Education of logistics according to engineering and economic considerations

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ABSTRACT: Presently, the role of logistics is becoming more acknowledged in production and service activities and, hence, the demand for logistics professionals in Europe has increased. Logistics education is linked to two disciplines: the training of technical engineers and of economists. The contemporary economy expects logistics experts to be able to plan, operate, control, supervise and optimise logistics systems. An outstanding logistics professional is proficient in both the engineering and IT fields, and has the knowledge of economics and legal matters. Imparting these many kinds of knowledge to students requires a structured and well defined educational programme. Important and critical issues for logistics education are presented and discussed in this paper.

INTRODUCTION

Workplaces and equipment providing technology and service operations are complemented by material and information flow systems. The optimal design of these material and information flow systems allows for the improvement of production and service systems. Material handling systems are based on material handling machines (i.e. machine systems) and their operation is ensured by information flow systems. It is the integration of the techniques and technologies of these two systems which leads to engineering logistics. The design and operation of logistics systems can be handled by theoretical methods, which require descriptive mathematical methods and the application of computer-aided mathematical models and methods. In the logistics processes, product identification and product management activities are determining factors. To solve these problems, IT and automation skills are indispensable. In order to investigate the economics of logistics systems, abstracting ability is necessary in order to model economic impacts and the various factors that affect costs.

DEFINITION OF MATERIAL AND INFORMATION FLOW SYSTEMS

Logistics systems can be divided into defined material flow systems. From the perspective of education, it is very important to give not only verbal information about logistics systems, but to be able to give a mathematical description of them. This is extremely important since systems can only be handled with time dependent numerical data. From the perspective of education, the notion of the logistics system should be defined. The logistics system is nothing more than a material flow system together with an associated information flow system [1-4].

Description of Material Flow System

Material flow systems are large systems characterised and described by many parameters. The material flow processes inside the system are changing, stochastic processes. Only rarely can these processes be simplified to stationary or quasi-stationary processes. Figure 1 represents the general, simplified model of the material flow system.

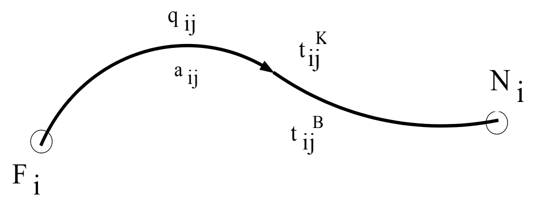

Figure 1: General model for the material flow system.

The connection between two arbitrary points of the material flow system is shown in Figure 1, and the notations are as shown in Table 1:

Table 1: The notations.

F_i	–	The *i*.th source in the material flow
N_j	–	The *j*.th sink in the material flow
$q_{i,j}$	–	The material flow intensity between the source *i*. and sink *j*. (material quantity/time)
$a_{i,j}$	–	The material type identifier between source *i*. and sink *j*.
$t_{i,j}^K$	–	The start time of the material flow between source *i*. and sink *j*.
$t_{i,j}^B$	–	The end time of the material flow between source *i*. and sink *j*.

A material flow connection $\left(Q_{i,j}\right)$ according to Figure 1, is as follows:

$$Q_{i,j} = Q_{i,j}\left(F_i, N_j, q_{i,j}, a_{i,j}, t_{i,j}^K, t_{i,j}^B\right) \tag{1}$$

When one gives for all possible connections *i-j* the connections $Q_{i,j}$ and one summarises them in a multi-dimensional matrix *Q*, then, it is possible to describe the material flow system mathematically. The main problem of this description is that each element of matrix *Q* varies stochastically in time. A reliable treatment of the matrix elements depends on the determination of the density and distribution functions associated with the elements. The structure for the material flow-time function is shown in Figure 2.

