Motivational management of enterprise innovation development in the context of limited resources and environmental influences

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Abstract. The article reveals the main characteristics of motivational management of the enterprise, directly related to the innovation development, especially in conditions of limited resources. The authors define the main goal of the motivation process and analyze the role of motivational management in the activities of modern enterprises and organizations. It is established that the development of an effective system motivation of employees stimulates their actions, and therefore activates and directs their actions to the development of innovative activities and contributes to increasing the level of interest in making a significant labor contribution to the achievement of the goals set by the enterprise. As a result of the research the internal and external motivational factors influencing motivational management and innovations implementation. It was found that creative activity in the innovative activity of enterprises is achieved through an optimal combination of various incentives, however, the current incentive system at enterprises is not able to effectively stimulate employees to engage in innovative activities. The authors propose the system of formation of motivational management of innovative development of the enterprise in conditions of limited resources and environmental influences. The coefficients of motivational management at the industrial enterprises in the conditions of limited resources have been calculated by means of mathematical modeling.

Keywords. Motivation management, innovation development, innovations, enterprise, limited resources, environmental influences

1 Introduction

In the modern conditions of economic development there is a constant complication of enterprise activities due to the deepening of crisis phenomena, increased competition and unstable situation in the economic and political spheres. In such unstable conditions, the
enterprise requires certain changes, improvements and new ways to solve problems. In order to solve them, enterprise managers are trying to find the necessary and rational innovation management system, which would fully reflect the weaknesses of the enterprise, suggest ways to improve them and maximize the profit of the enterprise in the process of applying this system.

Therefore, we can say that the motivational management of innovation development becomes relevant in our time, namely by increasing the rate of development innovations. After all, it is the motivation system that can encourage employees to intensify labor activity, invention and innovation (mastery of new processes on production and its modernization, development of new types of equipment, development of new products and goods), which in turn will ensure the achievement the maximum possible level of innovative activity. Enterprises that constantly use innovations and are actively engaged in innovative activities have great advantages in the market than competitors. This is manifested in increasing the efficiency of the company's activity, because the introduction of innovations helps to successfully face all the challenges of the external environment, which the business object faces in its activities. Also, active innovation activity helps the enterprise to improve demand indicators, competitiveness and quality of products, image, labor productivity, increase its profitability and reduce production costs. In modern conditions, when enterprises are constantly faced with the challenges of the external environment and operate in conditions of limited resources, the development of a conceptually new system of motivational management is an important component for their development. The concept of motivational management in the context of limited resources involves the re-profiling of business processes in order to maximize resource conservation, minimize waste through reuse, modernization, reconstruction, recycling and other elements. All of the above indicates the relevance and timeliness of considering the formation and improvement of motivational management of innovative development of the enterprise in a resource-constrained environment.

The problem of enterprise innovation development management is disclosed in the works of Ukrainian and foreign researchers such as [1,2], as well as foreign researchers [3,4] and others. These authors are engaged in disclosing the concept of "innovation" at micro- and macro-levels. The main emphasis at the company level is placed on the formation of an innovation strategy and finding devices for innovative development of the company. But a large number of researchers focus on the study of innovation in the enterprise, trying to reveal their essence, content and highlight the positive aspects of their implementation. Consideration of questions of motivational management is devoted by works of many scientists, among which it is possible to note such scientists, as [5-8] and many other scientists. According to scientists [9] motivational mechanism is considered as a complex system of different ways of influence on the personnel of the organization. Such scientists as [10] believe that motivational management is focused only on employees, namely on the formation of their needs and interests [10]. The motivation of personnel aims to create favorable conditions and incentives that encourage employees to work with more dedication, with a focus on quality and results.

According to [11], motivational management consists in the interrelationship between salary indicators and bonuses, which are interdependent between staff satisfaction and labor results [11].

