Model of "short cycles" as innovative product development

E A Gromova

1Peter the Great St. Petersburg Polytechnic University, Politechnicheskaya st., 29, St. Petersburg, 195251, Russia

E-mail: lizaveta-90@yandex.ru

Abstract. The fourth industrial revolution is a phenomenon that is actively becoming a reality and that initiates a change in the strategic guidelines of industrial enterprises. The previous strategic indicators such as scale of production, cost and quality have been replaced by a value system such as rapid response, flexibility, disruptive innovation and speed. Organization of production in today's reality has an important characteristic, reflecting the concentration at the stage of product development. Therefore, the purpose of the study is to offer effective product development concept in the context of reducing time to market. The concept of the model of "short cycles" is considered. The example of implementing this model in PJSC Severstal, which is the flagship of the Russian industry, is analyzed. The company has launched a global transformation, one of the points of which is the provision of excellent customer experience. Its implementation requires innovative and effective product development models, such as the model of "short cycles", which has already brought initial success to the company.

1. Introduction

In the early 2000s, the National Research Council of the United States identified the main tasks for industrial enterprises, which represented gaps in existing practice and determined the vision of production in 2020 [1]:

- ensure concurrency of operations;
- "instantly" transform information gathered from a wide variety of sources into useful knowledge for effective decision-making;
- integrate human and technical resources to improve workforce efficiency and satisfaction;
- rapidly restructure production facilities in response to changing needs and opportunities.

These tasks are extremely relevant for the current state of the industrial sector in general, and in particular, Russian industrial sector. In today's reality, an industrial enterprise faces a number of challenges. Along with those that have already become standard, which consists in achieving a high quality indicator and minimal costs, the following are becoming topical:

- reduction in time to market;
- wide variety of product range;
- increase in the rate of flow of production processes;
- use of the latest technological advances;
- accurate customer satisfaction.
Currently, great attention is paid to saving time in the course of production and sale of products. This is due to the onset of the Fourth industrial revolution – an increase in the degree of unpredictability and market instability, rapid changes in technology and increased competition.

Previously, R. Suri [2,3] proposed the concept of quick response manufacturing. It means responding to customer requests so that you can quickly develop and release products that are responsive to those requests. This concept focuses on the continuous reduction of the time required to perform all types of activities in the company, while ensuring quality improvement, cost reduction and faster response to changes in the situation. The roots of the concept go to the strategy "time-based competition", which was proposed by G. Stalk and T. M. Hout [4]. This model was based on the use of speed to gain a competitive advantage: a company that uses this strategy provides products or services to consumers faster than competitors. Also, many scientists [5-12] consider agile manufacturing as a concept of production organization based on the foresight of changes in the business environment and timely response to the rapidly changing needs of the market through the effective use of internal and external resources. Today A. Borovkov [13] rightly points out: «The key thesis is time to market. We are now witnessing the window of opportunity slamming in front of entire corporations and industries. The window existed for a year or two, during which time it was necessary to have time to enter the market. If this did not work out for some reason, you will have to wait for the next window».

So, the purpose of the study is to offer a product development concept, which will be effective in terms of reducing the time of product market entry in the realities of the Russian industry.

2. Materials and Methods
The model of "short cycles" is based on the Deming cycle (PDCA) [14], which is a model of continuous improvement. Each cycle of the development process is a mini-project and includes all the necessary range of operations: design, prototyping, testing, evaluation of results. This project is divided into the required number of "short cycles" depending on the identification of the most appropriate prototype (the standard procedure for product development often consists of one large cycle). It allows to visualize the scope of work and explain to the customer how the finished product will look. The duration of each cycle is from 1 to 4 weeks. The principal feature is the ability to influence each stage of the "short cycle" at any time (figure 1).

![Figure 1. Visualization of the model of "short cycles" (developed by the author).](image)

An interdisciplinary team in cooperation with the customer develops a prioritized list of tasks for the upcoming cycle (with the exception of the very first cycle, where there is virtually no feedback, the chosen concept prevails). The basic rule is that if the team has agreed on a certain number of tasks that need to be performed in one cycle, then it is impossible to add new ones. Small groups of end users have
the opportunity to get acquainted with the new prototype and provide feedback. At the end of each "short cycle", a stakeholder assessment will be conducted, which will result in a list of tasks for the next cycle, taking into account the adjustments received through feedback and based on the discussion of the results by the team.

Fast and frequent releases are not a new idea, it goes back to the idea of evolutionary development proposed by T. Gilb [15]. In his words, "evolution is a technique designed to create the appearance of stability. The chances of successful creation of a complex system will be maximum if it is implemented in a series of small steps and if each step contains a clearly defined success, as well as the possibility of "rollback" to the previous successful stage in case of failure. Before putting into action all the resources intended for the creation of the system, the developer has the opportunity to receive feedback from the real world and correct possible errors in the project».

