ORIGINAL ARTICLE
DOI: https://doi.org/10.30932/1992-3252-2023-21-5-1

World of Transport and Transportation, 2023,
Vol. 21, Iss. 5 (108), pp. 164–173

Matrix Approach to Designing Principles of Management of Transport Enterprises

Eugenia A. TARASENKO

Alexey P. TYAPUKHIN

Eugenia A. Tarasenko[1], Alexey P. Tyapukhin[2]

[1, 2] Orenburg Branch of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences, Orenburg, Russia.
[1] Orenburg Institute of Railways – a branch of the Samara State Transport University, Orenburg, Russia.
✉ *[1] t_e_a_t@mail.ru.*
✉ *[2] aptyapuhin@mail.ru.*
[1] ORCID 0000-0001-5940-5254; Russian Science Citation Index SPIN-code: 4963-2714; Russian Science Citation Index Author ID: 863450.
[2] ORCID 0000-0002-1819-5905; Web of Science Researcher ID: U-8251-2017; Scopus ID 57227058200; Russian Science Citation Index SPIN-code: 2503-5848, Russian Science Citation Index Author ID: 167766.

ABSTRACT

The objective of the article is to substantiate the matrix approach to the design of the principles of management of transport organisations and businesses, as well as to clarify and supplement the quantity and quality of these principles.

Classification was chosen as research method, and binary matrices formed based on classification features of objects and their variants were used as a tool.

The following results have been obtained within the study: an approach to the design of the principles of management of transport organisations and businesses has been substantiated, ensuring their structuring and coordination both vertically or at management levels, and horizontally or by positions; variants of the principles of management of an organisation or a business have been developed; directions for improving the management systems of transport enterprises and chains based on them are determined.

The implementation of the results obtained will reduce lost profits of enterprises and chains based on them, reduce the time and cost of preparing and implementing management decisions, allow timely responding to the unique requirements of end users and/or services, as well as ensuring compliance of the parameters and characteristics of the internal environment of enterprises and chains based on them with the duration and volatility of environmental factors.

Keywords: transport enterprises, principle, management, design, organisation, business, factor, feature of the object, variant of the feature, supply chain, management levels.

For citation: Tarasenko, E. A., Tyapukhin, A. P. Matrix Approach to Designing Principles of Management of Transport Enterprises. World of Transport and Transportation, World of Transport and Transportation, 2023, Vol. 21, Iss. 5 (108), pp. 164–173. DOI: https://doi.org/10.30932/1992-3252-2023-21-5-1.

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

It is rather difficult to overestimate the role of transport enterprises in all areas of modern business [1]. Business is developing at a rapid pace; therefore, managers are increasingly facing the need for timely delivery of various cargoes.

Since the transportation management system is an integral part of the overall management system of an organisation [2], it should be considered from the perspective of a matrix approach to the design of organisation and business management.

The principles of managing socio-economic systems play an important role in achieving the goals of transport organisations, including their supply chains [3].

They make it possible to specify approaches to achieving goals and solving problems; create the prerequisites for developing strategies; predetermine the content of methods of influencing the staff; regulate forms of cooperation with third-party organisations; contribute to implementation of organisational culture and to conflict resolution; indicate directions for change and innovation, etc.

If we consider a transport organisation as a system that requires management, then in its composition it is customary to distinguish a subject (who manages?) and an object (who is managed?). This means that the subject (an aggregate of managers) and the objects (a set of performers) organise their activities based on appropriate principles. It should be considered that the subject and the object have different structures, and the subject of management is characterised by the organisational structure of management, and for the object the production structure of the organisation is predominant. The subject and objects of management, once there is a common goal (usually making a profit), solve different problems and perform only their own functions. Based on this, we can conclude that the management principles used by the subject and object of management, on the one hand, have different content, and, on the other hand, they must be structured and coordinated not only within the organisation, but also outside it, for example, within chains creating values for end consumers of products and/or services.

