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EXPERT APPROACH FOR ANALYSING A LOGISTICS CONTROL SYSTEM AND QUALITY MANAGEMENT IN THE CONDITIONS OF SMALL AND MEDIUM SERIAL PRODUCTION

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ABSTRACT: *The organization and management of technological production is a complex and very imaginative process which combines economic, technical, organizational and highly efficient solutions. For this purpose, concepts are developed in order to define the logistical goals related to the purchase, production, distribution and disposal of the batch production. As a whole, it formulates logistics systems directly influencing organizational decisions. The management and control of modern logistics systems is based on many hierarchically distributed, organizational levels.[9] On these grounds, the set logistic goals must solve the problems that have to do with the organization and management of production processes.*

KEY WORDS: *production, logistics, distribution, logistics system, management*

The high quality of the products designed in the conditions of single and small series production -e.g. cars, metal-cutting machines and equipment, electrical appliances, etc.- requires the parts to be manufactured on specialized machines, while the assembly of the units and products must be done by the method of complete interchangeability. . This is achieved after a thorough technical and economical research and sound technical decision making, i.e. automated equipment for metalworking, tooling and specialized means for control must be used. A number of conditions are complemented with research of the competitive production of the same or similar products when new production is initiated. Similarities must comply with the Patents and Utility Registration Act. Waste materials must be minimized during design, which is one of the most important factors for achieving a competitive cost to the product. [6] When modern traditional methods are applied for the technological processes created- which are regulated by the existing standards- not all the technological factors influencing the quality of the assembled parts can be foreseen. At the stage of technological control of the design paperwork, the technological analysis of the products is incomplete due to poor logistics.

Plant engineers can develop and design only one technology variant because of the limited design time.

This leads to low quality of technological solutions, which on its turn requires the final processing of processability to be carried out during the last stage - when the product is assimilated and completed in the industrial unit. The purpose of the research is to manage the accuracy in the design and manufacture of mechanical engineering products, through the construction of intelligent production logistics systems based on single and small series production guaranteeing the quality of the product. The adjustment of such systems includes purposefully organized changes for the current business processes in the system in accordance with the conditions of the external business environment. [11]

A good example is the production of LED luminaires. As a concept, using this type of lighting should be significantly more cost effective for the end user due to the significantly lower power consumption while maintaining the same illumination. Unfortunately, in the pursuit of economic benefits, light fixtures with a simplified construction are designed, leading to frequent damage and short life of such appliances. As a result, the end user is harmed, although using more economical lighting appliances, due to the fact that he has to replace the damaged ones more often and at the same time more expensive ones. Studies and experiments by various authors show that, due to modifications to the structure, which significantly increase the cost and complexity of production, a significant increase in the efficiency and confidence in the end product can be achieved - in this case, LED lighting. In addition to households, the results and conclusions of rigorous research and experimentation to modify LED fixtures can be applied to significantly more powerful and more expensive lighting fixtures based on LED projectors for illumination of industrial premises or protected areas, where the economic impact of extending the life cycle of these lighting fixtures would be much more tangible [12,13, 14]. Obviously, this is a good estimate and balance of the losses and benefits of complicating the design and production process, and as a result, the price and placement of the final product.

Each alteration in the design and technological documentation at some point leads to additional losses related to the adjustment and, in many cases, to the design of new tooling. This causes additional time losses, which are significantly higher than those for the refinement of the technology at the design stage. Ensuring accuracy for the design and manufacturing of mechanical engineering products and the cost-effectiveness of manufacturing the abovementioned can be at the expense of improving current technologies in the preparation of production and technological control of the drafts of the products. In the examined technological processes, the alternatives are the following:

