



## WATERFALL OR SCRUM METHODOLOGY - HOW TO CHOOSE ACCORDING TO THE SPECIFIC PROJECT?

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**Abstract:** *This paper aims to perform a comparison of two methodologies used in project management and project work. It first describes the basic characteristics, strengths, and weaknesses of both methodologies to facilitate reaching certain conclusions. Then, it derives specific conclusions through a cross-comparison.*

### 1. INTRODUCTION

As an introduction, we will first briefly explain the concept of "project management." Project management is the process of planning, executing, and controlling activities with the aim of achieving specific goals within a defined timeframe, budget, and resources. Key elements of project management include: (R. Mulcahy, 2013)

1. Goal Definition: Setting clear and measurable project objectives to understand what needs to be accomplished.

2. Planning: Developing a detailed plan that includes tasks, resources, timelines, and budgets.

3. Execution: Carrying out activities according to the plan, monitoring progress, and addressing emerging issues.

4. Risk Management: Identifying and managing potential risks that may impact project success.

5. Monitoring and Controlling: Regularly tracking project progress compared to the plan and properly managing changes.

6. **Communication:** Effective communication with team members, stakeholders, and decision-makers.

7. **Project Closure:** Assessing achieved results and closing the project once objectives are met.

Project management requires a balance between precision in planning and the ability to adapt to changes. Learning from experiences and continuous improvement are also critical aspects of project management. In this regard, it's essential not to limit oneself to a single project management methodology, but to explore various methodologies, as each has its strengths and weaknesses that come to the fore depending on the project type and its planning and execution circumstances.

In the following text, we will compare the previously dominant Waterfall (Natural, Traditional) methodology with one of the most well-known agile methodologies, the Scrum methodology. However, to do this, we will first introduce both methodologies, discuss their fundamental characteristics, strengths and weaknesses, mention the "Agile Manifesto," and then, through analysis based on a hypothetical scenario, arrive at a conclusion regarding when and how to use these project management methodologies.

## **2. BASIC CHARACTERISTICS OF THE WATERFALL METHODOLOGY**

Project management in the Waterfall methodology is a traditional approach to project management that consists of sequential phases executed in order, with minimal backtracking to previous phases. The fundamental characteristics of this methodology are: (Project Management Institute, Inc., 2013)

- The project is divided into clearly defined phases, such as initiation, planning, execution, control, and closure.

- Each phase is executed sequentially, then proceeds to the next phase. Before moving to the next phase, each phase must have clearly defined objectives and specifications. This means that all project requirements and goals are identified and documented in advance.

- The Waterfall approach is carried out linearly, meaning there is no going back to previous phases. Each phase must be fully completed before moving on to the next.

- Quality control activities are conducted in each phase to ensure that objectives are met, and results are satisfactory.

- Projects managed with the Waterfall methodology often require detailed documentation in each phase, including plans, specifications, analyses, and reports.

- The Waterfall methodology is most suitable for projects that can be fully planned in advance and where significant changes are not expected during execution.

- The Waterfall approach can be rigid and less flexible for projects that require significant number of changes or adaptations during execution.

The advantages of the Waterfall methodology can be summarized as follows:

- The Waterfall approach provides a clear structure and precisely defined phases, making it easier to understand and manage the project. Each phase has its specific objectives and tasks, ensuring precision in planning and execution.

- Phases in a Waterfall project often include quality control and verification activities. This allows problems to be identified and addressed in the early stages of the project, reducing the risk of unexpected issues later on.

- The Waterfall methodology requires detailed documentation, including plans, specifications, and reports. This documentation facilitates project progress tracking, communication with stakeholders, and a better understanding of project requirements.

- The Waterfall methodology works best for projects whose requirements and goals can be fully planned in advance and are not expected to change significantly during execution. This is particularly useful for projects with strict regulations, such as healthcare, aviation, and military projects.

- The Waterfall methodology simplifies project planning, monitoring, and management because everything is predefined. This is valuable for organizations that prefer structured processes and precisely controlled end results.

