Quick response manufacturing as a promising alternative manufacturing paradigm

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Abstract. The fourth industrial revolution initiates a change in the strategic guidelines of industrial enterprises. The rapid trend towards a wide variety of finished products with a short development and production time has led to a number of problems for enterprises with inventory, overhead and efficiency. The imperative of implementing lean production is becoming irrelevant due to new challenges in the external environment and is giving way to more competitive paradigms. Now the modern production concept should be focused not only on the cost and quality of goods, but also on the speed of response and flexibility. Quick response manufacturing (QRM) is one of them, which is a corporate strategy to reduce time of execution of the order at the industrial enterprise. And it is an extremely new and unfamiliar management paradigm in Russia. The purpose of this study is to analyze quick response manufacturing and to relate it to the current state of the Russian industrial development. Theoretical and practical aspects of this concept are given. The examples of the quick response manufacturing implementation in the Russian industrial sector are presented. Summarizing, QRM is offered as a promising manufacturing paradigm for Russian industry.

1. Introduction

Now 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. With the beginning of the fourth industrial revolution, the business environment is characterized by changes that occur at the highest speed and on a huge scale, as well as described by the systemic nature of the consequences. The rapid trend towards a wide variety of finished products with a short development and production time has led to a number of problems for enterprises with inventory, overhead and efficiency. In this case, attempts to use mass production methods cannot be successful. The idea of "making large batches of products more profitable than small ones", based on achieving "economies of scale" and low unit cost, has lost its relevance. The mass production paradigm does not apply when consumers expect to receive highly customized products produced in a small batch, with an order reference point corresponding to the "custom development" position, and with the provision of additional services and value-adding benefits, such as subsequent product upgrades and reconfigurations, which are considered as important as the product itself. In turn, the imperative of implementing lean production (LP) [1-3] is also becoming irrelevant due to new challenges in the external environment and is giving way to more competitive paradigms – quick response manufacturing (QRM) [4-5] and agile manufacturing (AM) [6-10].

Thus, the purpose of this study is to analyze quick response manufacturing and to relate it to the current state of the Russian industrial development. Noteworthy that Russian sector of economy has traditionally been conservative. The theoretical and practical aspects of the modern production concepts are studied by many researchers. Among them the following scholars are highlighted: T. Ohno (1988), M. Imai (1997), J. Womack and D. Jones (2003), P.T. Kidd (1994), S.L. Goldman, R.N. Nagel and K. Preiss (1991), A. Gunasekaran (1998, 2014, 2017), R. Suri (1998, 2010). Focusing on QRM, R. Suri 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 is based 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 [11]. This model was concentrated 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.

2. Materials and Methods

Quick response manufacturing is a management concept that aims to radically reduce time costs at all stages of the production cycle and office operations. The external aspect of the concept is a response to the needs of the client, which consists in the rapid development and production of products that take into account all individual characteristics. The internal aspect is to reduce the time of any operation in the context of the whole enterprise. The QRM concept focuses on reducing the overall lead time. The bottom line is the downtime between segments of actual work that take up most of the time. So, the focus of management attention is focused on the critical production path, which covers the time period from the moment when the customer makes an order to the delivery of the first product from this order. Thus, the main idea is to reduce the order lead time due to all the company's operations, both internal and external. Companies that have mastered QRM concepts usually manage to reduce the time for developing new products and the time from receiving an order to shipping finished products by 40-60%, while reducing total costs by 20-30%. It is very important that such impressive results are achieved without major investments, mainly due to the organizational factor-changes in the organization of production and management.

According to the group of authors [12], QRM has a lot in common with the lean production paradigm, such as cross-functional teams, on-demand production, and quality programs. R. Suri [5] suggests that QRM actually strengthens lean production. A. Gunasekaran and Y. Yusuf [13] define QRM as a characteristic of an agile enterprise. Other scientists [14] express the opinion that regardless of the type of product characteristics shown, applying the fundamental principles of LP, based on relentless elimination of production losses to increase value for consumers, will always be an ideal starting point on the path to operational excellence. This also applies to the central principle of QRM-the constant reduction of execution time. The difference between modern concepts is presented graphically (figure 1).

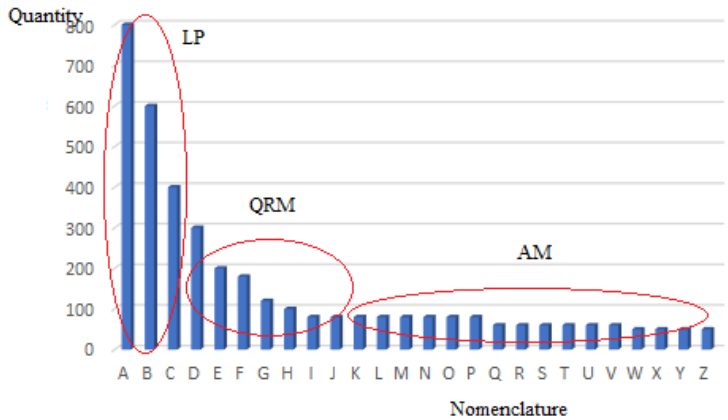

Figure 1. Differences in concepts in the quantity and range of products (developed by the author)

Figure 1 shows that the main difference between LP and AM is that when LP seeks to eliminate both product diversity and process variability (through strict application of standardization), AM systematically pursues the ability to respond by creating and providing flexibility.

3. Results and Discussion

Lean production is the most common modern concept in Russian industrial sector. Quick response manufacturing and agile manufacturing have been implemented sporadically in Russian industrial sector of economy [15-21].

