

# Educational Methodical Activity in the University: Simulation and Economics

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**Abstract.** The universities in Russian Federation are now in the transition process to competence approach usage. Federal State Educational Standards are used to guarantee appropriate level of university graduates competence. To achieve this goals a great methodical activity is needed. A complex set of educational methodical documents must be developed, controlled, published and implemented by each university. We focus on the labor costs of university staff on educational methodic activities. Our goal – is to estimate labor expenditures and to discuss the ways to reduce them. We use unified model language (UML) to create visual models of university methodical activity processes. Then we use computer-aided generation of simulation models from UML diagrams. Simulation results include labor costs on educational methodical activities processes. Simulation can discover most expensive operations and processes, estimate total expenditures of the university staff. Automation effect on educational methodical economics can be also assessed. We discuss directions of lowering expenditures on educational methodical activities with automation and process optimization.

## 1. Introduction

Under circumstances of competent approach introduction in Russian Federation educational institutions and Federal State Educational Standards (FSES) of the third generation and the following generations, the volume of educational methodological work increases greatly. The task of educational-methodological support formation and expertise mainly concerns the university teachers and leaders of educational departments. The goals of development, arrangement, control and monitoring of educational methodic documents demand great labor costs. Moreover, part of them, for example, improvement of working program from the previous year format to the new year format, may be called “routine”.

In such cases when the rate of teaching load extends the limit, it involves such troubles as: the lack of time for lessons' preparation and scientific research, negative moral state, professional burnout, decline in educational methodic supply.

The questions of State Standards implementation in Russian educational institutions and the problems connected with them, found their reflection in Russian science. Pedagogical, methodological, organizational and technical aspects of FSES3 and FSES3+ introduction into the teaching process is widely discussed in the materials of scientific conferences and in scientific journals [Suchomilin 15, Korchagin 16, Miroshnichenko 12, Korolev 18]. Besides, many authors underline the

necessity of a lot of effort, spent on educational methodological support and problems, connected with it [Korshunov 10, Freiman 12].

It must be mentioned, that European Universities come in touch with the same problems. They are connected with the efforts, spent on methodological maintenance of the teaching process under Bologna convention [Blatter 10, Surssock 10, Wilson 09].

The problems of educational institutions automation, under circumstances of FSES3 and FSES+, also arise and must be solved by practical specialists. The principles, directions, problems of automation are depicted in scientific and technical literature [Eremina 14, Nisman 11]. Moreover, the importance of teaching content model is admitted, as the basis for informational systems building. It concerns mathematical, visual, theoretical multiple models. [Archipova 13, Fionova 11].

So, this scientific research not only correlates with the existing tendencies, but also opens new direction. It concerns the question of economic constituent, relating to the process of educational methodical support formation. We apply to the formalized methods of analyses and modeling. Models, which suggest not only understanding of educational institution activity in providing educational methodical support, but also quantitative estimation of it, are suggested here.

**2. Task**

The aim of the presented article is estimation and minimization of teachers' efforts on the development of educational and methodic support of the educational institutions' teaching process. In order to do this it is suggested:

- to investigate and identify the process of formation of educational- methodic materials in the educational institution;
- to built a visual model of the educational-methodic supply formation processes;
- on the basis of this model, make a simulation modeling and get the estimation of work, spent on the fulfilling of these materials formation.

**3. Development of methodology**

*3.1. Process identification*

On the basis of the analyses of educational institution's departments activity, literature analyses and normative documentation, there were pointed out the main business-processes of educational-methodic activity. The list of the business processes is given in the following table 1, which shows the executives of different processes, period of their implementation and peculiar conditions of their fulfillment.

**Table 1.** Educational methodical process list.

<b>№</b>	<b>Process</b>	<b>Trigger Conditions</b>	<b>Teacher</b>	<b>Expert</b>	<b>Department Headmaster</b>	<b>Secretary</b>	<b>Education Department Head</b>
1.	Education and methodic work planning	Annually to each kind of training			+	+	+
2.	Work Program of the Subject (practice) Development	Annually for each subject/practice	+				