While the Waterfall methodology has its advantages, such as a clear structure and documentation, it may be less suitable for projects that change rapidly or require flexibility. In practice, this means that, for example, if you have a project that demands a highly developed user interface, the delivery of that interface, along with other parts of the software, will only occur during the execution phase. However, during the planning phase, the client did not have a clear plan for this interface, and ideas for improvements only emerged after receiving the finished product. This becomes problematic because there is no going back to previous project phases. The only solution is to open a new project, which introduces new problems, a new budget, additional time spent, and so on. This example is not exotic but something that occurs more frequently, especially with projects heavily involving information technology. Hence, other methodologies, such as agile approaches, have been developed to provide greater adaptability during project execution.

### 3. AGILE MANIFEST

Agile methodologies have been developed to enable rapid, flexible, and collaborative delivery of software projects and products. The core principles of agile methodologies are outlined in the "Agile Manifesto," which comprises 12 principles: (<https://agilemanifesto.org/principles.html>)

1. Customer Satisfaction: The primary purpose of software development is customer satisfaction. The agile approach focuses on delivering value to users.

2. Change Is Welcome: Agile teams welcome changes in requirements, even late in development. Agility means being able to adapt to changes to deliver greater value.
3. Frequent Deliveries: Software deliveries should be regular and frequent, with an emphasis on quickly delivering value. This allows users to see and use new features sooner.
4. Collaboration with Customers: Teams and customers should work together throughout the entire project. Open communication and collaboration are crucial.
5. Build Around Motivated Individuals: Provide individuals with the tools and support they need to get the job done. Motivated individuals make a difference.
6. Working Solutions Over Documentation: Agile teams focus on delivering software, i.e., work that brings value. This means less documentation and more action.
7. Maintain a Sustainable Pace: Establishing a stable work rhythm helps maintain productivity and quality. Work should be sustainable in the long run.
8. Technical Excellence: Technical excellence is essential. Teams should aim for high-quality standards and technological solutions.
9. Simplicity: The best way to convey information and solve problems is through simplicity. Avoid unnecessary complexity.
10. Self-Organization: Teams are responsible for planning and decision-making. Self-organized teams better understand and accept responsibilities.
11. Reflection and Adaptation: Regularly monitor team work and continuously adapt to achieve better results. This includes retrospectives and continuous improvement.
12. Team Spirit: Teams should collaborate, communicate, and act as a whole. Team spirit and unity are key to success.

These principles collectively shape the agile approach to software development and projects, enabling teams to be efficient, adaptable, and value-oriented. Reading these principles, it's clear that the aim is to have smaller, more flexible teams that are highly team-oriented and, as such, are flexible enough to deliver product increments during development, which can now be tested and adjusted in the early stages. It's evident that agile methodologies are highly adaptable for managing software projects.

#### **4. BASIC CHARACTERISTICS OF SCRUM PROJECT MANAGEMENT METHODOLOGY**

The Scrum methodology relies on incremental and iterative development, where functionalities are developed in small cycles known as sprints. Each sprint brings additional functionalities and enables the team to rapidly deliver new, incremental value. The key characteristics of this project management methodology are: (K. Schwaber, J. Sutherland,

2017)

- Scrum methodology relies on self-organizing teams responsible for developing, testing, and delivering software products. Teams are typically small, self-organizing, and aim to be sufficiently trained to independently perform assigned tasks.

- In Scrum methodology, there is a role called the Product Owner who is responsible for defining priorities and product requirements. The Product Owner communicates with the team and makes decisions about what will be developed. From other side he communicates with stakeholders and he is some kind of interfaces between team and stakeholders.

- The team plans and conducts sprints, typically lasting 2 to 4 weeks. Each sprint begins with planning, where goals and tasks to be completed during that sprint are defined.

- Teams hold daily Scrum meetings to synchronize, share progress information, and identify obstacles. These meetings are short and direct.

- At the end of each sprint, teams hold retrospectives to identify what can be improved in the upcoming sprints.

- Teams use visual control boards (Scrum boards) to track progress and see what is currently in progress, what is completed, and what is remaining.

- The Scrum methodology places a strong emphasis on delivering value to customers after each sprint. The goal is to provide functionality that is usable and can be immediately utilized. Incremental value means that, with each sprint, all the functionalities that were delivered before are in working condition, plus new functionalities resulting from the observed sprint.

- The Scrum methodology allows changes in requirements and priorities during development, facilitating adaptation to changes in the environment.

