



A securitization model development for research and development clusters of works execution risks hedging when creating distributed aircraft and aviation systems

Desarrollo de un modelo de titulización para cobertura de riesgos en clusters de investigación y desarrollo en la creación de diversos sistemas de aeronaves

ERMAKOVA Olga V. [1](#)

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ABSTRACT:

The purpose of the study is to substantiate the possibility and develop a model for the use of securitization for hedging the risks of performing research and development (R&D) work clusters. The securitization methodology is based on contractual relationships and the application of a set of derivatives. It is proposed to use the stages and types of R&D work, characteristics, incomplete research, and its results as assets and liabilities of a derivative. As a result, the author developed a conceptual functional model of R&D securitization, describes procedures of its using and hedging the risks of performing R&D work clusters when creating distributed aeronautical systems.

Keywords: Distributed aircraft and aviation systems, hedging, research and development (R&D), securitization

RESUMEN:

El propósito del estudio es fundamentar la posibilidad y desarrollar un modelo para el uso de la titulización para cubrir los riesgos de realizar grupos de trabajo de investigación y desarrollo (I&D). La metodología de titulización se basa en las relaciones contractuales y la aplicación de un conjunto de derivados. Se propone utilizar las etapas y los tipos del trabajo de I&D, las características, la investigación incompleta y sus resultados como activos y pasivos de un derivado. Como resultado, el autor desarrolló un modelo funcional conceptual de titulización de I&D, describe los procedimientos de su uso y cobertura de los riesgos de realizar grupos de trabajo de I&D al crear sistemas aeronáuticos distribuidos.

Palabras clave: Aviones y sistemas de aviación, cobertura, investigación y desarrollo (I&D), titulización

1. Introduction

The purpose of the study is to justify the possibility and the formation of the principles of applying the securitization methodology, previously applied only in the field of circulation of securities, secured by assets, to the processes of R&D.

The main features of R&D implementation when creating distributed aircraft and aviation systems are determined by the inherent characteristics of research work, it is a high degree of the result obtained uncertainty and the difficulty of direct comparison between the money costs and the results obtained during R&D. The urgent problem of scientific research effectiveness increase is the need to improve incentive mechanisms for meeting the deadlines for the stages and certain types of work, obtaining systems that meet modern scientific and technical requirements, differentiating and insuring risks that arise in the process of performing work.

To effectively manage the process of performing R&D and optimize the distribution of works sets between their Contractors, the use of cluster modelling approaches is proposed.

A cluster is a combination of several homogeneous elements, which can be an independent object with certain properties. "Cluster analysis" was first proposed by mathematician R. Trion (Tryon, 1939). It is used for large amounts of information in various fields of activity for grouping various sets of objects, works, concepts, etc.

The main tasks of cluster analysis and modeling for R&D are: typification, conceptualization, objectivity, and independence, improving the reliability of R&D.

For transferring to co-execution, the works are grouped into clusters this is a grouping according to the distinguished features and criteria of the research work types when creating distributed aircraft and aviation systems. In this case, the same type of works is not performed by different collaborators at the same time (Ermakova, 2017).

The resulting cluster can be transferred for co-execution to an enterprise, organization, company that specializes in solving this R&D problem, or to a group of specialists (specific performers with the appropriate level of education, specialization, qualification, work experience, the presence of relevant achievements in the field of research). The competence and qualification level, which can be also evaluated based on the achievements' results or in another way, is not yet a guarantee of the quality of each subsequent work. That is, in any case, there is a risk of not achieving the desired result or not receiving the specified technical, technological and other R&D results. At the same time, the existing contracting system for the performance of work does not stimulate Contractors to increase the result's scientific and technical level. This situation significantly slows down scientific and technological progress, not allowing bringing innovations to implementation in time or losing them altogether.

It is proposed to use the securitization methodology to reduce the level of uncertainty in achieving technical, technological, financial and economic results and hedging risks of the achievement degree based on the terms of reference (ToR) and not receiving actual R&D results. This methodology was previously used only in banking as a way to attract financing and reduce risks by issuing debt securities backed by certain assets.

