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Original Contribution

ABOUT THE GUARANTEED INTRADEPARTMENTAL RESERVE IN THE CONTEXT OF INTRALOGISTICS

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ABSTRACT: *In general, the current paper implies the conclusion that the determination of the impact of randomly occurring pauses in the work of the production unit with continuous technological process depends on the created intradepartmental guaranteed reserve.*

KEY WORDS: *Intralogistics, guaranteed intradepartmental reserve, technological operation, technological process.*

The subject of the discussed article is the unfinished production with its component technological reserve of the industrial production plant.

The topic of the article is the guaranteed intradepartmental reserve in the department with continuous technological process and its management.

The purpose of the presented scenarios is to determine the impact of randomly occurring pauses in the work of the production unit.

From an engineering point of view, and in view of the technological component of the microeconomic conditions of the resulting process management, intralogistics includes a sequentially interacting set of material flows and processes in an industrial production enterprise. It is the technological characteristic that is a primary logistic function. In its essence, it gives the specific ways of interrelation between raw materials, unfinished production and finished products with machines and mechanisms, regulating their behavior [18, p. 45, p. 46].

The unfinished production, as a commodity-material stock, being an expense whole, is identified with the semi-finished products that are in production. It is precisely this material flow of semi-finished products in the industrial production plant that is essential for the correct transition of the production process, preserving the rhythmicity and continuity of continuous production. Here we have to mention the role of the so-called technological

reserve, which can be intradepartmental and inter-departamental. On the other hand, the intradepartmental reserve, including all types of semi-finished products found in the respective production unit, contains the technological intradepartmental reserve, the transport intradepartmental reserve, the intradepartmental guaranteed reserve and the turnover intradepartmental reserve [6, p. 95; 14, p. 57 (Note 1)].

Also known as supplementary, the guaranteed intradepartmental reserve balances the impact of unexpectedly occurring pauses in the work of the production unit with continuous technological process. In relation to this, it should be mentioned that the technological process is divided into separate, interconnected technological operations carried out in a logical sequence. This series is reflected in the so-called technological route, representing a complete inventory of chain execution of technological operations. Each of them is a completed component of the technological process for processing a semi-finished product and in the preparation phase. It is performed by an independent unchangeable implementer, who is at a fixed constant workplace, over a given workpiece with continuous technological process. The change of a separate feature implies the cessation of the technological operation and the beginning of a new one [7, p. 148, p. 149; 17, p. 7, p. 8].

The above mentioned requires the presentation in general terms of the composition of the technological operation:

a) set-up – this is an element of the technological operation carried out solely by fixing the workpiece to be processed;

b) position – it is any of the positions of the workpiece with regard to the machine's executive parts, which are distinguished by their specific features, when it is only fixed on top;

c) transition – it is a component of the technological operation performed on a single surface with a single tool and in an operational order which is constant or logically variable;

d) pass – also called stroke, it is a component of a pass performed in a single removal of a layer of the material of the surface to be processed, in a single change of tool location and in a constant or logically varying cutting order;

e) grip – it is a behavior of uniquely performed and fully executed action of the worker, necessary for carrying out a certain technological operation or its preparation [5, p. 12, p. 13 – 14, p. 19; 7, p. 149; 17, p. 8, p. 9].

The mentioned continuity of the technological process of the production unit indicates that any technological operation requires that its execution proceeds immediately after the fixed moment of completion of the one preceding it, eliminating a delay. Thus, the continuity of the technological process is present, as is the movement of the semi-finished products in the preparation phase from one workstation to another, according to the organisation

of the production process in the industrial production plant. The result of the efforts aimed at determining the impact of randomly occurring interruptions in the operation of the production unit with continuous technological process should be the formation of the so-called guaranteed intradepartmental reserve. It is arranged exclusively after the workplaces which have the highest degree of unreliability, and its recommended number is *2%÷5%* of the production of one shift, or *4%÷5%* of the task for one shift. It is essential that the availability of each type of intradepartmental reserve should be no less than the level of the guaranteed intradepartmental reserve. In relation to this, its detailing is carried out by means of the ratio:

$$Z_{1_j} = \frac{T_{1_j}}{\frac{t_{1_{(j+1)}}}{M_{(j+1)}}} . \omega_1 \quad (1)$$

where:

