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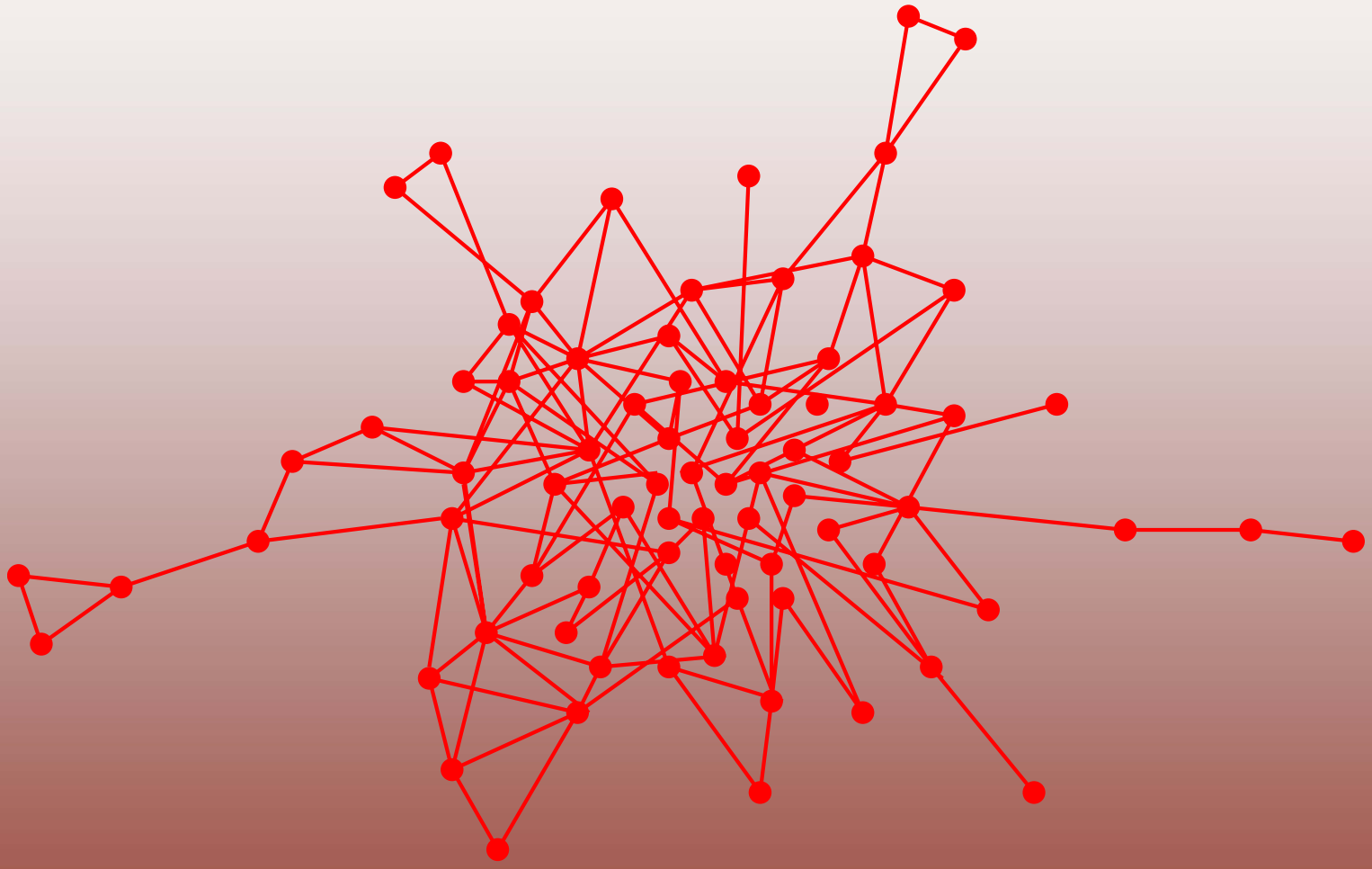

Conflict Cascades and Self-Organized Criticality in Dynamic Networks

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Scientific articles

Conflict Cascades and Self-Organized Criticality in Dynamic Networks

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Abstract

The complexity of human social structures often masks the simplicity involved in their development. Social networks are a product of dynamic processes and feedback. In other words, the ties that people make affect the topology of a network and the form of a network affects the ties that people make. Therefore, social network structure evolves in a path-dependent manner. In this paper, we begin to sift through the complexity of social network ties in an effort to unearth the fundamental rules of social interaction and their impact on network formation and evolution.

1. Introduction

The complexity of human social structures often masks the simplicity involved in their development. Social networks are a product of dynamic processes and feedback. In other words, the ties that people make affect the topology of a network and the form of a network affects the ties that people make. Therefore, social network structure evolves in a path-dependent manner.

We have all witnessed social turmoil in our midst – or even have been involved in its very middle. A long-married couple decides on a divorce – and suddenly their friends are faced with difficult decisions.

They may feel pressured to side with one partner or the other, potentially splitting long-standing friendships and dividing a formerly cohesive network into “his side” and “her side”. As the wounds of the split-up heal, the space is opened up for creation of new friendships and romantic relationships, and the cycle starts again. The example above illustrates several concepts. The first is the ability of change in network structure - particularly change of a destructive nature – to propagate through a network, potentially affecting a large number of people. Second, the network reacts

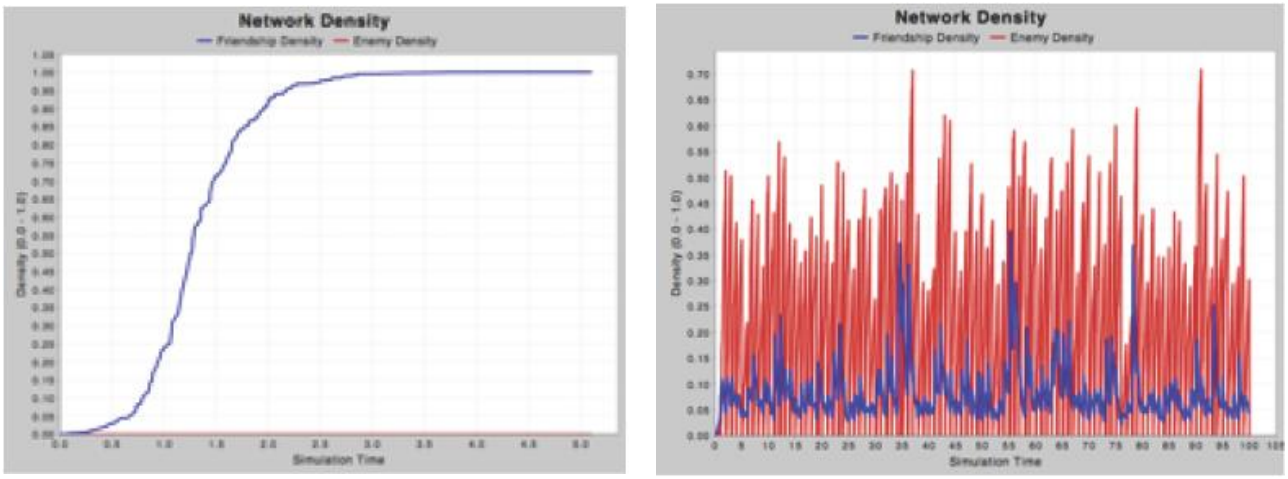
to addition and deletion of edges in qualitatively different fashions, depending on its density, undergoing a phase transition [1]. Finally, it has been observed [2] that networks in the real world settle to a certain density, suggesting the presence of a dynamic equilibrium [3].We hypothesize that conflicts play a regulatory role in social networks and help establish and maintain this dynamic equilibrium.

Considerable research [4-6] has centered on the generative processes of network creation. Such processes range from purely random models [7] to generation of small-world networks [8] and scale-free networks [9]. While methods of network generation and results vary widely, these methods have one common property: they consider only processes that add or change edges of the network. Although the generative processes that create giant component networks are theoretically valid, in real-world networks the forces responsible for this formation are mitigated by an unknown resistance. As the generative and resistance forces attempt to balance, the system enters and oscillates around a dynamic equilibrium. In this paper, we would like to consider the role of destructive processes, such as tie extinction and outright conflict, as an equally important influence upon network topology.

We implement a simple agent-based model to explore the complexities of network structures and the consequences of conflict upon these structures. We are interested in the micro-level mechanisms that produce the macro-level patterns observed in real-world networks.

The agent-level rules are based on the structural balance theory [10], derived from Heider's balance theory [11]. Balance theory suggests that people, from the perspective of the individual, have a preference for balance. Unbalanced structures occur when the primary individual perceives a dissonance between their affect and that of other objects. The agents address this dissonance through a change in affect and, thus, the network structure.

A simple triadic rule set can form the basis of a complex social network whose structure is dependent on the stability of the linkages: newly added actors or linkages act as generative processes (i.e. a couple's friends becoming friends) that percolate throughout the network. Similarly, conflict, which acts as a resistance process, may cause a relationship to reverse and can trigger a chain reaction, restructuring a network. Agents react to changes to their friendships and conflicts with a set of simple rules of triadic interaction:



(a) Growth of network density under Rule 1 regime (no conflict)

(b) Growth of network with both Rule 1 and Rule 2

Fig. 1. Network growth (a) without and (b) with conflicts

Rule 1 A friend of my friend is my friend (*Simmelian tie* [12])

Rule 2A An enemy of my friend is my enemy (*social balance* [10])

Rule 2B A friend of my enemy is my enemy

Rule 2C A enemy of my enemy is my friend[1]

Rules 2A, 2B, and 2C actually represent the same balanced triad containing two conflict links and one friendship link – with the only difference being identity of the node invoking the rule.

Thus, we can simplify the agent behavior to the following statement:

[1] Attributed to: the Bible (Exodus 23:22 and Matthew 22), ancient Chinese and Arab proverbs. Most likely, as old as the world.

Each node shall seek to be embedded in balanced triads that are either fully connected *Symmelian triads* (**Rule 1**) or *conflict-balanced triads* (**Rule 2**).

2. Simulation Model

To study the effect of conflict on the topology and density of networks, we propose a simple computational model: an agent-based version of a highly simplified social network. The model serves as an experimental environment using four "social rules" previously described.

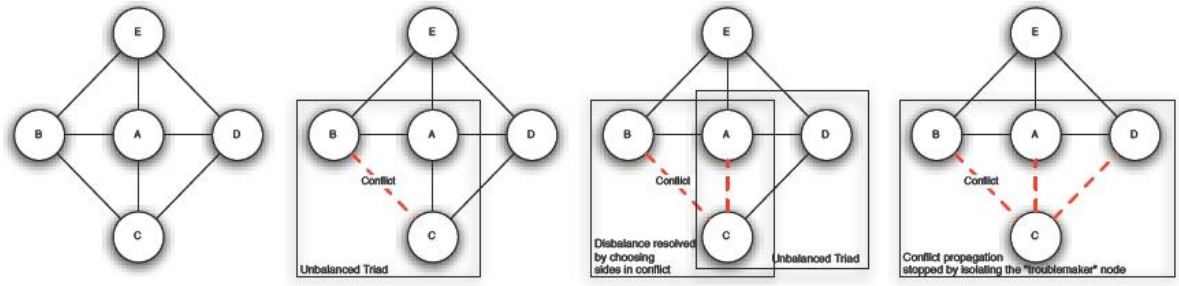


Fig. 2. Propagation of Conflicts in a Dense Network

The base model consists of a static set of 100 agents, with Poisson scheduling. Initially, edges are added at random, thus generating an Erdos random graph [7], with density growing at a linear rate proportional to the probability of edge addition.

2.1. Phase transition from linear to exponential growth

At every activation, agents fire Rule 1 and attempt to close any of the open triads they are embedded in (i.e. "Friend of a friend is my Friend"). As density grows, an increasing number of friend-of-friend triads begin to connect into balanced triads and the growth of network density accelerates dramatically.

After network density passes a certain critical amount, the growth regime of the network shifts from linear to exponential, marking our first phase transition. In

absence of conflict, our model produces a sigmoid curve of network density growth (fig. 1). As network density approaches 1 (i.e. a fully connected graph), the growth slows due to lack of available open triads that can be closed.

2.2. Conflict Propagation

Conflict is introduced in the network at a constant probability, by changing a single friendship tie into an enemy tie. What happens then is illustrated on figure 2. In this simple example, a network consisting of 4 closed triads is struck by a conflict on a single edge.

Table 1

Network Density Parameter Settings

Parameter	Experiment		
	A	B	C
Probability of making new friends	0.90	0.33	0.50
Probability of meeting friends friends	0.90	0.33	0.50
Probability of assessing a friendship	0.90	0.10	0.10
Probability of conflict	0.01	0.01	0.01
Probability of conflict decay	1.00	0.75	0.50
Probability of friendship decay	0.00	0.75	0.50

Triad A – B – C becomes unbalanced due to a conflict between B and C; thus A is forced to take sides in the conflict by choosing to remain friends with either B or C, at random. Adding conflict to the A – C edge forces another triad, A – C – D to become unbalanced, thus drawing agent D into the conflict. If agent D then chooses to isolate C from the rest of the network, the propagation of the conflict can be stopped. However, if instead it separates from A, this will cause the conflict to propagate further and destroy more links.

