

## Estimation Procedure of Industrial-Engineering Communication (IEC)

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**Abstract:** This study has summarized some aspects of industrial-engineering communication estimation procedure. It has shown up faults of such effectiveness research methods as industrial analysis ratio forming part of the communication, game theory, input-output balancing. There has been proved the method industrial-engineering communication estimation procedure. The method consists of qualitative analysis of industrial-engineering communication and its effect on the level of transaction cost and enterprises value, effectiveness of such communication from the view of social and infrastructural development. Mathematical method is based on the functional analysis and calculating the flexibility of transaction cost function which are formed in the result of the industrial-engineering communication development.

**Key words:** Industrial-engineering communication, technological conversion, vertical integration, transaction cost, effectiveness, functional analysis, cooperation, enterprise value

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### INTRODUCTION

Industrial-engineering communication is a system of sustainable industrial, innovational, economic-organizing and managing relations between economic entities which form interrelated technological conversions. Thus, industrial-engineering communication is formed between vertically-integrated branches of economic both on the basis of long-term contracts and within the limits of corporate integration (Kramin *et al.*, 2014). Industrial-engineering communication pays a big bonus in increasing the share of high-value-added production of regional economic which favors the resolve of wide range of regional social and economic problems.

Other conditions being equal, cost-effectiveness of industrial-engineering communication is defined by the amount of levels and intensity of the production processing. The amount of level is a number of technological conversions of products. Intensity of industrial-engineering communication presents a share of production, arriving and being processed within the limits of the communication in the structure of the upper level of communication.

From the view of argumentation of the ways of production chain improvement it is important to point out the level of economic efficiency and to set out its key reserves for increasing. So, the aim of the research bases on argumentation of methods of quantitative estimation of production chains efficiency.

### MATERIALS AND METHODS

**Theory:** A number of researches show that industrial-engineering communications have direct influence on increasing of the end-production competitiveness and the enterprises capitalization. It also provides fast growth of whole regional economic together with industrial-engineering communication functioning within it (Bagautdinova *et al.*, 2013; Safiullin *et al.*, 2013).

Along with what has been stated there is no agreement of opinions about methodical tools which could help to estimate the effectiveness of industrial-engineering communication. The simplest method is financial coefficient using, particularly product profitability within and out of the limits of the communication (Harrigan, 1983). The method by Loyko *et al.* (2013) in the field of financial analysis suggests such methodical tool as “data-flow network” in formation of industrial-engineering communication. In our judgment the key disadvantage of this method regarding the effectiveness of industrial-engineering communication is that what financial coefficients do not take into account such strategic effects of the communication development as its effect on the enterprises value, social parameters, etc. The method of inter-industry balance should be used for researches of vertical economic integration and development of industrial-engineering communication (Miller and Blair, 2009). At the same time, in the framework of inter-industrial balance there is unresolved question about its optimization system which precludes estimation of effectiveness of inter-industrial development in the

field of industrial-engineering communication. From the view of institutional economics relations of inter-industrial communication represent a kind of microinstitute (Hofstede, 2010; Schotter, 1981). Accordingly, it is advisable to estimate the level of sustainability of formal and informal standards, regulating relations of its members, with the aim of reaching good effectiveness of industrial-engineering communication.

The analysis of effectiveness of industrial engineering communication can be made with the help of neo-institutional economics, particularly theory of games (Nicoleta, 2013). In this case, the communication may be deemed effective if its members have long-term relations in condition of balance and equality or at least consensus. Complexity of practical application of this method is correct formalization of strategies of economic behavior of all members of industrial-engineering communication which is important for equal balanced “game”.

## RESULTS AND DISCUSSION

The researchers suggests the method of assessment of efficiency of industrial-engineering communication development which consists of further stages:

**Stage 1:** Qualitative analysis of the communication such as economic agreement, providing sustainable deliveries between the enterprises of the communication, possible integral relations, actual contradictions and potential conflicts between the members. Detailed study of possible risks of further IEC development. Determination of the government’s role (national and regional authority as well as bodies of local self-government) in development and improvement of economic-organizing mechanism of IEC.

