged,

sold, and acquired many enterprises having similar or related profiles.

These kinds of changes are typical for large businesses. Obviously, this has many IT-related consequences, such as mixed application architecture, complex business processes, and different data sources. The surrounding market is growing new competitors.

The telecommunications company started facing serious problems because of the lack of good market analysis and valuable insight data and reports. Thus, the company decided to optimize its controlling processes by one data warehouse and BI implementation. The warehouse and BI was linked to 300 different data sources. In order to demonstrate the scale of the data integration, it was estimated that, annually, the company produces 20 million lines of transactions in general ledger alone. Today, the company has 350 BI users.

Before the project started, the company calculated around 1,000 reports produced for different business areas at operational levels and management levels. Taking the traditional approach to project implementation, it was evaluated that, most probably, it would not bring value quickly. Identification of the scope was difficult because of the business case challenges (e.g., too expensive infrastructure and not enough employees with required skills). The company decided not to copy the same information flows and reports and to start instead from the beginning.

To meet these expectations, it was decided to manage the project using the agile method. This way, the actual time spent was happening only with a released product, decreasing the risk of failure associated with typical project phases' implementation found in the traditional approach, and elaborated above.

### **Project's organization**

BI users dedicated minimum 50% of their daily work to the project. Project management initially built five

parallel working teams, which consisted with staff from:

- sales – three teams focusing on three product lines,
- purchasing – one team from the procurement system,
- finance – one team from accounting system.

Teams were having typical Agile – Scrum members: Product Owner, Scrum Master, and development members (usually three people). All teams worked separately on some functionality deliverables. Some deliverables required linkage between teams. That was the role of Business Visionary and Project Manager.

Teams followed agile principles and methods based on user stories (instead of traditional requirements of report formats), prioritization method MoSCoW (Must, Should, Could, Won't), daily stand-ups, and regular cooperation and verification of requirements. With this approach, at the end of the project, the company declared it was a success.

### **Results of the first year BI project implementation**

During the first year, teams produced eight different products related to data analysis of the customer market in three business areas of products. The total investment within one year was 10% of the estimated cost of the project if the traditional approach was taken.

Table 3. ROI factors result  
(source: own research)

Cost of current vs. future system maintenance	50% decrease in annual maintenance
Total cost of FTEs involved in the current vs. future reporting process	15 FTEs reduced
Cost of time spend on the current vs. future reporting process	50% decrease of reporting time

The company managed to eliminate 170 useless reports, which were produced before BI functionality delivery. This improved controlling processes by 15 full-time employee (FTE). For ROI calculation, the organization assumed (Parker, 2014) – see Table 3.

ROI was calculated only for one-year investment in order to provide a prototype solution for the company. End-user expectations have been met and the first delivered product is in use. The company continues working on further implementation. However, the first year was crucial to see whether the agile approach and BI investment will bring any value.

Twenty End-users (middle management and operational level) were asked for the main reasons of success in a survey following agile principles. Results

confirmed all agile principles as elaborated in Table 4.

Table 4. Agile principles in context of BI users  
(source: own research based on agile principles by Thomas and Grenning, 2001)

Agile Principle	BI Response
Customer satisfaction because of early and continuous delivery of valuable software	Owing to the fact that BI users have a chance to see a product already after few weeks, it is easier to make sure that the project is meeting the requirements
Welcome changing requirements, even in late development	During the project, end-users requirements changes and it is not possible to avoid it, especially in the environment such as reports and data. Data is increasing in incredible fast way, which impact new required sources and new analytics. By agreeing to these changes, a project meets customer expectations
Working software is delivered frequently (weeks rather than months)	End-user has a chance to verify and challenge requirements on regular basis
Close, daily cooperation between business people and developers	Constant, daily end-user involvement helps the project to follow actual business needs and changes, which may impact the solution
Projects are built around motivated individuals, who should be trusted	Best involvement of committed people always helps to obtain success
Face-to-face conversation is the best form of communication (colocation)	End-users are committed and cooperative when the communication process is performed properly
Working software is the principal measure of progress	Working software means that users can actually work on it and test it. That helps end-users follow the project by seeing actual development and estimate its progress.
Sustainable development, able to maintain a constant pace	This way there is no rush and possible mistakes in the product delivery
Continuous attention to technical excellence and good design	These are factors always required by end-users
Simplicity – the art of maximizing the amount of work not done – is essential	Simple solutions especially in BI projects help users to understand and use the new functions better. At the same time, it might be easier to provide a change, if required
Self-organizing teams	The customer as a part of a team takes responsibility for working, valuable data, and reports. May impact the daily work and feed info on regular basis. At the same time, cooperation is more efficient by eliminating any walls between customer and vendor
Regular adaptation to changing circumstance	This point is one of the most important for BI users. Need for reports, information, and data sources might change often. Thus thanks to all of the above principles; users can deliver actual requirements and possible changes