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1.	Education and methodic work planning	Annually to each kind of training			+	+	+
3.	Appraisal Fund Development	Annually for each subject/practice	+				
4.	Methodic Guidelines	Annually for each subject	+				
5.	Annotation Development	Annually for each subject	+				
6.	List of Changes Development	On demand	+				
7.	Competence Passport Development	Annually for each subject practice	+		+	+	
8.	Main Educational Program Development	Annually		+	+		
9.	Expert Conclusion Development	Annually for each subject /practice		+	+		
10.	Education and methodic documents Development	On demand	+	+	+	+	+
11.	Documents Publishing on the Site Education and	Annually for each subject/practice				+	
12.	Methodic activity Monitoring	Every Week			+	+	+

The underlined processes are connected with each other [Veretennikova 17]. As the initial point we can investigate the process of educational and methodic activity planning in accordance with standards, syllabus and department teaching load. Next the formation of educational and methodic documents (working program, the fond of evaluation tools, annotation, methodic guidelines and so on) is provided. Then goes expertise and documentation control, and its placement on institution's site in the Internet. Monitoring of educational and methodic activity is permanently made by department and institution as a whole.

Every process includes some operations and processes.

The following specification and formation of the described processes aggregate of educational and methodic support, suggests building of visual models of the processes, using particular graphic notation.

3.2. SIM-UML as a simulation tool

As an simulation tool of the scientific research we use program system of simulation models synthesis on the basis of UML (SIM-UML) language [KhubShch 16]. The system is intended for the building of simulation models in sphere of economics and management, including simulation models of business processes of enterprises and organization [Khubaev 16].

The system is worked out within the integration conception of visual and simulation modelling of business processes and realize the corresponding method, metamodel and a number of algorithms. The system allows:

- to maintain a list of variables, providing to set quantitative characteristics to the model;
- with the help of graphic design built UML-models, characterizing structural and behavioral characteristics of the business process;
- automatically compose program code of simulation model.

The standard language of modeling UML 2 is used for the processes of visual modeling in composing educational and methodical materials. Such models are familiar to the most part of participants of the modeling and analyses process as the language UML actually became the standard of modeling as in the process of software development, as in sphere of business analyses.

The composed UML - models are automatically transformed into simulation models, which spares labor costs and gives an opportunity quantitatively estimate the suggested changes in business processes [Khubaev 17].

3.3. Visual modeling with SIM-UML

On the picture 1 we can see a diagram of precedents, describing the subset of process, formatting the education and methodic documents as a whole.

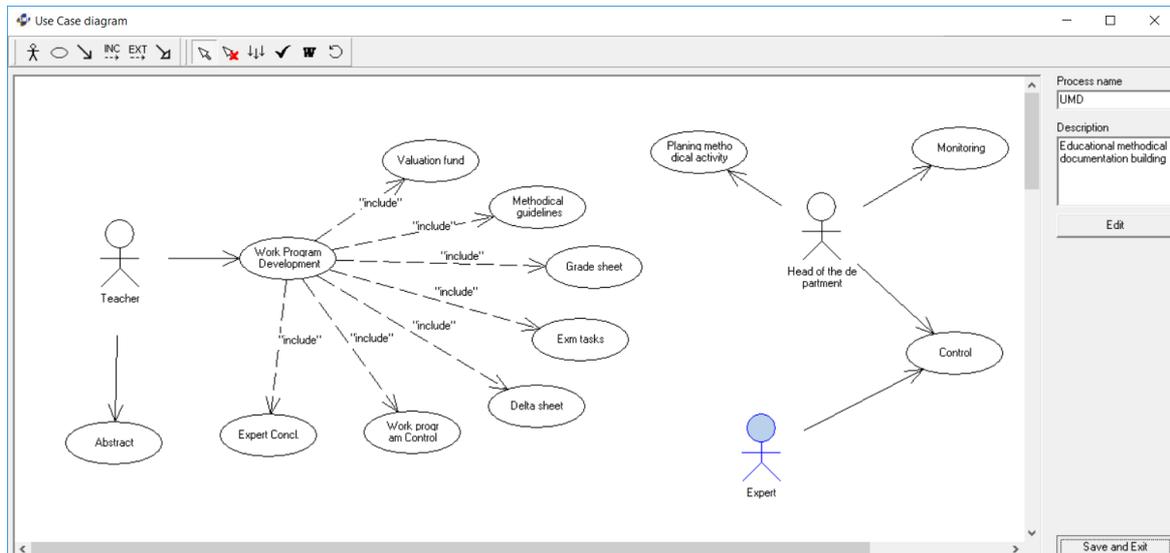


Figure 1. The model of business - processes set in the form of USE CASE diagram in the visual construction SIM-UML.

