

To Determine the Location of the Logistics -Transport Center Based on the “Green” Logistics Principle

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Abstract. To implement the supply chain management based on the logistics principle is becoming the social responsibility of the modern companies and the implementation of this principle is giving a great opportunity to have advantages in the competitions and reduce the costs. In this article assumed that the infrastructure location of the transport-logistics has less negative impact on the environment than a supply chain element. Analyzed the factories which may be influenced to determine the location of the logistic center that is environmentally – friendly and identify the principle of the “Green” supply chain management. Proposed a methodology for the creation effective logistics infrastructure for ecological transport on the basis of the identified factors.

Keywords: Green logistics, Green supply chain management, Transport and logistics infrastructure, Factors, Consolidated coefficients, Logistics location algorithm

1. INTRODUCTION

In the globalizing and internationalizing world we have considered the importance of ecological issues around the trend of sustainable development pillars time, are focused on the global development trend of technological progress and economic efficiency. Nowadays, time, space even the logistics which defines as a resource optimization has included its logistics concept, ecological requirements. Long-term trend of supply chain management field is a "green logistics"

According to specialists, transportation accounts for about 8% of all emissions of carbon dioxide in the world, for warehouse space is still 3% [8]. In this regard, the introduction of "green" technologies in logistics activities would make a significant contribution to the preservation of the climate on the planet suitable for human life.

In Mongolia however the entrepreneurs are focused on logistics issues, but the main issue is that they don't take enough care for developing "Green Logistics" and protect environment. In Mongolia, the "green" logistics for a long time no use, since in most cases it is believed that the use of "green" technology only leads to more expensive in logistics costs.

The purpose of this research is identifying methodology of implementation “green logistic” principle to the organizations/entrepreneurs. During this research we test the possibility of managing the supply chain, using "green logistics" impact model to determine transport-logistics infrastructure locations.

2. THE ESSENCE OF THE “GREEN LOGISTICS”

Logistics policy should be formed not only on the basis of consequences of economic condition of the company, but also considering the broader implications for society, for example, the effects of pollution on the environment. Green Logistics involves one side an efficient logistics system, from the other side the protection of the environment management. Green logistics activities include: measuring the impact the logistics processes on the environment, reduce energy consumption, reduction and management of waste level.

In the research of the Russian scientists indicates, the logistics has a significant potential for the implementation of ecological control of transport systems, recycling processes of product and packaging materials, control and minimize pollution, the implementation processes of energy and resource economy. Russian scientists were given the definition of "green logistics - is a system of activities, which involves the use of energy- and resource-saving technologies and modern logistics equipment in all sectors of the supply chain the purpose of minimization negative impacts on the environment and enhance the total customer value of products for consumers".

“Green” logistics describes all attempts to measure and minimize the environmental impact on logistics operations. This applies to all direct and reverse flow of products, information and services between the starting point and the point of consumption. As a "Green" approach leading the supply chain can be effective way to protect the environmental air, soil and hydrosphere.

3. COMPONENTS OF THE “GREEN” SUPPLY CHAIN FRAME

In order to make “green’ supply chain management design it is need to test its structure. Components of “green” supply chain are::

1. “Green” procurement and input
2. “Green” production
3. “Green” distribution and output
4. Return and recycling logistic

“Green” procurement - environmental procurement, which include reduction, reuse and recycling of materials in the procurement process. This process of selection and acquisition of product and services that minimizes the negative impact on the environment throughout the life cycle of production, transportation, direct use and recycling. Rational use of natural resources means savings of available natural resources as effectively as possible. With this principle closely connected the full and rational use of resources of the enterprise.

“Green” production - processes that use raw materials with minimum impact on the environment as efficiently as possible. Raw materials must generate minimum waste and pollution. Introduction of innovative technologies to reduce the environmental burden on the environment can be illustrated by examples of eco-innovative technologies: low-carbon energy and energy efficiency.

“Green” distribution means environmentally friendly packaging and environmentally oriented logistics. Distribution of environment-friendly principle leads to significantly reduce the costs that get the benefits of competition could reduce the flow of unproductive expenditures in the organization.

The concept of return logistics includes not only the return of goods customers, but also e-waste management. Return Logistics - the process by which the manufacturer receives the previously sending products from the point of consumption for possible recycling and / or re-manufactured. The principle of maximum usage of production waste, containers and packaging as a secondary raw material, or their environmentally safe disposal provides "green" return logistics, the usage of over-production or environmentally safe recycling.

To ensure a high degree of environmental protection demand for implement an integrated system of preservation of the environment in all stages of goods movement. The figure 1 shows the stages of the product life cycle from idea creation to its disposal in the within the concept of of "green" logistics. From this it follows that the "green" logistics focuses on loading and unloading materials, waste disposal, of the processed packaging and eco-friendly transportation. Although the Green Logistics encompasses diverse aspects of the logistics activities of the operating on the principles of "green" logistics company, can focus on one of them or apply many of them at the same time.

