

About the Issue of Decision Making Irrationality in the Activity of the National Industrial Modernization Design Office

Igor Stepnov, Julia Kovalchuk*

¹Ryazan State Radio Engineering University, Ryazan, Russia; stepnoff@inbox.ru; fm-science@inbox.ru

Abstract

Objectives: The relevance of the article has been determined by the need to study the role of government in industrial modernization in terms of establishment of national design offices. **Methods/Statistical analysis:** The study of the industrial modernization causes, forms and financing was made on the basis of comparative analysis. Irrational component of project selection was studied on the basis of the main provisions of behavioral finance theory, that in systemic terms provided the possibility to obtain an integrated assessment combining the investment views and the basic provisions of the theory of rational behavior. **Findings:** The study of the market situation influence on decision-making regarding the technological development of industrial enterprises led to the conclusion that the biggest irrationality is related to the estimate of the timing of rapid growth or downward wave, when the majority of individuals make the specified time to fit for their own strategies, ignoring objective indicators of scientific and technological progress. Analysis of reasons for the adoption of decisions on modernization, and features of its implementation, enabled to classify such decisions, which is necessary for the selection of modernization forms. A comparative analysis of utility maximization and choice alternatives when making decisions on industrial enterprise modernization made it possible to justify the need for descriptive rather than normative approach to modernization processes. The study of the behavior of the individual making decision on financing the modernization of industrial enterprises has shown that the traditional selection based on cost savings is not effective for modernization projects. **Application/Improvements:** The systemization of types and forms of industrial enterprise modernization has allowed proposing approaches and forms, countervailing the irrationality of the project selection, and practical recommendations for the national design office portfolio formation regarding the industry modernization.

Keywords: Irrational Choice, Market Design Office, Modernization

1. Introduction

The uncertainty of the future benefits of industrial development requires from the State to take special measures not only to create the conditions for development of industry, but also to carry out directive interference in the management of individual (priority) projects. The State should take steps not only to form the institutional environment, but also to perform directive interference in the management of priority projects. Leaving beyond the scope of this article the efficiency of state regulation as

a whole, we set sights on the formation of an approach to the selection of projects in such conditions. For these purposes, we assume a priori justified the creation of design offices at the state level, the goals and objectives of which is to support projects that determine at the greatest extent the usefulness of future modernization.

Economic development dictates also certain requirements to the development of enterprises that form the foundation of economic activity. It is beyond argument that it is an effective economy that provides the necessary level of enterprise modernization and progress of society.

*Author for correspondence

Modernization is essential in ensuring the sustainability and economic growth of the industrial enterprises, which is confirmed by historical trends. Thus, during the industrial revolution of the 18th century and early 19th century, the use of the ideas of classical economic theory and the neoclassical approaches contributed to the economic development, the creation of big finance and machine production. In the period of uplift of the productive forces in the 60's 70's 80's of the 20th century, the leading role in the modernization process was played by a scientific and technological revolution, involving the transformation of science into a direct force of the development of society, having a great influence on the socio-economic progress. Many modernization programs were based on the principle of unity of the four main approaches:

- economic approach (investment decisions¹ and balanced and unbalanced growth based on them² and others);
- technological approach (modernization based on the innovative development³⁻⁴); modernization based on the new technological order⁵ and others);
- sociological approach (modernization through the strengthening of traditions⁶ and cultural modernization⁷ and others);
- environmental approach (inclusive economic growth).⁸

Modernization theoreticians of 20th century sought to develop comprehensive programs for the implementation of “catch-up” modernization of the developing “non-Western” countries as per the Western model.⁹⁻¹² In this regard, varieties of modernization were created in various countries with account of their national features. Further intensification of the pace of modernization process was provided by the information and technology development in the world, accompanied by the phenomenon of globalization.

