Forecasting the Development of Innovation Processes in the Event of Trigger Effects

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Abstract: The relevance of the research topic is due to the fact that in the modern world, innovative development plays an important role in all areas of activity. Success in the field of innovation has a positive effect in all spheres of life, including economic and social ones. That is why in developed countries a lot of attention is paid to the stages of development of the innovation process. Innovations are the main factor of economic growth, they help to increase and strengthen the competitiveness and efficiency of the domestic economy. The purpose of the study is to develop an innovative process with the help of types of triggers, on which the success of the implementation and sale of innovative technologies often depends. The article presents the author's definitions of such concepts as trigger effect of depression, trigger, innovation process. The transformations characteristic of the innovation process and properties of innovations are considered. The work explored the stages of trigger models, which are presented in the form of a chain and substantiated to a linear model of the innovation process. Trigger models allow you to show how they affect the development of the innovation process as a whole. By describing the technology forecast, the authors show that the emergence of innovation and the impact of technology at a certain point in time in the future can be predicted.

1 INTRODUCTION

At the beginning of the 20th century, the term "innovation" was first introduced into economic theory as a new economic category that defines changes in order to introduce, produce and use new products, markets and forms of company organization. J. Schumpeter was the first to reveal this concept and theoretically substantiate the importance of innovation for market competition based on the achievements of science and technology. According to the definition of J. Schumpeter, innovation is a new combination of production factors motivated by the entrepreneurial spirit (Schumpeter, 1982).

It is known that N.D. Kondratiev made a great contribution to the development of innovative strategies, substantiating innovative development as the idea of trade and production cycles, which subsequently led to the development of the theory of large cycles. N.D. Kondratiev showed that innovations are unevenly distributed over time, have a wave-like character and consist of four synchronously repeating phases after each cycle (Diakonova, Artyshchenko, Sysoeva, Surovtsev, 2020).

Innovation and competitiveness among firms are now considered to be among the major economic multipliers in industrialized countries. The innovation process takes place at the level of firms and remains the main task and occupation for scientists.

An innovation process is the application or implementation of a new technology or method to do something that helps an organization stay competitive and meet customer needs. Tracking and amplifying innovative activity using the trigger effect is very

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important in our time to obtain an increase in the accuracy of forecasting methods.

The purpose of the article is to study the various phases of triggers that affect the model of the innovation process, as well as a description of the technological forecast, which can be used to predict the emergence of innovations and crisis phenomena at a certain point in time. The task of the work is to study the parameters of the process of transition from invention to innovation, using a graphical representation of growth in a competitive environment (Dyakonova, Artyshchenko, Sysoeva, Surovtsev, Karpovich, 2020).

2 RESEARCH METHODOLOGY

The purpose of this study is to substantiate the definition of the "trigger effect of depression", to reveal the trigger phases on the model of the innovation process and to give a description of each trigger phase that affects the innovation process.

Using the extrapolation method, carry out a description of the technological forecast, where historical data will be one of the criteria for making a forecast.

Give a graphical description of the Meyer logistic growth S-curve, which proves that it can be used to make a forecast for the future period of time, where the maximum number of innovations will enter the innovation process.

3 RESULTS OF THE STUDY

The innovation process is associated with the creation, development and dissemination of innovations.

Let's imagine the model of the innovation process in Figure 1.

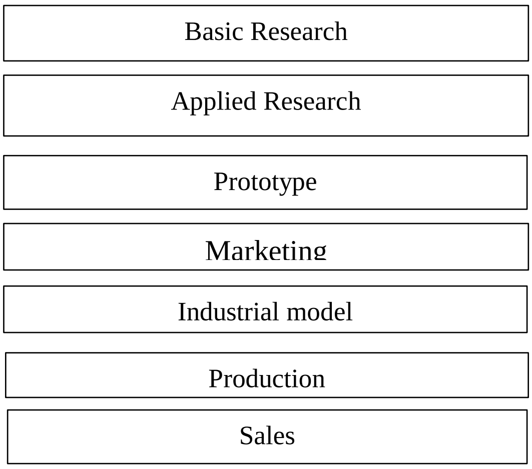


Figure 1: Model of the innovation process.

