Управление в социально-экономических системах

SMART MANAGEMENT METHODS AND MECHANISMS
OF INDUSTRIAL ENTERPRISES AND ORGANIZATIONS

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At present, the management of industrial enterprises and organizations becomes an increasingly challenging problem, so old traditional methods are impossible to use for its solving. This article describes methods and mechanisms of smart management that improve management efficiency of industrial enterprises and organizations. These mechanisms are grouped as follows:

– non-manipulative mechanisms (or mechanisms allowing to get right information from employees about their working results);

– coordination mechanisms (when using such mechanisms it is rational for employees to fulfill commitments or plans);

– supporting mechanisms (mechanisms that help develop recommendations to the decision maker);

– developing mechanisms (mechanisms stimulating the development of industrial enterprises (cost reduction, innovation, etc.)).

In this article, we analyze why still so few smart management methods and mechanisms are used in practice.

Keywords: management, non-manipulative mechanisms, coordination mechanisms, supporting mechanisms, development mechanisms.

Introduction

The twenty-first century is often called the century of "smart things" (smart home, smart car, smart systems, etc.). It is time for "smart management" including smart managers and smart methods and mechanisms.

Smart management methods and mechanisms of industrial enterprises and other organizational structures have a number of properties that allow society to develop dynamically. Firstly, smart management methods and mechanisms can be a strong educational tool. In this regard, the widely known statement "being determines consciousness" is impossible to agree on as something obvious as it is very difficult to change consciousness. The level of intelligence of a modern man is not far from a primitive man. The mentioned statement can be more correctly interpreted as "being determines behavior".

If you change management mechanisms, man's behavior will also change: inert and passive employees will become more hard-working, and employees who overstate the results of their work will give truthful information about it, etc. Secondly, mechanisms of smart management allow to change employees' attitude towards work: to make a person use resources rationally, use the equipment effectively; apply effective means of production, modern information computer methods and technologies to analyze and process information.

The main characteristics of doing business in modern conditions are:

– the increase of military-political and socio-economic instability in the world;

– significant contraction of international markets associated with a decrease in the purchasing power of customers and deterioration of industrial situation as a whole;

– the necessity of applying more modern industrial technology, due to technical progress and the problem of import substitution, primarily in the field of information and computer systems, etc.

The management of industrial enterprises and organizations becomes a more challenging and ambiguous problem, so old traditional methods are impossible to use for its solving. In order to improve the efficiency of management of industrial enterprises, a set of appropriate methods that can be called smart management methods is required. Among these, the most important ones are:

– strategic methods of developing priorities for certain periods of time;

– methods of comprehensive analysis of the dynamics of indicators of industrial enterprises compared to enterprises-competitors in the relevant spheres of material production;

– methods and models for enhancing the adjustment of industrial enterprises to constantly changing business conditions;

– methods of improving production logistics that is oriented towards growing dynamics of final product markets;

– methods and techniques to evaluate external factors that affect a company greater than the variation of internal factors;

– methods of forming modern structure of the company focusing on an increase of the flexibility of personnel management, providing various types of resources, effective marketing of researches, etc.;

– methods and technologies to create the information-computer structure of the company that are oriented on their computer information system management, strategic management, and operational management and control of special software for the preparation and management decisions by owners and managers of industrial enterprises.

Substantiation of the necessity to implement these positions, as well as the content, is presented in the works [1–3, 5, 7, 8]. A very important component of improving the management efficiency in any company is the problem of project management developed by industry or other organizations, taking into account the interests of various stakeholders. The paper describes the tools and the methods [6].

The composition and content of smart management mechanisms

Development of smart management plays a significant role in the theory of active management [1–3, 5]. There are more than thirty such mechanisms covering the entire management cycle.

One can group these mechanisms into certain groups. These are some basic examples of such groups:

1. Non-manipulative mechanisms (or mechanisms that allow getting true information from employees about their working results: lack of various types of additions, etc.). Thus, non-manipulative mechanisms are mechanisms in which it is rational for a person to be honest, that is, to provide reliable information about the real (not overstating) requirements, adequate (but not overstating) tasks that will allow us to achieve goals, the actual (not overstating) results. Non-manipulative mechanisms (they can be called mechanisms of "fair play") must meet the following requirement: obtained solutions based on smart mechanisms should not be harmful to people (that is worsen their situation or reduce the material consideration) who provide this information.