Z_{1_j} – guaranteed intradepartmental reserve after the workplace performing the *j*-th technological operation *[pcs]*;

T_{1_j} – duration of random time losses of the workplace performing the *j*-th technological operation *[min.]*, i.e.:

$$T_{1_j} = T_{a_j} + T_{b_j} . \varphi_j + d_j . t_{1_j} \quad (2)$$

where:

T_{a_j} – the probable duration of the random termination *[min]*;

T_{b_j} – the probable duration of the period with reduced productivity *[min]*;

φ_j – the probable rate of productivity decrease of the workstation performing the *j*-th technological operation;

d_j – the probable out-of-norm rejects produced during the reduced productivity period at the workstation performing the *j*-th process operation *[pcs]*;

t_{1_j} – the operating time for the *j*-th process operation *[min]*;

$t_{1_{(j+1)}}$ – the operating time for the *(j+1)*-th process operation *[min]*;

$M_{(j+1)}$ – the number of workstations performing the *(j+1)*-th process operation and fed from the previous workstation performing the *j*-th process operation;

ω_1 – safety factor, describing the features of random time losses *[ω_1=1,1÷1,3]* [4, p. 70 – 71; 8, p. 21; 9, p. 29; 10, p. 92; 12, p. 121; 13, pp. 212 – 213; 15, p. 390].

It is a priority that the technological process happens optimally, with appropriate management of the reserve, which in this case is the intradepartmental reserve. Optimisation implies a defined objective, constraints and acceptable impacts. It is based on a mathematical representation, i.e. modelling of a certain technological process, with the desired possibility of its implementation being specified by the so-called objective function, for which the sources of influence on it are factors in case their conditioning is not mutual. There are also optimization conditions that are imposed. They are specified with constraint functions. The elementary representation of the objective function (Z_1), itself, bounded by the factors $(x_1, x_2, \dots, x_n)$, together with the constraint conditions is the following [1, pp. 80 – 81; 2, pp. 16 – 17; 3, p. 82; 11, pp. 87 – 88 (Note *); 16, pp. 12 – 13]:

$$Z_1 = f(x_1, x_2, \dots, x_n) \tag{3}$$

$$x_{1_{min}} \leq x_1 \leq x_{1_{max}} \tag{4}$$

$$x_{2_{min}} \leq x_2 \leq x_{2_{max}} \tag{5}$$

……

$$x_{n_{min}} \leq x_n \leq x_{n_{max}}. \tag{6}$$

A varied selection of the mentioned target function is possible, i.e. the technological process to be carried out within the smallest possible monetary cost per unit of semi-finished product in the preparatory phase; the smallest possible consumption of energy resources, etc. In a significant number of situations, the successful realization of the target functions with particular features is counterbalanced, e.g., it is complicated to realize a maximum of high quality product at the minimum of cost at the same time. In relation to this, the so-called complex objective function can be formulated based on mutual concessions in a diametral environment [11, p. 88; 19, pp. 91 – 92].

The article suggests the conclusion that the determination of the impact of randomly occurring pauses in the operation of the production unit with continuous technological process depends on the established guaranteed intradepartmental reserve. It ensures increased reliability of production by using the appropriate resource. In order to resolve the complex issues, compromises are required and the decision is dependent on the priority when choosing the control parameters and controlled parameters.

References:

[1] Atanasov, B., Milkova, T. Quantitative methods in logistics. First edition. Varna, 2011, Publishing house "Science and Economics", University of Economics – Varna, Printing house of UE – Varna.

[2] Atanasov, B., Nikolaev, R., Milkova, T., Mihailov, D. Operations Research. Textbook. Varna, 2015, Publishing house "Science and Economics", University of Economics – Varna, Printed base of UE – Varna.

