An Approach to Research Teams Teaching “as you go” for High-Quality Grant Proposals Writing Based on the Experience of ITMO University

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***Abstract*—This work is devoted to teaching writing and submitting grant proposals “as you go”, which allows our university to involve new research teams in a full cycle of grant activity rapidly and keep win rate at the level of approximately 20%. This course, which is called “Effective grant proposals writing and submitting training “as you go”!”, available for every research team of our university. This course is for teams that have participated in external grant competitions less than three times. We have been teaching this course since 2010. We evaluated the effectiveness of the course based on the assessment of the probability of rejection of 613 grant proposals written during the training. The evaluation showed that if there was no course, the number of winning proposals could decrease for more than 70%.**

Keywords—grant proposal writing, the training course “as you go”, a win rate of proposals

I. Introduction

Grant funds make up a significant part of the budget of most universities. Over the past 15 years at ITMO University monetary funds were formed based on the results of competitions that were won for scientific and educational grants reaching half of the total annual budget. Some grants involve collaboration between research teams from different organizations, including those located in different countries ([1], [2]). Competitive proposals aimed at the right to implement the relevant projects are very complex. In developing a system of target indicators, the authors of this paper [3] used statistical tools to show the high importance of attracting grant funds to universities of various rankings. There is a direct correlation between the amount of funding and the number of papers in highly rated Journals. Paper [4] shows the important, if not the only possible, role of grant support in the funding and development of new scientific structures and teams with the active involvement of students. Article [5] discusses similar issues in the development of non-profit organizations. Therefore, there is no need to prove that the well-being of the university and its employees directly depends on the quality of participation in grant competitions.

Even experienced research teams can make mistakes both in forming a set of documents (formal component) and in the scientific content when they are writing and submitting a grant proposal. Also, teams may misinterpret the objectives of a grant competition and prepare an inappropriate proposal. Inexperienced teams make significantly more mistakes: the number of which can reach several dozen. Such a number of errors not only complicates the work of administrative services, but also there is a high probability that some of the errors will not be detected, and subsequently, the grant proposal itself will be rejected. Therefore, ITMO University has developed and has been implementing the course "Effective grant proposal writing and application: training “as you go”!" for more than a decade. This course leads not only to reducing the number of errors and improving the quality of grant proposals but also to developing the scientific skills of research teams.

II. Background and Related Works

A. Description of the life cycle of the grant proposals’ writing and submitting process

We consider writing and submitting a grant proposal a project with its own stages, methods and technologies. To define the list of stages of the grant proposal writing life cycle we analysed recommendations from several related support services, including [6]. In addition, common structures of grant proposals and stages of preparation can be found in analytical studies [7]. The related sources consider stages that include the idea and aim of the statement, collaboration with partners, working with analytical services to choose a competition suitable for the grant, content drafting, finalizing, final review and submission.

In ITMO University most scientific teams are specialized in fundamental, engineering and interdisciplinary spheres, including science-intensive IT solutions, physics, chemistry, ecology, and cyber-physics systems. It is difficult to form a universal detailed list of stages for all fields. Therefore, we decided to integrate some stages according to a project-based approach, taking into account the right step in choosing relevant competition. As a result, we selected four common steps to prepare and submit a grant proposal.

The first stage is "Finding and selecting the competition" (*the First stage*). We think that it is a necessary step for the scientific team. Applications are rejected not because of the team’s insufficient qualifications, but because the related university or division does not meet the competition requirements. Such compliance is determined not only by considering the general guidelines of the grant competition, but also by carefully studying and analysing the related documentation.

At *the second stage*, the team determines the general idea and framework of the project that is being submitted for the competition. At this stage, related scientific components for the future project may be corrected.

At *the third stage*, the team describes the content of the project in accordance with the documentation requirements of the grant competition and its framework determined at the previous stage. At this stage, formal indicators of the application are divided into two set parts. The first of them is formed from the available components, including a list of published scientific papers, projects completed in the past, and intellectual properties. The second component is the set of indicators, which will be achieved after finishing the project. It is very important here that such indicators correspond to the composition of the team, the status of its members, and their existing technical background and capabilities. For example, during project implementation, graduated students cannot be taken into account when calculating the corresponding indicator. Also, the number of articles that will be published by the end of the project should correlate with the number of team members, taking into account their qualifications.