At the same time, despite the significant amount of scientific work on this issue, there is still no clear vision of motivational management of enterprise innovation development in conditions of limited resources, which involves cyclic development and resource saving, in such circumstances, further research on this issue is relevant.
2 Methodology

The development of high-performance technologies of the new generation form new requirements on the state of the socio-and-economic system of the enterprise and its internal environment. In addition, modern conditions of hyper-competition emphasize the importance of the implementation of resource-saving mechanism in the economic system, which is relevant and practically significant. Motivational management of the enterprise in the conditions of limited resources contributes to the modernization of production and implementation of innovative technologies by increasing the organizational culture of the enterprise, environmental protection and reduction of harmful substances emissions. At the same time there is a need to differentiate approaches to the implementation of methods and tools of circular economy in different economic systems of the enterprise.

The primary problem of enterprise development in the conditions of information economy is a constant market research and identification of consumer demand on this basis, rapid development and mastering of new goods, informing customers about its advantages. The importance of information about the situation in the market comes to the forefront in determining the necessity of the very existence of the firm: if the firm cannot meet the needs, it will not be demanded by the market [12].

In the context of the above, the real motivation, material and moral interest of enterprise management in the implementation of innovation policy will be of great importance. All this allows allocating the motivational factors influencing the attitude of management to the implementation of innovation, which in turn allows forming the organizational, innovative and labor potential, shown in Figure 1.

![Factors of motivational management of innovative development of the enterprise](image)

**Fig. 1.** Factors of motivational management of innovative development of the enterprise
At the same time, motivation of management in conditions of limited resources requires the development of specific methods, ways, tools that promote the activation of labor activity of inventors and innovators (mastering new processes in production) and ensure the achievement of the highest possible level of using the labor potential of employees, which will ensure the preservation of the environment from pollution of harmful emissions into the atmosphere.

Innovations is defined as an important factor affecting not only the success of an individual organization, but also the socio-economic development of countries in general. Actually, the role of the mandatory component of positive changes in various spheres of life is fixed behind the innovations themselves, thanks to which new knowledge is implemented in everyday practices [13].

Motivational management of the enterprise should be considered as a system management of innovative activity and distribution of potentials into organizational, labor and innovative. Management of the innovative development of the enterprise involves the allocation of resources used to create innovations on the one hand, as well as the types of innovations that are created from these resources in accordance with the set goals. Therefore, the combination of three types of potentials allows to ensure the appropriate level of resources for creating innovations.

The theoretical basis for the formation of motivational management of the enterprise in conditions of limited resources is offered by a scientific and methodological approach based on a combination of methods for assessing the internal potential of the enterprise (organizational and labor potential) with an assessment of innovative potential under the influence of external environment, taking into account the influence of motivational factors (Fig. 2).

![Fig. 2. Components of formation of motivational management of the enterprise in conditions of limited resources](image)

Monitoring and rational use of resources of economic systems allows you to track changes in environmental impact on the environment and their compliance with established requirements to ensure environmental safety, efficient use of resources and environmental protection for future generations. Analytical decision-making to ensure the environmental safety of the region and the development of environmental projects are the key to ensuring the sustainable development of the state [14].

The approach to an assessment of motivational management of the enterprise in the conditions of limited resources is suggested, in which the continuous communication of operative, tactical and strategic periods of management which is considered by means of crossing of time frames (tab. 1) is provided:

- analysis of the effectiveness of operational management measures should be carried out at regular intervals, not longer than one year;
- it is reasonable to control the efficiency of measures aimed at forming the tactical management every six months to two years;
- strategic management of the enterprise should be critically assessed at least once every one and a half to three years.

Table 1. System of formation of motivational management of innovative development of enterprise in conditions of limited resources

<table>
<thead>
<tr>
<th>Levels of management</th>
<th>Indicators</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational level</strong></td>
<td>- analysis of internal reserves and potential of the company; - determination of resources and reserves in the company.</td>
<td>Measure available development reserves</td>
</tr>
<tr>
<td>Up to 1 year</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tactical level</strong></td>
<td>- resource efficiency; - flexibility of pricing policy; - business confidence; - market share index compared to the previous period; -organizational component; - material and technical component; - efficiency of core business; - coefficient of autonomy; - reputational component. - rational use of resources; - application of innovations in production.</td>
<td>Maintain the reserve of financial sustainability and market share</td>
</tr>
<tr>
<td>0.5-3 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strategic level</strong></td>
<td>- potential for sustainable development of the enterprise; - growth rate of assets; - growth rate of personnel expenses; - growth rate of net income; - level of innovation support; - application of advanced technologies of resource storage.</td>
<td>Multiply &quot;achievements&quot;, accumulate additional competitive potential, strengthen market power, expand market segments.</td>
</tr>
<tr>
<td>1.5-5 years</td>
<td></td>
<td></td>
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</tbody>
</table>

According to the system of formation of motivational management of innovative development of the enterprise (as it shown in Table 1), a system of fuzzy logic inference was created by means of Matlab Fuzzy Logic Toolbox (Version 1.3.0.1, 2020) application software package, which is the result of designing and training a neuro-fuzzy hybrid model.

