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**PERSONALITY BEHAVIOR IN A HIERARCHY BASED ON  
MUTUAL PERCEPTIONS**

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***Abstract***

Based on the analysis of management practices and the context of operational decision-making in a number of commercial and state organizations, the concept of mutual perception of people occupying positions in the hierarchical structure is formulated. The potential dynamics of the values of the personal and social aspects of perceptions is established. The specification of a simulation model of organizational behavior in a hierarchy is given. Decisions on belonging to organizational units (groups) are made by persons based on values of mutual perceptions. The driving force of individual and group behavior is the dynamics of mutual perceptions. The specification includes a list of model agents and their main attributes, the methods used, the scheme of information flows and the plan for the simulation experiment. The practical value of the study is that the results of a simulation experiment will allow us to develop practical recommendations for corporate HR and security services.

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**Keywords:** Hierarchy, person, perception, communication.



## **1. Introduction**

The issues of interpersonal compatibility and interaction in small groups were studied in (Abric, 2008; Tajfel, 1972). Studies of the phenomenon of social influence are given in the classical works (Tajfel, 1972; Tajfel & Turner, 1986; Turner & Oakes, 1986, 1989), as well as in (Bales, 1999; Worchel, 1998a; Worchel, 1998b). On this theoretical basis, based on an empirical base for observing a number of hierarchical structures in the work (Smarzhhevsky, 2019a) the concept of mutual individual perception in the hierarchy is formulated. The main content of the concept is as follows: a person occupying a position in a hierarchy reflects (perceives) in his mind other persons occupying positions in this hierarchy. The essential content of perception by person A of person B is completely exhausted by three aspects: personal perception, social perception and professional perception. These aspects are not reducible to each other.

## **2. Problem statement**

In the process of operational activity in the hierarchy, the composition of its formal and informal groups is changing. These changes are the result of the interaction of employees in hierarchy positions. Various types of interaction in the hierarchy were considered in a number of works (in particular (Gwinner, et al., 2005; Li et al., 2019; Mamoon, 2019; Mulyanto et al., 2018). However, the influence of the factor of their mutual perception on the organizational behavior of employees was not considered in these works. At the same time, the presence of such a factor is confirmed by the results of studies Mathwick and Mosteller (2016), Sumaneeva et al. (2018) and Zizhen et al. (2018). The problem that this work is aimed at is the development of the scientific apparatus necessary to study the influence of the factor of mutual perception of persons on organizational behavior in the hierarchy.

## **3. Research questions**

- What approaches to the study of the interaction of persons in the hierarchy are used in modern social science?
- Can simulation tools be used to reproduce organizational behavior in a hierarchy?
- What is the content of the specification model for the adoption of individual and group personnel decisions in the hierarchy?
- What simulation experiment allows you to conduct a model?
- What are the practical benefits of a simulation experiment?

## **4. Purpose of the study**

The purpose of this study is to develop the concept of perceptions and develop the specification of an agent-based model that describes the hierarchical structure occupied by operational activities. Persons (agents) whose behavior is described by the concept of mutual perception occupy positions in such a structure. Decisions on belonging to organizational units (groups) are made by persons based on values of mutual perceptions.

## 5. Research methods

The weak measurability of the values of the social and psychological properties of persons determines the research method: reproduction of the processes of interaction of persons in a hierarchy by means of simulation modeling and conducting a simulation experiment.

General approaches to the construction of agent-based models are contained in (Furian et al., 2015) (a conceptual approach to agent modeling based on tools representing hierarchically organized control systems), (García-Magariño et al., 2017), where discusses the technique of building simulation models and online systems for decision-making under uncertainty. In Xiong and Pu (2019), the principles of constructing models based on agent – action diagrams are considered. Close to the latter approach is agent-based model analysis using Causal Discovery given in (Janssen et al., 2019). The paper presents an algorithm for constructing a combined graph of causality of the parameters and outputs of the model, which allows revealing the emergent properties of the analyzed models.

Simulation models of managerial decision making in an organization are described in publications (Ashworth & Louie, 2002; Bendor et al., 2001; Fioretti & Lomi, 2008, 2010; Inamizy, 2009a, 2009b; Takahashi, 1997; Thorbjørn et al., 2012; Troitzsch, 2008), where the decision-making process is reproduced in the presence of an incoming stream of “problems” of varying degrees of complexity. The main result of this work is to confirm the significant impact of the type of organizational structure on the types of management decisions that are developed. A study of the relationship of the communication style with changes in the organizational structure is given in the model (Bela et al., 2018).