Having more ties increases an agents probability of forming even more ties, but also increases the probability that a conflict between two agents spread throughout

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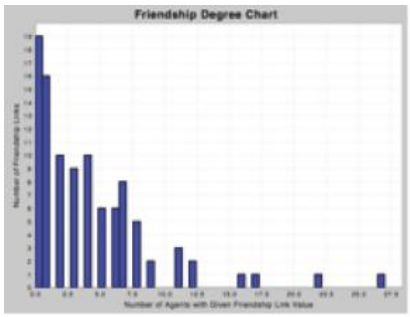
the network. Thus, percolation of both friendship and conflict is dependent upon the density and timing of agent connections.

3. Simulation Experiments

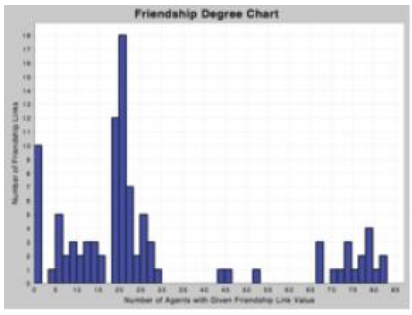
Our model allows us to experiment with a number of conflict- and friendship-based probability parameters: 1) the probability of making a new friend, 2) the probability of meeting your friends friends, 3) the probability of conflict occurring between yourself and one of your friends, and 4) the probability of assessing your current friendships to check for conflict amongst your friends.

The above result is found by observing the node degree distribution at the point just before the onset of conflict. We see in figure 3 that as the network cycles between formation of ties and conflict propagation, its degree distribution cycles from *lognormal* during periods of low conflict and high growth, and *PowerLaw* during periods of relative calm.

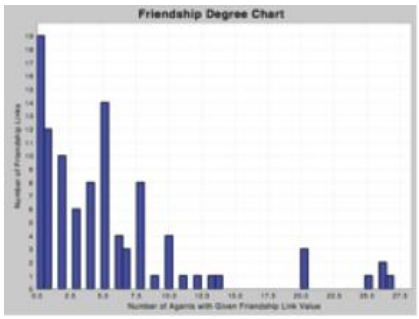
In other words, we observe self-organized criticality in terms of node degree distribution and a fluctuation of network density around a critical point that is highlighted by the structural phase transitions.



(a) Node degree distribution before minor conflict percolation



(b) Node degree distribution before medium to high conflict percolation



(c) Node degree distribution following large percolation of conflict

Fig. 3. Propagation of Conflict in Networks – Effect on density and distribution of degrees

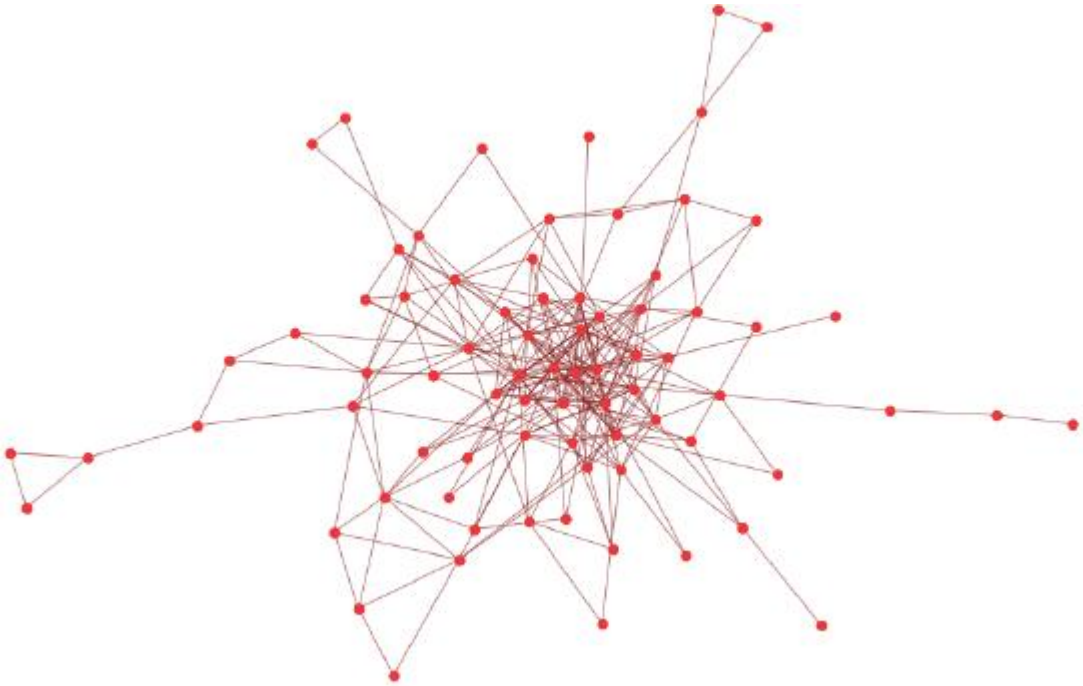
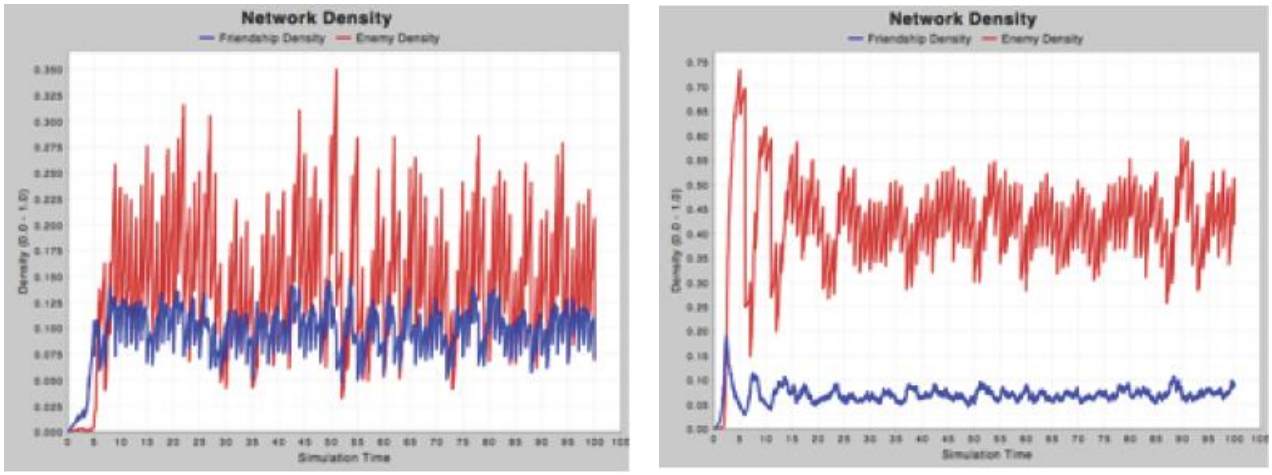


Fig. 4. Typical Network Shape in low-conflict phase

3.1. Sensitivity Analysis

Now that idea of conflict percolation and phase transition has been introduced, we can now turn to experimenting with the conditions needed to produce realistic conflict percolation and realistic network structures as a result of this conflict percolation. In the results from figures 3 and 4 above, we see two important and realistic features of network evolution present within this run. First, we see the a Power Law node degree distribution of friendship links throughout the simulation except for periods just before a large conflict. Second, we see a prominent critical density point. Upon reaching this point, the network settles in a dynamic equilibrium balancing introduction of new friendships and ongoing conflicts.



(a) **(b)**

Fig. 5. Sustainable network density at realistic parameter levels

In figure 3.1a, we see that a critical point around 0.10 can be observed given quite different parameter settings. Figure 3.1 shows a similar result with even more moderate friendship fluctuation and higher friendship probabilities and lower decay probabilities. Therefore, these two results show that realistic conflict percolation can certainly develop within our model under conditions that would also be empirically plausible.

4. Conclusion

In this paper, we demonstrate a simple agent-based simulation methodology that integrates destructive processes – conflicts – into the fabric of network evolution.

We also demonstrate two phase transitions in development of networks. The first phase transition occurs as network moves from linear growth and normally distributed degree (a-la Erdos) to exponential growth and power-law distributed degree of scale-free networks. This phase transition is precipitated by a single rule, and occurs at a critical density independent of network size or rate at which nodes are added.

At the same time as nodes are added, a conflict may strike a random pair of nodes with a constant probability. These conflicts propage through the network by

agents seeking to be embedded in balanced triads. Thus in dense network structures a single conflict can possibly produce a large-scale avalanche of propagating conflict ties. Alternate periods of rapid growth and destruction signal a new phase transition - from a growing network to one that oscillates around a dynamic equilibrium while maintaining a relatively stable density. The densities achieved through our simulation strongly mimic these found in empirical networks.

We demonstrate that the resulting network has strong core-periphery features and a power-law distribution of degrees, yet is derived from a socially justifiable process. We also demonstrate that conflict is strongly localized and the scope of its propagation is Power Law distributed.

References

1. Newman, M., Barabasi, A.L., Watts, D.J.: The Structure and Dynamics of Networks. Princeton University Press., Princeton, NJ (2006).

2. Kumar, R., Novak, J., Tomkins, A.: Structure and evolution of online social networks. In: Proceedings of KDD-2006. (2006).

3. Leskovec, J., Faloutsos, J.K.C.: Graphs over time: Densification laws, shrinking diameters, and possible explanations. In: 11th KDD. (2005) 177-187.

4. Tsvetovat, M., Carley, K.: Generation of realistic social network datasets for testing of analysis and simulation tools. Technical Report Technical Report CMUISRI-05-130, Carnegie Mellon University, School of Computer Science, Institute for Software Research International (2005).

5. Frantz, T., Carley, K.M.: A formal characterization of cellular networks. Technical Report CMU-ISRI-05-109, Carnegie Mellon University School of Computer Science Institute for Software Research International (2005).

6. Roth, C.: Generalized preferential attachment: Towards realistic socio-semantic network models. In: ISWC 4th Intl Semantic Web Conference, Workshop on

Semantic Network Analysis. Volume 171 of CEUR-WS Series (ISSN 1613-0073)., Galway, Ireland (November 2005) 29-42.

7. Erdos, Renyi: On the evolution of random graphs. Publication of Mathematics Institute of Hungian Academy of Sciences 5 (1960) 1761.

8. Watts, D.J., Strogatz, S.H.: Collective dynamics of "small-world" networks. Nature (393) (1998) 440-442.

9. Albert, R., Barabasi, A.L.: Statistical mechanics of complex networks. Review of Modern Physics 74(1) (2002) 47-97.

10. Doreian, P., Kapuscinski, R., Krackhardt, D., Szczypula, J.: A brief history of balance through time. Journal of Mathematical Sociology 21(1-2) (1996) 113-131.

11. Heider, F. Perspectives on Social Networks. In: On Balance and Attribution. Academic Press, New York (1979).

12. Krackhardt, D.: The ties that torture: Simmelian tie analysis in organizations. Research in the Sociology of Organizations 16 (1999) 183-210.

Difficulties of Artificial Intelligence Project

© *A. Yu. Alekseev (Moscow)*

Introduction

The issues of Artificial Societies (AS), presented in JASSS[1] and «Artificial Societies» journals[2] open wide perspectives for computer modeling of cultural, political, social, economic, moral, and other aspects dealing with human society. Methodology and applied methods for creating models of societies dwell on parameters for interacting agents. «Love», «power», «money», «truth» and other socially coded constituencies of «inter-subject» inter-agent relations influence both the way in which agents are represented as personalities, and the process of artificial personality creation. Therefore, an urgent issue is the study of artificial intelligence topic in the course of artificial society problem. The above issue was outlined in the very development of philosophy for artificial intellect in the middle of the 20th century. It was particularly reflected in the search for an answer to the question: «Can computer become a personality?» This question began to be actively discussed at least 15 years ago at symposiums and conferences, and in many articles and publications. A special field of inter-disciplinary research, called «artificial intelligence project» emerged, as well. The main purpose of this paper is to acquaint the reader with this project, as it is usually not mentioned in the Russian philosophic science. Another goal of the paper is to outline difficulties and problems, which arise within the study of «personal» abilities of computer systems.

The emergence of the project may be largely explained by societal factors: recently, it is impossible to analyze complex intellectual information and technology systems just in the technical framework, as they have gained socio-cultural, human-metrics dimension. Present and future cognitive computer systems are to be regarded in the context of social values, world-outlook, moral imperatives, legal norms,

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[1] The Journal of Artificial Societies and Social Simulation (JASSS) http://jasss.soc.surrey.ac.uk/JASSS.html

[2] Quarterly journal «Artificial Societies». Laboratory for artificial societies, http://www.artsoc.ru

aesthetic canons, and other components of spiritual character. The demand of post-neoclassic change of methodology for studying, constructing and developing complex systems, which was proposed in Russian philosophic science, became urgent.[3] This was the subject of the talk by Academician V.S.Syopin at one of the regular meetings of the seminar «Philosophic and methodological problems of artificial intellect» (October 31, 2007), organized by Scientific Council on artificial intellect methodology (Russian Academy of Sciences). However, the process of artificial intelligence emergence is largely explained by inner technological factors, i.e. the developments in artificial intellect. This is reflected in a systematically consistent shift from modeling pure intellectual activity to modeling consciousness. In their turn, cognitive computer models of consciousness are regarded as conceptual and realization basis for personification of intellectual information systems.[4]

Definition of artificial personality. Artificial personality (AP) is a cognitive computer system, which has 1) *«quasi consciousness»*, e.g. functional resemblance of human subjective reality; 2) functionally, behaviorally and/or physically is *indistinguishable* from human personality.