According to the existing point of view the USE CASE diagram let us make quantitative aspects of input models from the external influences. Each precedent is connected with some business process and when applied by actor makes start of this process to fulfilling it.

For actors and associative connections there are quantitative parameters in the form of variable systems. The variables can correspond to determinative value. Data was acquired from documents analyses of the graduating department, chronometric observations, expert survey of experienced teachers, working not less than 5 years.

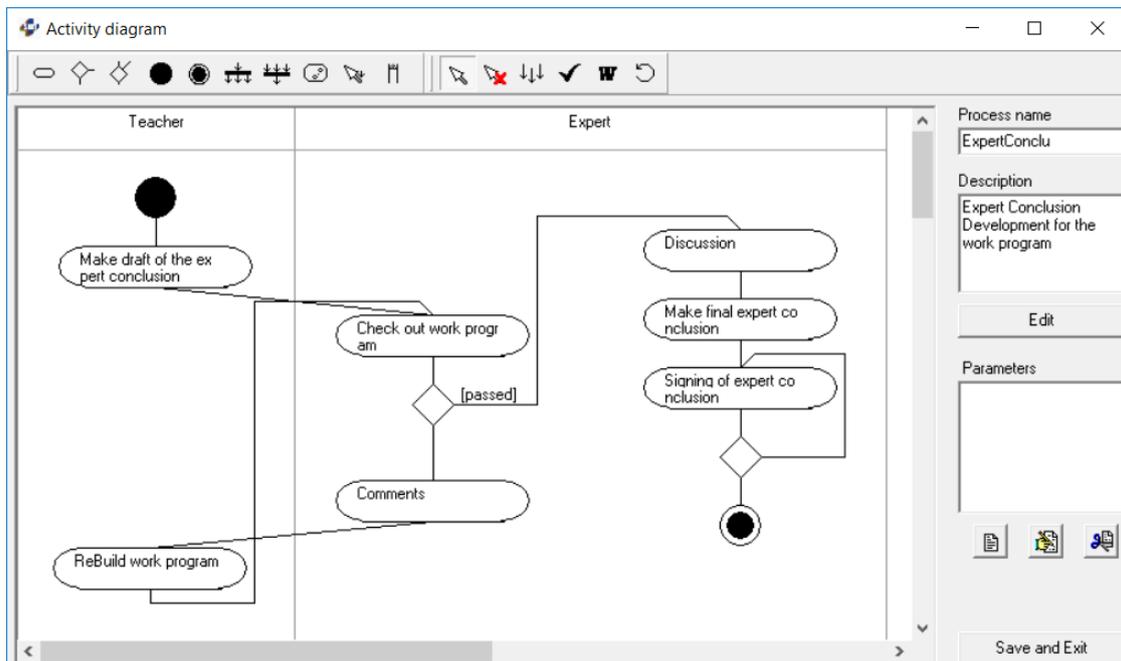
Actor «Teacher» is connected with the precedents «Work program development» and «Annotation». Applying to the USE CASE the fulfillment of the corresponding processes begins, depicted in activity diagram.

The USE CASES, following the work program development are started in sequence, immediately after it, which is reflected in the model with the help of «include» between the corresponding precedents.

Actor «Lab assistant» deals with registers formation of software, work program of the subject and literature. He also makes the monitoring of educational and methodic processes. Actor «Expert» and «Department head master» are connected with the precedent «Work Program Control».

To understand the process of educational documents development the activity diagram of UML language is suggested. The diagram of the UML language activity provides process operations, their sequence, executives, possible variants of process fulfillment. The process activity diagram «Work program expertise» is given on picture 2.

In the model process, under consideration, represented by activity diagram, operations are used and also conditions blocks are also involved. Applying to the first condition block, there was control in accordance with experts demand, applying to the second block the cycle was started (Every expert of the council signed it).



**Figure 2.** Process activity diagram «Expertise of the work program».

Each process operation is given quantitative parameters. (including occasional), but in the given model - they are parameters of executive time of this or that operation of business process. For representation of alternative variants of process execution and defining the choice parameters condition block is used. For example the possibility of program content correction can be provided.

