

A. Overview	A.1. Purpose	This is a model of organizational behavior in the hierarchy in which personnel decisions are made.
	A.2. Entities, state variables and scales	
	<i>Agents/individuals</i>	Agents in the model are persons, units, which forms a hierarchy, and coalitions.
	<i>Spatial units</i>	Spatial units in the model are absent, in the sense that space (World) is used for visualizing the relations between units (hierarchy structure) and between units and persons (person placed on unit or no).
	<i>Environment</i>	In the model there are no affecting (external) forces that drive the behavior and dynamics of all agents.
	<i>Collectives</i>	Collectives in the model are the departments (group of units subordinate to one boss) and coalitions. The goal of hierarchy is to increase total productivity of persons on units. The goal of persons is to increase value of units which they occupy.
	A.3. Process overview and scheduling	<p>The World of the model is a four-level hierarchical structure, consisting of shuff positions of the top manager (zero level of the hierarchy), first-level managers who are subordinate to the top manager, second-level managers (subordinate to the first-level managers) and positions of employees (the third level of the hierarchy), subordinated to the second-level managers. Such a hierarchy is a tree, i.e. each position, with the exception of the position of top manager, has a single boss.</p> <p>Agents in the model are persons occupying the specified positions, the number of persons is set by the slider (HumansQty). Personas have some operational performance (<i>harisma</i>, an unfortunate attribute name left over from the first edition of the model)) and a sense of other personas' own perceptions. Performance values are distributed over the ensemble of persons according to the normal law with some mean value and variance.</p> <p>The value of perception by agents of each other is positive or negative (implemented in the model as numerical values equal to +1 and -1). The distribution of perceptions over an ensemble of persons is implemented as a random variable specified by the probability of negative perception, the value of which is set by the control elements of the model interface. The numerical value of the probability equal to 0 corresponds to the case in which all persons positively perceive each other (the numerical value of the random variable is equal to 1, which corresponds to the positive perception of the other person by the individual).</p> <p>The hierarchy is occupied with operational activity, the degree of intensity of which is set by the external parameter Difficulty. The level of productivity of each manager OAIIndex is equal to the level of productivity of the department he leads and is the ratio of the sum of productivity of employees subordinate to the head to the level of complexity of the work Difficulty. An increase in the numerical value of Difficulty leads to a decrease in the OAIIndex for all subdivisions of the hierarchy. The managerial meaning of the OAIIndex indicator is the percentage of completion of the load specified for the hierarchy as a whole, i.e. the ratio of the actual performance of the structural subdivisions of the hierarchy to the</p>

		<p>required performance, the level of which is specified by the value of the Difficulty parameter.</p> <p>A specific hierarchy, the behavior of which is investigated in the course of a simulation experiment, is characterized by the following parameters:</p> <ul style="list-style-type: none"> • number of persons and positions (hierarchy structure is set by sliders (sliders Lev1Units, Lev2Units, Lev3Units set quantities of units in level 1, 2 etc. and sliders L0to1Dist, L1to2Dist, L2to3Dist set distance from level 0 unit and level 1 units etc.); • the <i>value</i> of positions (increases linearly with a decrease in the level from the third to zero), which is the amount of remuneration for the work of a person in this position, and thus the value of a particular position for a person; • percentage of positions occupied by persons at the initial moment of the experiment (FirstDistrDensity); • probability of negative perception of other persons by persons (ProbNegPercept); • individual performance of persons (<i>harisma</i>); • prohibition or absence of a prohibition on repeated (after release) occupation of positions by persons (OneTimeAsgn switch). <p>Decisions are:</p> <ol style="list-style-type: none"> 1. D_VoluntaryDismissal (mutual perception influences the decision) 2. Decision_EU_IB_FH (mutual perception influences the decision) 3. Decision_EU_IB_BH (mutual perception influences the decision) 4. D_DismissWorst 5. D_GetAnySuborder4L3 6. D_GetGoodSuborder4L3 (mutual perception influences