Solving these problems is significantly difficult due to the complexity, heterogeneity, variability and transience of factors in the external environment of organisations and requires the use of a system approach, which is based on the emergence of new properties or conditions, the hierarchy of constituent parts, as well as communication and management of these parts [4].

This article presents the results of a study, the *objective* of which was to design principles for managing an organisation or a set of managers who make and implement management decisions, and a business or a set of performers who create value for end consumers of products and/or services that can be used in the activities of transport organisations.

RESEARCH METHODOLOGY

The method of designing management principles belongs to the group of qualitative methods for studying complex objects [5].

Any complex object performs functions, while possessing quantitative parameters and qualitative characteristics. If the «management principle» is chosen as the object of a study, then it is characterised by qualitative characteristics or attributes. It is important to distinguish between objects of research and factors of the external and internal environment that predetermine the formation of several variants of the object of research. Factors in the external and internal environment of an organisation are also described by quantitative parameters and qualitative characteristics. In this study, priority will be given to their qualitative characteristics or attributes. A factor, characterised by a set of characteristics varying over a wide range, limited by dichotomies, influences the object of study. At the same time, the signs of external and internal environmental factors do not always change continuously and smoothly from one dichotomy to another [6]. In some cases, several fixed options can be distinguished. For example, the attribute «the role of an employee in the organisation» of the internal environmental factor «personnel» can be considered in two versions: the employee as an individual and the employee as a person making (executing) decisions. It is difficult to call these two options dichotomies, since for a given employee the main options for the attribute may be other ones, less significant for the researcher. Therefore, the characteristics of a factor and their variants should have priorities (ranks) depending on the objectives of the study [7]. It is also necessary to emphasise that several signs of one and the same factor can be used simultaneously, each of which can have several options. In other words, when

	Element: *position* (0)	Connections: *communications* (1)
Personality (0) **Employee's role in the organisation** Performer (1)	Competence (000)	Awareness (001)
	Organisational structure (010)	Behaviour in the group (011)

Pic. 1. Classification of groups of organisational management principles, code «0» [developed by the authors].

designing principles for managing an organisation and/or a business, it is necessary to identify factors of the external and internal environment, then the characteristics of these factors, and, finally, variants of these characteristics.

Thus, when designing principles for managing a transport organisation and/or a business, the following steps should be completed:

1) To determine priority: factors of the external and internal environment of the studied object; priority signs of these factors; and variants of these signs (descriptive method).

2) To form a set of binary matrices using together two signs of various factors influencing the object of study, including two variants of each of these signs, or less precisely, dichotomies (facet method).

3) To fill the cells of binary matrices with management principles that are adequate to the selected characteristics and their options.

The set of management principles obtained using these stages has the following properties:

a) The number of principles obtained is a multiple of 2^x, where the number «2» reflects the number of attribute options (dichotomies), and x is the number of factor attributes used. It is easy to see that each of the resulting principles can be designated by a binary code, which greatly facilitates their digitalisation for the development and application of computer support for management activities.

b) In the simplest case, groups of management principles are first formed, the number of which is a multiple of 2^x or their first level; each group in turn is divided into management principles; each principle, in accordance with the objectives of the study, can also be divided into components of principles, etc.

c) Management principles are interconnected both in terms of various factors and their variants, which facilitates the implementation of these principles by connecting their content vertically (management levels) and horizontally (positions).

d) In case of changes in factors of the external and internal environment of the organisation, the corresponding characteristics and options change, which makes it possible to either refine or redesign the set of management principles, thereby ensuring their continuity, flexibility, and adaptability to the changing conditions of the organisation's activities, including the chains (of values, supplies, requirements, innovations, etc.) created basing on them.

