

Renovation and sustainable development of the industrial energy enterprise: economic and legal management mechanism

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Abstract. The article improves the economic and legal management mechanism of renovation and sustainable development of the industrial energy enterprise, based on the dominant system, regularity and sequence of effective management decisions in strategic and tactical aspects, which combines goals, objectives, directions and problems of renovation sustainability. Using the hierarchy analysis method, main goals and activities of the industrial enterprise, aimed at improving sustainable development, were identified. The system of budgets allows to assess in advance the consequences of the current state of affairs and the implemented strategy of the financial condition of the enterprise. Budgeting becomes the link between strategic management by senior management and operational management at lower levels. Budgeting helps aim managers at all levels to achieve the tasks set before their centers of responsibility and increase the professionalism of managers. Budgeting contributes to a detailed study of activities of units and relationship between the centers of responsibility in the enterprise, which is relevant today.

1. Introduction

The solution to the problem of the sustainable development of the enterprise ensuring can be provided by forming the effective economic and legal management mechanism based on the idea of supporting self-organization processes, as well as the state of dynamic balance between elements and processes within the enterprise and in the external environment that allow to support renovation parameters of functioning in a certain range of efficiency of changes. The policy of management of renovation and sustainable development provides for the development of the management mechanism using the systematic and self-organizing approach. Due to the modeling of the management system of renovation and sustainable development of the enterprise, a rational way of integration and differentiation of system-forming elements is provided to stimulate processes of self-organization and ensure the economic stability of the industrial energy enterprise.

2. Critical literature review

In recent years, scientists have increasingly paid attention to the study of renovation and sustainable development of industrial enterprises, including O. Arefieva [1], T. Belyalov [2], I. Gryshova [3], E. Maslennikov [4], O. Kalchenko [5], P. Putzenteilo [6] and others. Despite the large number of



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scientific papers, theoretical, methodological and applied aspects of this issue remain insufficiently studied and require more thorough study.

Unresolved parts of the problem. A number of tasks related to the combination of processes of renovation and sustainable development, building the economic and legal mechanism for managing the definition of transformational change, finding priority areas for growth, remains underdeveloped in both theoretical and practical aspects at present.

The purpose of the study is to improve the economic and legal mechanism for managing the sustainable development of industrial energy enterprises.

3. Methodology and results

Rationality of management ensuring of renovation and sustainable development of industrial energy enterprise is achieved through systematic management of innovation and investment activities, aimed at forming and ensuring the achievement of economic growth through the rational use, accumulation and distribution of innovation potential, including material, labor, financial and information resources, in order to transform it into innovative capital that can ensure the stability of innovation and investment enterprise. The range of tasks for the management of renovation and sustainable development includes: work on marketing support for innovation; issues of innovative and investment organization; solution of dominant problems to change by staff; building a system of relationships with market participants; optimization of intellectual property management processes, etc. The management system of renovation and sustainable development of the enterprise makes it possible to increase significantly the efficiency and effectiveness of innovations, which in the strategic period will ensure a high level of competitiveness not only industrial energy companies, but also industries, regions and the economy as a whole [1, 5-6].

For effective management of renovation and sustainable development of the enterprise, it is necessary to develop the economic and legal mechanism based on the principles of system, regularity and sequence of effective management decisions in strategic and tactical aspects, which allows to combine goals, objectives, directions and problems of competitive stability (Fig. 1).

