

# INNOVATIVE APPROACH TO THE DEVELOPMENT OF AUTOMATED LOGISTICS INFORMATION SYSTEMS

## ИНОВАЦИОНЕН ПОДХОД ЗА ИЗГРАЖДАНЕ НА АВТОМАТИЗИРАНИ ЛОГИСТИЧНИ ИНФОРМАЦИОННИ СИСТЕМИ

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**Abstract:** *Technological advancement driven by innovation, fundamentally new industrial technologies and artificial intelligence, will naturally exert greater pressure not only on the growth of production but also on its structural properties which are expected to undergo significant changes. Moreover, the improvement of technological, auxiliary and information activities will invariably be regarded as a crucial factor in the development of modern production. Thus, with the structural transformation having been effected, the new communication and information achievements are more likely to reinforce the relationship of production with its external logistics components. In addition, it should be borne in mind that the production of the future will be constructed as a complete whole comprising the respective technical, technological and information processes along with the functionally integrated production components, including those of the logistics system. The purpose of the present paper is to explore the possibilities for designing automated logistics information systems and to propose an innovative approach incorporating not only the specific in-house (intra-company) logistics but also considering its interdependent relationship with the other logistics processes that have been excluded from the company's core business activities.*

**Keywords:** LOGISTICS, LOGISTICS INFORMATION SYSTEMS, AUTOMATED LOGISTICS SYSTEMS

### 1. Introduction

The vast range of information flows running inwardly within a given system of logistics and among its system components, as well as between the logistics system and its external environment join together to become part of logistics information systems.

Logistics information systems relate to a well-organised structure of interconnected electronic means, information technologies and software products delivering solutions to various functional tasks in order to gain control over the multiple flows of materials [2,4]. Logistics IT pertain to the class of so-called new information technologies, which are defined as a set of fixed ("embedded" within the organisation) management systems with principally new means and methods of data transfer and processing [6,9,10]. They act as integrated technologies and systems largely employed in the process of creation, transmission, storage and display of product information (data, ideas, knowledge, logistics support, etc.) at the lowest possible cost and consistent with the social environment legislation [3,5].

#### Key competency areas in logistics

All the necessary arrangements should be made for the logistics information that supplies the main strategic logistics resource to be distributed in the "supplier-consumer" model. Using computer technologies for processing of data helps to keep costs down as a result of a more effective management of the multitude of information flows, which, in turn, leads to increased speed and enhanced coordination [7,8]. The term "information resource" is established as an economic category, while that of information resource management implies:

1. An evaluation of the information needs at each level of logistics and in each function of logistics management;
2. Research and rationalization of documentation, organization of effective electronic document exchange;
3. Addressing data mismatch and incompatibility of data for the same purpose.
4. Development of a data management system.

Regarding logistics information as a resource involves, by analogy with the use of other resources, provision of an effective mechanism for its proper management through established uniform standards for information support.

Against the background of rapid development and proliferation of Internet technologies, the efficient supply chains occupy a crucial role in the successful growth of the Companies. Thence, the first step a Company takes in venturing out into the "Internet of Services" should be to define the role of the logistics processes as part of its effective management in addition to the creation of official company's website. Accordingly, the management of supplies is inextricably linked to the automation of internal resource planning. This means that the optimization of the business processes provides a sound basis for the creation of an effective delivery mechanism.

#### Logistics information systems based on digital dimensions

The process of material flow management is determined by the processing of logistics information circulating within the logistics system. Logistics information is a purposeful assemblage of facts, phenomena and events collected together to be submitted for further registration and processing and thus to ensure the company's process of logistics system management [1].

There are three forms of logistics information representation: symbolic, text, graphic. The symbolic form is based on the use of symbols - letters, numbers, and signs, including punctuation marks. The text form uses characters that follow each other in a predetermined sequence to form a text. The graphic form is the most extended and complex and covers multiple types of images. Equally applicable, furthermore, are the following concepts;

**Logistics system architecture** is a concept that describes the model, the structure, the functions performed and interconnectedness of the system components.