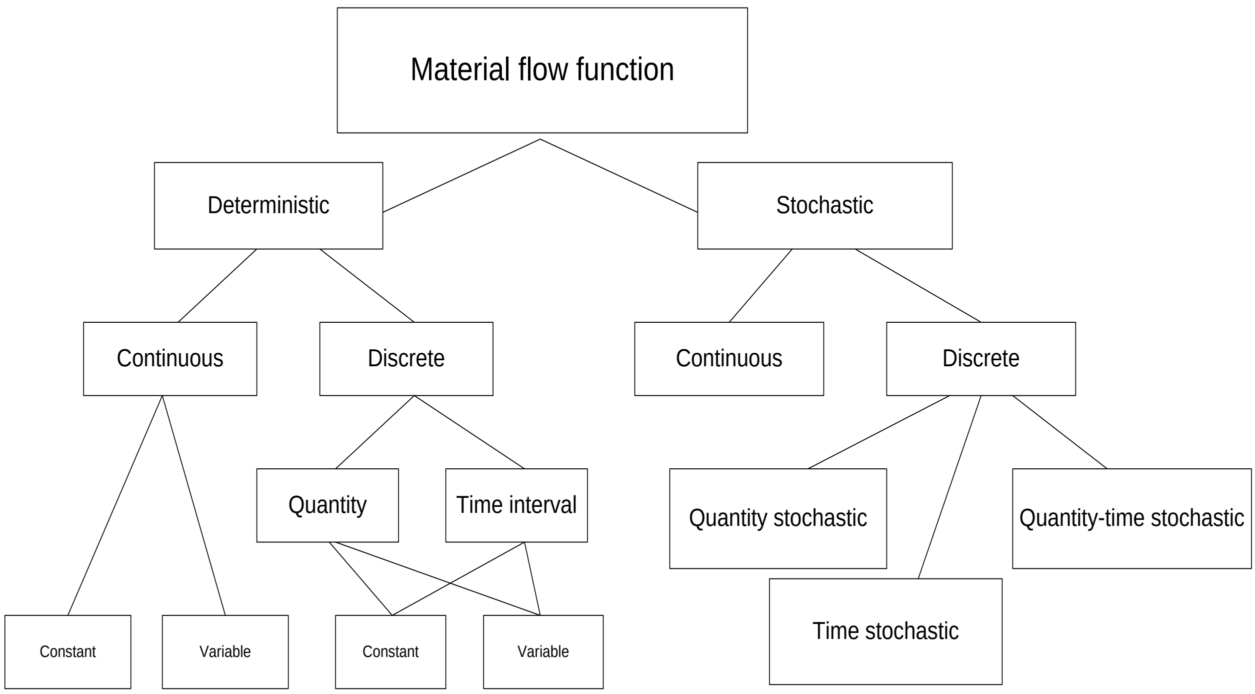

Figure 2: Material flow-time function structure.

The material flow-time functions allow the quantitative scaling of building blocks for logistics systems. Such properties are: storage capacity sizes, tool numbers for transport links, tool numbers for cargo handling equipment, etc.

Description of Information Flow Relationships

In the logistics system, there are several information flows. By definition, this information is tied to the material flow. It is practical to group these many types of information for clarity. The criteria for classification are connected to the material flow. The information set criteria for grouping are the following:

- information set inducing the material flow;
- information set accompanying the material flow;
- information set confirming the material flow.

A simplified model for the material flow connections is shown in Figure 3.