On the figure 3 the process of work program development is shown.

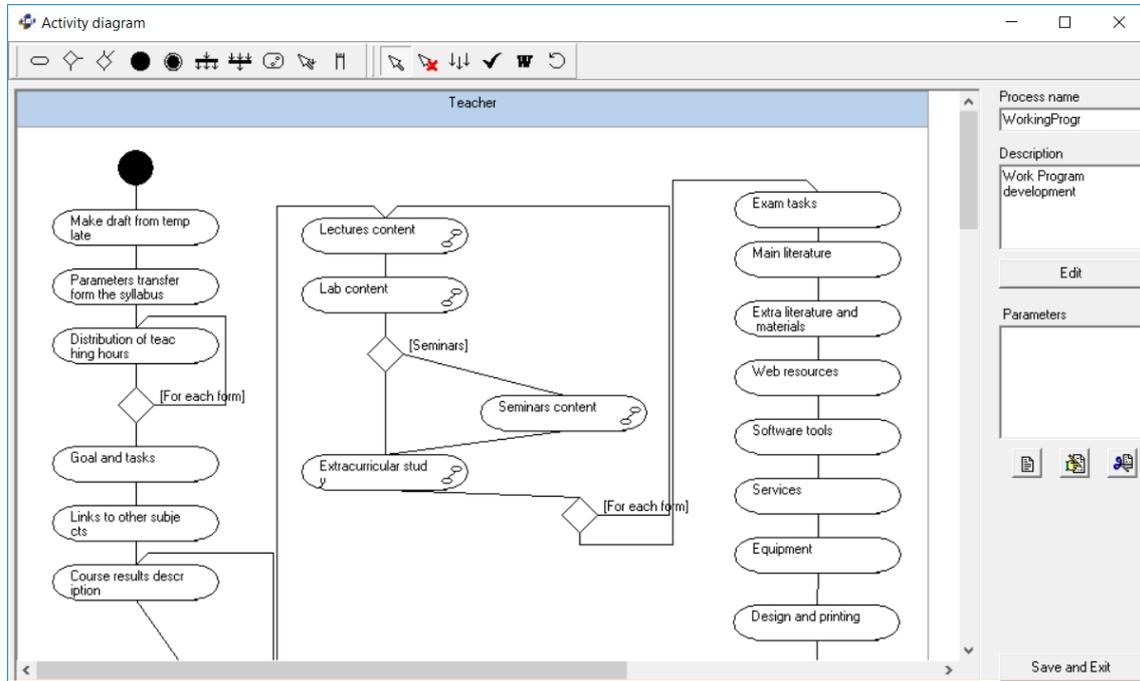


Figure 3. Process activity «Work Program» diagram.

4. Simulation model generation with SIM-UML

For modeling business processes on the quantitative level there was made data collection and analyses of time expenditures on the educational documents formation operations. [Klimenko 16]. To get the initial data there were used several methods : survey of the teachers, having substantial working experience; in some cases the time expenditure data was obtained through personal participation in the documents formation process, gathered with the help of timing. The results of processing data were used for defining of simulation model variables in SIM-UML system.

Variable systems of SIM-UML let us suggest quantitative parameters of the modeling business processes. Together with UML-diagrams variables are used for automated synthesis of simulation model.

On the basis of model built in SIM-UML environment, program code of simulation model is formed. Compilation and fulfilment of program code give the opportunity to make modeling and obtain the values of output model parameters.

In table 2 the example of basic input parameters of simulation model is shown. This parameters let us adopt the simulation model under the conditions of particular institution and get the labor cost estimation.

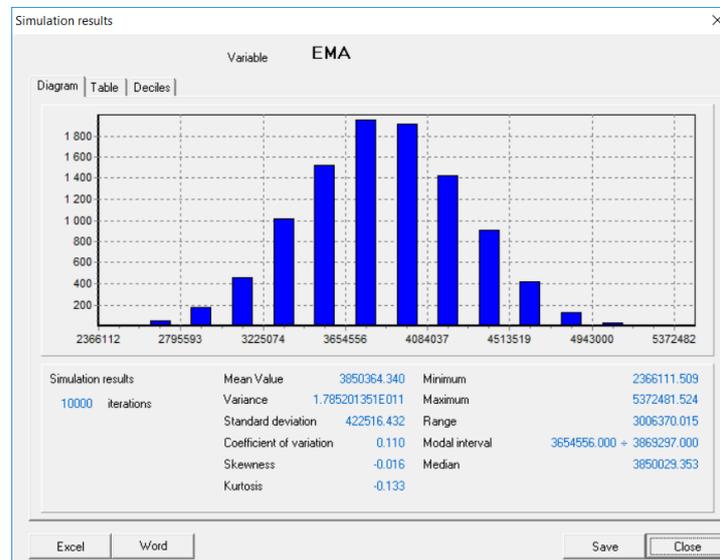
Table 2. Input simulations parameters (example).

