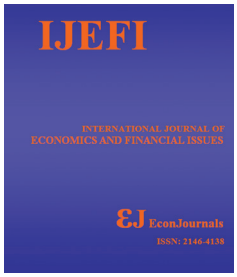

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Economics and Society in the Era of Technological Changes and Globalization

Peculiarities of Forecasting Competitiveness of Innovations for Industrial Enterprises

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ABSTRACT

This article considers peculiarities of forecasting competitiveness of innovations for industrial enterprises. The theme of the article is urgent, because under conditions of economic crisis the competitiveness of industrial enterprises and thus their success on the market in many, if not in all, respects depend on the implemented innovations. The latter ensure a decrease in expenses, improvement of the quality, and growth of the workforce productivity at the enterprise. In their turn, innovations are the subject of demand on the part of industrial enterprises, and form the market of innovations that like any other market is characterized by demand, supply, and competition. That's why it is not strange that the guarantee of successful commercialization of innovations is their own competitiveness that is made of the price and quality of the innovation. The goal of this work was to reveal the peculiarities of forecasting competitiveness of innovations for industrial enterprises and to offer recommendations on increasing the efficiency of forecasting. As a result of the conducted research, we have received the following essential inclusions: The innovation will be competitive in case of the availability of a reasonable innovation, stable demand, possibility to receive effect, and additional result that can occur as a result of implementing the innovation. Forecasting competitiveness of innovations of higher degrees must lead to the development of new methods of forecasting and, above all, methods of qualitative character that will supplement the methods and approaches that currently exist.

Keywords: Innovations, Competitiveness, Industrial Enterprises, Forecasting
JEL Classifications: L11, L15, L16, O14, O33

1. INTRODUCTION

Under the current conditions competitiveness of industrial enterprises is based on innovations that ensure an increase in the quality of the manufactured products as well as efficiency of the used resources. Strategic plans focused, above all, on innovations are necessary for successful competitive development (Burlakov, 2013, Kokurin, 2002). Due to innovations, industrial enterprises decrease expenses and increase their workforce productivity. Thereby, they can ensure their competitiveness on the market. Innovations are the key stimulus for civilized development at this stage of the World System's evolution (Freeman, 2005). To a large extent, one of the strategic tasks related to managing an industrial enterprise lies in searching for and implementing solutions that can ensure survival and competitiveness of the enterprise due to revealing future factors of success. Innovations are among such factors. They assume the implementation of new materials, technologies, types of products, organization, etc. The innovation factor is considered to be a dominant factor of the stable development, taking into account the restrictions in inner and outer environment of business and corporate entities (Dudin et al., 2014). The founder of innovational management Schumpeter defines

them as "implementation of new combinations" (Schumpeter, 1996), and considers them to be a means of overcoming economic crises. It is especially urgent for Russia at the present time in spite of the fact that "there are at least two basic problems on the way of ensuring competitiveness of the Russian national economy through innovations" (Dudin et al., 2013).

Under these conditions the market of innovations acquires paramount importance. Like any other market it follows the laws of demand and supply. The market of innovations is an obligatory component of creating, implementing and distribution of innovations for industrial enterprises. In fact, this is the basis of the market activity in the area of technological progress and industrial production. As a matter of fact, there is no market of innovations without so called commodity production of innovations, and there is no industrial production without the market of innovations.

We will mention the following definition: "The innovation is not neither novelty nor novation; this is the one that seriously increases the efficiency of the current system" (Drucker, 2007). According to statistics, only 10-15% of innovations are successful, while 85-90% of innovations do not bring any result. It means that success of "new combinations" at the industrial enterprise depends on the competitiveness of innovations and innovational projects themselves. In this case at first the innovation is a product, and only in case of the existing demand - it turns into a commodity. As a matter of fact, it goes about the innovation as a subject of demand on the part of industrial enterprises. As for the innovation that is becoming the market member, it will be competitive only when it ensures efficient correlation of the price and quality. Based on the above, the evaluation of innovations competitiveness is a serious task that must be solved by industrial enterprises.

We will note that the innovation is not merely a commodity, but the commodity that has a specific feature that makes it different from traditional commodities. High level of uncertainty when receiving the result is the peculiar specific feature of the innovation as a commodity (Lapin, 1981). The innovation possesses the feature that it can be in the hidden latent state without explicitly expressing itself for some period of time. If so, it is possible to say that the innovation possesses latency. "Latency" (from Latin latentis - hidden, unseen) is the feature of economic objects, processes, relations not to explicitly express themselves, stay in a hidden form" (Raisberg et al., 2011).