2. Coordination mechanisms

When using coordination mechanisms, it is rational for employees to fulfill commitments or plans that are real information about working results as it is more beneficial for an employee than overstating the results. Thus, the fundamental principle of coordination mechanisms is that plan implementation should maximize the utility of the employees.

Here is an example. In the 1970s, the ideology of SOFE (the System of Optimal Functioning of the Economy) was dominated in the economy of our country. The essence of this ideology was that, first, it was necessary to develop the optimal economic plan, and then this plan became profitable for enterprises based on the so-called dual estimates of L. V. Kantorovich, the world-famous academician. However, it appeared that hard structure of the dual estimates did not meet the interests of the companies (in the final works L. V. Kantorovich accepted this imperfection). Therefore, in the 1980s, the scientists from the Institute of Control Sciences of Russian Academy of Sciences proposed another ideology – SOCFE (System of Optimal Coordinated Functioning of the Economy). According to this ideology,

there was an optimal economic plan based on the agreed set of optimal plans of industrial enterprises, that is, profitable plans for companies.

The fundamental result in this area was that under general conditions the mechanism of optimal planning was the mechanism of coordinated planning. Systems of coordinated planning were implemented in several enterprises of Kazakhstan and Tver region. The ideology of SOCFE was very close to market economy: if a company develops a favorable plan, this plan will be chosen under the conditions of market economy. This market can be called information linked under the conditions of planned system. By the end of the 1980s, the ideology SOCFE was developed, tested and ready for mass implementation but due to "perestroika", the management of industrial enterprises took a different path. We think that such approach to the management of the economy based on the ideology of coordinated planning is possible in the contemporary environment.

3. Supporting mechanisms

Supporting mechanisms develop recommendations (advice) to the decision maker (DM). It can be an expert system or a group of experts. There are two types of supporting mechanisms: passive and active advisers. Passive advisers are not responsible for the effectiveness of their advice (e.g. weather forecast or the exchange rate). In the case of active advisers, there is a comparison of the effectiveness of the adviser's recommendation with the decision of the decision makers with appropriate incentives.

Here is an example of a passive adviser. In the 1980s, the Institute of Control Sciences conducted a research with the Academy of Sciences of Bulgaria for improving the management of water resources. Primarily, it analyzed the current mechanism of water resources allocation. It was very simple: all consumers had to apply for the amount of water they required. Usually, this water was not enough, so the applications were "reduced" proportionally to the value of the declared requirements. In fact, there was the principle of "the more you demand, the more you get", which naturally led to a trend of the increase in the number of applications ("artificial scarcity").

Mathematically it can be presented the following way:

According to applications of n consumers s_i ($i = 1, …, n)$ some resources are distributed (R).

If $\sum_{i=1}^{n} s_i > R$ (situation of deficit occurs), then it is necessary to determine x_i – some resources to ith consumer according to some rules.

In the case of equal priorities of applications, obviously, $x_i = \gamma s_i$, where $\gamma = R \bigg/ \sum_{i=1}^{n} s_i$ (all the applications are "cut down" by multiplying by $\gamma < 1$).

If there are established priorities for each consumer A_i, then according to the mechanism of direct priorities, the allocation is performed according to the rule

$$x_i = \min\left\{s_i, \gamma A_i s_i \right\}, \tag{1}$$

where γ – a common parameter for all consumers – can be derived from the formula

$$\sum_{i=1}^{n} x_i = R \tag{2}$$

(the resource is spent without anything being left).

It was clear that if one does not change the approach "the more you ask for, the more you get", the problem cannot be solved. Therefore, the opposite principle was introduced, namely "the more you ask for, the less you get" (but not more than you ask for). The justification of the latter approach is quite simple. It seems natural to distribute water in proportion to the average losses. However, the number of requests is in the denominator, and the bigger it is, the smaller the losses are. Thus, the problem was solved. It turned out that consumers' optimal strategy was to ask for even less than they required. This principle, called the principle of "reverse priorities", has also been introduced to the radio industry in the distribution of components.