The first criterion of AP is sustained, mainly, by the adherents of strong artificial intellect. They think that in order to realize complex self-organization of computer system and adaptive behavior under inner and outer environment dynamics, it is necessary to single out a special "quasi consciousness" (or sometimes called pseudo consciousness) block within the system's architecture. The role of this block is comparable to the role of consciousness in the life of conscientious feature. This block should accomplish projective, introspective, qualitative and other relations with outer and inner environment. Such a criterion is justified in the context of computerism paradigm, which is also called "functionalism of Turing machine",

[3] Styopin, V.S. (1991). Scientific rationality in humanitarian dimension. In: On Human in Humans. Frolov, I.T., ed. Moscow. (In Russian).
[4] Alekseev, A.YU. (1998). Humanism, personalism and informatics (on general theory foundations of modeling artificial intelligence. *Zdravyi Smysl (Common Sense)*. No.3/7, p. 52-56.

"functionalism of artificial intelligence, or "computable consciousness theory". Plausibility of proposed criterion, however, is shaking due to many reduction steps: personal is reduced to mental; mental – to intellectual; intellectual – to structural and functional architecture of a computer. Formal dependencies of intellectual activity, which are formed in relations between cognitive and computer components, are set with the help of simulation experiments, operations and functions. Causal dependencies of these relations are most generally described in implementation aspects of Turing machine. Calculation is regarded broadly, as combination of two approaches: representative, which models data and knowledge in the subject field; and connectional, modeling dynamics of neural system. The obtained integral representative and connectional coding structures are operated by the means of quail algorithm processing. As a result of multi step reduction we have computational formulation of Artificial Intelligence (Personality) project: *personal calculation is in fact quasi algorithmic*.

The second AP criterion, defended by the followers of weak intellect, the indicator for «indistinguishability» of natural and artificial personality becomes the ability of a system to pass full *Turing test* (TT)[5]. Besides verbal and communicative, perception and movements, anatomic and physiologic and (in certain types of TT) microphysical indistinguishability of artificial and natural systems, this tests fully incorporates externally observed indicators of spiritual life for personal activity, i.e. personal parameters. They include «purpose», «freedom», «love», «responsibility», «right», «creativity», «beauty» etc. Plausibility of the second criterion, as well, as that of the first one, is problematic. Here the link between the inner world of a person and its revelation is particularly unclear. Behaviorism faced the similar problem almost a century ago. In spite of the obvious merits of behaviorism in abolishing meta physics

[5] Alekseev, A.YU. (2006). Possibilities of artificial intelligence: is it impossible to pass Turing tests. In: Interdisciplinary Approach. Dubrovsky, D.I., Lektorky, V.A., eds. Moscow, IintelL, p. 223-243

of mental beings, methodological mistakes of behaviorism, found in the course of strong critics of liability of the method for assessing cognitive activity on the basis of observing actual behavior and on the basis of assumed behavior, are obvious.

In these conditions of problematic character for assessing computer systems as artificial personality systems, modern processes are developing.

Variety of artificial personality projects. The history of artificial intellect philosophy may be shown to be the history of discussing possibilities for computer realization of personal parameters. Let us remember polemic standard of A.Turing about creating thinking machines (1950)[6] – a set of arguments and contra-arguments in solving the «major issue» in artificial intelligence philosophy: «Can a machine think?» This set is called «standard», as it shapes and sometimes fills with essence modern discussions in philosophy of artificial intellect. «Standards» includes arguments and contra-arguments that are not at all of engineering and technical kind: theological, anti-scientific, creational, «in the first person», «from other consciousness» and even extra sensor one.

The following large projects in AP are noticeable since the beginning of 1990s: 1) Pollock's OSCAR, which was formed in the course of «universal rationality theory» with its applications for constructing artificial rational agents («artillects»);[7] 2) project of «human like agents» of A.Sloman, aimed at realizing a wide range of personal parameters, e.g., «love», «freedom»;[8] 3) humanoid robots project, where D. Dennett sees approbation of his theory of various drafts, so that personal arises as a combination of boundless series of narratives, and personality and society re substantial systems of countless robots, with «mental» represented as functional self-

[6] *Turing, A.* (1950), Computing Machinery and Intelligence, Mind 59(236), p. 433–460.
[7] Seryodkina, E.V. (2007). General theory of rationality in Pollock's OSCAR project. In: Philosophic and methodological problems of artificial intelligence. Seryodkina, E.V., ed. Perm, Perm State Technological University. P.108-122.
[8] *Sloman A.* What Sorts of Machines Can Love? Architectural Requirements for Human-like Agents Both Natural and Artificial (http://www.sbc.org.uk/literate.htm)

organization component.[9] These projects offer conceptual, logical, mathematics, and programming solutions. Here we dwell on methodological level of summarizing the ways of implementing AP projects.

Typical architecture of artificial personality. The three layer architecture of cognitive computer system is usually analyzed: 1) the level of connection images (patterns), implementing perceptive data processing; 2) the level of primary representation, transferring perceptions into discrete presentations and judgments; 3) the level of secondary representations, where presentation of presentations is implemented (modeling of other models of knowledge presentations and modeling of the own model). The approach of A.Sloman is particularly notable in this regard. He asks the question: «Which machines may love?» and offers architecture for «loving» machines, consisting of 1) reactive, 2) analyzing and 3) reflective (meta managing) levels.

At the *reactive level* the following things are typical for computer system (cognitive agent): mechanism and memory are aimed at solving strictly specific tasks; the means for creating new plans and describing system are absent; alternative structures are assigned explicit values; parallel features and perfecting of technical tools accelerate the work; many processes may be analogous (continuous); primitive forms of teaching are possible; agents may survive only under conditions of genetic pre-determination, and difficulties arise when there is the need for structural change; these agents are not subject for long consumption, as they disvalue soon and are in fact one-time.

At the *deliberative* layer motives are set directly; plans are made; new alternatives are created and developed; memory is used consequentially and repeatedly; teaching mechanisms and results, obtained in the course of study may be

[9] Dennett, D.S. (2004). Types of psychology: on the way to understanding consciousness. Translated from English. Makeeva, L.B., ed. Moscow.

transferred to reactive level; parallel features are no longer very important, as study mechanisms allow reaching certain complexity; there is consequential access to parallel associative memory; integral management is present; dynamic environment leads to many interruptions, frequent changes of goals; filtration by the means of dynamically changing thresholds helps, but does not solve all the problems etc.

At the *reflective level* there is self-monitoring, self-development, self-modification, and self-governing, as the mechanism for meta management perfects distribution of limited resources of deliberative layer; the memory keeps events, problems, decisions from deliberative mechanisms; managing patterns are produced (strategies for decision making incorporating all the conditions); new strategies and procedures are researched, and new abilities for generalization and categorization of notions are created; diagnostics of damages with the help of diagnostics of inner symptoms is done; higher-level strategies, i.e. procedures for goals and stereotypes of high level behavior, are developed; points of view are contrasted and analyzed, focus of attention is being chosen. Due to recursive mechanism, the endless meta-meta-meta… management is not necessary. According to A.Sloman, the quasi consciousness phenomenon emerges at the very third level.

Here the inner architecture of artificial personality system is reveled. An important issue is the question about **outer, physical resemblance of artificial and natural systems**. We consider the two approaches representative: 1) by Duglas Lenat, the author of vary famous program «Automatic mathematician» (1976), who considers that we should follow psychologic, sociocultural, linguistic, intellectual and other peculiarities of personality, and physical resemblance of system – is a unimportant second degree issuep; 2) by D.Lenat D.Lenat`s student Rodney Brooks, the author of the above mentioned КОГ and famous version of Kismet, imitating human face mimics. R.Brooks considers physical antropomorthness of a system (robot) as primary and necessary feature of its personal resemblance, as all socio-

cultural notions, on the basis of which robot will function, are pre-set by physical features. For example, according to Jonson and Lakeoff principle, to «legless» robot it will become difficult to understand the saying «Turn upside down – from head to legs».

The approach of D.Lenat and R.Brooks may be denoted correspondingly as *expert* and *roboto-technical* approaches for constructing AP.

To make distinction between these approaches more clear let us study hierarchy of Turing tests, offered by S.Harnad.[10]

TH (Harnad`s test) 0. This is the level of «game» TT – not full tests, but just certain fragments, limited both in length and contents. These tests do not correspond to initial desire of A.Turing. However, all recently known attempts to model intellect, have not yet reached anything above this level.

TH2 – common understanding of TT. This is the very one which A.Turing had in mind. Sometimes this level TT are called «pen friend» test. The length of TH2 equals to the length of human life.

TH3 – so-called «robotized» version of TH2. It allows for manipulating the objects of outer world. Procedure for indentifying the systems, which take this test, requires the principle «Вскрытие will show», e.g. anatomic study of system.

TH4 – computer systems, indistinguishable both in the sense of TH3-indistinguishability, and in the sense of micro physical organization of system. Here we have «total indistinguishability» between computer system and human, including minor inner nuances of body complexion. The future of this test today is connected to nano technologies.

As we can see, expert approach should pass TH2 level, roboto-technical – TH3 level.

[10] *Harnad, S.*, (2001). Minds, Machines and Turing: The Indistinguishability of Indistinguishables. *Journal of Logic, Language, and Information.* http://www.ecs.soton.ac.uk/~harnad/Papers/Harnad/harnad00.turing.html.

Aglo-American philosophy of artificial intelligences sees roboto-technical approach as prevailing one, it regards AP as autonomous robot having quasi consciousness. Expert methodology is not recognized by such famous foreign AI philosophers, as *McCarthy* [11] and A.Sloman[12]. Russian science, however, tends to expert approach: AP is regarded in social and epistemological context of interdisciplinary study, in the course of which data and knowledge of socio-cultural and personal content are formed. Let us consider these approaches in detail.

Artificial personality is roboto-technical personality. AP is robot, endowed quasi consciousness, i.e. the set of at least certain personal abilities and features of a human. The discussion on the work of Selmer Bringsjord «What Robots Can and Can't be» (1992, 1994),[13] continued then at the web-site http://psycprints.ecs.soton.ac.uk (section «Robot's Consciousness»). Positive statements about AP project are accompanied in this work by detailed critics. The major theme of the work is the following: «In future robot will do everything, that we do, but won't be one of us», i.e. won't be conscientious.

S.Bringsjord proves that a) cognitive computer technology will produce machines with abilities to pass stronger and stronger versions of TT, however, b) AP project on creating personality-machine will inevitable fail. In defense (a) inductive logics in creating TT versions is offered: Turing imitation game → observing appearance of players → study of their sensory and motion behavior → brain scan etc. (i.e. in fact, passing the above hierarchy of Harvard's tests). In the essence of AP project's groundlessness proof in (b) lies modus tollens of conclusions (1) «AP project»→«Personality is a machine»; (2) «Personality is a machine»; ⇒(3) «AP

[11] *McCarthy, John* (1995) Artificial Intelligence and Philosophy (http://cogprints.ecs.soton.ac.uk/archive/00000420)

[12] *Sloman A.* Ibid.

[13] Bringsjord, Selmer (1994) What Robots Can and Can't be , Psycoloquy: 5,#59 Robot Consciousness (1); http://psycprints.ecs.soton.ac.uk/archive/00000418/#html

project». Statement (2) intuitively appeals to the presence in the humans and absence in an automate machinery non reproducible personal parameters F, which include free will, ability for introspection, inner projective experience "what it's like to be" etc. F also incorporates ability for computer reproduction of artistic abilities, which the author analyzes in detail in the context of previous works on studying fiction and philosophic literature generation programs. He firmly proves – «computer can not create things!»[14] General conclusion is the following: (4) «personality possesses F»; (5) «machine (automate) does not possess F»; ⇒(6) «personality can not be automate». S.Bringsjord circumstantially justifies non-computability of F, using Gödel arguments, «Chinese room» of J. Sorel, argument of unconditioned multiple realization of N.Block etc. The result is the following: *«Robots can do a lot of things but they will never become personalities»*.