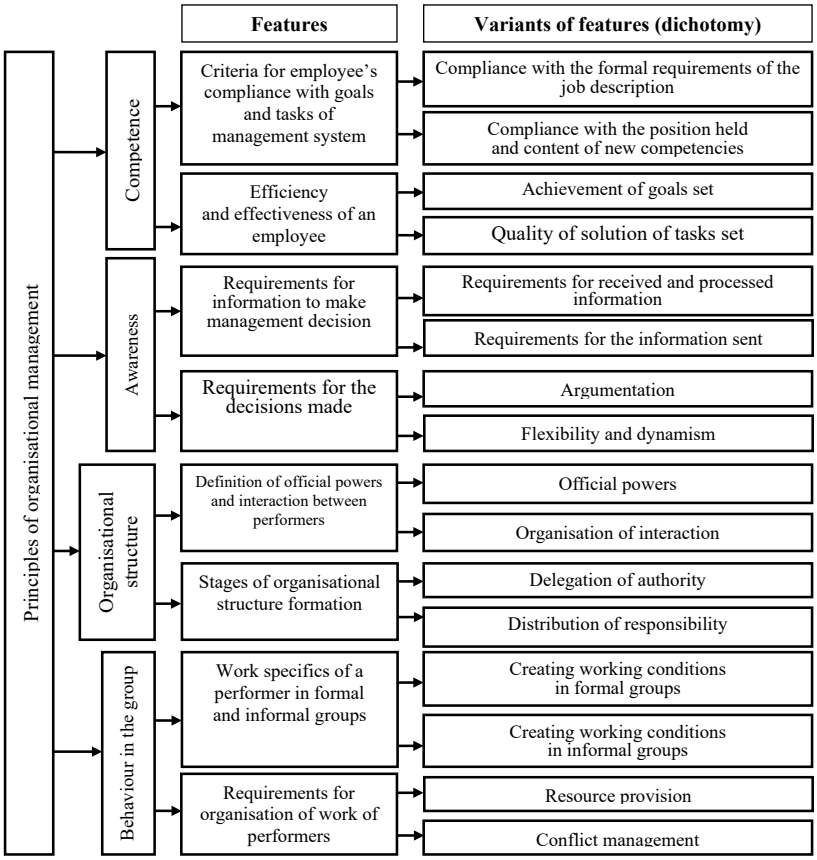
As has been shown earlier, the principles of managing socio-economic systems can be divided into two groups of principles (based on the attribute «type of person related to a management decision» and its variants: «persons making management decisions», code «0», and «persons involved in creating value for end consumers of products and/or services», code «1»). In the first case, the principles of managing an organisation are designed, in the second case, the prerequisites are formed for designing the principles of managing a business or, for example, supply chains. Based on the codes «0» and «1» groups of characteristics with a three-digit code are formed, as well as control principles with a five-digit code.

RESULTS

Designing Organisational Management Principles (by Management Decision Makers)

To form a group of principles for managing an organisation, it is necessary to highlight the main factor of its internal environment, which is the management system or the persons making management decisions. The basic features of this factor include: «components of a management system» and their variants: element or position, code «0», as well as connections or communications, code «1», as well as «an employee's role in the organisation» and its variants: personality, code «0», and performer, code «1».

The combined use of these characteristics and their options allows us to form four groups of organisational management principles or first-level principles: «competence», code «000», «awareness», code «001», «organisational structure», code «010», and «behaviour in the group», code «011» (Pic. 1).



Pic. 2. Hierarchy of features and variants that ensure the design of organisational management principles [developed by the authors].

From Pic. 1 it follows that the basis of design is constituted by: the competence of the persons making management decisions (their awareness, which allows them to justify these decisions); an organisational structure that provides conditions for structuring and coordinating management decisions across levels and positions within the organisation, as well as the behaviour of decision makers in formal and informal groups, facilitating their interaction at all stages of the life cycle of these decisions. It can be concluded that groups of management principles presented in Pic. 1 are sufficient to adjust the main sections of the organisation's management.

Groups of organisational management principles, code «0,» in turn, need to be specified. To solve this problem, it is advisable to use group features and variants of features presented in Pic. 2.

