Optimization model planning of sustainable innovation development of the electric power industry enterprise

Alexander Tsvettsykh, Tatyana Afanasyeva, Maria Chuvashova, and Natalia Moskvitina

1Reshetnev Siberian State University of Science and Technology, Institute of Engineering Economics, Krasnoyarskii rabochii prospekt, Krasnoyarsk, 660037, Russia
2Irkutsk State University, Institute of Social Sciences, Karl Marx, 1, Irkutsk, 664003, Russia

Abstract. The high scientific and practical significance of the problem of ensuring the sustainable development of electric power enterprises determined the topic, subject of research, purpose and tasks. The research purpose is connected with improving the tools of strategy for innovative development of the production field of the electric power industry enterprise. In the course of solving the set goal, the method of collective expert assessments, the method of morphological analysis based on successive approximations was used. The results of the research were substantiated methodological principles and methodology for planning the innovative development of an electric power industry enterprise. The elements of this methodology are the system of indicators of sustainable innovative development and the optimization model for the formation of a strategy for sustainable innovative development of an electric power enterprise.

1 Introduction

The solution of environmental problems and the sustainable provision of the population with electricity require the introduction of innovative technologies for the activities of electric power enterprises. The subject of the study is tools and methods for developing a strategy for innovative development of the production activities of the electric power industry enterprise. The main hypothesis of the study is the need to develop special tools for planning innovative development of the enterprise, which take into account their industry characteristics.
1.1 Objectives

The purpose of the study is connected with improving the tools of innovative development strategy of the production field in the electric power industry enterprise. The research study required solving the following tasks:

1. Disclosure of the role and significance of innovations in the development of production field of enterprises engaged in the transmission and distribution of electricity.
2. Determination and systematization of factors of development of production activities of enterprises engaged in transmission and distribution of electricity.
3. Analysis of tools those apply for developing the strategy of innovation development of the enterprise's production.
4. Definition of some principles for developing a strategy for sustainable innovative development of enterprises.
5. Development of an optimization model for the strategy of sustainable innovative development of the production on enterprises, based on taking into account its industry characteristics.

<table>
<thead>
<tr>
<th>Essence of sustainable innovative development of the enterprise</th>
<th>The signs of the sustainable innovation development of enterprise</th>
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<tbody>
<tr>
<td>Systematic, strategic development based on the preparation and implementation of innovations that allow improving the efficiency of production and which includes social aspects of the production fields on enterprises.</td>
<td>- irreversibility and long-term nature of qualitative production changes</td>
</tr>
</tbody>
</table>

2 Literature review

In special economic literature, several approaches to planning innovative development of enterprises have been proposed. Matrix methods for planning innovative development received the greatest development in economic literature and practice. The founders of matrix enterprise planning methods are Kembell E and Sammerce [1], Michael Porter [2], Prahalad C K and Hamel G [3], Rumelt R P [4], Igor Ansoff [5]. The coefficient method of strategic planning is based on the concept of balanced indicators, its founders were Kaplan Robert S, Norton David P [6]. The tools of matrix analysis and planning of the companies Boston Consulting Group [7], McKinsey [8], Artur D. Little [9] have received wide practical application. In practice, the analysis of innovative development is based on the concept of the life cycle [9; 10]. These methodological approaches do not take into account industry specifics, do not provide for the need to find an effective version of the strategic plan based on optimization calculations. These factors reduce the practical value of these concepts.

3 Methodology

3.1 The essence of the innovation development of electric power industry enterprise

Analysis of differs approaches for understanding innovation development permit to distinguish their distinctive features and give an author's definition. The author's definition
of the concept of innovation development is given in Table 1. The criteria for sustainable innovation development of an energy enterprise are:

- The 1st criterion is ecological, it means any measures that reduce the danger of production to nature, to the environment;
- The 2nd criterion is humanization, there is the production process reflects the complete safety of work and quality for the consumer.

3.2 Methodological basis for strategic planning of the innovation development of the enterprise

The need to select some methodological tools and levers for the development of a strategy for innovation development enterprises in the field of production required research of approaches that suggested by other scientists. The table 2 shows the features of these methods.