the decision) 7. D_ReplaceSuborder4L3onFreeHuman (mutual perception influences the decision) 8. D_Pass2NoBossUnit 9. D_Pass2FrendLev3 (mutual perception influences the decision) 10. D_Pass2FrendSameLevel (mutual perception influences the decision) 11. D_DownGradeOrDismiss (mutual perception influences the decision) 12. D_DownGradeWorstBoss 13. D_UpGradeBestBoss <p>The idea of the model is that the hierarchy does some operational work and is described by such characteristics as structure (number and interrelation of positions) and material, filling these positions (persons with their individual performance). A particular hierarchy is under certain external pressure (performance level requirement) and is characterized by the internal state of the material (the distribution of the perceptions of others over the ensemble of persons). Let some types of personnel decisions be allowed and the rules for their adoption are indicated (availability of solutions for positions of one level or another, performance criteria, local</p>
--	--	---

		<p>distribution of perceptions). Let's call a control scenario a set of personnel decisions together with the regulations for their adoption.</p> <p>Key Scenarios (set by change ScreenPlay):</p> <ul style="list-style-type: none"> • "Inaction" ("SP5 No Control"). Only individual solutions are allowed (## 1-3). Managers do not make decisions about subordinates. • "Chaos" ("SP4 (Random)"). Individual decisions ## 1-3 are allowed, in addition, managers randomly, with equal probability, make one of the decisions ## 4-13. • "Dictatorship" ("SP2 (3 Points Ctrl)"). Individual decisions ## 1-3 are allowed, in addition, managers make one of the decisions ## 4-13, depending on whether the current value of the OAIindex performance index falls into one or another range of values specified by the GradeL < GradeM < GradeH parameters. Thus, depending on the current value of OAIindex, managers vacate positions from less productive performers and replace them with more productive ones, guided, among other things, by the personal perception of subordinates. The intervals of performance values are set by the GradeL, GradeM, GradeH sliders. <p>A series of simulation experiments (see BehaviorSpace) is designed to give an answer about the influence of the control scenario on the performance of certain types of hierarchy under various initial conditions.</p> <p>You can create a coalition - a group of people in which mutual perceptions are positive.</p> <p>The number of coalitions is set by the CoalitionsQty slider. If you set (at SETUP) the switch AgressiveCoalition ON, coalitions will become "aggressive", in the sense that their members will negatively perceive everyone who is not a member of this coalition.</p> <p>The model allows you to collect statistics on the number of decisions made, on the performance of individual groups of agents, track the career path of any agent (positions occupied by him during the experiment and the time spent in positions), the number and types of decisions made at different levels of the hierarchy, etc. Try run experiments (see BehaviorSpace). Parser.xls for extracting data from table output file is attached.</p>
B. Design concept	B.1 Theoretical and Empirical background <i>Basic principles.</i>	<p>The model represents the second approximation to the implementation of the concept of mutual perception in the hierarchy formulated by the author in the works:</p> <ol style="list-style-type: none"> 1. Ivan Smarzhevskiy. The concept of mutual perception of persons in a hierarchy. Journal of Economy and entrepreneurship, 2018, Vol. 12, Nom. 12, p. 1120-1124. (И.А. Смаржевский, Концепция взаимного восприятия персон, занимающих позиции в иерархической структуре. // Экономика и предпринимательство. 2018. № 12. С.1120-1124). <p>Abstract. The issues of mutual perception of persons holding positions in the hierarchical organizational structure engaged in (some) operational activities are considered. Theoretical concepts have been introduced and provisions have been formulated that reveal the interconnections of the individual perception of each other by persons. Aspects (sides) of perception are established,</p>