Four directions dealing with implementation of artificial personality project may be classified in discussion on S.Bringsjord`s work: [15]

I. AP Project is *absurd*, as: 1) metaphysical terms «personality», «free will», «introspection» may not be the object for empirical analysis; 2) unclear determination of personality notion, figurative irrationality of AP project – all the above is not

[14] S.Bringsjord`s approach to criticizing computer art is clearly expressed in Lovelace argument. See S.Bringsjord, P.Bello, D.Ferrucci. Creativity, the Turing Test, and the (Better) Lovelace Test http://www.rpi.edu/~faheyj2/SB/SELPAP/DARTMOUTH/lt3.pdf

[15] See http://psycprints.ecs.soton.ac.uk/archive/00000418/ for discussion of the following authors: *Barresi, John* (1995) Building Persons: Some Rules for the Game; *Bringsjord, Selmer* (1995) Agnosticism About Neuron-Level Functionalism; *Bringsjord, Selmer* (1995) Agnosticism Re-Revisited; *Bringsjord, Selmer* (1995) Are Computers Automata?; *Bringsjord, Selmer* (1995) Computationalism is Doomed, and We Can Come to Know it; *Bringsjord, Selmer* (1995) Why Didn't Evolution Produce Turing Test-Passing Zombies?; *Bringsjord, Selmer* (1996) Artificial Intelligence and the Cyberiad Test; *Brown, Marina and O'Rourke*, *Joseph* (1994) Agnosticism About the Arbitrary Realization Argument; *Costa, Luciano da Fontoura* (1995) Is There More to Personhood Than Computing Theory and Logico-Mathematics?; *Hobbs, Jesse* (1995) Creating Computer Persons: More Likely Irrational Than Impossible; *Korb, Kevin B*. (1995) Persons and Things: *Massing, Walter* (1995) Metaphysical Windmills in Robotland; *Mulhauser, Gregory R.* (1995) What Philosophical Rigour Can and Can't be; *O'Rourke, Marina Brown and Joseph* (1995) Agnosticism Revisited; *Rickert, Neil W*. (1995) A Computer is Not an Automaton; *Scholl, Brian* (1994) Intuitions, Agnosticism, and Conscious Robots; *Tirassa, Maurizio* (1994) Is Consciousness Necessary to High-Level Control Systems?

worthy scientific attention; 3) personality parameters are logically non-describable – the attempts of their logical explication inevitable are accompanied by mistakes.

II. AP project is not *specific*, since: 1) appeal to intuitive arguments destroys logical strictness of deductive arguments; 2) it is not reasonable to use deductive conclusions as a method of argument (deduction is not a method, but a scheme of thought); 3) it is necessary to clearly form a particular type of functionalism, which lies in the basis of AP project, there is not functionalism «in general», but there is, for example, low-level functionalism, biological functionalism etc.

III. AP project is *implemental*, as: 1) human personality is similar automate, but of neo-classical type, i.e. represented not by Turing machine, but by other quasi algorithmic rules for processing calculating elements; 2) computer is not a machine and those with opposite opinion should not participate in computer consciousness discussion; 3) computer system should be tested by nature, and not by people.

IV. AP project is *valuable,* regardless of opportunities for its realization: 1) it is not important, whether AP is ever created o not, what is principal is the fact that AP projects reveal mechanical aspects of human consciousness; 2) projecting AP clears up the role and functions of consciousness in human life by putting the question about zombie – creatures without consciousness, but having human behavioral features.

We consider that the major conclusion of the discussion is the issue that projecting AP We consider that the major conclusion of the discussion is the issue that projecting AP clears up the *role and functions of mechanical and non-mechanical aspects in human personality*.

Artificial personality – expert assessment. At the time, when the above outlined discussion was taking place, i.e. in the middle of 1990s, the increase of interest to artificial personality problems was noticeable in Russia. On the demand of

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the Defense Ministry of defense of the Russian Federation (27 science and research institution, Director – Prof. V.V.Deev) there was organized interdisciplinary research on introducing non-traditional information technologies in decision making systems. Research was based on efforts to model «the sense». AP project was regarded as a stage in intellectual systems evolution. If traditional computer technology is characterized by the formula «data + algorithm», artificial intelligence technology – «knowledge + heuristics», AP project is set by the formula – «sense + understanding». Considering large research by Russian specialists in constructing expert systems, in particular, in semiotic modeling of the ways for «knowledge» representation, the basis for the analyzed AP project was expert methodology. In this framework, special methods reproducing «understanding» process provided conditions for «sense» explication, essential foundations for the decisions. «Sense» model fixed these «trajectories» and inside in a certain way codified information set.

A lot of literature is devoted to the problem of modeling «sense». The following models may be singled out in the sense of belonging to the «discipline»: cultural, psychological, linguistic, hermeneutic, rhetoric, discursive, semiotic, poetic, iconographical, esoteric, mathematical, engineering, synergetic, neoclassic etc.[16] The most productive in the context of computer realization is *contextual approach*, where «sense» – is a context of formalized expert «knowledge», having the properties of system unity. The general theoretic basis for this approach are classic models of «sense» by H.Frege (sense is the way of using signs to bring meaning to the value) and modification of this model by B.Russel and L.Vitgenshtein. In the analyzed AP project ideas of representation theory by M.Vartovsky were used along with the above outlined models. Vartovsky's theory systematically unifies the study of the model, the ways of its construction and interpretation. This link provides for

[16] Alekseev, A.Yu., Artukhov, A.A., Kryuchkov, V.L., Malikova, Ya.S., Rozov, M.A. Socio-cultural aspects of modeling «sense». In: Philosophy of Artificial Intelligence. Lektorsky, V.A., Dubrovsky, D.I., eds. Moscow, Institute of Philosophy RAS, 2005. P.134 – 138

dynamics in filling «sense volume» by various «sense trajectories» in the course of в ходе matching the method and the subject of representation. In a certain way, an expert gets absorbed in the quasi algorithm of constructing the model for the model and builds representation of representation.

Technically the «sense» model is realized as programming and information software over the system for «knowledge» presentation. «Sense creating» components are categorical codes «personality», «meaning», «sense», «value», «notion», «action», «role», «norm», «ability» etc. Instantiation and exemplification of these codes was realized within the paradigm of theoretic and activity approach. Expert should relate the obtained «sense trajectories» with certain formalized «knowledge», which is directly involved in the model for decision making. The name of the project – «artificial personality» – is justified by the fact, that «knowledge» about the taken decisions was adjusted with the use of personal parameters, including indicator of whether decision is taken freely or not.

Approbation of the expert approach to projecting AP, accomplished in the course of experimental use of the prototype, with the main part left «on paper», revealed a number of failures: dealing with methodology, organization, theory and implementation. The major methodological failure is inability to construct Turing test for personal. For example, let us imagine the situation of assessing the «free will» parameter. A standard mechanism of decision making is simulated, the goals are set; there is following the rule according to «other» will (will of developer). The generation of new goals, justified by the knowledge of past, current and forecasted environment is implemented at the reflex level of AP. Is the result of generation – the new goal – the revelation of free will in AP? Will the judge in Turing test assign «free will» to the tested system?

Despite all the failures, the *socio-cultural effect* was reached: the proposed tool caused specialists to implement reflexion over «knowledge», explicate «senses» of their own decisions and offer them for inter-subjective discussion.

Broadening the field for interdisciplinary research in the artificial personality project. Obviously, roboto-technical and expert AP projects amend each other in the sense of broadening possibilities for intellectual information technologies. If the first principle declares: «*Artificial personality is robot, endowed with quasi consciousness», the second states*: *«Artificial personality is an expert system, equipped by 'sense' mechanisms».* We think that expert approach of AP project should in its order and importance precede roboto-technical one. Expert system, answering to requests of various kind, provides for construction of verbal and communicative Turing test TH2. On the basis of solely this test, it is possible to construct more complicated tests TH3 and TH4, which are necessary for roboto-technical approach. Before studying how robot autonomously or in the surrounding of other robots is able to, for example, produce «communication», «explication of will», «moral imperatives», «religious beliefs» etc., it is necessary to determine operational definitions of these notions.

Projects enhance and strengthen the importance of interdisciplinary approach. It is hard to imagine the AP project itself away from the field of interdisciplinary research by specialists in psychology, logics, mathematics, linguistics, neurophysiology etc. AP project involves researchers in social sciences and humanities: sociology, politics, economics, art, law and others. As for our AP project (expert realization of AP project), it even saw participation of para-science specialists, although the latter did not help much. Priorities in AP project belong not to specialists of natural and technical sciences. The role of social and human sciences experts is particularly important, since these very researchers introduce «senses»,

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«values», «norms», «ideals» and other components of spiritual life in constructing process.

However, let us imagine an utopian scenario – all best human minds are concentrated on implementing AP project. All necessary methodological works in communication, coordination, and integration of scientific society are accomplished. Moreover, boundless financial and economic support is received from the part of state (According to D.Dennett, it is necessary to pay for artificial personality).[17] Will the AP project be realized? It is probable, however, in requires solving a number of methodological difficulties, connected to complexity of the research subject. Today these difficulties do not seem to be solved neither practically, nor theoretically. Problems are inspirited by consciousness philosophy and in combination with artificial intellect philosophy research. One of these interrelated difficulties is **the problem of constructing Turing test for personal.**

Applied to AP project, Turing test falls into two types: 1) *general test*– which questions to unknown system X may help to determine, whether you are facing personality or not (machine)? 2) *partial test,* test for conscientiousness – which questions help determine, where the system possesses consciousness or not.

Partial Turing Test, developed for passing these AP projects, must include conscientious abilities and properties, as assessed parameters. These abilities should, at minimum, include: 1) «sentience», i.e. perception of the world and reaction to it according to various perceptive and effecter features; 2) «wakefulness», i.e. capability to actually implement certain abilities, and not only have dispositions for their realization; 3) «self-consciousness», i.e. not only awareness about something, but also awareness about one's own awareness; 4) «what it is like», i.e. ability to perceive the world with regard to own attitude towards «being» or, perception of environment

[17] *Dennett D. C.,* 1995. The Practical Requirements for Making a Conscious Robot, http://www.ecs.soton.ac.uk/~harnad/Papers/Py104/dennett.rob.html

according to the answer to the question «what is it like to be?» (e.g., what is it like to be a bat, a robot, an expert system?).

Besides demonstration of the above enlisted abilities, the system may be considered to be quasi conscientious, if the judge in Turing test assigns it the following features: 1) it is in the sate of «awareness about»; 2) it possesses qualia – has qualitative properties of particular type (sees red, feels the smell of cafe etc.); 3) it is in phenomenal state, which is more structural than qualia and has certain special, temporal and conceptual organization of experience concerning environment and itself; 4) it possesses access consciousness – an access to inter-mental components of regulating speech and actions (N.Block); 5) it possesses narrative consciousness – produces a series of linguistic sayings, «expressed» from the point of view of actual and virtual self-understanding (D.Dennett); 6) it possesses intention – directs its attention to the subject of consciousness, it is active in making subjects out of the events of the environment (D. Sorel).

It should be noted, that the above abilities and characteristics of «quasi consciousness» are necessary, but not sufficient. Obviously, one may offer a long list of other features of quasi conscientious behavior. The problem of completeness of conscientious abilities and features is also called «conjunctive problem». This problem, along with so called «disjunctive problem» – the problem of multiple realization of conscientious phenomena in various substances, is given considerable importance in modern discussions.

Methodological problems of consciousness philosophy are usually divided according to the degree of their complexity. Some researchers, however, deny this approach (see below). Apparently, methodological complexity influences the stages

of AP project implementation – from solving simple problems to more complicated ones. Let us single out easy and hard problems, following D.Chalmers.[18]

Easy problems – those, that deal only with operational aspects of consciousness. Consciousness is limited by the following phenomena: reaction on outside stimuli, reports about mental states, integration of information by cognitive system, focus of attention, behavior control, learning. All these problems in their essence find solution in the above described three-level organization of AP project.

Hard problems relate consciousness to the presence of «subjective experience» and self-consciousness. The key issue is explanation of mechanisms for these subjective processes: how can AP behavior, externally treated by the judge as subjective experience, may be causally linked with computer architecture?

A number of opinions exist with regard to hard/easy problems:

1) HARD PROBLEM IS UNSOLVABLE.

- In 1890 William James, in a certain sense anticipating this discussion wrote, that nature in its inconceivable projects mixed us from clay and fire, brain and knowledge, and these two things exist, obviously, together, and determine the essence of each other, but no one mortal can ever learn, how and why; [19]
- Thomas Nagel (1994), wrote that problem of subjectivity is difficult and hopeless. Not only we do not have any solution – we lack even a small hint, how to explain mental by physical[20].
- C.McGinn (1999) believed that dualism is inevitably inherent in the existing way of studying mental issues and brain.[21].

[18] Classification of problems and approaches for their solution usually appeals to the work: *Blackmore, Susan J.* Consciousness : An Introduction. US Edition Published by Oxford University Press, New York, 2004; http://www.susanblackmore.co.uk/Books/Consciousness/Consciousness%20Chap%202.pdf

[19] Cited according to *Blackmore, Susan J.* 2003. Consciousness : An Introduction.

[20] *Nagel, T.* (1974) What is it like to be a bat? Philosophical Review 83, 435–50.

[21] *McGinn, C.* (1999) The Mysterious Flame: Conscious Minds in a Material World. New York: Basic Books.

- Steven Pinker (1997) thought, that it may take us infinitely long to try to understand, how mental works, but this understanding is for ever hidden off the boundaries of our conceptual horizon.[22]

The views of T.Nagel, K.McGinn and S.Pinker may be called *neo mystical approach* – they consider the problem of consciousness to be unsolvable, as consciousness is incomprehensible mystery.

2) HARD PROBLEM IS SOLVABLE UNDER THE NEW DETERMINATION OF UNIVERSE.

- David Chalmers demands creation of a new theory of information and its reconsideration from the point of view of two-aspect theory – «two-aspect theory of information». Information has two aspects – physical and phenomenal. Therefore, conscientious experience is, on the one hand, a certain aspect of informational state, and on the other, is an aspect, found in the physical organization of brain.