The reverse priorities mechanism is based on the assumption that the less consumer demands the resource, the more his application is substantiated. Accordingly, this resource allocation is carried out using the rule:

$$x_i = \min\left\{ s_i, \gamma \frac{A_i}{s_i} \right\}, \tag{3}$$

where γ is defined as the mechanism of direct priorities, from the condition (2).

It is not profitable for a consumer to submit a very small or a very large application; he/she will receive the maximum amount of resource if his/her application satisfies the condition

$$s_i = \gamma \frac{A_i}{s_i}.$$

Thus, the equilibrium set of strategies of the consumer is the following:

$$s_i = \sqrt{\gamma A_i}, \tag{4}$$

in this case $x_i = s_i$. From the condition 4 we can find γ:

$$\sqrt{\gamma} = \frac{R}{\sum_{i=1}^{n} \sqrt{A_i}}.$$

Note that the strategy (4) is an equilibrium since any deviation from this strategy will result in less resources for the consumer.

Here is an example of an active adviser. In metallurgy, the process of steelmaking is very complex. It is managed by an operator. There was developed a mathematical learning process model (operator's adviser). At first, it was a passive adviser. As the adviser was learning, his first advice was not very good. After some time, the operator did not pay attention to the advice of the adviser, although the adviser gave good recommendations. Therefore, it was proposed to organize a competition between the adviser and the operator so that after the completion of the steelmaking process, it could be evaluated what was more effective – the recommendations of the adviser or the decisions of the operator. If the decision of the operator was more effective, he would be given an award. After the introduction of such active advisers, the situation changed dramatically. At first, the operator still was not paying attention to the recommendations of the adviser. However, he began to lose the award, and his behavior changed. He began to listen to the adviser's recommendations. As a result, the steel industry team was awarded the State Prize of the USSR for the mass introduction of active advisers.

4. Development mechanisms

Development mechanisms encourage the development of industrial enterprises (cost reduction, implementation of innovations, etc.).

First, let us consider cost-effective mechanisms, i.e., mechanisms to encourage cost reduction. They are designed to combat monopoly. Indeed, in order to maximize his/her utility, the monopolist reduces costs and increases prices. To put it in a nutshell, the monopolist's slogan is "cheap to produce, expensive to sell". To combat monopoly, an attempt was made to limit the break-even (profit per unit of costs). It was believed that the monopolist would reduce prices. However, he/she just began to increase costs to the break-even point. In this case, the slogan is "expensive to produce and expensive to sell."

One should note that in the planned economy of the Soviet Union price is determined according to industry standards of profitability, which led to the cost-based economy. The problem was whether it was possible to implement pricing and taxation mechanisms when "cheap to produce and cheap to sell" was beneficial to the monopolist. Such mechanisms have been developed in the theory of active systems in the late 1980s. It was planned for the standard of profitability to be dependent on prime cost, that is, with a decrease in the prime price the break-even point increased so that the price was reduced. A tax mechanism, which is aimed at cost prevention, works the same way. The tax mechanism aimed at cost prevention has underwent pilot testing in the experiment in new tax systems in science, conducted by the State Committee on Science and Technology of the USSR in 1990 and 1991. The Institute of Control Sciences of the Russian Academy of Sciences and Institute of Moscow television participated in the experiment in the anti-spending system of taxation. The experiment completely confirmed theoretical inferences. It was not profitable for the institutions to take customer's money, although according to the type of production they were monopolists. Unfortunately, this unique experiment was also forgotten because of the "Perestroika".

Let us give an example of another development mechanism of smart management. Those are evaluation mechanisms of the activities of the officials and managers at any level, encouraging an increase in efficiency of areas they are responsible for, and for innovative development in particular. Today many people talk about the need to evaluate the activities of managers and officials. But, in fact, nothing is changing. There is no well-functioning mechanism to reward workers either materially or morally. From our point of view, without such mechanism, it is unlikely to solve the efficiency problem of the economy. Along with this, there must be enough material motivation. If, for instance, the department the official is responsible for increased its efficiency, which brought, let us say, 1 billion rubles to the country's economy, then why not encourage officials by giving them a couple of millions (or even more)? The mechanism of activity assessment is necessary to combat corruption. On the one hand, there is effective work with both a big reward for efficiency and a moral reward (hero of labor, the best manager, a man of the year, etc.). On the other hand, there is a corrupt income minus the cost of the threat of imprisonment, confiscation of property and public condemnation. Thus, all we need is to make the first approach win over the second one and corruption will not be profitable.