2. Concept Headings

Management decisions in relation to the modernization of the industrial enterprise always contain an investment component. Investment is generally understood as a capital investment, but in the conditions of innovative economy, we define that it the finances can be invested in development of the company as part of the competencies ensured by competitive advantages and opportunities

provided by the institutional environment. At the same time, regardless of the source of investment in the enterprise modernization, the condition for the very enterprise development is the benefit from investment exceeding the value of all resources expended taken into consideration their best alternative use. Therefore, quite often the investment attractiveness is a limiting factor in the modernization processes, which are badly needed for the society and at the same time unfavorable for the enterprise and certain groups of investors.

So, despite the obvious necessity and progressiveness of decisions on the modernization, there are different approaches to their implementation formed in society. For a free competitive market, it is necessary to talk about the need for investment attractiveness of projects, however, the uncertainty of the future and speculative sentiments in the industry markets may lead to the situation when many revolutionary projects remain unfinanced. It is obvious that many venture capital funds, whose task would seem to be the selection of risky projects beneficial for development, yet are using more and more often the principles of investment funds, without completion the assigned task. That is why the state is forced in one form or another to look for new forms of modernization project support. In the Russian practice, an essential priority was given to development institutions¹³ but the prevalence of the very investment component pretty much discredited their activities. Therefore, the emergence of new centers of project support and the direct participation of the state in the form of national design offices, in particular, are justified.

However, the state participation does not eliminate the problem of the irrationality of choice, since different judgements about the nature of future gains and losses will be made directly by an individual (including in the framework of the design office). It is therefore necessary to consider the factors influencing the irrationality of the decision-making regarding the industrial modernization.

3. Results

3.1. Impact of market conditions on the making decisions about the technological development of the industrial enterprise

We believe that in the period of economic downturn, when the market has a tendency to decline, and the

competition is becoming tougher, the modernization based on speculative motives is most likely, as for its full implementation there is not enough resources: they are all spent to survive in the competition. If we consider the main trend of development as an S-curve with the characteristic sections of the initial refusal from the technology, rapid growth and stable income extraction, in terms of the decline situation, the focus is on sections of stable technology use and starting point of its performance decrease. Therefore, the efficient industrial enterprises need to determine the outstripping potential and identify the technical equipment, which can be sold as long as it is still effective. Therefore, having obtained the funds from the sale of assets, industrial enterprises are focused on a new type of business, which has no competition, thereby stimulating innovation processes in the society. This position is consistent with the concept of⁴, stipulating that in a period of depression, there is an innovative process launched that gives impetus to the development of the economy and the investment flow.

If an enterprise introduces into production new products and types of equipment, opening new markets and sources of raw materials, and reorganize the very production process, it can get a “business super-profit” in the interpretation of⁵, as payment for high competence, proactiveness and risk.

After that, other enterprises and companies get involved in a new type of business, innovations cover a growing number of interrelated industries, and the economy became revitalized. Modernization processes become widespread and are accompanied by the growth of investment in the industrial companies, and this stimulates investment in the means of production, raw materials, etc. Against the background of a growing market (the market is in a phase of recovery), the enterprise has only to identify the growth potential of acquired or developed techniques and technologies, in accordance with a projected development pathway and make investments that will lead to an increase in the value of its business. Growing market causes also an increase in prices for raw materials and equipment, as well as a rise in credit resources interest rates, that, ultimately, leads again to a situation of increased competition and downward wave in the market. However, in the process of decision making, the most irrational feature is not so much the technology itself, as the prognosis regarding the time of beginning of a rapid growth or a downward wave. It should be noted

that most of individuals make the specified time to fit their own strategies, ignoring objective indicators of scientific and technological progress.

3.2. Reasons for taking decisions about modernization and special aspects of its implementation

In our opinion, the reasons for taking decision about modernization of an industrial enterprise should be divided into two groups:

- Macro-economic reasons (namely, technical and technological, market and institutional);
- Micro-economic reasons (namely, resource, organizational, investment and subjective).

