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Engineering Project Management: Agile Technology and Scrum Framework

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Abstract: The essence of Agile technology and Scrum method for unambiguous understanding of the subject of research is revealed. Research method: by search phrases “Scrum method”, “Scrum method in industry”, “Agile in industry” on Elibrary platform for the period from 2021 to February 2024 more than twenty sources were found and studied. Identified the manufacturing industries application of Agile and Scrum method, causes and effects of their use. It has been found that agile project management technologies have been used previously as production methods have evolved. And the pioneer of such an approach should be considered the Toyota company. The author's model of development of Agile methods of project and production management is presented. The tendency of development of agile project management methods based on artificial intelligence is outlined.

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1 INTRODUCTION

Before exploring the experience of applying one of the Agile methodology techniques, it is necessary to briefly introduce the essence of Agile itself and the Scrum framework.

Agile is a technology (methodology) of flexible project management. Agile management means that project tasks, conditions, requirements can be changed at any stage of design (at the stage of project initiation, development, implementation, and completion). It is based on the values of the Agile Software Development Manifesto and 12 principles underlying it (Agile Manifesto) (Beck et al., 2001),("What is Agile: exploring the method with examples," 2024), ("Flexible development methodology," 2024). Initially, this methodology was only used in the IT (software development) industry.

Manifesto developed and released in February 2001 in Utah USA (Beck et al., 2001). It was an alternative to "heavyweight" software development practices such as "waterfall", which was the main development standard at the time ("Flexible development methodology," 2024). Agile allows you to react quickly, to correct mistakes. The main thing in agile is the product, not the process. Filling out documentation is secondary and time spent on it is minimal. Agile methodology unlike the "waterfall" method does not contain a block of requirements management, or rather does not imply planning of requirements, but implies the possibility of the customer to suddenly and unexpectedly at the end of each iteration to put new requirements. Therefore, project timelines may be shifted in order to achieve the customer's requirements. This fact is a frequent cause of criticism of this methodology. But it should be noted that the application of this technology is more likely to occur in the development of a new product, the realization of an innovation project in an environment with one or more unknowns, with conditions changing in real time, i.e. in conditions of uncertainty.

Agile methodology includes various methods (e.g. OpenUP, Getting Real, Rapid Application Development, Extreme programming and others) ("Flexible development methodology," 2024). But the main two methods are: Scrum, Kanban. Analysts at ScrumTrek found that: 82% of survey participants use Scrum at work; 61% of participants use Kanban; 52% combine Scrum and Kanban ("What is Agile: exploring the method with examples," 2024). The subject of our article is Agile thinking and Scrum method.

The main modern and dynamic document that reveals the principles and provisions of the Scrum method is the "Scrum Guide" (Schwaber & Sutherland, 2020). The authors of this guide, Ken Schwaber and Jeff Sutherland, periodically develop it, supplement it, and bring it in line with current reality. Scrum is a framework (a set of rules, a tool) that helps people, teams, and organizations create value through adaptive solutions to complex problems. Scrum is based on empiricism and lean thinking. The source of knowledge is experience and decision making is based on observation. Lean thinking focuses on the essentials. Scrum involves groups of people who generally have all the skills and experience to do the job, sharing knowledge and acquiring the right skills. Scrum Team members are committed to their goals and to supporting each other and their work is built on the following five principles: commitment, focus, openness, respect and courage (Schwaber & Sutherland, 2020).

The basic unit of Scrum is a team of people or Scrum Team. A Scrum Team consists of one Scrum Master, one Product Owner and Developers. There are no sub-teams or hierarchies within a Scrum Team. It is a close-knit association of professionals focused on one goal at any given time - Product Goal. Scrum Teams work in iterations, short bursts of time (two weeks, a month) called Sprints. Sprints are the "pulse" of Scrum, where ideas are turned into value. Members of Scrum Teams have all the skills needed to create value in each Sprint (are cross-functional), self-managed (decide for themselves who does what, how and when). The result of each sprint is an Increment (variant, version) of the product that is ready to be used to a certain extent.