These features and variants make it possible to:

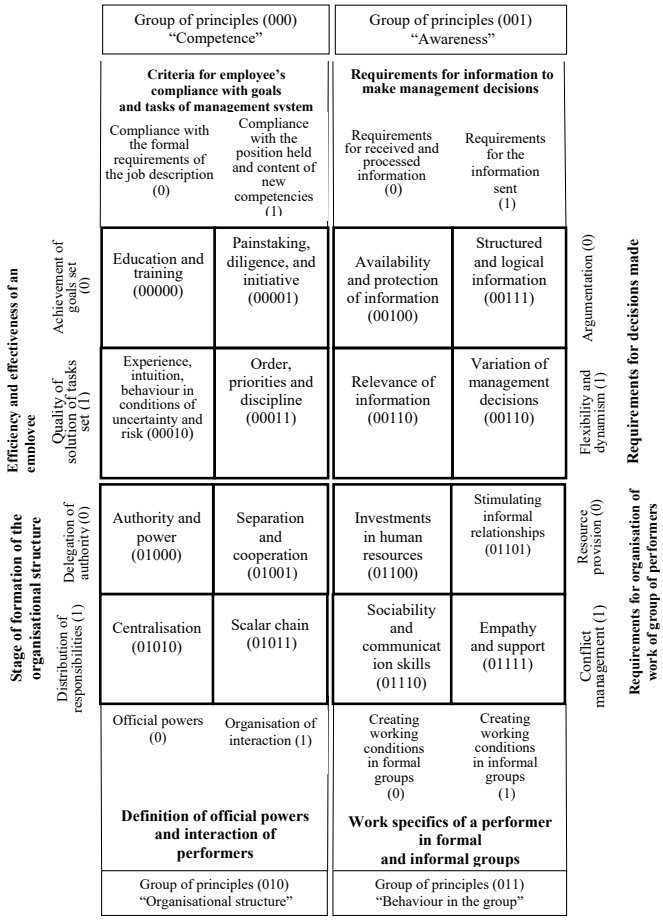
1) Assess the competence of management decision makers in terms of the goals and objectives facing the organisation's management system, considering their compliance with job descriptions and the requirements of the current management situation.

2) Clarify the requirements for information, management of information flows, as well as the quality of decisions made, not only under the operational, but also under the strategic aspect, considering their lost profits.

3) Control the rationality of the organisational management structure of the organisation in terms of its compliance with the state of the organisation's external environment, which predetermines the adjustment of its goals and objectives, as well as the functions performed by management decision makers.

4) Provide effective support not only to individual employees of the organisation in accordance with their positions, but also to formal and informal groups, allowing for a synergistic effect.

Using the information in Pic. 2, it is possible to justify the number and content of the principles of organisational management (Pic. 3).



Pic. 3. Classification of principles of organisational management system [developed by the authors].

Pic. 3 allows us to draw the following conclusions:

a) As noted earlier, the number of management principles when using several features and their two variants together is 2^x. With a multi-level structuring of these principles, there will be four of them at the first level, 16 at the second level, 64 at the third level, etc.

b) Each principle has a five-digit binary code that allows the use of computer support for management activities, with the help of which it is possible to process significant amounts of information accompanying the implementation and use of management principles.

c) Management principles have a clear structure that makes it possible to distribute these principles along the horizontal and vertical lines of management of the organisation and ensure the creation of relationships between positions and levels of management. So, the general director of the organisation is responsible for the implementation and use of all management principles, the functional directors are responsible for the group of principles, and the head of a department, reporting to the functional director, is responsible for each principle separately (if necessary).

d) The relationships between the principles (heads of departments) or their groups (functional directors) are maintained thanks to common options for the characteristics of the management object. For example, the principle of «scalar chain», code «01011», is connected with the principle of «centralisation», code «01010», through the variant «distribution of responsibilities» of the feature «stage of formation of the organisational structure». At the same time, the principle of «scalar chain», code «01011», has connections with the principle of «separation and cooperation», code «01001», due to the variant «organisation of interaction» of the feature «definition of official

Scalar chain component	Structure	Position
Integrity **Scalar chain characteristics** Restrictions	Hierarchy (0101100)	Replaceability (0101101)
	Formalisation (0101110)	Subordination (0101111)

Pic. 4.Classification of the first level components of the principle «scalar chain», code «01011» [developed by the authors].