In accordance with it, the industrial enterprise modernization can be intended for the following:

- focus on market demand;
- change in the volume of production per unit of time;
- product quality improvement;
- improving the efficiency of process equipment fleet;
- reducing the complexity of production processes and, as a consequence, the optimization of the number of operating personnel;
- reducing the duration of a production cycle of product manufacturing;
- reduction of losses (productive and non-productive);
- reduction of the product cost (through the use of advanced technologies and materials, energy saving, labor saving);
- economic incentives for the development of environmentally sound technologies;
- receiving preferences from the state (accelerated depreciation, tax incentives, environmental sanctions, etc.);
- acquisition of investment funds;
- opportunistic attitudes of the persons taking the modernization decision.

Therefore, we can determine the features of the opting for industrial enterprise modernization, based on the identified reasons for the decision about the enterprise

modernization and its objectives, according to the following criteria:

1. By the purpose of implementation:

- Modernization in order to save costs: is carried out in order to reduce the costs associated with the implementation of current operations. It may involve the replacement of equipment in order to reduce operating costs, the replacement of technology for material resources saving, etc.;
- Economically feasible modernization: is due to the need for compliance of the industrial enterprise with the requirements, arising in the external competitive environment and in conditions of scientific and technological progress, when the company modernization is to be a source for improving the economic performance of the enterprise and its development in the long term;
- Modernization in the interests of certain groups or managers: suggests a motivated interest in a certain group of people in improving the efficiency of industrial enterprise by making changes in accordance with the requirements of the environment;
- Economically unjustified modernization: is related to a lack of motivational interest of decision makers, or their opportunistic behavior, when the enterprise does not require modernization being in line with modern requirements.

2. By the nature of technological changes:

- Catch-up modernization: eliminates the significant technological lag between the industrial enterprise in question and the upgraded enterprise in the country, considered to be a model (modernization pattern), and is mainly based on resource saving technologies;
- Developing technological modernization: is focused on the changing technological structure of the enterprise as a set of technologies, specific to a certain level of development of production, therefore, in connection with the scientific and technical and technological progress, there is a transition from lower-level modes to higher-level ones;

- Advance modernization: has a value of strategic technological modernization as a focus on long-term demand for high-tech products in accordance with the results of "Foresight" or approved priority areas of technological development (breakthrough production technologies).

3. By the type of initiator of modernization:

- Modernization in accordance with the state policy: is carried out centrally by government programs and on the basis of state support mechanism, involves the development of a special industrial policy for modernization implementation;
- Modernization in accordance with international (industry) trends: industrial company, as an industry leader, sets the standard for the industrial enterprise, which is used as an example for the enterprises of the industry;
- Modernization by the decision of the owner of the enterprise: is due to an objective necessity, justified by the results of the diagnostics of the industrial enterprise, and supported by the owners (shareholders) of the enterprise;
- Modernization by the decision of the management of the enterprise: is due to an objective necessity, justified by the results of the diagnostics of the industrial enterprise, and supported by a group of persons taking and implementing decisions about the modernization of the industrial enterprise;
- Modernization at the suggestion of the labor collective: is associated with the collective opinion of the personnel regarding the state of the industrial enterprise, mainly associated with the technical re-equipment (replacement of worn-out or low-productivity equipment and processes).

4. By the specifics of the modernization decision-making:

- Justified modernization: modernization is a consequence of transformation processes in the enterprise and is associated with significant influence of the objective (technological change, emergence of new equipment, information systems, standards, environmentalization) and subjective (owners, state, competitors,

enterprise's personnel, financial institutions) influence;

- Forced modernization: is due to a poor state of the resource potential of the enterprise, threatening a closing down of an enterprise;
- Stimulating modernization: is related not with the need for change, but with the possibility to obtain certain preferences: tax credit, reduction of payments for hazardous substances emissions, company's reputation, using pioneering technology products, etc.;
- Mass modernization: is based on the principle that all companies get modernized, even when there are no serious reasons for implementation of modernization in the enterprise in question.

