PROBLEMS OF LOGISTIC SYSTEMS SUSTAINABLE DEVELOPMENT IN DELIVERY CHAINS

Sergey Uvarov
St. Petersburg State University of Economics and Finance, St. Petersburg, Russia

ABSTRACT. Background: Realization of supply chains management paradigm, covering significantly more volumes of logistic space, logically leads to complication of logistic systems, which, in its turn, arises significant number of problems of both theoretical and practical character. In our opinion, not all the aspects of logistic systems design and their sustainable functioning have received by the present time corresponding coverage in scientific literature. More detailed consideration requires specific problems of logistic systems interaction with their environment. We can talk about formation of new scientific direction (which we suggest to name logistic environics), being applied addition to classical approach to design of logistic systems.

Methods: the formalized description of interaction process for logistic systems with the environment was presented and discussed from ecological, social, economical, organizational and technological, technical, natural scientific positions.

Results and conclusions: there is an interaction between logistics systems and the environment, but formalized description of logistic systems interaction process with the environment requires performance of complex interdisciplinary research from many different positions.

Key words: supply chains, logistic systems, logistic environment, logistic approach.

The aim of this article is to propose the scientific and methodological recommendations on management methods of supply chains, which consider the specificities of supply chains influence on the environment as well as mutual interactions between logistics systems and the environment.

Realization of supply chains management paradigm, covering significantly more volumes of logistic space, logically leads to complication of logistic systems, which, in its turn, arises significant number of problems of both theoretical and practical character. Addressing to theoretical analysis allows to specify typology of logistic systems in supply chains, reveal their specific qualities in new conditions and state adequate requirements to the problem of logistic systems design [Logistics ... 2009]. Addressing the question of reliability provision for logistic systems, that allows to increase reliability of supply chains at the expense of system management factor [Uvarov 2010], and also considering of ecological, organizational and technological sides of the reverse flows formation process in logistics systems [Logistics ... 2010] allowed to make a conclusion on the higher-order problem.

In our opinion, not all the aspects of logistic systems design and their sustainable functioning have received by the present time corresponding coverage in scientific literature. So, more detailed consideration requires specific problems of logistic systems interaction with their environment. In our opinion we can talk about formation of new scientific direction (which we suggest to name logistic environics), being applied addition to classical approach [Bauersocks 2005] to design of logistic
Logistic system, as any material system, exists in concrete environment, which consists of everything, that is outside the considered system. Environment includes external in relation to it objects, which participate in forming of its integrative qualities mediately, through independent components of their systems and systems in whole [Lee et al. 2011].

Logistic system, as any open system, constantly exchanges substance, energy, information - all necessary for provision of its vital activity, growth, development and improvement, with the environment. Material system cannot exist outside environment, cannot stay indifferent to the influence from the side of environment. If environment is favorable, system can successfully develop, under the influence of negative factors of environment system can collapse [Hajdul 2010].

Environment can be determined as objective material world, existing outside this system in all diversity of its demonstration, directly and mediately influencing each other.

Environment of logistic systems we shall call macro-logistic environment. Along with environment exists also internal environment of the system, which consists of higher levels of sub-systems and elements of system and interaction process between them, and also interaction with the environment. Logistic system internal environment we shall call micro-logistic environment. Exists dialectic relation (unity and struggle) of external and internal environments. Environment creates systems, and every system forms its internal environment, that can only develop in unity with external environment.

Interaction determines basic content of any environment, aims for performance of concrete work, action. Environment content is conditioned by the type of system elements mutual interaction and system with the environment. Interaction types depend on purpose, to which the system aims. Such purposes in logistic system may be creation of clear organization structure and actually organization of management process for material and accompanying it flows; achievement of supply high quality; performance of effective logistic functions and operations; rational management for all above motioned interacting processes [Melo, Nickel, Gama 2009].

In correspondence with set aims in interaction process of internal functional sub-systems of logistic systems and logistic systems between each other, are formed corresponding environments (table 1).

Significance of any material system consists not in the very fact of its existence as a material object, but in its interaction with the environment.

Appearance, development, improvement of systems, their collapse - all these is related with the character of their relations with other systems, environment. Interaction determines existence, structural organization and qualities of any material system. Interactions inside logistic systems, and also of the systems with the environment are complicated, multivariant and bear strictly purposeful character [Ghadge, Dani, Kalawsky, 2010].