Securitization was proposed by L. Ranieri, head of the mortgage department of the Salomon Brothers investment bank, in 1977 in an article devoted to the description of the process of subscribing and placing the first issue of securities secured by a pledge of rights of a property claim on mortgage loans (Monroe, 1977; Kazakov, 2003; Cairns, Blake, Dowd, 2006).

According to the dictionary of financial terms, securitization comes from the English word "securities". In the banking sector, it is the process of converting bank loans or credits into issued securities such as eurobonds (Osadchaya; 2000).

Securitization is considered by some authors as the conversion of assets into securities (Osadchaya, 2000; Ber, 2007; Heyr, 2007), which allows to reduce the cost of financing sources and improve the balance sheet by freeing companies or financial institutions from illiquid assets and associated risks.

Securitization is often understood as the replacement of bank lending with new financing schemes based on the issue of securities traded on the stock market that have all the attributes of exchange instruments and are listed (Order, 2006; Nikolova, Rodionov, Mottaeva, 2016).

It is the process of creating securities backed by cash flows that are separate from the original owner (Ermolaev, 2009).

The study of the considered concepts and theoretical provisions determines the possibility of applying the securitization methodology for hedging the risks of performing R&D work clusters.

2. Methodology

It is proposed to use a securitization methodology based on contractual relationships and the use of a combination of derivatives to hedge the risks of performing R&D work clusters when creating

distributed aeronautical systems.

The possibility of applying this securitization methodology to regulate R&D implementation processes is due to the fact that, firstly, they have a contractual relationship, financing of work is secured by an agreement, according to which the money is transferred between participants in scientific research (in the banking sector, money is exchanged for securities); and secondly, R&D contract can be qualified as a security one.

For R&D, in accordance with the subject of the securitization use area introduced by L. Ranieri (Monroe, 1977; Kazakov, 2003; Cairns, Blake, Dowd, 2006), the following characteristics are also inherent:

- Long investment periods (typical for the mortgage process and issued securities), which corresponds to developments in the field of creating distributed aircraft and aviation systems;
- Emerging property rights to the results of R&D (typical for securities, which are the property claim of one person in relation to another), which are issued to business entities, participants of the research process relations.

Other important parallels can also be formulated that make it possible to conclude that securitization theory can be used to hedge R&D performance:

- When financing the R&D cluster of works, part of the funds is transferred by steps to the performers as advance payments, which corresponds to the principles of crediting;
- Due to the fact that the processes of creating distributed aircraft and aviation systems are characterized by a high degree of specialization, which justifies the need for the clusters of work formation, and cooperation, which implies a large number of Co-Contractors in carrying out R&D, Co-Contractors financing of the clusters of R&D works is a specific scheme;
- The agreement for the implementation, transfer of clusters to competent Contractors and an obligation to obtain a certain scientific result existence corresponds to the concept, issue essence and circulation of securities.

At the same time, in relation to R&D creation of distributed aircraft and aviation systems, the scientific-technical result has a more significant concrete value than the security, since the R&D result cost is potentially the sum of the scale of its implementation or application to new systems creation, and the scientific-technical result may also be used in various fields of activities, for example, through the conversion or development of parallel concomitant non-core production.

To reduce the cost of R&D, it is possible to offer additional financing through the issuance of bonds in the amount equivalent to the Co-Contractors' nominal capital. That is, to implement the securitization mechanism, it is proposed to use the property of R&D organizations for refinancing into liquid assets. Bond issue in this case is possible without the provision of any additional guarantee banking obligations, while significantly increasing the estimated capabilities of the R&D Co-Contractors, the degree of their financial rotation in relation to persons interested in research results.