Principles of hierarchy formation in a scalar chain	Legality	Statement
Unambiguity **Conditions for maintaining hierarchy in a scalar chain** Transparency	Status (010110000)	Regulations (010110001)
	Dependency (010110010)	Unity of command (010110011)

Pic. 5. Classification of components of the second level of the principle «scalar chain», code «01011» [developed by the authors].

powers and interaction of performers». In a similar way, it is possible to establish relationships between groups of organisational management principles, for which it is necessary to use the characteristics and options presented in Pic. 1.

e) Each of the principles of organisational management can be structured into components of several linearly ordered levels.

An example is the «scalar chain» principle, code «01011», which, with the help of features and their variants: «scalar chain component» («structure» and «position»), as well as «scalar chain characteristics» («integrity» and «restrictions»), can be divided into first level components: «hierarchy», code «0101100», «replaceability», code «0101101», «formalisation», code «0101110», and «subordination», code «0101111» (Pic. 4).

If, as a component of the «scalar chain» principle, code «01011», we take the «hierarchy» component, code «0101100», then with the help of such features and their variants («principles of hierarchy formation in a scalar chain»: «legality» and «statement», as well as «conditions for maintaining hierarchy in a scalar chain»: «unambiguity» and «transparency»), we can distinguish the second level components of the «scalar chain» principle, code «01011»: «status», code «010110000», «regulations», code «010110001», «dependency», code «010110010», and «unity of command», code «010110011» (Pic. 5).

The information presented in Pics. 4 and 5, can be specified using the example of information in Pic. 6, which shows the sequence of formation of groups of principles, specific principles, and their components of several linearly ordered levels. In addition, this picture presents an approach to creating codes for these objects intended for the use of computer support for management activities.

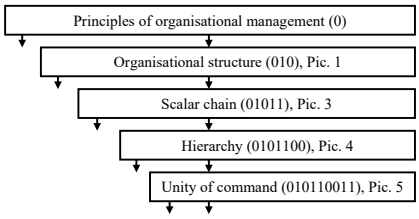
Designing the Principles of Transport Business Management (by Persons Making Management Decisions)

Previously, it was argued that one should distinguish between the principles of managing an organisation or decision makers, code «0», and the principles of managing a business or persons making these decisions, code «1».

The term «business» has different meanings, although it is clearly associated with the term «organisation» and with the association of organisations. As a factor that predetermines the quantitative parameters and qualitative characteristics of a business, we will choose the supply chain. There are two ways to define groups of business management principles:

1) Using literature sources, from which it follows that supply chain management is a series of integrated enterprises [8]; integration of trading partners [9]; a total system approach to managing the entire flow [10]; management of upstream and downstream communications [11].

2) Using the following features and variants for supply chain management features: «state of the supply chain over time» («statics» and «dynamics»), as well as «processes performed by the supply chain» («processing of resources» and «receipt and/or transfer of resources»). The joint use of these characteristics and variants repeatedly allows us to confirm that the main groups of business (supply chain) management principles include: «enterprises», code «100», «processes», code «101», «relationships», code



Pic. 6. An example of the sequence of forming codes of organisational management principles [developed by the authors].

«110», and «flows and/or stocks», code «111» (Pic. 7).

Groups of business (supply chain) management principles, in turn, need to be specified [12]. To solve this problem, it is advisable to use group characteristics and variants of characteristics presented in Pic. 8.

These features and variants make it possible to:

1) Monitor the external and internal business environment (supply chain), identifying threats and opportunities on their part, while adhering to a strategic orientation when making and implementing management decisions and eliminating restrictions that may have previously been necessary, but have lost their relevance, for example, due to the COVID-19 pandemic.