- Cris Klayrk (1995) demands reconsideration of fundamental physics. Mental is similar to certain phenomena in quantum physics. Consciousness and quantum effect are subjective and objective aspects of representing the same issue.

- Roger Penrose (1989, 1996) thinks that consciousness depends on neo-algorithmic processes, i.e. processed, that may not be accomplished by digital computer or be calculated with the help of algorithmic procedures. Cardinal reconsideration of mental- neural physical relation is necessary on the basis of quantum theoretical approach. Conscientious approach should be interpreted as a quality, caused by quantum sequence in micro canals of neurons.

Position of the above authors may be called neo-pan- psychical approach, ontologizing consciousness from the point of view of attributive interpretation of information. In particular, this is typical for D.Chalmers. However, according to D.I.Dubrovsky, «such views excessively autonomize categories of ontology and

[22] Cited according to: Blackmore, Susan J. P. 32

gnosiology, which leads to a number of theoretic ambiguities and inconsistencies».[23] In other words, the problem gets complicated, and not simplified.

3) ONE SHOULD DEAL ONLY WITH EASY PROBLEMS. F.Crick, A.Sloman, J.McCarty and the majority of "cognitive" scientists consider the study of consciousness as scientific and not philosophic problem. We approach more full understanding of the consciousness problem, if we start from something simple, for example, from the theory of visual fixation, which describes synchronization of electro-magnetic oscillations for explaining how various features of perceived object are joint in one unity in creation of perceptively unified essence.[24]

4) THERE IS NO ANY HARD PROBLEM.

O'Hara and Scutt (1996) in their special work «There is No Hard Problem of Consciousness»[25] list three reasons for ignoring hard problem: а) We know, what easy problems are. So we should start with them; б) Solutions to easy problems will change our understanding of hard problem, therefore, the attempts to solve hard problem now are untimely; в) The solution to hard problem might be useful, if we could distinguish this problem itself. However, now the problem is not understood in the due way and it is unclear, what type of difficulties researchers will face.

- P. Churchland (1996) thinks that hard problem is wrongly understood, as we can not forecast, which problems will be easy, and which - hard. How can we know, that explanation of subjective is more difficult, than explanation of «easy»

[23] See Dubrovsky, D.I. The Problem of Ideal. Subjective Reality. Moscow, 2002, P.39 on the problem of separating attributive and functional interpretation of information, and perspectives for the second type of interpretation for solving consciousness problem.

[24] *Crick, F.* 1994. The Astonishing Hypothesis: The Scientific Search for the Soul, London: Touchstone Books.

[25] *O'Hara, K. and Scutt, T.* (1996) There is No Hard Problem of Consciousness. Journal of Consciousness Studies 3(4) pp. 290-302.

problems? Are «hard» issues (qualia, subjective experience) determined well enough, so that they could be identified as hard. For example, are thoughts qualia or not?[26]

- Daniel Dennett (1994). For example, according to D.Dannett, there is no such a thing as «phenomenal». Not because consciousness is denied in humans, but due to the fact, that philosophers give wrong interpretation of consciousness.[27]

Position of these authors may be called *terminological* – give right definition to what is called «consciousness» and then problems will either be clearly outlined or will disappear at all.

5) HARD PROBLEM SHOULD BE SOLVED. This is *constructive* position. This is the point of view of N.Block. However, hard problem needs to be differentiated for more clear understanding of the research subject. Therefore, it is necessary to distinguish between hard and most hard (the hardest) problem.[28]

Hard problem deals with the fact that due to subjectively experienced events of consciousness we do not understand how phenomenal consciousness may be reduced to neurophysiologic facts, observed in studying mental processes. Why neuron basis of certain phenomenal quality is the neuron basis for this very quality, and not another, or not any quality at all. The problem of explaining this link is in explanation gap between neuron basis for certain phenomenal quality and the phenomenal quality itself. With this regard D.I.Dubrovsky interprets similar problem: «How to explain the connection between events of consciousness (subjective reality) and physical (in particular, mental) processes, if the former may not be attributed physical properties, and the latter possess them due to necessity?»[29]

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[26] *Churchland, P.S.* (1996) The Hornswoggle problem. Journal of Consciousness Studies 3, 402–8 (reprinted in Shear, 1997: 37–44).

[27] Cited according to *Blackmore, Susan J.* 2003. Consciousness: An Introduction. P. 35

[28] To demonstrate N.Block's point of view we use the work: Willianwell A. What are psychological feature? Metaphysics of psychology. Moscow, 2006.

[29] See issues, formulated by D.I.Dubrovsky for symposium «Consciousness and mind», 30 Nivember, 2007, Institute of Philosophy of the Russian Academy of Sciences, http://www.scm.aintell.info/default.asp?p0=107

Most hard problem deals with the fact that we do not have any grounds to consider artificial personality impossible, since the fact of passing Turing test for subjective reality may serve the basis for assigning consciousness to AP. Physical realization, in its turn, differs considerably from human one and just by itself is not the basis for persuading about the lack of consciousness. Nonetheless, we do not have any understanding about the proof of presence or lack of consciousness in other being.

It may be shown that the most hard problem takes the form of other problems, fundamental for modern analytical philosophy: 1) «*Zombie problem*», which touches upon justification of thinking and abilities (logical, metaphysical, natural) for beings without consciousness, whose physical structure, observed behavior, and functional organization do not at all differ from structure, observed behavior, and functional organization for conscientious beings (humans); 2) «*Problem of other*» – on what grounds other people, and other biological, or more broadly, physical systems, as well, may be assigned the fact of possessing consciousness and the whole range of conscientious life in the sense of personal and social features; 3) *Self-consciousness problem* – on what grounds can consciousness be assigned to oneself.

In classifying problems into hard and most hard, it is logical to assume that we lack another problem, which may be called «less hard».

Less hard problem deals with deciphering neuro-dynamic codes for mental phenomena. According to D.I.Dubrovsky, there are two types of code deciphering tasks: 1) «direct» task, when coded object is given and it is necessary to reveal information it contains, and 2) «reverse» task, when we are given certain information and it is necessary to determine its medium and the code organization for the medium. The latter task is more hard. However, both these tasks are quite solvable. For example, there exists A.M.Ivanitsky's method, which uses electric activity of brain to determine which mental operations are accomplished by person in the given

moment of time: whether s/he thinks in spatial objects or uses logical thinking.[30] Here we can track a solution to the first problem. To solve the reverse problem it is necessary to apply the principle of information invariance with regard to physical properties of its medium (D.I. Dubrovsky's principle).[31] With the presence of the system of analyzed code dependencies, there is a possibility to solve the task of reproduction of information in the substance, which differs from human mind, e.g. connection-representative coded images of artificial personality.

The solution of these tasks is extremely important, and demands special analysis of information invariance principle. In particular, this deals with comparing this principle with the argument of multiple realization, which requires studying reduction and anti-reduction paradigms for realization of mental phenomena in various physical systems.

Conclusions: 1) Artificial personality project is one of the most perspective projects in artificial intelligence. It is placed between the project of *artificial life*, aimed at reproduction of biologically equivalent forms of quasi organic life, and the project of *artificial society*, aimed at implementing the whole range of social life among artificial agents. For the former it sets the goal for creating more organized form of artificial life. For the latter, it creates the basis, as social grows from interrelations of personally active artificial agents.

2) Expert approach is currently most important among the projects of artificial personality. It provides construction of Turing test for personal. It requires interdisciplinary unity of specialists in natural, technical, and, in particular, human and social sciences. Specifically, particularly important is cognitive and computer study of ethical processes.

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[30] Ivanitsky, A.M. Thinking mind and artificial intelligence – counter motion // Works of XXV interregional science and technical conference "Problems of efficiency and safety for functioning of complex technical and information systems". Part 4. Serpuhov, 2006. P. 287.

[31] Dubrovsky, D.I. Artificial intelligence and natural intelligence (on the problem of interdisciplinary). Ibid, P. 276.

3) Artificial personality project should be realized in the sequence of solving the problems according to the increase in degree of their complexity: easy – less hard – hard –most hard problems. Easy problem is quite successfully solved in cognitive and computer science, participation of philosophy here is tracked only in organization of interdisciplinary methodological framework; development of most general notions and categories apparatus, and implementation of integration and communication functions. Beginning from less hard task, there is a start of the very philosophic analysis, special epistemological, ontological, and hermeneutic research in artificial intelligence. The most hard problem with regard to artificial personality project demands an involvement of axiological, praxeological and other socio-philosophic studies. Let us again answer the question, formulated in the beginning: «Can computer become a personality»? Yes, it can, but there are a lot of difficulties and extremely complex problems on the way of implementing artificial personality project. *We are all computers, but may become personalities and do become them.*

Agent-based investment technology (Part 2. Special issues in construction and macro models)

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Complex procedures of useful exchange between subjects of economic activities are mediated quantitatively by money; and distributions and accumulation of public goods are actually reduced to individual satisfaction of needs to a greater or lesser extent. The previous part of this study deals with the basic properties of applied agent-based technology of chain investment, allowing to exchange goods, works and services in innovative conditions by means of the corresponding software improving a commodity-money exchange.

Activation of the whole macro system activity is provided without the use of significant financial resources, thus stimulating the whole set of economic interactions involved in chain investment, by final calculation of the future consumption distribution and its financial conformity on the basis of information, which is delivered by agents to technological mega polis, is integrated and returned by this mega polis through various liaison channels and is paid by a financial conglomerate on the basis technological mega polis data.

The considered here technology is represented the uni-modal appendix capable to be adapted in any economic system. In the given part we shall show the functional component of chain investment scenarios and results of macro system modeling.

1. Constructive elements of scenarios

We developed four types of chain reactions: initial, local, total and global. The first two are intended for macroeconomic level. They accumulate taxation from different sources in one place, passing all intermediate structures, and transform the function of financial control into calculation control, making function of book keeping become an unessential procedure.

Total chain reaction is focused on the sphere of retail investment. It carries out payment of taxes at the place of producer dislocation and is intended for use by any

organizations having financial resources for purchasing goods, or for commodity mortgage. Global chain reaction does not make deduction of taxes and provides payments to businessmen in monetary units currency in the producer's country, or is transnational (Filippovsky, 2006). The detailed characteristics of chain reactions are the following.

Initial (*f*0) gives repeated growth of the money supply, provided by the commodity mortgage, due to money emission not leading inflation, under price stabilization (Marchenko, Gavrilov et al., 2005a).

The basic parameters: total volume of production (*W*), the commodity mortgage (*T*), producer's profit (*U*), investor's profit (*E*), profit of credit organization (bank) (*K*), demand for credit resources (*S*), volume of investment resources (*Dx*), commodity circulation (*Wij*) and taxes (*Nl*), are configured by criterion functions (*f*), for non-formalized analysis at the stage of decision-making on financing the production.

Investments are carried out in the pre-set sequence (*Oh*) and limited by minimal: sums (min*S*), stages of disintegration (min*Y*); maximal deviation (min*R*), positive profitability (*Eq*> 0) concerning the investor. Tax payments from profit (*Nl*) combine payments of producer (*Nlp*), investor (*Nli*) and the bank (the credit organization) (*Nlb*), (*Nl=Nlp+Nli+Nlb*), to the uniform address (*Rh*), without value added tax. The source for financing production process according to the given technology is one bank (for example, the Central bank and one investor (for example, the State).

The basic restrictions for the possibilities of the *i*-th producer, ($i \in I$ - set of manufacturers) to produce *w*-th production, ($w \in W$ – set of production types, the goods, works and services) on the set of variants *r*, ($r \in R$ – variants of producing *w*-th good) are technological mega polis (*IWR*) or the bank, in the format of the software "*TURBO*".

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$$f0 \supset \{[(\min Y, \min S, \min K, E(q)>0), f, Oh], (W, T, U, E, K, S, D, Wij)\} \quad \textbf{(1)}$$

$$Nl(y,q) \supset [Nlp(y,q), Nli(y,q), Nlb(y,q)] \in Rh \cup (Adr, Bnk, Inn, Bik, Rsh, Krh, Tlf). \quad \textbf{(2)}$$

where *Adr* – the address of the bank; *Bnk* – the name of the bank;

Inn – individual taxpayer number (INN);

Bik – BIK;

Rsh – settlement account;

Krh – correspondent account;

Tlf – telephone;

q – number of interaction (scrolling);

y – number of disintegration stage;

$q \in Q$ – the set of synthesized interactions (scrollings);

$y \in Y$ – number of disintegration stages (the length of the chain) for q–th scrolling, $1 \le y \le 10$.

The minimal sum ($\min S$) represents restrictions on the volumes of production, so that below this value investment is not carried out (for example, 100 rubles). The minimum number of disintegration stages ($\min Y$) is set by the number of participants in each scrolling. So, at $\min Y=3$, the circuits consisting of three elements (producers) and above are subject to investment. Investments are carried out only if investor has profit $E(q)>0$, $E(q) = \sum E(y, q)$, $y=1, 2, \ldots, Y$, as an aggregate result for all the stages (Y).