The development mechanisms include methods for solving mathematical programming tasks: Kantorovich production task, different types of transportation tasks, tasks of dynamic programming, etc. [4]. As an example, let us consider a brief description of a classical transportation problem – a problem that describes the most efficient transportation plan of the homogenous product (or substitutional products) from the point of production to the point of consumption.

The economic and mathematical model of the transportation problem in general terms can be described as follows: there are m items of one kind of product and n consumers. For each consumer i there is an amount of production A_i, for each consumer j there is a need (demand) B_j, which is known (in the same measurement units). There are known costs c_{ij} that are due to the transportation of products from point i to point j.

It is necessary to make a transportation plan that provides the most efficient way (i.e. least transportation costs) and meets all the conditions of all consumers due to the implementation of goods produced by points of production.

Transportation plan appears to be a set of numbers x_{ij}, where x_{ij} indicates how many units of the product must be transported from i manufacturer to j consumer. Note also that the term "transportation costs" (c_{ij}) is not always attached to strict economic meaning. This may be distance, tariffs, time, fuel consumption, etc. Each task has a specific meaning of the coefficients c_{ij}.

The system of constraints is the following

$$\sum_{j=1}^{n} x_{ij} \le A_i \ (i = 1, 2, \ldots, m); \tag{5}$$

$$\sum_{i=1}^{m} x_{ij} \ge B_j \ (j = 1, 2, \ldots, n). \tag{6}$$

The system (5) includes vendor balance equations and the system (6) – consumer balance equations. Total transport costs are expressed as the following linear function which needs to be minimized.

$$F = \sum_{i=1}^{m} \sum_{j=1}^{n} x_{ij} \to \min. \tag{7}$$

A mathematical model of transportation problem in the general formulation is as follows: on the set of nonnegative solutions of a system of constraints (5), (6) one needs to find a solution $X = (x_{11}, x_{12}, \ldots, x_{ij}, \ldots, x_{mn})$, in which the value of the objective function (7) is minimal.

A simple modification of this model is a model of the appointment process. Specifically, there are m different specialists who need to be appointed for n jobs subject to that every job is done only by one specialist, and every specialist must do only one job. A specific measure that characterizes the output of the ith specialist if he/she gets the jth position is represented by the coefficients c_{ij} of the matrix C. When modeling such processes the Boolean variable x_{ij} is introduced:

$$x_{ij} = \begin{cases} 1, \text{ if the ith specialist is assigned to the jth position;} \\ 0, \text{ otherwise.} \end{cases}$$

The right parts of all constraints, in this case, are equal to 1.

$A_i = 1$ ($i = 1, 2, …, m$), $B_j = 1$ ($j = 1, 2, …, n$).

It is remarkable that unlike the transportation problem solution, an attempt to use optimal problem solving in the problem of appointment process led to the unexpected social consequences. Teams, where this strategy was used, were usually falling apart within three months; workers began to flee from there. The point is that the list of duties stayed the same every day. Thus, the optimal solution also did not change. Therefore, certain types of work were performed by the same workers, which resulted in significant wage discrepancies and made it difficult to improve skills for those who were interested in it. That is why the more "experienced" foremen keeping in mind team members' needs selected positions for some workers, and for the rest of the team and positions there was an appointment. The results, of course, were not optimal, but it was peace and quiet in a team. The optimal solution was used only during the crucial time, i.e. when it is necessary to show the highest productivity.

One can specify quite a lot of practical problems, solutions to which can lead to the solution of the problem of appointments (allocation of aircraft to airlines, allocation of minister positions, etc.).

By these and many other smart management mechanisms, as well as other developments of industrial consulting, The Institute of Control Sciences RAS and the consulting firm "ROEL-KONSALTING" have developed a unique integrated technology for increasing the efficiency of enterprises and regions. It is based on three grounds – a program-target approach, project management and the complex of smart mechanisms.

The program-target approach provides clear objectives and the development of effective programs to achieve them.