In the case of R&D performance, the results of works creation can be equated with the issue of securities. In addition to derivatives in the securitization scheme, legally established R&D results such as: industrial design, license, patent, etc. can be applied in circulation. Each of these results can initiate a cash flow through licensing, concession and other relationships; in the scientific field of the aviation industry, the number of created intangible assets is significant, which also makes it possible and relevant to apply securitization theory in this study. In addition, the creation of R&D performance obligations can be amounted to the issue of securities, it means that an option to implement a securitization scheme can be offered, in which the right to perform R&D clusters can be sold to the Co-Contractors. This type of relationship will be of interest to scientific organizations with a high level of scientific-technical groundwork. By acquiring the rights to carry out research work, in fact, the company receives money for the previously created intellectual property.

Using the securitization methodology implies the formation of pools of stages and types of R&D work and giving them the form of a derivative that circulates among participants in the process of performing work.

In addition to the stages and types of work, various characteristics of the work performed, unfinished research, and R&D results can be used as assets and liabilities of the derivative.

Thus, when applying the securitization methodology to the R&D process, the risk associated with the assets (liabilities) is transferred, and not the asset (liabilities) itself. At the same time, not only basic assets, but also liabilities is collateral for circulating financial instruments.

3. Results

As a result of a study of the theory and practice of applying the securitization methodology, the possibility was identified and principles for applying the provisions to hedge the risks of performing R&D work clusters were formed.

The following critical functions of using securitization in R&D have been identified and formulated:

- Hedging of risks, which include not only the risks stated above, but also credit risks, liquidity risks, currency and others;
- Risk diversification by transforming subsidiary liability while performing R&D into joint liability of Co-Contractors;
- Risk diversification by R&D clusters;
- Improving risk management by:
 - Transferring to Co-Contractors who, for a fee and due to their qualifications and competencies, are ready to take them;
 - Reinvesting funds in the R&D cluster development or in the purchase of R&D obligations, which corresponds to the scientific-technical Contractor's capabilities and are of the minimum risk for him;
 - Deconcentrating of the cluster portfolio to carry out one or more R&D.
- Conversion of illiquid assets into liquid assets and liabilities;
- Cost reduction by attracting lower cost capital by placing convertible bonds of R&D Co-Contractors.

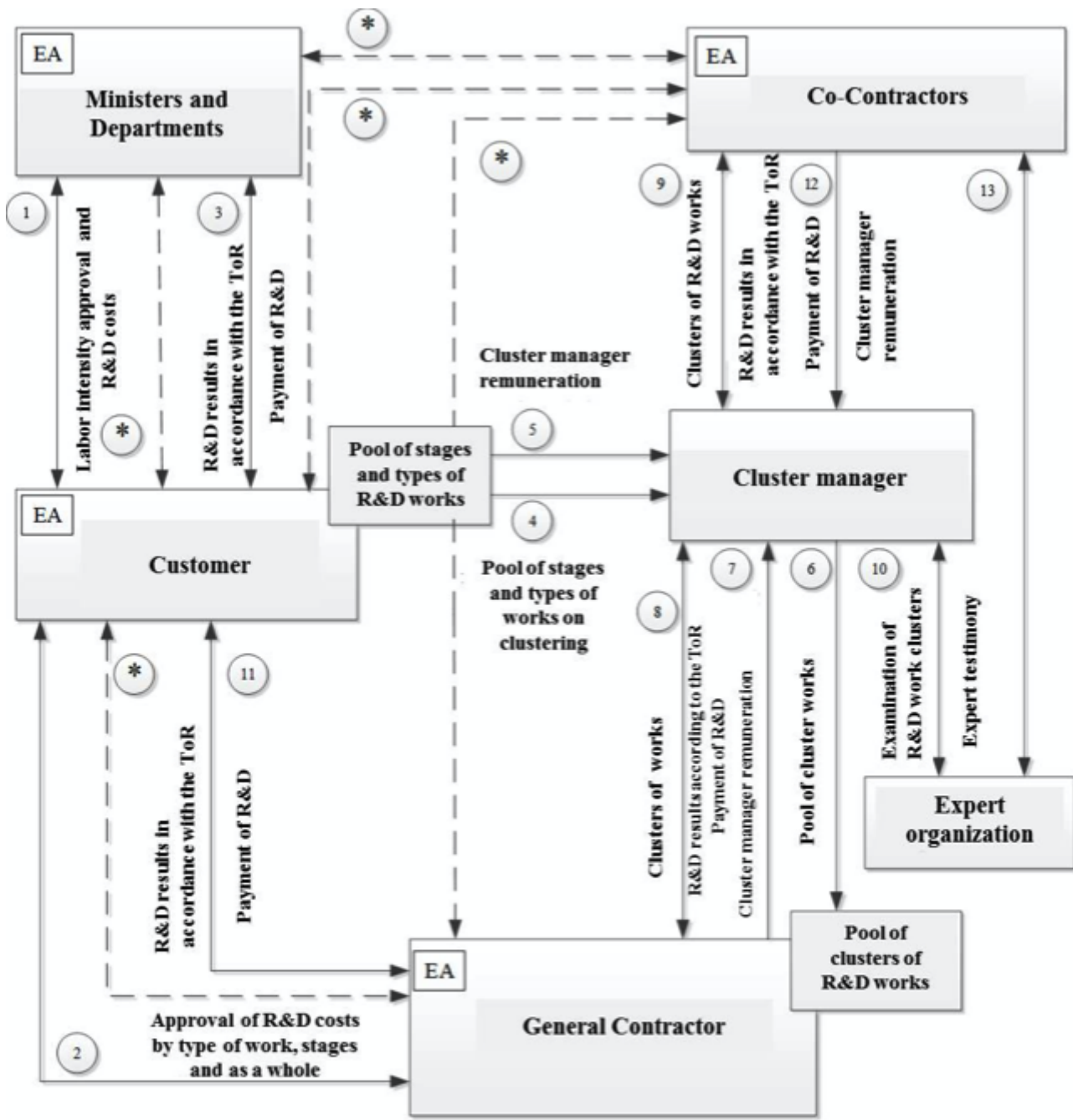
Using the securitization methodology involves the formation of stages' pools and types of R&D work and forming them as a derivative, it means, a derivative of a security circulating among participants in the process of performing work.