**Stage 2:** Analysis of transaction cost structure on different stages of IEC, definition of reasons of its formation and possibilities of minimization. It should be mentioned, that traditionally by transaction cost we mean any costs of an enterprise, connected with search and processing of economically significant information, property rights protection and securing effective contract relations (North, 1987).

It is necessary to point out that considerably less information exists in the literature on the problem of transaction cost analysis in conditions of economic relations formation and development within IEC than on the question of decreasing the level of operating costs in the result of the communication functioning. Particularly, Guriyanova *et al.* (2014) draw attention to the problem of transaction costs in the limits of technological

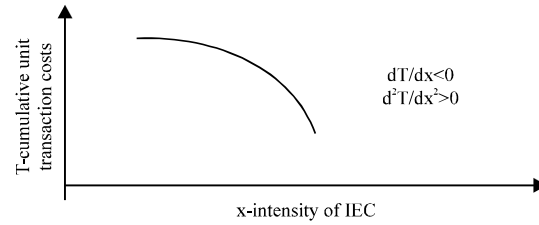


Fig. 1: Most preferred form of the dependence of the cumulative unit transaction costs on the intensity of IEC ( $T = f(x)$ )

communication of petrochemical complex of Russia but do not give methodical tools for evaluation its effectiveness (Gurianova *et al.*, 2014). On the whole, transaction costs in the limits of sustainable IEC might decrease in the directions as follows: reduction of search and processing cost of economically important information because of overall decrease of indeterminacy of contractual relations connected with the operation and development of the IEC, with reduction of IEC necessity in entering newly discovered markets and, accordingly, reduction of information and other costs associated with new markets. Decrease of legal costs associated with contractual relations within the framework of IEC as a result of reducing the risks of improper supply contracts execution and its payment. Reduction of possible corruption costs as an element of transaction costs in the case of greater transparency of information in economic relations within the limits of IEC.

However, irrationally organized IEC might not provide the minimization (moreover bring to increase) of transaction costs of its members, especially in such case if one or more companies are included in the communication are not influenced by economic expediency but by administrative enforcement of other more powerful members of the communication or regional authorities.

The most preferred form of the cumulative unit transaction costs dependence (the sum of transaction costs at all levels of the communication based on the volume of the end-product in a recent Technological conversion (T) on the intensity of IEC(s) is shown in Fig. 1. Thus, function of dependence of cumulative unit transaction costs on the intensity of IEC, ideally, should be decreasing and concave: intensity of the IEC increase should bring to rapid decline of cumulative unit transaction costs.

Petrochemical complex of the Republic of Tatarstan shall be taken as an example of impact of production chain intensity on change history of specific transaction costs (Table 1).

Table 1: Change history of specific transaction costs in dependence of intensity of production chain in petrochemical complex of the republic of Tatarstan, 2014 (on the materials of authors' own research)

Vertical integrated types of economic activity in industrial sector of the Republic of Tatarstan	Intensity of production chain	Specific transaction costs (%)
Petroleum production	100	4.9
Crude oil distillation	98	4.6
Refinery output	74	4.6
Chemical production	58	4.3
Plastics processing	43	4.1
Final plastic products production	42	4.1

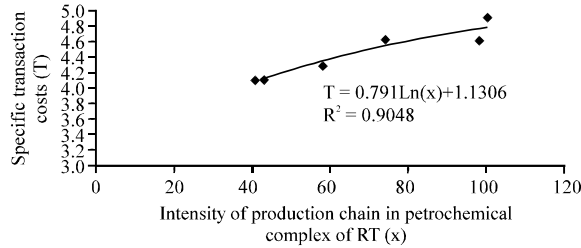


Fig. 2: A function of impact of intensity of production chain on the level of specific transaction costs in petrochemical complex of RT (on the base of table 1 by researchers)

The data in Table 1 gives a base to build function of impact of intensity of production chain on the level of specific transaction costs in petrochemical complex of RT (Fig. 2).

As it shown in Fig. 2, the slowly growing function is principally different from preferable one. As a matter of fact the growth of intensity of production chain in petrochemical complex of the Republic of Tatarstan brings to growth of specific transaction costs. It all goes to show poor efficiency of cooperative relations between independent levels of chain and necessity of its qualitative modernization (in particular, pass on inefficient distribution and dealer services) with the aim of decreasing of specific transaction costs as far as a chain grows.