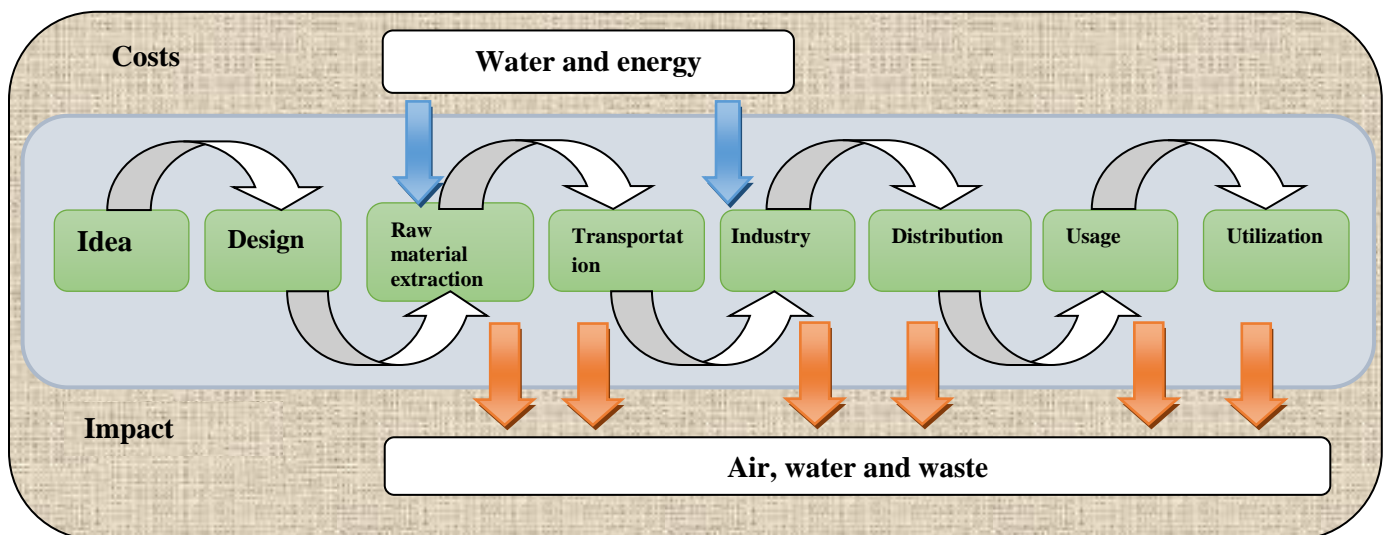


Figure 1. The life cycle of the goods and their impact on the environment

Globally, transnational corporations are choosing the supply chain management based on the "green" logistics principle in order to protect a sense of social responsibilities for global nature environment. This "green supply chain management" consists of the supply chain management and environmental management combinations. According to this article, the "green" supply chain management is understood as scientific and practical activity, suggesting the formation of an effective mechanism for the integration of environmental and socio-economic aspects in all stages of planning, designing and managing the supply chain of goods to minimize the ecological and economic damage, and enhance customer value products through the usage of energy- and resource-saving logistics technologies. The main objective of the "green" supply chain management is to define and reduce the negative impact of logistic activities on the environment

Having analyzed current direction of development of green technology, it can be noted that participating subjects in the effective management of the supply chain are:

- Government - regulation and the development of policies and programs in the field of environmental protection and nature management
- Business entities - the use of innovative eco-oriented technologies in the entire chain of the supply chain management;
- Consumers - with the growth of awareness will increase the proportion of consumers who prefer products with "green" image, intensified attention to the packaging and labeling of goods

The sphere of "green" logistics include environmental projects to build warehouses, using energy efficient technologies and environmentally friendly building materials; decrease expenses of thermal energy, while ensuring safety and loading and unloading goods; the use of reusable containers and packaging; increasing the capacity of vehicles; ensure recycling processes in the form of reverse supply chain.

The main "green" technologies in logistics activities include:

- selection of suppliers of raw materials at the lowest cost of non-renewable resources;
- reduction in inventory in order to reduce storage space requirements;
- optimization of transportation routes in order to reduce emissions of harmful gases;
- transition to environmentally friendly modes of transport (marine, water, rail) and the reduction of road transport;
- exclusion from the supply chain via points of storage and transshipment;
- Reduced paper document

4. TRANSPORT IS AN IMPORTANT PART OF THE “GREEN” SUPPLY CHAIN

Currently, “Green” supply chain is determined by the environmentally friendly technologies in transport. Today “Green” supply chain - is primarily a transition from ecologically adverse types of transport to environmentally sounds. Under present conditions the problem of "green" logistics is transformed into the problem of the integration of different types of transport, the implementation of their interaction with minimal participation of motor vehicles as the most unfavorable from the point of view ecology of the type of transport.

Key technologies to reduce the anthropogenic impact on the environment are: reduced distance for the transport of goods at all stages of the supply chain; reducing of fuel costs and harmful emissions into the atmosphere; the use of modern energy-saving environmentally friendly vehicles. Optimization transportation network can bring companies to a triple win: reducing burden on the environment, improving the image and reducing costs throughout the supply chain.

From the research it was determined that some economical measures to ensure environmental safety in the framework of the the green supply chain may be applied in the practice. For this purpose the author proposed a system, based on the promotion of types of transport, implementing "green" technologies and fining those types of transport that do not pay enough attention to environmental issues. Consequently, in the zone of the introduction of such a system is a reduced unfavorable type of transport, and to increase the types of transport that implements ecotechnology. This approach of evaluation of transport in the conditions of their integration into the supply chain is not only fair, but also effective.

In transportation, "green" trend is determined that not to be caused of the destruction of non-renewable natural resources and the significant climate change, to make the negative impact on the environment and human health protection during the provision of the transport demand. There to:

- A decision of the transport field is evaluated for transportation worth the same criteriaplaced on economic terms and environmental safety side
- To seek the possibility of reducing the transport demand to sensible level from societyand government
- Both organizations and citizens are responsible for selection of optimal ecological terms of transport development. When they make any decision they must aware of makingecological expertise to provide environmental protection legal norms and estimate howit effect the environment.
- According to "polluter pay fees" principle the transport companies or services must payall costs and ecological damages completely
- To implement a gradual action to handle the competitive relationship among varioustypes of vehicle using environmentally friendly modes of transport coordination.
- To focus on the International transport corridor and major cities to solve the issue of reducing negative impacts on the environment and transportation planning, and traffic safety.

Today's decision of increasing the efficiency of transport and logistics complex in the organization of cargo transportation, taking into account the "green" technology is a service of traffic on the system manufacturer - logistics center - consumer.

The key issue of formation an efficient transport and logistics infrastructure is the choice of optimal placements of the logistics center in terms of logistics costs, profits and environmental requirements in the process of service traffic.

5. THE RESEARCH METHOD ON THE TRANSPORT OPERATION OF "GREEN" SUPPLY CHAIN MANAGEMENT FIELD.

Currently, lack the necessary scientific and methodological basis of formation of effective transport and logistics infrastructure in a competitive interaction between different types of transports, taking into account the differences in the level of socio-economic development of individual regions of the country.

