Agile in project management system in mechanical engineering

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Abstract. The aim of the work is to highlight the practical application of the Agile concept in the life cycle management of investment projects in the field of engineering. The comparative advantages and disadvantages of the concept of flexible design are revealed. The themes of engineering projects in which the application of the Agile concept can be applied are identified.

1. Introduction

The current level of technology development and progress in almost all sectors imposes special requirements on production management. The pace of technology development worldwide is reaching its peak and is likely to continue to grow.

It is difficult to foresee what will happen to mankind in the next 50-100 years in the field of mechanical engineering and in other sectors [1], but on the example of the picture of the 1900s (see figure 1) it can be stated [2,3] that the pace of technology development will grow at a high rate in the future.

![Figure 1 - New York, intersection of Broadway streets, 5th Avenue and 23 streets (1905): where is the picture of the car? [1].](image)

The same street about 20 years later (see figure 2).
The pace of development of modern mechanical engineering (machine building) and other industries is directly related to the development of the Internet, computer technology and digital technologies. The progress of the development of society can be observed on the following examples [4]:

- in the 1990s about 1 million people have the mobile phone, in our time in free circulation is 5-6 billion phones, i.e. in 5-6 thousand times more;
- no one has won a chess tournament against a high-tech computer since 2005;
- every 2 minutes we take as many photos as all the people in the 19th century did. Only in 2014, humanity made 880 billion photographs. This is for 123 photos for every man, woman and child on Earth;
- People will create more information in the form of data in the next 2 days than was created in the history before 2003;
- the computing power of the iPhone 5S in 1991 was worth more than $3 billion dollars.

2. Discussions
Despite the progress of mechanical engineering technologies (active development of robots, electric vehicles, ADAS systems, etc.) – it can be stated that the next 10 years of mechanical engineering development will be closely related to digital technologies, data flows, artificial intelligence and the increasing speed of changes.

Traditional technologies in the management of production and engineering projects will go to the background, because active development is possible only in conditions of flexible fast-changing systems that have cybernetic possibilities for self-regulation and adjustment.

From a lifecycle perspective, the project management standard highlights [5]:

1. Predictive life cycles. Predictive life cycles (also known as fully managed plans) are a type of project life cycle in which project content, as well as the time and cost required to deliver that content, are determined at the earliest possible stage of the life cycle. These projects pass through a series of consecutive or overlapping phases, with each phase, as a rule, focused on a subset of project operations and project management processes.

2. Iterative and incremental life cycles. Iterative and incremental life cycles are life cycles in which project phases (also called iterations) intentionally repeat one or more project operations as the project team begins to better understand the product. Iteration determines the development of a product by performing a series of repetitive cycles, while incrementality determines the sequential increase in the product functionality.
3. **Adaptive life cycles.** Adaptive life cycles (also known as change-driven or agile methods) are designed to respond to high levels of change and they require a constant high degree of stakeholder engagement. Adaptive methods can be also iterative and incremental, but differ in that iterations are very rapid (usually 2-4 weeks) and fixed in terms of timing and cost. In adaptive projects, several processes typically run during each iteration, although earlier iterations may focus more on operations scheduling. The overall content of the project is broken down into a set of requirements, and the work that needs to be done is sometimes referred to as a backlog (requirements log). At the beginning of the iteration, the team determines how many high-priority items from the backlog can be retrieved during the next iteration. At the end of each iteration, the product must be ready for customer analysis.

It is obvious that the first model of project management – predictive cycles is a thing of the past. It has one significant drawback: a lack of time for detailed planning of all project characteristics.

The second model is iterative and incremental life cycles, most interesting in terms of speed, compared to predictive life cycle.

Adaptive life cycle, perhaps, has the most important advantage – the product is made for the customer, traditional technical requirements and specifications are replaced by a backlog. The key benefit is time. It will not be spent on the original plan.

No need to say that the most acceptable technology for project management is Agile technology, but there are subtleties of the process itself and a number of circumstances while restraining the process of applying new technologies for the management of engineering projects.

In general, mechanical engineering (machine building) projects can be classified as follows:

1. Food projects (new car, automobile knot, automobile unit).
2. Infrastructure projects (modernization of equipment, replacement of worn-out fixed assets, renovation, construction and modernization of new facilities).
3. Development of trade and service network (construction of buildings, modernization of equipment, construction of warehouses).
4. Research projects.
5. IT projects (CRM systems, PLM systems, MES systems and other software products).

3. **Conclusion**

Agile application for the projects specified in paragraphs 1-3 raises significant questions at the time of "redevelopment". For these categories of projects, so far, in the management of any technology (including "waterfall", in which the life cycle of the project develops consistently from the concept of research to prepare for the introduction and implementation of the project) there is a point of no return, marked by contracting for fixed assets (equipment, buildings and structures, etc.). Currently, it is difficult to assume what to do with equipment or tooling, which are usually unique, in the case of a sharp change in the course and changes in the market situation. The obvious answer can be the purchase of universal equipment, but it does not remove the questions of efficiency (such equipment is usually more expensive and less productive). Probably, answers to these questions can be found after a certain period of time with the advent and mass applications of 3D printing technologies (in tooling and equipment). With regard to the projects mentioned in paragraphs 4 to 5, there are far fewer questions in the application of Agile and it can be concluded that Agile can and should be used in information technology and research. The key benefit of Agile is time, and as a consequence, the absence of lost profits.

The world is rapidly changing, the speed of change has reached its peak and will continue to increase. Project management technologies from the perspective of life cycle management require more attention. One of the advanced and necessary for the development of engineering management technology, Agile, can be used in engineering projects in the sphere of information technology and research.

**References**

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