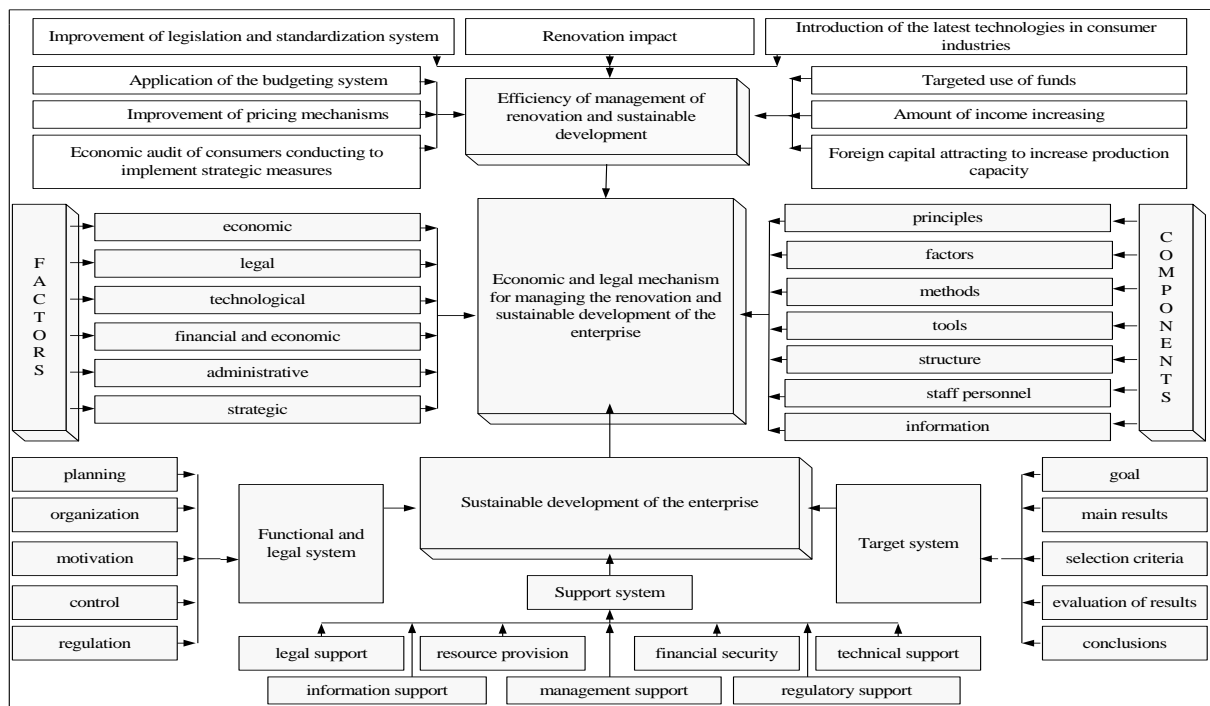


Fig: 1 Economic and legal mechanism for managing the sustainable development of the enterprise

The use of the mentioned management mechanism will provide the optimal ratio between variable factors influencing the competitiveness, modifying and improving the proportions between which ones a wide variety of states and options for management strategy building can be obtained to achieve effectively economic sustainability of the industrial energy enterprise [3].

Based on the suggested mechanism, the information transformed into knowledge is the basis of both types of competitiveness of the industrial energy enterprise: both in the area of “weak” (price) competition and in the area of “strong” (technological competition). In the first area of competition, information acts as the factor of uncertainty reducing and as the organizing factor. In the second one: as the organizing factor and the inseparable link with the innovative process [4, 7-12]. For industrial energy companies, the priority is to move to competitiveness in the area of “strong” competition, which is possible only with the use of renovation and innovation factors, which in turn are inextricably linked with information. This is a kind of quintessence of the economic and legal mechanism of management of renovation and sustainable development of the enterprise (Fig. 2).

