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KAIZEN IMPLEMENTATION METHOD OF "GREEN" PROJECT MANAGEMENT IN THE ORGANIZATION BASED ON LEARNING MODELS AND ARTIFICIAL INTELLIGENCE

The problem. The current stage of development of the project and program management industry requires the development of new approaches to respond to the serious challenges facing the industry. One of these challenges is the destruction of the ecosystem due to human activity and resource depletion. In such circumstances, the scientific direction of ensuring the environmental compatibility, inexhaustibility, and sustainability of project-oriented enterprises is of particular relevance. The mechanism for such provision can be "green" project management, which is proposed by the authors as a concept and individual artifacts.

The aim of developing the concept of "green" project management is to develop appropriate principles, models, and methods that would ensure the possibility of implementing green transformation projects for project-oriented enterprises in their transition to green entrepreneurship. The purpose of this study is to develop principles and models of green project management, as well as to develop a kaizen method for implementing green project management in an organization based on learning models and artificial intelligence.

Methods. This study used general scientific methods of analysis and synthesis, systems theory and a systems approach for the decomposition of the overall task into subtasks, classification theory to supplement the project classification model, life cycle theory, process management and project management to develop a life cycle model of the proposed method, and the SWOT analysis method for the general characterization of the research conducted.

Results. An analysis of scientific research in the field of "green" entrepreneurship and lean project management, in particular Lean production and Lean project management, is carried out. The principles of kaizen-oriented "green" project management are proposed. In the further development of models for classifying project management methods, taking into account the proposed field of research, additional features of the classification of such methods and varieties of methods within them are proposed. In the further development of the project management thesaurus, definitions of the terms "green" project management", "kaizen-oriented models and methods of "green" project management", "green transformation projects" are proposed. For the first time, a kaizen method for implementing "green" project management in an organization based on learning models and artificial intelligence is proposed, and a SWOT analysis of the proposed approach is conducted.

Conclusions. The task of survival of both project-oriented organizations and the ecosystem as a whole must be ensured by a conscious movement in this direction. The way to fulfill such a task is the transition of organizations to "green" entrepreneurship and the management of projects of such a transition using the principles, models and methods of "green" project management. This study proposes such an approach and conducts its SWOT analysis, based on the results of which it is possible to conclude about the prospects of further developments in the direction of "green" project management and the feasibility of their practical implementation. Vectors of further research in the chosen direction have been formulated: further development of models and methods of "green" project management, development of models for implementing and adapting (tailoring) models and methods of "green" project management into the activities of project-oriented and project-managed organizations, development of models for training personnel in models and methods of "green" project management, development of neural network models to ensure increased efficiency of involving artificial intelligence in solving the problems of projects and programs of "green" transformation.

Keywords: project and program management, green entrepreneurship, green project management, kaizen, artificial intelligence models, green transformation.

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МЕТОД КАЙДЗЕН-ВПРОВАДЖЕННЯ "ЗЕЛЕНОГО" УПРАВЛІННЯ ПРОЄКТАМИ В ОРГАНІЗАЦІЇ НА ОСНОВІ МОДЕЛЕЙ НАВЧАННЯ ТА ШТУЧНОГО ІНТЕЛЕКТУ

Проблема. Сучасний етап розвитку галузі управління проєктами та програмами вимагає розробки нових підходів для відповіді на серйозні виклики, що постають перед галуззю. Один з таких викликів – руйнування екосистеми, що пов'язане із людською діяльністю та вичерпністю ресурсів. У таких умовах особливої актуальності набуває науковий напрямок щодо забезпечення екологічності, невичерпності і стійкості діяльності проєктно-орієнтованих підприємств. Механізмом такого забезпечення може виступати "зелений" проєктний менеджмент, який пропонується авторами у якості концепції і окремих артефактів.

Мета. Метою розвитку концепції "зеленого" проєктного менеджменту є розробка відповідних принципів, моделей та методів, які б забезпечили можливість реалізації проєктів "зеленої" трансформації для проєктно-орієнтованих підприємств при переході їх до "зеленого" підприємництва. Метою цього дослідження є розробка принципів та моделей "зеленого" проєктного менеджменту, а також розробка методу кайдзен-впровадження "зеленого" управління проєктами в організації на основі моделей навчання та штучного інтелекту.

