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Distinctive features of the logistics approach to managing information flows

Abstract. The study aims to clarify the essence and complement the content of the logistics approach to managing information flows in a supply chain. The adopted approach features the following aspects: creation and delivery of value to the end consumer of products and services; focus on managing resource flows, elimination of cross-functional and cross-operational barriers in supply chains, reduction of lost profits. The methodological basis of the research rests upon theoretical and methodological concepts of logistics and logistics management regarding the management of information flows in supply chains. The authors employ the methods of terminological and systems analysis, logical and structural methods, grouping, and classification. The article proposes a classification of consumer values with regard to specifics of information resources; revises the classification of information resource flows and methods for their optimisation; develops a classification of the cross-functional barriers that exist in the information resource supply chains, and their root causes; specifies managerial options within supply chains and their interrelations; and reflects the structure of lost profits in supply chains of information resources. The findings make it possible to revise and supplement the theory and methodology of information flow management in supply chains and increase the competitiveness of their links through better service provided to end users of goods and services.

Keywords: value; supply chain; logistics approach; information flows; cross-functional barriers; managerial decisions; lost profit.

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Introduction

Successful development of an innovation economy relying on information (digital) technologies involves a large-scale application of the theory and methodology of logistics. Studies by foreign and Russian authors confirm that the logistics approach adopted in managing resource flows of regional enterprises and a country as a whole, that initially constitute supply chains, allows them to function successfully both in times of crises and at the stages of growth. It should be reminded that the supply chain is a set of processes consistently performed by the logistics system, namely aggregation/distribution, movement (logistics management), and making contracts for acquisition/transfer of the ownership for certain types of resources [Tyapukhin, 2018].

Managing information flows, i. e. flows represented by "… certain complete messages in verbal, documental (electronic or hard copy), and other forms intended for making and implementing managerial decisions" [Tyapukhin, 2018, p. 93], is of particular difficulty during the implementation of the logistics approach.

The difficulty in information flow management is associated with highly labour-intensive nature of its main functions, such as:

- information flow filtration, i. e. selective processing and rejection of certain data;
- accumulation of information and storage of data in the information array;
- consolidation and the downsizing of information flows in a logistics information system;
- transfer (transportation) of information flows;
- various information-element transformations;
- information processing aimed at obtaining the data related to the conduct of logistics operations[1].

The objective of this article is to revise the nature and supplement the content of the logistics approach to managing information flows in supply chains.

To accomplish the objective the following tasks were set and performed:

1) revise the classification of consumer values based on the specifics of information resources;
2) revise the classification of information resource flows and methods for their optimisation;
3) develop the classification of the cross-functional barriers that exist in the information resource supply chains, and their root causes;
4) identify the basic options for managerial decisions in the information resource supply chains and specify their interrelations;
5) specify the structure of lost profits in the information resource supply chains.

Literature review

The essence and specifics of the logistics approach to managing supply chain enterprises are disclosed in the works by the well-known foreign experts: R. H. Ballou [2006], D. Bowersox, D. Closs, and B. Cooper, [2007], D. M. Lambert [2006], J. T. Mentzer, T. P. Stank, and T. I. Esper [2008], J. R. Stock, and S. L. Boyer [2009].

The details of the logistics approach are also reflected in the works by the Russian authors.

According to S. A. Uvarova and M. N. Grigorieva [2017, p. 337]: "… the logistics approach ... views the objects of research in their reference to each other, in succession and evolution, in transition to a qualitatively new state, ... focuses on departure from handling the costs in isolation, and uses the criterion of the minimum amount of the specified costs based on the optimum value of each component".

This view is supported by N. S. Yem [2009, p. 40]. In his interpretation "… the logistics approach implies abandoning the local mindset and proceeding to comprehensive solutions and the constant readiness to implement organisational and technological innovations".

E. Kameneva and T. Krylova [2013, p. 25] believe that the "… implementation of the logistics approach requires an integrated management of the procurement, manufacturing, transport, distribution and transfer of information concerning the movement of supplies as a single system oriented towards meeting the requirements of various stakeholders".

R. V. Zharikov [2005, p. 20] emphasises an important aspect of the logistics approach: "Logistics approach requires the introduction of a new object of study – a flow that represents a system of material, information, financial, and labour objects being moved".

[1] Information flow management. Available at: http://center-yf.ru/data/Menedzheru/upravlenie-informacionnymi-potokami.php. (in Russ.)

M. M. Khaikin [2009, p. 94] elaborates on the essence of the logistics approach in the service sector, describing it as an "… optimisation of the processes of generation, transfer, and use of resources necessary for the production and consumption of services", also with regard to the object of study of logistics, namely, the flow of resources.

