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EVALUATION OF THE IMPACT OF INTELLIGENT LOGISTICS ELEMENTS ON THE EFFICIENCY OF FUNCTIONING INTERNAL LOGISTICS PROCESSES

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Abstract: The article focuses on the evaluation of the impact of intelligent logistics elements on the overall efficiency of logistics processes. The main goal is to propose the concept of evaluation of changes in the logistics process, which will provide transparent results in the decision making process. Logistics activities represent a significant component of business costs, especially in the engineering and automotive industries, and it is therefore important to pay attention to both innovation and optimization. The implementation of intelligent elements in the field of logistics brings changes that will influence the entire logistics process. The article describes the sequence of steps as well as the methods used to evaluate the changes. Knowing the added value of planned changes will help prevent inappropriate investment and ensure the competitiveness of the company.

1 Introduction

To gain an added value of a new internal intelligent logistics process solution, it is important to take a comprehensive approach to the overall evaluation process. The use of intelligent elements such as autonomous storage devices, autonomous handling equipment or autonomous storage systems provides scope for streamlining logistics processes. The implementation of such logistic elements entails considerable financial costs, both in terms of technology, space and organization. The process of evaluating a new logistics process solution is shown in Figure 1, which describes basic steps in evaluating a new solution. In order to evaluate a new design or change the internal logistics process or several logistic processes, it is necessary to thoroughly map or analyse the initial state of internal logistics processes by utilizing process audit methods such as process map, process analysis, process time frames, etc. In analysing the current state of logistics processes, in addition to the process mapping of logistics processes, an analysis of the logistics elements used is also needed, which are made up of technical and technological elements such as various handling equipment used for material handling. After obtaining an image of the current state of the individual logistics processes and the detection of drawbacks or shortcomings, a second step is coming up, namely designing solutions to optimize logistics processes. When choosing new logistics elements, the company must be able to decide what should be their beneficial outcome. In such a case, when more criteria need to be considered in the decision-making process, it is necessary to use multi-criteria decision-making methods such as the AHP statistical method. If one or more logistics elements were selected, it is important to be able to calculate and then express their contribution to the logistics process. The step of evaluating the impact of the change in the logistics process brought about by the change of logistics elements comes to the fore. The logistics process efficiency assessment within the logistics process can be performed using, for example, a matrix model of logistic process evaluation or a mathematical model evaluating the logistical process change efficiency.

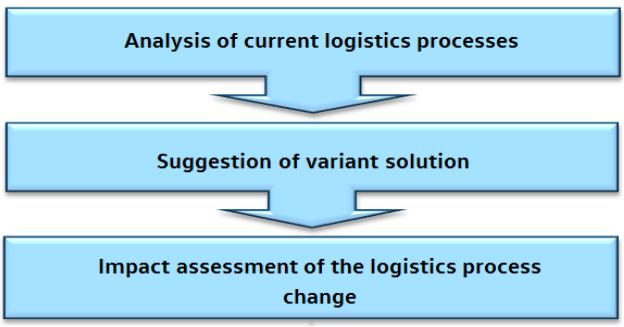

Figure 1 Intelligent Logistics Impact Assessment Concept

2 Analysis of current logistic processes and evaluation of logistic indicators

The first part of the evaluation concept is the analysis of current logistic processes. The evaluation of logistics indicators within integrated logistics chains is a prerequisite for achieving the set logistics goals [1]. Because properly designed logistical indicators and a functional assessment system have significant cognitive, assessment and motivational functions, and provide essential information relevant to logistical decision-making. Thus, exploiting the results from the analysis of the data obtained becomes an essential tool for determining both overall and sub-goals within the logistics chain. The integration of the logistics indicator evaluation system within the logistics processes represents the company's protective mechanism against the occurrence or increase of the problems of the existing logistics chains [2].

3 Solution variant proposal

The second part of the proposed evaluation concept is a proposal for a solution variant. All day-to-day activities that a person does, either consciously or subconsciously, are the result of some decision-making process. In the case of activities we do consciously, we try to get as much information as possible about the problem. We then use this information to achieve the best possible result. If more variations or alternatives are available and we cannot decide which of the variations we achieve the greatest benefit, it is necessary to divide the solution object into a clear structure and on the smallest possible elements. Thus, we need a tool that is able to work in parallel with multiple variations based on established criteria. If this problem is identified, we recommend that you determine in this section:

- the decision-making goal to remove the identified problem. Often the objective consists of several sub-goals that serve to reduce the proposed options,
- criteria that will be used to decide, in other words, the assessment aspect used to select the most appropriate option to solve the problem,
- the solution to the problem. These are alternatives that compared each other on the basis of established criteria to meet a set goal.