In the processes of modernization, industrialization and globalization, more or less stable systems oriented towards private conditions have been transformed into systems oriented towards relative competitive advantage, ever-increasing productivity from fossil and synthetic resources, and dependence on the international market. Business cycle analysis plays an important role in the possession of economic knowledge. A deep understanding of the mechanisms that cause economic booms and busts helps signal future turning points and crises. This reduces the overall economic and social tension (Diakonova, Artyshchenko, Sysoeva, Surovtsev, 2020).

In addition to the innovation process, triggers are used (Diakonova, Artyshchenko, Panfilov, Gusev, 2022;Dyakonova, Sysoeva, 2022). The trigger encourages innovation to enter the economic market. Inclining to the previously written article “Stages of periodic processes of changing the number of innovations in relation to Kondratiev cycles” (Diakonova, Artyshchenko, Sysoeva, Surovtsev, 2020; Dyakonova, Sysoeva, 2022), where an analysis of the stages of long wave cycles over several decades is made, which allow systematizing crisis phenomena and identifying peaks of innovative activity. The article proves that the active emergence of innovations, called the "avalanche growth of innovations", falls in the middle of the depression phase. This leads to stages of significant growth in economic activity at certain intervals (Diakonova, Artyshchenko, Panfilov, Gusev, 2022).

The trigger works in the depression phase. Leaning towards the cycles of N.D. Kondratiev, the phase of depression makes the market survive and bring more innovations compared to other phases (growth, rise and fall). This phenomenon is called the depression trigger effect (Dyakonova, Sysoeva, 2022).

Thus, triggers in the innovation process have a great impact on the economic market. Researches on triggers of two types are known: external and internal.

The external trigger is delivered through the environment. They contain information about what the user should do next. Types of external triggers include:

Paid triggers such as advertising and marketing;

Habit-forming companies tend not to rely on paid triggers, as paying for re-engagement is often not financially feasible;

An internal trigger is a certain association that is fixed in the brain of the consumer and prompts him to act, for example, negative thoughts at the level of sensations. To systematically select a particular product, you need to understand what feelings and sensations of the user (buyer) are subject to internal triggers. This will lead to the inclusion of external triggers and the acquisition of innovation, respectively. Figure 2 shows the characteristics of internal and external triggers.

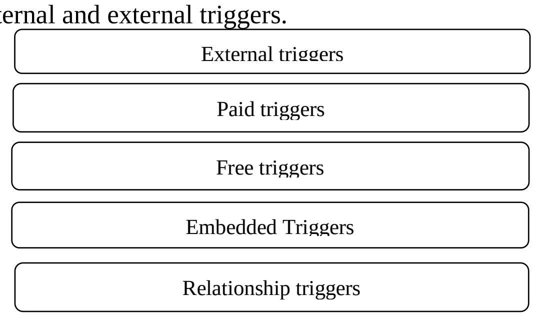


Figure 2: Characterization of trigger types.

The next stage of the trigger is the action phase. This is important for habit formation. To innovate and initiate action, three things are needed:

1. Motivated users;
2. The status of the requested actions;
3. It needs a trigger to activate.

In his book Something Really New: Three Easy Steps to Really Innovative Products, Denis Houptley breaks down the innovation process into its main steps. First, it offers to understand why people use the product. Next - describe the steps required by the consumer to achieve the result. And when the sequence of tasks becomes clear, from conception to implementation, he advises to start removing links from the chain until it is simplified as much as possible. People will more quickly adopt a technology or product that requires fewer steps to get results.

Six reasons that affect the complexity of the task:

1. The time required to complete the plan or action;
2. Financial expenses;
3. The amount of work required to complete;
4. Mental effort and concentration;
5. Social Acceptability: The degree to which an action is approved by society.
6. Unusualness: The degree to which an action corresponds to normal behavior.