At the stage of imitating the consequences of chain investment additional restrictions are used: the credit resources allocated by bank (*LimS*), direct investments (*Inv*) and target crediting (*Sum*). The sequence (*Oh*) represents the sequence of financing scrollings (q). Scrollings with direct investments (*Inv*) are invested in the first place, secondly, go scrollings with target crediting (*Sum*), then scrollings generated by criterion functions (f'), according to criterion of the maximal sum of

investments (max$W$), with the maximal number of parts in a circuit of disintegration, (max$Y$), to minimal (min$Y$, min$W$).

On the basis of these restrictions, calculations on technological mega polis (*IWR*) lead to configurations of circuits of payments (scrolling Q) with a priority, set by criterion functions (f) or a combination of parameters: max$L$ - the maximal opportunities of payment of producer's interests; max$P$ – the maximal relative density of profit in the costs of goods; max$I$ - the maximal interests of investor in profit of the producer; min$T$ - the minimal term of granting (producing) goods, works or services, $f \supset (F1, F2, F3, F4)$.

$$f \supset \{F1 \supset [\max L, (\max L, \max P, \max I, \min T)]; F2 \supset [\max L, (\max P, \min T, \max L, \max I)],$$
$$F3 \supset [\max L, (\max I, \max P, \min T, \max L)], F4 \supset [\max L, (\max P, \max L, \max I, \min T)]\}. \quad \textbf{(3)}$$

So, hundred rubles (s=100) at 50 % depth of disintegration (x=50) or losses, under transformation of means from one calculation to another, in a circuit consisting of ten producers (Y=10), will finance the total volume of production (w) in the sum 199.8 rubles. With increase in depth of disintegration by 10 % we receive growth of the total product (Gross Domestic Product) accordingly up to 248, 324, 446, 651 rubles. The maximal volume of GDP is 1000 rubles, at the depth of disintegration equal to 100 %.

$$w = s+s*x/100+s*x/100*x/100+\ldots+s*(x/100),\ y=1, 2, \ldots, Y;$$
$$w = \sum [\ s*(x/100)\ ] \geq \min S,\ x<100;\ \text{или}\ w = s*Y,\ x=100; \quad \textbf{(4)}$$
$$w = 100+50+25+12.5+6.25+3.12+1.56+0.78+0.39+0.2=199.8,\ x=50$$
$$w = 100+90+81+72.9+65.61+59.05+53.14+47.83+43.05+38.74=651.32,\ x=90$$
$$w = 100+100+100+100+100+100+100+100+100+100=1000,\ x=100.$$

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Accordingly, the demand for financial resources (s') equals to the total demand for them at all stages of disintegration or is made up from the financed volume of production (w=s), with subtraction of of payment of producer's (contractors') interests, (s*x/100) at the first stage (y=1), plus financed volume of production (w=s*x/100), minus payment of contractors, (s*x/100*x/100) at the second stage, (y=2) (etc.) plus the financed volume of production at the last stage, minus payment of contractors at deep scrollings.

$$s' = [(s\text{-}s\text{*}x/100),\ y=1]+[(s\text{*}x/100\text{-}s\text{*}x/100\text{*}x/100),\ y=2]+\ \ldots+$$
$$+[(s\text{*}x/100)\text{-}s\text{*}(x/100)]+\ldots+[(s\text{*}x/100)\text{-}s\text{*}(x/100)]+s\text{*}(x/100)$$
$$s' = \sum [s\text{*}(x/100) - s\text{*}(x/100)]+s\text{*}(x/100); \qquad \textbf{(5)}$$
$$s' = [(100\text{-}50),y=1]+[(50\text{-}25),y=2]+[(25\text{-}12.5),y=3]+[(12.5\text{-}6.25),\ y=4]+$$
$$+[(6.25\text{-}3.12),\ y=5]+[(3.12\text{-}1.56),\ y=6]+[(1.56\text{-}0.78),\ y=7]+[(0.78\text{-}0.39),\ y=8]$$
$$+[(0.39\text{-}0.2),\ y=9]+0.2=50+25+12.5+6.25+3.12+1.56+0.78+0.39+0.2=100\ ,\ x=50$$
$$s' = (100\text{-}90)+(90\text{-}81)+(81\text{-}72.9)+(72.9\text{-}65.61)+(65.61\text{-}59.05)+$$
$$+(59.05\text{-}53.14)+(53.14\text{-}4783)+(47.83\text{-}43.05)+(43.05\text{-}38.74)+38.74=100,\ x=90$$
$$s' =(100\text{-}100)+(100\text{-}100)+\ldots(+100)=100,\ x=100$$

Speed of financial resources transformation from one calculation into another may be compared with the clock frequency of a computer and is similarly limited by the speed of payments delivery. The last one is approximately equal to one payment assignment in a second.

Potential opportunities of initial chain reaction are limited by the condition of advance payment of interests of all parties: profits of the bank (k, $k \in K$ (qy), profits of the investor (e, $e \in E$ (qy), profits of the producer (u, $u \in U$(qy) and taxes of all parties. $Nl(q) \cup [(Nli(q), Nlb(q), Nlp(q)]$. More precisely, the minimal losses of investment resources at their transformation from one calculation to another, are equal to the sum

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of advance payments of interests of all parties, or all profit $U(y, q)$. From this follows, that depth of disintegration ($x \in Xiwr$), or the volume of financial resources directed from one calculation to another is always less than 100 %, (x <100) and is restricted by the value $100\text{-}U(y, q)/W(y, q) *100$.

The taxes collected from different sources (producers, the investor, the bank), are concentrated in one place, omitting all intermediate structures, and are distributed from this one place, according to the principle - from everyone on abilities, to everyone by opportunities. Legally, all work is carried out by financial conglomerate which does not require expenses for its existence and does not receive its own profit. Its powers are limited to dispatching of payments and obligations, and term of existence is set by work of the transferring device. Liquidation of information (its transformation in archive) about all payments at the level of financial conglomerate, leads to impossibility of affecting the performance of producers' obligation among each other, and also to uncontrolled growth of economy with serial acceleration.

The producer independently determines, where and for what to send its money, and bears full responsibility for the transit transfers, only before itself. More precisely, the buyer is fully responsible for quality of purchased goods (works or services) if the opposite has not been agreed upon. The produced goods are necessarily are demanded by someone, otherwise, there would have been no transfers (advance payment). It means that problems of goods realization in market economy are conceptually absent. The same occurs with the prices for goods. The advance payment of all expenses, $Zt(y, q)$ and profits, $U(y, q)$ to producer makes changing the price on calculation impossible, thus leading to conceptual stabilization of prices.

Local ($f1$). Contains all parameters of initial ($f0$), amended by the opportunity of rigid configuration of circuits and scrollings, including volumes of credits $S'(y, q)$ and investments $Dx'(y, q)$ in production $W'(y, q)$ on stages of disintegration (y) and synthesis into scrolling (q). Keeps the value-added tax (VAT), $Nds(y, q)$ from producers on the individual account (Rd). Its volume is defined as the difference

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between the sums of the VAT of current $Ndp(y, q)$ and previous calculation $Ndp[(y+1), q]$. Local chain reaction in a regular mode is presented by parameters ($f1$).

$$f1 \supset \{f0, [S'(y,q), W'(y,q), Dx'(y,q)], N'dp(y,q)\}, \quad \textbf{(6)}$$

$$Nds(y,q) = Ndp(y,q)\text{-}Ndp[(y+1),q] \quad \textbf{(7)}$$

$$Rd \cup (Adr, Bnk, Inn, Bik, Rsh, Krh, Tlf). \quad \textbf{(8)}$$

Local chain reaction is supplied by starting regime. From the whole set of calculations forming the technological mega polis, where the depth of disintegration equals to 100 %, we select only $X(y, q)$ =100. Therefore each producer fully transfers the financial resources allocated to him $S(y, q)$ to another one in the volume $S[(y+1), q]$, $S(y, q) = S[(y+1), q]$, satisfying his requirements (contractor), for calculation with the depth of disintegration 100 %, registered in the same megacity (*IWR*). Taxes are not paid, interests of the bank and the investor are not paid, and their sums are accumulated on the separate account, as starting capital (*Inv* and *LimS*) in a regular regime.

Growth rate of GDP in such regime is equal to the product of the initial sum (s) on operation time of the transferring device (in seconds). Ten channels for the transferring device in thousand cities, at average payment 100 rubles, will provide a daily gain of GDP of 86 billion rubles (24 hours * 60 minutes * 60 seconds * 1000 cities * 10 devices * 100 rubles). With the average size of profit (p), p=30 %, in a month, money emission in volume of the received profit (the additional product), or 774 billion rubles (86 billion rubles *30 % * 30 days) is possible.

The amount of money emission (D) is limited by the size of profit $U(y, q)$ (the additional product m from the formula $w=c+v+m$) of all financed calculations.

$$D < \Sigma\Sigma\, U(y,q), y = 1,2,\ldots,Y, q = 1,2, \ldots, Q. \quad \textbf{(9)}$$

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The produced money supply cannot be used in the sphere of consumption as there is no commodity maintenance for it. Investments of 100 rubles in any calculation will be provided by goods only in this calculation. At the same time, they will finance a long circuit of payments, creating in each chain the additional product (m). However, the latter is completely consumed by the sphere of production and is a sort of dope before the regular regime. The printed amount of bank notes (*D*) will become money in the full sense only after it becomes a measure of cost of the goods, or if the sum of the printed money there will be supported by commodity mortgage. All money emission (774 billion rubles) goes for repeated investment in the regular regime which completely provides money with the commodity mortgage and allows it to function as a measure of cost.

The printed amount of bank notes (774 billion rubles) is sufficient for its re-use in a regular regime, only if the average depth of disintegration in it will be in range of 80 %, at 50 % depth of disintegration, for GDP of 3000 billion rubles 1499 billion rubles, or two months of work of the starting regime (774*2=1548) are required. The minimal (critical) sum corresponds to each level of depth disintegration, and beginning from this sum there appears an opportunity of transition from the starting regime to the regular one.

In parallel to the work of the starting regime in a technological mega polis, the critical weight in a format of scrollings ready to investment, with the constant analysis of average depth of disintegration (x') is created. At its concurrence with available critical sum, the starting regime is disconnected. All the amount of the printed bank notes is distributed between the investor and the bank, the regular operating regime turns on. The latter is less effective due to additional financial streams, accompanying the loss of depth of disintegration for the sum of the VAT. In any case, even at 50 % depth of disintegration, in a year and two months after turning on the starting regime of local chain reaction, Gross regional product will reach 3000 billion rubles, with the advance payment of interests of all parties, including taxes.

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Total (*f*2). Provides functioning of chain (non-fund) investments in retail sphere of small and medium business, at the level of organizations having financial resources under the commodity mortgage (or under purchase of the goods) in any volume, starting from the minimal sum (min*S*). Bank technology of scrolling available financial resources. All calculations are made in a non-cash way through financial conglomerate, with the settlement account in any bank. Provides distribution of work depending on the realized abilities. Keeps structures carrying out functions of financial control and tax gathering. Has parameters of local one, except for the starting regime; only payment of taxes is carried out in the place of producer, the investor and the credit organization (with division into federal and local levels) dislocation.

$$f2 \supset (f1, Nds, Nlp, Nlb, Nli); \quad \textbf{(10)}$$

$$Nds \supset \{[Nds'(y,q)=\alpha*Nds(y,q), Rd'(i)], [Nds''(y,q)=\beta*Nds(y,q), Rd''(i)], \alpha+\beta=1\};$$

$$Nlp \supset \{[Nlp'(y,q)=\gamma*Nlp(y,q), Rh'(i)], [Nlp''(y,q)=\varphi*Nlp(y,q), \mathrm{Rh''}(i)], \gamma+\varphi=1\};$$

$$Nlb \supset \{[Nlb'(y,q)=\kappa*Nlb(y,q), Rh'], [Nlb''(y,q)=\lambda*Nlb(y,q), \mathrm{Rh''}], \kappa+\lambda=1\};$$

$$Nli \supset \{[Nli'(y,q)=\eta*Nli(y,q), Rh'], [Nli''(y,q)=\mu*Nli(y,q), Rh''], \eta+\mu=1;.$$

$$Rh \supset \{[Rd'(i), Rd''(i)], [Rh'(i), Rh''(i)], (Rh', Rh''), (Rh', Rh'')\} \cup$$

$$\cup (Adr, Bnk, Inn, Bik, Rsh, Krh, Tlf).$$

where α, β, γ, φ, κ, λ, η, μ – proportions of profit and VAT distributions between federal and local budgets;

Nds, *Nlp*, *Nlb*, *Nli* – matrices of payments of VAT taxes and all the parties' profits (the producer, the bank, the investor);

Rh – settlement accounts of all the parties with a typical set of parameters;

Nds'(*y*,*q*), *Rd'*(*i*) – VAT of *i*–th producer in *q*-th calculation at the stage (*y*), transferred to settlement account *Rd'*(*i*), into the federal budget, at the place of i–th producer's dislocation.

Nds''(*y*,*q*), *Rd''*(*i*) – VAT of *i*– th producer in *q*-th calculation at the stage (*y*), transferred to settlement account *Rd''*(*i*), to the local budget, at the place of *i*–th producer's dislocation.

Nlp'(*y*,*q*), *Rh'*(*i*) – profit tax of *i*–th producer in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh'*(*i*), into the federal budget, at the place of *i*–th producer's dislocation.

