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Support planning and optimization of intelligent logistics systems

Matej Kovalský[a]*, Branislav Mičieta[a]

[a]*University of Zilina, Faculty of mechanical engineering, Department of Industrial Engineering, Univerzitná 1, Žilina, 010 26, Slovakia*

Abstract

The present article deals with logistics planning, focusing on the use of static and dynamic analysis in the planning of automated logistics unit in the automotive industry. Article describes the basic steps of the planning process from the description of a collection of basic input data, perform static analysis to verification by dynamic simulation. Except Article describes the basic steps in planning the logistics of tractors includes the difference of static calculations necessary logistical capacity tractors and results of dynamic simulation. In conclusion, based on the results summarize the advantages and disadvantages of these two instruments for the planning of internal logistics.

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Keywords: Internal logistics planning ; computer simulation ; Plant Simulation

1. Introduction

Logistics planning is one of the key activities driving productivity growth and increased flexibility of a manufacturing plant. Properly designed internal logistics system is likely to ensure stable supplies of material in required quantities, on time, incurring reasonable costs. The first step in planning logistics is its design, complete with capacity calculation. The capacity calculation is figuring theoretical needs of a production system and the number of AGVs capable of completing all logistic tasks. Since it is not possible to utilize only a part of the AGV, the theoretical need is rounded up to the next whole number.

* Corresponding author. Tel.: +421-41513-2713 ; fax: +421-041-513-1501.
E-mail address: Matej.Kovalsky@fstroj.uniza.sk

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Theoretical need is determined both, statically and dynamically. We are able to determine what the difference between the static design and its dynamic simulation is for production systems of different complexity. Designing static solutions for internal logistic system and their subsequent dynamic testing verifies whether the expected requirements of cost cutting have been met, which in turn translates into increased production performance.

2. Static design of internal logistic system

Static design creates a concept consisting of basic information on a production system. Critical basic information accounts for all limitations affecting the very implementation of intelligent logistic devices. The following pieces of information are deemed to be especially of such importance:

- Possibility of the AGV passage (one-way or both-way routes).
- Determining AGV velocity.
- Determining material loading and unloading points.
- Determining the manner of automatic material exchange (in case of more options available).
- Determining the AGV charging stations.
- Determining the AGV bypasses (on one-way routes).
- Determining eventual limitations (e.g. workers).

The above information is then summarized and individual concepts of internal logistic routes are prepared. Due to newly emergent limitations, it is very often the case that the created concepts of internal logistic routes need to be updated. Updates happen especially when limitations are not described sufficiently or when production system layout is changed.

When a suitable concept of internal logistic routes is identified, individual task times of AGV are defined. Particular rounds are scrutinized in order to yield information on how many AGV are needed for a particular route, whether it is possible to implement this number of them, whether the material transportation time is not too long resulting in the material’s failure to arrive to its consumption point on time and, last but not least, a huge role is also assigned to power consumption, which has the potential of creating many difficult situations.

Following a research case study from a real manufacturing plant, individual AGV task times have been identified (Table 1). AGV BD 800 AF, manufactured by CEIT (Central European Institute of Technology), was used in the study in question (Fig. 1.a). Information collected in course of the research study was used in designing internal logistic routes [1]. The study featured one AGV BD 800 AF.

Table 1. Set properties of the production system (Source own calculation).

Identified parameters	Collected values
Material unloading time	0,5 min
Material loading time	0,5 min
Production line tact time	1,67 min
Number of material units on a pallet	12 pcs
Average velocity on a flat surface	1,1 $m*s^{-1}$
Average velocity in a bend	0,3 $m*s^{-1}$
Transportation route length	346 m
Transportation duration	18,04 min

The real production system layout has been made available for the purpose of the study, too. (Fig. 1.b). In the researched case, the AGV loads input material from the warehouse (A), from where it is loaded from two positions. The first position, marked in the warehouse as A1, supplies the consumption location L1 on the route T. The second position in the warehouse (A2) supplies the consumption location L2. The material transported from the warehouse