Project management studies a program as a project which is run by one team from its conception till its completion. In this area, it is worth mentioning some works of the scientists of South Ural State University [6]. The range of project management techniques is very broad: from the tasks related to the activities of individuals to projects involving hundreds of organizations and tens of thousands of people. Project management allows you to:

– generate a calendar plan to implement some complex of work;

– identify and mobilize time, labor, material and financial resources;

– manage a complex of work with forecasting and warning about possible breakdowns during work;

– improve the effectiveness of management as a whole with a clear distribution of responsibilities between the different levels of managers and contractors.

A complex of methods to increase the effectiveness of enterprises activity, a complex of smart management mechanisms, as well as modern models of project management can provide any industrial enterprise with a set of effective means and tools that allow owners and managers of this enterprise to realize their most ambitious plans and successfully develop even in difficult conditions of financial and economic instability. Summing up all of the above, it should be noted that new technologies in management are like new medication in medicine. Pharmaceutical companies spend a lot of money on long-term clinical trials of new drugs. Such trials are necessary for new technologies in management. They were carried out, and they are carried out along with the development of technology starting with the 1990s. Trials of the methods and technologies mentioned above at more than 150 enterprises of various scales and industries confirmed their effectiveness. The average revenue growth increased 1.5–2 times per year over 1.5–2 years. We are talking about a percentage of GDP growth, and here it is 150–200 % over 1.5–2 years. With no doubt, this is a significant result.

But with all this the question arises – why are there so few smart management methods and mechanisms that are used in practice? There are a few reasons for this:

1. The orientation of managers of industrial enterprises to short-term challenges that appear because of the socio-economic instability in the world, currency fluctuations, the complexity of defining the strategic priorities of enterprises, etc.

2. The lack of interest of managers of industrial enterprises in the implementation of methods and mechanisms of smart management, which is caused by:

– distrust towards consulting companies and many scientific developments over the period of 1990–2000s, preventing industrial enterprises from achieving significant positive results;

– the need to conduct a special inspection at enterprises by a group of management experts, who could choose and implement methods and mechanisms of smart management for specific industrial enterprises taking into account their way of thinking and other features in specific conditions of doing business;

– the absence of a sufficient number of professionals at the majority of the industrial enterprises who can face the challenges of implementing smart management methods and mechanisms, in other words, the need for additional training of such specialists.

Conclusion

In order to successfully implement smart management methods and mechanisms and conduct project activity efficiently at industrial enterprises, it is necessary to provide the highest quality of staff training for industrial enterprises, both in higher education and at various big industrial enterprises.

The Institute of Control Sciences of V.A. Trapeznikov RAS together with South Ural State University (National Research University) solves this problem at the modern scientific and practical levels. The program that is currently being prepared will allow to carry out this work, both with university students, and workers of industrial enterprises. This work is carried out under the supervision and with the direct participation of leading scientists of ICS RAS and SUSU. Soon there will be published papers and tutorials enabling the owners and managers of industrial enterprises to assess the scope of innovations that will be necessary in order to ensure the implementation of the new priorities, approaches, methods and mechanisms at the enterprises.

References

1. Burkov V.N., Novikov D.A. *Teoriya aktivnykh system:sostoyanie i perspektivy* [Theory of Active Systems: Status and Prospects]. Moscow, Sinteg Publ., 1999. 128 p.

2. Burkov V.N., Irikov V.A. *Modeli i metody upravleniya organizatsionnymi sistemami* [Models and Methods of Organizational Systems Management]. Moscow, Science Publ., 1994. 532 p.

3. Burkov V.N., Burkova I.V., Gubko M.V. *Mekhanizmy upravleniya:Upravlenie organizatsiey: planirovanie, organizatsiya, stimulirovanie, kontrol': uchebnoe posobie* [Management Mechanisms: Organization Management: Planning, Organizing, Motivating, Control: Tutorial]. Moscow, Lenand Publ., 2013. 216 p.

4. Venttsel E.S. *Issledovanie operatsiy: Zadachi, printsipy, metodologiya* [Operations Research: Objectives, Principles Methodology]. Moscow, Higher School Publ., 2008. 208 p.

