

**COLLECTIVE DECISION MAKING IN THE ENTERPRISE:
A THEOREM OF IMPOSSIBILITY**

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Features of system of decision-making at the enterprise play a determining role of activity of the enterprise. From in what interests, at what attitude to risk and on the basis of what mechanism of the coordination of priorities of interested persons strategic decisions at a microlevel - in interests of shareholders, managers, workers, creditors or other stakeholders, - not only a financial position of the enterprise, but also what will be the enterprise to a great extent depends, and together with them - all national economy (Stiglitz, 2001; Kleiner, 1994; Kleiner, 2008; Kachalov, 2009).

In the paper the model of functioning of the mechanism of the coordination and aggregation of priorities of participants of system of decision-making at the enterprise is offered. The general description of the multifactorial functions representing such mechanisms is proved. Natural indicators of relative power of each of participants of process of the coordination are defined. It is shown, that requirements of flexibility of action and universality of such mechanisms are inconsistent.

Each of participants of "groups of decision-making" has own preferences and individual "weight" or "bargaining power" in structure of decision-making. Between participants of process of the coordination of priorities there can be found both short-term, and long-term competitive relations. As a result, decision-making turns to process of the coordination of interests on the basis of a ratio of "powers" of all participants of the decision-making and aggregation of the priorities. Work of the mechanism of the coordination (aggregation, averaging, etc.) priorities in the formalized style one can present as follows. The fixed group $n \geq 1$ persons makes the joint coordinated decision concerning proportions of realization of $m \geq 1$ directions of activity of the enterprise. It is supposed, that intensity of activity of the enterprise on a direction j can be characterized in a quantitative scale some number $y_j, j = 1, \dots, m$. For example, if the question is process of distribution of net profit of the enterprise on three directions: on the investment into a fixed capital; expenses for research and development; payment of dividends, then $m = 3$, and y_1, y_2, y_3 express the sizes of the sums from the profit, directed on investments, research and development and dividends accordingly.

It is considered, that every i -th the participant of decision-making process ($i = 1, \dots, n$) has the priorities is relative intensities of realization of each pair directions. These priorities are expressed as a desirable ratio for the given participant $y_k:y_p$ between k -th and p -th coordinates of a final vector intensities of realization of directions, $k \neq p = 1, \dots, m$; these preferences are expressed as a m -dimensional vector $b_i = (b_{i1}, \dots, b_{im})$. In an above mentioned example of decision-making concerning distribution there arrived components of each of vectors b_1, \dots, b_n express desirable for the given participant distribution of the profit on the specified three directions. If the decision was accepted by one participant, $n = 1$, any vector $y = (y_1, \dots, y_m)$ proportional to a vector b_1 would be final; generally, at any number of participants $n > 1$, result of work of the mechanism of the coordination is a vector $y = (y_1, \dots, y_m)$, proportions of each which pair coordinates in the generalized kind reflect proportions between pair the same coordinates of vectors b_1, \dots, b_n .

As participants of decision-making process are interested only with proportions in realization of directions, it would be possible to introduce normalized vectors $b = b_1, \dots, b_n$ instead of vector $y = (y_1, \dots, y_m)$, however at statement of a task in substantial terms it is sometimes more convenient to deal with not normalized vectors intensities of realizations of directions in absolute values.

The final ratio between levels y_k and y_p as a result of work of the mechanism of acceptance of the coordinated decisions should be compromise, i.e. in any sense average from opinions of participants b_{ki}/b_{pi} . Thus, y_k/y_p depends from $b_{k1}/b_{p1}, \dots, b_{kn}/b_{pn}$: $y_k/y_p = f(b_{k1}/b_{p1}, \dots, b_{kn}/b_{pn}, \dots)$, where f - some function.

Let's assume, that comparison of pairs directions (k, p) and (r, q) at $(k, p) \neq (r, q)$ occurs independently, and during the coordination of priorities and p -to directions k and p priorities of each of participants only in relation to the same directions are taken into account. Generally work of the mechanism of the coordination can depend also on the order of carrying out of session of corresponding body. So, if for discussion are represented in the certain order of pair alternatives $(k_1, p_1), \dots, (k_T, p_T)$, results of the coordination of priorities for concrete pair (k_t, p_t) , $1 \leq t \leq T$, can theoretically depend on its position in a number of others. We, however, further shall assume, that dependence on the order of representation of pairs is not present. The mechanism of the coordination of the priorities, satisfying this and previous condition, we shall name *contextual - independent*.

Let's assume, that dependence on the order of representation of pairs is not present. We shall assume also, that the order of numbering of alternative directions and the order of presentation of alternatives of the coordination of priorities do not render influence on an essence of process of the coordination. In this case alternatives showed for the coordination are numbered with the help of the disorder pair (k, p) (such mechanism of the coordination we shall name *symmetric*).