At *the fourth (final) stage*, the prepared grant proposal involves finalizing and submitting forms in accordance with the documentation for the competition. Formal documents (for example, information about the organization, and forms of project team members), are also collected in the final grant proposal. The latter is sent to the competition board. This stage is no less important than the previous ones, since the violation of formal requirements may lead to the submitted proposal being rejected.

When writing a grant proposal, teams use the following approaches: (1) working with competitive services and documentation; (2) project management; (3) scientific research as a project. The first approach is necessary to correctly find related competition. The second approach contains ways to organize writing, checking, and submitting in general. The third approach defines concepts to form proposals as a representation of a prospective scientific project.

B. Related Works

A large number of academic papers are devoted to issues of training young scientists in scientific and project activities. In particular, [8] describes not only the importance of graduates' participation in real grant research projects and competitions for young scientists, but also the connection of such activities with the development of graduate competencies. A number of courses, devoted to academic writing in English, contain issues to grant proposal writing. For example, the ESP course presented in [9] includes sections on the high quality of the content of grant proposals. The paper [10] presents useful recommendations to improve the quality of grant proposals.

The authors of work [11] described a detailed survey study on the problems and motivations of writing and submitting grant applications. This study showed that, according to teachers' opinions, the main motivating factors in stimulating the activity of participation in grant competitions are administrative support and appropriate practice-oriented training. An equally interesting survey in this field was conducted at Concordia University by Ann Arbor [12]. According to the results of the statistical analysis of the teachers' opinions, the importance of training in the preparation of grant applications (including "mock grant proposal") at graduate and postgraduate levels was noted. In addition, an approach to study "learn as you go" (if possible) is offered. At the same time, the author could not find relevant open sources on the topic of the impact of such training on the effectiveness of participation in external grant competitions. The authors of this paper [13] described the effectiveness of a large-scale Grant Proposals Writing School among young scientists in the field of medicine, which was evaluated by feedback questionnaires. The main training specifics were the use of the cross-opinions of colleagues: in addition to the recommendations of experienced experts, the trainees received the opinions of their classmates (peers). Colleagues from the University of Windsor described an 8-month similar program for researchers in the social sciences and humanities [14]. The literary review of this article, referring to 39 sources, notes that research in recent decades has mainly been devoted to improving the quality of administrative management in a university, as well as factors that negatively affect the quality of academic writing. The effectiveness of the course was assessed by receiving feedback, on the basis of which the increase in the number of grant proposals submitted, as well as the percentage of wins, were calculated. In 2019, a special session was held at the conference "Frontiers in Education 2019". This session was dedicated to the organization of an effective advisory board for grant proposals [15]. In the description of the special section, numerous comments are noted that training activities aimed at improving the quality of proposals are general in nature. They did not take into account the specifics of both the scientific and engineering fields and the grant competition itself. Grant writing proposal training is held in the form of contests within conferences for young scientists. In particular, all of the authors of the best works of one of these contests, re-submitted applications for real contests and became the winners [16].

A review of related works shows that much attention is paid to training aimed to improve the quality of grant proposals in the entire scientific environment. This area is especially developed in graduate and postgraduate programs. Specialized seminars are also held, as well as competitions within the framework of young science conferences. The sources note that it is important to "learn as you go" when submitting a grant proposal for a real competition. At the same time, a number of sources indicate that many training activities are of a general nature, and it is not possible to find research descriptions in the area of "learn as you go" in open sources. Moreover, the evaluation of the effectiveness of the relevant courses is carried out either in small groups or by receiving feedback from the students themselves.