**Table 2. Features of methods for development of the innovation development strategy of enterprises.**

<table>
<thead>
<tr>
<th>Methods</th>
<th>Advantages of methods</th>
<th>Disadvantages of methods</th>
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<tbody>
<tr>
<td>Coefficient method</td>
<td>Availability of information base, convenience and ease of calculation; Ability to monitor innovative development</td>
<td>The method doesn’t take into account the marginal nature of the indicators of balance and proportionality and efficiency of production processes.</td>
</tr>
<tr>
<td>Matrix approach</td>
<td>Availability of the information base; Assessment of the balance and proportionality and efficiency of production processes; Easy to choose strategic solutions.</td>
<td>The method has prescriptive nature of recommendations of strategic planning matrices. The method doesn’t take into account the limiting nature of the performance indicators of production processes.</td>
</tr>
<tr>
<td>Balance Sheet Method</td>
<td>Availability of the information base; Assessment of the balance and proportionality and efficiency of production processes; Convenience and ease of calculation.</td>
<td>The method doesn’t take into account the marginal nature of the indicators of balance and proportionality and efficiency of production processes.</td>
</tr>
</tbody>
</table>

The analysis of the presented methodological approaches revealed their shortcomings, including the most significant is the lack of consideration of the marginal nature of the indicators of balance and proportionality and efficiency of production processes that allow assessing the level of sustainability of innovative development of the enterprise.

2.2 Principles of enterprise innovation development planning

The study of planning principles made it possible to distinguish a relevant list of methodological principles for the formation of strategy for the sustainable innovation development of any electric power enterprise. The most important methodological principles for the formation of a strategy for sustainable innovative development of an electric power enterprise are given in Table 3.
Table 3. Principles of enterprise innovation development planning

<table>
<thead>
<tr>
<th>Title of principle</th>
<th>Content of the principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemacity</td>
<td>The strategy of innovation development of production field is considered comprehensively as a system of interconnected, adaptively changing elements.</td>
</tr>
<tr>
<td>Completeness</td>
<td>Taking into account the main factors in the development of a strategy for innovative development of production, that affect the sustainability of innovative development of production.</td>
</tr>
<tr>
<td>Regularity, continuity</td>
<td>Systematic assessment of the implementation of the strategy of innovative development of production, the degree of ensuring the sustainability of innovative development of production.</td>
</tr>
<tr>
<td>Accuracy</td>
<td>The most accurate reflection of reality, unmistakable performance of planned and analytical calculations.</td>
</tr>
</tbody>
</table>

2.2 Optimization model for developing a sustainable innovation enterprise development strategy

The optimization model for the development of the innovation development strategy of the enterprise has the form:

\[ k_{\text{eff}} \rightarrow \max \]

\[ \sum \text{Cost} \leq \text{Budget} \]

\[ \sum \text{risk Pr} \leq \text{Budget} \]

Where: \( k_{\text{eff}} \) is the sum of points on the indicators of innovation development (assessment indicators of innovative development of the enterprise, points);
Cost: \( \sum \) – the amount of costs for the implementation of a specific project;
Risk Pr: \( \sum \) – the amount of costs for covering project risks;
Budget – the standard value of project costs.

The list of innovation development indicators is determined taking into account the industry characteristics of the project by experts. The optimization model is designed to increase the efficiency of choosing the composition of innovation projects and increase the sustainability of innovation development of an enterprise.

The model of optimization of the formation of a strategy of sustainable innovation development of the electric power industry enterprise allows increasing the efficiency of analysis and planning of innovation development of the enterprise. This is achieved through the formation of an effective portfolio of the innovative projects that gives the best indicators of sustainability of innovation development. These indicators are determined taking into account the industry peculiarities of the electric power industry enterprise by an expert.

5 Conclusion

The practical using of the optimization model takes into account the assessment of the criteria for the effectiveness of innovation activities of the enterprise engaged in the transmission and distribution of electricity. These criteria include the sum of the costs of
projects and the costs of production risks arising from the implementation and operation of projects.

The main problems of activities of these type enterprises continue to be:
- the lag of the technological level from the formed best world practices,
- insufficient efficiency of tariff regulation of the industry,
- the presence of gaps in the regulatory framework governing relations in the industry, etc.

These problems negatively affect the technical and economic indicators of the functioning of the power grid complex, the reliability and quality of power supply to the consumer. Therefore, it is necessary to introduce a special strategy for innovation development, for the development of which the authors proposed the optimization model. The next stage of the research should be the development of a system of indicators for planning and monitoring the sustainable innovation development of the electric power industry enterprise.

References

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5. Igor Ansoff: Strategic Management by Mike Clayton October 14 (2014) [2023-05-18]. https://www.pocketbook.co.uk/blog/2014/10/14/igor-ansoff-strategic-management/