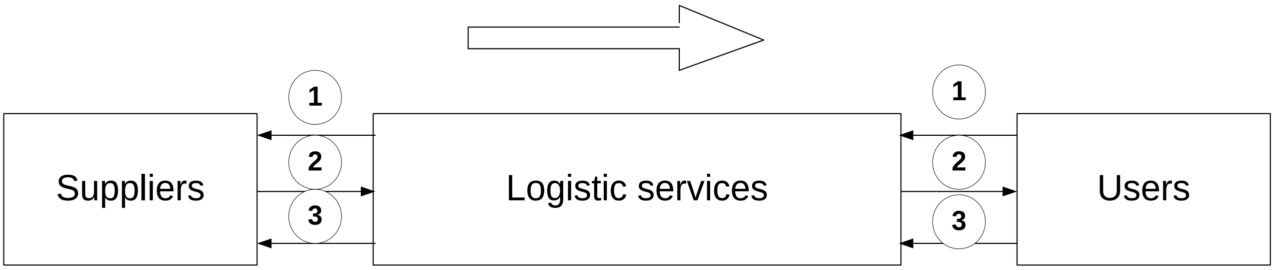

Figure 3: Information flow relationship model.

The notations for Figure 3 are shown in Table 2.

Table 2: The notations.

← (1)	Information inducing the material flow
→ (2)	Information accompanying the material flow
← (3)	Information confirming the material flow
⇨	The material flow direction

According to Figure 3, one can deduce the following:

- The information set inducing the material flow is characterised as it precedes the material flow and its direction is opposite to the direction of the material flow. It is called the primary information set.
- The information set accompanying the material flow is characterised that it flows simultaneously with the material flow in time and its direction is the same as the direction of the material flow. It is used to call the secondary information set.
- The information set accompanying the material flow is characterised that it is generated after the completion of the material flow and its direction is opposite to the direction of the material flow. It is used to call the tertiary information set.

The management of the information flow sets and the logistics system has a continuous connection in time.

Further, the development of information flow in logistics systems is a function of the material flow system. In education, great emphasis must be placed on becoming acquainted with the possible solutions of product identification. The product identification systems affect the reliability of information duration, as well as of the pace of decision making regarding management.

MANAGEMENT OF LOGISTICS SYSTEMS

Due to its complex structures, the management of logistics systems requires the formation of autonomous units and the aggregation of intelligence that is able to solve groups of problems individually. These autonomous groups receive only the information that is relevant for them. This leads to the development of a structure that enables the proper distribution of information. The navigation system of logistics systems is characterised not only by this distribution of intelligence, but also by its hierarchical structure.

As an example, the hierarchical structure of production logistics with the distribution of intelligence is shown in Figure 4. It should be noted that in education, both the navigation systems of the logistics systems and the investigation of the applicable strategies receive a high degree of focus.

SOME METHODS IN THE EDUCATION OF LOGISTICS

Logistics is an integrated science, and as such, appropriates existing methods from other sciences in order to optimise the planning, construction, management and monitoring of logistics systems. The applied methods are as follows:

- To search transport centres by mathematical methods, to choose suppliers by mathematical methods, installation and design by mathematical methods, to form unit loads by mathematical methods and design of different circular flights.
- Flight designs.
- Mathematical design of multi-stage collecting and distributor systems, mathematical treatment of logistics costs, stock management models and simulation methods.
- Quality management methods, etc.