Such an instrument is, for example, the AHP method - an analytical hierarchical process that is widely used as a multi-criteria decision-making method [3]. AHP serves to break down the whole problem into hierarchies and then to compare the two elements by which we get the criteria weights and partial evaluations of alternatives. The overall evaluation is then obtained by simple synthesis [4]. The use of this method can be supported by software support using the Expert Choice program.

We recommend following the sequence of phases shown in the following figure no. 2 [5]:

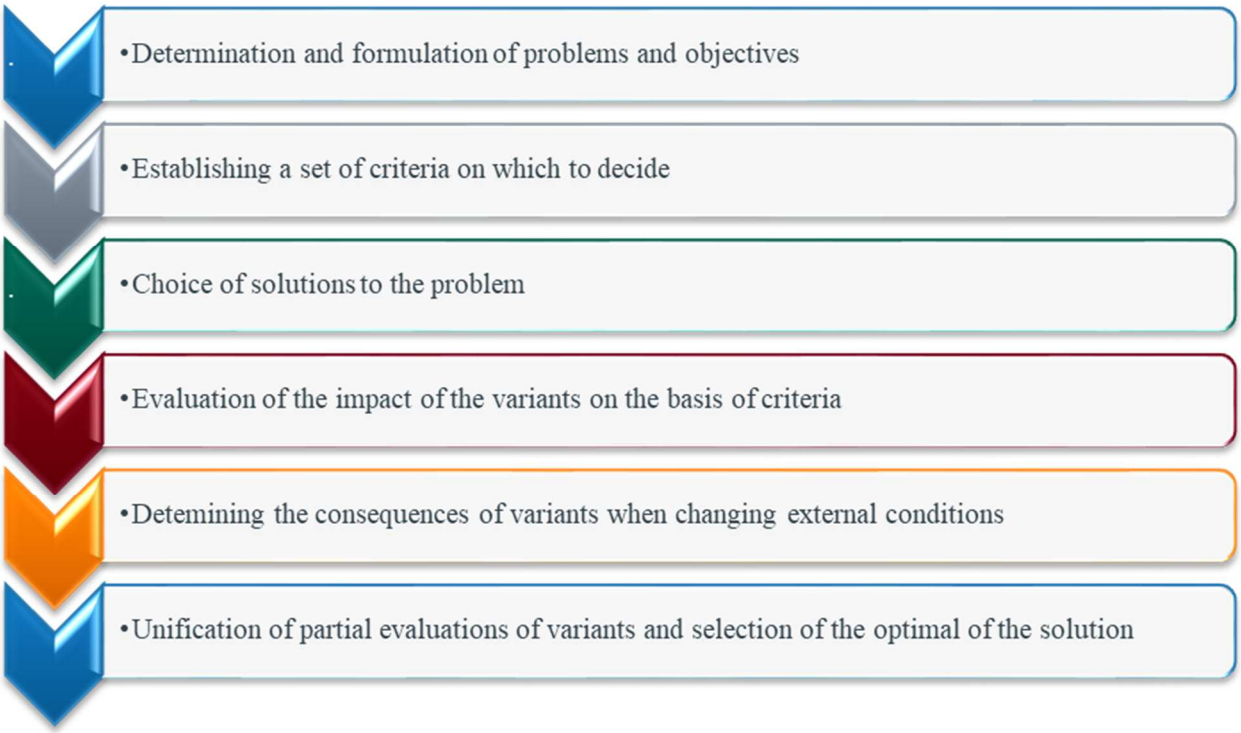

Figure 1 Stages of multi-criteria evaluation

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4 Impact assessment of logistical process change

The third and last part of the proposed concept is the assessment of the impact of the change in the logistics process. In this section there is an overall evaluation of the activities of the previous two parts of the proposal. Thus, if we have analysed the current state of business logistics processes, we have defined weaknesses or problems that need to be removed and we have selected options that are supposed to eliminate the defined problems, comes the last step and that is to evaluate the proposed changes to the logistics process. This process is cyclic, meaning that it is performed separately for each proposed variant and is made up of three basic steps as shown in Figure 3 below.

