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Organizational Principles of Industrial Corporation Management: the Role of the Conceptual Model

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ABSTRACT

The article studies the conceptual model of industrial corporation management under the process approach, based on the use of the systematic methodology of organizational design. As part of the organizational design the role of the conceptual model is rationalized, which, in fact, determines the structure, functions and main characteristics of the production system. In particular, the article is an example of implementation of the authors' methodological approach to the model representation of the internal environment of the corporation in the unity of the two main processes: operational and innovative, to form on this basis a single production and innovation plan. Authors' offers help to improve planning and strategic processes of the corporation and enable to balance more correctly operational and innovative activities, to form the technical and economic plan, taking into account the dynamics of the innovative potential in a corporation, including calculation of operational results.

Keywords: Conceptual model, production system, organizational design, system methodology, organizational action.

1. INTRODUCTION

Summarizing the results of the ongoing modernization of the economy under the banner of innovation development of the last decade, it should be recognized that actual positive results have not been achieved: new, significant businesses are not open, not everything went smoothly with import substitution, while the problem of choosing the competitive model of economic modernization has not yet found its solution (Ivanter 2010). It should be noted that the task of creating some modern, globally competitive industrial production works in Russia has always been important. However, under the sanctions and external pressure, it turned into a problem demanding immediate solution, the main things being a threat to national security, defense industry, import substitution. The country's leadership announced the new industrialization strategy, seeking to improve the quality of management and business assets.

What to rely upon: The government or corporations; small business or national innovation system, establishment of technology parks and related infrastructure?

The government is more or less clear: Its role in market conditions is to create favorable conditions and mechanisms to support especially important projects. Hardly can the Soviet experience be resuscitated, when innovations were the result of the integration of academic and sectoral institutes and design entities with enterprises. The players and the apologists of restructuring the Soviet economy say, "put on the market economy's rail tracks a planned economy locomotive" and waited for it to arrive. However, the reformers, who more or less effectively did the privatization, which was not enough to take the rate of development, have done nothing to implement the entire complex market mechanisms (Obolenskiy 2008).

That's why our market locomotive of industrialization is stalled, especially against the background of falling energy prices. It would seem possible to draw on the experience of advanced global TNCs, as the capitalist countries show a gradual evolutionary development of economies owing to the industrial production of goods with high added value (Innovative development as the foundation of Russia's economy modernization. National report, 2009; Chernyshyov, 2010). At the same time, in these countries, at all levels the interest in innovation is promoted and maintained while innovations as such rely on professionals. For this interest, support mechanisms and tools for implementation of innovations at the enterprise level are formed (Teece 2009).

2. METHODOLOGY

2.1. Organizational imperatives in management of an industrial corporation

What prevents Russian reformers to use such a rich and effective experience? In our view, the possible causes may be three: 1) lack of training of civil servants (federal and regional governments); 2) speculative interest of those responsible for the development of the industrial base; 3) lack of an adequate conceptual model as the basis for the organization and management of production systems and formulation of the state industrial policy. All other things being equal, there is a truism that the central core of the capitalist market is a large corporation (Kondratiev 2009). From the organization theory standpoint any organizational, managerial, technical actions or decisions begin with the formation by the organizer of a conceptual model. The more adequate such model to the dynamics of the environment, the more effective functioning of the real system, implemented on this basis. In this context, a key role in the organization of such systems is played by the organizer; we will give a formal definition of this rather complex concept.

Systems organizer is an active, interested, resource-provided, authorized, competent and active "element" of creation and management of a production system. This concept can be represented as follows (Mezhov, Kiseleva & Chuvaev 2015):

Systems organizer = DM + verbal model of the environment + model of system to be created or operating + resources + competences + interests + powers + strategies,

where: DM – decision-maker; verbal model of the environment – described or formalized views of organizer on the external environment, market, world economy, national specifics, etc.; model of system to be created or operating – formalized views of organizer on the functions, structure and goals of the production system transformed; resources – a full set of necessary and sufficient resources: material, intellectual, competence, financial; competences – complex knowledge of designing and transformation; interests – desires, preferences, motivation to commit organizational action; powers – absence of restrictions to act,

legitimacy, legality, absence of opposition from the environment; strategy – a set of programs, action plans, technologies for organizational change. This definition, if explicated to the economy, fully coincides only with such category as large company or corporation, because they contain all of the above attributes of the organizer. In general, individuals, companies, banks, foundations, state, social system, investors, creditors, shareholders meetings, etc. may act as system organizers.