The resulting indicator is suggested to determine the sales revenue ($y$), which is formed as a result of the following factors:

\[ y = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 \]

- $x_1$ - coefficient of autonomy;
- $x_2$ - fund productivity;
- $x_3$ - turnover rate of current assets;
- $x_4$ - material productivity;
- $x_5$ - innovation factor.
The linear equation of multiple regression, reflecting the quantitative influence of sales revenues \((y)\) depending on the factors \((x_1 - x_5)\) of motivational management, is received:

\[
y = 0.55 - 0.00115 \cdot x_1 - 0.335 \cdot x_2 + 0.003 \cdot x_3 + 0.354 \cdot x_4 - 0.243 \cdot x_5
\]

As a result of the study, empirical rules were formulated, reflecting the main ways of providing motivational management of innovation development in the context of limited resources (Table 2), balanced with the production activities of the enterprise and its resource component (Table 3).

**Table 2.** Empirical rules reflecting the main ways of providing motivational management of innovation development in the context of limited resources

<table>
<thead>
<tr>
<th>Title of a term</th>
<th>Type of membership function</th>
<th>Analytical expression of the membership function</th>
</tr>
</thead>
</table>
| Low | Gaus2mf | \[
\mu_{low}(x_4) = \begin{cases} 
\frac{1}{2} \left[ \frac{x_4 - 0.2077}{0.0258} \right]^{2}, & \text{in case } x_2 < 0.177 \\
1, & \text{in case } x_4 < 0.177 
\end{cases}
\]
| Medium | Gaus2mf | \[
\mu_{medium}(x) = e^{-\frac{1}{2} \left[ \frac{x - 0.4188}{0.07986} \right]^{2}}
\]
| High | Gaus2mf | \[
\mu_{required}(x_4) = \begin{cases} 
\frac{1}{2} \left[ \frac{x_4 - 0.6184}{0.08386} \right]^{2}, & \text{in case } x_4 < 0.2 \\
1, & \text{in case } x_4 \geq 0.2 
\end{cases}
\]

A system of rules is formulated for industrial enterprises, which together make it possible to influence motivational management depending on the concentration or diversification of its activities, the efficiency of the use of resources, the flexibility of pricing policy and business confidence.

**Table 3.** Methodological basis for assessing motivational management in industrial enterprises

<table>
<thead>
<tr>
<th>Name of the factor, the boundaries</th>
<th>Terms and membership functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x_1) Autonomy coefficient [0.01;3]</td>
<td>High level</td>
</tr>
</tbody>
</table>
| gaus2mf | \[
\mu_{required}(x_1) = \begin{cases} 
\frac{1}{1 + \left| \frac{x_1 - 0.7648}{0.62} \right|^{4}}, & \text{in case } x_1 < 1.34 \\
1, & \text{in case } x_1 \geq 1.34 
\end{cases}
\]
| \(x_2\) Fund return [0;0.94] | Low level |
| gaus2mf | \[
\mu_{low}(x_2) = \begin{cases} 
\frac{1}{2} \left[ \frac{x_2 - 0.01763}{0.1934} \right], & \text{in case } x_2 < 0.177 \\
1, & \text{in case } x_2 \geq 0.177 
\end{cases}
\]
Working capital turnover ratio
[0;2,1] gaus2mf