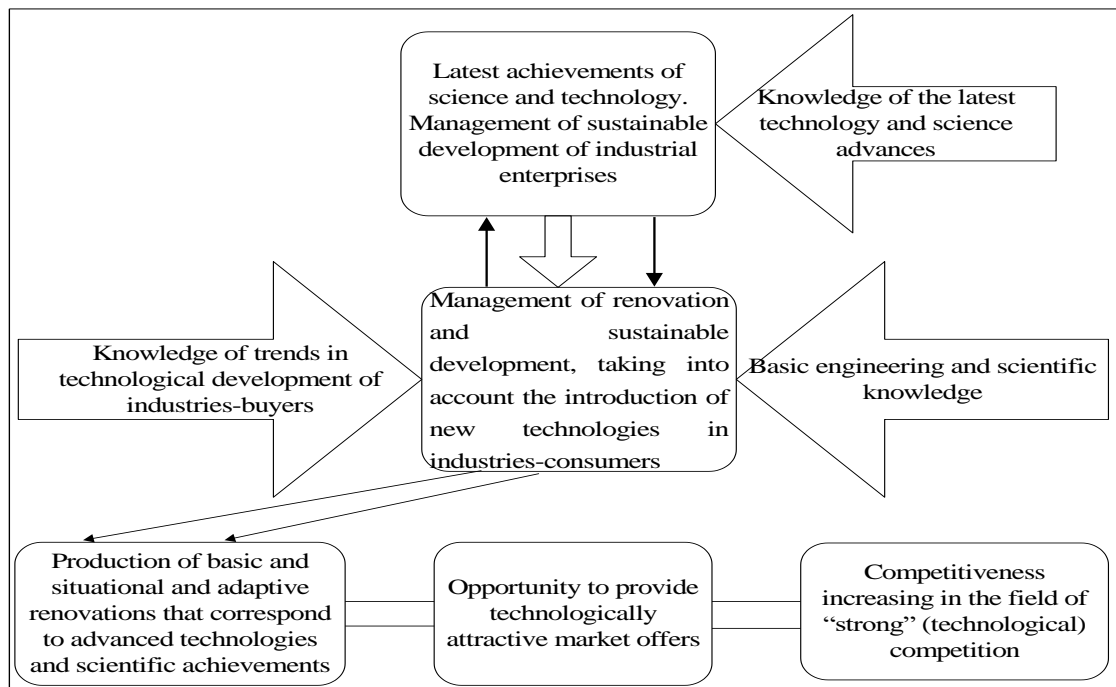


Fig: 2 Management of renovation and sustainable development, taking into account the introduction of new technologies in industries-consumers

For the normal operation of the renovation and sustainable system of the enterprise, a certain amount of basic engineering and scientific knowledge must be accumulated and obtained by entities, engaged in innovation in previous periods during education, and through experience in research in previous periods. For the effective functioning of the economic and legal mechanism in a particular enterprise it is necessary to have subsystems-blocks that determine the potential of the enterprise in a particular area and in which the processes occur, due to which the input phenomenon-cause generates the output phenomenon-consequence [2]. This structure reflects the decision maker's understanding of the problem. Each element of the hierarchy can represent different aspects of the problem to be solved, and both tangible and intangible factors can be taken into account, which are measured by quantitative parameters and qualitative characteristics, objective data and subjective expert assessments. In other words, the analysis of the decision-making situation in the method of hierarchy analysis resembles procedures and methods of argumentation used at the intuitive level [8-9]. Many industrial energy

companies don't have sustainable renovation and sustainable development of their activities. In order to change the defined situation, enterprises need to take a number of measures aimed at increasing the level of sustainability of development, i. e. to develop a strategy. The company may consider the following strategies: a strategy to reduce accounts payable; a strategy to reduce work in progress; a strategy to increase sales revenue; a strategy of receivables reduction; a strategy to reduce inventory, etc. The matrix of pairwise comparisons of alternatives is used to build the hierarchy of goals by answering the question: which of the two comparable sub-goals is more important to achieve the goal of a higher level. The result is a horizontal row. By sequential evaluation, it is determined which of each of the two compared strategies is best for the best achievement of the goal. The obtained data of pairwise comparison of scenarios, goals and strategies are made out in the form of matrices.

The scale of pairwise comparison of alternatives is shown in table 1.