The third stage is the variable reward phase. The reward received from the reward prompts action, and the desire to get rid of the passionate desire to receive it. There are three types of variable remuneration:

Tribal reward (the desire for social approval, fueled by maintaining connections with other people);

Reward with prey (the desire to possess material resources and information);

Internal reward (the desire for internal satisfaction, from one's own skill, abilities or the completion of some business).

Investment is the last and most important stage of the trigger when creating an innovation. They are:

- Storage of valuables;
- Content;
- Reputation;
- Skills.

The investment stage is needed to improve innovation for users as well as for companies.

Thus, the trigger chain consists of 4 phases: trigger, action, variable reward and investment, shown in Figure 3.

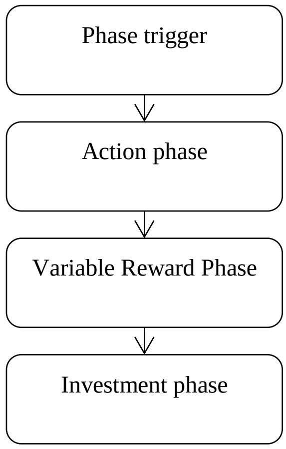


Figure 3: Stages of the trigger model.

The presented chain can be attributed to the model of the innovation process (Figure 4) and it can be concluded that triggers affect the innovation process by direct influence. If you do not use the trigger, then the cycles of the innovation process will not be increasing, which is very important for the organization and the economic market.

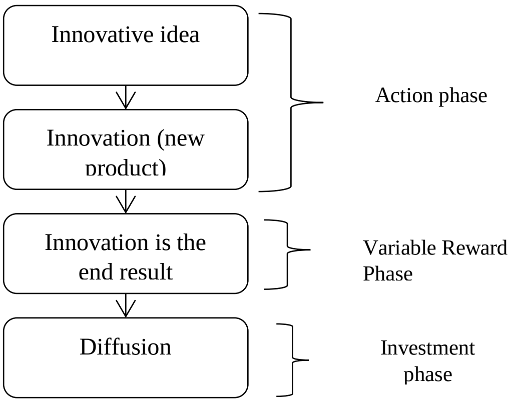


Figure 4: Model of the innovation process.

Technology Forecast - Describing the emergence of performance, features, and impact of technologies at a specific location and point in time in the future. For research, as an example, we use a well-known method - trend extrapolation - this method studies trends and cycles in historical data, and then uses mathematical methods to extrapolate into the future. All of these technologies assume that the forces responsible for creating the past will continue to operate into the future. A common feature of these mathematical models is that historical data is the only criterion for forecasting. It is possible that if two people used the same model on the same data, the predictions would be the same, but this is not necessarily the case. Mathematical models include smoothing constants, coefficients, and other parameters that the forecaster must determine. The choice of these parameters largely determines the forecast.

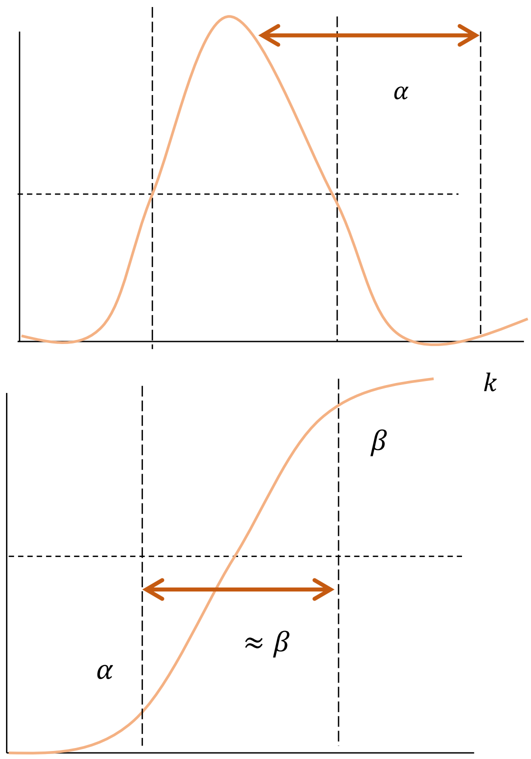
Analyzing the statistics of the spread of innovations, we calculated the rate of technology introduction, which is determined by three characteristics: p, which is the rate at which implementation occurs, and q, the rate at which subsequent growth occurs. A cheaper innovation may have a higher p value.