Most of the existing logistics optimization approaches allow you to define elements of the transport and logistics infrastructure, taking into account only the cost of transport, without assessing its environmental impact as a whole, considering only factors such as traffic volume, distance, cost of transportation. The disadvantages of the existing methods are: static data - are not taken into account possible changes in consumption and sources of supply factors; the limitations of the factors taken into account - not addressed market, socio-economic, infrastructure and environmental factors

Necessary to develop a methodology that takes into account the complex various market factors affecting the deployment of elements of the transport and logistics infrastructure, the dynamics of their changes and the possibility of saving energy and resources by attracting cost-effective types of transport.

To highlight the main parameters that influence the formation of the transport and logistics infrastructure, we investigated the factors of demand for freight transportation and warehousing services, and also the factors of the investment attractiveness of the region

Statistical analysis conducted in the case allowed to reveal depending on the volume of transport services to various market factors. Thus, the volume of transport services have a linear dependence on the volume of trade and living standards (fig.2)

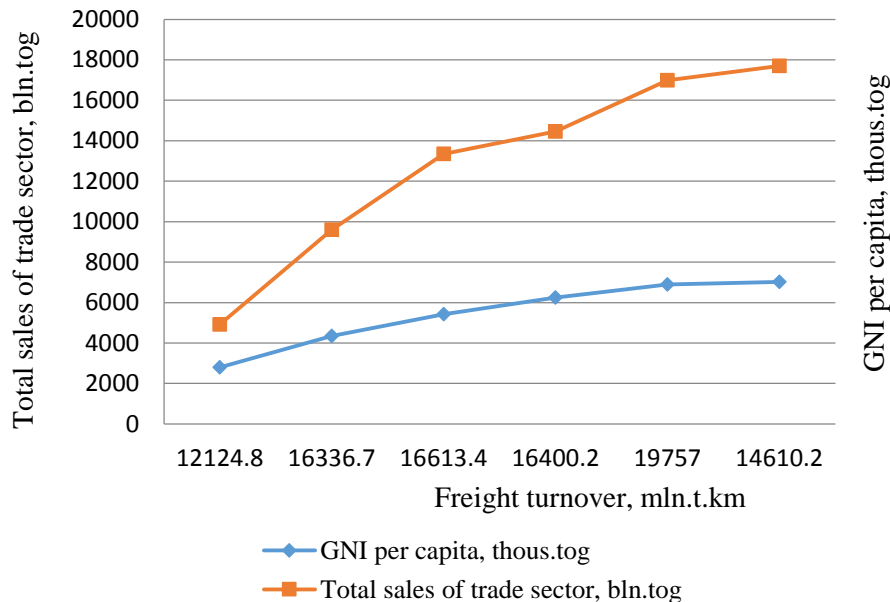


Figura 2. Dependence freight turnover of total sales of trade sector and incomes of population

With the increasing standard of living increases the purchasing power of the population, resulting from the growing volume of trade and the demand for imported products. For our country we have few rail road networks so road transport is the advantage to deliver imported goods to the rural regions. The volume of transport services increased in proportion to the country's GDP. High values of GDP does not guarantee an equally high rate of per capita volume of transport services (fig. 3). For our country which leads in the world for territory of per person, more efficient transport and logistics' infrastructure is suitable for regional freighter cargo current transshipment, storage, processing and export import customs controls.

Supply and demand for quality warehouse space, which include logistics centers, dependent on the purchasing power of the population and included in the service area of the warehouse. Similarly, at the country level and the regions analyzed various factors that have a significant impact on the ecological efficiency of transport and logistics infrastructure. Groups identified factors are presented in Table. 1

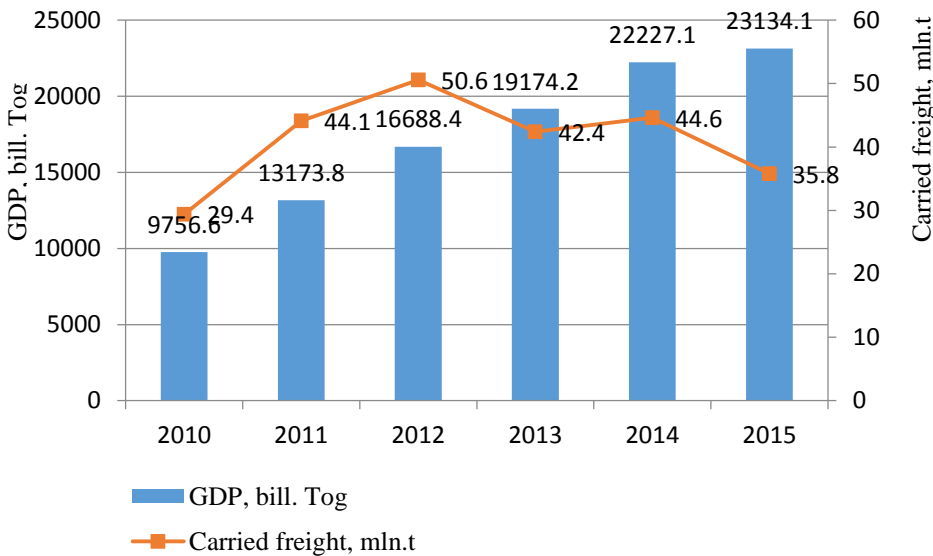


Figura 3. GDP dynamics and Carried freight

Table1. Factors ecological efficiency of transport and logistics infrastructure

<i>Nº</i>	<i>Group factors</i>	<i>Factors</i>
1	social-economic factors	<ul style="list-style-type: none"> • Population • Per capita income • Gross Domestic Product • The volume of industrial production • The volume of retail trade turnover • The volume of import and export
2	Infrastructural factors and indicators of transport work	<ul style="list-style-type: none"> • The density of roads and railways • Availability of transport corridors in the region • The volume of cargo transportation by road and rail • The volume of transport services per capital
3	Geographical and environmental factors in the region	<ul style="list-style-type: none"> • The level of pollution • Belonging to climate zone

Analysis of selected factors for the regions in the territory of which are already operating logistics centers, by comparison with the average values of the factors in the country revealed, that the large logistics centers in subjects that have a high rate of development of industry and trade, the population, as well as a favorable geographical position in relation to land transport corridors

Since the identification of the factors assessed both quantitative and qualitative indicators, as well as have a hierarchical structure of the complex, it is proposed to take into account their impact on the ecological efficiency of transport and logistics infrastructure with the use of "integrated assessment of the attractiveness of the region." Integrated assessment of the attractiveness of the region - is an indicator of the effectiveness of the placement elements in the region of energy-efficient transport and logistics infrastructure, which allows to take into account its impact on the energy efficiency of the system of socio-economic, infrastructural, geographical and environmental factors and transportation.

