



# Classification of Objects of Supply Chain Management to Ensure Their Sustainability



Evgenia A. TARASENKO

**Evgenia A. Tarasenko** <sup>1,2</sup>

<sup>1</sup> Institute of Economics of Ural Branch of Russian Academy of Sciences, Orenburg, Russia.

<sup>2</sup> Orenburg State Transport University, Orenburg branch of Samara State Transport University, Orenburg, Russia.

✉ [t\\_e\\_a\\_t@mail.ru](mailto:t_e_a_t@mail.ru).

## ABSTRACT

Classifications of objects of supply chain management create the basis for managing their sustainability. The author proposes a hierarchy of priorities regarding managed objects – systems, processes and relations, which implies creation of adequate anti-crisis measures for operational management of resource flows.

The objectives of the study are to clarify and supplement classifications of supply chain management objects based on their qualitative characteristics. The tasks of the study are to identify the problems of classification of objects of supply chain management, to determine the prerequisites and to determine ways to solve these problems.

The methodological basis of the research is formed by the provisions of logistics as a science of resource flow management

and supply chain management as a science of managing systems and processes of creating value for end users of products and/or services.

Logical-structural methods and tools of binary matrices have allowed to develop classifications of flows of the first (A) and second (B) levels, creating basis for adoption of codes of those flows indicating types of systems and processes and ensuring thus their sustainability. The proposed hierarchy of prioritisation of managed objects reveals the dependences that govern the anti-crisis measures of operation management of resource flows. The research results make it possible to eliminate the contradictions between the goals of the supply chain links (suppliers) and requirement chains (consumers) and, on this basis, to organise their effective interaction.

**Keywords:** flow, integrated flow, flow sustainability, process, supply chain, value.

*For citation:* Tarasenko, E. A. Classification of Objects of Supply Chain Management to Ensure Their Sustainability. World of Transport and Transportation, 2021, Vol. 19, Iss. 2 (93), pp. 192–198. DOI: <https://doi.org/10.30932/1992-3252-2021-19-2-7>.

**The text of the article originally written in Russian is published in the first part of the issue.**  
**Текст статьи на русском языке публикуется в первой части данного выпуска.**

INTRODUCTION

The term «supply chain» refers to terms, the essence and content of which are still not entirely clear. On the one hand, the supply chain is defined as «a group of independent organisations connected together through the products and services that they separately and/or jointly add value on in order to deliver them to the end consumer» [1]. On the other hand, a supply chain is «a complex network of relationships that organizations maintain with trading partners to source, manufacture, and deliver products. It encompasses all activities associated with flow and transformation of goods and services from the point of origin, through to the end user, as well as the associated information and financial flows» [2]. The ambiguous interpretation of the term «supply chain» imposes serious restraints on the theory and methodology of sustainable supply chain management (hereinafter – SSCM).

The *objective* of the study is to clarify and supplement classifications of supply chain management objects, such as flows, enterprises, relationships between them and processes based on their qualitative characteristics, formed based on the components of the logistics complex, which include quality, quantity, costs, time, territory, and trajectory. Achievement of the set goals is ensured through binary matrices formed based on a set of actual qualitative features and their dichotomies which are two opposite states of these features.

This makes it possible to clarify the content of the management system for supply chain management components based on a systematic approach, as well as to create necessary theoretical

prerequisites for increasing its efficiency in highly competitive markets.

The *methodological* basis of the research is made up of logical-structural methods, such as analysis and synthesis, induction and deduction, grouping, typology and classification, and binary matrices are used as a research tool, which makes it possible to unambiguously characterise the objects of supply chain management.