- The Scrum methodology promotes a culture of continuous improvement and learning from experience to enhance processes and outcomes.

Scrum methodology offers several advantages over the waterfall methodology, especially for projects facing changes and dynamic requirements: (F. Heath, 2021)

- Scrum is highly flexible, enabling teams to adapt to changes in requirements during development. In a waterfall approach, changes are harder to accommodate and often require significantly more effort and resources.

- Scrum allows for early collection of user feedback because functionalities are delivered in short iterations. This helps in identifying and addressing issues and changes before they become significant.

- Scrum focuses on delivering value to customers after each sprint, whereas the waterfall approach typically requires the entire project to be completed before users receive any value.

- Scrum promotes transparency in the project. All team members have insight into progress, priorities, and obstacles, making project management more efficient.

- Scrum encourages teamwork and shared responsibility. Each team member is

accountable for delivering value, which fosters better collaboration and engagement.

- Risks are identified and managed early in Scrum. Teams work on risks in real-time, reducing the likelihood of serious issues in later project stages.

- Scrum enables faster delivery of functionality, which is particularly important in dynamic markets where rapid responses to changes are highly valued.

- Scrum strongly focuses on customer satisfaction. Teams regularly communicate with users and adjust products to meet their needs.

- Scrum fosters continuous process improvement and better results through retrospectives and iterations.

- Scrum allows for better cost and resource control as teams regularly estimate and adjust the scope of work.

Scrum is an agile methodology used for developing software products, but it can be applied to other domains as well. The primary goal of the Scrum methodology is to enable efficient project management and deliver value to customers in iterative cycles. While Scrum methodology has many advantages, it's important to note that it is not a one-size-fits-all solution and may not be suitable for all projects. Some projects, such as those with strict and well-defined requirements, may work better with a waterfall approach. The choice between Scrum and the waterfall methodology depends on the specific project requirements and circumstances.

## **5. COMPARISON OF SCRUM AND WATERFALL METHODOLOGIES**

It is clear from the above that for smaller software-oriented projects, agile methodologies, especially the Scrum methodology, have prevailing advantages over the Waterfall methodology. However, what happens when managing large projects with well-defined requirements and a heterogeneous composition of participants (meaning that project members are not only IT professionals)? In these situations, project management can be complex, and the choice between Scrum and the Waterfall project management methodology will depend on the specific needs and characteristics of the project. Accordingly, the following key factors should be considered:

- If the project requirements are tightly defined, and changes are not expected or are minimal, the Waterfall methodology may be appropriate. In the Waterfall methodology, all phases are meticulously planned in advance, which can be useful for projects with clear requirements.

- If there is a need for greater flexibility in the project, Scrum can be beneficial. Scrum allows for quick adaptation to changes and adjustments during development, which is particularly useful if the project faces uncertainty or changing requirements.

- In some cases, projects may use "hybrid approaches" that combine elements of both Scrum and Waterfall methodologies. For example, a project may use the Waterfall methodology for the planning and design phase and then switch to Scrum for the execution and testing phase.

- Projects with a heterogeneous composition and a large scope often carry higher risks. Scrum can enable better risk management because risks are identified and managed in real-time during iterations.

- It's important to consider the level of experience and training of project participants. Scrum requires a certain understanding of agile principles and practices, while the Waterfall methodology may be more familiar and easier to apply, especially for project members who are not from an IT background.

- Projects with a diverse composition often require good communication and collaboration. Scrum promotes this type of interaction, while the Waterfall methodology may require a stricter communication structure.

- Large projects require efficient monitoring and management. The Waterfall methodology can provide a clear structure for monitoring, while Scrum requires continuous tracking of progress during iterations.

In essence, the choice between Scrum and Waterfall for larger projects depends on the specific characteristics of the project, as well as the needs and preferences of the team and organization. It is possible to combine elements of both approaches to achieve the best balance between control and flexibility. It's important to thoroughly consider all factors and make a decision that best suits the project.