E. A. Babkin and A. S. Fomina [2011, p. 94] attach significance to the information technologies in implementing the logistics approach: "... the importance of the information technologies cannot be understated. Experience shows that ERP systems with the SCM module allow a six-fold increase in the order processing rate and a two-fold increase in customer satisfaction with the parameters of the logistics service".

This point of view is further developed by A. A. Kizim, S. Z. Bekirova, and E. Yu. Kopytko [2014, p. 67]: "Logistics ... allows one to practically increase the information flow rate, the service provision rate, the rate of provision with... the necessary resources, the speed of financial and information decision-making flows in management and, ultimately, to improve the quality of the provided service on the part of the human resources".

Basing on the foregoing and other publications, it can be concluded that the features of the logistics approach comprise:

- an inextricable connection with the marketing interpreted as "an activity, a set of institutions and processes aimed at generating, transmitting, delivering, and exchanging offers of value to consumers, customers, partners, and society as a whole"[1];
- focus on managing the flows of resources, starting from their initial supplier (manufacturer) and ending with the end consumers of the finished goods and services;
- a switch from "enterprise" to "supply chain" as an object of research;
- lowering or elimination of the so-called cross-functional and cross-operational barriers that impede the flow of resources in supply chains and within their links. It is important to note that a cross-functional barrier is a hindrance or obstacle restricting the intensity and speed of the resource flow between two or more supply chain links for economic, organisational, technical, technological, environmental, and other reasons;
- processing resources in small batches along with the continuous reduction of stocks in the supply chains to their optimum amount;
- reduction in lost profits in the resource supply chains by minimising the losses incurred while managing transport, stocks, and expectations [Tyapukhin, 2018, pp. 28–29, 36, 136].

The findings of the literature review performed in accordance with the above distinctive features of the logistics approach to managing the information flows are as follows:

In relation to its value to the consumers, customers, partners, and society as a whole:

- in marketing, consumer value is viewed as a "… unique combination of benefits received by a target customer group, including quality, price, convenience, on time delivery, pre-sale and after-sales service, i. e. a generalised view and opinion of value to the consumer"[2];
- according to A. P. Tyapukhin, and E. A. Tarasenko [2017, pp. 129–130], "… value is a combination of the unique characteristics of products (goods and/or services) and processes that have a positive or negative value to a consumer depending on their material, mental, or spiritual state". In the same paper, the concept of a "value flow" was first introduced and a classification of the flows of this type was presented;

[1] About American Marketing Association. Definition of Marketing. Available at: https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx

[2] Research into the market behaviour of consumers. Available at: https://studme.org/45320/marketing/issledovanie_povedeniya_potrebiteley_rynke. (in Russ.)

• V. I. Zorin [2002, p. 378] states that "… there are biological (health, strength), economic (wealth), aesthetic (beauty), moral (virtue), religious (sacred), and other values. ... values can be divided into three groups: true, good, and beautiful";

• the value of information is usually determined "… by comparing the options for achieving a given goal by some criteria. For example, the probabilities of attaining a certain goal may be compared with or without regard for the available information, or the options for achieving a goal can be compared before and after receiving information on the consumption of any useful resources"[1];

In relation to managing the flows of information resources:

• S. I. Ozhegov and N. Yu. Shvedova [1998, p. 572] define the flow as follows: "A flow is… 2. A moving mass of something …". From the definition it follows that it is not an actor that moves among the static inventory but the resources are moving toward their processors;

• information management refers to the establishment and use of information support systems for the production and business processes in an enterprise. It is based on a systems approach that covers all activities related to planning and managing processes aimed at providing the enterprise with the relevant information [Kuznetsova, 2017, p. 201];

• information flow management includes the "… collection, processing, storage, and interpretation of certain information, as well as the development and monitoring a system that allows for the most efficient collection and use of information"[2];

• "an information flow can be controlled ... by:

a) changing the direction of a flow;

b) limiting the transmission rate to the corresponding reception rate;

c) limiting the volume of a flow to the capacity of an individual node or path section" [Yanaeva, Rudnik, 2016, pp. 157–158];

• a detailed classification of the information resource flows is presented in the study guide edited by B. A. Anikin and T. A. Rodkina [2005, pp. 294–297];

• E. Yu. Davydova [2007, pp. 70–73] provides a classification of the corporate information systems, their modules, and stages of evolution;

• the process of managing the flows of information while working on the order placed by a consumer of goods and services is examined in the paper by V. I. Ionov and S. A. Makarenko [2011, pp. 247–253];

• organisation of the information flows within the company's innovation activities is studied by I. S. Minko and P. N. Kryakov [2014];

• D. A. Semushkin looks into the applied aspects of information flow management in relation to the production and logistics lifecycle support of the equipment [2012, C. 13–20].