RESULTS

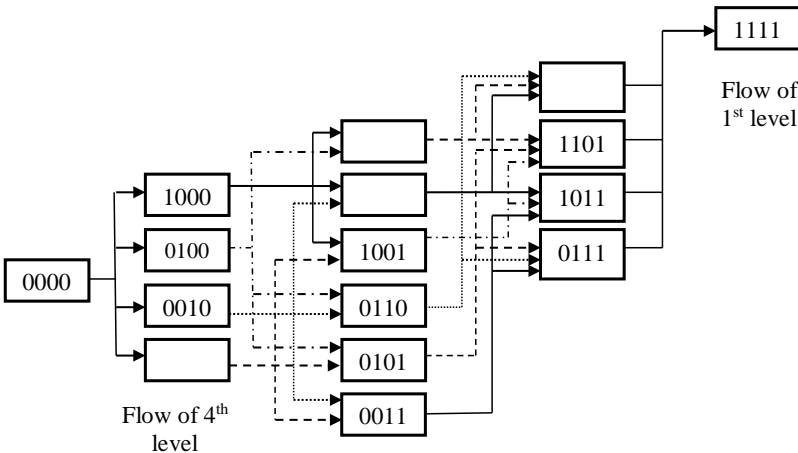
Clarifying and Supplementing Classifications of Objects of Supply Chain Management

A very significant aspect contributing to achievement of the research objective is the definition of SSCM as management of material, information and capital flows, as well as cooperation between companies along the entire supply chain, considering the goals... of three dimensions of sustainable development, i.e., economic, environmental and social factors, taking into account the requirements of customers and stakeholders [3].

In the above definition, the term «flow» is used, which, according to a number of authors, is the object of logistics research [4].

Thus, classification of supply chain management objects can be used to ensure sustainability of resource flows.

The specificity of managing stability of resource flows is determined by their type. Various classifications of flows have been proposed [5–9]. Nevertheless, within the framework of sustainability management, it is advisable to refine these classifications using the following qualitative characteristics:



Pic. 1. Sequence and variants of formation of an integrated flow of resources (developed by the author).



**Classification of variants of the integrated flow of resources  
(developed by the author)**

Material flow (not taken into account – 0, taken into account – 1)	Information flow (not taken into account – 0, taken into account – 1)	Financial flow (not taken into account – 0, taken into account – 1)	Human flow (not taken into account – 0, taken into account – 1)	Code of resource flow
0	0	0	0	0000
0	0	0	1	0001
0	0	1	0	0010
0	0	1	1	0011
0	1	0	0	0100
0	1	0	1	0101
0	1	1	0	0110
0	1	1	1	0111
1	0	0	0	1000
1	0	0	1	1001
1	0	1	0	1010
1	0	1	1	1011
1	1	0	0	1100
1	1	0	1	1101
1	1	1	0	1110
1	1	1	1	1111

• Type of resource flow object: real; not material.

• Factors of activity of links of the supply chain: economic, managerial ones.

These signs of classification (type «A») make it possible to distinguish four types of resource flows: material, information, financial, and human flows. The use of human flows as flows (Pic. 1) is due to the opinion of A. Halley, A. Guilhon [10] that «logistics is based on sustainable human resource management».

If we imagine the process of forming the structure of an integrated flow as a sequential combination of flows of the same level (jets), then on the basis of four types of flows identified above, 16 variants of the integrated flow can be obtained (Table 1).

As follows from Table 1, based on the fourth level of flows with codes 0001, 0010, 0100, and 1000, six third-level flows, four second-level flows and one first-level flow (integrated flow) can be obtained. The sequence and options for formation of an integrated flow are shown in Pic. 1. The formation of an integrated flow can occur in parallel, bypassing one or another level [11]. It is expedient to consider the flows of the lower level in relation to the flows of the higher level as jets. When managing resource flows, each of flows is characterised by a level of stability, which can change under the influence of the internal and external environment, which implies establishment and monitoring of priorities for

managing certain jets of resource flows. The priorities of jets of flows imply their classification of type «B» using the attributes: the relation of the flow to the value of the end user (creation; accompaniment); type of link forming the flow (absorbing link; generating link); the influence of the flow on quality of the value (determining; secondary impact) (Table 2).