The analysis shows that the development of production, change of technological paradigms, innovations occur after the changes in the external environment, not automatically, but as a consequence of power and resource influence of organizer-type actors, in our case, on the processes of industrial evolution. If from this point of view we see the actions of the government in the implementation of the modernization strategy proposed by them (Innovative development as the foundation of Russia's economy modernization. National report, 2009), it is obvious that the government appears not the organizer but rather the expert. When complete group of powers, resources and other attributes that allow implementing the organizational process is missing, and there is only a conceptual view, this is a feature of the expert.

However, the imperative of organizational activities is the conceptual model formed by the operator, which is denoted as CM. The conceptual model may reflect somewhat "ideal", "exemplary", reflecting the desires and interests of the organizer or a "world-class company". Structurally, CM can be represented as a set of: vectors, properties, functions, system characteristics, structure, objectives, resources, strategies and management (Mezhov, Kiseleva & Chuvae 2015), *i.e.*,

$$CM = \{S, F, S, ST, O, P_m, P_e, P_i, S_r, U\}, \quad (1)$$

where in curved brackets are the formalized descriptions of the entire multitude of attributes and sources of resources, namely: S – multitude of the desired properties of the production system; F – multitude of functions; S – multitude of system's characteristics; ST – multitude of strategies; O – system's objective; P_m – material resources; P_e – energy resources; P_i – information resources; S_r – verbally presented system's structure:

$$S_r = \langle G; q \rangle, \quad (2)$$

where G – multitude of elements; q – multitude of links; U – multitude of controls.

Relations (links) of the structure are determined by the properties of m_i, interaction of P_m, P_e, P_i, which are formally built by the operator based on interaction of resources on the three basic process levels: technological, associative and management. The technological process unites all the resources in the production system; the associative – only input (for making products and goods) and output (products sold in the market); the management process determines the basic information channels, coordination and regulation relations, cash flows to distribute incomes. Based on the above, a multitude of links may be formalized.

Multitude F is determined by the type of products, technology of production and sale, sector, market type, etc.

Parameters of S reflect general quality/quantity characteristics of the production system as represented by the operator, for instance, total capitalization, equity capital, capital structure, share price, priority markets and other feasibility parameters.

2.2 System methodology and organizational design

In practice, the system characteristics are implicitly reflected in the design documentation and basically realize the properties of organization: order, stability, reliability, optimization, adaptivity, evolutionism, etc.

Strategies, objectives, management are determined by the conceptual view of life of the operator to realize its interests, motivation and preferences. The conceptual model of the production system can be represented as a meaningful description or a matrix. CM implementation procedures, in accordance with the logic of organizational design, are usually performed via sequential transformation of models (engineering design) from CM to real production system to be created.