Multitude of logistic systems, and also micro and macro-logistic environments exists only in constant interaction between each other. The more complicated is logistic system or environment, the more diverse and differentiated are their interconnections and properties. On the character of these interconnections depend degree, organization level of logistic system, its quality, reliability, sustainability, ability for development.
Tabela 1. Środowisko logistyczne wraz z jego podsystemami

<table>
<thead>
<tr>
<th>Logistic environment</th>
<th>Content</th>
<th>Aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Micro logistic environment</td>
<td>Different types of interactions between managers and specialists, working in sub-divisions of logistic system, aimed at creation of its rational organization</td>
<td>Development and improvement of logistic systems; organization of basic and auxiliary logistic processes; effective usage of transportation and warehousing capacities; reduction of duration of order execution cycle; logistic coordination of interrelation with suppliers, consumers and logistic agents; rational decision of ecological problems.</td>
</tr>
<tr>
<td>1.1. Economical component of micro-logistic environment</td>
<td>Totality of economical relations, determining possibilities of logistic system</td>
<td>Performance of processes of production supply and support, distribution, and also effective functioning of the company in whole in the market.</td>
</tr>
<tr>
<td>1.2. Technological component of micro-logistic environment</td>
<td>Interaction between materials, incomplete production and finished product, between machinery and mechanisms of different stages of logistic process.</td>
<td>Improvement of machinery work and improvement of quality of logistical services for consumers.</td>
</tr>
<tr>
<td>2. Macro logistic environment</td>
<td>Economical, political, social and cultural environments, in conditions of which functions concrete logistic system</td>
<td>Optimization of conditions of goods movement process organization.</td>
</tr>
<tr>
<td>2.1. Economical component of macro logistic environment</td>
<td>Interactions (transactions) between logistic systems in the process of industrial and economic activity of companies and enterprises, distribution, exchange and consumption of finished product.</td>
<td>Creation of logistic potential of national economics, increase of possibilities for effective international economical relations in conditions of world economics globalization.</td>
</tr>
<tr>
<td>2.2. Technological component of macro-logistic environment</td>
<td>Interactions, connected with the development of technics and technology, with saturation of society with technical systems, growth of machinery, mechanisms and other technique influence on environment.</td>
<td>Development of innovation technologies, creation of more productive machines, mechanisms, equipment, transportation means, and also technical systems designated for provision of country economical security.</td>
</tr>
</tbody>
</table>

For every system are typical its own types of substance, energy and information, their determined volumes, which can be called affecting factor, transforming the system. Exactly affecting factor, possessing necessary and sufficient amount of substance, energy and information, is able to move, transfer, support development and improvement of the system. Imagine logistic system as result of interaction of micro- and macro-logistic environments factors. Logistic systems are impacted with the following factors:

- \( x_i \) - factors of macro-logistic environment, positively influencing on logistic system;
- \( x'_{i} \) - factors of macro-logistic environment, negatively influencing on logistic;
- \( y_{i} \) - factors of micro-logistic environment, that allow logistic system to influence on environment;
- \( y'_{i} \) - factors of micro-logistic environment, that do not allow logistic system to influence on environment;
- \( z_{i} \) - energy, which is spent by logistic system for counteraction to external factors;
- \( z'_{i} \) - factors, collapsing logistic system from inside.

In this case, condition of sustainable development of logistic system will be the following:

\[
\sum (x'_{i} + y'_{i} + z_{i} + z'_{i}) \leq \sum (x_{i} + y_{i})
\]

Logistic system is able for sustainable development in the case, if the sum of positively influencing factors of micrologistic and macrologistic environments exceeds the sum of negatively influencing factors.
factors of micrologistic and macrologistic environments, factors, collapsing logistic system from the inside and expenses of energy, which it is necessary to spend by logistic system for counteraction to external factors.

Thus, logistic aims to regulation of the whole process of production manufacturing and services rendering from resources supplier to the final product consumer. It shall be noticed, that market economics in whole and sphere of distribution and circulation in particular are extremely sensitive to alien structures, artificially introduced to economical system. Logistics consistently fit into modern market economics, i.e. it is in demand by the whole way of economics development.