Data of Tables 1 and 2 create the prerequisites for creation of resource flow codes that are convenient for the use with the help of computer support within the digitalisation of supply chain management. So, for example, the code «1100–010» means an auxiliary integrated flow (third level), which includes material and information flows (jets). For a detailed understanding of types of flows of Table 2 Table 3 was developed, specifying their types using the example of «the value of clean clothes for the end user».

Let's define these parameters and characteristics of the flow using the example of the flow of material resources.

First, it is necessary to identify objects of the flow of this type based on the following classification features: purpose of the flow object (maintaining value; value delivery); relation of the flow object to the value (creation; accompaniment). It is possible to differentiate the following objects of material flow: products (value carriers), containers (packaging), vehicle and loading-unloading devices.

Based on the modern works developing the model of marketing mix whose foundations have

Table 2

Classification «B» of flows of resources (developed by the author)

Ratio of the flow to the end user value (creation – 0, maintenance – 1)	Type of the link that forms the flow (absorbing link – 0, generating link – 1)	Influence of the flow on quality of the value (determining impact– 0, minor impact – 1)	Flow type
0	0	0	Main
0	0	1	Optional
0	1	0	Auxiliary
0	1	1	Indirect
1	0	0	Accompanying
1	0	1	Side
1	1	0	Supportive
1	1	1	Utility

Table 3

Components of the flow with the code «1100–010» using the example of «The value of clean clothes for the end user» (developed by the author)

Flow type	Example of an object	
	Material flow	Information flow
Main	Washing machine	Instruction manual
Optional	Houses for water and its drain down the drain	Recommendations for installation of houses for water
Auxiliary	Vehicle to move a washing machine and washing powder to the place of their sale	Information about the location of the purchaser of the washing machine and washing powder
Indirect	Loading-unloading devices of the manufacturer and the consumer	Safety instruction for operation of loading-unloading devices
Accompanying	Washing powder	Data on consumption of washing powder
Side	Dispenser for washing powder	Price data for dispenser for washing powder
Supportive	Fuel and lubricants for a vehicle and loading-unloading devices	Fuel consumption standards for a vehicle and loading-unloading devices
Utility	Pull attachments	Load limit information and checking of pull attachments

been created in the works of E. J. McCarthy devoted to 4P's [12], it is possible to reveal several enlarged quantitative parameters of flows (Table 4).

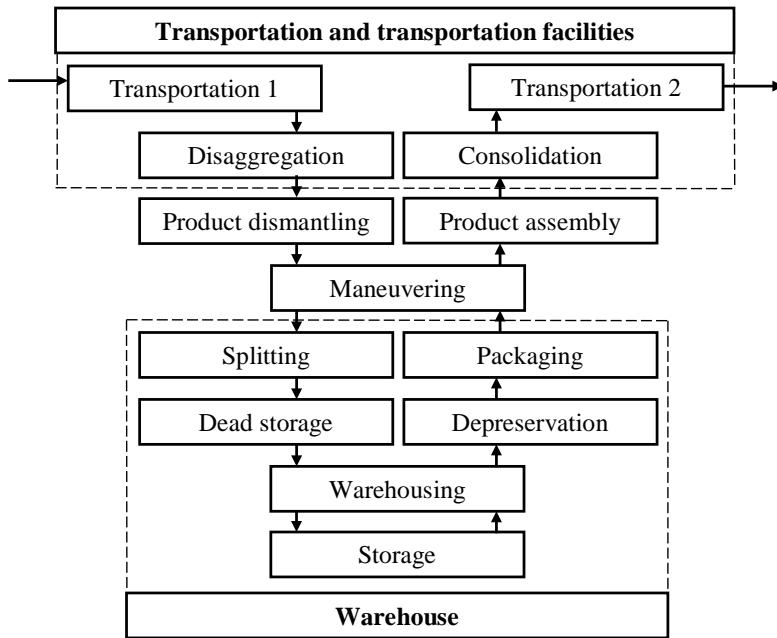
As can be seen from Table 4, in addition to the parameters «quantity», «quality», «costs» and «time», it is proposed to use the parameters «trajectory» and «territory». It is easy to see that these parameters concretise the «place» component of the marketing [13]. The parameter «trajectory» is used in trajectory-based management to generalise, update and implement the description of transport processes at all stages of strategic and tactical coordination and operation [14]. The «territory» parameter assumes focus on economically justified boundaries of the activity of the supply chain link. For example, when the growth in sales of products and/or services is constrained by an increase in transportation costs for their delivery to the end consumer [14].