At the same time, these and other publications pay little attention to the processes of managing information flows in supply chains which is the main control object in the innovation economy.

In relation to the cross-functional barriers in the information resource supply chains:

• the conflict situations between the chain links that lead to the cross-functional barriers "… arise due to differing operational goals and priorities, ... differing requirements to the composition and quality of the logistics service parameters, ... existence of the heterogeneous

[1] The value of information. Available at: https://www.intuit.ru/studies/courses/2191/423/lecture/9630?page=2. (in Russ.)

[2] Information flow management. Available at: https://technical_translator_dictionary.academic.ru/252270. (in Russ.)

information systems and document management systems, inconsistencies in specifications and parameters of the storage/retrieval units, ..."[1].

This means that at any time, there is a threat that the interests of an individual link (member) or several links would prevail over the common interests of the supply chain members and their opportunistic behaviour;

In relation to processing information resources:

- "… information processing is a process of deriving information objects from other information objects by running certain algorithms"[2];
- "… the functions (of information processing – authors' note) include acquisition and recording information resources, their storage, processing, updating to ensure the relevance of the supported information model for the subject area ..., as well as processing requests from the users"[3];

The reasons for the currently inefficient use of information technologies and, therefore, the information flows in the supply chains are:

- failure to understand the significance of the systems approach to the design and generation of the data intelligence intended for the supply chain links;
- lack of financial resources and poor management of their flows;
- poor reliability of data-transmission channels:
- cross-functional barriers of the information flow management within their supply systems **[Ogorodnikov, 2003, p. 7]**;

In relation to the reduction of lost profits in the resource supply chains:

- "…losses mean the ... non-realised income that ... a person would have received under the normal stream of commerce had their right not been violated (lost profit)"[4];
- "… lost profit means ... the unfulfilled opportunities to generate income, profit due to an ill choice of the course, mode of action"[5].

Thus, almost all managerial decisions have certain weak points. Therefore, there is a need to identify, analyse, develop, and implement the recommendations on reducing the lost profit within supply chains.

Logical and structural methods using a set of classification features derived from a terminological analysis of the information resource control objects and processes were chosen as research methods.

Revising the classification of values to the information resource consumers

To address the first task of the study, the concept of consumer value needs to be given an unambiguous interpretation, and differentiated from other related concepts.

One of the solutions is suggested in the paper by A. P. Tyapukhin, E. A. Tarasenko **[2017, p. 130]** (Fig. 1): "… value is distinct from a want in the unique consumer properties of a product

[1] Cross-functional and cross-organisational coordination in supply chains. Available at: https://docplayer.ru/62525116-Mezhfunkcionalnaya-i-mezhorganizacionnaya-koordinaciya-v-cepyah-postavok.html. (in Russ.)

[2] What is information processing? Available at: https://www.examen.ru/add/manual/school-subjects/mathematics-and-computer-science/computer-science/elektronnaya-versiya-uchebnika-po-informatike-10-11/glava-1-1-vvedenie-v-informatiku/18-chto-takoe-obrabotka-informaczii-19-chto-takoe-informaczionnyie-resursyi-i-informaczionnyie-texnologii. (in Russ.)

[3] The functions of information systems. Available at: https://studizba.com/lectures/10-informatika-i-programmirovanie/320-lekcii-po-avtomatizirovannym-informacionnym-sistemam-i-subd/4274-2-funkcii-informacionnyh-sistem.html. (in Russ.)

[4] The Civil Code of the Russian Federation. Part 1 of November 30, 1994 No. 51-FZ (eds. of August 3, 2018) (with the Additions and Amendments of September 1, 2018). Available at: http://www.consultant.ru/document/cons_doc_LAW_5142/4734407fbf4d5eec5306840f8b75b994e5d57090/. (in Russ.)

[5] Lost profit. Available at: https://ru.wikipedia.org/wiki/Упущенная_выгода. (in Russ.)

(goods and services) or, more precisely, in the particular way they are perceived by the consumer, and also from the usual way of living – in its dependence on the material, mental, or spiritual state (or stability of the state) of the consumer".

From this solution, the following conclusions can be drawn.