Nlp''(*y*,*q*), *Rh''*(*i*) – profit tax of i–th producer in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh'*(*i*), into the local budget, at the place of the *i*–th producer's dislocation

Nlb'(*y*,*q*), *Rh'* – profit tax of the bank in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh'*, into the federal budget, at the place of the bank's dislocation.

Nlb''(*y*,*q*), *Rh''* – profit tax of the bank in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh''*(*i*), into the local budget, at the place of the bank's dislocation.

Nli'(*y*,*q*), *Rh'* – profit tax of the investor in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh'*, into the federal budget, at the place of the investor's dislocation.

Nli''(*y*,*q*), *Rh''* – profit tax of the investor in *q*–th calculation at the stage (*y*), transferred to settlement account *Rh''*, into the local budget, at the place of the investor's dislocation.

Each producer places the information on his opportunities on any web-site in the format of software "TURBO" calculations and transfers authority to make full advance payment, including profit, by rules of chain investment. Calculations contain additional parameters with addresses of sites of current dislocation *e*(*iwr*) and

addresses of sites of contractors, $e[(iwr), j]$, where $j \in J$ – the set of variants of payment of producer's interests. The latter can constantly vary and have no technological binding to calculations.

$$e \supset \{e(iwr), e[(iwr), j]\}. \quad \textbf{(11)}$$

Each organization having financial resources for purchasing commodity-material assets is a potential investor and can create the limited technological mega polis (*IWR*) in any place by calculations, obviously forming circuits with necessary commodity mortgage. So calculation $k1$, located in the site $e1$, with the necessary commodity mortgage, provides an opportunity of payment of contractors on the set of calculations $k2$, $k3$, …, $k(j, y)$, located in the site $e(j,y)$. From all calculations located in sites $e(j,$ y), only calculations $k(j, y)$, with contractors on calculations k$[j, (y+1)$, located in sites $e[j, (y+1)]$ are used.

$$k \cup [k(j,y\text{-}1), e(j,y\text{-}1), k(j,y)], y=2,\ldots, Y. \quad \textbf{(12)}$$

So at $y=1$, the technological mega polis consists of calculation $k1$, chain reaction is impossible, at $y=2$, the circuit consists of two elements and unites calculation $k1$ providing basic commodity mortgage, with calculation $k[j, (y=2)]$, providing payments of software producer interests in calculation $k1$. The longer the circuit, the more calculations will be invested and the more profits will be received

$$IWR \cup \min K(j,y), y \rightarrow \max \quad \textbf{(13)}$$

Each scrolling can be made in the format of an applied package of documents and serves as a subject of achieving consensus between the commodity mortgage and credit resources. The sequence of directing investment capital from one scrolling to another, together with the opportunity of a configuration of circuits of payments in scrollings, represents a combination with the set of opportunities defining rates of growth of investment capital. The cumulative set of scrollings (Q) with the calculated consensus between the commodity mortgage and credit resources, represents a financial casino which is not judicial person, does not have expenses for its existence

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and owns profit on its activity, being computer bank of calculations; functionally carries out process of accumulation of variants of scrollings of financing of processes of producing goods, works and services, with their sorting on profitability.

Financial casino is presented by the opportunity of scrollings configuration in production chain financing, the credit resources allocated under the commodity mortgage, and the investor having interests in each production. Actions of the investor (as player № 1) are reduced to choice of sequence of direction of the profit received from the previous scrolling. The player № 2 is any organization having credit resources at the mortgage of the goods acts. Interests of this organization consist in reception of the necessary quantity of the goods with the maximal insurance stock, and of profits for use of credit resources. Concurrence of interests of two players (the commodity mortgage necessary for the credit organization and the set of the scrollings prepared by the investor or the manager) leads to their financing and payment to the investor its profit. Unlike an ordinary casino, where one party losses and another wins, the financial casino makes profit only on the basis of consensus between the investor and the owner of financial resources.

The sphere of financial casino existence constantly varies and fully depends on financial resources allocated under the commodity mortgage, work or service. The place for existence - any computer with the software "TURBO", having technological mega polis or Internet connection. Time of existence is set by the speed of achieving consensus, increased for the speed of registration of payments and obligations and can be limited by hours and even minutes. The quantity of financial casinos work is defined by the quantity of isolated sources of financing on chain investment technology. The basic condition of existence is the presence of technological mega polis.

Global (*f*3). Carries out the function of financial casino and provides its independence from any operating systems of tax taxation and financial control. Has all parameters of the total one, except for providing tax deduction, (*Nds*, *Nlp*, *Nlb*,

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Nli), leaving it as confidential function to each party. The given scenario does not provide for changes in the structures of management, taxation and financial control, is focused on the use of Internet, by the means of transforming payments from one currency into another, has the opportunity to work with set of investors ($e \in E$) and the credit organizations ($b \in B$) simultaneously, irrespective of a place of their disposition or is transnational, without what or restrictions, unlike all previous reactions.

$$f3 \supset \{(\min Y, \min S, \min K, E(q)>0, f, Oh), \\ [Z(i)+U(i)]*V(i), (W, T, E, K, S, D, Wij)\}. \quad \textbf{(14)}$$

where $V(i)$ – currency exchange rate in calculations;

$Z(i)$ – the cost of i–th producer in invested calculation;

$U(i)$ – the profit of i–th producer in invested calculation.

Global chain reaction is intended for scrolling investment sources of any sizes in transnational scale, irrespective of place of all parties dislocation (banks, investors, manufacturers) on principles chain (non fund) investments, without the use of securities (stocks and shares). Provides for serial gain of investment sources, with guarantees of commodity mortgage. Conceptually provides for repeated gain of volumes chain (non fund) investments, reduces relative density of the stock market in economy to the minimal size, due to transformation of stock market sources in investment scrollings.

Defining in advance economic efficiency of applied application of chain non stock market investments at the regional level it is not obviously possible, as applied information bases can be created only by directly by the very agents. Conceptually chain investment cannot be tested on a small object and then, applied in other scale. In this connection we shall make the analysis of potential opportunities using

imitating models of innovative mechanism of investing in regional development. The quantitative and cost structure of technological mega polis is similar to the initial variant offered in the previous part (Filippovsky, 2007). The basic unit is the region with population of 5 million people, having 50 rayons, with 50 settlements in each rayon. Each other citizen can potentially give calculation for any kinds of works, goods or services, all together 2,5 million calculations. At the territorial level there is one thousand calculations from each settlement; which in aggregate form a technological mega polis of the same capacity.

The software "TURBO" enables dependently work with producers' calculations in the volume up to 150 thousand pieces (the loading module bux.bat, bux.exe) (Marchenko, Gavrilov et al., 2005b). To save memory, only the regimes providing non stock market investment for regional level modelling are involved. Its reconfiguration is made for work with greater capacities, and the regime uniting calculations of 50 rayons in a regional technological mega polis with capacity of 2,5 million calculations (the loading module mgp.exe) is added. Installation of the programming complex is made by the special installation program (the loading module instal.exe). The reduced software "TURBO" can be applied in large rayons where the quantity of calculations exceeds 100 thousand units.

Imitation of technologies is made by the test program (the loading module test.exe). Calculations are made on computer Intel Celeron with clock frequency of 1.6 GHz, hard disk 60 Gb, operative memory of 256 Mb. For organizing technological mega polis at the rayon level (150 thousand calculations) 13,8 Gbytes of memory of hard disk are required, at the regional level (2,5 million calculations) its usage increases up to 18,5 Gbytes without transformation in accounting documents and appendices (payment registers and notices to producers, registration of interests of all parties: investments, the commodity mortgage, profit of the investor and the credit organization, decoding of taxes on INN).

Detailed characteristics of separate files are presented in Table 1. The process of uniting regional technological mega cities in one regional technological megacity required about 9 hours.

Table 1

Information package for technological mega polis

The name and purpose of the files	**Rayon (Mb)**	**Region (Mb)**
Calculation of production prime cost, *kal.dbf*	210	3430
Potential possibilities, *miwr.dbf*	37	605
Transit payments, *liwj.dbf*	95	1530
The major and additional salary, *zpl_1.dbf, zpl_2.dbf.*	86	838
Raw, major and additional materials, *mat_1.dbf, mat_2.dbf*	109	902
Accounting documents, *buxdok.dbf, bux0.dbf ÷ bux9.dbf*	5270	-
Technologic mega polis and financial casino, *urx.dbf, urxy.dbf*	97	2042
Information transformer, *urg.dbf, urg1.dbf ÷ urg5.dbf*	722	9570
Supplements	3556	-
Programming, service and information files	1500	-
Intermediate databases	2468	-
Total	**14150**	**18915**

Imitation of technological megacities on 2,5 million calculations and 150 thousand calculations has been made. The first technological megacity will show potential opportunities of non stock market investments in the scales of the region, the second at the rayon level. The technological megacity of 150 thousand calculations is also a typical example of private financial casino work, having credit resources under the commodity mortgage, e.g. the bank.

Imitation of non stock market investment opportunities was conducted on total and starting chain reactions. A special-purpose designation - installation of concrete volumes of investment and the commodity mortgage (the sum> the producer> the goods> calculation> the mortgage). In our example all the information is of imitating nature and, consequently, the regime for concrete volumes of investment installation is not used. For determining potential opportunities, we made investments into all calculation, forming a circuit from two and more elements (min$Y$), with the volume

of production over 100 rubles (min*S*). The financial casino (the sequence of investments) for rayon and regional technological megacities was created.

In the total regime rayon technological mega polis of 150 thousand calculations, has appeared capable to give GDP of 73 billion rubles; according to accounting balance commodity circulation was 48 billion rubles, financial expenses of producers equal to 5,8 billion rubles, the net profit of producers was 4,1 billion rubles. The credit organization (for example, private financial casino) could involve credit for the sum 22 billion rubles, and has received 800 million rubles, net profit for granting credit resources, together with the commodity mortgage (instead of stock market one), in a required assortment and volumes cost 22 billion rubles.

The investor can receive net profit equal to 3,3 billion rubles, the tax bodies - advance payment of taxes from producer profit - 1,7 billion rubles, the investor - 1,4 billion rubles, and the credit organization - 300 million rubles. The value-added tax (VAT) from producer in amount 4,5 billion rubles is calculated Total amount of investment capital equals to 3,2 billion rubles.

Starting regime in rayon technological megacity with 150 thousand calculations is capable to give GDP of 191 billion rubles. According to accounting balance commodity circulation it was 166 billion rubles, financial expenses of producers were 17,4 billion rubles, the net profit of producers - 3,6 billion rubles. The credit organization can involve credit for the sum of 21 billion rubles, without profit for granting credit resources with commodity mortgage, in a required assortment and volumes in cost of 21 billion rubles. The profit of investor and taxes are not considered. The total amount of investment capital has reached 14.2 billion rubles. (Fig. 1).

In the total regime a regional technological megacity with 2,5 million calculations is capable to give GDP of 1171 billion rubles. According to accounting balance, commodity circulation has reached 798 billion rubles, financial expenses of producers were equal to 179 billion rubles, the net profit

of producers was 65 billion rubles. The credit organization (in our example, the bank) could involve credit for the sum of 366 billion rubles, and received 12 billion rubles, net profit for granting credit resources, together with the commodity mortgage (instead of stock market), in the required assortment and volumes cost of 366 billion rubles.

Investor will have net profit of 53 billion rubles, tax bodies receive advance payment of taxes from producer profit of 28 billion rubles, the investor - 23 billion rubles, and the credit organization 5 billion rubles, all together 56 billion rubles. The value-added tax (VAT) from producers in the volume of 73 billion rubles is withheld. The total amount of investment capital will make 17 billion rubles (Figure 2).

Starting regime in the regional technological mega polis with 2,5 million calculations. is capable to give GDP of 3000 billion rubles. According to accounting balance, commodity circulation has made 2650 billion rubles, financial expenses of producers were equal 290 billion rubles, the net profit of producers reached 64 billion rubles. The credit organization can involve credit resources for the sum 350 billion rubles, and receive commodity mortgage in the same volume in the required assortment without profit for granting credit resources. The profit of investor and taxes are not considered (Fig. 2).

Proceeding from the revealed potential opportunities, it is possible to illustrate dynamics of gross regional product of Krasnodar krai on Figure 3. In practice it is difficult to assume in what degree it is possible to realize the opportunities of chain investment. Everything depends on actual capacity of producer calculations in technological mega cities and presence of credit resources under the commodity mortgage.

Practical implications

Economic efficiency of chain investment technology is non-comparable with any other investment projects. Heads of regions can provide economic growth with serial acceleration, without an opportunity to prevent to this process, basically, due to activization of small and medium business. Investment companies can use this technology for increase in investment resources without problems of recoupment and technological dependence. Businessmen can receive advance payments for all expenses on calculations and profit, not having problems of goods realization in market economy.

In case of technology introduction tax and stock market bodies will repeatedly increase their receipts by advance payment, without problems of controlling their receipt. The above considered mechanism does not mention property interests, does not provide for changes in taxation. The agent-based chain investment opens new opportunities for bank hourly operations, super profitable scrollings of credit resources, in any volumes with advance payment of interests of all parties. The guarantee is the commodity mortgage (instead of stock market one), the volume and nomenclature are established in advance, surpassing the sum of the credit and interest on it.