SUSTAINABILITY MANAGEMENT

Flow sustainability management is provided by enterprises which are links in the supply chain. These links form systems of various configurations depending on the requirements of end consumers. The type of links and their geographic locations form the trajectories along which resources move. Classification of the links in the supply chain, based on such classification features as tasks of the links in the supply chain (value creation and maintenance), priority type of goods (product; service), allows us to highlight the technological, trade, logistics links and infrastructure links [15].

The movement of resource flows is provided by processes (operations), which can also be assessed from the standpoint of their sustainability and impact on management of resource flows. These processes can be distinguished using the classification features: state of resource flow objects (rest and movement); stability of resource





*Pic. 2. Sequence of processes (operations) of management of material resources flows (developed by the author).*

flow parameters (parameters do not change and do change). Based on these features, the following resource flow management processes are formed: transportation, storage, packaging (picking), and consolidation/unbundling. In some cases, it is advisable to move from processes (Pic. 5) to operations. If we use such classification signs as location of the product (outside the storage area (vehicle) and in the storage area (vehicle)), type of flow object (product and loading and unloading device), it is possible to distinguish operations that link storage and transportation of products: depreservation (removal from long-term storage)/preservation, storage (manoeuvring), installation/dismantling and waiting.

The totality of the processes and operations highlighted above allows us to draw the following conclusions. Only logistic processes (operations) are considered. If necessary, technological and other types of processes (operations) can be added to them. Evaluation of flow sustainability management should be carried out over a time interval that assumes that several processes are performed by supply chains. If we take the warehouse form of movement of resources according to the scheme «transportation–storage–transportation» as a basis, then it is possible to form a sequence of processes (operations) for managing resource flows (Pic. 2).

During movement of the material flow (if it is the main one), the accompanying flows are also moving (Table 1). The stability of accompanying flows can significantly affect stability of the main flow. By analogy with the above classifications of processes related to material flow management, the processes accompanying information, financial and human flows can also be identified (Table 5).

Analysis of the contents of Table 5 allows us to draw the following conclusions. Each of the processes (operations) of resource flow management can be structured into components. When controlling an integrated flow, at a certain point in time, several processes (operations) can be performed with flows (jets) entering it, differing in parameters and characteristics, which requires their joint analysis. Each of flows can be denoted by a code similar to the code used for a material flow. The flow code is constantly changing during its movement, including due to changes in the parameters of the accompanying flows. An integrated flow can be designated by a four-level code, depending on the types of flows (jets) included in it, identified according to the classifications «A» and «B». Moreover, each of flows (jets) includes flows (jets) of the lowest level with their corresponding codes. The topic of coding resource flows and the methodology for its use is the topic of a separate study.