Among the main advantages of the model of "short cycles" can be distinguished:

- reduction of product's time to market;
- increase the speed of execution of a specific order;
- high speed of product development generates disruptive innovations [16];
- reduction of total costs;
- improving the quality of finished products;
- better satisfaction of consumer preferences;
- minimize risk by reducing development to a series of short cycles.

3. Results and Discussion

Since the beginning of 2018, PJSC Severstal, as one of the world's leading steel and mining companies, has sold 85.5 tons of new complex products. The project "Product innovations" started in 2017. The project includes the work of product teams in 5 categories: coated steel, cold rolled and hot rolled steel, thick sheet with large diameter pipes and long products. Product innovations brought $ 12 million in profits only in 2018. In 2019, product innovations are expected to yield about $ 20 million. During the period 2018-2023 Severstal plans to earn more than two billion dollars of additional income. Half will come from product, process and business model innovations.

In 2018, the company moved from local projects to a large-scale transformation of the organization. Severstal has started a major transformation that will require a lot of effort from all employees. According to A. Mordashov – chairman of the Board of Directors of the company, the creation of excellent customer experience is its most important element. "Excellent customer experience" is aimed at bringing the service to a fundamentally new level, quality customer service and finding new ways to bring them exceptional benefits [17]. Today Severstal analyzes new markets and develops further processing of products to strengthen relations with end users and joint development of products with major customers. The main goal is to further differentiate Severstal from its competitors and to bring products that have no analogues to the target markets. So, company need to find new opportunities in the market, produce new products and offer unique solutions. The model of "short cycles" helps to make the process of creating new innovative products more efficient. The model has proven itself well in Severstal in the process of development and market launch of a new product. The work is divided into two-week cycles. Before the beginning of each cycle, goals are set, tasks that need to be performed to achieve the goal are painted. The results are summarized at the end of each cycle, a retrospective is held and measures to improve the efficiency of the team are determined. There are also monthly demo days, where each cross-functional team, where each member is an expert in their field, has the opportunity to talk about their results and share best practices.

The result of each short cycle deserves special attention. A minimum viable product helps to get meaningful feedback from users: understand what they need and not create what they are not interested in and what they are willing to pay for. It's a hypothesis that needs to be confirmed or disproved. Procedure for identification of the minimum viable product:

1) clearly formulate the hypothesis;
2) determine the criteria by which its viability will be determined;
3) make the minimum viable product to confirm the hypothesis and run it;
4) measure the performance indicators on the basis of the obtained results;
5) draw conclusions, check the following hypothesis, if necessary.

The minimum viable product is schematically shown in figure 2.

![Minimum viable product](image)

**Figure 2.** Visualization of the minimum viable product (developed by the author).

Minimum viable product does not mean raw product made in a hurry. Minimal time is spent on its development, and it contains only key characteristics, the relevance of which for real clients should be checked. Research shows that up to 60% of product properties are generally not important to customers. The concept of a minimum viable product allows to reduce the time to start a project by creating only the necessary functions and characteristics and begin to receive real feedback on your product. That's the trick. Minimum viable product will allow to include only the most necessary options and work out the necessary characteristics.

By creating a minimally viable product, it becomes possible:
- save money without investing them in a failed project;
- check if the product is of interest to potential users;
- choose the optimal direction of development due to iterations;
- create a potential customer base and find early product loyalists.

A pilot project in the development of a new type of product was the development of a new, more durable plastic packaging tape for the production of flat products. To release a new product is planned not only for internal customers, but also for external ones. One packaging tape is used in almost every redistribution of metallurgical production. The tape must have high strength, withstand heavy loads, as well as high ductility so that it is not torn during transportation. Thanks to the model of «short cycles», at the beginning the experts selected the optimal chemical composition, which should satisfy the customers’ requirements for the packing tape. Next new product was tested. After the customer and the cross-functional team have reached a final agreement, they will be engaged in the release of a new cold-rolled tape in flat-rolled products. The team consists of employees of the directorate for sales, marketing, technical quality development, customer support services. The leader of the team is the Business System Development Center. Single criterion of success is to bring the finished product to the client, satisfy him, and bring the company profit. Director of Business System Development "Severgrupp" A. Kolobov argues that the use of model of «short cycles» in the work helps in the conditions of "very large uncertainties." He emphasizes constant contact with the client as an integral part of successful activity. Turning to the results of a pilot project for the production of a new type of product - high-strength packaging tape, the efficiency of the achieved indicators is reversed: the product creation period was 9 months, instead of 2-3 years, obtained using traditional methods, that is, acceleration of product launch to than 3 times. There were 28 short cycles for obtaining the final result. The product was distinguished...
by unique properties that gave reason to recognize this product as innovative. Another value is the increased demand among consumers. The pilot project was recognized as successful by the company’s management.