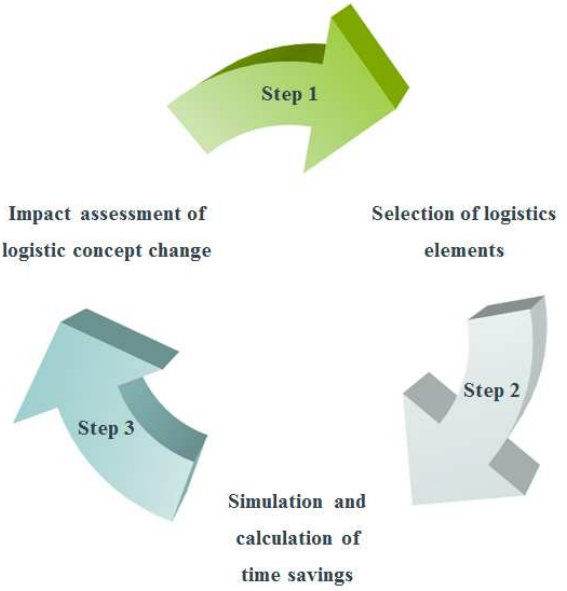

Figure 2 Procedure to evaluate the change of the logistics process

The first step in assessing the impact of the new internal logistics process is to select logistics elements. The choice of logistics elements consists of two parts. The first part consists of the logistics elements used in the company in the field of internal logistics for transport, handling and storage, and the second part consists of selected logistics elements, which were designed as elements with expected savings of, for example, the time of supply of material through the multi-criteria decision method. Savings in logistics processes are most often expressed in time, financial or cost units. Saving time in logistics processes means that an enterprise is able to meet customer needs in a shorter time, making it more flexible and capable of performing more logistical tasks per unit of time. Cost savings are one of the fundamental goals of any company, and since logistics as such accounts for a significant proportion of total business costs, it is important that logistical costs are of interest to any optimization of logistics processes.

The second step in the process of optimizing internal logistics processes after selecting suitable logistics elements is to include the step of simulation and calculation of the proposed solution. Various techniques are used in simulation and calculations, and it is important to know all the parameters of the individual elements of the proposed solution. We recommend performing individual simulations either through software support or through mathematical models or computational methods or statistical methods such as MTM. The MTM methodology, including its several blocks (MTM-1, MTM UAS, MTM Logistics), is a method that works with predefined times for each workflow that is used to design workflows, plan and analyse work done so that a trained worker can perform a given workflow long-term activity without excessive fatigue.

In the third step to express a concrete contribution, we propose to include an impact assessment of the change in the logistics concept. Assessing the impact of a change in the logistics process by proposing a new concept within the design of the implementation of new logistics elements serves to express the usefulness of the change to the previous solution. This process is cyclical and therefore is carried out whenever one or more logistics elements are changed in order to find the optimal solution to change the logistics process.

We recommend using several computational models such as a matrix model of logistics efficiency evaluation or a mathematical model of efficiency evaluation changes in the logistics process.

The use of a mathematical model to evaluate the efficiency of change in the logistics process is very simple compared to the matrix model and we recommend using it in every change within the logistics chain. The calculation is based on the following values [2]:

- Hp – represents the value that a customer is willing to pay for a given product or product service,
- Cp – determines the total running time of the given service or service. delivery of the product to the customer,
- Np – represents the total costs incurred to carry out the given activity.

The resulting logistics process change efficiency relationship (1) is as follows [2]:

$$\Delta Np / \Delta Cp < Zp / Cp \qquad (1)$$

- ΔNp – expresses the difference between the increased costs that a new variant brings with respect to the original logistics process.
- ΔCp – expresses the time difference between the execution of the given logistics activities between the original state and the state proposed by the change of logistic elements.

The mathematical model (2) also brings with it several conditions, such as the condition of the efficiency of the change in the activity of the logistics process, where the proposed change in logistic activity must show a greater profit generation rate (*Ip*) than the original process that we calculate by the following relationship [2]:

$$Ip = Zp / Cp \qquad (2)$$

The second important condition in assessing the efficiency of a change in the logistics process is that the proposed change in the logistics process must show a positive time saving by ΔCp.

5 Conclusion

The process of streamlining logistics processes itself is a constantly repeating cycle that provides companies with space for increasing their competitive advantage in rapidly changing market conditions and increase of demanding customer requirements. The aim is to point out the necessity of monitoring and evaluation of individual logistic indicators at every change of logistic process. Each logistics process consists of a number of logistics elements, each of which in a certain way contributes to the resulting efficiency. Assessing the impact of changes in the logistics process when changing its elements therefore plays a very important role in planning for changes in the logistics process. By following the logistics indicators, by identifying the right criteria for the new active logistics elements used in the change of the logistics process, the basic data is generated to evaluate the proposed changes in the logistics system and thus create an efficient logistics system. The result of the evaluation concept is the creation of a comprehensive procedure for the evaluation of the impact of intelligent logistics elements on the efficiency of internal logistics processes, from the analysis of the current state through the design of solution variants to comparison and subsequent evaluation of each variant with one another.

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