Table 5

**Classification of processes accompanying information, financial and human flows  
(developed by the author)**

Flow types	Classification features	Processes
Information	<ul style="list-style-type: none"> <li>• type of link in the information supply channel: sender, recipient.</li> <li>• aspect of work with information flow: managerial and technical.</li> </ul>	<ul style="list-style-type: none"> <li>• structuring information, preparing a message.</li> <li>• choice of information transmission method and its coding.</li> <li>• transmission of information and its decoding.</li> <li>• processing of the received information.</li> </ul>
Financial	<ul style="list-style-type: none"> <li>• type of link in the supply chain of financial resources: the sending bank; beneficiary bank (1).</li> <li>• aspect of work with financial flow: economic; technical.</li> </ul>	<ul style="list-style-type: none"> <li>• writing off by the consumer's bank of financial resources from the consumer's account.</li> <li>• transfer of financial resources by the consumer's bank to the supplier's bank.</li> <li>• crediting financial resources to the supplier's account.</li> <li>• receipt of financial resources by the supplier.</li> </ul>
Human	<ul style="list-style-type: none"> <li>• stage of human flow formation: analytical and practical.</li> <li>• levels of coordination of the parameters of the human flow: process operations.</li> <li>• knowledge, skills, and abilities – human resources.</li> </ul>	<ul style="list-style-type: none"> <li>• research of the content of operations of the process and determination of the list of resources for its implementation.</li> <li>• justification of knowledge, skills and abilities of human resources to carry out the operations of the process.</li> <li>• training and/or attracting human resources of the relevant profession and qualifications.</li> <li>• formalising relationships with human resources and familiarising them with the operations of the process.</li> </ul>

Table 6

**Parameters of managed objects (developed by the author)**

Parameters of managed objects	Managed objects		
	Resource flow	Resource supply chains	Processes (operations) of resource flow management
Quantity	+	+	+
Quality	+	+	+
Costs	+	+	+
Time	+	+	+
Territory		+	
Trajectory	+		

Table 7

**Hierarchy of priorities of managed objects (developed by the author)**

Quality (Q)	Quantity (K)	Costs (Z)	Time (T)	Priority of managed objects (code)
0	0	0	0	Usual (5)
0	0	0	1	Actual (4-T)
0	0	1	0	Actual as per costs (4-Z)
0	0	1	1	Significant (3-ZT)
0	1	0	0	Actual as per quantity (4-K)
0	1	0	1	Significant (3-KT)
0	1	1	0	Significant (3-KZ)
0	1	1	1	Important (2-KZT)
1	0	0	0	Actual as per quality (4-Q)
1	0	0	1	Significant (3-QT)
1	0	1	0	Significant (3-QZ)
1	0	1	1	Important (2-QZT)
1	1	0	0	Significant (3-QK)
1	1	0	1	Important (2-QKT)
1	1	1	0	Important (2-QKZ)
1	1	1	1	Especially important (1)





Thus, sustainability of resource flows is a criterion for sustainability of supply chains, requirement chains, value chains, and the processes that these chains perform. By analogy with the data in Table 4, each of the managed objects listed above can be assessed by six basic quantitative parameters (Table 6). Each of the objects of management presented in Table 6 (first of all, the flow of resources) has a priority, which is formed on the basis of stability of their parameters. These priorities form a hierarchy both at the stage of preparation for creating value for the final consumer of products and/or services, as well as at the stage of operational management of facilities. Based on four parameters of managed objects, five levels of priorities can be distinguished: usual, actual, significant, important and especially important (Table 7).

## CONCLUSIONS

As a result of the research carried out, classifications of flows of the first («A») and second («B») levels have been developed that seem to be of research novelty/ The classifications create the basis for using the codes of these flows indicating the types of systems and processes that ensure their stability.

The hierarchy of priorities of managed objects has been suggested depending on which anti-crisis measures of operational management of resource flows are implemented.

The developed approaches allow to eliminate contradictions between the links of the supply chain and the requirement chain that achieve their own goals and are interested in reducing the lost profit, to organise their interaction within the framework of managing relationships with suppliers and consumers, to create and maintain a system for monitoring sustainability of the flow of resources, as well as introduce anti-crisis measures to prevent a decline in the values of end consumers.

