A New Product Release Algorithm Helps a Firm Enter into New Markets and Boost Its Competitiveness

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Abstract. The article describes a topical matter that is the development of approaches to boosting high technology enterprises’ effectiveness while retaining existing and creating new competitive advantages. A key approach, the authors believe, is launching the production of new types of items using existing technological solutions. An algorithm has been developed to evaluate a company’s capability of creating new types of products; the algorithm is based on an economic–mathematical model, which calculates using advanced optimization methods. The research results can be used to create methods relating to diversification and import substitution programs.

1. Introduction

One of the most important tasks faced by companies is maintaining existing and creating new competitive advantages [1, 2]. This necessitates the use of algorithms that could help outline a new process management plan to create new products and sell them in existing and prospective markets. Successful implementation of such a plan can boost a firm’s competitiveness and financial status.

Any plan to create a new product should rely on the scope of a firm’s existing production capabilities, as well as its operating rate and use of human resources. In today’s market environment, any company should maintain a sufficiently high competitiveness [3]. There are a number of methods that can help a business solve this problem. One of them arises from having to update the assortment of products being released using existing process solutions. The second method of improving a company’s competitive abilities is launching the production of new types of goods [4]. Not infrequently, industrial modernization implies a necessity to properly update and upgrade the highly priced equipment. Not all businesses (especially in Russia) are ready to sustain modernization and/or product development costs due to high costs and high cost recovery risks. Definitely, prior to deciding to create a new product, a firm should carry out an in-depth research of its potential and costs required for launching a new production line, as well as assess its future competitiveness and financial capabilities.

There are traditional production process management methods [5, 6, 7]. One of them implies designing innovative products, which are far from current ones in terms of designation. This approach focuses on launching a new line inside a company and reaching high marketability indicators. In most
cases, this requires a long-term financial backup. Another approach implies release of new products at existing enterprises. This is the approach to making new products, which this paper describes in detail. Next, it describes stages of the new product release algorithm.

2. Methods
Management of a firm’s competitiveness is the process of creating an environment, which would ensure its stable economic growth resulting from the production of goods and services with new consumer properties, and their distribution in current and future markets. Also, management of competitiveness mitigates the risk of crises. This management process includes the following integral elements:

- Assessment of a company’s industrial potential and identifying prerequisites for creating new types of products.
- Defining types of products to be released with consideration of the need for financial investment in process modernization.
- Assessment of sales opportunities for new products

The economic effectiveness of the new product release process should be evaluated through studying the dynamics of financial and economic results (operational profit, marketability of corporate tools, etc.) The effectiveness of risk management process is assessed based on indicators that reflect possible financial losses.

The original data used by the algorithm is presented by qualitative characteristics of a company’s strong and weak points (use of innovations, personnel’s education, age of productive assets, potential for claiming new line advertising levels, etc.), data on companies’ industrial potential (capacity utilization, staffing level), assessment of costs resulting from preparing for the production of new types of goods, financial and economic indicators to be used for assessment of the economic effect.

3. Results
The main stages of economic analysis, following which can help to implement an optimal new product release management strategy, include the following steps.

First, high quality should be used to assess a company’s competitiveness. In cases whereby the company follows several directions, each one can be analyzed separately.

SWOT analysis [11] systemically describes strong and weak points of an enterprise (an integrated structure), reveals opportunities for targeting weak points and identifies factors that pose danger for strong points.

Also, it is advisable to reveal and describe the enterprise’s key functions [12]. The analysis of the company’s functional profile lies in revealing its ability to reach new advertising levels. This reflects the company’s potential (scope of functions) to develop and implement advanced technologies for new spheres.

The next stage implies analysis of the environment, in which the company operates, and it is aimed at finding effective venues for new types of products. Thus, it is necessary to research the needs of the economy to define optimal venues for new products.

It is necessary to identify the most suitable sales areas. Also, it is possible to define predicted sales values and the possibility of a dramatic decline in demand for the product (e. g. due to external risk factors).

The next stage is assessment of the company’s production assets. To calculate the potential production volume, an economic-mathematical model can be used. First, working time fund limits for equipment should be calculated using the formula:

\[
S_i = d \cdot t \cdot k \cdot n
\]

where \(d\) is the number of workdays within the period in question, \(t\) is the work pattern (shift length with the number of shifts), \(k\) is the factor of adjustment and maintenance of equipment, \(n\) is the number of equipment units, \(S_i\) is the effective working fund for equipment of type \(i\).
Staffs should qualify to operate respective types of equipment. Planned effective working time fund reflects the employee’s total number of work hours over the period under review. The planned effective fund can be compensated for through the use of the correction factor, which reflects temporal losses resulting from the employee’s activity. As a result, the $T_i$ value stands for the planned working time fund with account for losses. Based on equipment and personnel limits, the effective time fund value for a production operation is defined according to the formula:

$$\hat{b}_i = \min(S_i, T_i)$$

(2)