5. By financing sources:

- Modernization carried out using the amortization funds: is carried out from the enterprise's own funds, using the money accumulated in the amortization fund.
- Modernization carried out at the enterprise's own expense: is carried out using the accumulated and reinvested profits of the enterprise, obtaining an additional source of funding by means of increasing the share capital when implementing the IPO.
- Modernization carried out using the debt capital: involves the use of borrowed funds of financial institutions and funds raised by bond loans.
- Modernization carried out using the investment funds: is related to the search and attraction of professional strategic investors for the purpose of financial support of the modernization of industrial enterprise.
- Modernization supported by the state funding: involves the use of means of the federal and regional budgets allocated in the framework of special programs of state support in case of strict conformity with financing criteria.
- Modernization based on a set of financial resources: involves the combined use of the options outlined above.
- Since most sources of funding for the industrial enterprise modernization are a combination of its own funds, borrowed ones and budget ones, the adoption of a final decision by the investor

regarding the financing of the modernization of a particular company is based on the following:

- For capital owners: return on equity.
- For the owners of loan capital: return on invested capital.
- For the state: achievement of public policy objectives (solving of socio-economic problems and an increase in tax revenues for the treasury).

We will not focus on the well-known performance evaluation of investment projects related to the modernization of industrial enterprises (net present value, payback period, internal rate of return, etc.), and will focus on theoretical concepts, based on the mechanism of financial modernization decision-making.

4. Discussion

4. 1. Maximization of the utility and choice alternatives when making decisions about industrial enterprise modernization

It is known that individuals formulate financial decisions based on the utility of the object which, in turn, depends on personality factors of each individual. Accordingly, the value of objects is determined not by their cost but by their utility. This definition of utility in conjunction with the law of diminishing marginal utility is significant for investors: the wealthier they are, the less utility they receive from each added unit of profit. However, in the works of M. Kritzman¹⁴ it is stated that individuals usually feel a strong risk aversion, preferring unburned prospects rather than blurred ones in case of an equal expected value.

So, there is a dilemma: when individuals take decisions, they maximize utility, but an individual cannot maximize utility on the basis of risky choice, especially in the situation of taking decisions on the financing of the industrial enterprise modernization, when the uncertainty is part of the decision. That is why there is an effect of expected utility, based on the rational behavior of individual taking decision by comparing the expected utility of decision alternatives. Thus, J. von Neumann and O. Morgenstern¹⁵ theoretically proved that if in the process of decision making the individual performs certain basic axioms of rational behavior (transitivity and invariance), his decisions maximize expected utility.

However, in contrast to the expected utility theory, H. Simon, a Nobel Prize laureate, introduced the concept of “bounded rationality”,¹⁶⁻¹⁷ which explains the decision taken by the individual in the field of investment, aimed not at maximizing the utility but at its satisfaction as the search for alternatives that seem to meet the most important needs of individuals limited in terms of the perception and choice of information. This thesis is also valid for the modernization of industrial enterprises: the decision about modernization is based on the taking account of the environment trends and the analysis of the cash resource potential of the enterprise; and the decisions are taken by the company owners (managers) when comparing the available or accessible sources of financing.

The psychology of industrial modernization decision-making is important as well. Thus, the maximum utility theory is also limited. For example, according to the “prospect theory” of D. Kahneman and A. Tversky,¹⁸ when making choice, economic agents are subjectively based on their own opinions, and process a result or a transaction, focusing on their subjective utility (value), which they expect to get. Therefore, the initial selection of factors is based on some heuristic observations, and the second phase (assessment) due to this becomes easier to be reconstituted. Subjective utility function is S-shaped, so at a certain given value of the absolute value, the subjective value of the loss is higher than the subjective value of profit.

With regard to approaches to decision making we can distinguish chronological approach,¹⁹ explaining that individuals are trying to build a consistent story to organize their vision of the event and to form mutually exclusive decisions. In addition, individuals imagine scenarios in order to predict future developments. And a prescriptive approach to decision making is implemented in the activities of development institutions that are focused on breakthrough projects financing, the directions of which are indicated in the government economic policy.

It is inexpedient to determine normative models of decision-making, focused on rational individuals who make decisions that process information in general and unassumingly, as it is important to take into account the psychological factors of making decisions (i.e., descriptive approach) about the modernization and choosing the sources of its financing. The normative approach describes a static process of moving toward a result: the company’s modernization, but it is impossible to do in the

conditions of innovative economy and the development of scientific and technological progress, the impact of a dynamic competitive environment; so speaking of modernization, the descriptive approach is more applicable being adaptive and process-oriented.