Information resources are capable of:

• satisfying consumer needs, provided that they are in consistent demand and the information has typical properties – for example, through the mass media;

• satisfying the wants under conditions of variable consumer demand for the typical information, for example, by disregarding bits of information or requiring further details of its specific aspects;

		Consumer properties of resources	
		Typical	Unique
Consistent	Need	Usual way of living
Properties (parameters) of consumer demand			
Variable	Want	Value

Fig. 1. Classification of resource consumer's preferences

Рис. 1. Классификация предпочтений потребителя ресурсов

• ensuring the usual way of living of the consumer with regard to some unique properties of the information received by the consumer, which makes the sender make adjustments to it in advance;

The value of information to its consumer:

• uniqueness and dependence on demand, which requires the creation of a local data transmission channel that would ensure its confidentiality and ensure sender feedback;

• ability to ensure consumer's competitive advantages in the market by means of its timely processing, as well as through the development and implementation of rational managerial decisions;

• influence on other links in the resource supply chain; therefore, one should bear in mind the main types of information values at the level of a separate actor (individual) (Fig. 2) and at the level of the resource supply chain, in whole or in part (link, channel) (Fig. 3);

Figs. 2 and 3 intend to clarify the concept of the "supply chain sustainability management", which is currently understood as "managing material, information, and capital flows, as well as the cooperation among enterprises in the form of supply chains that use three aspects of sustainable growth – i. e. economic, ecological, and social – as their goals, with reference to the customer interests and owners' requirements" [Seuring, Müller, 2008, p. 1700]. Figs. 2 and 3 imply that there are not three but eight of such aspects.

		Pattern of actor's behaviour towards the external environment	
		Adaptation	Development
As an organism	Biological value	Physiological value
Nature of actor's evolution			
As an individual	Educative value	Innovative value

Fig. 2. Classification of actor's values

Рис. 2. Классификация ценностей исполнителя

	Pattern of behaviour displayed by the system in whole or in part	
	Towards the external environment	Links towards each other
Survival **Society goals** Improvement of the quality of living	Ecological value	Communicational value
	Economic value	Moral value

Fig. 3. Classification of society values
Рис. 3. Классификация ценностей общества

Revising the classification of the information resource flows and their optimisation methods

Managing resource flows in their supply chains is usually accompanied by poorly structured information entering the management system, the need to process large volumes of often unrelated data, their seasonality.

As for the human factor, the big role here is played by prompt decision-making and professionalism of those who do that.

Both factors are based on the information and all the related concepts. The very concept of information obviously implies the existence of two objects, namely, the source of information and the consumer. At the same time, it is important for the information to make sense to the consumers, so that they could evaluate it depending on where and for what particular purpose it is being used. In this regard, we can distinguish the aspects of information (Fig. 4).

	Approaches to information management	
	Quantitative	Qualitative
Processing **Stage of information management** Use	Statistical aspect	Structural aspect
	Pragmatic aspect	Semantic aspect

Fig. 4. Classification of information management aspects in resource supply chains
Рис. 4. Классификация аспектов управления информацией в цепях поставок ресурсов

The *statistical aspect* is presented in a sub-discipline of cybernetics – the information theory – which deals with mathematical description and evaluation of information transmission, storage, and classification methods. The foundations of the information theory were laid in 1948 by C. Shannon, the US mathematician who introduced the concept of the "quantity of information" as a measure of uncertainty that is cleared up once the information is received; and developed a probabilistic approach to estimating the quantity of information, according to which the measure of the missing information appears as the entropy of a system. The *semantic aspect* builds upon the concept of the "information value" that depends on the time of its receipt and use. The semantic measure of information can be evaluated using the concept of a "thesaurus". The *structural aspect* involves the construction of information arrays, which is of particular relevance to the information storage and use. The *pragmatic aspect* covers the achievement of goals facing the resource supply chain at a given time with a possible disregard for a portion of information that impedes the development and making of managerial decisions appropriate to the current situation.

It is well-known that the information circulating within a resource supply chain can be divided into external and internal. Such division is conditional and depends on the level at which a specific link or links are in the resource supply chain. The internal information is mainly

systematised by GOST, OST, and other regulatory documents, i. e. it is structured. The external information can be unstructured, in whole or in part, and generally be of an advisory nature, aimed at improving the efficiency of a resource supply chain.

Apart from division by various functional areas, when addressing the logical issues, the classification of information that circulates in the resource supply chains is categorised by its relevance and importance (primary, secondary or unrelated to a particular supply chain link). It requires sorting by selected aspects or those that are most important at a given time.

Therefore, it is important to identify the necessary and sufficient information. This is confirmed by the studies that proved that dependence of the control system response (e.g. decision-making) is inversely proportional to the signal intensity (of the incoming information).