The developed method of selecting energy-efficient form of transport and logistics infrastructure in the regions, based on a calculation of an integrated assessment of the attractiveness of the region, includes four basic steps:

1. Private calculation factor estimates for the j-th region by statistical analysis of the "Pattern" (the actual value of the factor related to the maximum value). Because each factor in varying degrees affects the choice of locations for the logistics center and the effectiveness of its work in the future, at the first stage, the weighting coefficients of each factor is the method of hierarchy analysis;
2. Calculation assessment j-th region in view of the weighting factors for each group of factors: social-economic (Ω_{ec}), infrastructure and transport operation region (Ω_{inf}), geographical and environmental factors and (Ω_{en});
3. Determining consolidated coefficients of each group factors using the formula:

$$K_j = 1 - \frac{|\Omega_{max} - \Omega_{ec}|}{|\Omega_{max} - \Omega_{min}|} \quad (1)$$

where,

K_j : j consolidated coefficient of each group of factors for the j-th region (K_{ec} , K_{inf} , K_{en})

Ω_{max} , Ω_{min} : respectively the maximum and minimum values, assessment of the j-th region for each group of factors;

4. Calculation an integrated assessment of the attractiveness of the region by the formula:

$$K_j = 1 - \frac{\sqrt{(K_{ec}^j)^2 + (K_{inf}^j)^2 + (K_{en}^j)^2}}{\sqrt{3}} \quad (2)$$

The decision on the placement of a logistics center by comparing the values of the consolidated coefficients accepted if condition expressed in the form of inequality:

$$K_{inf}^j \times \frac{K_{ec}^j + K_{en}^j}{2} \geq K_{inf}^a \times \frac{K_{ec}^a + K_{en}^a}{2} \quad (3)$$

where,

K_{inf}^a , K_{ec}^a , K_{en}^a : average consolidated coefficients, respectively, a group of infrastructure, socio-economic factors and environmental factors in the region.

The algorithm for determining locations of the logistics center is illustrated in Figure 4

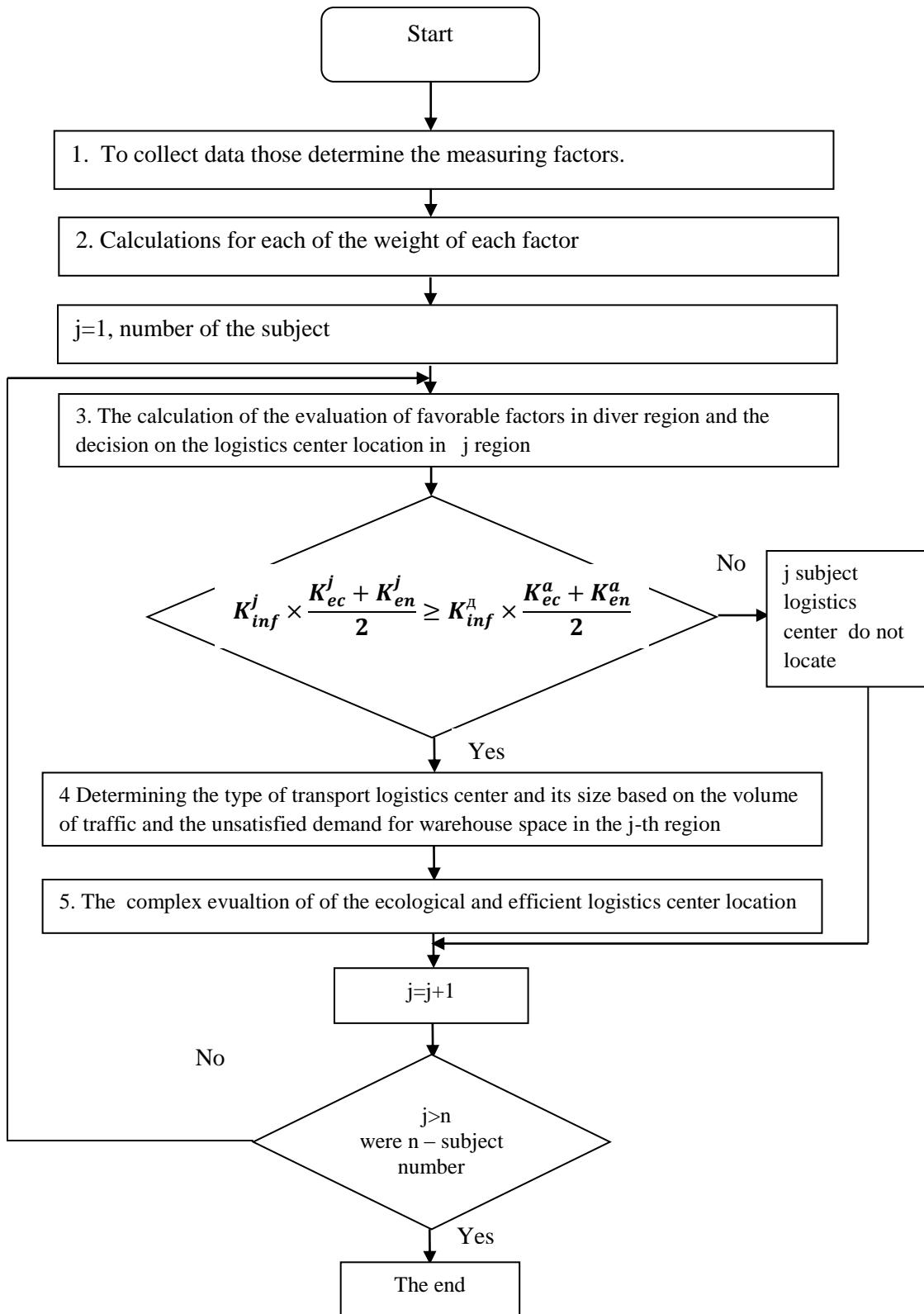


Figure 4. The algorithm for determining locations of logistics centers

CONCLUSION

Environmental issue on transport field plays a greater role in today's efficient supply chain management but they have not yet reached levels to the current situation. It has opportunity to increase competitiveness and to reduce costs if we can create the eco-transport logistics infrastructure within the friendly green logistics system, the environment and social responsibility of companies in the road freight transport.