References

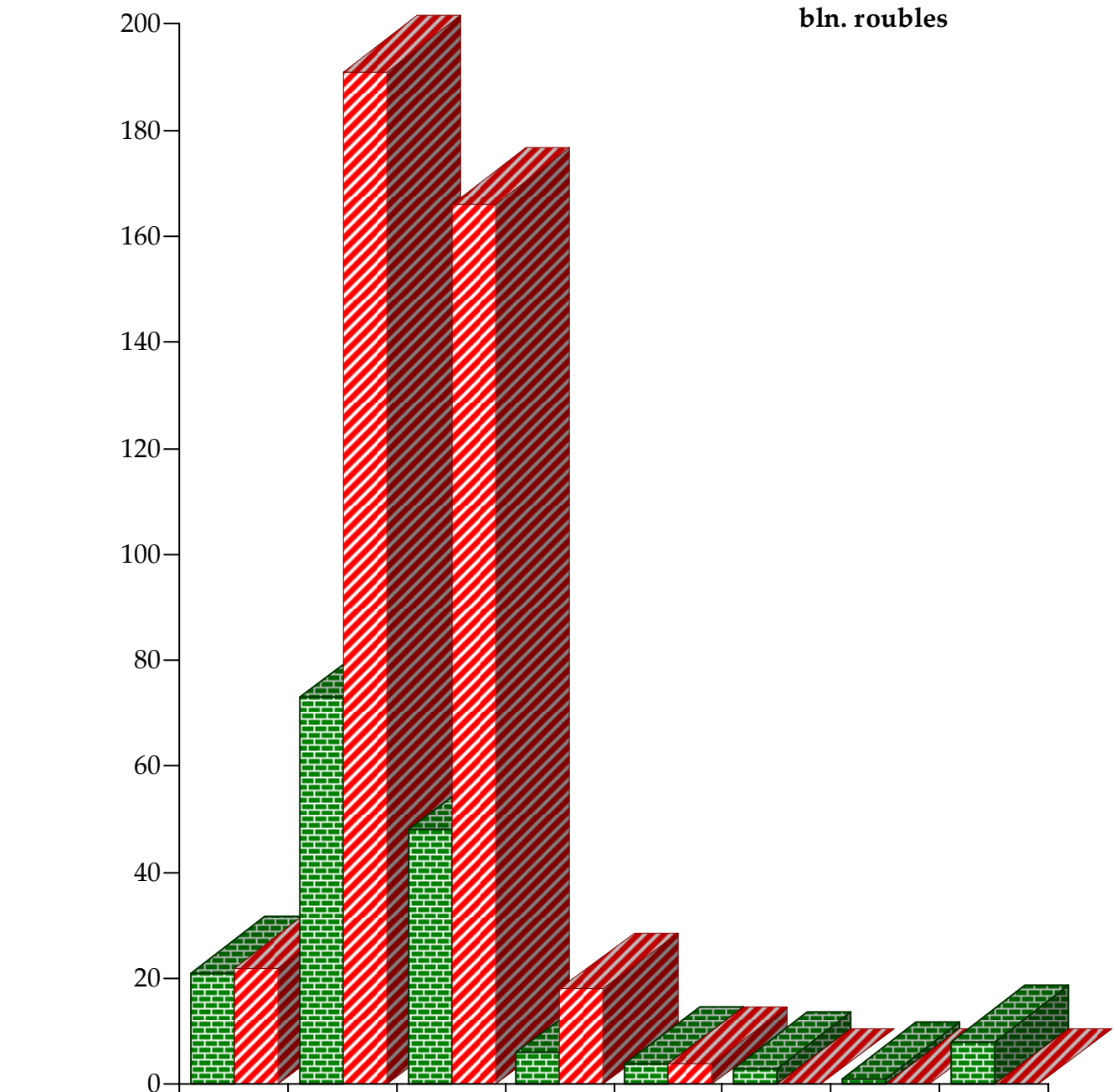
1. Marchenko, D.V., Gavrilov A.A., Trunin S.N., Molochnikov N.R., Schepakin M.B., Baryshevsky I.O. (2005a) Financial hurricane. Chain (non fund) investment. Manuscript in INION, the Russian Academy of Science 08.06.2005 № 59305. Certificate on intellectual product № 73200300046, All-Russia scientific and technical information center.

2. Marchenko D.V., Gavrilov A.A., Trunin S.N., Molochnikov N.R., Schepakin M.B., Baryshevsky I.O. (2005b) "TURBO" Calculations, contracts, analytical accounting, amortization, salary, book keeping. Kuban State University, Krasnodar.

Certificate on an intellectual product № 73200300047, All-Russia scientific and technical information center.

3. Filippovsky, M.L. (2006). Various types of chain reactions in economic development. In: Works of young scientists. The Krasnodar University of the Ministry of Internal Affairs of Russia, Krasnodar.

4. Filippovsky, M.L. (2007). The Agent-based investment technology (Part 1. Initial data). Artificial societies. CEMI, the Russian Academy of Science, 2007. Volume 2, number 2, II quarter.



	Credit	GDP	Commodity circulation	Producer's financial costs	Producer's profit	Investor's profit	Profit of the bank	Taxes
Total	21	73	48	6	4	3	1	8
Starting regime	22	191	166	18	4	0	0	0

Figure. 1. Potential possibilities of chain investment at rayon level (150 thousand calculations).

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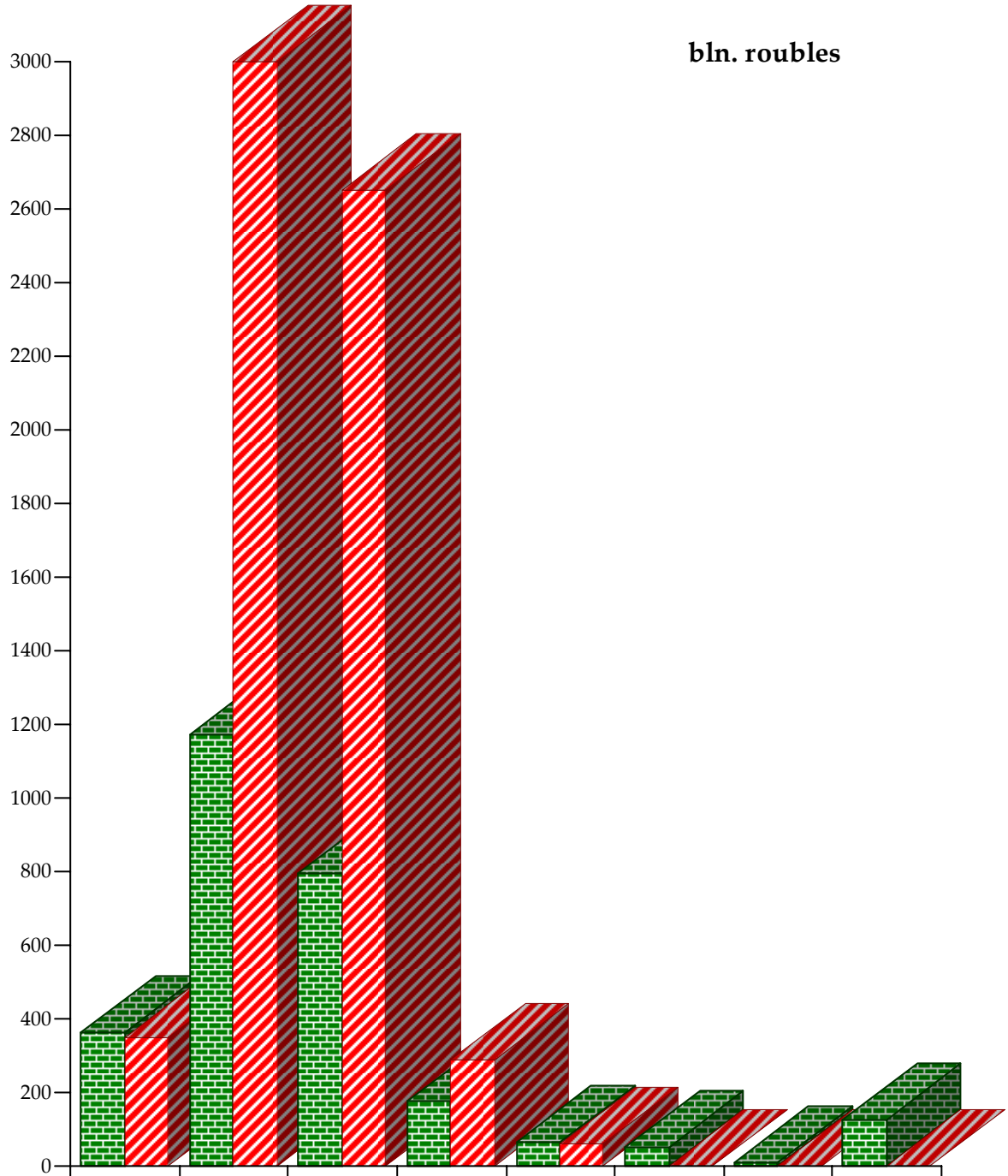

	Credit	GDP	Commodity circulation	Producer's financial costs	Producer's profit	Investor's profit	Profit of the bank	Taxes
Total	366	1171	798	179	65	53	12	129
Starting regime	350	3000	2650	290	64	0	0	0

Figure 2. Potential possibilities of chain investment at the regional level (25 million calculations).

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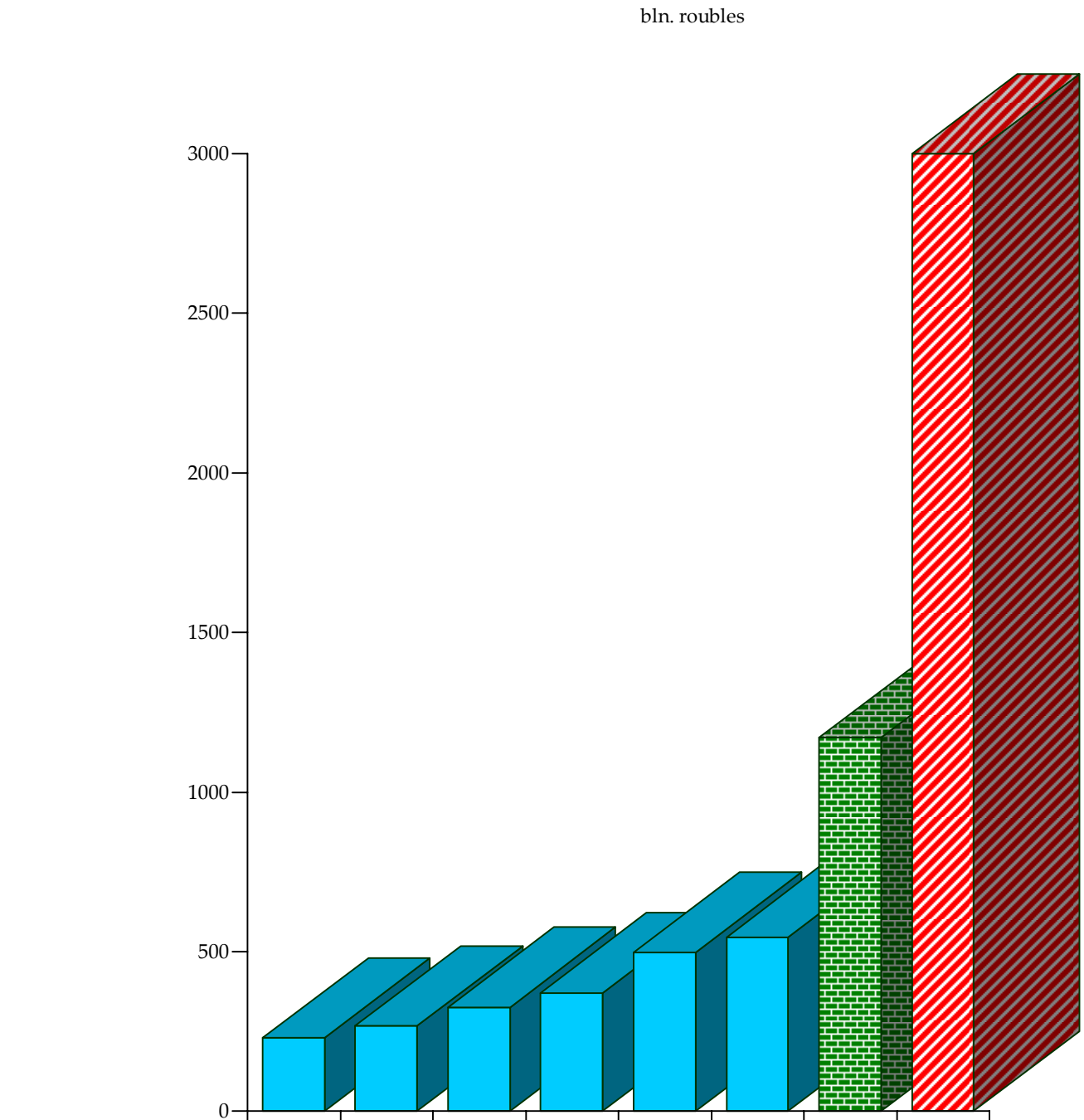

Figure 3. Potential possibilities of GDP growth.

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