Table 1. Scale of pairwise comparison of alternatives

Mark	Definitions	Clarifications
1	Equivalent factors	Factors make an equal contribution to achieving the goal
3	Slight advantage	Experience and judgment give a slight advantage to one factor over another
5	Significant advantage	Experience and judgment give a significant advantage to one factor over another
7	Obvious advantage	The advantage of one factor over another is emphasized
9	Absolute superiority	Evidence in favor of the superiority of one factor over another is highly convincing
2,4,6,8	Intermediate values between adjacent scale values	Situation when a compromise solution is required

When comparing two objects of analysis, the corresponding value of the scale V_{ij} is chosen, the comparison of these objects in the reverse order should be estimated by the inverse value $V_{ji} = 1/V_{ij}$. The matrix of assessments of different aspects of improvement of sustainable development is shown in table 2.

Table 2. Matrix of pairwise comparison of goals

Goals	A1	A2	A3	g_i	p_i
A1	1	1/5	1/3	0.405	0.11
A2	5	1	1/3	1.186	0.323
A3	3	3	1	2.08	0.567
s_j	9	4.2	1.667	3.671	1

For each row of the matrix, the geometric mean value g_i and the probability of the alternative p_i are calculated as the ratio of the corresponding geometric mean to the sum of all geometric mean estimates G .

The geometric mean value is calculated by formula 1.

$$g_i = \sqrt[n]{\prod_{j=1}^n V_{ij}} \quad (1)$$

where g_i is the geometric mean value for each row of the matrix,
 V_{ij} is the corresponding value of the scale.

$$g_1 = \sqrt[3]{1 \times \frac{1}{5} \times \frac{1}{3}} = 0.405 \quad (2)$$

The sum of geometric mean estimates is calculated by the formula:

$$G = \sum_{i=1}^n g_i \quad (3)$$

where G is the sum of all geometric mean estimates.

$$G = 0.405 + 1.186 + 2.08 = 3.671 \quad (4)$$

The probability of the alternative is calculated by the formula:

$$p_i = \frac{g_i}{G} \quad (5)$$

where p_i is a probable alternative.

$$p_1 = 0.405/3.671 = 0.11 \quad (6)$$

Other rows of the matrix are calculated similarly.

For each column of the matrix the sum of estimates s_j is determined. The sum of the products of the obtained total estimates s_j and corresponding probability values allows to determine the maximum eigenvalue of the matrix, which must be not less than the dimension of the matrix $\lambda_{max} \geq n$:

$$\lambda_{max} = \sum_{j=1}^n s_j \times p_i \quad (7)$$

where λ_{max} is the maximum eigenvalue of the matrix,
 s_j is the sum of the products of the obtained total estimates.

$$\lambda_{max} = 0.11 \times 9 + 4.2 \times 0.323 + 1.667 \times 0.567 = 3.292 \quad (8)$$

The coefficient of consistency or inconsistency (CI) is determined as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (9)$$

where CI is the coefficient of consistency or inconsistency,
 n is the dimension of the table.

$$CI = (3.292 - 3)/(3 - 1) = 0.1 \quad (10)$$

The hierarchy analysis method allows to bring together inconsistent data with consistent ones.

If the inconsistency ratio exceeds the critical value of $CI > 0.1$, then managers should review their basic estimates.

To verify the consistency of the opinions of experts, the consistency ratio is determined as the quotient of the division of the inconsistency factor by the value of random consistency, as per the table 3.

Table 3. The value of the variable of random consistency

The dimension of the matrix (n)	1	2	3	4	5	6	7	8	9	10
Random consistency	0.00	0.00	0.58	0.93	1.13	1.24	1.33	1.41	1.45	1.49

The value of the variable of random consistency it is considered acceptable if the consistency ratio is $\leq 10\%$, and it is acceptable, if the consistency ratio is $\leq 20\%$, if the consistency ratio is $> 20\%$, then the V_{ij} estimates need to be revised.

The consistency ratio = $0.1 / 0.9 = 0.1$ (or 10%).

