Sustainability assessment for environmental construction projects, implemented in the arctic zone of the Russian Federation

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Abstract. The relevance of this article is caused by the construction development in the Arctic zone of the Russian Federation. These construction works should be performed considering ecological safety. The objective of this article is to elaborate methods of evaluation for sustainability of ecological construction projects, implemented in the Arctic zone of the Russian Federation. This process should be based on systematization of data on the essence of the projects in question, taking into consideration ecological, economic and social aspects of the notion “sustainability”. The paper defines such notions as “sustainability of results of ecological construction projects” and “ecological construction projects sustainability” and distinguishes between them. The article suggests methods of evaluation for sustainability of ecological construction projects, considering the need for prolongation of positive impact, when these projects are over.

Introduction
The strategic goal of ecological construction in the Arctic zone of the Russian Federation is to switch to closed cycle projects, when surrounding environment remains intact, there are no emissions and discharges and industrial and household wastes are totally recycled. M.A. Nekrasova, V.S. Plugin, D.A. Skorobogatov and A.V. Tsvetkov argue that this model has been considered utopic for a long time, for the estimation of infrastructure facility actual cost indicated that such projects are rather break-even than profitable, due to expensive environmental solutions [1].

This state of things resulted in that in 2013 in the coastal zone of the Arctic Ocean there were about 4 mlm. tons of industrial and construction litter [2].

However, nowadays the situation is a little bit different, the public campaign on pollution reduction is on the way. Under this campaign the key direction of development for the Arctic zone of the Russian Federation is to maintain ecological safety in this region, and that is impossible without the implementation of the “green” management in the construction industry.

The crucial breakthrough of the “green” project management is that it is aimed at solving most of the stated issues, and environment preservation or renovation is an obligatory factor for the successful implementation of any construction project [3] in the Arctic zone of the Russian Federation.
According to the state program “Socio-economic development of the Arctic zone of the Russian Federation” up to 2030 the principal construction activity is to be carried out in eight specific “support“ zones: Kola support zone; Archangelsk support zone; Senets support zone; Vorkuta support zone includes municipal unit urban district “Vorkuta” (MU UD Vorkuta) in the Republic of Komi; Yamal-Nenets support zone; Taimyr-Turuchansk support zone in the Krasnoyarsk Krai; North-Yakutsk support zone in the Republic of Sakha (Yakutia); the Chukotka support zone.

Another support zone is to be located in the Arctic zone of Karelia, where new sea port, transport and industrial infrastructure facilities are to be constructed.

All objects should be constructed or reconstructed within the framework of sustainable development, which requires elaboration of appropriate evaluation methods in terms of ecological construction implementation in the Arctic zone of the Russian Federation.

Different construction projects evaluation methods are reflected in the works of L.B. Kalmykov and E.Yu. Chrustalev [4], V.B. Perevyazkin [5], O.V. Laptev [6], but none of them proposes evaluation methods that fit the framework of sustainable development.

**Ecological construction projects: notion, management methods**

According to the author’s point of view, an ecological construction project is the complex of interrelated activities in the field of construction and (or) reconstruction of infrastructure facility under time or resource limitations, complying with “green” standards, as well as sustainable development principles, including ecological safety maintenance at the territory of project facility construction.

Ecological construction projects can be implemented within the following financial frameworks: participatory budgeting; public private partnership; municipal private partnership; concession agreements; special investment contracts; budget financing; commercial financing.

By the criterion “management methodology” the projects can be divided into: projects, implemented under project management standards; projects, implemented under project management and eco-management standards; projects, implemented under project management, eco-management and sustainable project management standards. The examples of these categories are provided in table 1.