In addition to the stages and types of work, various characteristics of the work performed, unfinished research, and R&D results can be used as assets and liabilities of the derivative.

The main result is the developed conceptual functional model of R&D securitization for risks' hedging of performing clusters of works when creating distributed aircraft and aviation systems which is presented in Figure 1.

Figure 1

Conceptual functional model of R&D securitization for hedging the risks of performing work clusters when creating distributed aircraft and aviation systems



1-13 R&D implementation contour when creating distributed aircraft and aviation systems

- * R&D process hedge contour
- derivatives on work clusters
- derivatives for additional R&D results
- additional R&D results
- recurring payments under the contract it means variation margin

The main subjects of the securitization model functioning are:

- Ministries and departments which can manage the budgetary funds in accordance with the Budget Code, form orders for R&D, distribute orders to General Contractors, and settle contracts on R&D.
- A company that can be institutionally represented by any domestic or foreign organization which is interested in the R&D results as a direct consumer, intermediary, person that is going to further refine what has been received.
- General Contractor is an enterprise in the aviation industry that is selected by the Ministry, the department or the company as the institution that signs the general contract or framework contract on the R&D implementation, forms the final result and transfers it to the customer.
- Co-Contractors of works are the enterprises of the aviation industry that carry out separate clusters of works in accordance with agreements, where the customer is the General R&D

Contractor.

- A cluster executive is a specialized company or department in the structure of an enterprise whose functions are to transform the pool of types of works performed by R&D into clusters based on them, taking into account competence, specialization, qualifications and other scientific work Co-Contractors. The cluster executive carries out permanent monitoring to rank the companies, potential Co-Contractors of R&D. At the same time, various assessment indicators can be used, including those officially recommended for determining the organizations' scientific potential. The R&D clusters formed on the basis of the types of works are also evaluated to determine novelty, complexity and other characteristics. To ensure the distribution of works' adequacy, the cluster executive compares the characteristics of R&D and the Co-Contractors' possibilities according to the criterion of the estimates' minimum deviation. The resulting assessments and recommendations are transmitted to the general Contractor, which further decides on the distribution of clusters for R&D.