Macroeconomical aspect of logistics is in increase of public production effectiveness at the expense of reduction of expenses in the sphere of circulation, first of all of material and technical provision and transportation, with which is connected up to 98% of time and up to 40% of resources, appearing in the process of reproduction. Practically the search of ways for reduction of expenses is performed in the following directions:

- Improvement of management for the sphere of production provision, storage and distribution;
- Optimization of economic relations by improvement of marketing activity and interaction of suppliers, consumers and brokerage structures;
- Positive changes of material flows movement technology.
- Logistics suggests to consider the circulation system in all its complexity and diversity. Research of the development and functioning of large systems requires system approach. Other approach is impossible here. We can say, that logistic approach - is the system approach to research of social and economical and man-machine systems. Application of logistic approach to design of economical systems development supposes the solution of the following tasks:
  - Set of aims for development and determination of their optimal combination;
  - Determination of ways and means for achievement of these goals through revelation of connections and research of interaction of considered factors and concerned objects in quantitative form;
  - Associativity of goals and means of their achievement with demand in resources, considering their limitedness.

From the point of view of integrated logistics, logistic approach is a multicriteria optimization of the business-process: so, designers shall take into account the requirements of manufacturability, transportability, ability for utilization at the stage of new products elaboration, and elaboration of package shall be performed with consideration of peculiarities of cargo treatment in different transportation types. Main instruments of logistic approach are analysis and synthesis of the researched system. System analysis allows to disclose the most significant factors, gives their characteristics, quantitative estimation of interaction with each other, determines their influence of researched system parameters. Synthesis is provided in the process of elaboration and functioning of formalized model of researched system parameters; this model unites factors in development dynamics of considered system [Hofer, Knemeyer 2009].

On micro-level logistic approach introduces changes into many conceptions of company's economics and organization of production process:

- Task of full use of capacities is replaced with the task of minimization of terms of circulation means pass through the enterprise;
- Initially may be foreseen reserve capacities for rapid reaction on the change in the market demand (it is understood, that doesn't mean availability of idle capacities. Under reserve is understood possibility of cooperation, purchase of services on products manufacturing or performance of certain production operations);
- One-sided orientation on reduction of expenses as a method of competition is replaced with the aim for the higher level of logistic service;
PROBLEMY ZRÓWNOWAŻONEGO ROZWOJU SYSTEMÓW LOGISTYCZNYCH W ŁAŃCUCHACH DOSTAW

STRESZCZENIE. Wstęp: Realizacja paradygmatu zarządzania łańcuchem dostaw, która to obejmuje znaczny obszar logistyki, prowadzi do większej złożoności systemów logistycznych. To z kolei stwarza wiele istotnych problemów zarówno teoretycznej jak i praktycznej. Nie wszystkie zagadnienia związane z projektowaniem i funkcjonowaniem systemów logistycznych znajdują odpowiednie odzwierciedlenie w literaturze naukowej. Szczególnej uwagi wymagają powiązania i zależności systemów logistycznych z otaczającym je środowiskiem. Można tu mówić o nowym kierunku nauki (logistic enironics) jako dodatku do klasycznego podejścia do projektowania systemów logistycznych.

Metody: Przedstawiono sformalizowany opis współzależności między systemami logistycznymi a środowiskiem, który następnie został przedyskutowany przy uwzględnieniu aspektów ekologicznych, socjальных, ekonomicznych, organizacyjnych i technicznych.

 Wyniki i wnioski: Istnieje zależność między systemami logistycznymi a środowiskiem, lecz sformalizowany opis tych zależności wymaga kompleksowych międzydiscplinarnej badań, uwzględniających różne podejścia do tych zagadnień.
PROBLEME DER NACHHALTIGE ENTWICKLUNG DER LOGISTIC SYSTEMS IN LIEFERKETTEN


Methoden: die formalisierte Beschreibung der Zusammenhang zwischen logistischen Systemen und die Umwelt wurde vorgestellt. Dann wurde es von ökologischen, sozialen, wirtschaftlichen, organisatorischen, technologischen, technischen und naturwissenschaftlichen Positionen diskutiert.

Ergebnisse und Fazit: Es gibt eine Wechselwirkung zwischen logistischen Systemen und die Umwelt, erfordert sie aber die Leistung der komplexeren interdisziplinäreren Forschungen.

Codewörter: Lieferketten, Logistik-Systeme, logistische Umwelt, logistischer Ansatz.