Theoretical aspects of the theory of decision-making in terms of contracting in the field of metrological support

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Abstract. The article is dedicated to consideration of the role and significance of applied applications of the theory of finite automata and the theory of relational contracting in economics and metrology. The applied use of the theory of automated control in the general theory of decision making is substantiated in the form of formalizing the rules of rigid logic in the analysis of decisions. The optimization importance of discrete finite automata in the monitoring of economic objects is concretized, a diagram of the relationship between the measuring tasks of metrology and the parameters of the elements of a typical production process is indicated.

1. Rationale

Relational contracts in the field of business of individual entrepreneurs can be implemented or identified as agreements between the parties in which the parties of the agreement (agents) do not try to take into account all possible future circumstances, but, nevertheless, enter into such a long-term relationship (here the past, present and expected future personal relationships that arise between them are important).

In this case, such contracts are related to latent, informal and non-binding. Auto-fulfillment of all contract conditions plays a particularly important role here.
In fact, most transactions in relational contracting are more or less firmly entwined in a dogma of relationships that go beyond the transaction that caused by a discrete random variable. Such transactions are an autochthonous part of current and long-term business alliances. They express their value\[8\].

However, the stochasticity of the form of relations and their relational inconstancy (as well as the frequency incompleteness of contracts in general) are inevitable and deliberate. It is a consequence of the consistency and expressed will of the decision of one of the subjects, but at the same time, within a certain framework, it gives the right to respond to uncertainty to the other party. And all of this can be repeated many times in the future, and this already imposes restrictions on the variety and accuracy of verifiable contract terms. Moreover, quite often incomplete contracts are deeply embedded in the current realities of the relationship.

The parties to the contract in the basis of the contract under consideration are familiar with each other, may have family ties that have a high value parity, and at the same time create circumstances that cause distrust on the part of financial and law enforcement agencies. A significant part of their interaction is carried out outside the framework of the contract, and already within the framework of an analogue random variable, and is directed not by explicitly fixed conditions (the observance of which is ensured by the judicial authorities, primarily by arbitration) but by a balanced combination of synergy of coercion, and the construction of a communication "transparent" legal environment.

2. Mechanism for analysis of relationships based on the principles of contracting

Thus, in general terms, the consideration of relations between individual entrepreneurs in the theory of relational contracts is applicable to precedents in which there is a two-way dependence of agents or contract roles, due to the presence of certain specifiers \[9\].

How to achieve the capabilities of a supervisor in the entire path of relations between people?

After all, contracting is almost everywhere. For example, in the same agriculture, which has been in the focus of many legislators and information technology specialists for a long time. Their job is to find regulation that removes the distortions created by the discrepancy in bargaining power between the parties of the contract and correct imbalances that could automatically put the farmer at a disadvantage without endangering the bargaining process itself.

In general and synthetic terms, the establishment of precise rules for the regulation of such contracts is mainly based on a preliminary definition of the criteria that must be met in such transactions. In this context, there are two fundamental models: models which distinguish contracts for the cultivation of land and contracts for livestock production (in which it is definitely easier to integrate the primary sector and other economic sectors) \[6\].

A valid way to bring the efforts of the formalized logic of economists and lawyers aimed at regulating the economy of the contract is to formalize the theory of decision-making to the relations that exist in the food farming system (for example) between farmers and their counterparties \[4\].

It is necessary to introduce mutual performance between the parties. So in addition to the sale of the farmer's product, the industrial operator is obliged to fulfill obligations in terms of products and services but not only simply pay for the value of agricultural goods.

It is imperative to come to a "deal" from the part of the agricultural hub and go beyond simple payment of the cost of production or barter.

It shall be formalized as a rule of case law that when it comes to animal breeding as a related industry (for example) the transfer of ownership of an agricultural product from a farmer to an integrator is not of fundamental importance \[5\].

The dominant activity may also consist solely in the provision of services in terms of breeding, fattening and production of food of animal origin. At the same time, the rule is a direct reminder of the obligation of the farmer to comply with the rules concatenated by the other party in relation to breeding, supply of factors of production and distribution of finished products.

In general, the formalization of this logic became possible thanks to the theory of finite automata. At the first stage, an indefinite set has been reduced to a non-finite digital automaton, since a relationship that connects indefinite participants based on a certain property of their relations has been introduced.
Then, using the laws of formal (Boolean) logic, everything has been reduced to a mandatory transaction between the parties, eliminating the “transaction is a deal” manoeuvre.