- An expert organization is an independent company that forms a conclusion on the conformity of the results obtained during R&D with the terms of reference (ToR). A conclusion on the presence of additional significant R&D results that exceed the characteristics of the ToR is also drawn up. The conclusion about the availability of additional scientific results is the basis for initiating the variation margin movement between the participants in the derivative contract.

The scheme includes two contours of relations between the subjects of the securitization model: the R&D implementation contour and the hedging contour.

The distinguished R&D implementation contour includes the processes of interaction between subjects during the initiation of work, the formation of pools of stages and types of R&D works with their subsequent clustering, the implementation of clusters of works, the works' evaluation and their results, the transfer of R&D results and their payment.

The R&D process includes the following actions:

- 1 and 2 Labor intensity approval and R&D performing costs by the types of works, stages and R&D as a whole, the preliminary calculations' results are the information basis for approval. The approval object at this stage is a pool of types of work, combined into stages, which are recommended to be grouped in accordance with the methodological principles developed in (Ermakova, 2018).
- 3 Transfer of R&D results in accordance with the ToR, if the R&D Contractors is the Ministries or Departments, they receive R&D results and further decide on the results' transfer to the enterprises of the aviation industry for management, use, registration of the scientific result;
- 4 Transfer of a work types pool and R&D stages to clustering, the cluster executive groups the work into clusters, generates various recommendations for attracting collaborators;
- 5 Payment for the services of a cluster executive does not lead to a cost rise of R&D as a whole, since the use of a securitization mechanism reduces the cost of possible improvements, which, as a rule, lead to a rise in the cost of R&D in the future;
- 6 Approval of clusters with the general Contractor. The general Contractor, as the person responsible for the R&D results before the Customer, makes the final decision on the distribution of work;
- 7 Payment for the services of a cluster manager, if changes are required in connection with the dissenting opinion and priorities of a brilliant performer, the clusters are adjusted, such work is paid for by the funds of the general Contractor;
- 8, 9 Placement of clusters for R&D; transfer of R&D results within the terms of reference; payment for scientific research it means that the general contractor can carry out relationships with Co-Contractors – directly or through the intermediary of a cluster manager; when paying for R&D, methods like advance payment, phased prepayment, in accordance with the agreed time schedule for payment; it is recommended to constantly monitor R&D results to make operational decisions on adjusting clusters of R&D works, identify inconsistencies and identify signs of a possible improvement in results, this information is the basis for making managerial financial and economic decisions when implementing a hedge contour for the R&D process;
- 10 Expert evaluation of R&D results; obtaining a decision which means that the general Contractor independently or the cluster manager, order and receives the decision on the conformity of the R&D results with the ToR under the authority;
- 11 Transfer of R&D results within the terms of reference; payment for scientific research it means that the general Contractor generates the aggregated results of R&D and transfers it to the

Customer in accordance with existing procedures in the aviation industry;

- 12 Payment for the services of a cluster manager means that Co-Contractors, to obtain additional results of scientific research, can modify them with the involvement of third parties, which may require the development of clarifying clusters that will allow to obtain the extra results than expected in the terms of reference;

- 13 Expert evaluation of additional R&D results; obtaining a decision which means that such an expert evaluation is ordered by the Co-Contractors, the expert testimony is a documentary basis for making managerial financial and economic decisions in the implementation of a hedge contour of the R&D process.

- The action procedure of the R&D fulfillment contour shows organizational and documentary connection with the hedge contour of the R&D performing risks of clusters of works when creating distributed aircraft and aviation systems.

Within the framework of the R&D securitization functional model, the hedging contour is indicated by double-sided dashed arrows. The following entities participate in the risk hedging procedure: from Ministries (departments) to Co-Contractors of work; from Ministries (departments) to the Customer; from Co-Contractors to general Contractor; from co-executors to Customer; from general Contractor to Customer.

At the same time, the main tasks of making justified calculations for performing clusters of R&D works in accordance with the results obtained in the framework of the ToR and for achieving additional results that exceed the ToR level of the results that can be obtained.