## 6 Case study: comparison of Agile and waterfall methods in BI implementation

Additionally, to the case study presented in the previous section, the following pilot research shows that the agile method of BI systems implementation is more efficient from the end-user's perspective. This pilot study will be followed by further research, which will be published in materials available at the Warsaw University of Technology.

The method of research is based on the surveys and interviews in the following three service companies:

- a media company, 70 BI users, where BI was implemented following the agile method,
- a digital company (specialized in mobile software and video production) with a subsidiary, 150 BI

users, where BI was implemented following the traditional method,

- an insurance company (offering many types of insurance for individual and business customers), 245 BI users, where BI was implemented using the traditional method.

In total, there were 65 BI end-users who responded to the survey and were interviewed. Fifteen BI users (Agile N = 15) experienced implementation with the agile method; 50 BI users (Waterfall N=50) experienced implementation with the waterfall method. Participants of the survey and interviews were mixed with middle level managers and senior managers from different business areas. Figures 2–4 present the results of the survey.

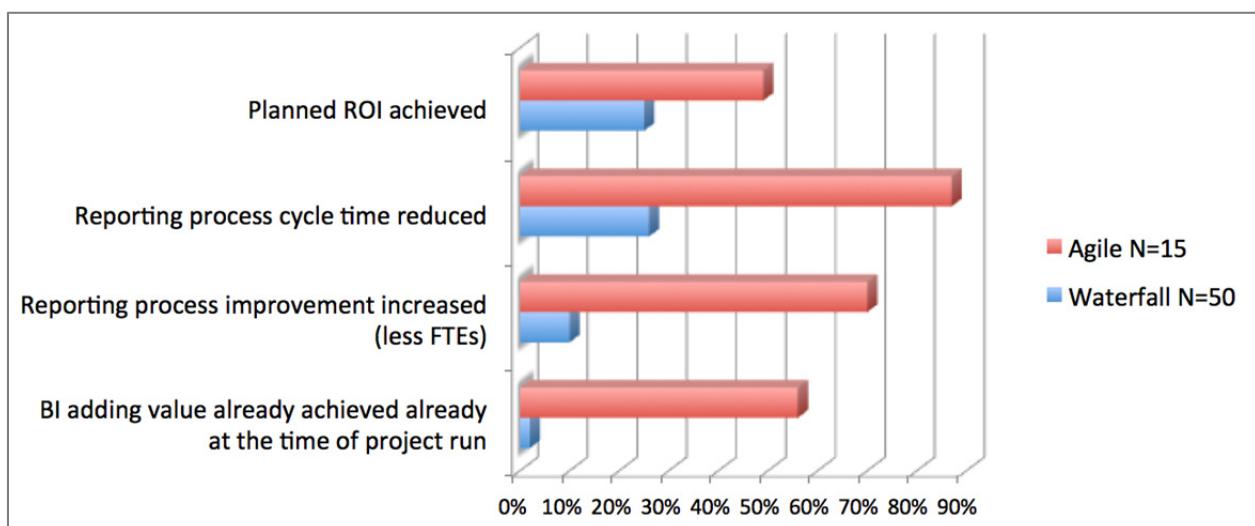


Figure 2. BI investment completion according to the prior assumptions  
(source: own research)

Fig. 2 presents two aspects. One aspect is related to the actual BI value gain by the organizations: planned ROI was achieved and BI adding value was achieved already during the project run. Another aspect is related to business process improvement by reducing time of reporting and less involvement of FTE. Results are much more positive in projects managed in agile mode, where for agile project, 50% of the participants stated the achievement of ROI and for traditional project, it is only 20%. BI started be-

ing used during the agile project run by 53% of the interviewed users, what was not the case for any users in traditional projects. Reporting cycle time was reduced according to 93% of the agile respondents and only 20% of the waterfall respondents. Similar results were achieved in case of process improvement. During interviews, media company representatives stated that users started using first BI reports after first 3 months from the project kick-off.