The Product Owner (product customer) is responsible for maximizing the value of the product and for the effective management of the Product Backlog (product requirements). The Scrum Master is responsible for applying Scrum in accordance with the Scrum Guidelines. He helps to understand the theory and practice of Scrum, is the "soul" of the team, its "conductor". More information about the Scrum framework can be found directly in the "Scrum Guide" (Schwaber & Sutherland, 2020).

2 RESEARCH METHODS

The research was conducted by searching and analyzing relevant sources (articles, conference proceedings, reports, etc.) on the subject of Scrum method, Scrum method in industry, Agile in industry on Elibrary platform for the period from 2021 to

February 2024. More than 20 sources obtained for the above search phrases were reviewed.

3 RESEARCH

Where can you meet the application of Agile method or Scrum framework in industry? First of all, the area of development and implementation of digital platforms and/or engineering project management or operational activities management software. The authors of the article (Boev & Voronin, 2019) substantiate the relevance and feasibility of introducing digital platforms – flexible intelligent information and analytical systems that unite personnel, technologies and resources of production companies into a single highly efficient project - at Russian enterprises. In particular, a management algorithm for the development and implementation of an enterprise digital platform based on the Scrum method is proposed. The advantages of the Scrum method and limitations in its application, both budgetary and qualification are systematized.

In another paper (Gavrilenko & Zhemerikin, 2018), the authors justify the advantages of Scrum method in the process of managing digitalization projects of chemical complex. This approach harmoniously combines elements of classical and agile approaches to project management and allows you to move to the requirements formulated by the customer, which can change over time. It is an important fact that the responsibility for the implementation of the project lies with all participants, including the customer himself. The main advantage of this approach is the possibility of achieving quick results, regardless of the adjustments made to the project.

Russian enterprises often use new methods in an attempt to "ride the first wave of change". According to ScrumTrek (Leonenko & Kunev, 2021), agile project systems were very popular in the domestic industry and oil and gas sector in 2018 (an 11% increase in the number of such enterprises compared to 2017). The number of Agile teams whose work results in a tangible product increased from 4.6 to 8%. In practice, it is not so easy to effectively carry out transformation to an agile approach to management (Agile-technology or specifically Scrum-method). Partly because employees (from execs and operations managers to senior managers) are openly resistant to innovation.

The authors of the following article (Dymov, Ruban, & Ustinova, 2023) review the basic concepts and benefits of Agile technology, Scrum, Case Method and Lean methods. It is suggested to use a combination of different methods to get the best results (each method is suitable for different types of projects). Agile and Scrum are most suitable for extending engineering project management.

If the project is implemented in an industry where there are frequent changes, new production technologies are introduced (digital technologies in the financial sector, IT sector and manufacturing industry), then the Scrum framework has a place in the implementation of this project. In a comparative characterization of Scrum and Kanban methods, (Aseydulin, 2021) identified significant advantages of Scrum for managing large projects, with constant change throughout the lifecycle at various stages of the lifecycle, with projects with different priorities and multiple phases, iterations or sprints.

Disclosing the essence of the Scrum method in (Kozlovskaya & Deliaev, 2022) authors came to the conclusion that this method can be applied in various industries: education, manufacturing, construction, but is more often used in the IT-sector. But along with the advantages of Scrum method (work is done in short stages (sprints); different tasks in the project are solved simultaneously; time for finding errors is reduced; the team is more motivated to work) there are also disadvantages: the success of the project depends on the competence of the Scrum master and the team as a whole; the presence of feedback at each stage can slow down the process of developing the project implementation.

Professor A.V. Polyanin of the Russian Academy of National Economy and Public Administration believes (Yakovleva, Lysenko, & Ovsyannikova, 2023) that Agile technology may not give the desired results for low-volume production (production of one specific product) or for production, which involves few employees, where interaction, communication and so will be at the appropriate level. On the contrary, Agile technology is more likely to lead to complexity. There is also a need for a continuous process of quality control of the work done with the help of metrics that allow to quantify the work done, identify weaknesses of the product and make preventive changes and adjustments. In general, the use of Agile in industrial production activities will increase its efficiency. It is proposed to take into account the advantages of the traditional method of project management ("waterfall") and build a hybrid management model.