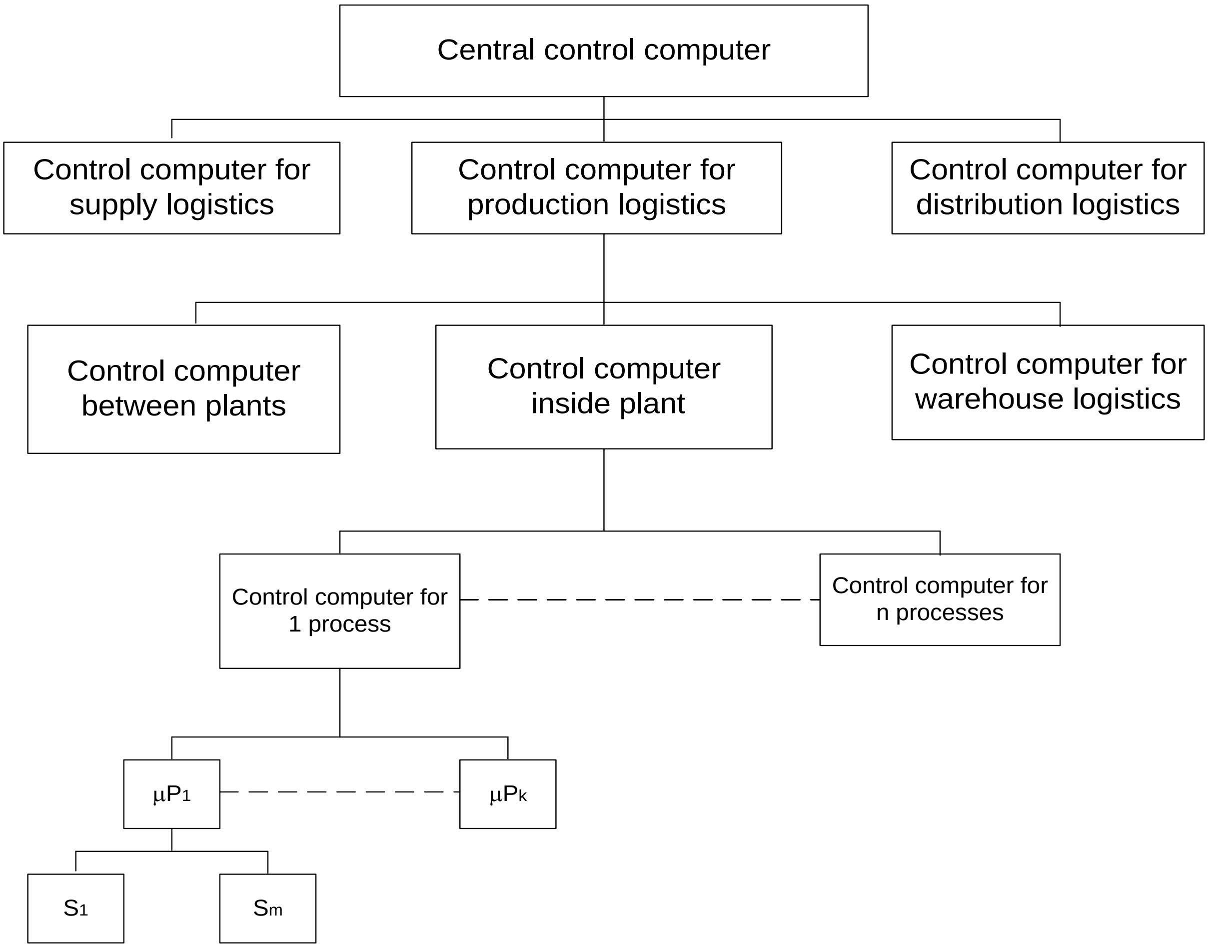

Figure 4: The structure of a hierarchical logistics management system with distributed intelligence.

CONCLUSION

The above-mentioned considerations outline a few of the reasons why the education of logistics requires a structured programme that allows for imparting a constantly changing and complex knowledge base. In order to provide a high quality, up-to-date and modern education, research in the application of industrial and economic uses, as well as networking with international stakeholders must be built in to the curriculum.

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REFERENCES

1. Cselényi, J. and Illés, B., *Logistics Systems I*. Miskolci Egyetemi Kiadó, Miskolc, 1-378 (2004) (in Hungarian).
2. Cselényi, J. and Illés, B., *Design and Management of Material Flow Systems I*. Miskolci Egyetemi Kiadó, Miskolc, ISBN 963 661 6728, 1-384 (2006) (in Hungarian).
3. Illés, B., Glistau, E. and Machado, N.I.C., *Logistik und Qualitätsmanagement*. Budai Nyomda, Miskolc, ISBN 978 877 3814, 1-195 (2007) (in German).
4. Illés, B., Glistau, E. and Machado, N.I.C., *Logistics and Quality Management*. Budai Nyomda, Miskolc., pp:. ISBN 978 963 877 3807, 1-197 (2007) (in Hungarian).