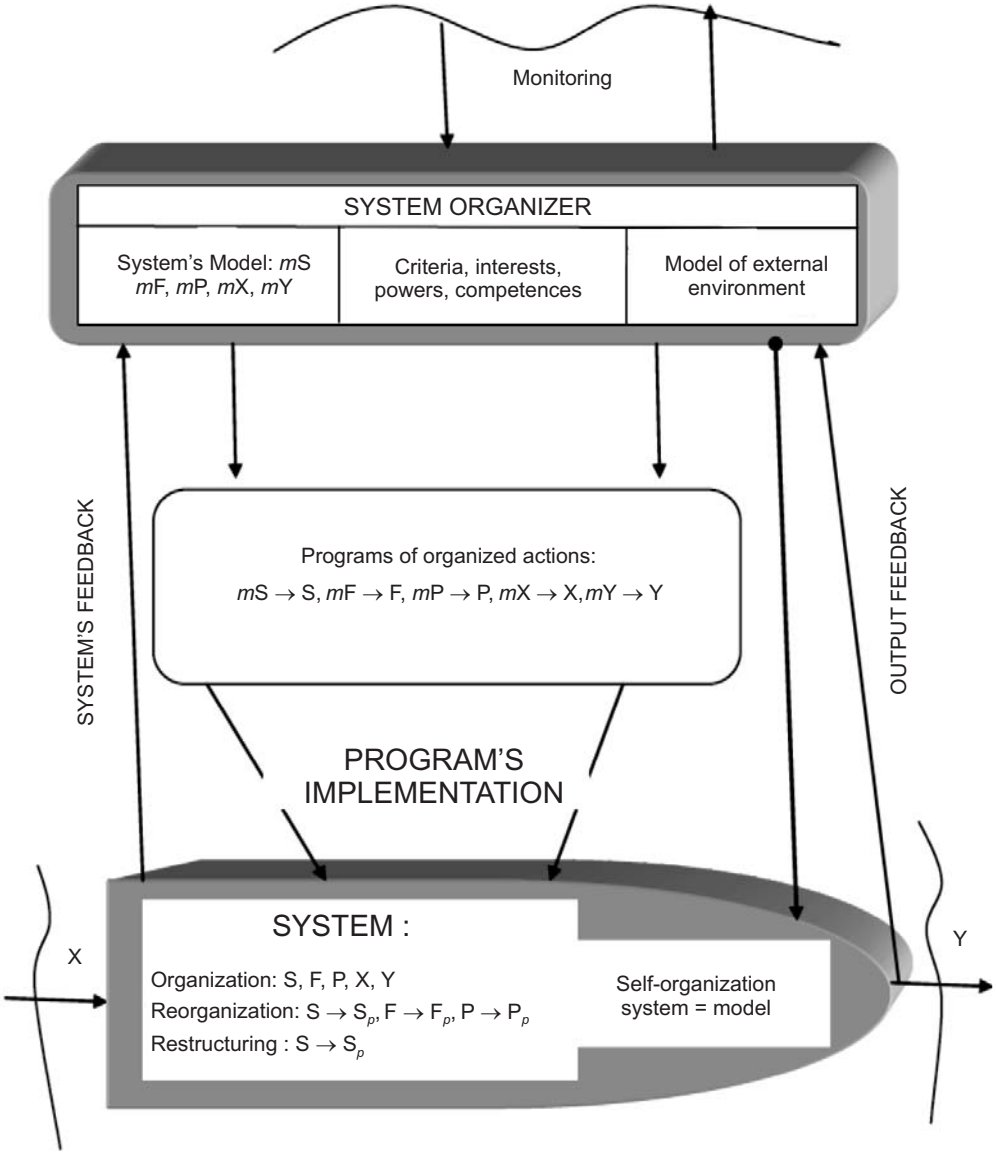

Figure 13.1: Principal scheme of the organizational process (Mezhov, Kiseleva & Chuvaev 2015)

In the center of the organizational processes (Figure 13.1) is the organizer, the initiator: individual, person, group of people (team), organization or state. The organizer has a fundamental attribute to do organizational actions, namely, motif, interest for meeting own real or imagined needs, which it wants to achieve through a particular system, by setting its appropriate goals. The organizer surely has all the competences and knowledge, resources and powers for the implementation of organizational actions. In the first steps, it contemplates the general view (concept) of the system in the form of a verbal model

and then realizes that principle in the system's model, in which it describes the structure of (*m*S): here, m means that it is a model structure, possibly drawn on paper; functions (*m*F); processes (*m*P); input resources (*m*X) and output (*m*Y), those may be products, services, etc. However, for production systems Y is not an automatic condition to achieve a goal as the environment (market) should perceive/use that output.

Actually, it occurs that the environment forms with regard to Y somewhat opposite Y_{dem} – the demand on products and services which determine the input Y, and hence, we may formulate objective achievement criteria K_{SC}, reflecting the level of compliance of system's output with the level of environment's output.

From the quality standpoint, that criterion means that the less K_{SC} , the more output Y is "needed", perceived by the external environment, the more efficiently the system's objective is fulfilled.

Thus, the organizer forms a model of the system and a model of the environment, upon the synthesis of these models it determines all the elements, resources, processes, technologies and parameters used to create the system. Figure 13.1 illustrates such a synthesis unit called "program of organized actions". That is, the program sets the entire procedure for the establishment of a new system, the transformation of an existing or managing a current one; the structure of *m*S → S type means a set of actions, methodologies, procedures to make a plan the reality.

As is known, within the strategic planning, among other things, the main trends of development of the enterprise are identified to predict future trajectories and parameters of the production system and to choose a trajectory that is most immanent to achieve the ultimate goals. Whatever management technologies are applied by organizations to improve the management and performance efficiency, the basis is always the conceptual model of its systemic organization. Meantime, the leading role in management is played by a balanced operational and innovative program of a corporation, the essence of which is the need to make out such a plan of activities (the nomenclature of current production and innovation), which would enable to increase, or at least not to lose competitiveness in the long term (Maksimov & Khalikov 2009).