After receiving of a discrete automaton with states already at the stage of registration of case law, the stochastic correlation has been levelled to the level of statistical error in control theory [3].

In order to determine random processes covering the sphere of relations, numerical methods have been used.

First of all, Monte Carlo algorithms that have a wide and confirmed in practice use (in particular, in the analysis of random processes, which will help to unambiguously determine not only the nature and quality of mutual supplies of goods and services, but also the relationship between, on the one hand, fluctuations in the supply prices produced or received by the farmer and, on the other hand, the term, extension, revision and termination of the contract).

But due to the fact that Monte Carlo algorithms work with pseudo-random sets of numbers, data processed on the basis of the history of relationships between agents, expressed in scalar and vector quantities using the mathematical apparatus of graph theory and reinforcement learning on the side integrator of this check (supervisor) can be used as a two-factor way of confirming the theory.

First of all, the criteria adopted for determining performance weights often leave limits of uncertainty and lack of clarity. Moreover, in some cases it is impossible to conduct full assessment of the value of the production (for example for farmer it is impossible to do it upon entering into a contract in terms of his obligation to produce something).

Even if the farmer may know in advance the price of those fertilizer or pesticides that he shall buy from the counterparty and the price of the final product he will receive, he cannot know in advance how much of fertilizers or pesticides he will need.

However, the integrator has the right to decide for him in the course of cooperation, i.e. during the entire production process he has right to process and analyse the state of the discrete system of the seller, which takes place on the farmer's land. Moreover, in animal breeding, farmer is often paid per weight, and the payoff is carried out for the animals remaining in the integrator's ownership, while the risk of death or becoming unfit for sale due to disease is directly on the farmer.

And all of this cannot be calculated in advance or calculated approximately (and inaccurately) especially when the results depend not only on the efficiency of the farmer, but also on the quality of feeds supplied by the industrial enterprise. The cost of these feeds is usually charged to the breeder.

This entropy can be levelled again using finite automata, using the means of Boolean algebra. Considering the finite state machine of a simplified enterprise model, in which there are only counterparties and products, including those products that are purchased for internal needs, Monte Carlo algorithms shall be applied again [7].

It is also recommended to use Monte Carlo methods in an algorithm that simulates policy iteration. Policy iteration consists of two phases: policy evaluation and policy improvement.

It is also used at the stage of evaluation of the generated discrete policy. At this step the goal is to compute the values of the function (or a good approximation to them) for all state-action pairs taking into account the stationary deterministic policy.

Let suppose (for simplicity) that there are enough computational resources to accommodate the action values and that the logistics problem between agents is of an episodic nature, and after each episode a new one starts from some random initial state. An estimate of the value of a given state-action pair can then be computed by averaging the sample incomes obtained from over time. Thus, if sufficient time is available, this procedure can construct an accurate estimate of the action value function. This concludes the description of the policy evaluation stage.

3. Metrology of digital measurements as an indicator of the optimization significance of the made decisions
The analysis of the generated parameters, however, can entail a high waste of time to evaluate sub-optimal policies.
The Monte Carlo algorithm uses sampling inefficiently because a long trajectory improves the estimate of only one state-action pair that started the trajectory. When trajectory returns are highly scattered, convergence is slow [10].

After evaluation, formalization is reduced to a regulatory solution from management theory. For example, in case of violation of a certain provision, the contract can be automatically declared invalid at the request of only the farmer [5].

This helps to reduce the information gap that can affect the farmer, who is often subject to the general terms of the contract (if it is not about the forms prepared by the other party unilaterally). In particular, the current regulation is not aimed at changing of the economic balance of the exchange that is left to the discretion of the parties.

But in this case, an unjustified and unregulated risk to the economic security of the measures taken is the aspect of the depth of accuracy of both the calculation itself and the decision-making.

The indispensable reduction of analog values (specific indicators of entrepreneurial activity to discrete values determined by the depth of sampling) is an important parameter.

Modern digital-to-analog converters have different bit depths (as well as adjacent electronic devices). The variety of logical levels determines a decisive role for the quality of measurement control.

In order to determine the relationship between the measuring tasks that are solved in the economic application and the parameters of the components of a typical production process (including the process considered above), a graphical diagram of this interaction has been prepared (figure 1).

![Figure 1. Processing map of the impact of metrological measurements on economic losses.](image-url)

The constructed graphical diagram allows to apply the system analysis diagram as follows.