**Table 1.** Possible standards that can be employed for ecological construction projects management in the Arctic zone of the Russian Federation

| Eco-management standards | Sustainable project management standards | Project management standards |
|--------------------------|----------------------------------------|-----------------------------|
| 1. GOST R ISO 14001-2016. Eco-management systems. Requirements and Application Guide | 1. GPM P5 Sustainable project management standard | 1. Project Management Body of Knowledge (Project Management Body of Knowledge Guidelines); |
| 2. GOST R ISO 14004-2007. Eco-management systems. Guidelines on principles, systems and methods of proper functioning | 2. ISO 26000:2010 Social responsibility Guidelines | 2. IPMA Competence Baseline |
| 3. GOST R ISO 14015-2007. Eco-management. Ecological evaluation | | 3. (ICB) This standard describes international requirements to qualification of project management experts; |
| | | 4. ISO 10006 Guidelines on quality management in engineering; |
| | | 5. GOST R ISO ISO 21500-2014 Project management; |
| | | 6. GOST R 54869-2011 Project management. Project management requirements; |
| Methods of evaluation for ecological construction projects sustainability |
|:------------------------------------------------------------------|
| Nowadays the scientific community has formulated many sustainability strategies, among which we can emphasize the following: strategy of ecological results priority; strategy of digital models of sustainable development; strategy of focus on financial components of the sustainable development; strategy of technological sustainability; strategy of combining ecological, economic and social components of development. |
| It is worth mentioning that the notion “sustainable development” has different interpretations in Russia and in the rest of the world. In Russia the current state strategies and programs of socio-economic development of territories use the notion in question in terms of sustainable economic growth. As for the rest of the world, there the sustainable development is much more fundamental process. That is balanced development of economic, social and ecological components [7]. |
| The UN strategy provides the most precise description of the sustainable development goals with regard to three components. Taking into consideration geographic and climatic conditions, as well as economic interests of the Russian Federation in the Arctic zone, we can identify 6 of 17 UN goals that have the major ecological focus: “Pure water and sanitation”, “Available and pure energy”, “Sustainable cities”, “Responsible consumption and production”, “Climatic changes”, “Preservation of oceans”, “Preservation of biological diversity”. |
| Of course, this is not the whole list of goals that contain ecological component. All the goals of the sustainable development in the UN contain environmental targets to one extent or another [7]. Thus, the implementation of the ecological construction projects in the Arctic zone of the Russian Federation should prevent negative effects for every of 11 mentioned goals. |
| At the same time in the project management the notion of “sustainability” is often employed during the evaluation of possible project results, in the meaning of “presence of prolonged positive effects”, which depend both on climatic conditions and on presence of financial sources to maintain operation facility in proper technical state. |
| Within this approach it is reasonable to use the category “projects results sustainability” [8]. |
| In particular, to forecast the sustainability of the results for ecological construction projects, implemented under local initiatives support program in the Murmansk region, we can use a certain combination of tools and methods, such as: |
| − to select the object to be financed within ecological construction project in the area, corresponding to the art.14 (local matters) of the Federal Law № 131 “Concerning the General Principles of the Organization of Local Government in the Russian Federation”; |
| − to include in tender documentation the documents that confirm the possibility of prolongation of positive effects from projects without regional budget employment. This tender documentation should be submitted by the municipal unit administration to the Ministry for the internal policy and public communication of the Murmansk region, which is responsible for implementation of projects under local initiatives support program on the territory of the constituent of the Russian Federation. |
| − to perform peer evaluation of the project applications. Such evaluations should be performed by a specific tender commission formed by the Ministry for the internal policy and public communication of the Murmansk region in order to select projects, applying for subsidies from the regional budget, taking into consideration criteria and sub-criteria (byi), reflecting the presence of the mentioned above financial sources and mechanisms of efficient operation and management of infrastructure facility of the implemented project. |
The ecological construction project can be considered sustainable, if $R_p = \max$, relatively sustainable, if $\max > R_p > 0$ and not sustainable, if $R_p = 0$. 

$$R_{pr} = \sum_{i=1}^{n} b_i \times p_i$$

(1)

Where, $b_i$ – point for the $i$-th criterion, reflecting the presence of financial sources and mechanisms of efficient operation and management of infrastructure facility for project implementation;

$p_i$ – weight coefficient for the $i$-th criterion, reflecting the presence of financial sources and mechanisms of efficient operation and management of infrastructure facility after the project implementation;

$n$ – total number of criteria, reflecting the presence of financial sources and mechanisms of efficient operation and management of infrastructure facility after the project implementation;

Under efficient operation of facility of ecological construction project, implemented in the Arctic zone of the Russian Federation, we mean the use of infrastructure project facility, preserving its initial or planned technical properties, including heat-insulating ones.