4.2. Specifics of behavior of the individual making the decision about the financing of the industrial enterprise modernization

Above, on the basis of the specifics of the industrial enterprise modernization decision-making, we identified a justified, forced, stimulating and mass modernization. It is the mass modernization that is influenced by external factors and is directly related to psychological aspects. In this regard, the decision about modernization can be due to the reflection and presupposition regarding the behavior of counterparties in relation to the industrial enterprise in question, which launches an averaging and self-regulating psychological process of making one’s own decisions at the collective market level. Therefore, mass modernization is explained by the need to predetermine and copy the behavior of competitors under the influence of factors of the institutional environment, state of uncertainty in dynamic conditions of decision-making, and with account of the expected losses in case of making a wrong decision, differing from those of the majority.

It should be noted that the decision about modernization can be negative due to the propensity of decision makers to inappropriate changes, i.e. to maintaining the current status (“Status Quo”), even despite the fact that the selected industrial enterprise management processes are not optimal. In terms of utility maximization, the “Status Quo” decisions are irrational and lead to further taking decisions which are clearly biased from a psychological point of view. Thus, the modernization decision for the owner is a decision aimed at maximizing profits, but it is based only on the future prospects and rates of return, rather than on the fact that the initially selected strategy is correct for subjective reasons. In addition, the desire to maintain the “Status Quo” may be due to the fact that the individual feels risk aversion (and the modernization always involves risk-taking) and will go out of his way to avoid it, because the disadvantages of the on-going changes will seem more significant to him than the possible advantages.

During the modernization of the industrial enterprise, there can be a situation where either during the modern-

ization design or due to dynamic factors determining the modernization content, decision-makers cannot refuse from the further implementation of the modernization program because of the capital already invested in the process. This leads to “the effect of the money invested”, when individuals choose those alternatives in which they have already invested their money, effort or time. This interpretation can also be applied to institutions, in particular, the ones financing projects by the given parameters, or investors who pre-determine in advance the cost of capital use.

In our opinion, the psychological theory of “anticipation of regrets”,¹⁰ explaining that the individuals make decisions in favor of the alternatives, which help to minimize regret, does not apply in case of making decision about modernization. In conditions of innovative development and the competitive environment, modernization with minimal cost is not the best option as it involves an initial orientation on the technical and technological upgrading and professional development of employees, even when technologies of imitation and copying are used.

5. Conclusion

In connection with the above it can be concluded that if an industrial enterprise during the implementation of the modernization uses standard resources, then investors are dependent on the actions of partners and choose the projects of modernization of enterprises, which are less vague and provide the desired level of profitability. If during the modernization, the enterprise is focused on specific resources (its own development works), there are risks of decrease in security of contracts for the modernization of industrial enterprises. With the participation of the state, the essential features of the modernization discussed above begin to dominate.

In general, in our opinion, the choice of projects in the framework of the national design office for the modernization of industrial enterprises to reduce irrational behavior should be provided with specially developed standards that take into account the features discussed above. Thus, several standard solutions reducing the impact of irrational thinking can be formed. These standard solutions should include both traditional solutions, such as:

- Co-financing (government and business entities invest in the modernization of industrial enterprises in a certain proportion, and the state proportion should be lower than the proportion of business entities, that helps to eliminate the use of budgetary resources in inefficient projects);
- Target financing (financing of specific projects with specific expected results);
- and new ones, compensating irrational decision-making in certain areas;
- Non-monetary support (instead of allocating funds that can be used inappropriately, it is possible to provide services using the state resources (for example, educational services in the public universities, equipment purchasing from manufacturers, supported by the state, connecting to utility networks, built by the state);
- A clearly formulated withdrawal from the project (a company involved in the project of investment in modernization, should clearly understand the extent to which it will participate in the distribution of the results of this project, which creates incentives for a fixed period of modernization of the enterprise).