2) Eliminate supply chain management problems, thereby ensuring the continuity of processes, solving various problems both within supply chains (local tasks) and in the external environment of chains of this type (global tasks), such as sustainability and sustainable development.

3) Identify and maintain relationships with suppliers and consumers in supply chains when creating value for end consumers of products and/or services.

4) Increase the efficiency and improve the effectiveness of supply chains by reducing the time it takes to satisfy consumer orders, including by identifying and preventing hidden threats.

Using the information in Pic. 8, it is possible to justify the number and content of business (supply chain) management principles (Pic. 9).

Pic. 9 allows us to draw the following conclusions:

a) Supply chains involve enterprises that have special competence, for example, technology, and are interconnected following the direction of the flow of resources, the movement of which is not hampered by natural or artificially created barriers that are eliminated by the contractor or their group at any workplace or division of the enterprise.

b) The basis for organising any process when creating values for the end consumer of products and/or services is a pull system, the implementation of which requires a system approach and the elimination of both typical and unique problems for the enterprise, most of which in supply chains involve process integration and synchronisation.

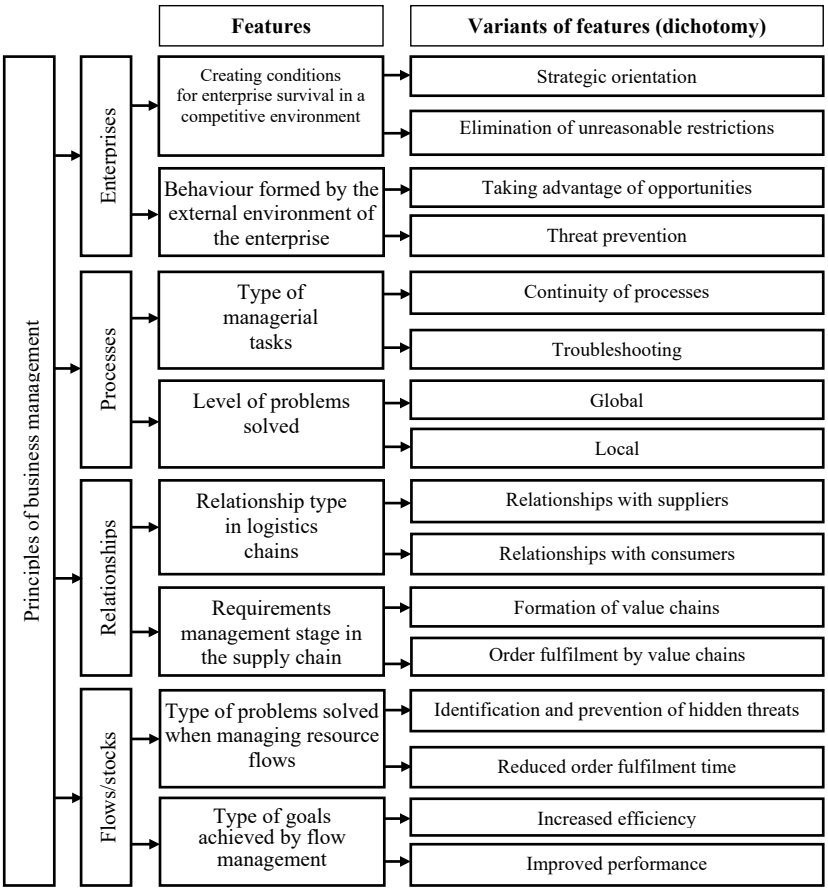
c) Process integration and synchronisation are necessary for joint creation of value by both its consumer and suppliers under the conditions of an optimal combination of attracted material, information, financial and human resources, achieved through global optimisation with the involvement of virtual enterprises and the conclusion of economically feasible relations with them, including on a long-term basis.

d) One of the forms of achieving economic goals in supply chains is to reduce lost profits by eliminating possible barriers to the trajectory of resource flows, which, when creating unique values for end consumers, include single products within the framework of lean production, the basis of which is formed by inventory management.