For the "Measurement Processes" group, three sets of subgroups of the object of economic contracting shall be identified by analysis: a measuring device, flow rate measurements during accounting and dosing, measurements during process control.
Then the most important parameters of the product shall be determined and divided into conditional subgroups: "resource consuming" and "resource consuming during use". In this case, it is proposed to apply the metrological apparatus of all units of the entrepreneurial activity facility.

Moreover, there are technical passports for all types of modern devices. It became possible due to the many years of work of organizations responsible for metrology and standardization. At the same time, if these parameters are not directly indicated in the technical passport (its digital copy, convenient for analysis within the framework of decision-making theory), it shall be established empirically, having predetermined the simulation of the device operation due to the described instrumentation in the form of the Monte Carlo algorithm.

Empirical sampling shall focus on the largest possible number of input and output data [1], which is achieved by using the bitness of the data equal to the bit width of the technological device or control device. In the case of analogue devices, matching scheme shall be applied taking into account the possibility of sampling the bit width by one order more. During analysis of the accuracy of the parameters of equipment (for example farmer’s equipment), a comparative approach shall be applied by taking a list of devices of a similar configuration and, by analysing of the digital copies of technical documents and by establishing of the average error of this class/type, in order to check the compliance with the average values of specific devices. Reliance on the existing electronic databases of actuators, sensors and elementary base for system analysis will significantly reduce the level of differentiation [2] of all types of errors without replacing equipment. In this case volatile parameters of raw materials, materials and energy which have an indefinite effect on the level of error and which are less suitable for the synthesis of certain solutions will ultimately have a negligible impact in the final decision-making related to the purchase and sale of goods between objects of relational contracting [11].

4. Findings

Thus, carrying out a multilateral systematic analysis of the relationship between the farmer and the buyer allows us to solve the general problem of one-sided and bilateral validity of contractual relations, solve the issue of analyzing and checking the subjects of long-term relations, increase the accuracy of measurements and correct decision-making in the strategic planning of an economic activity object. The optimization value is supported by the impartiality of the input data, the significant components are delegated to the analysis of random variables, while the subjects themselves are formalized in the form of finite state machines. The use of hybrid methods from discrete mathematics and stochastic studies allows one to give consistent and maximally close to real values results with minimal computational costs.

References

[1] Begunov A A 2013 Metrology. Analytical measurements in the food and processing industries: Textbook for universities (Saint Petersburg: GIORD (The Publishing house of food and agriculture industries)) 464 p
[2] Begunov A A and Patsovslyi A P 2016 Metrology. Methods, tools and techniques for analytical measurements in the food and processing industries. St. Petersburg, GIORD, Textbook for universities (Saint Petersburg: GIORD (The Publishing house of food and agriculture industries)) 608 p
[3] Vapnik V N 1979 Recovery of dependencies based on empirical data (Moscow: Nauka) 449 p
[4] Zakharov V A and Temerbekova G G 2016 On the Minimization of Finite State Transducers over Semigroups. Modeling and Analysis of Information Systems 23(6) (Moscow: Publishing house of the Moscow State University) pp 741-53
[5] Ivanova E V 2018 Contractual law in 2 volumes. Volume 2. Special part: Textbook for bachelor and master programm 2nd edition (Moscow: Publishing house "Urait") 420 p
[6] Malaya T N and Nesterova T I 2016 Agricultural producers as the side of the contract of contracting (of sale of agricultural produce) Property relations in the Russian Federation 7 pp 38-45
[7] Podinovskiy V V and Gavrilov V M 1975 *Optimization as per consistently applied criteria* (Moscow: Soviet radio publisher) 176 p

[8] Shamin R V 2019 *Machine learning in problems of economics* (Moscow: Green Print) 140 p

[9] Morozova T, Akhmadeev R., Lehoux L, Yumashev A, Meshkova G and Lukiyanova M 2020 Crypto asset assessment models in financial reporting content typologies *Entrepreneurship and Sustainability* 7(3) pp 2196-21 doi: 10.9770/jesi.2020.7.3(49)

[10] Akhmetshin E M, Kovalenko K E, Mueller J E, Khakimov A K, Yumashev A V and Khairullina A D 2018 Freelancing as a type of entrepreneurship: Advantages, disadvantages and development prospects *Journal of Entrepreneurship Education* 21(2) https://www.abacademies.org/articles/Freelancing-as-a

[11] Vasilev V L, Gapsalamov A R, Akhmetshin E M, Bochkareva T N, Yumashev A V and Anisimova T I 2020 Digitalization peculiarities of organizations: A case study *Entrep 7* 3173-90