The properties of persons holding positions in the hierarchy are an essential factor. The influence of the individual characteristics of persons described by the Big Five model on the process of adaptation to the market environment is presented in (Bajwa et al., 2017). Group dynamics in teams of individuals united by strategic goals are explored in the work (Penagos-Londoño & Ruiz-Moreno, 2019). Farsi et al. (2019) use the modular hybrid simulation method to build a model that describes the behavior of complex production systems.

The first approximation to the construction of a model for the interaction of persons in a hierarchy is given in (Smarzhhevskiy, 2019b). This agent model was developed using the NetLogo simulation environment (Wilensky, 1999), the code and documentation are publicly available at [www.comses.net](http://www.comses.net) (Smarzhhevskiy, 2019c). The model is a simplified version of organizational behavior - it takes into account only personal perceptions of each other's personalities. Leaders based on personal perceptions carry out the formation of groups. The goal of managers is to maximize group productivity. Individual strategies of the agents include approaching positively perceived agents, which positively affects the productivity of groups, and distance from negatively perceived people.

The initial data for this study was the concept of individual perception (Smarzhhevsky, 2019a). Empirical objects, the analysis of managerial practices, which created the factual basis of the research, are as follows: a large financial organization with more than 200 thousand employees, an educational institution with a total of 6 thousand employees, an industrial enterprise with 3 thousand employees, a private enterprise of the SME sector with about 100 employees. The period of parallel monitoring of these organizations is more than ten years.

The factual material was also obtained in the course of a number of projects for large commercial and state organizations, such as TNK-BP, the Moscow government, JSC Transneft, JSC Severstal, JSC TyumenNII Giprogaz. The research method is the observation of managerial practices, the selection, systematization and comparative analysis of facts, the introduction of basic concepts and the formulation (refinement) of the theoretical provisions of the concept of perception.

The methodology for developing a model specification is based on methodological and instrumental principles for constructing simulation models (Furian et al., 2015; García-Magariño et al., 2017).

The essential content of perception by person A of person B is completely exhausted by three aspects: personal perception, social perception and professional perception. Personal perception is a "child" perception of a person as such, without regard to what role it plays in the organizational hierarchy. The value of social perception is the identification of the perceived (other person) on the one-dimensional continuum "the outgoing (from him) threat is the possibility of (his) use in his own interests". Professional perception is completely independent of personal. You can compile it simply by the publications and reviews of others about the results obtained by a certain person in the field of operational activities, and at the same time not have the slightest idea about her personal qualities. It is also possible, with a negative personal perception of a person, to pay tribute to her competence, professional qualities, achieved results, etc.

At each particular point in time, all three aspects of person A's perception of person B have some values. We introduce a scale with a minimum set of values: "positive - neutral value - negative." Denote the aspects of perception: C - professional (competence); P - personal (a person); S - social. Perceptions are tuples of the form {C, P, S}. In a minimal scale, each of the perceptions has the following potential values (for example, for C): C-- C- C= C+ C++.

The source of changes in perceptions is non-fulfilment or over-fulfilment by others of the obligations attributed to him by us. A role is a set of expectations of others regarding the behaviour of a role actor. Assigning a role to another, we establish some rules that must correspond to the behaviour of another. Inconsistency of role behaviour is updated at the time of violation of the assigned obligations. Such updating can be the result of both non-fulfilment and over-fulfilment (unexpected help, altruistic behaviour of another, etc.) of obligations. Awareness of inconsistency leads to a change in the values of perception.

The analysis of empirical data on managerial practices allowed us to develop the concept - to describe the potential dynamics of perceptions. Suppose the value of the professional aspect is constant (C (Competence) = const). In the Table 1 values of the social (S) and personal (P) aspects of perception with lower indices "+" correspond to positive perception, values with lower indices "-" correspond to negative perception, the neutral value of the scale in the table is omitted. Corresponding combinations of personal and social aspects of perception are numbered from 1 to 4.

**Table 01.** The implications of the social and personal aspects of perception

	S+	S-
P+	1	2
P-	3	4

Potential transitions indicated below as: "No. from > No. to").