		<p>scales of measurement and potential values of aspects of perception are defined. The significance of aspects of perception is revealed depending on the relative positioning of the positions of the perceiving and perceived persons in the hierarchy. The basic statement of the concept is formulated: 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.</p> <p>2. Ivan Smarzhevskiy. The development of the concept of mutual perception of persons in a hierarchy: the dynamics of perceptions. Journal of Economy and entrepreneurship, 2019, Vol. 13, Nom. 1, p. 830-833 (И.А. Смаржевский, Развитие концепции взаимного восприятия персон в иерархической структуре: динамика восприятий // Экономика и предпринимательство. 2019. № 1. С. 830-833.)</p> <p>Abstract. The work develops the concept of mutual perception of persons holding positions in a hierarchy engaged in (some) operational activities. The potential dynamics of the social and personal aspects of perceptions are investigated. As applied to the simplified case (the professional aspect of perception is accepted unchanged), the most probable combinations of personal and social perceptions are defined and the probable ways of changing such combinations are established (routes in the “personal x social” perception matrix). The second main statement of the concept is formulated: in the case of individual personnel decisions, the dynamics and mutual influence of aspects of the person’s perception, which is the object of the decision, the decision maker determines the content of the (personnel) decision itself.</p> <p>The first approximation to the implementation of the concept of mutual perception in the hierarchy is “Organizational behavior in the hierarchy model” (Version 1.1.0). Ivan, Smarzhevskiy (2019, June 18). CoMSES Computational Model Library. Retrieved from: https://www.comses.net/codebases/3a538672-cc55-497c-8f9c-1f3a9522fcd1/releases/1.1.0/</p>
	<i>Emergence</i>	<p>Some results of the experiment:</p> <p>1) in a comfortable environment (moderate operational load, mostly positive interpersonal perceptions), the formal management scenario (“Dictatorship”) gives the best result in terms of productivity of the hierarchy as a whole. The inaction of managers (approving incoming applications for positions according to the criterion of a positive personal perception of the candidate) and the random choice of a personnel decision (“Chaos”) according to this criterion differ slightly.</p> <p>2) in an aggressive environment (high operational load, mostly negative interpersonal perceptions)</p> <ul style="list-style-type: none"> • inaction of leaders does not contribute to the growth of productivity of the hierarchy as a whole; • a random selection of a personnel decision from a predetermined list gives better results than inaction; • the scenario of control on a formal basis (“Dictatorship”) gives the best result in terms of productivity of the hierarchy as a whole.

	B.2. Individual decision making (<i>Adaptation</i>)	
	<i>Objectives</i>	<p>The goal of persons is to increase value of units which they occupy. The goal of hierarchy is to increase total productivity of persons on units, but the hierarchy is not agents in this model. The goal of the hierarchy is achieved by the implementation of different management scenarios by managers (persons, placed on units) of levels 0, 1 and 2.</p> <p>Overall hierarchy Performance Indicators are measured quantitatively and are available to the survey in the model interface (plots, figures on World window and digitals in Observer window, see B.5. Observation section for details).</p>
	<i>Learning</i>	Persons have and at each tick update the list of target (desired) units (<i>MyObjectives_list</i>). Units maintain a list of persons previously assigned to them (<i>history_list</i>), which allows you to prohibit the re-assignment of a person to a position.
	B.3. Individual prediction	Individuals do not predict future condition.
	B.4. Stochasticity	<p>The value of the productivity (attribute <i>harisma</i>) of persons is defined as a random variable that has a normal distribution (distribution parameters are set by the control elements of the interface).</p> <p>Initial agent's coordinates in the World is random value.</p>
	B.5. Observation	<p>Reports:</p> <ul style="list-style-type: none"> • Total Productivity (for humans un units versus theoretical productivity (for the hierarchy) max, plot) • Productivity Per Human (mean for humans un units and free humans versus total mean productivity, plot) • FreeUnits (plot) • OAIndex by Levels (plot) • PowerPerHuman (mean Value of positions occupied across coalitions, plot) • Productivity on Units (personal productivity distribution, plot) <ul style="list-style-type: none"> • Decisions 1-13 quantity (screens) • Free units by levels (screens) • LastChangeTick, Total ChangesQty, Units quantity (screens) • Total free units and persons (screens) <ul style="list-style-type: none"> • Subsets of units, button (Departments, Heads, coalition's objectives, Unit (by who)) (output to the World window) <ul style="list-style-type: none"> • Data about some result of run, collected by such procedures (buttons) as DecisionsbyLevels, ShowHumansHistory, ShowSuborders, Show Personal Objectives and so on (numbers in Observer window).