**Information flow** is a system of messages that are distributed within the logistics system, between the logistics system and its external environment that are considered strictly necessary for the management and control of the logistics operations. The information flow may be transferred on paper and electronic documents.

**Digitisation of information flow** based on digital conversion and transformation of the logistics processes.

Information processes being distributed across space and over time are regarded as high priority carriers capable of transmitting administrative influence within the structure of a certain organisation. The organisation's business (activity) data models and its environment determine the possibilities of effective collaboration and shift the focus onto the final outcomes (end results). In logistics systems, however, there is a critical need for information interaction

among participants in the real-time supply chain with the optimal cost-effectiveness for managing the system. A possible solution to this problem is offered by a relatively new sector of scientific knowledge - information logistics.

But let us first examine the most important characteristic features of the concept of information logistics under discussion.

Information logistics can be viewed on the one hand in a systematic way of organizing enterprise information resources as specified by the basic principles of logistics (consistency, rationality and precise calculation), and on the other hand, in its supportive function or in a regional perspective – a function of logistics management.

Information logistics can also be considered as a method for gathering, processing, storage and dissemination of information in industrial and economic systems and their immediate environment in compliance with the established logistics rules (the importance of information, in the right quantity, at the right time, in the right place and with optimal cost-effectiveness).

In light of this, the overall purpose of the information logistics can be described as a rational management of the flow of information throughout the entire logistics network and at all levels of hierarchy.

**System connectivity in logistics information processes.**

The levels of the logistics processes in terms of the systematic approach are presented in fig.1.

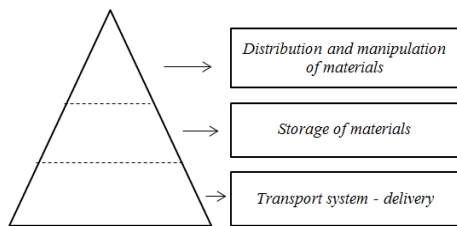


Fig.1. Logistics connectivity in the system

In line with the concept of logistics affiliation (relatedness), information systems, pertaining to different logistics groups are integrated into a single information system. Such integration takes place in a vertical and horizontal direction.

Vertical integration is the link between the planned, dispositive and executive (control) system transmitting vertical information flows.

Horizontal integration, being a medium for horizontal information flows, is the link between the individual sets of tasks in the dispositive and executive (engineering) systems.

Illustrated in fig.2 is the way in which the horizontal and vertical integration are brought together.

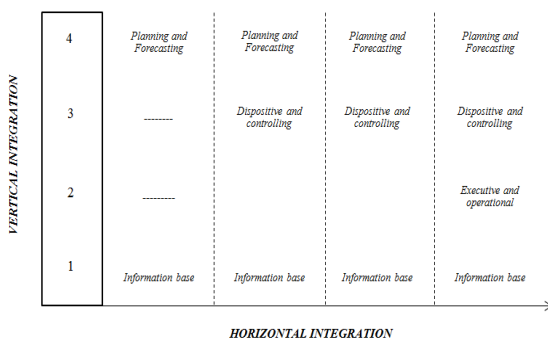


Fig.2. Relationship between the horizontal and vertical integration

Clarifying the relationship between horizontal and vertical integration proves necessary for a more accurate construction of logistics information systems through automation. These refer not

only to separate logistics processes subject to specific integration requirements but also to all the business activities the company undertakes in-and out-of- house.

Viewed from the perspective of information and logistics, improvement in the company's integration activity is entirely consistent with automated management of the material flow.