Material efficiency
[0,25; 2,8] gaus2mf

Innovation rate
[0,76; 15,14] gaus2mf

\[ \mu(x_3)_{medium} = y \frac{1}{2} \left( \frac{x_3 - 0.817}{0.338} \right)^2 \]

\[ \mu_{low}(x_4) = \begin{cases} \frac{1}{2} \left( \frac{x_4 - 0.6184}{0.08386} \right), & \text{in case } x_2 \leq 0.2 \\ 1, & \text{in case } x_4 \geq 0.2 \end{cases} \]

\[ \mu_{required}(x_5) = \begin{cases} \frac{1}{1 + \left( \frac{x_5 - 0.565}{0.391} \right)^2}, & \text{in case } 1.74 \leq x_5 \leq 9.56 \\ 0, & \text{in case } 1.74 \leq x_5 \leq 9.56 \end{cases} \]

Fig. 3 shows an even influence of factors of the coefficient of autonomy and provision of material and technical resources (material efficiency) on sales revenue.

Fig. 3. Influence of parameters \( x_1 \) and \( x_4 \) on the result indicator \( y \)

Fig. 4. shows an even influence of the factors of fund return of innovation activity on the sales revenue.

Fig. 4. Influence of the parameters \( x_2 \) and \( x_5 \) on the result indicator \( y \)
On the basis of generalization of the data three factors explaining 86.6% of variability of initial indicators and characterizing level of motivational management have been revealed, among which the most influential is a factor of innovative activity (43.9% of total variance), material efficiency (28.5% of total variance), fund return (14.2% of total variance).

In order to design the system of fuzzy logical inference, an in-depth study of a sample of 15 observations of operating industrial enterprises for 2017-2020 was carried out, which provided a sufficient amount of information, to determine the level of motivational management of enterprises. Data for the analysis of the research were used scientific works of leading domestic and foreign scientists, monographic studies of specialists in motivational management, data from financial and statistical reports of industrial enterprises, Internet resources.

3 Results and Discussion

As the research showed, out of 15 studied industrial enterprises, the group with a high level of motivational management included enterprises that increased their market share in the analyzed period, the efficiency of their activities slightly decreased, and the assets increased ("JSC" Motor Sich", PJSC" LLRZ", PJSC" Conveyor").

The group with an average level of motivational management includes the enterprises (K.A.N. LLC, TMM LLC, DZAK PJSC, DATAGROUP PJSC, S. KOROLEV MERIDIAN)

Group of enterprises with low level of motivational management (PJSC "Kyiv Plant RADAR", PJSC "Kyiv Radio Plant", "UNIBURTECH" LLC), Table 4.

The features of industrial enterprises with a high level of motivational management and characterized and a higher level of financial stability (autonomy coefficient $C_{aut} = 0.29$), compared with other groups and the industry average ($C_{aut} = 0.13$). More effective use of current assets (turnover coefficient $C_{wc} = 1.95$ compared to the industry average of 1.05), funds return (1.3 compared to the industry average of 0.44). However, this group of enterprises is characterized by a lower value of material productivity than the other two groups, which indicates the ability of enterprises to reduce material costs, increase profitability and achieve long-term goals (increasing market share and assets).

**Table 4.** Comparison of development indicators of three groups of enterprises with "high", "medium" and "low" level of motivational management

<table>
<thead>
<tr>
<th>Years</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Average value for 2017-2020 in industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{aut}$</td>
<td>0.29</td>
<td>0.01</td>
<td>0.08</td>
<td>0.13</td>
</tr>
<tr>
<td>$C_{fun}$</td>
<td>1.3</td>
<td>0.54</td>
<td>0.68</td>
<td>0.44</td>
</tr>
<tr>
<td>$C_{wc}$</td>
<td>0.2</td>
<td>0.82</td>
<td>0.4</td>
<td>0.84</td>
</tr>
<tr>
<td>$C_{innov}$</td>
<td>9.14</td>
<td>8.83</td>
<td>5.13</td>
<td>2.7</td>
</tr>
<tr>
<td>$C_{mat}$</td>
<td>1.95</td>
<td>1.01</td>
<td>1.02</td>
<td>1.05</td>
</tr>
</tbody>
</table>

$C_{aut}$ – coefficient of autonomy, $C_{fun}$ – fund return, $C_{wc}$ – working capital return, $C_{innov}$ – coefficient of innovation, $C_{mat}$ – material efficiency

Based on the above-mentioned study, the authors propose to apply a system of measures to ensure a high level of motivational management of innovative development, because it is
through the introduction of innovation and innovations can achieve a high level of competitive advantage.