1. Maintaining the application of technological processes and the use of semi-finished products, prefabricated units and aggregates of the design for the needs of the designed machine, the level of classical implementation includes: the use of materials and raw materials that meet previously accepted quality indicators and design solutions; setting the parameters of the production program based on analyzes that meet the logistical requirements; structure of the production process, innovative technologies for production and minimization of volume of parts and units; parameters related to the volume and patency of production chains, structuring of elements and logistics in the management system; adjusting production chains to market requirements (redundancy, concept of resources, expansion of production, change of technological processes and logistics systems); creation of logistics networks related to production cooperation, volumes of delivered modules and systems as well as their integration in the final processes; modular structuring of logistics units, subdivisions, lines, elements, sections, fractals and their integration within the internal and external logistics processes; structuring a storage system, deploying flow-oriented equipment, minimizing the number of stages, and applying technologically flexible equipment: clear and accurate formulation of selected indicators that ensure all members of the expert group understand them consistently, provided they operate completely independently from one another; mutual independence and a minimum criteria that can evaluate alternatives with sufficient research precision; availability of various technical equipment, unified for the needs of the respective production for the purpose of fast replacement depending on the type of manufactured products; storage of a large amounts of structural and technological paperwork, including information and software, as well as sufficient storage of materials, raw materials, semi-finished products which are required for a particular type of technical production. This means that only the predefined parameters of the desired logistic concept guarantee the realization of the production program [2, 5].

The chosen criteria allow a comprehensive assessment of all the essential aspects of the alternatives, which meet the following requirements:

Table 1: Criteria for alternative assessment

Criterion No	Description of the criterion	Designotion	Content of the criterion
1	Scale Application	Q	Production technology
2	Technological capabilities	T	Opportunity to develop promising technology to reduce operations
3	Impact on the technological processes performed so far	B	To raise the level of technical and technological production possibilities
4	Organizational and technological prerequisites.	C	Opportunities for proper organization in the execution of the processes.
5	Ability to universalize used machines	M	Use of innovations included during the period considered
6	Commitment of all participants to the end results	N	Likelihood of achieving quality indicators as required
7	Organization of test methods for articles	R	Possibility for reconstruction and use of already acquired units and units
8	Cost-effectiveness for streamlining processes	S	Possibility of further significant interest in the processes
9	Determining the probability of technological and technical success.	K	Competitiveness in entering the external market
10	Staffing and information assurance of the production process	L	Qualified specialists to improve the technology.

The degree of detail also depends on the available information flows embedded in the technological production of the manufacturing process in terms of logistics. The established logistical parameters affect the flows directly (material, personnel, information, technological, and waste disposal) along the entire production chain- from production to marketing- including their changing state in terms of technological features of the equipment and aggregates. It also affects the management and organizational structure.

There is a significant increase in market demand when the product conforms to current standards and is compatible with mass-market equipment. Mass production leads to a much lower cost of production compared to single manufacturing [7]. In practice, a mixed type scale is used to evaluate the criteria in Table 1. It is a continuous scale that is subdivided. The characteristic features of the criterion evaluated have been formulated for each of these sundivisions [1, 3, 4,]. Consumption problems can be manifested by differences between the requirements of consumers in terms of certain technical and operational characteristics of a product. That product cannot be refined in the desired direction by using current technological processes. The analysis of the available information on the product evaluation criteria and models for structuring the multiple activities involved in the innovation process within a company can be described by the following phases: monitoring and researching the internal and external environment of the company and the methodology of the logistics system ; selecting an innovation strategy that the firm can respond to; providing resources for the initial development of the innovative alternative (idea); final development and implementation of new advanced production technologies; training of management and executive personnel in the field of innovation and logistics [4].

One of the modern concepts, related to the management of the technological process in the company, is the concept of strategic architecture. Some authors argue that the implementation of the company's innovation strategy, which is aimed at utilizing the company's core competencies and transforming them into competitive advantages, can be accomplished by setting up a new corporate strategic architecture. It has been assumed that strategic architecture is conveyed by establishing relations between the customer's functional requirements, potential technologies and core competencies of the company. It also consists of the following basic elements: knowledge of the organization, stimulation of innovation and experiments, constructive competition, empowerment, optimal potential for value creation, corporate sustainability, strategic transformation. In the future, organizations that spread knowledge and train will prevail. In reality, the improvised discussions are common, thus evoking desire for work. As a phenomenon which is difficult to manage, they do not have a significant impact on the content aspect of training. A discussion with the manager in the course of planned seminars is more appropriate [8]. Innovation will increasingly penetrate the organizational culture of companies, and experimentation will be stimulated in various ways. An atmosphere of constructive competition will be formed. It will include a critical review of already established and accepted assumptions. Companies, based on their core competencies and sustainable competitive advantages, strive to ensure their resilience and continue to exist in an environment characterized by increasing turbulence [5, p.9]. The most competent specialists have been included in the expert group.