The authors of the article (Gromova, Malevskaya-Malevich, & Kudriashov, 2023) define the concept of agile manufacturing as a production system that is based on the integration of highly skilled and knowledgeable people, advanced technology in a coordinated system to achieve a breakthrough effect, at the expense of abilities superior to those obtained from traditional production management practices. The main resource for an agile enterprise is the knowledge of the developers of the agile team. By utilizing each other's knowledge, the project team transforms this knowledge into new products and services. Agile mechanism is the integration of the unique expertise, production capabilities, advanced technologies of several enterprises for a particular project that they cannot do separately. In the long term, the most important result of the agile mechanism is a continuously growing knowledge base.

In the article (Lovkova, Kashitsina, Goncharov, & Sokolov, 2023) the tendencies of using Agile technology in the textile industry are given, the possible advantages of project management using this technology in this sphere are characterized, special attention is paid to the improvement of the project team in the aspect of improving the qualification of team members. But the practical experience of using a particular tool in real activities is not described. But there is a beginning and interest in the application of Agile technology in this or that tool.

In contrast to the previous article, (Bukhanov, Krasavina, Sologub, & Zubaikin, 2023) presents concrete examples of possible applications of Agile methodology in food production. Namely, when developing a new product, this technology allows breaking down a large process into separate iterations, setting short deadlines for each iteration. The second example of the use of agile technology is the inventory management of raw materials and supplies in a food production facility. This will make it possible to take into account fluctuations in demand and promptly react to changes. In general, it is found that the application of Agile technology in food production can reduce production cycle time, improve the flexibility of inventory management in food enterprises, and allow for the prompt identification and correction of errors and defects in the development and production process.

McKinsey & Company (Shafigullina & Puryaev, 2022) conducted a study on the application of Agile technology and made the following conclusion: energy, chemical industry, oil and gas industry, mining industry implement modern Agile management techniques often only in crisis situations. It can be assumed that they do not fully adopt the new project management technology due to lack of experience, lack of competences and lack of expectation of contingency.

According to research from the ScrumTrek portal (Evdakimov & Rogachev, 2023) on the use of Agile methodology, the share of industry is only 4.5%, information technology is 34%, finance 34%, commerce 6.5%, telecommunications 5%, energy 4.7%, consulting 3%, public services 1.5%, education 1.2%, logistics 1%. There is a decline in industry (in 2020 it was 8%) (Shafigullina & Puryaev, 2022). In Russia, the number of those who use Scrum is 82% (in the world 87%, according to the State of Agile Report), which is not much less than the world level.

At the enterprise PJSC “AVTOVAZ”. there is a problem of unevenness of production supply (Novitsky & Gilmanov, 2024). One of the flexible management methods based on "Just In-Time" does not allow to solve it due to the following reasons:

- lack of information on the need to supply components;
- lack of planning for the current and future work shift.

To eliminate this problem, the authors (Novitsky & Gilmanov, 2024) propose the implementation of the "Min Max" strategy, which will help to reduce the number of components in the warehouses (it is assumed to calculate the maximum possible level of components, taking into account all the factors affecting the process).

In 2016, United Company RUSAL (metallurgy) introduced the Agile methodology to improve the process of finished product supply chain management. PJSC “Gazprom Neft” implemented Agile in the regional sales directorate, which manages a network of petrol stations and is engaged in small wholesale supplies of petroleum products (Shafigullina & Puryaev, 2022).

Foreign enterprises use Visure toolkit (artificial intelligence based requirements management software), which is an ALM (Application Lifecycle Management) platform and is designed for application lifecycle management (“Visure. The #1 software solution for AI-based requirements management,” 2024). Visure's main customers from the engineering industry are Audi, Honda, Bosch, Saab and Husqvarna AB. The main features of Visure software are: compliance with automotive industry standards; provides comprehensive transparency in the system by providing access to the software; supports Agile technology of project (product) development; provides XML standards, which facilitates the process of communication between the customer and suppliers; guarantees proper protection of information and requirements due to strict access policy; contains a system of automatic filtering of requirements, marking some as ambiguous or non-compliant.