	B.6. Implementation Details	<p>The world topology is a "torus".</p> <p>Lists are used to remember career history and store time series.</p> <p>Service variables are used to transfer values from one context enclosed in brackets [] to another.</p> <p>The model code itself does not contain any fragments of an innovative or particularly instructive nature, it is quite trivial.</p> <p>The model is coded in Netlogo 6.2.2, Open source and available on CoMSES (https://www.comses.net)</p>

C. Details	C.1. Initialization	The SETUP button forms hierarchy, set level of operational load on the hierarchy, number of persons, set perceptions, control scenario selection, some control parameters, percentage of positions initially filled and presence of coalitions.
	C.2. Input data	The model does not use input data to represent time-varying processes.
	C.3. Submodels	
	setup	The SETUP button forms hierarchy and set perceptions (ProbNegPercept slider), control scenario choice (ScreenPlay), three-point control parameters (GradeL, GradeM, GradeH), and FirstDistrDensity.
	go	Implements the simulation process. The GO button keeps the model running until ticks less value of LastTick slider. The procedure calls one or another control script (depending on the choice in ScreenPlay), calls procedures that are performed at each tick, calls data collection and diagnostic procedures at the end of the experiment.
	Decisions cathegory	Indidividual
		The first two decisions are initiative from below, allowed if the flag is set <i>Initiative</i>
	Decision_EU_IB_FH	Empty Unit Is Boss (person on boss unit) Free Human (as applicant) Decision maker level: 0,1,2 S (Source): free humans D (Destination): Random Empty unit, sub ordered to some Boss (there is The Person on Boss Unit) C(Condition): If Switch PerceptON is TRUE, then positive Perception by the Boss of the applicant. If FALCE, then no condition
	Decision_EU_IB_BH	Empty Unit Is Boss (person on boss unit) Busy Human (as applicant) Decision maker level: 0,1,2 S: busy human, who search empty unit (with Boss) with value more than current unit value D: no assignment to unit C: positive Perception by the Boss of the applicant
	VoluntaryDismisial	S: busy human D: no assignment to unit C: the sum of the perceptions of neighbors (Boss, subordinates and colleagues - units subordinate to the same Boss) is less than zero
	Decisions cathegory	Dismisses
	D_DismissWorst [BossWho]	Decision maker level: 0,1,2 Boss (Human with who equal to BossWho), placed at some unit (at any Level), dismiss the worst person from sub ordered Units S (Source): humans, placed at sub ordered to BossWho Units D (Destination): no assignment to unit C(Condition): min OAIndex from BossWho suborders
	Decisions cathegory	Replacing
	D_Pass2NoBossUnit [BossWho]	Decision maker level: 0,1,2 Boss (Human), plased at some unit, pass worst person from suborders to unit (at the same level as current suborder's one), which has't the Boss Pass person to the same Level as it placed now

		S: busy humans, sub ordered BossWho D: Empty units, without Boss C: min OAIndex (ONLY!!!! no perception conditions, coalitions etc.)
	D_Pass2FrendLev3 [BossWho]	Decision maker level: 0,1,2 !!! Boss pass worst person from suborders to unit, led by a boss that he perceives negatively S: busy humans, sub ordered BossWho D: Empty units, with Boss C: min OAIndex, negative current Boss perception of new Boss
	D_Pass2FrendSameLevel [BossWho]	Decision maker level: 0,1,2 Boss (Human), placed at some unit, pass worst person from suborders on the same level to unit, led by a boss that he perceives negatively S: busy humans, sub ordered BossWho D: Empty units, with Boss C: min OAIndex, negative current Boss perception of new Boss
	Decisions cathegory	Down/Up grades
	D_DownGradeOrDismiss [BossWho]	Decision maker level: 0,1 Pass person WITH NO SUBORDERS (then OAIndex = 0) to the next down Level then it placed now, OR if no empty units for him, dismiss him S: busy humans, sub ordered BossWho D: Empty units, of next Level, sub ordered to BossWho or no assignment to unit C: min OAIndex
	D_DownGradeWorstBoss [BossWho]	Decision maker level: 0,1 Pass person to the next down Level then it is now (from 1 to 2 level, for example) S: busy humans, sub ordered BossWho D: Empty units, of next Level, sub ordered to BossWho C: min OAIndex
	D_UpGradeBestBoss [BossWho]	Decision maker level: 0,1 <i>For Calling from Level 0 and Level 1 units</i> Pass person to the next up Level then it is now S: busy humans, sub ordered to suborders of BossWho D: Empty units, sub ordered to BossWho C: max (on the level) OAIndex
	D_GetGoodSuborder4L3 [BossWho]	Decision maker level: 2 Search person to the empty unit at Level 3 or free human S: free and busy (at Level 3) humans D: Empty units of Level 3 C: free human with harisma > HarismaMean and Perception (of new Boss) = 1 OR (if we have not free human): OAIndex > 1, Perception (of new Boss) = 1 and Perception New Boss of old Boss (if exist) -1 and Perception Applicant of new Boss = 1 (he agrees to pass to new unit) OR (if we have not yet a candidate): First and Second conditions, OR only First
	D_GetAnySuborder4L3 [BossWho]	Decision maker level: 2 Find any free person to assign to the unit S: All free humans D: Empty units of Level3 C: No!!!!