The most accurate estimates should be expected from them. The procedure for forming the expert group is as follows: drawing up a list of questions and criteria on the grounds of which the expert opinion should be obtained; drawing up a list of potential experts; sending a list to each of the experts and asking them to indicate which questions they can answer competently in the assessment form; the expert group shall be constituted so that at least one expert can be assessed on each question (references point out that the number of experts is considered to be at least 15) [4, 5].

After obtaining and dividing the proposed technological solutions for the optimization of the technological processes in the conditions of drought and changing climate, the results are compiled in an expert ranking table. The resulting primary ranking matrix of "preferences" will be incomplete based on the assumption that some of the included experts will not be able to evaluate the proposed technological and technical solutions from the totality. A total division based on the sum of the rankings gives unrealistic results. Gordon and Hayward's method was used to overcome the difficulties resulting from the incomplete ranking. The following symbolic symbols have been introduced for this purpose:

(1) $$R_{cp.j} = \frac{\sum\limits_{n-1}^{n}\sum x_{ij}}{\sum m_j},$$

where: x_{ij} – the rank that the i-th expert has assigned to the j-th technological solution; n - the number of technological solutions evaluated; m - the total number of experts involved; mji - the total number of experts who evaluated the j technological solution.

Determining the average rank of each of the technological solutions, $R_{cp.j}$. Determining the average of all rank estimates $S_{cp.d}$

(2) $$S_{cp.d}^2 = \frac{\sum\sum x_{ij}^2 - R_{cp.\sum\sum x_{ij}}}{\sum m_j - n}$$

Determination of dispersion $S_{cp.d}^2$ of average rank variance for all technological solutions:

(3) $$S_{cp.p}^2 = \frac{\sum\limits_{j-1}^{n}\left[R_{cp.j\sum x_{ij}}\right] - R_{cp\sum\sum xij}}{n-1}$$

Defining the average value N for technological solutions:

(4) $$N = \frac{\left(\sum m_j\right)^2 - \sum m_j^2}{n-1\sum m_j}$$

Determining average reliability y for single ranking:

(5) $$y = \frac{S_{cp.d}^2 - S_{cp.p}^2}{S_{cp.p}^2 + (N-1)S_{cp.p}^2}$$

Determining the reliability rating y_i of each technological solution:

(6) $$y_i = \frac{m_i.y}{1+(m_i-1)y}$$

Determining the actual rank rating a_j of each technology solution

(7) $$a_i = R_{cp}(1-y_i) + y_i.R_{cp.j}$$

In the case of unrelated ranks, the accuracy factor W is determined by the formula:

(8) $$W = \frac{12M^2}{m^2\left(m^2-1\right)-m\sum_{j=1}^{n}T_j}$$

where: n - the number of technological solutions evaluated;

m - the total number of experts involved; M - the accordance of the opinion of the experts;

In the case of full accordance of the expert opinion, the sum of M2 has a maximum.

(9) $$M^2 = \frac{1}{12m^2\left(n^3-n\right)}$$

(10) $$T_j = \sum_{j=1}^{n}\left(t_{i.j}^3 - t_{i.j}\right)$$

where t_i is the number of repetitions for each i-th rank in the j-th order.

The accuracy coefficient assumes values in the range $0 < W < 1$. When W = 0 there is complete discord in the experts' opinion, and when W = 1 there is complete accord of their opinion. The significance of the coefficient of concordance is checked by $\chi 2$, since the number of factors is $n > 7$. ($n = 11$) $\chi 2 = m\ (n - 1)\ W$, for the true null hypothesis No: W = 0 and the quantity $\lambda 2$ has a $\lambda 2$- distribution with degrees of freedom $k = n - 1$. When $\chi 2 > \chi 2\alpha$, k, the hypothesis Ho is rejected and the coefficient of accuracy is significant. Maintaining a variety of finished products requires the manufacturing subsystem to maintain its effectiveness, regardless the structural and technological changes that may occur in production during the process of customization (when the customer intervenes in the process of adding value through the so-called "Customer Order Contact Point". An alternative is to organize production activities on the grounds of virtual-cellular production systems.

The variety of manufactured products is determined by the ability to implement the relevant technological processes with the available automated technological modules [2]. In order to support the organization process and at the same time reducing the diversity of technological operations/processes caused by the structural and technological features of the manufactured products, there are three main aspects in the implementation of the processes: - modularity; - multi variety; - availability of narrowness in production.