Pre-designed heat-insulating properties should be stated at the project planning stage, while determining project result requirements.

When we implement ecological construction projects and want them to be sustainable, then the competences of the CEOs and experts, dealing with project are extremely important. They should have proper knowledge in the field of environmental protection and ecological safety, according to the Federal Law of the Russian Federation “on environmental protection”, dated 10 of January 2002. Besides, these experts should perform their activities in the projects pursuant to the professional standards, related to waste disposal. About 10 such standards have been adopted nowadays.

The use of the best available technologies at construction in the Arctic zone of the Russian Federation is also very important. These technologies help to minimize ecological impact, preserving economic (investment) availability [9].

Coming back to the sustainability of the ecological construction project within the UN strategy, we can propose a methodology that distinguishes between projects per provided property. An ecological construction project can be considered sustainable, if all its parameters meet the criteria, divided into three units: socio-economic; eco-economic and socio-ecological.

Such a division into units within the UN strategy is used, when calculating the ranking of sustainable development among the regions of the Russian Arctic.

If we use proposed methods sustainability evaluation for ecological construction projects ($R_{ep}$), implemented in the Arctic zone of the Russian Federation, we should assess presence or absence of the following components, based on the objective evidence:

1. Socio-economic unit includes: the compliance of project goal with strategic planning documentation in the region ($A_1$); project results sustainability ($B_1$), this project was identified as $R_{pr}$ in the formulae, mentioned above; observance of rights of native minorities ($C_1$); the number of project beneficiaries ($D_1$); public participation in discussion of project facility determination ($E_1$); amount of created workplaces as a result of project implementation ($F_1$).

2. Eco-economic unit: share of expenses on environment protection in the project budget ($A_2$); share of expenses on land recultivation in the project budget ($B_2$); application of the best available technologies at project implementation ($C_2$); fee for excess emissions during the project implementation ($D_2$); hazardous wastes, emerging due to the project implementation ($E_2$); wastes recycling during project implementation ($F_2$); implementation and (or) use of energy-efficient or energy-saving technologies during construction, including renewable energy sources ($G_2$).

3. Socio-ecological unit: increase in supposed life expectancy of native minorities of the North, Siberia and the Far East of the Russian Federation, who live in the Arctic zone of the Russian Federation ($A_3$); in adaptation of population and economic systems to the climatic changes, deriving from project implementation ($B_3$).

Values and weight for proposed criteria are presented in table 2.
### Table 2. Evaluation criteria for ecological construction projects, implemented in the Arctic zone of the Russian Federation

| No. | Criteria | Criterion value | Number of points | Weight |
|-----|----------|-----------------|------------------|--------|
| 1.  | Socio-economic unit: | | | 0.3 |
| 1.1 | A₁ | Consistent | 100 | 0.025 |
|     |     | Inconsistent | 0 | |
| 1.2 | B₁ | Sustainable | 100 | 0.075 |
|     |     | Relatively sustainable | 50 | |
|     |     | Not sustainable | 0 | |
| 1.3 | C₁ | Consistent | 100 | 0.025 |
|     |     | Inconsistent | 0 | |
| 1.4 | D₁ | ≥ 1000 | 100 | 0.075 |
|     | > 500. < 1000 | 70 | |
|     | > 100. ≤ 500 | 40 | |
|     | ≤ 100 | 10 | |
| 1.5 | E₁ | Implemented | 100 | 0.05 |
|     | Not implemented | 0 | |
| 1.6 | F₁ | ≥ 1000 | 100 | 0.05 |
|     | > 500. < 1000 | 70 | |
|     | > 100. ≤ 500 | 40 | |
|     | ≤ 100 > 0 | 10 | |
|     | 0 | 0 | |
| 2.  | Eco-economic unit: | | | 0.35 |
| 2.1 | A₂ | ≥ 30% | 100 | 0.05 |
|     | > 10%. < 30% | 70 | |
|     | ≤ 10%. > 1% | 40 | |
|     | ≤ 1%. > 0 | 10 | |
|     | 0% | 0 | |
| 2.2 | B₂ | ≥ 30% | 100 | 0.05 |
|     | > 10%. < 30% | 70 | |
|     | ≤ 10%. > 1% | 40 | |
|     | ≤ 1%. > 0 | 10 | |
|     | 0 | 0 | |
| 2.3 | C₂ | Used | 100 | 0.05 |
|     | Not used | 0 | |
| 2.4 | D₂ | Not implemented | 100 | 0.05 |
|     | Implemented | 0 | |
| 2.5 | E₂ | Not formed | 100 | 0.05 |
|     | Formed | 0 | |
| 2.6 | F₂ | Implemented | 100 | 0.05 |
|     | Not implemented | 0 | |
| 2.7 | G₂ | Used | 100 | 0.05 |
|     | Not used | 0 | |
| 3.  | Socio-ecological unit: | | | 0.35 |
| 3.1 | A₃ | Possible | 100 | 0.2 |
|     | Impossible | 0 | |
| 3.2 | B₃ | Presupposed | 100 | 0.15 |
|     | Not presupposed | 0 | |
The ecological construction project can be considered sustainable, if $R_{ep} = \text{max}$, relatively sustainable, if $\max > R_{ep} > 0$ and not sustainable, if $R_{ep} = 0$.