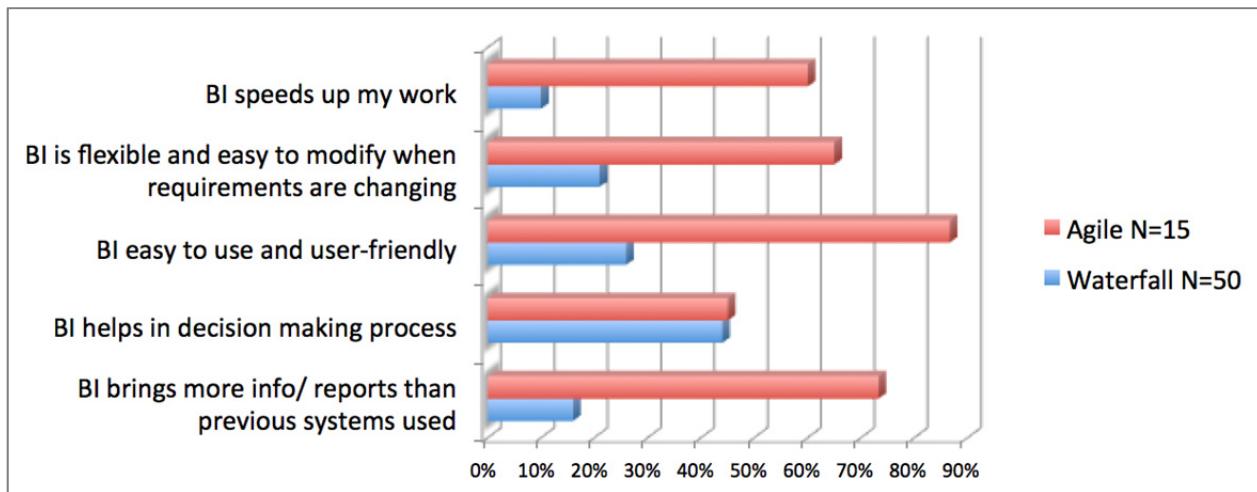


Figure 3. Level of requirements met by the BI implementation  
(source: own research)

First sprint delivered data model based on accounting data only. Users and project team had a chance to learn more about the tool functionalities, logic of data retrieving, and algorithms. It helped to build next products within sprints and find solutions matching actual business requirements. Thus, it brought some room for optimizations and even better system performance related directly to the development of the effective database programs.

Fig. 3 presents the level of requirements met by BI tool. Majority of agile respondents said that BI speeded their work (60% of the agile compared to 8% of the waterfall), brought more information and reports (73% of the agile compared to 12% of the waterfall), and is user-friendly and easy to modify (86% of the agile compared to 22% of the waterfall).

According to the interviewed participants, the concept of BI functionalities and architecture in the traditional approach has not been discussed in details. Vendor of the solution, in order to meet deadlines, built a logical model by selecting the elements and data that are the fastest to implement. Priority analysis was not performed. Reporting requirements have been frozen after approved concept, which is about 4–6 months before BI launch.

In agile teams, the requirements were collected until the end of the project. Teams focused on selected issues – those that were identified as necessary (must have) by the owners of the concerned areas. It can be concluded that in case of agile teams, consultants

had better understanding of the users' requirements and the entire team was focused on delivering a specific product in high quality. As a result, products delivered by agile teams were matching the requirements better and provided overall process improvement.

Additionally, agile respondents rated highly customer-supplier collaboration on a day-to-day basis throughout the project. This allowed them to get an in-depth understanding of the objectives, data that is being processed, their relevance to the organization in order to provide BI as a valuable business tool.