[3] Georgieva, M. Pedagogical concept "Smart education" and European educational practices. – Proceedings of the Scientific Conference "Knowledge, Science, Innovations, Technologies" (Veliko Tarnovo, 19 July 2024), Veliko Tarnovo, 2024, Publishing House "Institute for Knowledge, Science and Innovations", 74 – 96.

[4] Gigova, T. Exercise manual on production engineering (Engineering 1). Plovdiv, 2012, Publishing house "Imeon".

[5] Dikov, A. Technology of mechanical engineering. General course. Second edition. Sofia, 2006, Softtrade Publishing House.

[6] Dimitrov, I., Dimitrova, A. Economic logistics. Second supplemented and revised edition. Sofia, 2022, Publishing house "Avngard Prima".

[7] Dinev, P. Technological Practical. Part 1. Textbook for higher education institutions. Second revised and supplemented edition. Sofia, 2011, Publishing house "Novi znaniya".

[8] Kucheryavenko, S. (co-editor). Production management in Mechanical engineering. Methodical instructions for practical work on the subject "Production Management in Mechanical Engineering" for students of the IV course, studying in speciality 080200 "Management". Yurga, 2015, Publishing house of Yurga Technological Institute (branch) of Tomsk Polytechnic University.

[9] Lanin, V., Kostiukevich, A., Dostanko, A., Khmyl, A. Assembly processes. Training and methodical manual for practical classes in the disciplines "Design and technology of electronic systems", "Technology of RPS", "Technology of RPS", "Technology of medical electronics" for students of specialties 36-04-01 "Electronic-optical systems and technologies", 39-02-01 "Modeling and computer-aided design of RPS", 39-02-02 "Design and manufacture of RPS", 39-02-03 "Medical electronics". Minsk, 2008, BSUIR.

[10] Malyuk, V. Production management. Textbook for Academic Bachelor's Degree. 2nd edition, revised. Moscow, 2019, LLC Yurait.

[11] Maslarov, I., Shopov, Y. Industrial technologies. First edition. Sofia, 2010, Publishing house "Avangard Prima".

[12] Milkova, T. Models for optimal inventory management in the logistics system. Varna, 2023, Publishing house "Science and Economics", University of Economics – Varna, Printing house of UE – Varna.
[13] Milkova, T. Optimization of profitability in inventory management. – Mathematics as a fundamental and applied science, Proceedings of the International Scientific and Practical Conference, Dedicated to 45 years of the Department of Applied Mathematics, Varna, 2015, Publishing House "Science and Economics", University of Economics – Varna, Printing house of UE – Varna, 209 – 214.
[14] Milkova, T. Optimization of material flow distribution in logistics system. – Journal of the University of Economics - Varna, Issue 4, 2013, Varna, Science and Economics Publishing House, University of Economics – Varna, 57 – 70.
[15] Milkova, T. Peculiarities of inventory management systems under uneven consumption. – Modern logistics – business and education, Proceedings of the international scientific-practical conference on the occasion of the 10th anniversary of the establishment of the Department of Logistics at the University of Economics – Varna (19 – 20 October 2017), Varna, 2017, Publishing House "Science and Economics", University of Economics – Varna, Printing House of the University of Economics – Varna, 388 – 396.
[16] Milkova, T., Mihailov, D. Operations Research. Manual. Varna, 2016, Publishing house "Science and Economics", University of Economics – Varna, Printed base of UE – Varna.
[17] Mitev, I. Modern industrial technologies. Part I. Conventional forming methods. First edition. Gabrovo, 2016, Ex-Press Publishing House.
[18] Nosko, A., Rakhilin, K. Intralogistics – what is it? – Journal of Logistics, №8, 2016, Moscow, Agency Market Guide, 44 – 47.
[19] Tsonev, S., Vitlyemov, V., Koev, P. Methods for optimization. (Library for the doctoral student). Second edition. Ruse, 2004, Academic publishing house "Rousse University", Printing house "Ivona" Ltd – Ruse.