The enterprise strategy focused on innovations can be successful and efficient only subject to competitiveness of innovations themselves, whether they are proprietary or acquired. For the implementation of innovational projects to be successful, it is necessary to timely and accurately evaluate the competitiveness of innovations themselves (Burlakov and Dzyurdzya, 2014).

2. METHODOLOGY

The theoretic basis of the present article was the works of national and foreign researchers devoted to various aspects of the innovations and innovational management theories. The following methods were applied as the methodological basis: Method of selecting innovations with the aid of criteria list, method of expert analysis, and method of specific engineering level. When writing this scientific article, the authors took into account and used results and conclusions from numerous works of leading Russian and foreign specialists in the area of innovational management and entrepreneurship as well as materials from online resources. Based on the existing works, the authors have stated their provisions on further development of forecasting innovations competitiveness.

3. RESULTS

Under conditions of dynamic competitiveness innovations play a great economic role. Unlike the 90s of the previous century when innovations allowed to receive monopoly surplus profit, today innovations are above all the means of survival. Expenses related to creating innovations are considered as necessary and inevitable investments focused on maintaining the positions on the market. Dynamic competitiveness means sustainable development and testing of some innovations focused on the decrease in expenses, occurrence of a new niche of the market, and demand under conditions of the environment uncertainty.

How does the market of innovations look like for industrial enterprises? Yes, of course, this is the aggregate of economic interrelations that arise between sellers and buyers of innovations; to be more exact, in relation to our market between both founders of innovations and industrial enterprises. Herewith, industrial enterprises can act both as buyers of novelties and their founders. It is also possible that the innovation is created for the enterprise and further commercialized on the innovations market. In our opinion, the main subjects of the market of innovations in the area of industrial enterprises activity include enterprises founders or owners of technological solutions, small enterprises specializing in distribution and implementation of innovations at enterprises, venture firms, industrial enterprises and the state (Dudin et al., 2013; Kovalev, 2000).

We will note that to a large extent the creation and implementation of the innovation is initiated not with the demand but with the need of industrial enterprises to survive on the market. Expenses and possible result (success) of the novelty during the life cycle will be determinative of the future commercial success of the industrial enterprise. As it was said above, the distinguishable feature of innovations from traditional commodities is a high level of uncertainty that characterizes them and is stipulated by the following terms and conditions:

- The consumer does not know to what extent the innovation will be able to meet his/her needs
- The consumer's behavior is affected by new factors and cannot be thoroughly predicted
- In case the consumer acknowledges new products, there is a problem of its compatibility
- It is difficult to predict the speed and scale of the innovation distribution as well as to define the market capacity
- In addition, the following peculiarities are characteristic of the market of innovations for industrial enterprises

- Inflexibility
- Limited number of buyers and sellers.

Taking into account the fact that the peculiarity of innovations is a high level of uncertainty, there is much tension around the issue of forecasting competitiveness and efficiency of the novelty during the whole life cycle. We propose to call high (hidden) level of uncertainty as the innovation latency. "We propose to understand the innovation latency as separate features of the novelty, their combination or aggregate that can be expressed at some period of time under the existing terms and conditions and circumstances" (Burlakov, 2013). Thus, in our opinion, competitiveness of innovations will consist of the price, quality and latency. "We understand the innovation competitiveness as the ability to compete with other innovations due to fuller satisfaction of the existing specific and future, yet not evident demands" (Burlakov and Dziurdzia, 2014).

To a large extent, "the lifetime" of an innovation, i.e., the period of its expression, use and receipt of additional result will be defined by its latency. In our opinion, it is reasonable to single out the following levels of innovations latency for future forecasting and selection of a competitive innovation for the industrial enterprise:

- Latency of innovations of the low level. It will be characteristic of so called pseudo innovations focused on partial improvement of outdated generations of equipment and technologies.
- Latency of innovations of medium level. It is applicable for improving innovations that usually realize small and medium inventions and prevail at the phases of distributing and stable development of the research and technology cycle.
- Latency of innovations of the highest level. In this case it goes about basic innovations that realize large inventions and become a basis for forming new generations and directions of equipment.

It is necessary to mention that the higher the level of latency is, the more innovational potential the innovation will have and the longer the innovation will be efficient and competitive. Today the above mentioned is especially important for industrial enterprises that plan to operate for a long period of time.

