SIMULATION EXAMINATION OF LOGISTICS SYSTEMS IN THE AUTOMOTIVE INDUSTRY

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Abstract: The automotive enterprises apply simulation methods for the examination of the complex material flow systems. This paper introduces the more important possibilities of simulation examination and the obtainable possible advantages at different automotive logistics systems. Furthermore some research projects will be introduced in a nutshell. We will describe the defined aims and achieved results of the examinations.

Key words: simulation, automotive industry, logistics system

1. INTRODUCTION

The application of the simulation techniques was needed in the interest of the reduction of enterprises’ wastes regarding the complex logistics systems [1]. In the last decades the simulation modeling’s application was very useful at more logistics fields, such as production scheduling [2], development of the material flow processes [3], optimization of the disaster relief systems [4], planning of the logistics systems [5-6].

The Logistics Institute of the University of Miskolc has been using simulation modeling for more than ten years [7-8]. In the last few years we have taken part in the solution of numerous practical problems regarding the automotive industry. We can use simulation modeling in two cases, which are the improvement of the current logistics systems and the planning of new subsystems. In general we have to use simulation modeling if mathematical description of the logistics processes is very difficult or impossible and we would like to improve this logistics process.

Basically the aim of simulation modeling is the determination of the future working of a logistics system on the basis of defined operational processes, conditions and aims. We can increase the efficiency of the logistics processes with this device. The values stream mapping’s method is an important device of the lean philosophy which was created in the interest of decreasing logistics processes’ waste [9-10]. We can distinguish two versions of this method namely the static and the dynamic value stream mapping. The static value stream mapping can be used for only process improvement of a product line in order to guarantee transparent [11]. The application of this method is realized on the basis of the collected data on an A3 sheet of paper, thus we can examine simultaneously only one product line. The dynamic value stream mapping’s method is based on simulation modeling, which enables simultaneously examination of more product lines’ processes too [12].

In this paper we will introduce the simulation examination possibilities of the automotive logistics systems, steps of the simulation examination, some practical research projects and educational possibilities of this method.

2. SIMULATION INVESTIGATIONAL POSSIBILITIES

The automotive logistics processes have a very big complexity in a lot of cases, which is the consequence of the next causes:

- creation of the corresponding product variation for the customers [13],
- assurance of the JIT/JIS principled material catering,
- application of the multilevel assembly process,
- use of the flexible manufacturing systems.

The simulation examinations’ realization is in a lot of cases necessary in the interest of the improvement of the complex logistics processes. The automotive logistics processes’ more important investigational possibilities are the following:

- elimination of planning failures at the complex logistics systems [2],
- optimal planning of the procurement-, manufacturing and distribution logistics systems,
- comparison of planning variations,
- determination of the highest performances and boundary status,
- support of the Kaizen workshops,
- comparison of the system control variations,
modeling of the system failures and their eliminations.

We can see from the listed research areas that this is a very useful device. The simulation process improvement is realizable through the total value stream or in the case of an assigned subsystem (procurement-, production-, distribution-, recycling logistics).

3. STEPS OF REALIZATION OF THE SIMULATION EXAMINATION

We have to realize numerous tasks in the interest of the solution of the complex logistics problems with simulation method. These are the following:

- **Determination of the simulation’s aim, define the examined logistics system’s boundary:** We have to determine clearly the investigational aims before making the simulation program and after that we can assign the logistics area to be examined.

- **Understanding the working of the examined system:** The examination maker people have to understand the material flow properties and working principles of the assigned logistics system in order that these people could take into consideration the most important things at the creation of the simulation model.

- **Determination of the logistics indicators’ set:** In this phase we have to determine the set of those logistics indicators which enable the comparison and evaluation of the investigational results (e.g.: operational workstations’ utilization, lead time, …, etc.).

- **Determination of the input and output data:** After the previous steps, we have to define the input and output data of the simulation model, so we can determine the final data request to the examined enterprise. The requested data are not available in every case, so we have to decide whether we will create these data with estimations or field measurements.