Методи дослідження. У цьому дослідженні застосовувалися загальнонаукові методи аналізу і синтезу, теорія систем і системний підхід для декомпозиції загальної задачі на підзадачі, теорія класифікації для доповнення моделі класифікації проєктів, теорія життєвих циклів, управління процесами та управління проєктами для розробки моделі життєвого циклу запропонованого методу, метод SWOT аналізу для загальної характеристики проведеного дослідження.

Основні результати дослідження. Проведено аналіз наукових досліджень у галузі "зеленого" підприємництва і ощадливого управління проєктами, зокрема Lean production та Lean project management. Запропоновані принципи кайдзен-орієнтованого "зеленого" управління проєктами. У подальший розвиток моделей класифікації методів управління проєктами з урахуванням пропонованої галузі досліджень, запропоновано додаткові ознаки класифікації таких методів та різновиди методів у їх межах. У подальший розвиток тезаурусу управління проєктами запропоновані визначення термінів "зелений" проєктний менеджмент", "кайдзен-орієнтовані моделі і методи "зеленого" проєктного менеджменту", "проєкти "зеленої" трансформації". Вперше запропоновано метод кайдзен-впровадження "зеленого" управління проєктами в організації на основі моделей навчання та штучного інтелекту, проведено SWOT аналіз запропонованого підходу.

Висновки. Виконання задачі виживання як проєктно-орієнтованих організацій, так і екосистеми в цілому має бути забезпеченим усвідомленим рухом у цьому напрямку. Шляхом виконання такої задачі є перехід організацій до "зеленого" підприємництва і управління проєктами такого переходу з використанням принципів, моделей та методів "зеленого" проєктного менеджменту. У цьому дослідженні пропонується такий підхід та проведено його SWOT аналіз, за результатами якого можна зробити висновок про перспективність подальших розробок у напрямку "зеленого" проєктного менеджменту та доцільність їх практичного впровадження. Сформульовано вектори подальших досліджень у обраному напрямку: подальша розробка моделей і методів "зеленого" проєктного менеджменту, розробка моделей впровадження та адаптації (тейлорінгу) моделей і методів "зеленого" проєктного менеджменту у діяльність проєктно-орієнтованих та проєктно-керованих організацій, розробка моделей навчання персоналу моделям і методам "зеленого" управління проєктами, розробка моделей нейронних мереж для забезпечення збільшення ефективності залучення штучного інтелекту до вирішення задач проєктів і програм "зеленої" трансформації.

Ключові слова: управління проєктами та програмами, "зелене" підприємництво, "зелений" проєктний менеджмент, кайдзен, моделі штучного інтелекту, "зелена" трансформація.

Introduction. In difficult times of challenges facing the project management industry, the Ukrainian economy and Ukraine as a whole, the vectors of scientific research are directed towards the development of more effective models and methods of modern project management. An important aspect of the projects being implemented is the environmental friendliness of their products, as well as implementation processes. Increasing requirements for environmental protection, a thrifty attitude to resources, optimization of costs in projects and other requirements have formed a research direction that can be identified as "green" project management. This approach combines the Lean methodology, the Agile methodology, classical standards in their latest editions with elements of tailoring and the principles of sustainability and inexhaustibility, and provides them with further development in a new concept.

At the same time, aspects of developing models and methods for "green" project management remain under-researched and under-covered in scientific sources. Therefore, the topic of this study can be considered relevant.

Literature review. Lean management of environmental projects has been studied by many researchers, and the foundations of such management are laid in leading standards and methodologies for project and program management. The first relevant approach that began its triumphant march into future application in project management is Lean Production [1], originating from the Japanese management system. Its main concepts are a lean attitude to production, inventory reduction, and elimination of uneven load on employees and equipment. Studies of the Lean approach [2,3] prove its effectiveness and applicability in increasing competitiveness and creating the foundations of economic growth and development. After the emergence of the Agile IT project management methodology, the Lean approach was added to the Agile umbrella as a separate component. Since then, its active application in project management [4] has begun, including IT, but not exclusively in this field.