To delve deeper into this comparison, consider a situation where we want to convince the bank's management to support the replacement of the Core Banking System (CBS) with a newer one from another vendor, using the Scrum methodology, for example. Scrum methodology can be beneficial, although it requires a different approach compared to traditional Waterfall methodologies. One possible scenario could be:

1. Create a sprint campaign plan: Begin by defining sprint campaigns, i.e., sets of goals that will be achieved during each sprint. The goals should be focused on preparing for the replacement of the CBS and achieving concrete steps in the process.
2. Identify key functionalities and requirements: Think about the key functionalities and requirements of the new CBS and identify them in advance. This will help prioritize the development and implementation of these features.
3. Create a backlog: Create a backlog, a list of requirements and functionalities that will be implemented during the sprint campaign. This list will serve as the basis for planning and tracking work during sprints.
4. Assemble a Scrum team: Put together a Scrum team to work on the project. This team should be multifunctional and include members with different skills required for the implementation of the new system.

5. **Sprint planning:** Plan sprints with the aim of achieving concrete value and progress towards replacing the CBS. Decide how long each sprint will last and what the priorities will be for each sprint.
6. **Regularly communicate with the bank's management:** In Scrum methodology, transparency and regular communication are key. Therefore, regularly update the management on the project's progress and the achievement of goals defined in the sprint campaigns. Organize Sprint Review meetings to present the progress made and engage in open discussions with significant stakeholders.
7. **Adapt to changes:** Scrum allows for quick adaptation to changes. If new information or changes in priorities arise during the project, the Scrum team can easily adjust the plan and priorities.
8. **Continuous improvement:** After each sprint, organize retrospectives to identify what worked well and what can be improved. These retrospectives enable the team to continuously enhance their work.
9. **Documentation and risk monitoring:** While Scrum promotes "less documentation and more action" it's still important to document key aspects of the project and monitor risks. This will help stay within the boundaries and be prepared to respond to possible challenges.

At first glance, it might be said that using Scrum can achieve better transparency, a faster response to changes, and a focus on delivering value during the CBS replacement process. It's essential to highlight the advantages of the agile approach, such as quicker adaptation to changes and continuous improvement, to convince the management of the benefits of this approach in such a project. However, in practice, management may demand precise indicators, particularly costs, employee engagement, duration estimates. Additionally, considering that more banking professionals are involved in the project than programmers, it raises the logical question of what to expect in such a case.

In such cases, the traditional Project Chart (Gantt chart) can provide more clarity and precision in project management compared to agile methodologies like Scrum. Taking this into consideration, we arrive at the following comparison:

1. **Developing a Project Chart involves:**
  - **Precision in planning:** The Project Chart enables detailed planning and provides accurate estimates for each project phase. This is useful for budgeting and cost management.
  - **Defined deadlines:** The Gantt chart allows for clearly defined deadlines for each project phase, aiding in time tracking and management.
  - **Easier communication with management:** The Project Chart offers a visually clear representation of the project, simplifying communication with management and conveying critical information.



- Compatibility with the Waterfall method: The Project Chart aligns better with this approach as it provides a stricter plan and control.
2. Scrum methodology implies:
- Flexibility: As mentioned before, Scrum is flexible and allows for adaptation to changes. This is useful when it's challenging to predict all project elements accurately in advance. It's worth noting that for a project that is mostly well-planned but has some less certain parts, Scrum can be beneficial in such cases.
  - Focus on value: Scrum concentrates on delivering value throughout the project's development. This can help in demonstrating progress during the early project phases.
  - Improved interaction with end-users: Scrum enables regular interaction with users, which can enhance understanding of their needs and promote their involvement in the development process.
  - Continuous improvement: Scrum encourages continuous process and results improvement, valuable for optimizing the team's performance over time.

The choice between a Project Chart (Gantt chart) and Scrum methodology depends on the specific needs and requirements of the project, as well as the preferences and expectations of management. In situations where precise costs, accurate deadlines, and a firm plan are of utmost importance, the Project Chart may be the better choice. However, Scrum can be useful in projects where there is a need for greater flexibility, faster adaptation to changes, and improved interaction with end-users.

Here, some of the characteristics of the Scrum methodology, which were not critical in the previous example, have been intentionally reiterated. We will attempt to further elaborate on the fact that the success of the Scrum methodology primarily depends on the ability of Scrum teams to independently perform their assigned tasks, be self-organizing, and act as a homogeneous team. Additionally, one of the tenets of the Scrum methodology is that the Developer team is structured in a way that eliminates titles and rankings within the team (to facilitate homogeneity) and that there is only collective responsibility for the work done. On the other hand, banks are traditionally organized hierarchically, which can pose a challenge when forming Scrum teams.