	D_ReplaceSuborder4L3onFreeHuman [BossWho]	Decision maker level: 2 Replacing an employee with a minimum OAIndex with a free employee with greater productivity, and positively perceived by the boss. The old employee is released from the unit. S: person on unit with min OAIndex, free human with Perception (of Boss) = 1 and harisma > harisma of person on Unit now D: Units of Level3 C: min OAIndex, Perception (of Boss) = 1 and harisma > harisma of person on Unit now
	Key properties of agents	
		<i>Harisma</i> is person property, productivity Normally distributed random variable N (70 10).
		<i>PerceptOfOther</i> is person property - list (with two possible values values -1 and 1) of my (person's) perception of other humans (in order of their who).
		<i>MyObjectives_list</i> is person property - list of units the person wants to occupy.
		<i>Site</i> is person property – <i>who</i> of unit occupied by the person or -1.
		<i>PersonID</i> is unit property – <i>who</i> of person assigned to unit or -1.
		<i>Value</i> is unit property – value of unit.
		<i>Power</i> is unit coalition – sum of <i>values</i> of units, occupied by persons at the current tick
	Key global variables	
		<i>InfluenceRadius</i> – global variable (value set by slider) 1) the distance to which the released person moves away from the position (including when solving VoluntaryDismissal), i.e. for visualization purposes. 2) the distance at which a person searches for level 3 positions (position reachability area) in the SetPersonalObjectives procedure to be included in the list of their targets <i>MyObjectives_list</i> .
		<i>HumanList</i> – global variable, some procedures put a list of persons into it, others read this list.
	Procedures called from SetUp	
	SetHumans	Creates the number of persons specified by the slider HumansQty .
	SetCoalitions	Creates the number of coalitions specified by the slider CoalitionsQty .
	AssignPerceptions	Sets the mutual perception of persons according to the probability of negative perception ProbNegPercept .
	SetCoalitionPerceptions	Sets (for all existing coalitions) mutual positive perception to members of the same coalition. If the switch AgressiveCoalition is ON, coalitions will become "aggressive", in the sense that their members will negatively perceive everyone who is not a member of this coalition.
	SetUnits	Creates top manager unit and number of units in a hierarchy specified by the sliders Lev1Units , Lev2Units , Lev3Units (quantities of units in level 1, 2, 3) and sliders L0to1Dist , L1to2Dist , L2to3Dist distances from level 0 unit and level 1 units etc.).
	AssignTop	Assign human on unit with level 0.
	AssignHeads	Assign humans to all (no matter of FirstDistrDensity) Head's Units.

	AssignSuborders	Assign humans to units with level = 3 regardless of the value FirstDistrDensity
	AssignAnyUnits	Assign humans to all level Units in according with FirstDistrDensity
	AssignOnlySubs	Assign humans to units with level = 3 in according with FirstDistrDensity Procedures Assign... can be used in different combinations, now only procedures AssignTop and AssignAnyUnits are called in the model code.