Another related direction that is currently actively developing is sustainable entrepreneurship, which is associated with increasing requirements for the environmental friendliness of products, projects and processes - both technological processes and management processes [5]. In the search for a combination of environmental friendliness and sustainability of entrepreneurship, the concept of "green entrepreneurship" [6] appears and develops, which later found its reflection in the world of project and program management [7]. The conceptual principles of "green entrepreneurship" [8] allow us to express a hypothesis regarding the feasibility of their application for the initialization and implementation of relevant "green" projects.

We analyzed the possible prerequisites for the effective implementation of a "green approach" that are embedded in standards and research in the field of project management. One of the main industry standards, PMBOK [9], in its latest edition, formulates a foundation of principles and additional domains that allow the deployment of a "green" project management approach to be based on them. The vast majority of principles (creating a collaborative environment for the project team, embedding quality in processes and deliverables, being a diligent and respectful and caring manager, etc.) are aimed at substantiating sustainable, inexhaustible project management. This also applies to the new project management domains introduced by the standard – the "value delivery system" domain and the "tailoring" domain. The PRINCE2 standard in its latest edition has also developed towards sustainability and environmental friendliness of project management [10]. While the previous edition of the standard described project performance in six dimensions, the seventh edition of PRINCE2 introduces a seventh: sustainability. The "Change Management" domain has also been added, which concerns how to move an organization from its current state to its planned future state. This domain can be used by project-oriented organizations to transition to "green entrepreneurship". In this context, one of the seven principles of the standard – Tailor to the Environment – is also important. In the Japanese P2M standard [11], the basis for the implementation of "green" project management can be considered: the "Value Assessment Management" domain regarding program management (a set of interconnected projects) and the new parts of the standard that appeared in its latest edition – Knowledge Foundation and Human Capability Foundation. In the modern study of Harold Kerzner [12], environmental friendliness and inexhaustibility are also mentioned as a guarantee of project-oriented organizations sustainability when considering real cases of innovative project activity. Studies by Ukrainian scientists also emphasize the importance of such an approach, in particular in the context of the value-oriented project management application [13] and safety-oriented project management [14].

An important component of the "green" project management basis should also be considered Lean project management, which is an interpolation of the Lean production approach into the field of project and program management [15, 16], it is also worth mentioning the works on some practical aspects of implementing the described approaches to one of the projects types [17].

Research on "green" project management considers both theoretical [18] and practical [19] aspects of application. However, an unresolved part of the problem remains innovative methods of its implementation using elements of artificial intelligence.

In general, it is worth noting that in the sources considered, models and methods of implementing "green" project management are not sufficiently studied, which determines the relevance of research in this direction.

Methods. This study used general scientific methods of analysis and synthesis, systems theory and a systems approach for the decomposition of the overall task into subtasks, classification theory to supplement the project classification model, life cycle theory, process management and project management to develop a life cycle model of the proposed method, and the SWOT analysis method for the general characterization of the research conducted.

Research results. The development of models and methods for improving project activities has led to the enrichment of project culture with the achievements of Japanese management, among which we highlight the Kaizen concept. This concept

has undergone a long development from this scientific formulation [20], the emergence of branches in the Gemba-Kaizen style [21], integration with other Japanese development concepts in the Ikigai, Wabi-Sabi style, etc. – and to modern application in the management of project data and knowledge bases [22, 23]. This application seems appropriate for the field of "green" project management, the concept of which is also based on the development of one of the Japanese approaches – Lean.

We propose eight principles of kaizen-oriented "green" project management:

-orientation of a project-oriented organization towards "green" entrepreneurship, "green" products of activity, "green" processes and "green" projects;

-kaizen of project products;

-kaizen of project management processes;

-kaizen of technologies for obtaining a project product;

-involvement of not only the project team, but also all employees of a project-oriented enterprise in kaizen;

-regulation of kaizen processes, their description and constant monitoring;

-kaizen of kaizen – continuous improvement of kaizen processes (it is recommended to allocate them as a separate process, describe them and carry out constant monitoring);

-motivation of employees for successful kaizen (also in the form of a described and controlled process).

We will also consider expanding the classification models of project management methods taking into account the proposed field of research. In the further development of such models, we will propose the following classification features and types of methods within them:

1. According to the leading model of "green" project management
- Lean-oriented models and methods of "green" project management;
- Kaizen-oriented models and methods of "green" project management;
- Models and methods of "green" project management based on classical standards in the field of project management;
- Hybrid models and methods of "green" project management.