In this regard, this study, which is based on the experience of ITMO University, was devoted to the following two questions. Q1: What percent of proposals may have a high probability of being rejected, owing to a lack of "as you go" training? A rejection means that the proposal cannot be considered in a competition, due to either not conforming to formal requirements or having a critical number of content errors. Q2: To what extent does the same lack of training affect the number of applications that are won? Here we take into account that in case the application is not rejected, this does not mean that it is guaranteed to win. As a rule, the number of proposals won is significantly less than the number of approved applications.

The last part of this paper is structured as follows. The third section contains the procedure to build our course "Effective grant proposals writing and application: training "as you go!" The goal, structure, and learning outcomes of this course are the main objectives of this paper. The design of this course is based on the X-Matrix approach. The fourth part is

Life cycle stages	Search for a grant competition and making a decision on participation	Forming a project's framework	Preparation of grant proposal	Grant proposal finalisation and submission
Approaches working with competitive services and documentation	Search for services. Getting access to services and grant competition documents (GCD). Detection of requirements from the GCD and comparison with the capabilities and qualifications of the research team.	Selection of the necessary components of the scientific and technical background and the qualifications of the team in accordance with the requirements of the competition and the conditions for the grant implementation.		Filling forms and submit the application with the proposal
Project management approaches	Arranging and control to business process to selection of grant competition.	Arranging and control to business process to forming a project's framework	Arranging and control to business process to grant proposal writing	Arranging and control to business process to grant proposal finalizing according to the appropriate forms and its
Project-based approaches to research	Comparison of the conditions of the competition with the qualification and scientific background of the research team.	Project's framework building according to grant competition requirements and scientific background of the research team.	Texts' preparation for the grant proposal	

Fig. 1. Map of problem areas in the process of grant proposal writing and submission

devoted to determining how necessary it is to hold this course based on the experience of ITMO University. We defined two criteria related to the above-mentioned questions. After the evaluation of the values of these criteria, we discussed related results to confirm the necessity of this course for a university. The paper finishes with a conclusion and a list of sources.

III. Building a Training Course Using the X-Matrix

To build a course, we use the systematically synergistic approach to design advanced training courses presented in [17], [18]. This approach involves the implementation of two activities: a formation map of problem areas (in the source – steps 1-2), and filling in the X-matrix (steps 3-7).

The map of problem areas is constructed in the form of a table; in the rows, general methods, approaches and technologies are indicated, and in the columns – the stages of the lifecycle of grant writing and submission. Tasks/problems, entered in the matrix, are solved during the stages by means of appropriate approaches and technologies. The resulting map is required both to determine the needs at which the course is aimed and to form a list of topics and their content. After brainstorming with the participation of several ITMO University experienced research teams and the authors of this paper, the following matrix was obtained (Fig. 1).

According to the above map, at *the first stage*, it is important for the team to maintain a vision of their capabilities and qualifications when searching for competitions and studying the competition's documentation. At *the second stage*, when building the project framework, the team solves tasks to select suitable components of the scientific background (capacity) and its qualification. *The third stage* is characterized by the preparation of the grant proposal texts (description of the project) without contradictions, stylistic, grammatical errors, and typos. For example, the list of published works contains papers issued in the last 10 years: the requirements determine the list of works in the last five years. In this stage, is important that the content of the proposal is clearly in line with the scientific field (similar to the scope of a journal [19]), as well as the requirements of the grant competition. *The last (fourth) stage* is determined by the careful preparation of formal documents, the arrangement of the application, and its timely submission in accordance with the requirements of the competition.

In our case, two needs were identified, which were clearly understood by research teams and specialists of the administrative divisions of the research unit and university:

1) Preparation of a qualitative grant proposal for a given competition.

2) Finalizing, assembly, registration of documents, and submission of the proposal in accordance with the tender documentation.

The choice of the competition and the formation of the project framework at the brainstorming stage were not included. But they should be clearly reflected in the design process of the training course since successful participation in the grant competition depends on the quality of actions at all stages.

