



White Paper 2023-01

When is Agile Project Management Suitable for Industrial Projects?

Abundant literature exists that confront agile and waterfall (predictive) approaches to projects. The two approaches to project management are not necessarily exclusive, and a project plan can benefit from both. Like tools, it is important to know when and how they can be used. In this White Paper we expand on how to use agile or waterfall on large, complex industrial projects.

Introduction: Waterfall versus Agile: definitions

Waterfall (predictive) project management is the conventional project management approach of planning in detail what has to be done, and then deliver the full project while accepting the minimum of changes from the initial project plan. This assumes that the client is capable of clearly describing upfront what are its exact expectations of the final product.

Agile project management is a newer project management philosophy initially developed for software projects where the project is a succession of short runs (typically a few weeks) producing some deliverables that are then evaluated and vetted by a representative of the client or confronted to a test trial. The scope of the next run is then defined according to the feedback received. This allows to develop products in a situation where the client may not be able to fully express its needs up front and it is much more flexible to actual changes of stakeholder requirements. It also allows for a much more flexible accommodation of changing circumstances, and an accelerated learning curve through trial and error. The frequency of the agile runs can be adapted to the type of project and product, ranging from a week to several months.

What types of projects are suitable for agile or waterfall approaches?

We observe in practice that the main border between agile and waterfall projects is when hardware is physically being produced that has a significant lead time, or when irreversible physical transformations are involved (such as clearing a site, demolishing infrastructure, etc.). Another important case is highly regulated industries where the project outcome must be sufficiently well defined in advance to be vetted by the regulatory authorities.

Agile approaches can be suitable as long as the product is relatively easy to modify such as lines of code or engineering documentation (i.e. the product is basically virtual information).

When hardware or irreversible physical transformation are involved, that requires weeks or months for production and strong limitations of possible modifications in the meantime, agile approaches show their limit because the implementation of late changes becomes very costly

including in terms of schedule. In recent times however, this border tends to become somewhat fuzzy when the functionality of hardware can be significantly adjusted by software changes without impacting the hardware itself.

Agile is best when convergence needs to be ensured in transformation or problem-solving

Agile is an extremely interesting approach to control developments that are uncertain and require a number of iterations. This could typically involve R&D efforts, organisational transformation, setting up organisations and processes in an area that is not well known or subject to significant changes, or for which the success criteria require a collaborative definition.

The main benefit of the approach is that it defines a set pace for the work with short term objectives and milestones and thus maintains a collective tension over clear short-term achievements. It also allows early successes and rapid, regular and visible progress. The redefinition of priorities and targets at each iteration then makes the approach flexible to accommodate new information, test results and any change to the project environment. The essential part when applying agile is really to maintain an unambiguous pace for each run to motivate delivery and insisting on the proper delivery of the objectives of each run.

The core of large industrial projects is driven by physical constraints or irreversibility and thus needs a waterfall approach

On large industrial projects the lead time of major equipment and material may be months or even years and most long lead time equipment is ordered at Final Investment Decision (FID) or even before as it drives the critical path of the project. Therefore, the core of those projects, from the ordering of major equipment, necessarily has to be executed overall in waterfall mode: Implementing significant changes in the design or performance expectations of the facility after long lead time equipment has been ordered can have dramatic consequences and iterations between the different parties and hardware involved will be extremely expensive, time consuming and may even never converge.

Because long lead time hardware is involved which often cannot be modified without substantial consequences on the project, industrial projects are mainly executed in waterfall project management mode and will remain so in the future.

However, certain aspects of industrial projects are still candidates for agile approaches or hybrid approaches.

Agile and hybrid approaches for essential parts of industrial projects.

Project definition

The first phases of large industrial projects – the project definition phases – are essentially virtual and are thus suitable for an agile approach. The duration of the runs is determined by the amount of effort needed to bring together all aspects of the project and generally involves several months. Each run is typically one project definition stages, separated from the subsequent run by a governance meeting during which project objectives can be adjusted or changed (refer to specific upcoming White Paper [2023-02] “[Why Project Development Phases Need to be Split in Stages](#)”).

Within each definition stage, certain key issues can also be addressed in task forces driven with a higher frequency pace, in an agile-like approach.

R&D activities

Research & Development activities are also good candidates for agile approaches, to accelerate the learning curve. They are often conducted on reduced scale equipment that are quicker and easier to source than industrial-size equipment, which is generally custom-made.

Project execution

Even during project execution itself, agile approaches are interesting to consider for certain aspects and could certainly be deployed more frequently in a more rigorous form:

- During the first few months of project execution, when the project is being setup and orders for the main equipment are being prepared, up until engineering data is received back from the main equipment suppliers (which marks the end of detailed engineering iterations),

- During the planning and setup of certain project phases (e.g. setup of logistics arrangements, construction site etc),
- For tasks forces created to resolve particular project issues in an uncertain context.

The essential aspect is to clearly understand at all moments of the project what are the parts of the project that remain flexible, and those that cannot be changed without major impact (typically, while hardware is actually being produced, or key milestones of irreversible decisions). As the project progresses, flexibility, and thereby the opportunity to use agile approaches, diminishes progressively (as well as the possibility for the project management team to influence its outcome).

Agile project management approaches could be used more frequently and explicitly during the project definition phases, and to tackle certain issues during execution

Product or infrastructure evolution through underlying software

More and more hardware is actually controlled by software. It is thus possible to update the functionalities of the hardware only by modifying the software. Such products are suitable for agile approaches of software evolution, as long as it does not require any hardware upgrade. A good example is the automotive industry. It is still not often applicable to large industrial infrastructure but can be expected to be a trend in a not so far future for key equipment.

Summary

Because long lead time hardware is involved which often cannot be modified without substantial consequences on the project, industrial projects are mainly executed in waterfall project management mode and will remain so in the future. However, agile project management approaches could be used more frequently and explicitly during the project definition phases, and to tackle certain issues during execution, in particular to respond to unexpected situations. Therefore, lessons learnt and practices from agile project management could still be deployed with substantial value in those areas.

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