**Stage 3:** Evaluation the IEC effectiveness from the point of transaction costs minimization. This assessment should be made by elasticity function investigation  $T = f(x)$  (Eq. 1):

$$Etc = -(x_1/T_1) \times (dT/dx) \quad (1)$$

Where:

- Etc = The IEC effectiveness from the point of the specific transaction costs minimization
- $T = F(x)$  = The function of dependence of the specific transaction costs on the IEC intensity
- $x_1$  = Value of the IEC intensity in the latter (reporting) period

- $T_1$  = Level of specific transaction costs in the reporting period
- $dT/dx$  = Value of the derivative function  $T = F(x)$  in the reporting period

**Stage 4:** Assessing the impact of the IEC intensity on the IEC enterprises value. The idea that the long term growth of the enterprise value is one of the most common criteria for the effectiveness of its financial and economic development is one of the dominant in the modern economic science (Koller, 2010).

It is clear that the entry of the company into IEC and its development within its framework has its influence on the enterprise value. In our opinion such effect is caused as well by increase of the operating efficiency of its activity as by improvement of liquidity and financial stability improvement, what positively effect on the potential for raising capital, its price, cash flows discounting value and other cost drivers. At the same time, however, it is crucial to the rational organization of the IEC which firstly and foremost means economically equitable and parity distribution of an additional economic benefit of its participants. We propose the measure of total cost multiplier of the IEC companies depending on its intensity level changes (Eq. 2):

$$M_c = (T_c/T_m) / (x_1/x_0) \quad (2)$$

Where:

- $M_c$  = Cost multiplier of the IEC companies depending on its intensity level changes
- $x_1$  = Alue of the IEC intensity in the reporting period
- $x_0$  = EC intensity level in the base period
- $T_c$  = Eal growth rate of the integrated IEC enterprises cost in the reporting period compared to the base period
- $T_m$  = Growth rate of the total enterprises value of similar fields of the economy in the market

Integrated IEC enterprises value might be determined either by market capitalization in condition of all of these companies have regular stock quotes or by valuations methods (method of economic value added EVA, profitable or analog approaches to business valuation).

As a basis for comparison ( $T_m$ ), there might be adopted any stock index companies of similar industries or some average values of the dynamics of the market value of companies within the IEC industries.

**Stage 5:** Evaluation of the IEC social effectiveness. It should be noted that the issues of the IEC impact on the social effectiveness is relatively unexplored. In our opinion, the development of social efficiency of any company can be reviewed in several ways: from the point of investment in human resources, the influence on the state budget formation and, accordingly, the development of social and other public programs as well as from the perspective of influence on the development of common household and engineering infrastructure (public roads, communications, etc.). Accordingly, we propose the following measure of the IEC social efficiency (Eq. 3):

$$E_s = (HK_1/HK_0) \times (TX_1/TX_0) \times (INF_1/INF_0) / (x_1/x_0) \quad (3)$$

Where:

- $E_s$  = Level of the IEC social efficiency
- $HK_1$  and  $HK_0$  = Average share of investment in human resources of the IEC companies for the reporting and base periods, respectively (The investment in the human resources, in addition to the payroll, includes social payments, corporate education costs, supplementary pension at the expense of the company, etc.)
- $TX_1$  and  $TX_0$  = Average share of taxes to the budgets of various levels of the IEC companies in the reporting and base periods, respectively
- $INF_1$  and  $INF_0$  = Share of investments on the social and engineering infrastructure development from the total investments of the IEC companies in the reporting and base periods

**Stage 6:** Calculation of the proposed complex index of the IEC development on the basis of multiplying of the considered indexes at stages 3-5, taking into account the relative profitability of products delivered into the IEC (Eq. 4):

$$K = (R_c/R_t) \times E_{tc} \times M_c \times E_s \quad (4)$$

Where:

- $K$  = A complex index of the IEC socio-economic efficiency
- $R_c$  = Average profitability of enterprises in terms of products supplied to the IEC
- $R_t$  = Average profitability of the IEC companies in general

**Stage 7:** Identification of the most significant reserves of the IEC efficiency of development increase. Such reserves can be determined on the base of the determination of dynamics of the complex index of the IEC efficiency ( $K$ ) and its constituent elements.