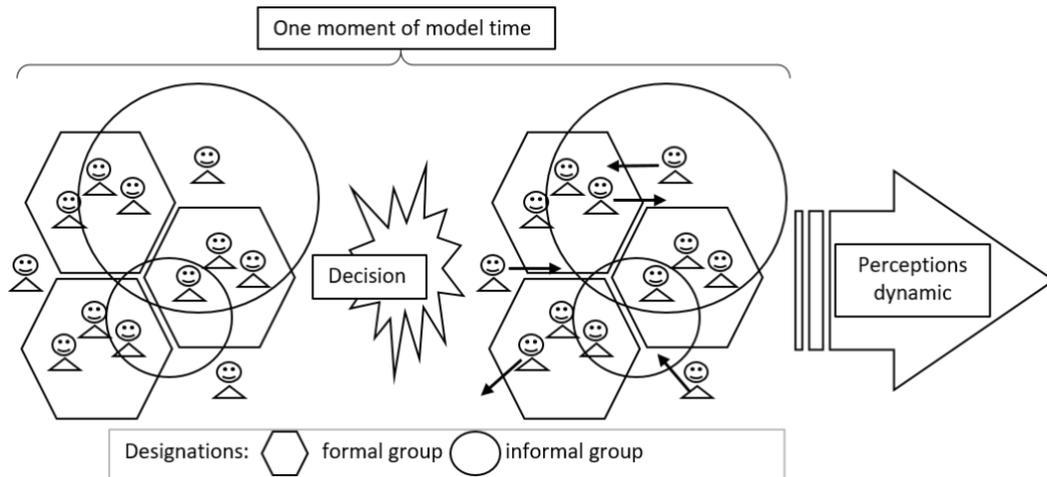
- Transitions  $1 > 3$  and  $3 > 1$  are possible and associated with a change in the purely personal perception of another.
- State 4 represents the perception of the person, from the position of which there is a threat to the perceiver. The transition  $4 > 2$  is unlikely, because it corresponds to the masochistic type of personality. The transition  $4 > 3$  is possible (social perception is inverted from S- to S+ in the event that the perceiver managed to “turn” the situation). Transition  $4 > 1$  is unlikely, because difficult to explain psychologically.
- State 2 is unlikely, as it represents a positive attitude towards the oppressor, which corresponds to the masochistic type of personality. This state is unstable: the route  $1 > 2 > 4$  is possible (betraying me by others leads to state 2, but my personal perception of the other by inertia remains positive for some time).
- The transition  $1 > 4$  is possible: a person whom I previously positively perceived in a personal aspect (socially) betrayed me.
- The transition  $2 > 1$  is possible (the return of moral debt, in which the former debtor consciously allows himself to be used. Perhaps the cyclical transitions  $1 > 2 > 1$  are most characteristic of good personal relationships (under the condition of "weak" fluctuations around the neutral meaning of social perception).
- The transition  $2 > 3$  is possible (liberation from oppression as a result of certain actions of another person or a change in her position in the hierarchy).
- The transition  $3 > 4$  is quite likely: another “turned” the situation (against the background of my negative personal perception of him).
- Transition  $3 > 2$  is extremely unlikely psychologically. The only explainable trajectory from state 3 to state 2 is the path  $3 > 1 > 2$ .

These are all possible types of transitions between states of perception in the coordinates “Personal - Social” with a constant value of the professional aspect of perception. Understanding this dynamic makes it possible to develop an agent model specification.

## 6. Findings

The specification of the model is given in aggregate, only the main elements of the model are described and the main attributes of the agents are indicated. In the process of implementing the model, refinements and changes required by a particular modeling technology can be made. When modeling perceptual values, instead of a discrete scale ( $C- C = C+$ , etc.), a continuous - numerical scale will be used.

The “world” of the model is a two-level hierarchical structure consisting of the positions of managers and operators. The key elements of the model are agents (persons) occupying positions in the hierarchy, two types of associations of agents (formal and informal groups), the process of changing perceptual values, and a decision module (Figure 01).



**Figure 01.** The main elements of the model  
 Source: Compiled by the author

Persons possess values of their own personal and social perceptions of each other. The main attributes of the agents are shown in Table 2. When modeling perceptual values, a continuous scale will be used instead of a discrete scale (C- C= C+, etc.).

**Table 02.** Key Agent Attributes

Attribute	Variable type	Value Comment
Personal perception of others	Numeric (a set of several values according to the number of agents in the hierarchy)	Positive perception by person A of person B corresponds to a positive numerical value, negative perception - negative.
The social perception of others	Numeric (a set of several values according to the number of agents in the hierarchy)	Positive perception by person A of person B corresponds to a positive numerical value, negative perception - negative.
Supervisor (Head, Manager)	Logical	Yes or no. Status that allows you to be the leader of a formal group.
Formal Group Number	Numeric	An agent can be a member of only one formal group or not belong to any group
Informal Group Number	Numeric	An agent may be a member of one or more informal groups or may not belong to any group
Charisma	Numeric	Determines the degree of activity (vitality) of a person. Affects individual decisions.