2.3. The paradigm of integration of operational and innovative processes in corporation management

The logic of the development of modern corporate management systems suggests considering the overall production process in the unity of the two major subprocesses: operations and innovation (see Figure 13.2). Figure 13.2 shows, in fact, a conceptual model of organization and management of business processes of the modern corporation, being the basis for the implementation of specific processes and management tasks. The main content of this conceptual model is owing to the fact that the operational process is the solution of current production and sales tasks while the innovative one is, respectively, the solution of all long-term tasks for future production. The operational process is a source of financial resources for all forms of investments (I), including innovation-related. Operating stability provides investment attractiveness of the enterprise while investments, in turn, provide current and strategic competitiveness. The entire complex of costs (investments) in an enterprise is divided into two components: operating (ICo) and investment (IC*i*). One of the main problems of strategic management in this case is transformation of innovative processes into operational in relevant future times.

Thus, without current operations, ensuring the resources for existence, an enterprise cannot exist today, and without innovation activities, there can be no future operations, *i.e.*, an enterprise will not exist tomorrow. Consequently, the overall task of strategic management is the task of organizational development of the enterprise, put by the two main strategic processes: operational and innovative.

As to the operational process, the main task is to choose the production program for the current period, to make assessment of demand for products, volumes and sources of investment, ensuring financial stability. Creating innovation runs through all of the above processes starting from the user through technical making of products, human resources, information resources, and as a result is embodied in the long-term corporate strategy. However, one of the most difficult tasks of planning investment for innovation is the challenge of correct calculation of cash flows and costs of an innovative project.

2.4. The process approach as a self-organizing tool

The strategic planning process, covering different time horizons, determines the trajectory of economic agent's development. Its essence is modeling future internal/external changes in terms of achievement of a desired state and coordination of all system's elements in order to achieve that desired state (Aoki 1995; Omae 2008; Jehle & Ren (2001). Strategic management model by P. Lorange most fully reflects the essence of this process (Lorange 1980). It includes three levels of strategy: functional, divisional and corporate, while on each level strategic planning, organization and control are implemented.