**Sequence of the steps in the development of automated logistics information systems**

Constructing automated logistics information systems is controlled by the following sequence of events ensuring its proper implementation:

1. Establishing principles of identity and adherence to the belief that all the relevant operations, processes and activities should be integral to logistics. Distinct identification of the intersection points of the logistics processes with the other company's (business) processes.
2. Designing the structure of the system through the application of modern information technologies.
3. Determining the company's internal and external linkages and relationships.
4. Exploring the possibilities of gradual development of automated logistics information system.
5. Enhancing automated logistics information system with the possibility of using hardware and software modules based on digitisation.
6. Improving the logistics information system flexibility in meeting some specific requirements of the logistics subsystems.
7. Considering the potentiality of assuring the achievement of improved user-friendliness and compatibility with the abilities of the users from the lowest to the highest level of automation of logistics processes and activities.
8. Promoting synergies by integrating the logistics sub-systems between the vertical and horizontal distribution (dimensions).

The suggested sequence of steps in the development of automated logistics information system is further outlined in fig.3.

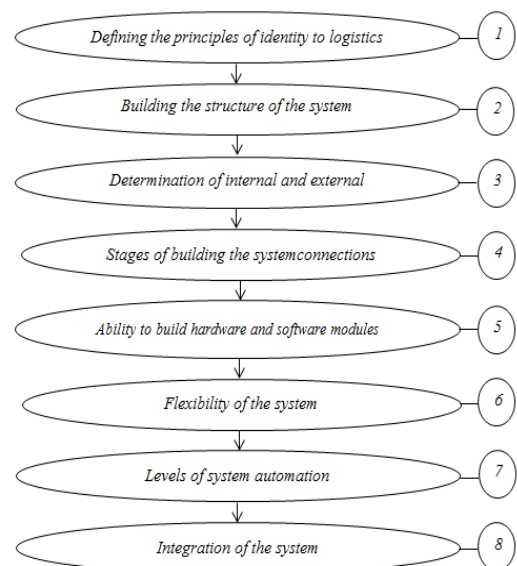


Fig.3. Sequence of development of automated logistics information systems

**Provisions for the engineering of automated logistics information systems (ALIS)**

## 1. E-logistics as a component of the automated logistics information system.

E-Logistics facilitates the processes of planning, execution and controlling of the respective logistics activities or tasks through the application of modern Internet technologies for the purposes of improving the existing logistics services and enhancing the collaboration between the separate partners in the supply chain (Supply Chain). More specifically, full account is taken for the provision of all the decisive steps towards the securance of smooth electronic commercial transactions as to the acceptance of an order, storage, commissioning, packing, franking and dispatch (delivery) of the corresponding articles.

Essential prerequisites and conditions for the implementation of electronic logistics:

1. Integration of Internet-based systems in the portfolio of existing IT systems;
2. Further support of the classical organisational processes and procedures;
3. Inter-company cooperation or inter-departmental collaboration with the clear objective of pulling together all the partners in the supply chain in order to overcome the barriers that restrict the flow of information.
4. The complexity of integrating electronic logistics solutions into the existing architectures and applications should not be underestimated.

The key advantage of electronic Logistics is the prospect of economic organisation and accomplishment of logistics tasks through the use of Internet technologies. Moreover, this might produce a steady improvement in the philosophy of the service itself (Service) in classical logistics and electronic commerce.

E-logistics is also perceived as the collective expression of the shared logistics processes in a given company that might be defined and accessed electronically.

Without electronic logistics, an effective and unimpeded processing, handling and transfer of goods in the field of the electronic commerce is inconceivable. Undoubtedly, this is associated with prudent planning and cautious development of all logistics processes and systems that are considered necessary for the electronic transaction processing. Electronic logistics is also the common denominator for future organisation and planning of the related logistics systems and processes, and thus, securing the successful realization of the electronic disposition of a company's business processes. In light of this, it could be deduced that E-logistics is one of the principal components of the automated logistics information systems.