But first, let's consider the challenge of building a good Scrum team and what it takes to achieve that. Creating a highly-profiled, homogeneous team can be challenging, especially in situations where teams are new and have limited experience with Scrum. In such cases, it would be useful to do the following:

1. The first step is to provide team members with education on Scrum methodology and agile principles. Understanding the basics of Scrum is crucial for successful implementation.
2. Engaging mentors or Scrum experts can be helpful, especially in the early stages of team work. Mentors can share their experience and provide guidance.
3. It's important for team members to build trust among themselves. Encourage open communication and collaboration to create a positive work atmosphere.

4. Define clear goals and expectations for the team. Each member should understand what is expected of them.
5. Encourage team members to take responsibility for their work and contribute to the team's goals.
6. Teams without experience should receive ongoing support and learning opportunities. This may include regularly conducting retrospectives and identifying areas for improvement.
7. Help the team understand the focus on delivering value. Encourage them to concentrate on customer satisfaction and achieving project goals.
8. Scrum promotes continuous improvement. Encourage the team to identify and resolve issues to improve their work over time.
9. Developing a high-performing Scrum team takes time. Expect challenges at the beginning and be prepared to address them together with the team.
10. Creating a positive team environment is essential. Encourage the team to innovate, collaborate, and engage in continuous learning.

Developing such a team requires patience and dedication, but it can result in a highly efficient and productive team capable of self-organizing, self-managing, and successfully completing projects. It's important to support the team and work together to develop skills and capabilities.

Let's now consider the conclusion regarding the development of a Scrum team, which is patience and dedication. Does this mean that a bank looking to transition to a new program should first form Scrum teams, train them, and patiently wait for them to mature? How long would this maturation process take, and on the other hand, the bank is naturally impatient as it wants to renew its program to remain competitive in the market?

In such situations, there are several strategies that an organization can employ to expedite the maturation process of Scrum teams:

- As mentioned earlier, engaging experienced agile coaches can accelerate the learning and implementation of Scrum. They can work directly with the teams to provide guidance and support.

- An organization can consider a hybrid approach, combining elements of Scrum with some traditional methods to meet the need for quick responsiveness. For example, teams can use Scrum for software development aspects of the project while employing a traditional approach for other project aspects.

- Intensive training programs and mentorship can help teams quickly grasp Scrum and apply it. This involves working with experts who collaborate with the teams until self-organization, self-management, and high efficiency are achieved.

- The bank can hire experts in the banking industry who understand the specific needs and regulations of the sector. This can help teams develop solutions that align with banking requirements more rapidly.

- Defining clear and measurable project goals can help teams focus on delivering value as quickly as possible.

- Regular monitoring and evaluation of team progress are essential. This will allow the identification of project areas that need improvement and the opportunity for quicker adaptation.

It's important to note that there's no universal timeframe for the maturation of Scrum teams, and the speed of maturation will depend on various factors, including the current knowledge and skills of the teams, the resources available for training and support, and the complexity of the projects on which the teams work. Organizations aspiring to adopt an agile way of working should be aware that it takes time to achieve a high level of self-organization, self-management, and efficiency. In the meantime, organizations can use hybrid approaches to balance the need for rapid responsiveness with the development of agile teams.

Among the aforementioned tips, the one mentioning the adoption of a hybrid method is particularly interesting, especially in situations where there are many non-IT professionals involved in the project, as they are more challenging to train within Scrum teams. A hybrid approach can be an effective way to strike a balance between the need for agility and flexibility and the requirements for clear planning and control, especially in situations such as the replacement of the CBS in a bank.

A hybrid approach can be considered beneficial for several reasons:

- Flexibility in Implementation: A hybrid approach allows for selecting the best elements from different methodologies to meet the specific needs of a project. For example, it can involve using agile methodologies for software development while simultaneously applying the traditional Gantt chart for planning and tracking activities.

- Managing Complexity: Large projects, especially in the banking sector, are often extremely complex and require detailed planning and management. A hybrid approach can provide better management of this complexity.

- Incorporating Non-IT Team Members: Team members who are not from an IT background may feel unprepared to work in a fully agile environment. A hybrid approach can accommodate their needs and comfort.