If in addition to assume, as it and is done further, that the mechanism of the coordination does not depend on time (is *stationary*) for stationary contextual - independent mechanisms of the coordination agreeing functions can be written down as:

$$y_k/y_p = f_{kp}(b_{k1}/b_{p1}, \dots, b_{kn}/b_{pn}), k, p = 1, \dots, m, k \neq p.$$

Each function f should satisfy to a condition

$$\min(x_1, \dots, x_n) \leq f(x_1, \dots, x_n) \leq \max(x_1, \dots, x_n).$$

The mechanism satisfying this requirement, it is possible to name advantageous as in his frameworks no manipulation priorities will allow any of participants to leave for the interval, containing all declared priorities.

Let's formulate some more natural conditions with which should satisfy aggregating functions f_{kp} .

The above the priority x_i the participant I, $i = 1, \dots, n$, the should be the general final priority above (or, on less measure, is not lower). From the substantial point of view, it means, that between participants of process of decision-making there are no hostile or spiteful personal relations and their behaviour always is loyal under the relation to each other (we shall name such mechanism of decision-making *loyal*). We can note, that if the mechanism of decision-making is not loyal, one can not speak about the coordination of interests, and about conscious drawing damage to those or other participants of process as in this case increase of a priority direction k in comparison with direction p for some participant leads not to attempt to take into account it in final result, having increased it, and, on the contrary, to decrease in the general ratio between these intensities of directions. The condition of loyalty means, that functions $f(x_1, \dots, x_n)$ do not decrease on each argument x_1, \dots, x_n . Let's assume also continuity of function f and to name correspondent mechanism *continuous*.

The following two propositions describe structure of aggregating functions.

Proposition 1. Let $f(x_1, \dots, x_n)$ - the non-negative function not decreasing on every argument and determined on non-negative part of n -dimensional space. The following conditions are equivalent:

(i) $\min(x_1, \dots, x_n) \leq f(x_1, \dots, x_n) \leq \max(x_1, \dots, x_n)$ at any $x \in R^n_+$;

(ii) $f(\lambda, \dots, \lambda_n) = \lambda$ for every $\lambda \geq 0$;
(iii) there are non-negative functions $g_1(x_1, \dots, x_n), \dots, g_n(x_1, \dots, x_n)$, defined on R_+^n and satisfying a condition

$$\sum_{i=1}^n g_i(x_1, \dots, x_n) = 1,$$

such that function $f(x)$ can be represented a linear combination of the variables with variables x_1, \dots, x_n with coefficients $g_i(x_1, \dots, x_n)$:

$$f(x) = \sum_{i=1}^n g_i(x) x_i \text{ for every } x = (x_1, \dots, x_n) \in R_+^n.$$

Proposition 2. Let $F(x)$, $G(x)$, $H(x)$ - continuous non-negative not decreasing functions on R_+^n , satisfying condition $F(x_1, \dots, x_n) G(z_1, \dots, z_n) = H(x_1 z_1, \dots, x_n z_n)$ at any (x_1, \dots, x_n) , (z_1, \dots, z_n) . Then functions F , G and H coincide and look like multiplicate-dergee linearly homogeneous function

$$F(x_1, \dots, x_n) = G(x_1, \dots, x_n) = H(x_1, \dots, x_n) = x_1^{a_1} \cdots x_n^{a_n},$$

where $a_i \geq 0$, $I = 1, \dots, n$, - - constants, $a_1 + \dots + a_n = 1$.

This result can be formulated in style "theorems of impossibility" by K. Arrow (Arrow, 1951; 1963), Gibbard (Gibbard, 1973), and others.

We name the mechanism of the coordination of priorities *universal*, if it works with any number of priorities, and *continuous*, if all functions $f_{kp}(b_{k1}/b_{p1}, \dots, b_{kn}/b_{pn})$ are continuous. At last, we shall name the mechanism *flexible*, if it reflects of any changes in the ratio bargaining powers (which are understood as elasticities of a final ratio of intensities on change of it's initial ratio) of participants depending on external for given mechanism circumstances.

Using propositions 1 and 2 we can prove the following theorem of impossibility of the flexible accordance of the priorities in group systems of decision-making.

Theorem. Continuous, universal, loyal, flexible, contextual – independent and disadvantage mechanisms of the coordination of priorities in systems of decision-making do not exist.

The above mentioned results as a whole speak about limitation of the set of variants the construction of rational mechanisms of the coordination of priorities in systems of decision-making. It means, that practically all such variants can be inventoried and analyzed both with functional, and with institutional points of view, and the most effective - are fixed in internal rules of the enterprises and the organizations. In our opinion, it would raise) a management efficiency the enterprises, would lower a level of corporate corruption and would help Russia to leave for the too long stage of the "economy of physical persons" (Kleiner, 2001, 2002, 2008).

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