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Modelling of construction processes in logistics context

theses

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Content

1. Introduction, the main objectives of the research

The aim of the research is to achieve new scientific results in the field of modeling of construction, through the analysis of logistical aspects of construction processes. The work was largely helped by the fact that in the other areas of logistics there were good technological developments and methods in the past few decade, that could be used in my work. These tools and methods are neither self-reliant, they increase productivity, with managing resource management, and helping to make production more effective, and thus making the logistics processes more cost-effective. My research goes beyond adaptation as it focuses on the development of a new building logistics process model and the new methodology of its route optimization subsystem.

There are several reasons why I found this area worthy for deeper deployment and development. The first obvious reason is that the construction industry is the utmost importance are for Hungary as it can be the engine of the dynamic development of the economy, as a well-functioning construction industry helps both the creation of new investments and the development of the infrastructure background. Proper management, monitoring and optimization of construction processes (time-consuming, cost-effective and resource-minimizing) is therefore not negligible in terms of overall social utilization.

Of course, the recognition of this problem has a long tradition in the University and within the Department of the Material Handling and Logistics Systems. The area is primarily part of the competence of the Construction Equipment Workgroup, but within the department, I have been able to utilize many of the synergies that can be found thanks to the diversified logistical competencies. The second reason is that by taking advantage of the synergies of the newly formed department, I could concentrate on the logistical planning and organization of construction automation and construction technology processes, but I also emphasized the mechanical and automation-technical implementation of theoretical solutions, that is mechanical engineering as well as management aspects I have the opportunity to develop an integrated solution

Another reason is that Hungary's membership of the European Union requires that results achieved abroad in the field of science and development are used in the domestic industry (in our case, in the construction industry). This endeavor can also have positive effects in improving the competitiveness of the Hungarian industry.

In my research I have defined two main directions. On the one hand, I have examined the applicability of existing scientific methods, advanced engineering and IT solutions in the international literature, in the field of construction processes and construction and material handling automation, on the other hand I have examined the other logistics fields (transport logistics, city logistics, Lean logistics etc.) and I wanted to serve as a logistical development of the construction industry. My further aim was to create a test system in the laboratory of our Department, an environment where I can implement it in real-world conditions with a process control system with monitoring function, which also allows to optimize the processes. As a result of the tests carried out on the created test system, the theoretical assumptions of the research were proved in practice, that is, they gave an example of the feasibility of the theory in mechanical and infocommunication.

Here I would like to thank the financial support of the state in the project entitled "Building research processes in order to improve the logistics and IT characteristics" (Project ID: KTIA AIK 12-1-2013-0009), which took place within the framework of my research and my thesis was born. State funding of the project also indicates that the utilization of the society is highly desirable.

2. Presentation of the results achieved

The dissertation examines the development possibilities of building processes and the development possibilities of building logistics from several directions. Below I would like to present the results achieved briefly and in context, before expounding the theses, so that the entire research arc can be seen.

As a first step for the research, I studied what the position is the area of modeling of building processes compared with process modeling methodologies used in other industrial fields as well, I analyzed the process modeling methodologies currently used in logistics, in terms of what methods can be used directly in the construction process modeling. The result of my research is that there are some methods already in use in logistics, which can be applied to certain sub-processes in the field of construction applications. But the complexity of construction processes and the similarity of individual production, cause that none of the modeling processes can be used either directly or indirectly. So indirectly I had to conclude that a model adapted to a new construction process is needed.

After that, I focused on the new logistic model that I was wanted to create on the basis of the above: it became clear that in the construction process the spatial position and its sequential changes are of outstanding importance due to the large and outward-looking workspaces and the constantly changing layout. As regards construction processes, the issue of transport routes and their change in workplaces is of particular importance to the spatiality. After this discovery, I have developed a new and unprecedented mapping and route optimization up to now unavailable for machine material handling in the workspaces.

Widening the blend of the research, and then developing a logistic approach to the entire process, which can model a complex and real construction process with multiple functions and adaptive tools. I have adapted this to the Simul8 environment, what is already used in other areas of logistics, with the help of my colleagues.

As a final step dealt with the applicability of this model by examining the hardware side and needs, as well as the results of tests run on the physical model testing system established tests.

3. Thesis formulated during the research

1. thesis

The material related to this thesis is contained in chapter 3 of my dissertation.

Based on the critical analysis of the process models found in the literature, I have taken the following:

For complex construction tasks, currently used construction process modeling procedures alone are insufficient to analyze the logistics characteristics of the process.

2. thesis

The material related to this thesis is contained in chapter 4 of my dissertation.

In my research, I could find the answer to the assumption that a new approach to material flow relationships, which can be used for special construction in terms of logistical features, can also be invent:

I developed an A * and fuzzy logic-based complex method for modeling the spatial aspects of material flow relationships, which I have validated by way of example.

3. thesis

The material related to this thesis is contained in chapter 5 of my dissertation.

The pre-researchal conjecture that a new process model can be created with a new perspective that is capable of mapping the whole process of a construction project:

In my dissertation, I developed a theoretical construction process model including prediction and emulation functions, which I described in detail, and I performed my own model along with the principles of Simul8 environment.

4. thesis

The material related to this thesis is contained in chapter 6 of my dissertation.

The testing of the new process model (in thesis 3) was carried out with a physical test system that was implemented by my colleagues under my leadership at the department's lab. My experiments on this pilot system prove that the new model I have developed can be suitable, along with modeling and simulation, with the appropriate IT background, to implement process control.

4. Summary and future research

The results presented in the dissertation cover a large area , but the scientific results point the focus in one direction: what model is suitable for satisfying managing of the material flow of construction projects. Because of the nature of the present research, the unique use of cyber-physics systems and the industry-specific concept of Industry 4.0, originally referred to as production systems, is unique, as the construction process is not characterized by such complexity due to its complexity. During the research, I experienced that, in developing an operable system, many difficulties must be overcome due to the diversity of communication between different system elements and the diversity of data inputs.

For future research, I consider examining how the general model can be applied (or can it be developed variants that are suitable) special building / construction site areas (such as special civil engineering, tunnel construction, railway or road network development) to describe its technological characteristics properly.

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Further references:see in the dissertation.