- Regulatory Compliance: Banking is often subject to strict regulations. A hybrid approach can facilitate reporting processes and compliance with regulatory requirements.

- Balancing Speed and Control: A hybrid approach allows an organization to maintain a balance between the speed of delivery and project control.

It's essential for the organization to carefully consider the specific requirements of each project and adapt the methodology accordingly. A hybrid approach can be especially useful in situations where different team members have varied skills and constraints.

Given all these analyses, one proposed approach for the described case of replacing the CBS in a bank is as follows:

- Organize Scrum teams with IT professionals and banking technologists who have expertise in specific areas.

- Use the Waterfall methodology for other aspects of the project.

- Generally proceed with the Waterfall method, while handling critical tasks such as GAP analysis (which identifies differences between the existing and new CBS to support already sold products not covered by the new software solution) and the user interface development iteratively through small groups organized into Scrum teams.

This approach offers several key advantages:

- Rapid Value Delivery: By using Scrum teams for critical IT project components, software and technology aspects that are of paramount importance can be developed and delivered more swiftly. The mentioned GAP analysis can be carried out through Scrum teams, while parallel work is done on iterative user interface development, training, and more.

- Greater Adaptability: Scrum allows for quick adaptation to changes, which is valuable in the IT field where requirements often change, especially for user interface development, for instance.

- Precision in Traditional Aspects: The Waterfall methodology enables precise planning and control of other project segments, making it easier to organize team members who are not in Scrum teams.

- Clear Deadlines and Budget: Using the Waterfall approach allows for precisely defined deadlines and budgets, which are crucial for projects in the banking industry.

- Resource Optimization: Teams specialized in specific areas can efficiently leverage their skills and resources.

- Risk Mitigation: Combining agile and Waterfall methodologies can help reduce risks and facilitate project management.

The key is to carefully assess where Scrum and agile approaches best meet the project's needs and where precision and clearly defined control are necessary. A hybrid methodology can be a highly effective way to strike a balance between these requirements. It's crucial to involve relevant experts and adapt the approach to the specific characteristics of the project.

## 6. CONCLUSION

Based on everything discussed, the conclusion would be as follows. For purely IT software projects, Scrum is the best solution. For well-defined large projects that require "military" precision, the Waterfall methodology emerges as the best solution. In other variations, especially when it's a mixture of IT and business, as in the case of replacing a CBS in a bank, it's best to go with a hybrid method.

For - Scrum (Agile Approach for IT Projects):

- Scrum enables rapid value delivery through iterations, which is useful for IT software projects where requirements often change.
- The agile approach allows better adaptation to changes in requirements.
- Regular interaction with users improves understanding of their needs and enhances user satisfaction.

Against - Scrum:

- Implementing Scrum may require changes in an organization's culture and practices, which can be challenging to carry out. For example, reconciling an extremely hierarchical approach in an organization (such as a bank or the military) with Scrum's logic of self-organizing teams where self-management and equality prevail.
- Scrum is less precise in terms of long-term planning and budgeting.

For - Waterfall Methodology (for well-defined projects):

- The Waterfall methodology allows detailed and precise project planning, which is useful for projects where requirements are well-defined in advance.
- The Waterfall methodology provides clearly defined deadlines and budgets, which are important in situations where precision is critical.

Against - Waterfall Methodology:

- The Waterfall methodology can be inflexible when changes in requirements are needed during the project.
- Long-term projects are susceptible to unforeseen issues, which can increase risk.

For - Hybrid Methodology (for projects that require a balance between precision and agility):

- A hybrid methodology allows balancing between agility (through Scrum) and precision (through Waterfall) according to project needs.
- Projects can be effectively managed by following agile principles for rapid delivery and precise methodologies for control and planning.

Against - Hybrid Methodologies:

- Requires effective management by experienced managers to ensure that both components (agile and Waterfall) work together and achieve the project's goals.

In the end, it's important for each organization to carefully consider the specific needs of its project and environment and choose the methodology that best suits those needs. Each of the mentioned methodologies has its advantages and disadvantages, and the right adapted methodology can help in the successful completion of the project. It's also important for the organization to be ready to adapt its approach to deal with changes during the project.

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