Therefore, the consistency ratio is acceptable.

From the matrix it turns out that managers consider the implementation of the second direction the most probable, i. e. to reduce the period of capital turnover.

Based on this, we will evaluate the options for the development of the industrial energy company in relation to the sub-objectives of "improvement in capital turnover".

The importance of alternatives for the sub-objectives of "improvement in capital turnover" is shown in table 4.

Table 4. The importance of alternatives for the sub-objectives of "improvement in capital turnover"

Sub-objective	C ₁	C ₂	C ₃	C ₄	C ₅
C ₁	1	2	1/3	3	3
C ₂	1/2	1	1/3	5	3
C ₃	3	3	1	5	5
C ₄	1/3	1/5	1/5	1	2
C ₅	1/3	1/3	1/5	1/2	1
Priority	0.061	0.051	0.126	0.021	0.016

Significance of alternatives for the sub-objective "improving the profitability of sold products is shown in table 5.

Table 5 shows a comparison of strategic options for the criterion of "improving the planning of financial resources of the enterprise", and priorities identified using the hierarchy analysis method.

Table 5. Significance of alternatives for the sub-objective "improving the profitability of sold products"

Sub-objective	C ₁	C ₂	C ₃	C ₄	C ₅
C ₁	1	3	1/3	1/5	1/5
C ₂	1/3	1	1	1/5	1/5
C ₃	3	1	1	1/3	1/3
C ₄	5	5	3	1	1
C ₅	5	5	3	1	1
Priority	0.381	0.32	0.075	0.164	0.059

Based on available estimates, a hierarchy of alternatives can be identified. To do this, it is necessary to summarize the weighted priorities obtained by the hierarchy analysis method, for all sub-objectives. The result has been assumed in the form of table 6.

Table 6. Summary table of indicators

Objective	Sub-objective	C ₁	C ₂	C ₃	C ₄	C ₅
	A1	0.069	0.058	0.014	0.029	0.011
	A2	0.061	0.051	0.126	0.021	0.016
	A3	0.035	0.086	0.083	0.108	0.232
	Common Priorities	0.165	0.195	0.223	0.158	0.259

For this example, the hierarchy of strategic alternatives is as follows:

$$B_5 = 0.259 > B_3 = 0.223 > B_2 = 0.195 > B_1 = 0.165 > B_4 = 0.158.$$

4. Conclusions

It can be concluded that the most acceptable strategy is B₅, i. e. reducing the value of tangible assets. Among the main factors of increasing the renovation and sustainable development of the industrial energy enterprise are such measures as the implementation of economically feasible stock standards, improving the organization of supply, by establishing clear contractual terms of supply and ensuring their implementation, optimal choice of suppliers, proper transport, excessive stocks of materials liquidation, reducing the duration of the production cycle, increasing the organizational and technical level of production, increasing integrated mechanization and automation of production processes, and it is necessary to establish certain conditions for crediting debtors (for example, prepay 50% of the cost of production), use economic and legal development management mechanism and focus on a larger number of customers in order to reduce the risk of non-payment by one or more large consumers, monitor the compliance of accounts payable and receivable. Sustainable development achieving isn't possible without the organization of budgeting at the industrial energy company. The system of budgets allows to assess in advance the consequences of the current state of affairs and the implemented strategy of the financial condition of the enterprise. Budgeting becomes the link between strategic management by senior management and operational management at lower levels. Budgeting helps aim managers at all levels to achieve the tasks set before their centers of responsibility and increase the professionalism of managers. Budgeting contributes to a detailed study of activities of units and relationship between the centers of responsibility in the enterprise, which is relevant today. Budgeting, as a management approach to the renovation and sustainable development of enterprises, can be done with a balanced management accounting in the enterprise, which will ensure, first of all, transparency of all life processes of the enterprise for its management and further, i. e. the possibility of efficient economic and legal management of all systems and processes.

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