Toyota Corporation has implemented the Agile Development Process. This is a software development process based on the Toyota Production System (TPS). It involves the implementation of basic TPS concepts (loss elimination, production levelling and automatic detection of abnormal conditions) in IT software. The TPS system is oriented to the complete elimination of losses and is based on two principles: a) the principle of "just-in-time", when on the production line the parts required for assembly are available strictly at the right time and in strictly required quantity, using the means of information transfer "Kanban"; b) the principle of autonomisation (automation with an element of intelligence) (Zlygostev, 2024).

4 RESULTS AND DISCUSSION

Having studied the experience of application of flexible technologies for project and operational management of industrial enterprises, we can distinguish two stages of its development:

1. The “Agile: Start” stage. This is the period before Scrum (in 1995) and Agile Manifesto (in 2001) were mentioned. This period begins with the beginning of Toyota Corporation's introduction of its own production system, the Toyota Production System (c 1945). And ending with the introduction of an agile framework for software development – Extreme Programming (XP) in the late 1990s (Iraidina, 2018).
2. The "Agile: Next" stage. This period begins with the introduction of Scrum (in 1995) and the Agile Manifesto (in 2001). And continues into the present. During this period a "symbiosis" of the two methods was formed – the Scrumban methodology as a hybrid system combining the best features of Scrum and Kanban (Atlassian, 2024). Scrumban was introduced in 2009. One of the latest improvements of agile tools for project and production management should be considered the development of SAFe (Scaled Agile Framework). It is a set of tools for scaling agile approaches in large companies. The framework combines the best practices from the world of Agile, lean manufacturing and systems thinking (“Scaled Agile Framework,” 2024). Helps to significantly organize the work of large teams (when 50 or more people work on a project) to maintain the flexibility and speed of small startups.

The chronology of the development of Agile methods of project and production management is summarized in the figure below.

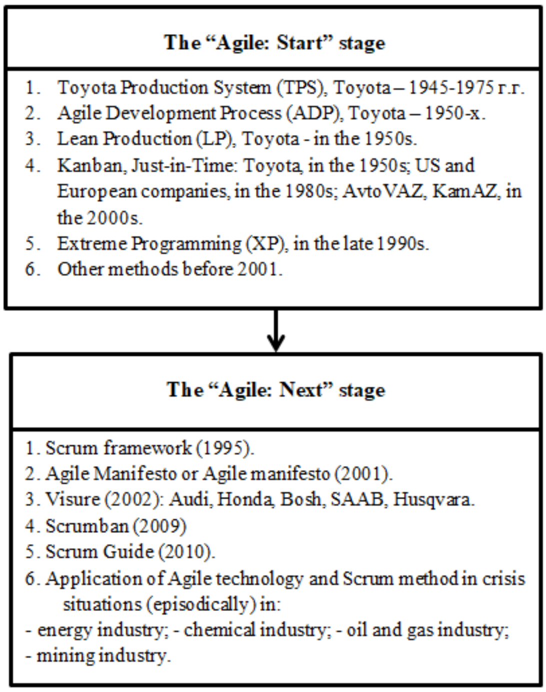

Figure 1: Development of Agile methods of project and production management.

5 CONCLUSIONS

In conditions when time is shrinking to a point, i.e. when there are more changes per unit of time than in the 19th and 20th centuries, the development of agile technologies for project and operations management becomes more and more relevant and inevitable.

Looking ahead, in our view, the 2020s and beyond will see the enhancement of existing agile tools, project and operations management techniques based on artificial intelligence (AI), which is increasingly attracting the attention of creatives and researchers. And industrial production in integration with AI will definitely be the No. 1 object of application of new frameworks, methods and control technology in general. The main function of the project manager will most likely be project selection, control and regulation of the project team's performance results, of which the AI will also be a member.

REFERENCES

Aseydulin, I. R., 2021. Comparative analysis of Scrum and Kanban project management methods. *Scientific Knowledge Matrix*, (11–2), 130–132.

Atlassian, 2024. Scrumban: mastering two Agile methodologies. Retrieved March 30, 2025, from https://www.atlassian.com/ru/agile/project-management/scrumban

Beck, K., Beedle, M., Bennekum, A. van, Cockburn, A., Cunningham, W., Fowler, M., Thomas, D., 2001. The Agile Manifesto of Software Development. Retrieved March 29, 2025, from https://agilemanifesto.org/iso/ru/manifesto.html.