A. Formation of stacks of methods and technologies, needs, and competencies

Filling in the X-matrix begins with the formation of stacks of means (methods and technologies) and needs. The first stack was formed during the preparation of a map of problem areas. The stack of needs (step 3, [18]) was also formed above in the following areas: (1) preparation of a qualitative grant proposal; (2) the formal side of the full process, including submission to the grant competition. The connections between the elements of the stacks (the north-western part of the X-Matrix) determine the degree to which methods and technologies are used to cover needs. It turns out that only six elements of the North-West part of the X-Matrix (Fig. 2). At a minimum, all methods and technologies *are used* to cover the needs. Therefore, the minimum number of characters "X" is two – "XX". At the same time, the "Project-based approaches to research" may be changed depending on the scientific direction and type of grant competition. Therefore, "XXX" (it is means use and change) is put in the appropriate cell. Thus, we have completed step 5 [18].

To complete the skipped step 4, we form a stack of skills needed for grant proposal writing. The first of them covers the nonincluded, but very important need for high-quality preparation of a proposal. It consists of the ability to choose a suitable grant competition, having fully and carefully studied the relevant documentation. Therefore, we called this: "the skill to search and choose a suitable grant competition." This skill includes both the use of competitive services and the study of related documentation. The second skill is obvious and is associated with high-quality work on the formation and preparation of the vision, framework and description of the project reflected in the grant proposal: "The skill to form a framework of the project in a timely manner and prepare a related grant proposal in accordance with the requirements of the competition." The latter skill covers the formal side of the preparation and submission and is formulated as follows: "The

XX	XX	XX	Paperwork, assembly and submission of the application in full compliance with the grant competition	X	XX	XX
XX	XXX	XX	High quality grant proposal writing according to the competition	XX	XXX	XX
Project management approaches	Project-based approaches to research	Approaches working with competitive services and documentation	University Needs / Approaches & Technologies / Skills of Graduates / Course's Topic	Skill to search and choose a suitable grant competition	Skill to form a framework of the project in a timely manner and prepare related grant proposal in accordance with the requirements of the competition	Skill to assembly and submission of grant proposal in full compliance with the grant competition
X	X	X	Introduction to the grant approach to the support of individual and team scientific activity	X	X	X
X	XX	X	Evaluation of the qualification capabilities of the research team, it's environment and the existing scientific background	X	XX	X
X	XX	XX	Grant competition services. Methods of search and selection of grant competitions	XX		X
XX	XXX	XX	Qualitative definition of goals and objectives, preparation of a consistent description that takes into account the scientific and technical background of the team	X	XXX	X
XX	XX	XX	Preparation of formal documents, assembly and submission of the application according to grant competition	X	X	XX
X	X	X	Analysis of typical errors in the grant proposal writing and submission	X	X	X
XX	XXX	X	Practice: preparation of grant proposal in real competition	X	XXX	XX

Fig. 2. X-Matrix of the course "Effective grant proposals writing and application: training “as you go”!"

skill to arrange and submit a grant proposal in full compliance with the grant competition."

The connections in the top right part of the matrix reflect the levels of engagement of the above skills to cover the needs. In other words, connections reflect the levels of learning outcomes of the course to solve the relevant tasks in preparing and submitting a grant proposal. It can be noted that the first skill is used at a required level to cover the needs of preparing a qualitative description of the future project. To cover the need for "Paperwork, arrangement, and submission of the application in full compliance with the grant competition," it can be used both at the level of use and at the level of understanding. It depends on the existence of a division at the university, which verifies grant proposals or their components, and methodically accompanies the relevant activities of scientific teams in the context of the requirements of the competition. Since ITMO University has such a division – Office of Information Support for Open Tenders – OISOT, the corresponding connection reflects the involvement of competence at the level of understanding ("X"). In the absence of such a division, the competence level should be raised to the level of application ("XX").

It is obvious that the competence "Skills to form a framework of the project in a timely manner and prepare related grant proposal in accordance with the requirements of the competition" should be considered for the need "High quality grant proposal writing…" not only at the level of application, but also at the level of evaluation and changes. Therefore, "XXX" is put in the corresponding cell of the top right part of the X-Matrix. In the remaining cells of this part of the X-Matrix, it is written: "XX", which means the use of a skill at a required level. We have completed step 6.