The evaluation of the innovation competitiveness is the basis for making decision on creating or selecting the innovation and carrying out further works on implementing the whole innovational project by the industrial enterprise. Due to the fact that innovations are characterized by uncertainty and can give postponed and not evident (latent) effect, the following tasks arise:

- To preliminarily define the indicators of the created innovation according to which its competitiveness will be evaluated in the future.
- Based on the analysis of the state of the technological progress, to define the competitiveness of the innovation for the specific period of time, as well as to establish directions of the innovation improvement (Kastels, 2000).

That's why in order to solve the above tasks, forecasting is required. It must be implemented for a rather long period of time and must define the level of the innovation competitiveness at any period of the innovation lifetime (Cliquet, 2002; Porter 1980).

The following factors affect the decision about selecting any competitive innovation:

- Legal security of the innovation
- Economic effect from implementing the innovation
- Expenses required for receiving a result
- Latent impact both on the external and internal environment.

When selecting competitive innovations, it is necessary to pay special attention to such criteria as:

1. Ecological criteria
   - Impact of the environment
   - Expenses related to the compensation for the impact on the environment.
2. Social criteria
   - Labor content
   - Quality and length of life.
3. Labor resources
   - Availability of production personnel that is sufficient in terms of its number and qualification
   - Growth of qualification, specialties, specialization.
4. Innovation latency
   - Assistant innovations
   - Possibility to satisfy new demands.

In our opinion, the decisions on selecting any novelty must be made on the basis of the comprehensive approach. Only using the comprehensive approach, it is possible to make the most complete analysis of innovations against criteria, see and evaluate their advantages and disadvantages, and thereby exclude those novelties that are unmarketable for further development and implementation.

The application of the comprehensive approach to the evaluation of innovation competitiveness and its selection by the industrial enterprise are expressed in the fact that along with the calculation of direct economic effect it is also necessary to take into account other effects that are complicated according to the calculation method, for example, social or ecological effect. When evaluating the innovation competitiveness, the comprehensive approach must include the following:

1. Qualitative analysis
   - Method of selecting innovation with the aid of a criteria list. It is applied for the analysis of advantages and disadvantages of the project, and for decreasing the uncertainty level.
   - Method of expert analysis. It includes ranging criteria according to the level of impact on the results of the innovation realization; the repeated analysis is made according to these results.
2. Quantitative analysis
   - Method of specific engineering level. Indicators of the novelty competitiveness are analyzed and evaluated.
   - Economic effect from implementing the innovation is calculated.
3. Forecasting

We will consider here some of the specified methods.

3.1. Method of Selecting Innovations with the Aid of a Criteria List

This method diminishes the level of uncertainty in all areas that define success of the novelty (market, operational, financial, research and technology, social). The analysis of innovations against criteria allows to see their advantages and disadvantages and to exclude those novelties that are unmarketable for further development.

When selecting competitive novelties, it is necessary to pay special attention to such criteria as:

1. Ecological criteria
   - Impact on the environment
   - Expenses related to compensating for the impact on the environment.
2. Social criteria
   - Labor content
   - Quality and length of life.
3. Labor resources
   - Availability of production personnel that is sufficient in terms of its number and qualification
   - Growth of qualification, specialties, specialization.
4. Innovation latency
   - Assistant innovations
   - Possibility to satisfy new demands.

3.2. Method of Expert Analysis

Establishing a hierarchy of criteria is an important condition when selecting the competitive novelty. It is necessary to divide criteria into obligatory and evaluative ones. In case the innovation does not correspond to the obligatory criteria, it must be excluded from further analysis. If the novelty receives contradictive evaluations according to a number of criteria, or if a number of innovations get the same evaluations, it is necessary to conduct an additional expert analysis (Parfenova, 2014).

3.3. Method of Specific Engineering Level

In case of quantitative analysis, in order to evaluate indicators of novelties competitiveness, it is possible to use the method of specific engineering level (Valdaitsev, 1990). This method enables to evaluate both technical and economic characteristics of innovations competitiveness.

Based on the variants of calculating economic efficiency of new equipment, Valdaitsev (1990) proposes to synthesize relative indicators that have strong correlation with economic efficiency of new equipment whose numerator must present comparative level of the considered basic indicators of the novelty, and the denominator must present a change as compared with the analogue of the prime cost of new equipment and specific capital investments for its creation and assimilation.

$$Y`i = \frac{Yi}{C + En * CI}$$

Where *Y'i* is a specific engineering level of the novelty according to *i* parameter

- *C* is a prime cost of the yearly output
- *Yi* is a technical level of the novelty according to *i* parameter
- *En* is a normative coefficient of efficiency
- *CI* is capital investments for creating and assimilating the novelty.

As a result of calculating, the novelties whose forecasting indicators of competitiveness have a higher specific engineering level are to be selected.