	Procedures called on every tick	
	MeanCalculation	Calculates the average productivity of persons assigned to units.
	OAICalculation	Calculates the value of OAIndex. If the index is less than a given level, then the head of the department changes, dismisses, looks for a new subordinate, etc.
	TotalPowerCalc	Calculates the sum of the values (Value) of the positions occupied by each of the coalitions and the sum of the unit's values for all persons who are not in coalitions.
	SetPersonalObjectives	Sets the personal goals of persons (units in the hierarchy that the person wants to occupy). Free persons in the list MyObjectives_list can have positions of any level, because the numbers of the desired positions are added to this list. Those. when a person occupied a position of the 3rd level, he remembered the position of the 2nd level in the list and, after dismissal, the number of this position was saved in the list.
	PerceptSum4UnitCalc	Calculates the sum of the perceptions of other personas by the person holding the position. It is performed for all positions occupied by persons on this tick.
	Procedures, launched at the end of the run	
	PersonsDoublingUnits	Diagnostic procedure. Checks the correctness of the algorithm (the absence of double assignments).
	UnitsDoublingPersons	Diagnostic procedure. Checks the correctness of the algorithm (the absence of double assignments).
	DecisionsbyLevels	Collects statistics at the end of the experiment.
	Result	Collects statistics on the performance indicators of the hierarchy.
	Buttons	
	ShowHarismaByLevels (Button)	Calculates the average productivity by hierarchy levels at the current moment (by busy units).
	ShowHumansHistory (Button)	Shows the person's career history (appointment decisions, units numbers, etc.)
	ShowUnitsHistory (Button)	Shows the history of the unit in the hierarchy (appointment decisions, person numbers, etc.)
	ShowSubset (Button)	Shows a subset of the agents (by the number entered in the box AgentWho) selected from the procedure menu.
	ShowPerceptions (Button)	Shows how people perceive each other.
	ShowSuborders(Button)	Shows the subordination structure throughout the hierarchy: person numbers (or -1 if the unit is not occupied by a person) by units. Shows the subordinates (Who of persons and units).
	OA Indexes (Button)	Shows OAindex by hierarchy levels (OAICalculation procedure).
	DecisionsbyLevels (Button)	Shows the number of decisions made at different levels of the hierarchy

	ShowHumansList (Button)	Shows the numbers (<i>who</i>) of persons and units surrounding the given (by the number of unit entered in the box AgentWho) unit (manager, subordinates and colleagues - units subordinate to the same leader).
	ShowCoalitionsResults (Button)	Show OAIndexes and who of units and persons by levels for coalitions (if exist).
	PersonsDoublingUnits (Button)	Diagnostic procedure. Checks the correctness of the algorithm (the absence of double assignments).
	UnitsDoublingPersons (Button)	Diagnostic procedure. Checks the correctness of the algorithm (the absence of double assignments).
References		<p>Ivan Smarzhevskiy. The concept of mutual perception of persons in a hierarchy. Journal of Economy and entrepreneurship, 2018, Vol. 12, Nom. 12, p. 1120-1124. (И.А. Смаржевский, Концепция взаимного восприятия персон, занимающих позиции в иерархической структуре. // Экономика и предпринимательство. 2018. № 12. С.1120-1124).</p> <p>2. Ivan Smarzhevskiy. The development of the concept of mutual perception of persons in a hierarchy: the dynamics of perceptions. Journal of Economy and entrepreneurship, 2019, Vol. 13, Nom. 1, p. 830-833 (И.А. Смаржевский, Развитие концепции взаимного восприятия персон в иерархической структуре: динамика восприятий // Экономика и предпринимательство. 2019. № 1. С. 830-833.)</p> <p>If you mention this model or the NetLogo software in a publication, we ask that you include the citations below. For the model itself: Ivan Smarzhevskiy (2022). Personnel decisions in the hierarchy. https://www.comses.net/codebase-release/b4ca1801-b048-4568-93dc-70d56087cc5f/</p> <p>Please cite the NetLogo software as: * Wilensky, U. (1999). NetLogo. http://ccl.northwestern.edu/netlogo/. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.</p>