By analogy with the conclusions regarding the implementation of organisational management principles, code «0», principles of business (supply chain) management, code «1», can also be adapted to the specifics of positions and levels of enterprise management. In addition, these principles must be agreed upon between adjacent parts of the supply chain or within the logistics chain [12]. In this case, we can talk about the formation of a logistics supply chain management system at the first stage of its creation and supply chain management systems covering the initial suppliers of resources and ending with the final

State of the supply chain over time	Statics (0)	Dynamics (1)
Processing of resources (0) **Processes performed by the chain** Receipt/transfer of resources (1)	Enterprise (100)	Processes (101)
	Relationships (110)	Flow and/or stock (111)

Pic. 7. Classification of business (supply chain) management components, code «1» [developed by the authors].



Pic. 8. Hierarchy of features and variants that ensure the design of business (supply chain) management principles [developed by the authors].

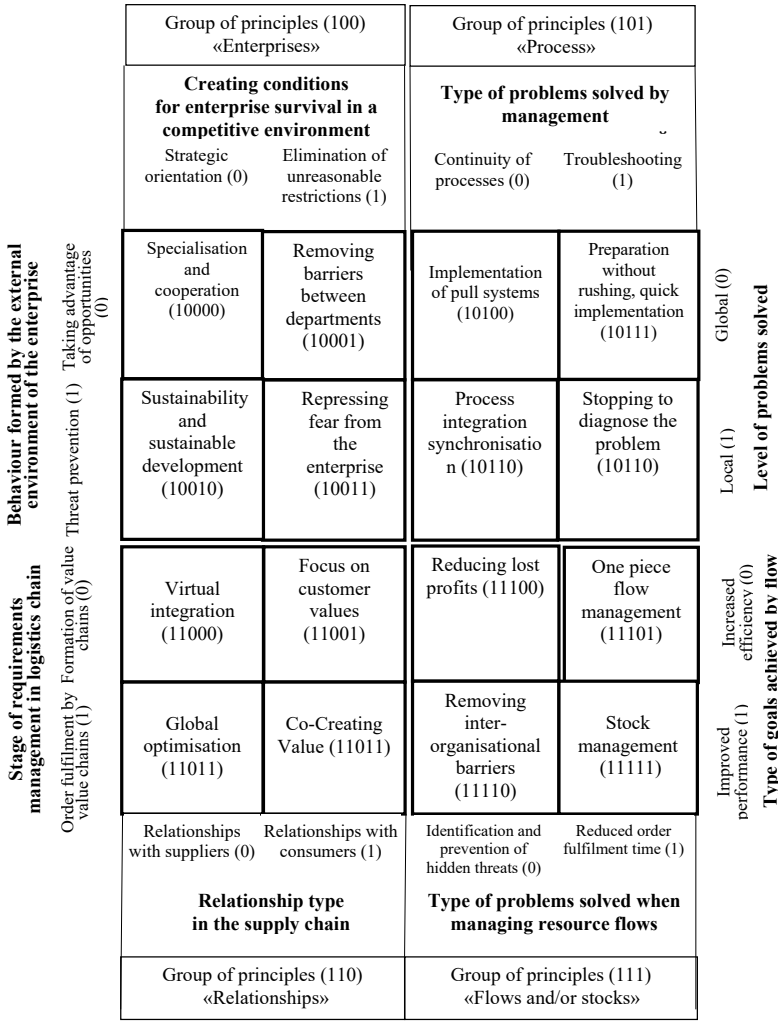
consumers of products and/or services, a problem to which researchers pay very little attention.

DISCUSSION

The relevance of management principles that apply to the activities of persons making and executing management decisions is beyond doubt. At the same time, justification for their quantity and quality; creating prerequisites for their structuring and coordination vertically or by management levels and horizontally or by position; monitoring the effectiveness of the principles used; their adjustment and design raise many questions.