$$R_{ep} = \sum_{i=1}^{n} be_i \times pe_i,$$

(2)

Where, $be_i$ – the value for the $i$-th criterion that reflects sustainability of ecological construction project, implemented in the Arctic zone of the Russian Federation;

$pe_i$ – weight coefficient for the $i$-th criterion that reflects sustainability of ecological construction project, implemented in the Arctic zone of the Russian Federation;

$n$ – the total number of criteria, reflecting sustainability of ecological construction project, implemented in the Arctic zone of the Russian Federation.

Thus, the sustainability of ecological construction project is the compliance of its implementation procedures with the synergy of economic, social and ecological factors, if the prolonged positive effects are still present, when the project is over. These effects depend both on climatic conditions and on presence of financial sources to maintain operation facility in the technical state, claimed at the launching stage during the whole planning horizon.

The proposed evaluation pattern can be used not only for separate project, but also to analyze dynamics of development for sustainable ecological construction in the set period: on the whole, in the whole Arctic zone of the Russian Federation, in particular areas or within support zones.

To do this the criteria, elaborated by the authors can be employed for the dynamic normal method, justified by the works of V. Turko and A. Korshunov [10].

In this study under dynamic normal we mean a structural-dynamic model, which allows to compare values of actual development with reference ones. This comparison is based on establishing connections and priorities for the criteria of ecological construction projects evaluation methods in each unit.

By determining deviation of actual growth rate for certain criteria values from the „reference“ one, we can identify priorities of public regulation in terms of obtaining optimal values for each criterion.

To use dynamic normal method we should:

- Identify priority ranking of criteria in every unit: socio-economic, eco-economic, socio-ecological;
- Calculate growth rate and increase rate of ecological construction sustainability during one year, one month or other set period in the area, chosen by the researchers, possible variants are mentioned above;
- To determine deviation of actual sequences ranks and dynamic normal for all parameters;
- To set up adjusting dynamic normal, in which growth rate for certain criteria values will depend on the degree of deviation of their actual level from the “reference” one;
- To prioritize spheres regulation for certain values or for the whole unit, depending on the degree of deviation of the actual criteria values from the “reference” ones.

**Summary**

Exploration and development of the areas in the Arctic zone of the Russian Federation requires application of stable tools, such as ecological construction projects, which comply with the principles of the UN strategy and provide prolonged positive effect of project facility usage, taking into consideration climatic restrictions.

The methods, proposed in this paper can be used to evaluate the sustainability in question. The mentioned methodology can serve as a basis for development of standards for ecological construction projects implementation in the Arctic zone of the Russian Federation.

For further development of this topic we should make a pilot approbation of this methodology, it also can be amended, if necessary. We also should work out special mathematical tools for the dynamic normal application algorithm in order to analyze dynamics of development for sustainable ecological construction in the set period: on the whole, in the whole Arctic zone of the Russian Federation, in particular areas or within support zones.

The results of the present study are practically relevant for public authorities, experts in project management and construction, scientists, dealing with sustainable development.
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