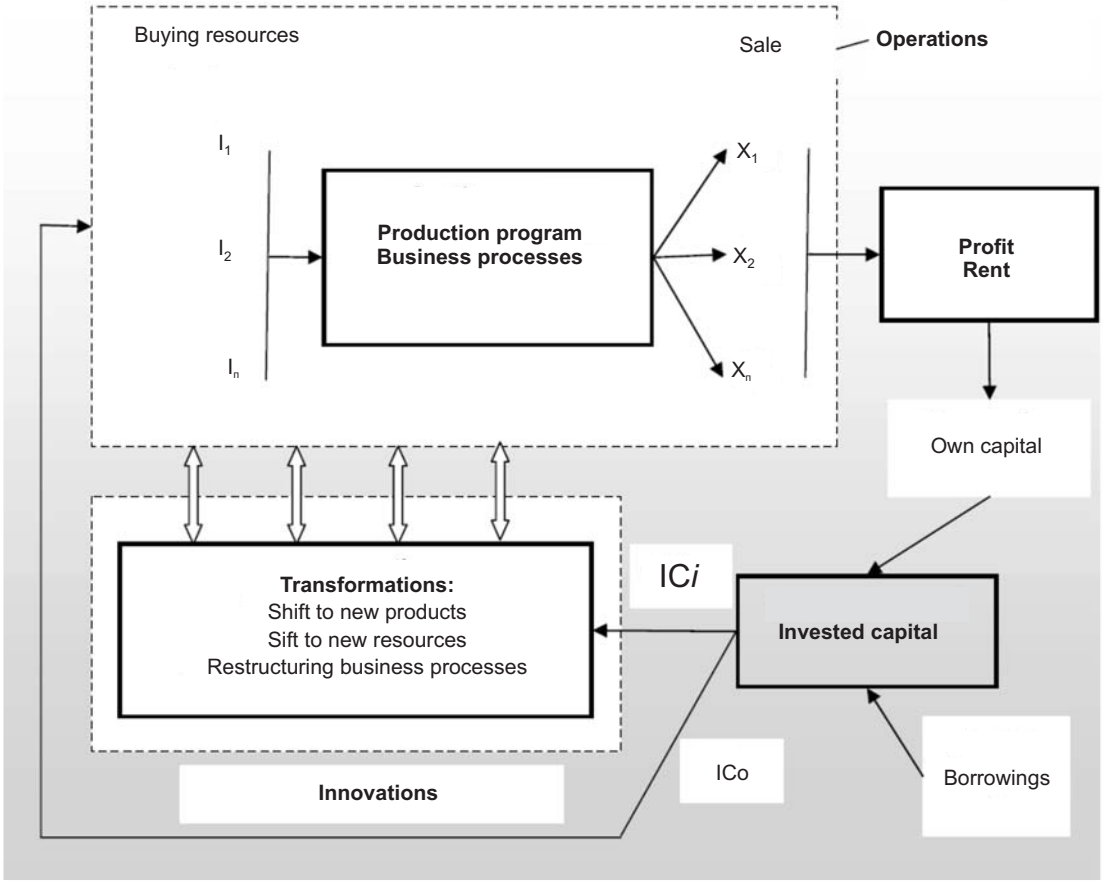

Figure 13.2: An example of conceptual presentation of operational and innovative projects (Mezhov & Mezhov 2015)

Whatever management technologies are applied by organizations to improve the management and effectiveness of activities, they are always based on process management.

The initial basis for the planning of business processes becomes a marketing plan, in which the cost and quantitative characteristics of business process outputs are determined – prices and the volume of sales in value and in kind.

Business process budgets are formed on the basis of the sales program, which determines the production plan.

The costs of the functions considered need to reflect only those that arise as a result of the corresponding business process. The costs of carrying out functions that are parts of the processes implemented by the organization's back office constitute the expenditure of the budget of the entire organization. Incoming proceeds in the course of implementation of a business process are subject to withholdings to secure those budget items.

For project budgeting, costs of w-th business process are the following items: "Remuneration and charges on labor" FZP^{w}; "Material costs" M^{w}: raw materials, semi-finished products, purchase of fixed assets.

The plan of material costs for l-th year is calculated on the basis of norms of material costs of an arrangement (or per point of performance indicator for the j-th function $N^{m}_{1O_j}$).

The above norms are determined on the basis of last periods' data on material costs of the divisions in charge for that arrangement in l – 1 year:

$$N^{m}_{1O_j} = \frac{M^{f}_{j(l-1)}}{O^{f}_{j(l-1)}}, \quad (3)$$

where $M^{f}_{j(l-1)}$ – material costs of f - th functional division in charge for j-th arrangement in l – 1 year;

$O^{f}_{j(l-1)}$ – performance of f - th linear and functional division exercising j - th function in l – 1 year.

Thus, the material costs budget of w - th business process adjusted for price index of l - th year by j-th function are calculated as follows:

$$M^{w}_{jl} = O^{w}_{jl} \cdot N^{m}_{1O_j} \cdot INF_l \quad (4)$$

where O^{w}_{jl} – performance of w - th business process by j - th function in l - th year; $N^{m}_{1O_j}$ – norm of material costs per point of performance indicator for the j - th function; INF_l – price index for l - th year.

Planning remuneration and charges on labor for w-th business process for l-th year for the implementation of j - th function FZP^{w}_{jl} is determined based on the labor intensity of work NT_j and the average cost hourly rate ZP_1:

$$FZP^{w}_{jl} = PERS^{w}_{jl} \cdot NT_j \cdot ZP_1 \quad (5)$$

Similarly to material costs, the plan for labor costs (the amount of human resources required for implementation an arrangement), is estimated with the use of labor costs norms $N^{FZP}_{1O_j}$. These norms are determined based on last periods' data accounting for the labor costs to perform j-th function in l-1 year:

$$N^{FZP}_{1O_j} = \frac{PERS^{f}_{j(l-1)}}{O^{f}_{j(l-1)}}, \quad (6)$$

where $PERS^{f}_{j(l-1)}$ – the amount of human resources involved by f – th linear and functional division exercising j – th function in l – 1 year; $O^{f}_{j(l-1)}$ – performance of f – th linear and functional division exercising j – th function in l – 1 year (Dronova 2015; Dronova 2015*a*).

Obviously, the most important area to improve production management based on business processes budgeting is the development of self-organizing mechanisms in the production and commercial system through the investment and innovative component of the corporation's economic growth strategy.