It would seem, why change approaches to solving these issues? Moreover, the results of implementing the developed management principles are already known, ensuring that enterprises obtain the results they need. However, difficult-to-predict environmental factors «exact in unnecessary quantities of unnecessary quality at unnecessary times, causing unnecessary costs, affect many consumers who do not receive the goods they need in the place they need.» To overcome the negative consequences of these factors, new approaches to managing organisations and businesses, including supply chains, are needed. The accelerating pace of changes forces organisations to be in a state of continuous change [13].

The main problem here is the impossibility of unambiguously measuring management objects, since in most cases they are described by qualitative characteristics, which, as a rule, do not imply development of a scale of characteristics of these objects and, as a result, are subjective and sometimes authoritarian in nature. This article once again emphasises the need to identify and rank relevant and irrelevant features of management objects using computer support for research activities. No one is surprised by the need to justify the keywords of any article, allowing it to be found from many research articles on a given topic. The authors claim that it is exactly in the same manner, but in relation to a specific object of study, for



Pic. 9. Classification of business management principles (supply chains) [developed by the authors].

example, supply chains, that you can select its «key words» or features that are relevant at a specific point in time. If these signs are identified and «standardised,» this will greatly facilitate mutual understanding not only among researchers, but also among practitioners, as well as students of educational institutions, who operate with different signs of a given object that do not allow it to be used most effectively to achieve sometimes vital results.

It is on this aspect of research, in the authors' opinion, that a discussion should begin in journals that are initially focused on discussions of various kinds, which cannot be fruitful until the objects of these discussions are, at least partially, «measured.» One of the approaches to solving the problem of qualitative research of almost any management object, including principles, is once again outlined in this article.

CONCLUSION

The results obtained in this study are preliminary in nature, suggesting continued research not only into the principles of management of a transport organisation and business, but also into other components of the management system of socio-ecological-economic systems, such as goals, objectives, approaches, methods, functions, etc., i. e., those results may be applicable in other areas of the national economy. Similar to the well-known balanced scorecard system [14], it is necessary to develop subsystems of balanced components of enterprise management systems, on the basis of which a new balanced values, supplies, requirements and new products chain management system will ultimately be created, focused, on the one hand, on creating value for end consumers of products and/or services, and,

on the other hand, on ensuring sustainability and sustainable development of the human community.

It is obvious that objects managed by various types of systems are constantly becoming more complex, changing their quantitative parameters and qualitative characteristics, and appearing in various combinations [15]. It is impossible to influence them effectively without the use of computer support for management activities. Therefore, it is necessary to «explain to the computer» which objects, with what parameters and characteristics, are concerned. To do this, it is necessary to learn to measure objects of any type, using only their inherent actual features in a certain quantity and (close to optimal) quality. It is these characteristics that should form a scale for measuring these objects, understandable for an electronic computer, which cannot tolerate understatement, unclear formulations, excessive diversity, and other attributes that creatures with a higher organisation of mental activity have to reckon with. Taking a step forward towards an objectively justified unification of characteristics and options for managed objects means creating the prerequisites for formation of teams of performers, regardless of their location, clearly representing the structure of the studied object and, on this basis, foreseeing directions for its optimisation. Then it is quite possible that the goals and objectives of sustainability and sustainable development will be achieved and solved in a shorter period than expected.

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Information about the authors:

Tarasenko, Eugenia A., *Ph.D. (Economics), Researcher at Orenburg Branch of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences; Associate Professor at the Department of Logistics and Transport Technology of Orenburg Institute of Railways – a branch of the Samara State Transport University, Orenburg, Russia, t_e_a_t@mail.ru.*

Tyapukhin, A. P., *D.Sc. (Economics), Professor, Director of 2Orenburg Branch of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences, Orenburg, Russia, aptyapuhin@mail.ru.*

Article received 23.06.2023, approved 27.09.2023, accepted 02.10.2023.