2. In the direction of kaizen-oriented models of "green" project management:
- focused on improving the processes of interaction of the project with the environment (stakeholders);
- focused on improving the processes of interaction of the project team;
- focused on improving the processes of project management;

- focused on improving the product and results of the project.

3. In the direction of integration of kaizen-oriented models of "green" project management:
- kaizen-oriented models are used separately from the organization's project management methodology;
- the organization's project management methodology is built on kaizen-oriented models;
- the organization uses a methodological hybrid with the inclusion of kaizen-oriented models and methods in the structure of such a hybrid.

In the development of the project management thesaurus, we offer several definitions of terms.

Definition 1. "Green" project management is an approach to project management that can be applied by project-oriented or project-managed organizations, which orients such organizations to environmental friendliness, inexhaustibility, and sustainability in all aspects of their activities. Such aspects may include the organization's processes, organization's projects, project team, products, and project results.

Definition 2. Kaizen-oriented models and methods of "green" project management are models and methods that implement step-by-step (incremental) continuous improvements in aspects of the activities of a project-oriented organization towards full compliance with "green entrepreneurship" with flexible periodization of such improvements.

Definition 3. Green transformation projects are a system of activities and works formulated in the form of individual projects or a program consisting of them, aimed at achieving environmental friendliness, sustainability and inexhaustibility of all aspects of the activities (products, processes, projects, team) of a project-oriented organization. Such projects can use kaizen-oriented models and methods of green project management to achieve the set goal.

Based on the above, we will develop a kaizen method for implementing green project management in an organization based on learning models and artificial intelligence (Fig. 1).

Let's describe the phases and steps of the method.

1. In the starting phase, the method implementation team is formed as part of the project management team. All employees of the organization and all participants in its projects are involved in kaizen, but the management of the method implementation should be assigned to individual participants of the project management team. Three roles are proposed as mandatory in this regard – the method implementation manager, responsible for kaizen (or kaizen consultant on outsourcing terms) and a specialist in "green" entrepreneurship (or

consultant on "green" project management on outsourcing terms). In the starting phase, the boundaries of the method implementation and the list of main entities (artifacts) that are the external and internal environment of its implementation are determined $A = \{a_1, a_2, \dots a_{i-1}, a_i\}$.

2. The external artifact initialization phase begins with step 2 of identifying all method stakeholders $H = \{h_1, h_2, \dots h_{j-1}, h_j\}$, their values $\dot{H} = \{\dot{h}_1, \dot{h}_2, \dots \dot{h}_{j-1}, \dot{h}_j\}$, influence $\ddot{H} = \{\ddot{h}_1, \ddot{h}_2, \dots \ddot{h}_{j-1}, \ddot{h}_j\}$, and interest $\underset{\cdot}{H} = \{\underset{\cdot}{h}_1, \underset{\cdot}{h}_2, \dots \underset{\cdot}{h}_{j-1}, \underset{\cdot}{h}_j\}$.