2.5. Adjustment of the basic concept of assessment of innovation projects

Combining operational and innovative processes in the framework of the formation of a single operational and innovative plan, it is necessary to adjust the accepted postulate for investment project assessment, in which cash flow is mainly considered as a function of the volume of invested capital, profitability and risk. The calculation of the discounted cash flow becomes a permanent part of the planning of operational and innovative program. In these circumstances, it should be noted that an innovative project is characterized by a complex, recursive dependency not only on variables such as the volume and price of the new product, but, above all, on the feasibility or rather technological factors. It should be pointed to the fact that the innovative process, among other things include the contours of feedforward and feedback links between the volume and the mechanism of investment and the process of return on investment (Omae 2008; Polterovich 2009; Jaruzelski & Dehoff 2009).

Thus, it can be formally assumed that:

$$I_{NK} = I_{NK}(C^{n}_{nt}, X^{n}_{n}, \partial^{n}_{n}, \beta, \eta, \gamma) \quad (7)$$

where C^{n}_{nt} – estimated sale price of the new product; X^{n}_{n} – estimated total volume of production of the new product within the project approach; ∂^{n}_{n} – threshold level of return on investments (profitability); β – assessment for product's complexity (materials, structure, consumer properties), to be found via expertise or analytically via comparing with the sample; η – the parameter showing the character of scientific development (theoretical, search, technological works), affecting the volume of costs on funding R & D stages; γ – the factor of systemic assessment of the innovative potential, showing the availability of unique competences, technological paradigm, lab instrumentation, sectoral leadership – a corporation as an average player has its history, stable market share, innovations, etc. (Maksimov & Khalikov 2009; Mezhov 2008; Teece 2009).

The structural complexity may be assessed, for instance, on five-point scale through a few core parameters:

$$\beta = 1/5(0.3\beta_1 + 0.25\beta_2 + 0.20\beta_3 + 0.15\beta_4 + 0.1\beta_5) \quad (8)$$

where β – average expert assessment on five-point scale, including: β_1 – level of scientific novelty; β_2 – assessment of technology; β_3 – assessment of materials used; β_4 – complexity of making the product; β_5 – quality assessment of market. Factors' coefficients were identified upon experts' survey (Mezhov 2008; Titova, Mezhov, Lyamzin, et al. 2010).

The scientific development level η is determined by R & D stages and answers the question when to invest in the works or since which stage the innovative process commences. In this case, having 6 stages (m = 1) it may be assumed that $0 \le \eta \le 1$. The first stage covers fundamental research (η = 1), meaning that it is required to finance the entire cycle of works from fundamental research to commercial or mass production. The second stage is applied research (η = 0.75), the third – construction (η = 0.5), the fourth – trial model (η = 0.25), the fifth – trial lot (η = 0.1), the sixth – start of production (η = 0.0).

In addition, the ratio (7) indirectly shows that the costs of innovation are defined by production potential, specified herein by the integral indicator γ. The more scientific and production potential of the corporation, the less money it will spend on innovative processes, compared to a similar corporation, but with less potential, because it will require less money for training, new equipment, devices, etc. Of great importance is the historical experience of the company, since this experience defines sectoral competences.

3. RESULTS

Complex influence of the factors characteristic of the innovative project and the enterprise, namely, β – structural complexity of a product; η – depth of scientific development (theoretical, search, technological work); γ – the integral indicator of scientific and production potential of an enterprise may be accounted for by using a special adjustment multiplier. Complex influence of these factors characteristic of the innovative project and the enterprise can be taken into account by introducing a special multiplier (adjustment factor), for example, using an exponential function (Mezhov & Mezhov 2015; Titova, Mezhov, Lyamzin, et al. 2010):

$$\sigma = e^{\frac{b\beta\eta}{\gamma}} \tag{9}$$

b – coefficient taking into account the cost of the forecast accuracy in the design of complex products, b can reflect the degree of inaccuracy of the planned investment decisions in relation to actual and may be determined by expertise. b is determined by expert employees of corporation's planning divisions, and is configurable.