Resource constraint and logistic S-curve is calculated by the formula:

$$N(t)=\frac{k}{1+e^{-\alpha t-\beta}} \tag{1}$$

α - growth rate parameter, the time required for the "trajectory" of growth from 10% to 90% of the k limit;

characteristic duration (Δt);

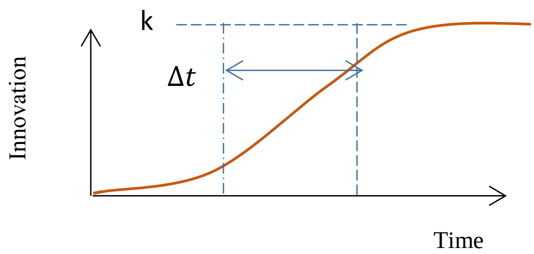


β - parameter specifying the time (t_m) , when the curve reaches the middle 0.5k of the growth trajectory; k - asymptotic growth limit.
Figure 5: Resource constraint and logistic S-curve.

A graphical description of the Meyer logistic growth curve is shown in Figure 6 and is calculated using the formula:

$$N(t)=\frac{k}{1+e^{-\frac{In(81)*(t-t_m)}{\Delta t}}} \tag{2}$$

$$\frac{dN}{dt}=\frac{In(81)}{\Delta t}*N(t)(1-\frac{N(t)}{k}) \tag{3}$$



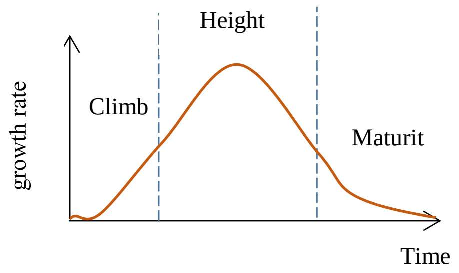


Figure 6: Graphical description of the Meyer logistic growth curve.

Natural growth in competition can be described by the logistic equation and the logistic S-curve. Natural growth is defined as the ability of a "species to reproduce in a finite" container niche. For sociotechnical systems, a 3-parameter S-shaped growth model is used to describe "trajectories" of growth or decline over time (Figure 7).

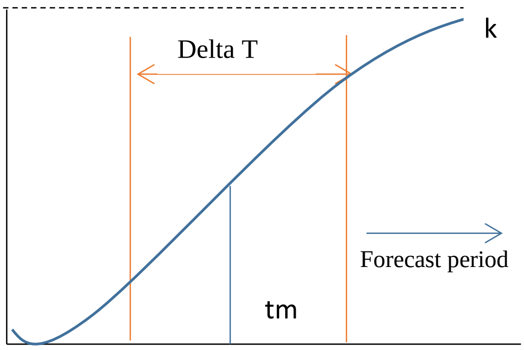


Figure 7: Growth in a competitive environment.

In developing technology (α), it is necessary to provide for the parameters of the process of transition from invention to innovation (implementation, distribution, infrastructure, commercialization).

A growing technology is a technology that grows exponentially (from α to β). It is necessary to provide parameters (speed and limits) of exponential growth.

Mature technology - technology after the trigger saturation threshold (β). It is necessary to provide for the parameters of the process of replacing one technology with another, where the mechanisms are hidden.

4 SUMMARY

The authors substantiated and expanded the concept of "trigger effect of depression", which can also be referred to as a "trigger", i.e. certain actions leading to the transition of the system to a new state.