The hedging contour, taking into account the formulated tasks, is implemented by the following procedure:

- Choose the type of derivative that allows you to receive funds that can be used to refine the R&D cluster or transfer it to bring the desired result to third parties when an insured event occurs. As a derivative, you can use various derivative financial instruments – swaps, futures, options, forward contracts (Hall, 2007).

- Insure the case of failure to achieve the desired results by paying the value of the derivative. The payment made is the higher, the greater the probability of not achieving the required scientific result. The hedging fee is paid before the start of the R&D cluster work, which, from the point of view of bringing money to a zero point in time, makes these payments more significant than the value of the variation margin when an insured event occurs. All this stimulates the Contractors to conduct research with high quality and on time.

- If an insured event occurs, the opposite side of the derivative contract pays the variation margin to the Contractor.

- In the case of obtaining an additional result when performing a R&D cluster, confirmed by an expert testimony, the Contractor pays the variation margin to the opposite side. However, the Contractor has property rights to additional results obtained, which may be alienated in the future, and for which the Contractor receives a refund. Additional results can be evaluated at market value.

To improve the securitization functional model implementation, it is proposed to use a specialized account for its main subjects – Ministries, Departments, the Customer, the General Contractor, and the Co-Contractors of works, which allows making counter payments of variation margins without any additional problems. This account is indicated for each entity in the form of an escrow account (EA). It is used to record and block funds received from the account holder for the purpose of transferring to another person when the grounds stipulated by the contract arise, therefore it can be used as a way to ensure the execution of circumstances (Slesarev, Bogacheva, Belova, 2016). In the form of an EA type account there are made payments between participants in the securitization procedure if there are documentary conditions confirming the presence or absence of scientific research results. Such documents include expert testimonies, a transfer and acceptance act, a registered patent, an industrial pattern and the results of its approbation, etc. Based on these documents, a financial institution makes payments.

4. Conclusions

The application of the securitization methodology and the inclusion of additions to the R&D agreement that allow hedging risks, improving legal, economic, and managerial relations between the parties made it possible to distinguish its reversible part, which corresponds to the derivatives, in the structure of the R&D agreement, to form uniform pools of assets and liabilities and give

them the form of derivative financial instruments that are freely traded among a variety of stakeholders.

The following may serve as various assets and liabilities: characteristics of work performed; R&D work stages; individual work or group of work; blocks of incomplete research; R&D results; amount of funding needed to carry out R&D and other assets.

Interested parties to the securitization process include: customers, contractors and co-executors of R&D, investors, ministries, departments, management companies, expert organizations, etc.

Any combination of characteristics, R&D results and financing volumes can be transformed into market instruments and offered to interested parties (securitized).

As a result of the study, the principles of applying securitization to R&D processes were formulated and justified, conceptual functional model of R&D securitization was developed to hedge the risks of performing work clusters when creating distributed aeronautical systems, procedure for R&D using the securitization methodology was described, risk hedging procedure and main subjects of R&D securitization was identified.

The developed conceptual functional model of R&D securitization uses a grouping of works according to the cluster principle, which allows them to be divided into logical groups, lay down various signs of dividing the types of work performed, isolate homogeneous work for transfer to co-execution, hedge risks by transferring risk to specific clusters rather than R&D in a whole.

It is possible to insure the following risks: violation of the movement of payment flows at the stages of the execution of work clusters; change in the complexity of the work when they are transferred for co-execution; change in the cost of R&D; change in requirements, conditions or scope of work; change in funding for R&D; deadlines for their implementation; impossibility of achieving the work results specified in the ToR.

Thus, the securitization of the implementation of R&D work clusters is a mechanism that allows expanding the possibilities of efficient movement of funds under the work contract, converting illiquid assets into liquid form, and hedging the risks of R&D when creating distributed aircraft systems.

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1. PhD, Docent, Moscow Aviation Institute (National Research University), 125993 Volokolamskoe highway 4, Moscow, Russia, over_econom@mail.ru

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