- **Creation of the simulation model:** The simulation model is created on the basis of the available information. After this we can examine the working of the modeled logistics systems with the use of the given input data.

- **Control and repair of the realized simulation model:** We have to calibrate the investigational model together with enterprise professionals (for example: with comparison of the current statuses’ logistics indicators and/or with control of the modeled material flow). Numerous cases can occur when we have to modify the created model in the interest of the correct working.

- **Evaluation of the investigational results, elaboration of the proposals:** Using the calibrated model we can determine the working characteristics of the examined logistics with the changing of the selected parameters. With the analyzation of the given data we can elaborate proposals to the examined enterprise. In a lot of cases the task is the optimal determination of more parameters, in such cases we need to use optimization algorithms.

4. PRACTICAL APPLICATION OF SIMULATION MODELING

In the last few years we have made a lot of simulation models for more enterprises (for example: AUDI Hungaria Motor Ltd., Claas Hungaria Ltd., …, etc.), as a result of this the materials processes’ working efficiency was increased. Besides the industrial research tasks more PhD research topics were elaborated in which the simulation modeling played a relevant role [2, 7]. Henceforth, some practical examples will be presented and the achieved results in connection with them (because of the privacy causes they will not be introduced in details)

- **Simulation examination of the flexible manufacturing systems [2]:**

  Manufacturing of the small-scale body parts has a very relevant complexity from the point of view of material flow. The cause of the complexity is that a workstation is able to work products of more product lines, consequently the products’ material flow routes are very different.

  Inside the material flow different materials handling equipments and unit loads making devices are used. The simulation modeling enables the examination of such complex systems too. The examined enterprise have planned the enhancement of the manufacturing activities because of the customer demand’s increase at the manufacturing of the small-scale body parts. The expansion of the plant was necessary in the interest of the realization of these plans.

  The essential problem was the determination of the warehouses and work in processes’ sizes because of the complexity of the material flow. We determined the relative frequency functions of the various storage areas’ stock levels, which function shows the occurrence of the various storage areas’ stock levels in percentage (for example: 4 unit loads was placed in the work in process 1 through in the 40 % of the examination time).

  The examined enterprise’s worker determined the final storage areas on the basis of this data. In addition, the elaborated investigation model was able to run and evaluate the different manufacturing plans too.
Simulation examination of the finished goods storage activities’ outsourcing [14-15]:

The finished products’ storage position and stockpiling mechanism play a relevant role in the competitiveness of the distribution logistics systems (they have effect on changing of the logistics costs and/or service quality).

We have created such a simulation model which enables the examination of the finished good warehousing system’s working in the future state, consequently we can make a better decision regarding creation of the corresponding warehousing system.

Essentially the examinational system determine the storage places and stockpiling strategies of the examined enterprise’ products in order that we can get the most efficient distribution logistics system working. The examination’s goal function contains more components (cost, quality indicators). The examined enterprise’s experts determine the weight of this components.

5. SIMULATION MODELING IN THE EDUCATION

More and more automobile companies need to make simulation models, first of all because of theirs complex logistics processes and application of the lean philosophy [16]. The essential demand of the enterprises in this area is the training of such professionals in the higher education, who are able to determine the aims of the improvement, assign the
examined logistics system and solve the determined tasks.

In the interest of these demands’ catering the Institute of Logistics of the University of Miskolc created a simulation investigational lab. The students can learn the use of the simulation softwares and the methodology of the simulation examination through examples in this lab. The other important knowledge (for example: planning of the systems, optimization, …, etc.) can be learnt in other subjects. The Institute of Logistics have started this training in two areas, which are the Software engineering BSc and the Logistics engineering BSc.

6.  SUMMARY

This paper introduced such a modern planning system which enables the decrease of the wastes inside the logistics processes in the interest of enhancement of the enterprises’ competitiveness. The application possibilities of this device and some realized practical researches’ results were presented. This paper mentioned the educational demands from the part of the enterprises, as well as the created simulation lab at the University of Miskolc.

7. REFERENCES


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