The study carried out a description of the technological forecast, namely the extrapolation method, where historical data is one of the criteria for making a forecast. They gave a graphical description of the logistic S-curve, which proves that it can be used to make a forecast for the future period of time, where innovations will enter the innovation market in the maximum amount. They gave a classification of technologies, where it is necessary to provide for certain parameters of innovation for implementation in the innovation process.

5 CONCLUSION

In this article, the authors worked on the study of triggers in the development of the innovation process. The types of triggers often determine the success of the implementation and sale of innovative technologies, as well as the entry of new products into the economic market.

According to the Kondratieff cycles, the depression phase has a depression trigger effect, where the market is most likely to innovate. Thus, the market moves from the trigger phase to the trigger action phase, then rewards and investments, where the market is already ready for a new or improved product.

The market of the economy cannot do without crisis phenomena, according to N.D. Kondratiev, innovations spread unevenly over time. And in order to track innovative activity and bring it to the market as much as possible, you need to use a trigger. There are different types of triggers, and each type is used differently in the innovation process. The purpose of the work was to show that it is possible to predict the development of technologies to support R&D and investment and innovative solutions.

REFERENCES

Surovtsev, I.S., Dyakonova, S.N., 2015 Innovations and innovative activity: explanatory terminological dictionary.

Surovtsev, I.S., Dyakonova, S.N., Karpovich, M.A., 2014. Innovation management; textbook allowance. 189 p.

Dyakonova, S.N., Artyshchenko, S., Sysoeva, D.V., Surovtsev, I.S., Karpovich, M.A., 2020. On the application of the thermal conductivity equation to describe the diffusion process. In the collection: E3S Web of Conferences. XIII International Scientific and

Practical Conference “State and Prospects for the Development of Agribusiness – interagromash 2020”. p. 05050.
Diakonova, S., Artyshchenko, S., Sysoeva, D., Surovtsev, I., 2020. Stage of periodic proctsses of changing the number of innovations in relation to Kondratiev cycles. In the collection: E3S Web of Conferences. Key Trends in Transportation Innovation, KTTI 2019. P. 04031.
Diakonova, S., Artyshchenko, S., Panfilov, D., Gusev, M., 2022. Factors Influenced on the Connection Density in the Innovation Diffusion Process. In: Beskopylny A., Shamtsyan M. (eds) XIV International Scientific Conference “INTERAGROMASH 2021". Lecture Notes in Networks and Systems, vol 246. Springer, Cham.
Dyakonova, S.N., Sysoeva, D.V., Osipov, A.A., 2022. Innovative Entrepreneurship (Explanatory Dictionary).
Dyakonova, S.N., Sysoeva, D.V., 2022. Study of triggers in marketing affecting the economic market of the innovation process. *Innovation, technology and business*, No. 2 (12). pp. 33-38.
Dyakonova, S.N., Artyshchenko, S.V., Baev, S.A., Gusev, M.V., 2022. Investigation of the dynamics of development of innovative processes using the Verhulst logistic equation. FES: Finance. Economy. Strategy, V. 19. No. 4. pages 80-84.
Diakonova, S.N., Artyshchenko, S., Shevchenko, L.V., Tsaregorodtseva, O.V., 2021. Models of interaction between education, science, innovation and production in the theory graph theory. In the collection: 8th International Conference on Education and Education of Social Sciences. Abstracts & Proceedings e-publication. pages 201-206.
Lavrikova N.I., 2021. Development of theoretical provisions for the study of innovative processes in economic systems. *Management accounting*. No. 10-3. pp. 515-521.
Rakhimova S.A., 2013. Innovation process, the need to manage the innovation process. *Topical issues of economic sciences*, No. 32. P. 121-125.
Rakhimova, S.A., 2016. Approach to the formation of the innovation process. The structure of the innovation process. *Topical issues of economic sciences*, No. 48. pages 61-74.
Dyakonova, S.N., Sharapova, E.A., Safonova, N.A., 2016. Research and clarification of some innovative terms and concepts. In the collection: Problems of modern science. Materials of the II All-Russian Scientific and Practical Conference. pages 58-62.
Schumpeter J., 1982. Theory of economic development. 455 p.