One of the notable innovative solutions in 2018 is the production of damping steel. Severstal was the first company to produce such steel in Russia. After analyzing the market and listening to customers, the company has developed a new brand of steel, simultaneously absorbing noise and vibration, which is very important for architects of modern cities. In addition, the production of cryogenic steel for liquefied natural gas production and storage facilities was started within the framework of the program of import substitution of construction materials, implemented jointly with PJSC Gazprom. More one, "SeverFarm" [18] is a galvanized metal with a special coating that is resistant to the damaging effects of biologically and chemically aggressive environments. The characteristics of the new brand provide high resistance to corrosion even under the influence of acids, ammonia, disinfectants, organic solvents, alkalis and steam. The coating has maximum UV protection and increased resistance to mechanical damage. It became the first premium brand fully developed within the framework of the project "Product innovations". More innovative products are expected in the near future.

4. Conclusion
A key priority of the updated strategy of PJSC Severstal is to provide an excellent customer experience. The future belongs to those companies that can quickly provide consumers with unique solutions based on a deep understanding of their needs. The goals set for the company cannot be achieved without a number of changes in internal processes, including the organizational design of the company, which are necessary for the new format of cooperation with customers. The model of "short cycles" reduces the time to develop new products from several years to several months. Also, this concept of product development contributes to the genesis of innovative products due to the achieved speed. Although Severstal has started to actively introduce innovations relatively recently, today the results of work in this direction are already noticeable. Now there are more than 1400 ideas at different stages of implementation in the product portfolio of the project, which can potentially bring a huge effect.

Severstal is the first steel company in Russia to make such profound changes, transforming its structure to suit the client. As a result of these changes, customers of Severstal will have an even more sustainable and reliable partner that is able not only to offer high-quality steel, but also steel-based solutions that meet their business objectives. And the model of "short cycles" can be promising for enterprises of the industrial sector of the Russian economy.

References
[1] Camarinha-Matos L M, Afsarmanesh H, Galeano N and Molina A 2009 Collaborative networked organizations – Concepts and practice in manufacturing enterprises, Computers & Industrial Engineering 57(1) 46-60
[2] Suri R 1998 Quick response manufacturing: a companywide approach to reducing leadtimes, Productivity Press
[3] Suri R 2010 It's About Time: The Competitive Advantage of Quick Response Manufacturing, Productivity Press
[4] Stalk G and Hout T M 1990 Competing against time: how time-based competition is reshaping global markets, Free Press
[5] Goldman S L, Nagel R N and Preiss K 1995 Agile competitors and virtual organizations: strategies for enriching the customer, Van Nostrand Reinhold
[6] Gunasekaran A 1998 Agile Manufacturing: Enablers and an Implementation Framework, International Journal of Production Research 36(5) 1223-1247
[7] Gunasekaran A 2017 International Journal of Production Research 1-13
[8] Dubey R and Gunasekaran A 2014 Agile Manufacturing: framework and its empirical validation, The International Journal of Advanced Manufacturing Technology 76(9-12) 2147–2157
[9] Kidd P T 1994 Agile manufacturing: forging new frontiers, Addison-Wesley
[10] Larman C 2004 *Agile and iterative development: A manager's guide*, Addison-Wesley
[11] Sharp J, Irani Z and Desai S 1999 Working towards agile manufacturing in the UK industry, *International Journal of Production Economics* **62** 155-169
[12] Sutherland J 2014 *SCRUM. The art of doing twice the work in half the time*, Crown Business
[13] *Do not oversleep the revolution 2019*, http://atomicexpert.com/page747353.html (accessed on Jun. 2019)
[14] Deming E 1982 *Out of the crisis*, MIT Press
[15] Gilb T 1988 *Principles of Software Engineering Management*, Addison-Wesley
[16] Christensen C M 1997 *The innovator’s dilemma. When new technologies cause great firms to fail*, Harvard Business School Press
[17] *Creation of metallurgy of the future. Business development today 2019*, https://www.severstal.com/files/23850/Annual_report_2018_RUS.pdf (accessed on Jun. 2019)
[18] Gromova E 2019 Introduction of Flexible Manufacturing Systems as a Necessary Measure for the Russian Industrial Development, *Materials Science Forum* **957** 195-202