Development of the classification of the information resource flows and methods for their optimisation should be grounded on, among other things, identification of a number of their classification features that were not previously considered:

1) a supply chain as "… a system of suppliers and intermediaries (links) who form channels, chains, fronts, and echelons of supply and perform resource flow consolidation and downsizing processes in order to design, create, inform customers and deliver values to the end users of goods and services" **[Tyapukhin, 2018, p. 98]** (homogeneous and heterogeneous information flows such as "channel", "chain", "front", and "echelon") (Fig. 5);

		Homogeneity of information flows	
		Consistent (homogeneous)	Inconsistent (heterogeneous)
Series		"Channel" or "chain" homogeneous flows	"Channel" or "chain" heterogeneous flows
Information flow transmission methods			
Parallel		"Front" or "echelon" homogeneous flows	"Front" or "echelon" heterogeneous flows

Fig. 5. Classification of information flows by types of supply systems

Рис. 5. Классификация информационных потоков по типу систем поставок

2) "number of information flow consumers" and "number of messages in a flow" (the simple and complex flows of an exclusive and public nature) (Fig. 6);

		Number of information flow consumers	
		Limited	Unlimited
Insignificant		Simple exclusive flows	Simple public flows
Number of messages in a flow			
Significant		Complex exclusive flows	Complex public flows

Fig. 6. Classification of information flows by their nature

Рис. 6. Классификация информационных потоков по их характеру

3) "control object" and "stage of managerial decision-making" (reference, analytical, administrative, and regulatory information flows) (Fig. 7);

		Stage of managerial decision-making	
		Preparation	Implementation
Information		Reference	Analytical
Control object			
Personnel		Administrative	Regulatory

Fig. 7. Classification of information flows by types of managerial decisions

Рис. 7. Классификация информационных потоков по характеру управленческих решений

4) "control object" and "functions of information provision" (associated information flows) (Fig. 8);

	Functions of information provision	
	Auxiliary	Primary
Resources	Reference	Analytical
Control object		
Processes	Administrative	Regulatory

Fig. 8. Classification of associated information flows by functional criterion

Рис. 8. Классификация сопутствующих информационных потоков по функциональному признаку

5) "availability of access to information" and "identification of information consumers" (closed and open flows with no or restricted user access) (Fig. 9).

	Identification of information consumers	
	Unidentified	Identified
Not available	Closed flows (no access)	Closed flows with restricted access
Availability of access to information		
Available	Open flows (with access)	Open flows with restricted access

Fig. 9. Classification of information flows in terms of their security

Рис. 9. Классификация информационных потоков с точки зрения их безопасности

6) "supply chain field of activity" and "identification of information consumers" (routine, control, statistical, analytical, regulatory, and training and security-related flows) (Fig. 10);

	Identification of information consumers		
	Preparation	Implementation	Analysis
Economy	Routine	Control	Statistical
Field of activity			
Management	Analytical	Regulatory	Training/security

Fig. 10. Classification of information flows by their role in the management system

Рис. 10. Классификация информационных потоков по их роли в системе управления

4 "novelty of information", "access to information", and "commercialisation of information" (eight types of information flows in their supply system (Table 1) – security-related, confidential, introductory, marketing, research, commercial, educational, and innovative);

Table 1. **Comprehensive classification of information flows**

Таблица 1. Комплексная классификация информационных потоков

Novelty of information	Access to information	Commercialisation	Type of information flow
None	No	No	Security
None	No	Yes	Confidential
None	Yes	No	Introductory
None	Yes	Yes	Marketing
Yes	No	No	Research
Yes	No	Yes	Commercial
Yes	Yes	No	Educational
Yes	Yes	Yes	Innovative

If we recall that logistics as an enterprise management concept includes not only supply-chain (process flow) management, but also value flow management based on the aspects of "quantity", "quality", "costs", and "time" [Tyapukhin, 2018, p. 51], we can suggest a classification of methods for information flow optimisation (Fig. 11).

		Information flow objects	
		Quantity	Quality
Costs		1.1 Focus on cost saving by reducing the amount of information	3.1 Focus on cost saving by improving the quality of information
Restrictions to the information flow parameters		1.2 Focus on increasing the amount of information by increasing spending	3.2 Focus on improving the quality of information by increasing spending
		2.1 Focus on time saving by reducing the amount of information	4.1Focus on time saving by improving the quality of information
Time		2.2 Focus on increasing the amount of information by increasing the time input	4.2 Focus on improving the quality of information by increasing the time input

Fig. 11. Classification of methods for optimisation of information flows

Рис. 11. Классификация методов оптимизации информационных потоков

When implementing the logistics approach to managing the information flows, it is important not only to identify their quantitative parameters and qualitative characteristics, but also, following the situational approach, to justify the choice of optimisation methods for the resource flows and other components of logistics management, which include systems, territories, and their movement patterns [Tyapukhin, 2018, p. 51].

Developing a classification of the cross-functional barriers within supply chains of information resources and their root causes

To classify the cross-functional barriers within supply chains of information resources the following classification features were applied: "functions of the resource supply chain" and "nature of tasks performed by the resource supply chain" (Fig. 12).