Working in small teams allowed them to refine their products to the level of required quality and impose full responsibility for the final report, analysis, or indicators. Sprints forced the customer to prioritize requirements, giving it the ability to report requirements related to that sprint to the very end. As interview participants said, if the organization's strategy is well implemented in the project, then first sprints already focus on delivering the cockpit or analysis required by the top management.

It is worth to highlight that for agile implementations, BI system was rated as easy to use and user-friendly. It is interesting because exactly the same tool was implemented for media (agile method) and digital company (traditional method). It may mean that rather the project management style impacted actual system usage than chosen technology.

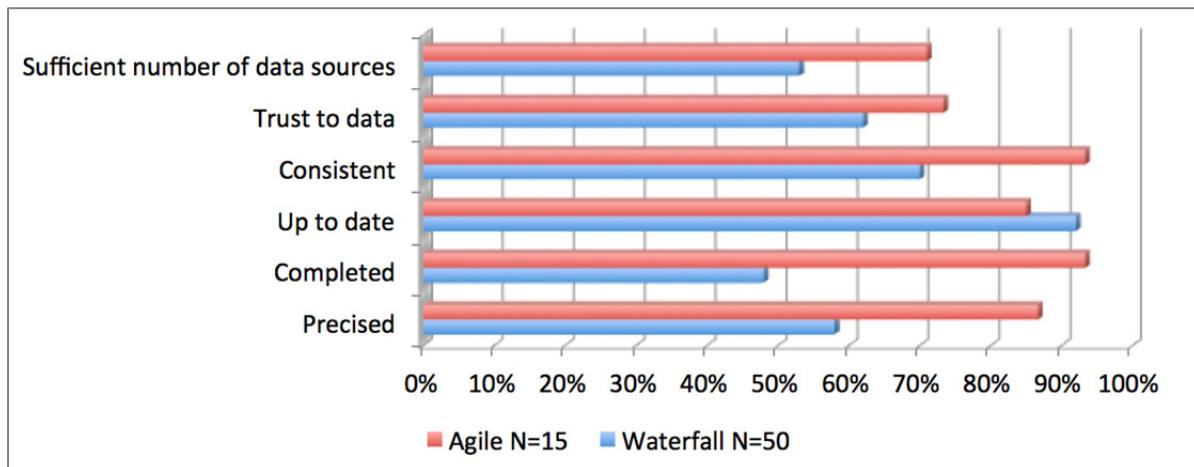


Figure 4. Data quality in BI  
(source: own research)

Fig. 4 presents the users opinion about the data quality in the BI they use. All respondents believe that the data available in BI is up to date. In case of completeness and consistency of data, however, there is a large discrepancy in the assessment by agile and traditional teams. About 93% of the agile respondents find data consistent and completed, and only 48% of the waterfall users declare data completeness and 70% of the waterfall users declare data consistency. Definitely, the team working in agile mode achieved better results.

During the discussion, detailed questions were asked about the project organization for product design, the profile of the people involved in the product development, and the technical capabilities of the tool itself. For agile groups, the teams consisted of 6–8 people – both customer representatives and suppliers. Depending on the functionality provided or the business area for which a sprint was supposed to be delivered, the composition of employee's profiles was different. It allowed delivering exactly required data scope and model without any conflict of interests.

In traditionally managed projects, project organization included people from all departments involved in BI implementation (sales and marketing, finance, and administration). Justification for building the entire BI architecture at the same time was the difficulty of setting priorities by the customer organization.

According to the traditional approach, the solution concept was approved before the tool was config-

ured. Time of the concept design has almost doubled compared to the planned one. Customer respondents stated that the main reason for the extension of the schedule was the lack of clear direction and common goal of the various departments of the company.

At the same time, requirements were changing and project could not finalize the concept document in order to continue next phase of the project. Longer timeline has naturally led to an increase in the budget, so the organizations were forced to limit the scope of BI.

Additionally, participants concluded that:

- data is not complete because the requirements were collected separately, which resulted in creation of silos,
- lack of expected completeness and accuracy of the data results from misunderstanding of the possibilities and tool limitations, what, in case of agile project, was discovered in the first sprints and helped project team to understand the need of proper data cleansing.