Freight rates and the natural choice of location-friendly transportation and logistics infrastructure environment depend on market factors and market industry-specific. So we offer a methodology for estimated difference between basic researches based on regional development factors. This methodology is the basis for determining compliance with various government can be used at the local level, and potential investors to less negative environmental impact on transportation and logistics infrastructure and location of the public company's environmental strategy aims. Based on this proposed "green" logistical element of transportation and logistics infrastructure optimization Site Selection economic and mathematical methods it is possible to implement "green" supply chain management.

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Abstract. Implementing the supply chain management based on "Green" logistics principles is now a social responsibility of modern companies and the principle of achieving this principle will be maximized competition and reduced costs.

In this article we assumed that as part of the supply chain element, the location of the transportation and logistics infrastructure is considered to be negatively impacting the environment.

The "Green" supply chain management principles were analyzed and factors influencing the location of the environmentally-friendly logistics center were analyzed. Based on the calculated estimates of factors, the proposed methodology for eco-logistic transportation and logistics infrastructure is recommended.

Keywords: Green logistics, Green supply chain management, Transport and logistics infrastructure, Factors, Consolidated coefficients, Logistics location algorithm

INTRODUCTION

The global trend of integration is the eco-friendly approach to sustainable development, as technological advances are in high-efficiency economies.

Nowadays, the logistics of ecologic requirements, which are optimally determined by space and time, are incorporated into their own concepts. Prospects for the Supply Chain Management Framework are "greenlogistics"

According to experts, it is estimated that 8% of the total carbon dioxide emissions from the cargo are 3% out of storage. [8]. In this regard, introducing "green" technologies into logistics can significantly contribute to the global climate change. While Mongolian businesses are focusing on logistics, it is still a challenge to protect the environment and to develop "green economy".

The reason for not being used for long-term "green logistics" in Mongolia is that in many cases the "green" technology increases the logistics costs.

The purpose of the study is to define the "green logistics" approaches to organizations.

During the survey, the location of the transport and logistics infrastructure was analyzed to facilitate the supply chain management using the "green logistics" impact model.

1. THE “GREEN LOGISTICS” CORE

When an organization determines its logistics policy, it is not just a matter of economic outcomes, but also a broader range of social issues, including environmental pollution.

Green Logistics is an efficient logistics system on the one hand and on the other hand, environmental management.

Measures taken by the green logistics include logistics activities, measuring environmental impacts, reducing energy use, and minimizing waste management.

According to scientists, logistics has the potential for ecological control, waste pollution control, and energy-saving measures in transportation systems and product packaging materials.[3]

According to Russian scientists, green logistics is defined as "a set of measures that include the logistics and modernization of energy and energy efficiency technologies in every supply chain to reduce the negative impacts on the environment and to maximize the value of consumer goods" [3].

Green Logistics determines the ecological impact of logistics activities and defines all attempts to achieve the lowest level.

It refers to all direct and return activities from the original source of the product, information, and service streams.

Managing supply chains with "Green" logistics approach can be an effective way of protecting the environment in air, soil and water.

2 COMPONENTS OF THE "GREEN" SUPPLY CHAIN FRAME

It is necessary to analyze the structure of the 'green' supply chain management model to make the model.

Components of "green" supply chain are:

1. "Green" procurement and inputs
2. "Green" production
3. "Green" allocation and output
4. Logistic recycling or recycling

"Green" procurement - Ecological procurement is defined by material savings, reuse, and processing in the procurement process.

It is the process of selecting and obtaining goods and services to minimize adverse environmental impacts during the entire cycle of production, transportation, direct use and processing. Rational use of natural resources means that it is best suited to the highest possible use. This is largely incompatible with the organization's use of its resources.

"Green" production - the most efficient use of raw materials in the environment with the least effect.

Raw materials should be minimized and polluted. The use of eco-technology technologies such as energy-efficient technologies and low energy carbon emissions to reduce the ecological burden of the production is more important.

"Green" allocation is a logistics system with ecological packaging and ecology. An environmentally sound allocation principle reduces inefficient costs in outflows, leading to greater cost savings in an organization.

As a return logistics, it only includes consumer refunds, including electronic waste management.

Return logistics is the process by which a manufacturer receives a previously delivered product from the point of use for recycling or recurrent production at the point of use.

The principle of maximum utilization of industrial and packaging waste as secondary raw materials or their ecological safety destruction is a "green logistics" return.

In order to maximize environmental protection, it is necessary to introduce integrated environmental protection systems at all stages of traffic movement. The figure 1 shows the "green logistics" principle illustrates the ecological impacts from the initial idea to the end-stage of the product cycle to the final stage.

From this point on, the "green logistics" focuses on the handling of inventory, waste disposal, packaging recycling and eco-friendly transport. Although "green logistics" contains many different logistics features, the organization that operates on the principle of "green logistics" focuses on a particular area or in several directions.