At the same time, it is necessary to take into account the dynamics of changing indicators in time. In order to do it, it is necessary to extend the summation taking into account time *T*, during which indicators remain stable. Thus, the formula will be as follows:

$$Y'_i = \frac{\sum_{J}^{k} Yi_j * T_j}{T_e \sum_{j}^{k} R_j}$$

Where Y'_i is specific engineering level of the competitiveness indicator:

- Y_{ij} is an engineering level of the indicator of the novelty competitiveness during the *j* period of time
- T_j is a period of time when the indicator remains stable
- *k* is a number of period of time of the novelty exploitation
- T_e is a normative period of exploiting the considered novelty
- R_j is reduced expenditures at the *j* period of time.

Indicators of specific technical level define advantages, competitiveness of one considered novelty against another one.

3.4. Economic Effect from Implementing the Innovation

In our opinion, it is necessary to define economic effect from the innovation by making calculations according to the following formula:

$$E_i = \sum P - \sum CKd + El$$

Where *P* is gross profit according to years of the innovational project implementation:

- *C* is expenses for implementing the innovational project
- *Kd* is a discounting coefficient that takes into account the factor of time.

We propose to take into account a latent component of the economic effect E1 in the above formula.

$$El = \sum Eli \times Pi$$

- *El* is expected economic effect from the innovation latency
- *Eli* is economic effect under *i* condition of the innovation latency occurrence
- *Pi* is a probability to realize the *i* condition of the innovation latency.

In the general case, it is recommended to calculate economic effect from the expression of latent features of the innovation according to the following formula:

$$Eli = \lambda \times E\max + (1-\lambda) \times E\min$$

Where *Emax* and *Emin* are the biggest and the smallest mathematical expectations of the economic effect according to admissible probability distributions:

λ is a special standard for accounting the uncertainty of the effect that reflects the system of preferences of the relevant enterprise under conditions of uncertainty. It is recommended to accept it on the level of 0.3.

Due to the mentioned above, it is interesting to consider the effect from the occurrence of various latent features of innovations, their interaction with one another, analysis and forecasting, i.e., everything that directly affects the receipt of effect due to latent features.

It is possible to expect a specific result only when relevant resource prerequisites have been created. In this case it is necessary to say about the necessity of the national innovation system that would reflect interests of basic institutional members: Science, entrepreneurship structures, government, and civil society. The national innovation system as an aggregate of all forms of ownership and mechanisms of their interaction, based on which activity on creating, storing, and spreading new knowledge and technology is affected. The operation of the national innovation system involves preserving stability over a relatively long interval of time (Dudin et al., 2013). As a result, the innovational process will equivalently reflect the potential used for its receipt. Thus, by the moment latent features occur, it is necessary to have personnel, technical and technological bases that would correspond to the expected level of the innovation and its latent features. Factors contributing to the occurrence of the innovation latent features are analyzed in this context.

3.5. Analysis of Dynamics of Factors Related to Innovation Latency

3.5.1. Analysis of dynamics of factors related to innovation latency

Innovations can bear both intensive and extensive character. That's why the occurrence of the innovation latency is possible due to the above parameters.

In our opinion, the analysis of the dynamics of latent potential is as follows:

$$Il = Iel \times Iil$$

Where *Il* is an index of the latent potential,

$$Iel = \sum Ii$$

Iel is an index of the extensive latent potential,

$$Iil = \sum Ii$$

Iil is an index of the intensive latent potential.

Every index of the right part of this equation is considered as an indicator that synthesizes particular characteristics of factors of occurrence of the innovation latent features. For example, the index of extensive growth of the advertisement factor can be calculated in the form of the following average weighted index:

$$Iea = it * s * \text{in}$$

Where *it* is an index of the advertising period duration:
in is an index of the number of employees of the advertising department,
s is a share of the advertising budget in the volume of production.

The logic of calculation is evident: The more employees work in the advertising department and the more volume of the advertising budget is, the bigger the index of the advertisement factor potential is.

The second index generalizes qualitative characteristics of factors affecting the occurrence of latent features that allow to increase their mass.

$$Iil = \frac{\sum (Fi - Ei)}{Fi}$$

Where *Fi* is an actual result from the impact of the *i* factor of the innovation latency,

Ei is expected economy from the *i* factor of the innovation latency.

Since the innovational effect in the form of economy takes number values with the minus sign, in case of real economy of the factor of latent features, the numerator of this formula will be higher than the denominator, and the index will show the growth of the innovation latency due to the intensive part of the latency factors. So, for example, big advertising budget does not mean that it will be spent efficiently. This is intensive, in other words qualitative index of the advertisement factor that will show the efficiency of the funds use.