The values of mutual perceptions of most agents, as shown by analysis of empirical data, change relatively slowly. However, in some cases, they can undergo an inversion: the value of perception of one agent by another (by others) changes the sign and magnitude of the module. The process of changing the values of perceptions can be implemented in two ways. The first, more detailed, is to directly model the interaction of agents, in which one agent sends an informational message to one or more others. Upon receipt of such a message, the value of the perception of the sender by other agents may change. The intensity and content of messages is determined by the current perceptions of the sender and, in the simplest

case, his charisma. A more detailed option is to describe the personal properties of a person with additional attributes, for example, based on the Big Five personality model.

This specification uses a second, less detailed, way to model dynamics. The values of perceptions directly change. Their dynamics can be implemented 1) as weak fluctuations relative to the initial values, 2) as a slow limited increase in values in absolute value with the same sign, 3) as a combination of rules 1 and 2. And, 4) as a random process in which changes are more likely to behave according to rule 3 and, with a low probability, the personal and / or social perceptions of part (one or more) agents by others change their sign to opposite.

The block for the development of personnel decisions includes the following types of decisions:

- Individual decision to leave the formal group (D1).
- Individual decision to join a formal group (D2).
- Decision of the manager to exclude a person from the formal group (D3).
- Association of persons in an informal group (coalition) based on their mutual social perceptions (D4).
- The exclusion of individuals from the informal group (coalition) based on their social perceptions by the majority of the informal group (D5).
- A group (coalition) decision to exclude a person from the formal group (D6) by influencing the manager of the group in order to impose decision D3 on him.
- Group (coalition) decision to exclude the manager from the formal group (D7).

The decision block is launched at each step of the model time and generates solutions D1-D7 when the condition  $CR_{D_i}(\text{Const}, \{P, S\}_j, Ch_j, j=1, n) = \text{TRUE}$  is fulfilled. Here  $CR_{D_i}$  is the decisive rule for the type of solution  $D_i$ ,  $\{P, S\}_j$  – are sets of personal and social perceptions of the agent with number  $j$ ,  $Ch_j$  is charisma of the agent with number  $j$ ,  $n$  is the total number of agents in the model. Const - parameters (numerical values) specifying the operation of the decision block. In the process of a simulation experiment, a variation in the parameters is possible. The decision can be made based on the current state of perception values (agents are deprived of memory) or based on historical data (agents have memory). In the second case, the process of changing the values of perceptions becomes an essential factor in the model. At a particular moment in model time, a block of decisions can develop several solutions or not develop a single solution.

The goals of the simulation experiment is to study the dynamics of the composition of groups and to identify the relationship of the distribution of perceptions across multiple agents with the types of staffing decisions that are developed. The study of group productivity from the values of perceptions and individual productivity of agents in this edition of the model is not planned.

Simulation Experiment Plan:

- Stage 1. Setting up the model. The formation of data sets that specify the initial values of perceptions that determine the specific structure of formal and informal groups. Data collection

by types of worked out personnel decisions. Verification of decision making from a given perceptual profile.

- Stage 2. Realization of the initial values of perceptions of agents as random variables with variable distribution parameters. Collection of statistical data on the types of worked out personnel decisions. Identification of the dependence of types of decisions on the distribution parameters of perceptions.
- Stage 3. Investigation of the influence of types of dynamics of perceptions on the occurrence of sets of values of perceptions leading to one or another type of decision. Collection of statistics on types of perceptual dynamics. Identification of the dependence of types of decisions on types of dynamics of perceptions.

## 7. Conclusion

The obtained results expand the approach used in the study of the types of employee interactions in the operational process and their impact on organizational behavior presented in (Gwinner et al., 2005; Mathwick & Mosteller, 2016; Mulyanto et al., 2018; Mamoon, 2019; Li et al., 2019; Sumaneeva et al., 2018; Zizhen et al., 2018). The potential dynamics of the values of mutual perceptions has been identified above, the specification of the model is given, and the plan of the simulation experiment is presented. The content of operating activities in such a review is not detailed. The developed model specification allows you to technically implement the agent model and conduct a simulation experiment.

The practical value of this study lies in the fact that the data sets obtained as a result of a simulation experiment that are characteristic of specific types of solutions will have prognostic properties. Based on their typing, it will be possible to formulate practical recommendations and tools for corporate HR and security services. Such tools will make it possible to predict — in the presence of measurable perceptual data — the occurrence of potential situations in the organization's landscape of perceptions that generate specific decisions about moving people around the positions of the organizational structure.

The difficulty in using such an instrument lies in the fact that the service using it will be forced either to evaluate the values of personal and social perceptions of employees of the service itself, or to exclude them from consideration, distorting the picture of the organization as a whole. Also, assessing the values of personal and social perceptions of top management can be a difficult task. The owners of the company (supervisory board or management structure of a higher level than the hierarchy being evaluated) should authorize the HR service to perform such an assessment or top management should also be excluded from consideration.

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