At the seventh step, we need to fill in the lower part of the matrix: to create a list of course topics and to determine their relationship with methods and technologies, as well as with skills. In the first case, it is indicated how deeply the relevant methods and technologies are taught, and in the second – how highly the graduate’s skills develop due to the learning of a given topic.

B. Formation of stacks of methods and technologies, needs, and competencies. Relations between elements of the stacks for the X-Matrix

To attract a wide audience to the course, we will use the classical approach to form a list of course topics with a practical component: from an overview introduction to the practice of covering the full cycle of writing and applying for a grant proposal for a real competition at least three times.

The theoretical part of the course considers approaches to assessing the qualifications of the research team and its groundwork in terms of the requirements of a given competition and provides the capabilities of modern internet services that allow us to search for competitions, receive and study documentation, and submit a grant proposal (in some cases in the remote mode). The course does not bypass the project-based approach to the activity and development of the research team. This topic is useful not only for graduate students and young scientists, but also for skilled teams who can adopt external successful experience and receive unique system analysis tools. In particular, this course provides recommendations for achieving a goal, which reflects the necessary scientific result in *measurable* degrees. Also, this course considers the issue of preparing a consistent description of the future project with the correct use of existing and introduced terms. Also, the main part of the course contains an equally important topic: the compliance of grant proposals with formal requirements: from the specifics of the filling forms to the rules for submitting documents to the competition board.

The theoretical part of the course ends with an analysis of typical errors during the stages of the lifecycle of grant proposal writing and submission. In particular, we offer to consider the case of writing and submission of the grant proposal "Museum of Digital Life" from the team of the Faculty of Digital Transformations for the competition devoted to digital museums. Despite the full compliance with the formal requirements, the involvement of experienced employees from the Museum of Optics of ITMO University in the research team, as well as the high level of the proposal, the latter was rejected. The team did not take into account that the competition was aimed to form digital profiles of existing museums in the area of IT. The competition board noted the experience of the museum team so far as the topics of optical devices and phenomena were concerned, as well as the other part of the team responsible for the field of digitalization. However, the board made a reasonable conclusion that the team had no experience in creating and managing a museum dedicated to digital activities. Therefore, the commission doubted the success of the execution of the declared project within the specified two-year period.

The final and main part of the course is the practice: research teams prepare a grant competition for a given real

competition. During the course, teams should prepare and submit grant proposals at least for three different competitions.

C. The X-Matrix

The filled X-matrix is shown in Figure 2. There is an empty cell in the bottom right part of the matrix, which means that, according to the author's opinion, the topic related to the use of services during choosing a competition does not contribute to the development of skills in the field of forming and outlining a future project.

We note the relevance of the level of teaching methods and technologies in the field of "Project-based approaches to research" and the development of the skill "Skill to form a project framework in a timely manner…" It is obvious, since the relevant technologies are the important basis of the skill. The practical part of the course (the seventh topic) is aimed at consolidating the skills at specified levels: trainees receive initial experience in using appropriate methods and technologies during the writing and submission of a grant proposal. As already noted, ITMO University has an OISOT division that verifies proposals or their components and methodically accompanies the scientific teams through the process in line with the requirements of the competition. Consequently, in the practical part, the knowledge of technologies for working with competitive services and documentation are considered. During this part of the course, trainees not only write and submit a proposal. Teachers and staff of OISOT, along with experts, provide trainees with full information support at all stages of the related process, monitor the revisions according to recommendations and detected errors.

Thus, we have built a course in the form of an X-Matrix. In the next part of this paper, we will consider the experience of conducting the developed course, which was obtained at ITMO University in the period from 2011 to 2021.