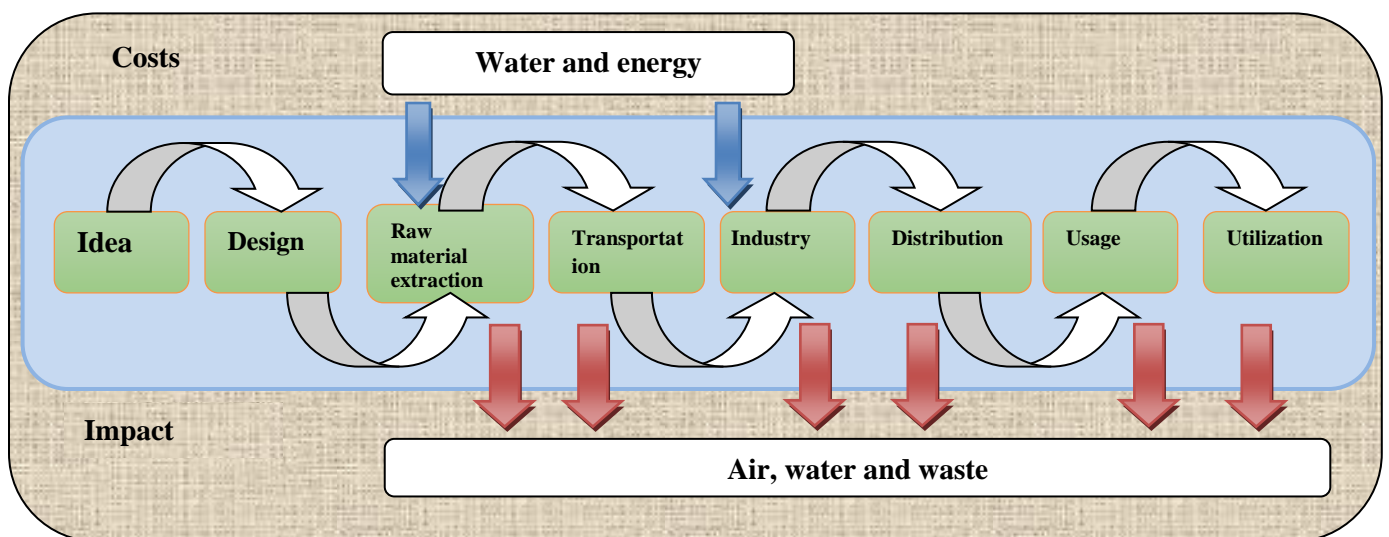


Figure 1. The life cycle of the goods and their impact on the environment

Globally, multinational corporations have chosen a supply chain management based on the principle of "green logistics" to protect the environment from a global perspective.

This "green supply chain management" consists of the supply chain management and environmental management combinations. Under this report, the concept of green supply chain management is the supply chain planning project in order to maximize the value of use of products that minimize the ecological and economic loss using logistics technology, and the ecological and socioeconomic directions of project management and all stages of management, efficient and scientific activities that integrate effective mechanisms.

The main purpose of the Green Supply Chain Management is to minimize the negative impacts on the environment into logistics activities in the supply chain and to minimize the minimum level.

Effective management of green supply chain management subjects:

- Government - taking responsibility for development of strategies and programs for environmental protection and natural resource use

- Business entities - use innovative technology with ecological approaches in total supply chain;
- Consumers—Focus on eco-friendly ‘green’ features and packing issues

The sphere of "green" logistics include environmental projects to build warehouses, using energy efficient technologies and environmentally friendly building materials; decrease expenses of thermal energy, while ensuring safety and loading and unloading goods; the use of reusable containers and packaging; increasing the capacity of vehicles; ensure recycling processes in the form of reverse supply chain.

The main "green" technologies in logistics activities include:

- selection of suppliers of raw materials at the lowest cost of non-renewable resources;
- reduction in inventory in order to reduce storage space requirements;
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- exclusion from the supply chain via points of storage and transshipment;
- Reduced paper document

3. TRANSPORT IS AN IMPORTANT PART OF THE “GREEN” SUPPLY CHAIN

Nowadays, the "green supply chain" has been linked to ecologically clean transportation technology. The "Green Supply Chain" is the first to move to an ecologically safe form from an unpleasantly transported ecology. In today's context, the green supply chain policy is shifting to integration of various forms of transport and minimizes auto transport participation, which is the most disadvantageous of vehicles, from ecologically low to minimal potential.

Green technology "green" mitigation of negative impacts: reducing transportation distance, fuel consumption and air emissions, and using eco-friendly energy-efficient vehicles at all stages of the supply chain. The optimization of transport networks illustrates the following three benefits to the company: reducing the burden on the environment, - increasing reputation, and cost reduction throughout the supply chain.

The study suggests that companies that use eco-friendly transportation technologies to encourage eco-friendly transportation technologies within the green supply chain management, and to take measures to impose sanctions for organizations that do not pay attention to ecology.

As a result, the number of eco-friendly vehicles decreased in the area where this activity is being implemented, and the type of transportation introduced by eco technology increases. From this point on, this approach to evaluate vehicles is not as efficient as the supply chain in terms of integrity.

The "green" trend in transport is defined by the lack of a significant natural change and non-renewable resources that will not adversely affect environmental and human health attainment of transport needs.

Thereto:

- Decisions on transport are assessed as being of equal value to the economy and environmental safety aspects.

- Search for possibilities to reduce the transport needs to the level of Society and Government
- Organizations and individuals are both responsible for selecting optimum ecology in transport development. In making decisions on management, an environmental impact assessment must be conducted and ecological expertise to ensure legal environment protection.
- Under the principle of "polluter pay", the transportation service provider must pay ecological damages from the use of the resources used by the service provider to the destruction of the vehicle and transport service waste.
- Take steps to use ecologically clean transport types of freight-passenger transport to deal with competition between different forms of transport
- Focus on major urban and international transport corridors to address issues of transport planning, transport safety and the environment.

4. THE RESEARCH METHOD ON THE TRANSPORT OPERATION OF “GREEN” SUPPLY CHAIN MANAGEMENT FIELD.

At present, there is a lack of theoretical and methodological basis for introducing green transport logistics in different regions for different regions of the competitive environment of different types of vehicles.

The current logistic optimization approach takes into account transportation and logistics costs, not just ecological efficacy, but also factors that depend on the distance, freight and shipping costs. The disadvantages of existing methodologies are the absence of limited market, socio-economic and infrastructure factors as factors that consider data statistics or the potential changes in consumption and supply sources.