During the interviews, participants were asked about the collaboration in the project. Cooperative work style has been rated highest in teams working with the agile method. Once again, the ease of working in small teams, the coordination of team members, and the lack of tolerance for individuals who did not work or did not deliver scheduled tasks were emphasized. In the case of projects run in traditional mode, respondents believed that sessions were taking place in too large groups. In case of the insurance company, up to 80 people attended project meetings.

Frequent disputes in connection with delays created an unfriendly atmosphere. Lack of responsibility for the product from start to finish provides to weak relationships and motivation in the project team. In the case of unanimity and the pursuit of the same goals, all teams spoke in a similar way – individual departments have a different perspective on the needs of the organization. There is also a different interpretation of the strategy and related needs, information that leads to clashes between members of the project team.

During the interview sessions, the need for documentation in the project has also been discussed. IT systems implementation, including BI, is associated with a large amount of documentation that the customer is obliged to read and approve. Agile methods introduce a change in this approach. The interviews show that, especially in the case of BI implementations, the documentation is less important compared to the practical use of the tool from the beginning of the project implementation.

Summarizing, the pilot results of the survey confirms agile effectiveness in BI projects by achieving ROI, fast BI solution availability, and end-user's satisfaction in terms of functionality and actual BI help in their work. However, at the same time, results of the BI system's implementation with traditional methods show that goals were not achieved. Causes include lengthy time of solution delivery and a less flexible product at the end of implementation. This is a small sample taken into consideration though. However, it is a meaningful sample because of the size of the organizations and their position in the market.

## 7 Conclusion

Currently, BI systems are the most required systems in the market. However, organizations continue to struggle with the decision to implement them in their environment. Changing markets and big data insight forces organizations to react fast especially due to growing competition. However, to meet customer's requirements, BI methods of implementation need to change from a traditional waterfall method to more agile approach. The study in this article presents the benefits of agile methods especially in the

area of user's constant involvement and delivery in iterations. Today, business cannot wait long for first results of a system's implementation.

This can be achieved only thanks to a few main critical factors:

- easy adaptability to changes when required,
- frequent functionalities delivery,
- fast ROI,
- easy and cost-effective maintenance after BI implementation.

The agile approach provides methods and techniques to meet these above factors. As the case study and surveys show, organizations find BI more valuable when it is implemented using the agile method.

BI implemented with the agile method started to bring savings already during the project run. As the case study in the telecommunication company showed, BI brought 50% decrease in the annual maintenance and reporting time. In the survey, 50% of the agile project participants, compared to 20% of the waterfall, stated the achievement of ROI in their business areas. BI started being used during the agile project by 53% of the interviewed users (0% of the waterfall). This can be related to the faster delivery of individual BI elements (e.g., reports) to users what allows to implement some process improvements.

In case of data quality, their consistency, and completeness, agile methods work better – 93% of the agile respondents find data consistent, completed, and accurate, whereas 48% of the waterfall users declare data completeness and 70% of the waterfall users declare data consistency. Especially for BI systems, quality of data plays major role and determines its usage. Owing to the fact that agile is committed to delivering high-quality products, the supplier and customer will develop final reports and analyzes as long as they present complete fulfillment of customer information expectations. In the case of traditional methodologies, the completeness and accuracy of the data may be lost because of the wide spectrum of analyzes and indicators provided at the same time.

However, it is worthwhile to make sure during the work and to carefully analyze the quantity and quality of sources from which data is downloaded.

BI scalability, especially having “big data” in the future plans, is becoming critical, and sources of key data for organizations might change very quickly.

Effective usage of the BI tool is linked as well to the collaboration style on agile projects. According to 60% of the agile respondents, compared to 8% of the waterfall respondents, BI speeded their work. About 73% of the agile compared to 12% of the waterfall declare that BI brought more suitable reports and analysis. Human factor here is important for better understanding of the business and thus required system functionalities. Small groups and a trust among members cause that people are eager to work in more effective way and try to find compromises. At the same time, team’s attitude to delivery of absolute high-quality products brings tools matching real business requirements. Finally, actual effective BI usage brings process optimization and cost reduction.

Agile methods help to achieve the goal and effective BI implementation. It helps to provide not only reliable data and good analysis but, at the same time, optimize the process and increase added value.

Presented study is based on few companies that are similar in terms of company size and type. Thus, it will be followed by further research.

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