For an integrated assessment of the innovative project investment strategies we apply an approach based on the adjustment of NPV calculation procedure. Using the innovative potential of the enterprise, the complexity of products, R & D depth, including the multiplier in the formal ratios, we obtain an equation of the volume of the initial investment estimate for the innovative project, depending on the characteristics of the innovative process:

1. We represent the return on the current costs ρ of production X as the sum of profitability of outlay R_1 and the additional return that provides Schumpeterian rent R_2 (Chesbrough 2007):

$$\rho = R_1 + R_2. \tag{10}$$

2. The product's price is represented as the product of returns and costs S_t in t period:

$$c = (1 + \rho)S. \tag{11}$$

The simplified formula to calculate NPV as adjusted is as follows:

$$NPV = -I + e^{-\frac{b\beta\eta}{\lambda}} \sum_{1}^{T} \frac{\left[(1+\rho)\cdot S_t X_t\right] - S_t X_t}{(1+\delta)^t} \tag{12}$$

In the expression (12) in the numerator under the sign of sum, is the gross profit. Adjustment factor before the sign of sum reduces the probability of the cash flow's value depending on the characteristics of the project and the innovation potential. Parameter *b* just reflects the probability of deviation of the original planned value of the cash flow from its actual value: here T – planning time; S – cost per unit of output of new products; X – volume of production; I – planned volume of investments: a fixed value for NPV calculation.

In the competitive environment corporations begin to develop advanced products and gradually the related yield is leveling, becoming the sector's average.

The following table provides estimates for some corporations that invest in innovative projects the same amounts. The calculations in Table 13.1 show how the net present value is changing, depending on the parameters characterizing the potential and complexity of the project. The data in Table 13.1 show that the adjustment of NPV alters the effectiveness of many projects, which means that without adjustment they could be accepted, and upon adjustment would, on the contrary, be rejected.

Table 13.1
Modeling cash flows from implementation of investment projects in enterprises with various potentials

Corporations	*Investments, mil. rubles*	*Innovation parameters*			*NPV, mil. rubles for 7 years*	
	I_n	β	η	γ	*Unadjusted*	*Adjusted*
CRP_1	5	1	1	1	5.09	3.77
CRP_2	5	1	1	0.6	5.09	2.84
CRP_3	5	0.8	0.86	0.47	5.09	3.05
CRP_4	5	0.7	0.86	0.63	5.09	3.64
CRP_5	5	0.6	0.63	0.49	5.09	3.89
CRP_6	5	0.54	0.29	0.35	5.09	4.35
CRP_7	5	0.54	0.19	0.58	5.09	4.78
CRP_8	5	0.4	0.03	0.55	5.09	5.05

4. DISCUSSION

Thus, the actual value of the total investment in full development of innovative products, including launching, lies in the range wherein the lower boundary is the planned volume and the upper boundary is the volume of investment corrected using the multiplier.

$$I_n \leq I_{act} \leq I_{cor}. \quad (13)$$

The upper boundary of the interval depends in the most significant way on the innovation potential, the structure of which is determined by the technological level factors, human capital, R & D and so forth. When the level of innovation potential grows, the length of the interval is narrowed, resulting in higher accuracy of prediction of the actual amount of investment in innovation.

Summarizing, we emphasize that this paper shows the role of the conceptual management model in an innovation-oriented industrial corporation, the systemic formulation of the general task to form the operational and innovative program being specification of the requirements put by the general concept of

management. We have shown a methodological approach to the formation of a more specified mechanism of innovation planning within the general operating corporate program, taking into account the feasibility parameters of product's complexity, the depth of development and innovation's potential.

5. CONCLUSION

The proposed methodological approach to the study of the role of organizational principles of corporate management has clarified some basic concepts, in particular, the role and importance of the conceptual model, a way of accounting for the innovative potential, the complexity of innovative products and depth of development.

It seems that our proposals contribute to the improvement of the strategic planning of corporate process and enable to more accurately balance the operational and innovative activities, feasibility and financial plan, with due regard to the corporate innovative potential within corporate dynamics including calculation of operating performance. In particular, it is possible to do the following:

1. Constructing corporate development models.
2. Forming a normative planning framework as a basis for optimization and control of corporate expenses and costs.
3. Forming of the system of lifecycles of products and technologies.
4. Linking into a single complex of manufacturing, financial and investment planning methods based on the project approach.
5. Forming of a formal program strategy for implementation of innovative solutions: duration of R & D stages, tactics of financing stages, tactics of launching products, marketing tactics, including methods of promotion and pricing.
6. Identification of the total investment and the proportion between productive and innovative areas.
7. Calculation of the optimal rate of corporate growth within sustainable financial framework.

In addition, it is possible to select the optimal volume of investment in innovation and assessment of the most preferred strategies for the implementation of R & D, taking into account the complexity of products and the innovative potential.

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