		Nature of tasks performed by the resource supply system	
		Economic	Managerial
Resource processing		Technological	Human
Functions of the resource supply system		Financial	Organisational
Resource processing support			

Fig. 12. Classification of cross-functional barriers in information resource supply chains by function

Рис. 12. Классификация межфункциональных барьеров в цепях поставок информационных ресурсов по функциональному признаку

Fig. 12 allows us to identify not only local (technological, financial, human, and organisational) cross-functional barriers, but also the combined binary (e.g. technological and financial) and ternary (e.g. technological, financial, and organisational), as well as the complex ones which comprise the barriers of all types shown in Fig. 12.

There is an obvious need to classify cross-functional barriers that exist in the supply chains of information resources by their major components:

- management of value flows: by the quantity and quality of information, costs and time required to transmit it;

• supply chain (process flow) management: by the type of links in resource supply systems, i. e. technological (Tch), commercial (Cm), logistics (L), and end user (Usr) (Table 2).

Table 2. **Classification of cross-functional barriers in information resource supply chains by types of their links**

Таблица 2. Классификация межфункциональных барьеров в цепях поставок информационных ресурсов по типу их звеньев

Link type	Technological	Commercial	Logistics	End user
Technological	Tch - Tch	Tch - Cm	Tch - L	Tch - Usr
Commercial	Cm - Tch	Cm - Cm	Cm - L	Cm - Usr
Logistics	L - Tch	L - Cm	L - L	L - Usr
End user	Usr - Tch	Usr - Cm	Usr - L	Usr - Usr

As it follows from Table 2, there are 16 types of cross-functional barriers that can be distinguished in the supply chains of information resources, each of which needs to be elaborated and further standardised in order to facilitate the making of managerial decisions in the analysed supply chains. Since the links of the information resource supply chains also have a complex structure, it is advisable to identify the main types of cross-functional barriers at the level of their major subsystems presented in the article [Kameneva, Krylova, 2013, p. 430], similar to the data in Table 2. It needs to be remembered that among these subsystems there are those associated with routs of logistic flows, plant and equipment, production tools, transport, storage, packaging, energy, personnel, and subcontractors.

In terms of logistics, the basic classification of the cross-functional barriers existing in the information resource supply systems is the one that reflects the interrelations between various types of logistic flows – material, information, financial, and human.

It is also worth considering the classification of the cross-functional barriers by types of main business processes performed by the links of the information resource supply chain [Tyapukhin, 2018, p. 53], such as strategic management and management of products, technology, logistics, finance, requirements, personnel, as well as consumer and supplier relation management.

In a similar way, it is possible to identify the cross-operational barriers that exist in the supply chains of information resources. This requires pairwise comparison of the main types of logistics operations, such as transportation, storage, warehousing, consolidation/downsizing, sorting, labelling, packaging, and stocking up.

Classification of root causes of the cross-functional barriers in the supply chains of information resources is presented in Fig. 13. These barriers are identified from such classification features as the "type of management situation" and "functions of the resource supply chain".

	Type of management situation	
	Force-majeure	Non-routine
Resource processing **Functions of the resource supply chain** Resource processing support	Malfunctions/failures	Inconsistency with the rate (rhythm) of technological operations
	Lack of supporting resources	Inconsistency with the type of information resources

Fig. 13. Classification of root causes of cross-functional barriers in supply chains of information resources

Рис. 13. Классификация причин возникновения межфункциональных барьеров в цепях поставок информационных ресурсов

It can be seen from Fig. 13 that these causes include: malfunctions/failures, lack of resources supporting the main resource flow, inconsistency with the rate (rhythm) of technological and

logistic operations, as well as unfitness of the information resources for the equipment and resources used by the links.

Identifying the basic options for managerial decisions in the information resource supply chains and specifying their interrelations

To address the fourth task, we should use the recommendations of the article by A. P. Tyapukhin [Tyapukhin, 2018, p. 35] that reflects the basic options for managerial decisions in the supply chains of material resources. Choosing in the similar way the same components of the value flow management ("product" and "price") we come to four options for the targeted managerial decisions – A, B, C, and D (Fig. 14).

Managerial decision A involves building up and using the stock of information resources to reduce the time needed to collect and process the information, as well as to implement this decision. It should be kept in mind that the economies of scale intrinsic to processing material resources may not be achieved when processing the information resources.

Managerial decision B is focused on increasing the spending on collecting and processing information. It is assumed that higher-quality information would reduce the amount of lost profits in resource supply chains.