Boev, A. G., Voronin, S. I., 2019. Use of Scrum method in the implementation of the project on implementation of the digital platform of the industrial enterprise. *Production Organiser*, *27*(2), 16–26.

Bukhanov, V. O., Krasavina, E. V., Sologub, V. A., Zubaikin, Y. V., 2023. Formation of principles of using Agile-development in management processes of writing industries. *Economy: Yesterday, Today, Tomorrow*, *13*(7A), 279–286.

Dymov, E. B., Ruban, N. Y., Ustinova, Y., 2023. Modern project management methods: Agile, SCRUM, case method, Lean. In *Economy of the XXI century: Collection of materials of the III International Scientific and Practical Conference* (pp. 85–89). Novosibirsk.

Evdakimov, A., Rogachev, S., 2023. Agile in Russia 2022 research report. Retrieved December 4, 2024, from https://scrumtrek.ru/blog/agile-scrum/11200/otchet-issledovanie-agile-v-rossii-2022/

Flexible development methodology, 2024. Retrieved March 30, 2025, from https://clck.ru/3K8hb3

Gavrilenko, T. Y., Zhemerikin, O. I., 2018. Industrial Internet of Things in the Russian Chemical Complex and Project Management Tools: Implementation Peculiarities. In *Management Sciences in the Modern World: Collection of Scientific Conference Papers* (pp. 259–264). Moscow: Publishing House “Real Economy.”

Gromova, E. A., Malevskaya-Malevich, E. D., Kudriashov, V. S., 2023. Agile mechanism as a driver for knowledge generation in industry. *Natural and Humanitarian Research*, (5(49)), 78–81.

Iraidina, M., 2018. Extreme programming or management: how not to be confused by the terms. Retrieved March 30, 2025, from https://skillbox.ru/media/management/ekstremalnoe_programmirovanie_ili_upravlenie/

Kozlovskaya, S. A., Deliaev, G. V., 2022. The “scrum” method in project management. *Service Sector: Innovation and Quality*, (62), 71–82.

Leonenko, E. A., Kunev, S. V., 2021. Managing the company’s organisational culture based on the principles of change management and agile methods. *Scientific Review: Theory and Practice*, *11*(8 (88)), 2468–2481.

Lovkova, E. S., Kashitsina, T. N., Goncharov, A. V., Sokolov, I. V., 2023. Applying of Flexible Approaches To Project Management in the Textile Industry. *Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil’noi Promyshlennosti*, (1(403)), 54–59.

Novitsky, I. S., Gilmanov, M. M., 2024. Theoretical foundations and trends in the development of project management systems based on the Agile methodology in machine-building production. *Priorities of Socio-Economic Development of Russia in the Context of Digitalisation of the Economy: Collection of Scientific Articles*. Rostov-on-Don: Manuscript.

Scaled Agile Framework, 2024. Retrieved March 30, 2025, from https://ru.wikipedia.org/wiki/Scaled_Agile_Framework

Schwaber, K., Sutherland, J., 2020. *Scrum Guide*.

Shafigullina, G. G., Puryaev, A. S., 2022. Development and implementation of a management system based on Agile technology in the oil and gas industry. *Transport Information Bulletin*, (7-2(325)), 91–102.

Visure. The #1 software solution for AI-based requirements management. (2024). Retrieved March 30, 2025, from https://visuresolutions.com/ru/

What is Agile: exploring the method with examples. (2024). Retrieved March 30, 2025, from https://getcompass.ru/blog/posts/chto-takoe-agile

Yakovleva, M. V., Lysenko, M. V., Ovsyannikova, U. S., 2023. The Agile concept: the possibility of applying agile methodologies in manufacturing industries. *A Century of Quality*, (3), 207–217.

Zlygostev, V. Y., 2024. Japanese-style management. Features of the system of personnel management and labour motivation in Japanese personnel management at modern Japanese enterprises. Retrieved March 30, 2025, from https://monographies.ru/en/book/section?id=11670.