3. Also in this phase, at stage 3, green patterns (scenarios) of "green" models and methods already applied by stakeholders or those that can potentially be applied are determined, for which their respective management systems are ready $G_s = \{g_{s1}, g_{s2}, \dots g_{sm}\}$.
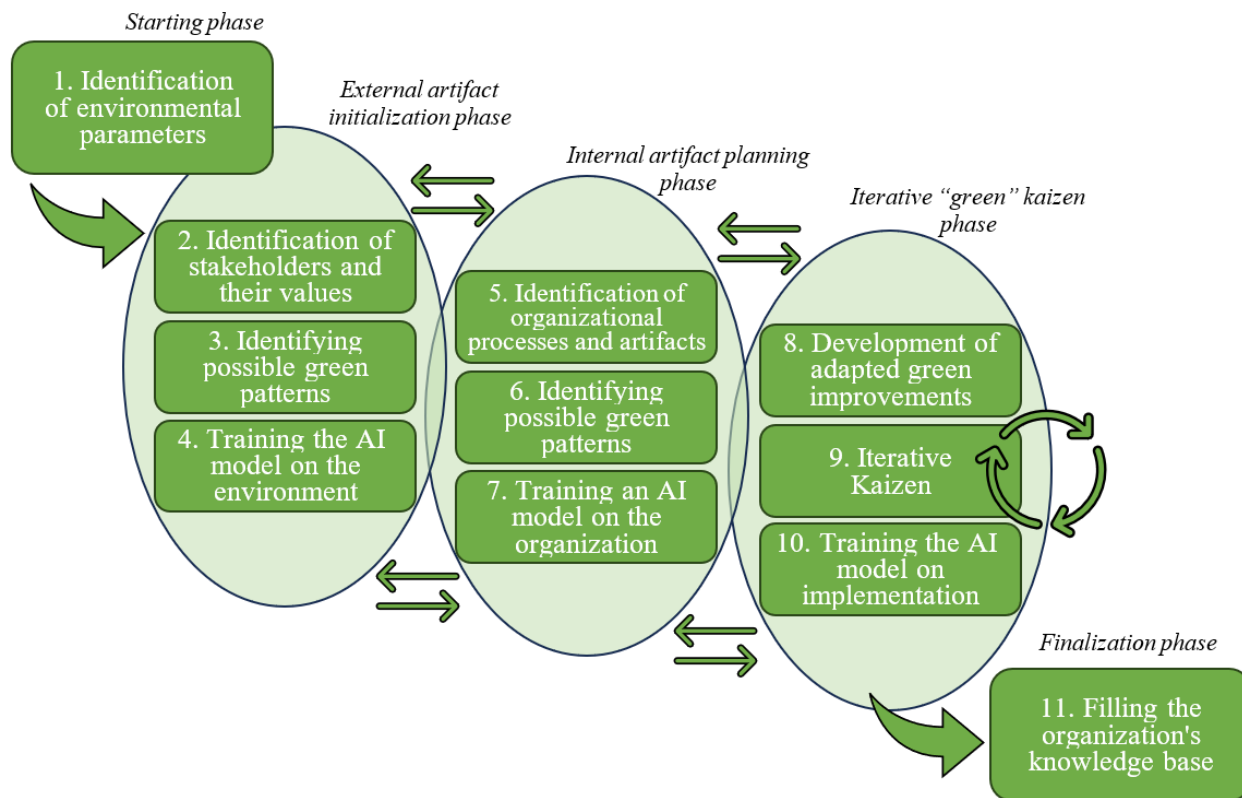

Fig. 1. Life cycle model of the kaizen method - implementation of "green" project management in an organization based on learning models and artificial intelligence

4. The phase of external artifacts initialization is completed by selecting the neural network model to be used in this method, and initial training of the neural network. Training should be aimed at studying the external environment of the project-oriented organization, which will be affected by the implementation of the method (structure, relationships, patterns).

5. The phase of internal artifacts planning begins with step 5 regarding the identification of the organization processes and artifacts in which the method will be implemented $P = \{p_1, p_2, \dots p_{n-1}, p_n\}$.

6. Also in this phase, at stage 6, green patterns (scenarios) of "green" models and methods already applied by the organization or those that can potentially be applied are determined, for which the corporate management system is ready. $G_o = \{g_{o1}, g_{o2}, \dots g_{om}\}$.

7. The internal artifacts planning phase is completed by secondary training of the neural network, which should relate to the project activities of a project-oriented organization, in which the implementation of the method will be concerned (structure, relationships, patterns).

8. The iterative "green" kaizen phase begins with the development of a backlog for the implementation of "green" transformations. The person responsible for kaizen, together with the method implementation team, in step 8 develop a list of "green" improvements adapted to the organization $G_p = \{g_{p1}, g_{p2}, \dots g_{pk}\}$. Such improvements can concern operational and project business processes, project products, organization personnel and project teams.

9. Next, there is an iterative kaizen of implementing the formulated backlog. One of the differences between iterative kaizen and sprints in the Scrum method is the flexible boundaries of the iteration implementation periods. The duration of each iteration can be determined by the team individually; it is not necessary to fix the constant

duration of iterations at 2 weeks, as can happen in Scrum. Iterations continue until the last improvement defined in the backlog is implemented.

10. During the entire phase of iterative "green" kaizen, basic training (type 3 training) of the neural network takes place, which should concern models, methods and scenarios of adapted implementation of "green" initiatives in the activities of a project-oriented organization.