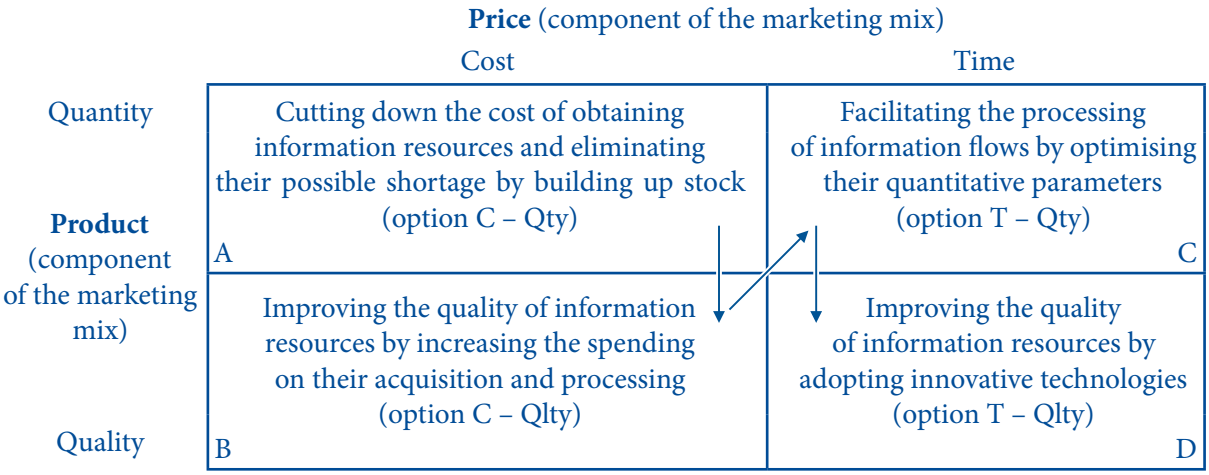

Fig. 14. Basic options for managerial decisions in information resource supply chains and their interconnection

Рис. 14. Базовые варианты управленческих решений в цепях поставок информационных ресурсов и их взаимосвязь

Managerial decision C provides for dealing with small volumes of information in order to reduce the lead time for collecting and processing that information;

Managerial decision D is aimed at generating value to the consumer of information resources, which includes the adoption of innovative technologies to facilitate management.

While material resource management is more likely to have one of the managerial decisions implemented, as follows from the evolution of the resource supply chain, information resource management can implement decisions A, B, C, and D together at various levels.

An important logistical aspect to be considered when making decisions related to information flow management (IFM) is their relationship with the management of other types of resource flows – material (MFM), financial (FFM), and human (HFM). Combinations of these solutions with preference given to managing information flows in the resource supply chains are presented in Table 3.

Table 3. **Main combinations of managerial decisions in resource supply chains with prioritisation of the information flow management**

Таблица 3. Основные комбинации управленческих решений в цепях поставок ресурсов при приоритете управления информационными потоками

Flow management			Combinations of managerial decisions
Material	Financial	Human	
0	0	0	IFM
0	0	1	IFM - HFM
0	1	0	IFM - FFM
0	1	1	IFM - HFM- FFM
1	0	0	IFM - MFM
1	0	1	IFM – MFM - HFM
1	1	0	IFM – MFM - FFM
1	1	1	IFM – MFM - FFM- HFM

The use of the data from Table 3 implies managing integrated resources flows, generally described in the article by A. P. Tyapukhin [2018, pp. 215–223] drawing on the example of material flow management.

Specifying the structure of lost profits in the information resource supply chains

To address the fifth task of the research, we will also use the recommendations given in the article [Tyapukhin, 2018, p. 135]. After the relevant revision of the initial solution, an improved structure of logistics costs in the information resource supply chains is presented (Fig. 15).

	Logistics cost element	
	Actual costs	Lost profit
Object of management **Element of the information resource supply system** Subject of management	Costs of performing logistics functions and information processing operations	Losses due to immobilised assets in stock or to disregarded information resources
	Costs of operating the information resource supply system	Losses due to poor management of the information resource supply system

Fig. 15. Structure of logistics costs in information resource supply chains

Рис. 15. Структура логистических затрат в цепях поставок информационных ресурсов

Unlike the losses in the supply chain of material resources, the losses caused by immobilisation of assets in information resource reserves:

- are generated mainly by the lack of or delay in receipt of relevant information in the supply chain management system. Therefore, losses of this type should be dealt with and evaluated together with those caused by poor management of information resource supply chains;
- arise due to the existence of chronic and repetitive cross-functional barriers in resource supply chains;
- concern not only the interruption, but also the excess of information, its irrelevance, distortions, misinterpretation, and obsolescence of information in supply chain links;
- are analysed and summarised after a certain period of time, when previously unclear aspects related to the making and implementation of managerial decisions become available to researchers.