The elements (indexes) of the complex index which show satisfactory dynamics are suitable to taking actions in terms of improving organizational and economic relations in the framework of IEC, namely: in conditions of unsatisfactory dynamics of index ( $R_c/R_t$ ) it is suitable to mobilize the reserves for the IEC operating efficiency increasing (in terms of reducing transport and storage costs through joint development of the IEC companies, transport and logistics infrastructure, implementation or resource-saving technologies and other ways to reduce production and distribution costs).

In conditions of not entirely satisfactory dynamics of Etc index it is required system-defined targeted measures on reduction the level of specific transaction costs of IEC (improvement of economically significant information circulation between the participants of the communication, the establishment of joint planning and analytical center, unification of contractual relations, increasing of procurement transparency which reduces the risk of corruption, etc.).

Unsatisfactory dynamics of the  $M_c$  index requires implementation of measures on the IEC enterprises value increasing, in particular in the direction of increasing its investment attractiveness and improvement its investment image; unsatisfactory dynamics of  $E_s$  index requires joint implementation of programs on human resource development by the IEC enterprises (creation of a joint inter-enterprise university, the unification of social programs on human resource development, etc.).

## CONCLUSION

The proposed method of assessing the IEC effectiveness gives complex, on the basis of studies of operating, transactional and social efficiency of the IEC in the same coordinate axes and its impact on the value of its members, determination the IEC effectiveness and performance and substantiates the activities on efficiency improvement.

The developed method integrates economic and mathematical tools of neoclassical, neoinstitutional paradigms of economic theory as well as the modern concept of sustainable socio-economic development of production systems.

**REFERENCES**

- Bagautdinova, N.G., I.R. Gafurov and A.Z. Novenkova, 2013. The transformation of region's economic area governed by the development of industrial region. *World Appl. Sci. J.*, 25: 1113-1117.
- Gurianova, E.A., I.N. Gurianov and S.A. Mechtcheriakova, 2014. Analysis of the transaction cost in modern conditions. *Asian Soc. Sci.*, 10: 67-72.
- Harrigan, K.R., 1983. *Vertical Integration, Outsourcing and Corporate Strategy*. Beard Books Publisher, Frederick, Maryland.
- Hofstede, G., 2010. *Cultures and Organizations: Software of the Mind*. 3rd Edn., McGraw-Hill, New York, USA., ISBN:978-0-07-177015-6, Pages: 560.
- Koller, T., 2010. *Value: The Four Cornerstones of Corporate Finance*. Wiley, Hoboken, New Jersey, ISBN:978-0-470-42460-5, Pages: 272.
- Kramin, M.V., L.N. Safiullin, T.V. Kramin and A.V. Timiryasova, 2014. Drivers of economic growth and investment attractiveness of Russian regions. *Life Sci. J.*, 11: 526-530.
- Loyko, V.I., T.P. Baranovskaya and S.A. Boyarko, 2013. Streaming interaction of agricultural and processing enterprises of agroindustrial complex. *Polythematic Online Sci. J. Kuban State Agrarian Univ.*, 92: 1056-1075.
- Miller, R.E. and P.D. Blair, 2009. *Input-Output Analysis: Foundations and Extensions*. Cambridge University Press, UK., USA.
- Nicoleta, S., 2013. The theory of the firm and the evolutionary games. *Ann. Univ. Oradea*, 22: 533-542.
- North, D.C., 1987. Institutions, transaction costs and economic growth. *Econ. Inq.*, 25: 419-428.
- Safiullin, M.R., A.R. Safiullin, P.O. Ermolaeva and E.P. Noskova, 2013. Interdisciplinary approach to the analysis of the competitiveness types of the economic activities based on the example of the oil and gas industry (republic of tatarstan case). *Middle East J. Sci. Res.*, 18: 42-49.
- Schotter, A., 1981. *The Economic Theory of Social Institutions*. Cambridge University Press, Cambridge, England, ISBN:9780521230445, Pages: 177.