6. Acknowledgments

This research was financially supported by the grant from the Russian Science Foundation (Project No. 16-18-10149), the Market Economy Institute of Russian Academy of Sciences.

7. References

1. Solow RM. A Contribution to the Theory of Economic Growth, *The Quarterly Journal of Economics*. 1956; 70(1):65–94.
2. Toward a new strategy for development: a Rothko Chapel Colloquium. <http://www.sciencedirect.com/science/book/9780080239132>. Date Accessed: 1979.
3. Schumpeter J. *Theory of Economic Development: A study of business profits, capital, credit, interest and economic activity cycle*, Transaction Publisher: London, 1934. p. 255.
4. Mensch G. *Stalemate in Technology: Innovations Overcome the Depression*, Cambridge, Mass: Ballinger Publishing Company. 1979; 15(3):806–08.

5. Eisenstadt SN. (Ed.). Social change and development. Readings in Social Evolution and Development: The Commonwealth and International Library: Readings in Sociology. Elsevier. 2013; 3–33. 10.1080/00220387208421405.
6. Huntington SP. The third wave: Democratization in the late 20th century. Vol. 4. University of Oklahoma Press. 2012. ISBN 9780806125169.
7. Inclusive Green Growth. The Pathway to Sustainable Development. The World Bank. Washington, D.C. 2012. URL:<https://openknowledge.worldbank.org/bitstream/handle/10986/6058/9780821395516.pdf?sequence=1>
8. Dang G, Sui Pheng L. Infrastructure Investments in Developing Economies. Springer Singapore, 2015, 11-26. DOI 10.1007/978-981-287-248-7.
9. Lane D, Myant M. Varieties of Capitalism in Post-Communist Countries. Basingstoke: Palgrave Macmillan. 2007. DOI 10.1057/9780230627574.
10. Myant M, Drahokoupil J. International integration, varieties of capitalism and resilience to crisis in transition economies. *Europe-Asia Studies*. 2012; 64(1):1–33. DOI 10.1080/09668136.2012.635478.
11. Tregenna F. Deindustrialization and Reindustrialization. Pathways to Industrialization in the Twenty-First Century: New Challenges and Emerging Paradigms. Oxford Scholarship Online. 2013;76–101. DOI 10.1093/acprof:oso/9780199667857.001.0001.
12. Kovalchuk YA, Stepnov IM. On the principles of institutionalization of the state organizational platforms of economic modernization. Russia in the 21st century: global challenges and development prospects: the Fourth International Forum (Plenary lectures). Moscow: Central Economic Mathematical Institute of the Russian Academy of Sciences. 2015. 189–195. <http://www.russia-globalchallenge.ru/upload/materials/СБОРНИК%20IV%20ФОРУМ.pdf>.
13. Kritzman M. Risk Disparity. MIT Sloan School of Management. MIT Sloan Working Paper 5001-13. Cambridge, MA. 2013. <http://www.top1000funds.com/wp-content/uploads/2013/07/130717-Risk-Disparity.pdf>
14. Oberlehner T. FOREX Market Psychology. Moscow: SmartBook, 2012.
15. Simon GA. Rationality as a process and a product of thinking. *THESIS*. 1993; 3:16–38. https://igiti.hse.ru/data/003/314/1234/3_1_2Simon.pdf.
16. Sarasvathy SD. MAZES without minotaurs: Herbert Simon and the sciences of the artificial. *European Management Journal*. 2013; 31(1):82–87. DOI 10.1016/j.emj.2012.11.002.
17. Tversky A, Kahneman D. Advances in Prospect Theory: Cumulative Representation of Uncertainty. Readings in Formal Epistemology. Springer International Publishing. 2016; 493–519. DOI 10.1007/978-3-319-20451-2_24.
18. Jonassen DH. Designing for decision making. *Educational technology research and development*. 2012; 60(2):341–359. DOI 10.1007/s11423-011-9230-5.
19. Das T K. Intelligent Techniques in Decision Making: A Survey, *Indian Journal of Science and Technology*. 2016 Mar, 9(12).