The research justifies the sequence of operations required to implement a logistics approach to managing information flows in resource supply chains, as presented in Fig. 16.

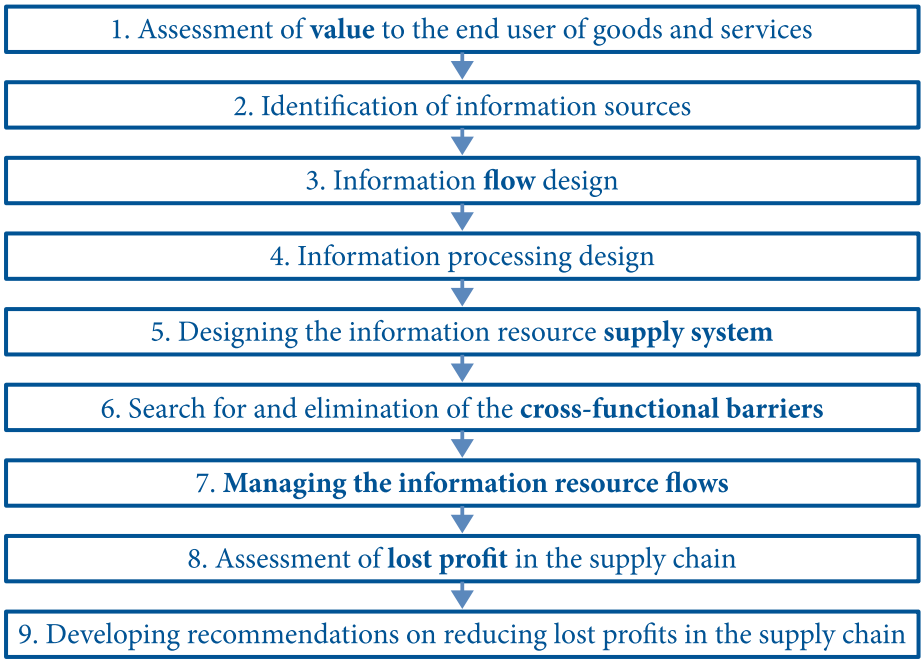

Fig. 16. Sequence of operations required to implement the logistics approach to managing information flows in supply chains

Рис. 16. Последовательность работ по внедрению логистического подхода к управлению информационными потоками в цепях поставок

Conclusion

The study suggests that development of the theory of logistics and application of its principles and methods to the business processes of the Russian enterprises are an important factor in ensuring their competitiveness in an innovation economy aimed at creating value to the end users of goods and services.

The article provides the following findings being a scientific novelty:

- revised classification of consumer values based on the specifics of information resources;
- revised classification of the information resource flows and methods for their optimisation;
- classification of the cross-functional barriers that exist in the information resource supply chains, and their root causes;
- specified options for managerial decisions in the information resource supply chains, and their interrelations;
- specified structure of lost profits in the information resource supply chains.

The future research may focus on:

- developing methods for assessing the value to the information resource consumer, including those in the organisational structures of management;
- specifying the information resource concentration, distribution, and motion processes within their supply chains;
- developing methods for identifying the cross-functional barriers in the information resource supply chains, as well as recommendations on their minimisation or elimination;
- revising the qualitative characteristics of information flows and the content of managerial decisions when implementing the main business processes of the resource supply chains.

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Особенности логистического подхода к управлению информационными потоками

Аннотация. Исследование направлено на уточнение сущности и дополнение содержания логистического подхода к управлению информационными потоками в цепях поставок. Особенностями подхода являются: создание и доставка ценности конечному потребителю продукции и услуг; ориентация на управление потоками ресурсов, устранение межфункциональных и межоперационных барьеров в цепях поставок, сокращение упущенной выгоды. Методологической базой исследования являются теоретические и методические положения логистики и логистического менеджмента применительно к управлению информационными потоками в цепях поставок. В исследовании использованы терминологический и системный анализ, логико-структурные методы, методы группировок и классификации. Предложена классификация ценностей потребителей с учетом специфики информационных ресурсов; уточнена классификация потоков информационных ресурсов и методов их оптимизации; разработана классификация межфункциональных барьеров в цепях поставок информационных ресурсов и причин их возникновения; уточнены варианты управленческих решений в цепях поставок и их взаимосвязи; отражена структура упущенной выгоды в цепях поставок информационных ресурсов. Результаты исследования позволяют уточнить и дополнить теорию и методологию управления информационными потоками в цепях поставок и повысить конкурентоспособность их звеньев на основе повышения качества обслуживания конечных потребителей продукции и услуг.

Ключевые слова: ценность; цепь поставок; логистический подход; информационные потоки; межфункциональные барьеры; управленческие решения; упущенная выгода.

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