The complexity of the methodology used in the market place to influence the diversity of factors affecting the transport and logistics infrastructure elements and the dynamics of their transformation and the choice of economical means of transport.

In order to distinguish the fundamental dimensions of the transport and logistics infrastructure, demand factors for freight and warehouse services as well as factors attracting regional investment were studied.

The statistical analysis of the survey has allowed the reliance on various factors of the transportation service. The transportation service is linearly dependent on the size of trade and the living standard of the population. \ Figure 2 \

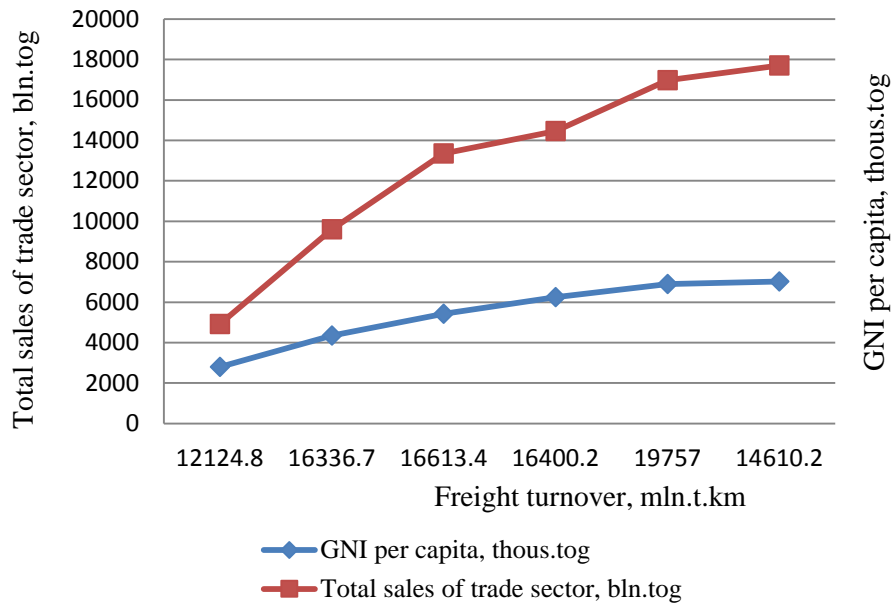


Figure 2. Dependence freight turnover of total sales of trade sector and incomes of population

Increasing living standards will increase the purchasing power of the population, as a result of increased demand and demand for imported products. The railway network is advantageous for our country and it is advantageous to deliver imported goods to regions in auto transportation. \ Figure 3 \

Figure 4 shows that transportation services are increasingly dependent on gross domestic product. The growth of GDP does not necessarily reflect the per capita transport service. One of the world's most populated territories is Mongolia's most suitable transportation-logistics infrastructure for freight forwarding, storage, recycling, and export control and customs clearance for regional consumption.

The demand and supply of quality warehouses belong to the logistics center depends on the purchasing power and the number of people entering the service area.

At the same time, there are many factors that have significant implications for transport and logistics infrastructure at the country and regionally, and ecologically friendly. The grouped factors are shown in the table 1.

Factors affecting the efficiency of transport and logistics infrastructure:

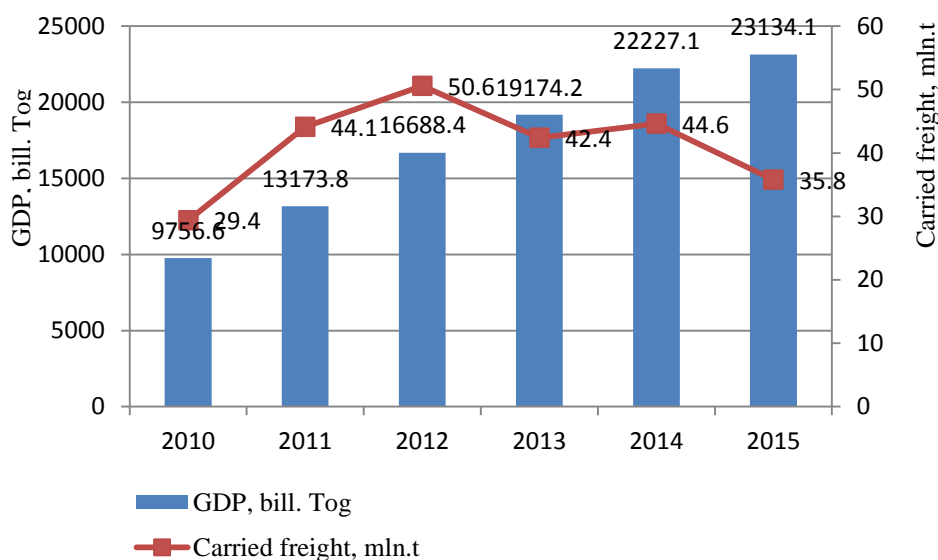


Figure 3. GDP dynamics and Carried freight

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Since the identification of the factors assessed both quantitative and qualitative indicators, as well as have a hierarchical structure of the complex, it is proposed to take into account their impact on the ecological efficiency of transport and logistics infrastructure with the use of "integrated assessment of the attractiveness of the region." Integrated assessment of the attractiveness of the region - is an indicator of the effectiveness of the placement elements in the region of energy-efficient transport and logistics infrastructure, which allows to take into account its impact on the energy efficiency of the system of socio-economic, infrastructural, geographical and environmental factors and transportation.