Parameter	Bachelors	Masters	Postgraduate studies
The number of the new specialties	8	6	-
The number of new training profiles	12	9	-
The number of existing specialties	26	23	6
The number of existing profiles	38	29	14

- The formed simulation model let us:
- make simulation modeling of definite educational an methodical activity processes, of the educational institution as a whole, with the aim of labor costs evaluation on their fulfilment;
  - evaluate labor costs on educational and methodic maintenance according to the executors (teacher, expert, headmaster of the department, teaching department employee).
  - point out the most laborious processes and operations
  - evaluate the suggested modifications of the process in order to lower labor costs.
  - choose the most effective directions of automation processes in educational and methodic maintenance formation.

**5. Results**

Figure 4 shows the results of simulator modeling for the subset of business processes of educational and methodic maintenance formation in the educational institution during one year of studies.



**Figure 4.**The results of subset modeling processes «Preparation of educational documents».

The results obtained as a result of labor costs simulator experiment of definite executors on the educational and methodic activity are pointed out in The table 3 (in hours).

**Table 3.** Labor costs of process executors.

Title	Mean	St. Dev.	Min	Max
Teacher	60360,82	6124,38	42600,12	77509,08
Department Headmaster Education	1094,06	77,30	885,36	1325,96
Department member Education	749,20	187,21	539,90	993,38
Department Head	318,11	33,69	250,72	415,82
Expert	1575,69	109,01	1237,76	1880,92
Total	64097,88	7050,77	49291,27	80314,64

From table 3 it is evident that to form and renew the educational and methodic documents, under given parameters, more than 60000 are demanded.

The main part of the hours are fulfilled by department teachers-60360 hours, it comprises 7545 working days.

The most laborious processes are the processes of composing work programs and evaluation resources funded by the teacher. The work on them comprises 70 per cent of the time, spent by the teacher on making documents.

To convert the results into monetary form we can use the data of the given educational institution staff wages.

## **6. Discussion**

It must be mentioned that firstly, the obtained results are actual in case of the existing stable normative basis. For example transition to the fourth generation State standards will demand another great labor costs.

Secondly, our model suggested the fulfilling of normative documents (for example, real expertize process, but not only formal one). The educational methodical activity quality decline and its reflection in labor cost needs the future research.

The obtained results give the opportunity to raise a question of education and methodic activity economic side. Looking into the formation of education and methodic maintenance from the economic point of view a number of features can be pointed out:

- the gap between consumer (students) and customer (state organs);
- time gap between development and use of education and methodic documents;
- a great deal of “hidden” expenditures on creation, support, control and monitoring of education and methodic documents. All this is not reflected in accounting documents of our educational institution, but demand a great volume of restricted resources, which come off scientific – pedagogical activity.

In such a way it is possible to speak about “time tax” on higher educational institutions.

To lower education and methodic costs the institution has several possible ways:

- reduction of specialty and profiles nomenclature;
- maximum unification in educational programs;
- business processes optimization, for example composing a special department for education and methodic maintenance. In such cases teachers suggest a definite education and methodic content and department’s employees make the necessary work, forming documents;
- the union of educational institutions for developing education and methodic maintenance. Education and methodic materials and services market;
- automation of the most laborious processes [Kosmacheva 16, Sherbakov 17].

The combination of the enumerated measures is also possible.

The analyses the different variants effectiveness and their favor for the educational institution demands future research.

## **7. Conclusion**

The given research provided the opportunity to estimate labor costs of educational and methodic activity of educational institution in modern circumstances and gave the opportunity to analyze educational and methodic activity from the economic point of view.