When using motivational management of innovation activities in the enterprise it is necessary to:

- create a complementary system of incentives for employees;
- optimize the use of material (15% reward for useful and profitable invention) and moral incentives;
- to apply organizational-psychological incentives;
- to ensure the effectiveness of a permanent process of stimulating the work of workers in the innovation sphere;
- to create the right conditions for innovators and inventors to discover their creative capabilities in the innovation process.

Transformational changes now taking place in most enterprises have a tangible impact on the consciousness, value and motivational orientation of employees, encourage them to think about further changes in the functioning and development of their enterprises, where their labor is invested, to realize the new requirements for the organization of production processes in economic activity, to direct their opportunities to use new scientific achievements in the field of innovative technologies. Meanwhile, the main reasons of existing negative tendencies in innovative activity of enterprises are: long recession of production, high cost of innovations, economic risks of mastering of new products, lack of own funds to purchase innovations with very expensive credits, low intellectual level of innovative potential that caused disintegration of innovative infrastructure due to disinterest of new owners in implementation of innovations in all fields of production activity. That is why the implementation of innovative activities in the enterprise encourages the creation of high-quality products, the introduction of new production technologies, methods and management styles. It ensures resource conservation, which is the main condition for a circular economy. Therefore, high efficiency of enterprise development is practically impossible without the use of innovations in the production of products.

We believe that the main motivational factors affecting the level of innovation use are:

- relationships between the initiators, organizers of the implementation of innovative activities, managers and employees;
- the nature and content of work;
- creativity and mutual understanding in the implementation of production activities;
- interests, personal needs and the desire of employees to achieve the best results in order to master new production processes.

However, the relevant motives for the innovation will be ineffective if the executives and managers of enterprises do not have appropriate knowledge and skills in the field of innovation activities. Moreover, in this situation, it is important to foresee the characteristic changes and their benefits in society and production and timely respond to them by providing a higher level of motivation of employees to achieve the goals of innovation policy of a particular enterprise.

The enterprise under the influence of the external and internal environment, in the context of investment and security aspects, as well as the development of effective measures to prevent the risks of unstable activity [15]

The analysis of the industrial enterprises successfully carrying out innovative-and-investment activity, shows that the dominant inducement for development of innovations is the aspiration of a management to conduct strategically variable activity in general and innovative-and-dynamic activity in particular. Other basic condition for introduction of innovations is presence of a preventive system of marketing and the sales, carrying out communication of the enterprise with final consumers for the purpose of constant revealing of new requirements of buyers, made to quality of made goods, works and services.
Summarizing these and other conditions, we note that for the implementation of effective innovation activities it is necessary to have a dynamic development of the market of managerial and instrumental technologies, characterized as an economic platform for the creation of a rational model of socio-corporate management [16]

4 Conclusions

Innovative activity ensures successful functioning enterprises in modern conditions. Therefore, modern economic conditions require intensive innovative activity, effective organization of research and development, innovations, reduction of innovative risks, strategic management in everyone's innovative activity enterprises.

As motivational management is the main stimulus for introduction of innovations, it is necessary to motivate organization of innovative process so that each employee makes maximum efforts for performance of tasks set by the enterprise irrespective of his/her personal problems. However, it is necessary to ensure the interrelation of labor results of concrete workers with the interests of enterprises regarding the stimulation of highly productive activity, it is expedient to carry out on the basis of rational combination of means of material and moral encouragement of workers. When managing the personnel of an innovative enterprise, one should concentrate on intangible motives for work, including: career growth, praise, influence through the company's corporate values, involvement in the management of the company, the opportunity to freely choose the subject of research and development or the field of work, as well as, extremely it is important, constant professional growth and personal development, etc. It is appropriate to analyze the motivation of the staff at each stage of the innovation process, because for each stage, the appropriate motives leading to specific work results will be more effective. We believe that innovative activity at enterprises should be: strengthening of scientific-production research and development, use of new methods of motivational work, purchase of modern machines and equipment, high-tech preparation of main production and processing industries, introduction of the latest resource-saving technologies, professional advertising of competitive products.

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