11. After completing the backlog, the method finalization phase begins. In this phase, the final training of the neural network takes place, and the knowledge base for implementing the method is formed $N = <A, H, \dot{H}, \ddot{H}, \underline{H}, G_s, G_o, G_p, P, M>$, where M are lessons learned (identified patterns) regarding the implementation of the method.

Thus, the life cycle model of the kaizen method of implementing "green" project management in an organization based on learning models and artificial intelligence combines the waterfall and Agile approaches, is flexible (allows transitions between phases, in particular, the transition to the implementation of the previous phase) and is aimed at gradual, iterative kaizen improvement of the activities of a project-oriented organization within the framework of the "green" transformation project (program).

We propose an AI model called a convolutional neural network for use in the above method, as such networks are adequate for multidimensional data and can be trained using standard backpropagation. An additional advantage of convolutional neural networks for the above method is that they are easier to train than other conventional deep feedforward neural networks and have fewer parameters to estimate.

Discussion of research results. Based on the results of the research, in the context of discussing their results, we will conduct a SWOT analysis in its first form – we will identify the strengths and weaknesses, opportunities and threats of the proposed approach (principles, model and method), the results are presented in Table 1.

Among the main advantages of the above approach, it is worth identifying the focus on environmental friendliness, inexhaustibility and sustainability, as well as sufficient systematization. Among the disadvantages and threats are the need for consistency between competing goals of the "green" direction and ensuring high profitability.

Table 1

Results of the SWOT analysis of the proposed approach

Strengths	Weakness
- ecological orientation, which implies the inexhaustibility and sustainability of a project-oriented organization; - sufficient justification of the approach by innovative models and methods of modern project management standards and methodologies; - structuring and systematization of the presented approach.	- formalization of the proposed models and method requires further improvement; - insufficient research into the implementation of the proposed approach in the activities of project-oriented organizations and unproven effectiveness of such implementation; - potential conflict between the goals of "green" entrepreneurship and increasing profitability.
Opportunity	Threats
- the possibility of harmonious, environmentally friendly development in line with modern trends; - the possibility of ensuring participation in energy efficiency improvement projects through the implementation of the proposed approach; - the possibility of increasing the reputation of project-oriented companies, and therefore an increase in the number of projects from customers.	- increased military risks and the depreciation of the approach as a result, switching the emphasis of project management from ensuring environmental friendliness to ensuring survival; - pressure from customers and stakeholders, which may be associated with demands to abandon "green" principles for the sake of increasing profits; - significant external resistance from the internal environment of the implementation of the approach (personnel of a project-oriented organization).

In general, based on the results of the SWOT analysis, we can conclude that further developments in the chosen direction are promising and that their practical implementation is appropriate.

Conclusions. Modern project management is forced to develop in difficult conditions of an increasingly unpredictable and turbulently risky external environment. At the same time, the requirements for environmental friendliness, sustainability and inexhaustibility of entrepreneurship remain relevant in conditions of limited resources, which are felt more and more

acutely. Therefore, the topic of "green" entrepreneurship and the corresponding project activities to achieve it remains relevant.

This article examines the principles, models and methods of "green" project management, in particular, an analysis of scientific research in the field of "green" entrepreneurship and lean project management is carried out, the principles of kaizen-oriented "green" project management are proposed. In the further development of models for classifying project management methods, taking into account the proposed field of research, additional features of the classification of such methods and varieties of methods within them are proposed. In the further development of the project management thesaurus, definitions of the terms "green" project management", "kaizen-oriented models and methods of "green" project management", "green transformation projects" are proposed. For the first time, a kaizen method for implementing "green" project management in an organization based on learning models and artificial intelligence is proposed, and a SWOT analysis of the proposed approach is conducted.

In general, the approach (consisting of principles, models and methods) that has been proposed will ensure the implementation of the mission of achieving full compliance with "green entrepreneurship" by project-oriented organizations through continuous improvements in aspects of activity with flexible periodization of such improvements.

The following can be identified as vectors for further research in the chosen direction:

1) further development of models and methods of "green" project management;

2) development of models for implementing and adapting (tailoring) models and methods of "green" project management into the activities of project-oriented and project-managed organizations;

3) development of models for training personnel in models and methods of "green" project management;

4) development of neural network models to ensure increased efficiency of involving artificial intelligence in solving the problems of projects and programs of "green" transformation.

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