## 2. Standardisation and self-regulation as an essential component in ALIS development.

The mechanism of self-regulation can serve as a basis for effective functioning of the integrated supply chain. Self-regulation is intended to optimise all the processes occurring in the chain (network) by transforming its structural elements according to stringent safety criteria and high performance achievement. Even more, it is precisely the increased value added by all the participants in the supply chain that accounts for its effectiveness and efficiency. Special attention, therefore, should be paid to various problem-solving methods in management, with an increased focus on the "critical points" of the supply chain integration.

Thus, in order for the self-regulatory mechanism to operate efficiently, ALIS is to be introduced as an inseparable part of the integrated supply chain since, with its strong effect on the "critical points", it is more likely to smooth over the violent fluctuations of the entire system.

Taking full advantage of modern logistics technologies would improve the industry's competitiveness and create the most important prerequisites for the radical transformation of the underlying infrastructure into self-regulating business communities.

## 3. Distinctive features of ALIS

ALIS can be readily distinguished from the other types of information systems by the level of integration of its information space through automation.

The systematization of the concepts in this field of research makes it possible for three existing approaches to defining ALIS come to the fore:

- ALIS is part of the corporate automated information system;
- ALIS has a higher degree of flexibility for integration of software solutions and is included in the corporate automated information system;
- ALIS is an independent self-contained structure isolated from other information systems.

The second, but no less important issue for building up ALIS is its functionality (functional structure).

ALIS functionality is contingent upon the types of information flows that penetrate into the system. The specificity of ALIS is determined by the fact that flow management takes place both within the particular business organisation and between the different participants in the logistics chain.

## Conclusion

The issues that have been discussed so far in the present paper point to the conclusion that information is becoming a critical production factor of logistics activities.

Information logistics should be recognised as an area of logistics that explores and addresses issues related to the organisation and integration of information flows for decision-making in logistics management systems.

On the whole, automated logistics information systems are capable of integrating all the logistics subsystems, including supply logistics, inbound (production) logistics, distribution logistics, et al., with the intention of establishing connecting units (linkages), upon which the respective elements of the logistics system will be built up.

In closing, the paper strongly upholds the idea that automated logistics information system is a special case of the more general information systems, designed for automated receiving, transmission or processing of data related or integral to the processes of logistics.

## References

1. Barbarino S., A new concept for logistics: a Physical Internet, Presentation at GS1 Transport & Logistics Workshop (12–13 October 2015, Warsaw, Poland), 2015
2. Bartodziej C.J., The concept industry 4.0: an empirical analysis of technologies and applications in production logistics, 2016
3. Davis J., Edgar T., Porter J., Bernaden J., Sarli M., Smart manufacturing, manufacturing intelligence and demand-dynamic performance, *Comput Chem Eng*, 47 (2012), pp. 145-156
4. Demirova S., Industrial Information Technology - A Revolutionary Factor In Logistics, *Acta Technica Corviniensis - Bulletin of Engineering*, Tome X, Fascicule 4 (Oktober-December), pp.25-28, ISSN 2067-3809, 2017
5. Demirova S., The Technical Development and Industrial Logistics, *Innovations in Discrete Productions*, Issue 1/2016, Sofia, ISSN 1314-8907, pp.32-33, 2016
6. Grigoriev M.N., Information systems and technologies in logistics, 2006
7. Guo Y, Qu J., Study on Intelligent Logistics Management Information System Based on IOT and Cloud Computation in Big Data Era, *Open Cybernetics & Systemics Journal*, 2015, 9(1):934-941
8. Kavka L., Virtual Reality in Logistics, *The International Journal of Transport & Logistics*, 2011
9. Klotzer C., Pflaum A., Cyber-physical systems as the technical foundation for problem solutions in manufacturing, logistics and supply chain management, *Proceedings - 2015 5th International Conference on the Internet of Things, IoT*, 2015
10. Kovacs G., Kot S., New logistics and production trends as the effect of global economy changes, *Polish Journal of Management Studies*, 2016