5. Novikov D.A. *Teoriya upravleniya organizatsionnymi sistemami* [Theory of the Organizational Systems Management]. Moscow, Publ. House of Physics and Mathematical Literature, 2012. 604 p.

6. Gelrud Ya.D., Loginovsky O.V. *Upravlenie proektami: metody, modeli, sistemy: monografiya* [Project Management: Methods, Models, Systems: Monograph]. Chelyabinsk, South Ural St. Univ. Publ., 2015. 330 p.

7. Korennaya K.A., Loginovsky O.V, Maksimov A.A. *Integrirovannye informatsionnye sistemy promyshlennykh predpriyati: monografiya* [Integrated Information Systems of Industrial Enterprises: Monograph]. Chelyabinsk, South Ural St. Univ. Publ., 2012. 315 p.

8. Korennaya K.A., Loginovsky O.V, Maksimov A.A. *Upravlenie promyshlennymi predpriyatiyami v usloviyakh global'nou nestabil'nosti: monografiya* [Industrial Enterprises Management in Conditions of Global Instability: Monograph]. Chelyabinsk, South Ural St. Univ. Publ., 2013. 403 p.

МЕТОДЫ И МЕХАНИЗМЫ УМНОГО УПРАВЛЕНИЯ ПРОМЫШЛЕННЫМИ ПРЕДПРИЯТИЯМИ И ОРГАНИЗАЦИЯМИ

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На современном этапе управление промышленными предприятиями и организациями становится все более сложной задачей, ее решение старыми традиционными методами невозможно. В данной статье описываются методы и механизмы умного управления, способствующие повышению эффективности управления промышленными предприятиями и организациями. Данные механизмы сгруппированы следующим образом:

– неманипулируемые механизмы или механизмы, позволяющие добиться от работников правдивого отражения результатов своей деятельности;

– согласованные механизмы, при использовании которых исполнителям становится выгодным выполнять принятые обязательства или планы;

– советующие механизмы, которые разрабатывают рекомендации лицу, принимающему решения;

– развивающие механизмы стимулируют развитие промышленного предприятия (снижение издержек, внедрение инноваций и т. д.).

Анализируются причины, по которым до сих пор мало методов и механизмов умного управления используется на практике.

Ключевые слова: умное управление, неманипулируемые механизмы, согласованные механизмы, советующие механизмы, развивающие механизмы.

Литература

1. Бурков, В.Н. Теория активных систем: состояние и перспективы / В.Н. Бурков, Д.А. Новиков. – М.: Синтег, 1999. – 128 с.

2. Бурков, В.Н. Модели и методы управления организационными системами / В.Н. Бурков, В.А. Ириков. – М.: Наука, 1994. – 532 с.

3. Бурков, В.Н. Механизмы управления: Управление организацией: планирование, организация, стимулирование, контроль: учеб. пособие / В.Н. Бурков, И.В. Буркова, М.В. Губко; под ред. Д.А. Новикова. – М.: Ленанд, 2013. – 216 с.

4. Вентцель, Е.С. Исследование операций: Задачи, принципы, методология. – М.: Высш. шк., 2008. – 208 с.

5. Новиков, Д.А. Теория управления организационными системами / Д.А. Новиков. – 3-е изд. – М.: Изд-во физ.-мат. лит., 2012. – 604 с.

6. Гельруд, Я.Д. Управление проектами: методы, модели, системы: моногр. / Я.Д. Гельруд, О.В. Логиновский; под ред. д-ра техн. наук, проф. А.Л. Шестакова. – Челябинск: Издат. центр ЮУрГУ, 2015. – 330 с.

7. Коренная, К.А. Интегрированные информационные системы промышленных предприятий: моногр. / К.А. Коренная, О.В. Логиновский, А.А. Максимов; под ред. д-ра техн. наук проф. А.Л. Шестакова. – Челябинск: Издат. центр ЮУрГУ, 2012. – 315 с.

8. Коренная, К.А. Управление промышленными предприятиями в условиях глобальной нестабильности: моногр. / К.А. Коренная, О.В. Логиновский, А.А. Максимов; под ред. д-ра техн. наук проф. А.Л. Шестакова. – Челябинск: Издат. центр ЮУрГУ, 2013. – 403 с.

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