The first Russian QRM Conference was held on April 16-17, 2015 in Perm. The Conference featured presentations by leading developers of the QRM concept and consultants from the USA, Germany, France, Holland, Switzerland and Russia. Participants had the opportunity to get acquainted with the experience of QRM implementation in Russian enterprises, both from the presented reports and during a visit to a company that is successfully implementing this concept.

Public joint stock company "Perm scientific and production instrument-making company" (PJSC" PNPPK") is engaged in the development and production of sensors and systems for navigation, stabilization and orientation of various types of mobile objects. It is one of the leading Russian suppliers of navigation devices and systems. The company has a developed scientific and research base for the production of various types of fibers and fiber-optic components. Together with its subsidiaries, PJSC PNPPK forms the Photonics cluster of fiber-optic technologies.

The company's QRM strategy policy for 2017-2020 has been adopted. The essence of the policy is to achieve the following strategic goal: to reduce the time required to complete customer orders and increase competitive advantage by creating a QRM methodological base and a flexible organizational structure in PJSC PNPPK.

Main policy principles [22]:

- strategic reference point. Creating a strategic reference point in the company-reducing the order lead time;
- comprehensive approach. Applying the principles of the QRM strategy throughout the company: in all production and office divisions, at every workplace;
- improvement. Optimize existing company processes with an emphasis on reducing lead time.
- competence. Education in production and office collectives of multifunctional employees who have the ability to perform related professions and functions, mutual training and mutual assistance in work;
- motivation. Implementation of a comprehensive motivation of the company's employees, which takes into account, along with the main indicators, the guideline for a permanent reduction in order completion time;
- organizational structure. Formation of cellular structural units in the production and office environment aimed at reducing the critical path of production and functioning on the basis of the principles of self-organization, interchangeability and orientation to the overall result;
- planning. Strategic planning of resource utilization and backup capacity, ensuring rapid response to changes;
- management of the relationship. Translation of the principles of the QRM strategy when interacting with partners and contractors of the company.

An unique QRM system is also being implemented at the Public joint-stock company «Chelyabinsk forging and press plant». PJSC «Chelyabinsk forging and press plant» is one of the leading enterprises in the machine-building industry. The main goal of implementing this organizational technology is to respond more quickly and adequately to market changes, and to effectively switch from fulfilling serial orders to producing short batches designed for specific needs of consumers. In the production of dies and molds, so-called cells are created, "sharpened" for the production of certain products. Since November, the cell for the production of round inserts of forming dies and ejectors for forge No. 2 has been operating in full operation. In the near future, there will be six more cells. They will work on the principle of "one window" – when all operations are performed by one team, in one area. The effect of

reorganization is obvious. The team speaks "the same language", people solve problems without delay, do everything possible to reduce the number of operations by combining or eliminate unnecessary ones that do not provide an increase in value for the client.

Already, the cycle time for the production of stamps in the shop has been reduced to 15 days. For comparison, a year ago, this figure was 45 days [23]. The goal set for production workers is to reach an average cycle of 7 days. All this, in the end, allows you to reduce the time to develop new products, reduce inventory throughout the production chain. Working within the production cell creates conditions for increasing the level of competence of everyone involved in the process. In particular, machine operators successfully master related professions: toolmaker, slinger, turner, milling machine operator.

According to the head of production of stamps and molds M. Davydkin: "The implementation of the QRM concept is not limited to production halls. Large time losses in the overall cycle from order to delivery of finished products fall on office structures – "efficient producers" of overhead costs. Therefore, special emphasis will also be placed on optimizing office procedures in the near future." Thanks to the acquired flexibility, the output of new products has increased. If in 2015, about 70 new products were developed in the blacksmithing industry, in 2016-200 [23]. These new products helped to cover the decline in the market: the plant makes parts for all mechanical engineering, from the automotive industry to energy engineering, and there in many segments last year, the decline continued. So, the plant has become more responsive to the needs of the market, and as a result, its share has grown. The plant as a whole increased revenue in 2016 by 35%, and production where stamps are used — by 50%. The percentage of deliveries of the plant "just in time" has increased. All the components in the end add up to one big advantage – the plant produces high-quality products in the shortest possible time.

4. Conclusion

In conditions of extremely high competition, which characterizes the current state of business, companies that are able to respond quickly to changes in the external environment, will survive. Many companies strive to implement modern manufacturing paradigms, such as quick response manufacturing (QRM), which is a corporate strategy to reduce time of execution of the order at the industrial enterprise. Thus, the following conclusions can be drawn:

1) the fourth industrial revolution initiates a change in the strategic guidelines of industrial enterprises. Transformation of operational models into new digital models entails an identification of new effective models for the industrial development in new reality. QRM is one of them, which main idea is to reduce the order lead time due to all the company's operations, both internal and external;

2) at this critical time for the Russian industry, the ability of business organizations to quickly respond to customer requests, develop new products in the shortest possible time, and at the same time ensure high quality and reduce costs is of particular importance. In achieving these goals, the unique QRM toolkit, which has been adopted by an increasing number of manufacturing companies in the United States and Western Europe over the past decade, can be very useful. In Russia QRM is an extremely new and unfamiliar management paradigm;

3) successful existing initial examples (PJSC «Perm scientific and production instrument-making company», PJSC «Chelyabinsk forging and press plant») of QRM implementation indicate the possibility of improving the state of the Russian industrial sector of the economy and, in general, the prospects of this concept in Russia.

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