It is difficult to display qualitative features of the factors related to the occurrence of the innovation latent features in the qualitative form. That's why, in our opinion, it is possible to calculate qualitative indexes of factors of the innovation latency according to the following formula:

$$Iil = \frac{U * \sum \frac{X1i - X\min i}{X1i - X\max i}}{\sum \frac{X0i - X\min i}{X0i - X\max i}}$$

Where *U* is a forecasted indicator of the value of intensive factor of the innovation latency (over the range from 0 to1) with the sum not more than 1,
*X*1*i* and *X*0*i* are forecasted and basic characteristics,
X min *i* and *X* max *i* are forecasted minimum and maximum values of qualitative features of the innovation latency factors.

3.6. Analysis of Latent Potential of Innovation

The interrelation between the innovation latency indicator and latency factors can be presented as the following function:

$$Il = I^{\alpha} p * I^{\beta} si * I^{\chi} a * I^{\delta} sf * I^{\varepsilon} s$$

Where Il, $I^{\alpha}p$, I^{β}si, I^{χ}a, I^{δ}sf, I^{ε}s are indexes of the innovation latency and factors of the innovation occurrence: Politics, assistant innovations, advertisement, assistant factors, and service,

α, β, χ, δ, ε are parameters characterizing the limit values of using factors related to the innovation latency occurrence.

It is necessary to carry out the forecasting analysis of this dependence on the basis of statistical material.

Thus, it is necessary to evaluate competitiveness of innovations for industrial enterprises on the basis of the comprehensive approach that does not rely on any universal method and thereby allows to decrease the level of uncertainty in all areas (market, operational, financial, research and technology, social) that define success of the novelty.

4. CONCLUSION

Today innovations are, above all, means of survival for industrial enterprises. It means that success of industrial enterprises depends on the competitiveness of innovations and innovational projects themselves. The innovation becomes a member of the market. It will be competitive only when it ensures efficient correlation of the price and quality. Based on the above, the evaluation of the innovation competitiveness is a serious task to be solved by industrial enterprises.

We will note that the innovation is not merely a commodity but the commodity that has a specific feature that makes it different from the traditional commodities. In other words, the innovation possesses the feature that it can be in the hidden latent state without explicitly expressing itself for some period of time. If so, it is possible to say that the innovation possesses latency (Guilloux, 2000).

In our opinion, innovations competitiveness must be forecasted for a long period of time. During this period of time it is necessary to provide the level of the novelty competitiveness at any period of its life cycle.

Forecasting competitiveness of innovations is extremely important, because the novelty can become a commodity at the stage of developmental work. That's why its further commercial fate (and under the conditions of the license trading - consistency and efficiency of the work of partners that participate in the transaction) depends on the veracity and accuracy of innovations characteristics forecasting.

In our opinion, the comprehensive evaluation of competitiveness of innovations for industrial enterprises must include qualitative and quantitative analysis and forecasting. The approach from the qualitative point of view is used most often. It is based mainly on modifying the existing methodologies of evaluating the efficiency of capital investments. Their difference lies in the fact that various criteria of efficiency and number are used. However, their essence reduces to accurate and detailed qualitative calculations of perspectives for the future. In case of quantitative analysis, in order to evaluate indicators of novelties competitiveness, the method of specific engineering level developed by Valdaitsev can be used.

Along with this, there are a lot of factors that are commensurable with the basic criteria of selecting the novelty variant, and a lot of them merely cannot be evaluated on the qualitative basis. The specified factors considerably affect the final efficiency of the innovations implementation, and ignoring them is not admissible. That's why qualitative evaluation of innovations is extremely important. Qualitative evaluation allows to assess the impact of novelties on the activity of the enterprise, and further qualitative analysis must specify this impact.

Forecasting is important when evaluating competitiveness. It is an integral part of both the qualitative and the quantitative analyses. Forecasting indicators of the novelty competitiveness during the whole life cycle is one of the most difficult problems. For example, while selecting innovations of the highest degree when there is rather high level of uncertainty and risk of the novelty, forecasting contributes to more accurate calculations of the economic efficiency of the project and its impact on further activity (Mahajan and Wind, 1985). That's why the forecasting function is one of the most important ones when creating and managing competitiveness of innovations. Especially it is related to basic (breakthrough) innovations that implement large inventions.

In addition, when forecasting the competitiveness of basic innovations, so called innovations of the highest degrees must lead to the development of new forecasting methods and, above all, methods of qualitative character that will supplement the methods and approaches that now exist.

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