The developed method of selecting energy-efficient form of transport and logistics infrastructure in the regions, based on a calculation of an integrated assessment of the attractiveness of the region, includes four basic steps:

1. Private calculation factor estimates for the j-th region by statistical analysis of the "Pattern" (the actual value of the factor related to the maximum value). Because each factor in varying degrees affects the choice of locations for the logistics center and the effectiveness of its work in the future, at the first stage, the weighting coefficients of each factor is the method of hierarchy analysis;
2. Calculation assessment j-th region in view of the weighting factors for each group of factors: social-economic (Ω_{ec}), infrastructure and transport operation region (Ω_{inf}), geographical and environmental factors and (Ω_{en});
3. Determining consolidated coefficients of each group factors using the formula:

$$K_j = 1 - \frac{|\Omega_{max} - \Omega_{ec}|}{|\Omega_{max} - \Omega_{min}|} \quad (1)$$

where,

- K_j : jconsolidated coefficient of each group of factors for the j-th region (K_{ec} , K_{inf} , K_{en})
- Ω_{max} , Ω_{min} : respectively the maximum and minimum values, assessment of the j-th region for each group of factors;

4. Calculation an integrated assessment of the attractiveness of the region by the formula:

$$K_j = 1 - \frac{\sqrt{(K_{ec}^j)^2 + (K_{inf}^j)^2 + (K_{en}^j)^2}}{\sqrt{3}} \quad (2)$$

The decision on the placement of a logistics center by comparing the values of the consolidated coefficients accepted if condition expressed in the form of inequality:

$$K_{inf}^j \times \frac{K_{ec}^j + K_{en}^j}{2} \geq K_{inf}^a \times \frac{K_{ec}^a + K_{en}^a}{2} \quad (3)$$

where,

- K_{inf}^a , K_{ec}^a , K_{en}^a : average consolidated coefficients, respectively, a group of infrastructure, socio-economic factors and environmental factors in the region.

The algorithm for determining locations of the logistics center is illustrated in Figure 4

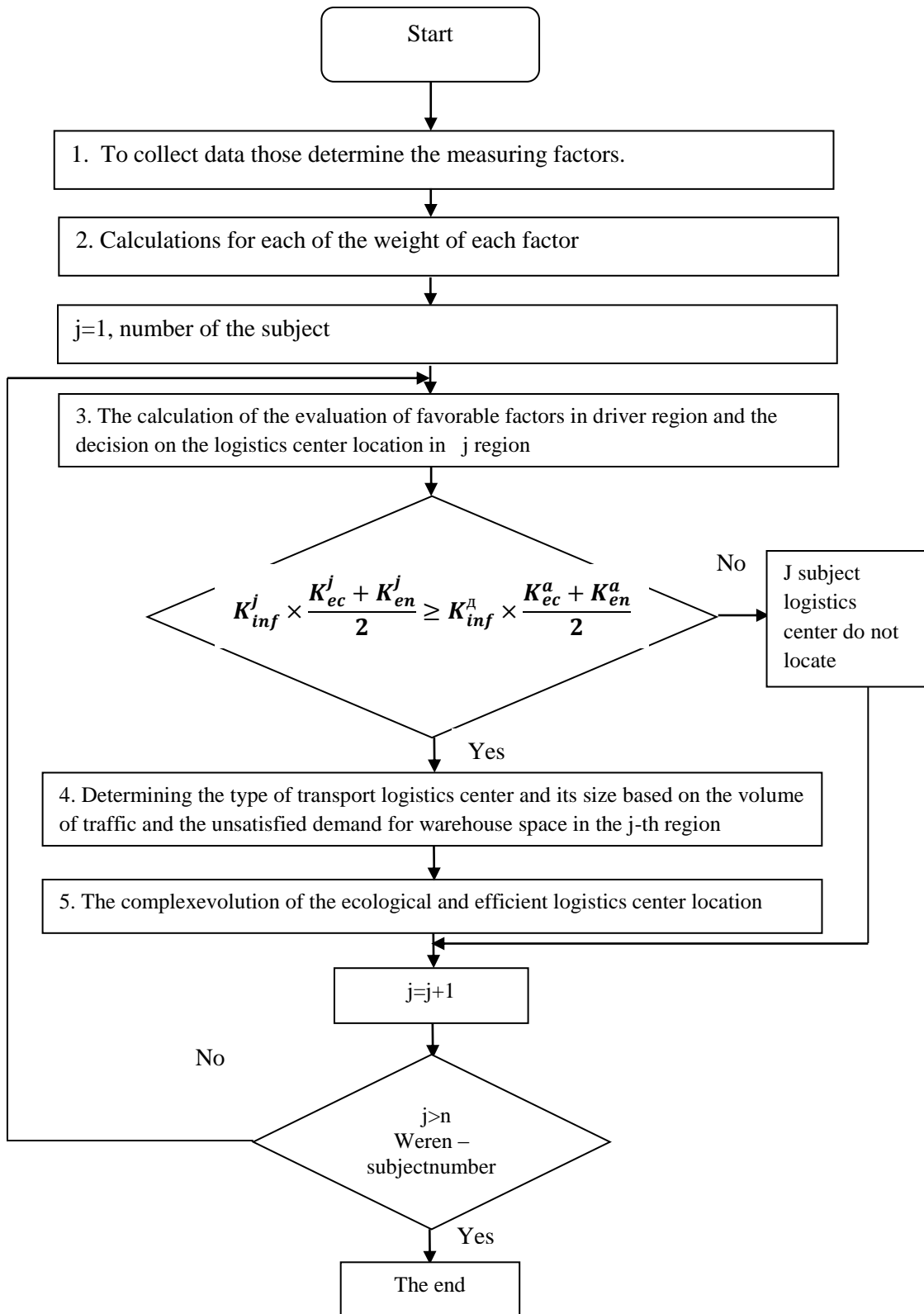


Figure 4. The algorithm for determining locations of logistics centers

CONCLUSION

The ecological issues in the transport sector are important in the current supply chain management but are not yet in the current situation.

Enabling eco-transport logistics infrastructure within the environmentally friendly green logistics system of companies responsible for freight transportation by freight will enable increased competitiveness and reduce costs

The choice of location and freight transportation logistics infrastructure depends on many market and industry factors. A methodology was used to estimate the difference in regional development levels based on factors of analysis. The processed methodology can be used by various local governments at the local level, and potential investors will be the basis of establishing the location of transport-logistics infrastructure that is less-impacted in the environment with the state and company's ecological frameworks.

It is possible to implement a "green" supply chain management based on the economics-mathematical modeling methodology of the optimal choice of transport and logistics infrastructure as suggested by the "green" logistics element.

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