Also, it is necessary to define actual machine and personnel workload $\hat{b}_i$ within an existing enterprise for each production operation. Thus, the idle time fund value for each production operation is expressed in the differential:

$$b_i = \hat{b}_i - \hat{b}_i$$

(3)

The original data for the model, which uses free production assets in an optimal way, includes the following values: $a$ is the column vector expressing the total labor output for the manufacturing of items; $b$ is the column vector reflecting effective working time fund for each production operation; $a_{ij}$ (where $i$ is the type of equipment and $j$ is the type of item produced) is the duration of each production operation set values; $a_{ij}$ values make up a matrix for $A$, and the number of lines in it reflects the number of equipment types; the number of columns reflects the number of product types.

To calculate the exact labor output for each type of products with a division into all necessary production operations, supplementary research is often required, and it can be lengthy. Therefore, for the model, which ensures optimal use of productive assets, interval estimates of labor output can be used conveniently, and so can interval estimates of effective working time funds. Thus, these parameters can take on any value from within a set interval. In this case, a solution to a span task can be found as an adequate deterministic decision for the entire set of linear programing problems generated by different combinations of the model’s parameters borrowed from within respective intervals.

Thus, the linear programing problem for the production asset optimization is expressed in the following way:

$$a'Q \rightarrow \max,$$

$$\begin{align*}
AQ &= b, \\
|A - A| &\leq \Delta A, |b - b| \leq \Delta b, |a - a| \leq \Delta a, Q \in \mathbb{R}.
\end{align*}$$

(4)

$A_i$, $\Delta A$, $b_i$, $\Delta b$, $a_{ij}$, $\Delta a$ are set values, and they determine intervals, within which the model’s parameters can be found.

The result of calculation based on the model should be a maximal output $Q_i, Q_j, ..., Q_n$ providing that the working time funds are used to the full within the given period. Also, the optimization can be supplemented by limiting the output for some types of products.

If there are several production plans for new types of products, the relevance of the choice of the planned assortment can be estimated based on the standard operating surplus, which is calculated as follows:

$$EBIT = \sum_{i=1}^{N} (p_i - v_i)Q_i - FC,$$

(5)

where $N$ is the number of types of products being released, $p_i$ is the price of an item of type $i$, $v_i$ are variable costs per item $i$, $FC$ are the constant production costs.

Finally, the effectiveness of the chosen new item production scheme must be assessed. First, the dynamics of a company’s operating surplus should be used as an evaluation criterion for the economic effect of the competitiveness management process.

Another criterion, which is mandatory for deciding upon producing new types of goods according to a certain plan, is the cost of preparing an existing enterprise for producing these types of goods.
Finally, economy experts use the marketability of corporate ROE tools to evaluate the effectiveness of such enterprises, which is a ratio of the business’s net surplus to the size of its own funds (Table 1). Economics literature on diversification [10] presents a detailed analysis of major diversified companies (General Electric, Westfarmers, ITC, etc.), and a pronounced relationship between successful diversification and return on equity. To calculate return on equity over a given period (for example, a year), it is recommended to use end-of-the-year net surplus and start-of-the-year corporate fund size. The literature source offers a qualitative diversification process evaluation scale, which is based on ROE indicators. Based on long-term statistics, expected ROE values have been calculated, which should attribute the company to a certain category.

### Table 1. Marketability levels based on ROE.

| Symbol | Meaning                          | ROE, % |
|--------|----------------------------------|--------|
| A+     | Maximal effectiveness            | 20.1   |
| A-     | High effectiveness               | 15.2   |
| A      | Above-average effectiveness      | 14     |
| B+     | Average effectiveness            | 12.1   |
| B      | Below-average effectiveness      | 9.6    |
| B-     | Low effectiveness                | 5.9    |
| C      | Ineffective diversification      | <0     |

Based on the complex study of the evaluation criteria, it is necessary to draw a conclusion on the feasibility of the scenario as to the production of new types of goods, as well as on the possibility of increasing the company’s and its business units’ competitiveness.

### 4. Conclusions and suggestion

This paper presents a dynamic marketability management model to be applied to a company and its business units, and it relies on new and demanded products. The results of the qualitative analysis of potential new product venues make it possible to outline an optimal production pattern, which could strengthen the company’s competitive advantages and increase its operating surplus. Meanwhile, the production of new goods can be viewed as a risk management strategy. In this context, optimal management consists in reducing the share of constant costs, which is part of operating surplus.

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Acknowledgments

This reported study was funded by RFBR, project number 19-010-00981 a “Methodology of development and practical use of software and analytical services for solving specific economic problems”.