## REFERENCES

1. Lu, D. Fundamentals of Supply Chain Management, 2011. [Electronic resource]: <https://library.ku.ac.ke/wp-content/downloads/2011/08/Bookboon/Magement%20andOrganisation/fundamentals-of-supply-chain-management.pdf>. Last accessed 12.01.2021.
2. Chen, Hui-Huang; Liu, Kuo-Shean; Chen, Shih-Chih; Chang, Chan-Yen; Hsieh, Kai-Shih; Yang, Wang. An overview of workflow management system structure in the supply chain. *Australian Journal of Business and Management Research*, 2012, Vol. 2, Iss. 4, pp. 12–19. [Electronic resource]: <http://www.ajbmr.com/articlepdf/aus-24-04i4n2a2.pdf>. Last accessed 12.01.2021.
3. Seuring, S., Muller, M. From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 2008, Vol. 16, Iss. 15, pp. 1699–1710. DOI: 10.1016/j.jclepro.2008.04.020.
4. Harrison, A., van Hoek, R. Logistics Management and Strategy: Competing through the supply chain. 3<sup>rd</sup> ed., Pearson Education Limited, 2008, 346 pp. [Electronic resource]: <https://vulms.vu.edu.pk/Courses/MGMT615/Downloads/Logistics%20Management%20and%20Strategy%20Competing%20Through%20the%20Supply%20Chain.pdf>. Last accessed 12.01.2021.
5. Forrester, J. W. Industrial dynamics. *Journal of the Operational Research Society*, 1997, Vol. 48, Iss. 10, pp. 1037–1041. DOI: <https://doi.org/10.1057/palgrave.jors.2600946>.
6. Handbook of Supply Chain Management. Ed. by Ayers, J. B. Taylor & Francis Group, CRC Press, 2000, 488 p. eBook ISBN 9780429247439. DOI: <https://doi.org/10.1201/9781420025705>.
7. Croom, S., Romano, P., Giannakis, M. Supply chain management: an analytical framework for critical literature review. *European journal of purchasing & supply management*, 2000, Vol. 6, Iss. 1, pp. 67–83. DOI: [https://doi.org/10.1016/S0969-7012\(99\)00030-1](https://doi.org/10.1016/S0969-7012(99)00030-1).
8. Dherment-Férère, I. Maîtrise d'ouvrage et ERP, processus logistiques, comptables et financiers. Ed. Lavoisier, Paris, 2007, 294 p.
9. Pfohl, H.-C., Gomm, M. Supply chain finance: optimizing financial flows in supply chains. *Logistics research*, 2009, Vol. 1, Iss. 3–4, pp. 149–161. DOI: <http://dx.doi.org/10.1007/s12159-009-0020-y>.
10. Halley, A., Guilhon, A. Logistics behaviour of small enterprises: performance, strategy and definition. *International Journal of Physical Distribution & Logistics Management*, 1997, Vol. 27, Iss. 8, pp. 475–495. DOI: <https://doi.org/10.1108/09600039710182644>.
11. Shapiro, R. D., Heskett, J. L. Logistics Strategy: Cases and Concepts. St. Paul. Minnesota: West Publishing, 1985, 602 p.
12. Tarasenko, E. A., Karkh, D. A., Tyapukhin, A. P. Management of logistics systems: Monograph. Moscow, Ruscience, 2021, 156 p.
13. Engler, E., Gewies, S., Grunewald, E., Banyás, P. Trajectory-based multimodal transport management for resilient transportation. *Transport problems*, 2018, Vol. 13, Iss. 1, pp. 81–96. DOI: 10.21307/tp.2018.13.1.8.
14. McCarthy, E. J., Perreault, W. D. Basic marketing: a managerial approach. 10<sup>th</sup> ed., Homewood, Irwin, 1990, 734 p. ISBN 0-256-06865-8.
15. Tyapukhin, A. P. Sustainability of Resource Supply Systems. *World of Transport and Transportation*, 2019, Vol. 17, Iss. 6, pp. 142–165. DOI: <https://doi.org/10.30932/1992-3252-2019-17-142-165>. ●

### Information about the author:

**Tarasenko, Evgenia A.**, Researcher at Orenburg Branch of the Institute of Economics of Ural Branch of Russian Academy of Sciences; Lecturer at Orenburg Transport Institute, a branch of Samara State Transport University, Orenburg, Russia, [t\\_e\\_a\\_t@mail.ru](mailto:t_e_a_t@mail.ru).

Article received 12.01.2021, approved 21.04.2021, accepted 23.04.2021.