## **8. Acknowledgments**

The reported study was funded by Russian Foundation for Basic Research (RFBR) according to the research project № 19-013-00690 “Economics of educational and methodological activities in high school”.

## **References**

- [1] Arkchipova E N, Belgorodtseva V O, Shakhgeldyan K I 2013 New generation curriculum model Informatizacia obrazovaniya i nauki **2(18)** 96-110

- [2] Blättler A & Santa R (eds) 2010 Bologna at the finish line An account of ten years of European higher education reform *The European Students' Union*
- [3] Eremina I I 2014 Problems of developing a competence model for training IT professionals in the information educational environment of a federal university Scientific notes of the Institute of Social and Humanitarian Knowledge *Issue number 1(12)*
- [4] Fionova L R, Zolotova T A 2011 Development of components of the information system for educational process management based on the competence-based approach *Informatizacia obrazovaniya i nauki 4(12)* 14-28
- [5] Freiman V I 2012 The approach to automating the main stages of developing a graduate competency model Energy Innovative trends in energy *CALS-technologies in power engineering 1* 330-338
- [6] Khubaev G N, Shcherbakov S M 2016 The system of automated synthesis of simulation models based on the UML 2.0 language (SIM-UML 2.0) Certificate of state registration of computer programs № 2016661676 *M.: Rospatent*
- [7] Khubaev G N, Shirobokova S N, Babeev M S 2016 Visual models for assessing the complexity of the accounting process reengineering Innovative development of the Russian economy: IX Intern. scientific-practical Conf.: *Moscow: Plekhanov Russian University of Economics 3* 93-96
- [8] Khubaev G N 2017 Business processes: mathematical and instrumental methods for the labor intensity assessment Russian economic online magazine **2** 49
- [9] Klimenko A A, Samarskaya M V 2016 Simulation modeling of labor costs for the formation of educational and methodological documentation at the university New directions of scientific thought: materials of the International Scientific and Practical Conference *Publishing and printing complex RSUU (RINH)* 171-174
- [10] Korchagin E A, Saphin R S 2016 Competence approach and the traditional idea of higher education *Higher education in Russia 11(206)* 47-54
- [11] Korolev E V, Bepalov A E, Agafonova V V 2018 Educational-methodological support of educational programs *Construction: Science and Education* vol 8 **3** 5 DOI: 10.22227/2305-5502.2018.3.5
- [12] Korshunova S V 2010 Designing the main educational programs of the university in the implementation of the level of training on the basis of federal state educational standards *M.: MIPK MGTU them. N E Bauman* 212
- [13] Kosmachyova M, Kvyatkovskaya I Yu, Sibikina I V 2016 "Automated system for the formation of work programs of educational disciplines" *Vestn. Astrakhan. state tech. un-that. Ser. control, computed tech. inform. 1* 90-97
- [14] Nisman O Yu, Zatsepin V A 2011 Automated information system of methodological support for the implementation of the new generation of Federal State Educational Standards Proceedings of the international scientific-practical conference "Info-Strategy 2011: Society. State. Education» (Samara) 65-68
- [15] Shcherbakov S M, Klimenko A A, Samarskaya M V 2017 Simulation modeling of educational and methodical activities at the university Proceedings of the Eighth All-Russian Scientific and Practical Conference "Simulation modeling. Theory and practice» (St. Petersburg). *SPb.: Publ. VVM* 565-570
- [16] Sukhomlin V A 2015 On the training of specialists in the field of information technology *Pedagogical informatics 4* 25-39
- [17] Sursock A & Smidt H Trends 2010 A Decade of Change in European Higher Education Report 2010 by the European University Association 124
- [18] Wilson L 2009 Implementing Bologna: Lessons learned and ongoing challenges for post 2010 in EUA Bologna Handbook
- [19] Miroshnichenko I I 2012 Structure and content of educational processes in a university as a basis for ensuring the quality of graduate education Innovations in Science, Education and Business *Proceedings of the 10th International Scientific Conference* (Kaliningrad: KSTU) 167-

170

- [20] Veretennikova E G, Shcherbakov S M, Miroshnichenko I I, Savelieva N G 2017 Management processes of educational support in higher education Black Sea-Caspian Cooperation Forum: Security. Sustainability Development: Materials of the International Discussion Platform (Rostov-on-Don, RSUU (RINH)) 696-701