The experiments that were carried out compare the eleven technological operations for assembling the machine. The technological control card and the calculated provisional data are recognized, the reason to take over is widely accepted and regular based on expert opinion.

and seeking management solutions require a study of the ongoing processes. [10]The analysis of the methods for calculating the magnitudes of the assumptions for the operating dimensions allows us to conclude that the assumptions defined analytically and tabularly, providing statistical accuracy of processing, are related only to the method of processing.

1. A summary scheme for the statistical control and management of technological processes and the determination of the total error in assembling the assembly line have been drawn up.

2. The results of the statistical analysis of technological processes make it possible to choose the optimal variant, ensuring a high quality of execution of the assembly operations of the individual units and units of the machine design.

Reference:

[1]. A. Lengerov, K. Lengerov, Adaptive system for stabilization of force deformations during machining of parts on CNC lathes. “Mechanical Engineering and Mechanical Engineering”, TU-Varna Publishing House, Issue no. 20, year IX, book. 1, 2014, pp. 84-87.

[2]. A. Lengerov, K. Lengerov, Statistical control of machining accuracy. “Mechanical Engineering and Mechanical Engineering”, TU-Varna Publishing House, Issue no. 23, Year X, Book. 1, 2015, pp. 36-41.

[3]. A. Lengerov, K. Lengerov, Computer control of precision of machined parts with CNC based on statistical control of 32 processes. “Mechanical Engineering and Mechanical Engineering”, TU-Varna Publishing House, Issue no. 23, Year X, Book. 1, 2015, pp. 42-45.

[4]. A. Lengerov, K. Lengerov, Scattering of the Qualitative Indicators of Cylindrical Surfaces Treated with Regulated Feed Modes. Science and Technology Conference "Transport Priorities - In My View", 10-11. 04. 2014, Plovdiv, 2014, pp. 14-17.

[5]. K. Lengerov, Automated sizing of nodal structures using compensators. VI National Scientific Conference for Students, Doctoral Students and Young Scientists, Plovdiv, 2015, pp. 133-138.

[6]. Tsankov Ts., Toncheva Y., Spasov S. A technology without waste for the production of a small trailer body. MATTEH 2018, Konstantin Preslavsky University of Shumen, 2018, ISSN 1314-3921.

[7]. Ts. Tsankov, A. Aleksandrova, M. Spasova. Useful model of a trailer for a walking tractor. MATTEH 2018, Konstantin Preslavsky University of Shumen, 2018, ISSN 1314-3921.

[8]. H. Hristov, Ts. Tsankov. Use of the e-Learning Shell system in the training in engineering disciplines. Scientific Conference of the Faculty of Technical Sciences, Shumen, 2009, ISSN 1311-834X.Christ's H., Tsankov Ts. Using the e-Learning Shell system in engineering training. Scientific Conference of the Faculty of Technical Sciences, Shumen, 2009, ISSN 1311-834X.

[9]. A. Bogdanov, P. Dyankov, Optimization models in logistic engineering, International scientific refereed online journal with impact factor, ISSN 2367-5721, Issue 37, Septebmer 2017

[10]. P. Dyankov, K. Davidov, Dynamic modeling of logistic processes in enterprises, ISSN 2367-5721, Issue 29, 2017

[11]. P. Dyankov, E. Zhechev, The Conception of Engineering Logistics in Production Companies, International Scientific Refereed Online Journal with Impact Factor, ISSN 2367-5721, Issue 38, 201

[12]. S. V. Stanchev, D. V. Dimitrov, Opportunities for using the Raspberry Pi in remotely operated aviation platforms. Proceedings of the Scientific Conference "Modern Trends in Aviation Training", "V. Levski ”- Faculty of Aviation, 2017, pp. 159-165, ISBN 978-954-713-110-1

[13]. G.V. Stanchev, Extending the life cycle of an LED lamp. Proceedings of the Annual International Scientific Conference, V.V. Levski ”- Faculty of Aviation, 2018, pp. 307-311, 2018, ISBN 978-954-713-114-9.

[14]. 14. D. V. Dimitrov, G.V. Stanchev, One way to modify LED lamps. Proceedings of the Annual International Scientific Conference, V.V. Levski ”- Faculty of Aviation, 2018, pp. 320-326, 2018, ISBN 978-954-713-114-9.