IV. The Experience of Conducting the Course Research Teams of ITMO University

A. The Criteria of Evaluating the Effectiveness of the Course.

If we talk about evaluating the effectiveness of the course, then a classical experiment with control and experimental groups is not suitable. It is impractical to introduce a control group that will prepare and submit applications for external competitions without formal training, due to a significant increase in financial and reputational risks, as well as the unlikelihood of open access being available for certain parts of proposals (please, see below). Therefore, the effectiveness was evaluated as follows. During the external competition (the practical part of the course), the following related events were held at ITMO University. Firstly, review and consulting seminars (webinars) were conducted to explain the specifics of related competitions. Secondly, support was given to the research teams in following the timing, complying with formal and qualification requirements, as well as building a set of prospective results for the project. If the research team passes the support stage, without any critical comments from teachers of OISOT and from experts in at least three different competitions, they will *successfully complete the training.*

The effectiveness criteria follow from generalized errors that are made when preparing proposals, regardless of their direction and scale. The first type of error consists of *direct non–compliance with formal requirements* (*Formal Requirements Error – FRE*). For example, there may be no mandatory document in the proposal, or one or more documents are issued in violation of the specified rules. The following five types of errors are common in grant proposal content.

1) An error in selecting the competition, for example, the discrepancy between the qualifications of the team and (or) the organization of the competition's requirements (Contest Selection Error – CSE);

2) Errors in the presentation of qualifications and the scientific background (previous research) of the team. Although, the quality of the application is high, and the main qualifications of the team and the organization seem, sufficient, there are other qualifications that are overlooked, which leads to the application being rejected. For example, there is no list of advanced training courses that team members have completed that are relevant to the direction of the competition (Team Skills & Scientific Background Error – TS&SBE);

3) Incorrect interpretation of the content fields of the forms or insufficiently detailed descriptions of the prospective project (Description Error – DE);

4) Parametric errors: the presented values of the parameters of the project results or indicators (including the parameters of the project budget) are either technically unattainable or do not meet the requirements of the competition (Scientific Indicators Error – SIE).

5) Language errors and violation of stylistic norms of the scientific community (Language and Stylish Errors – L&SE).

Together we have six types of errors: FRE, CSE, TS&SBE, DE, SIE, L&SE. The presence of one of the above errors in the application is the reason for rejecting the proposal. However, the experience of external experts in relation to ITMO University shows that 100% of applications were rejected due to the FRE error. For the remaining errors, the deviation probabilities were as follows: CSE – 90%, TS&SBE – 80%, DE – 70%, SIE – 80%, L&SE – 60%. The percentages are rounded downwards in increments of 10% to increase the purity of our experiment. The success of proposals with these errors was determined by the possibility of correcting related documents after the submission deadline. This possibility was determined solely by the requirements of the competition and the decision of the relevant board not to withdraw an application due to errors that do not affect the possibility of obtaining a desirable scientific result. But in the last five years, such events are rare. Even those grant proposals in which grammar and spelling errors are found (errors related to the L&SE type) are rejected.

The criteria for evaluating the effectiveness of the course are as follows. Firstly, the percentage of applications whose probability of rejection, according to experts' opinions (see percentages above), will increase to at least 85% (C1 – Q1). Secondly, the evaluation of the percentage of reduction in the number of winning applications (C2 – Q2). Both criteria are considered in case the scientific teams were not trained at ITMO University before.

B. Numerical data of errors detected in grant proposals

During the period from 2011 to 2021, research teams of ITMO University submitted 1750 proposals. We considered only those that (a) were submitted during the course. The

number of such proposals was 613 (35% of the total number). The remaining proposals (1137 = 1750 – 613) are the intellectual property of scientific teams. The contents of these proposals are not in open access. Therefore, we could not analyse them. Table 1 shows the distribution of the number of proposals in which errors of a given type were detected. In particular, deviations from formal requirements (FRE error) were found in 276 applications. If such errors had not been identified and eliminated, all 276 proposals would have been rejected.

Table 2 shows the distribution of the number of proposals (including cumulative total) by the number of errors of all the above types. For example, we detected two types of errors in 133 proposals. 257 proposals contained one or two error types.

According to the tables, errors were found in almost half of the proposals in the content of the descriptive fields of the required forms, as well as in the formation of a set of indicator values. In a third of the proposals, language errors were found, as well as errors in the presentation of the competence profile of the research teams, including its scientific background and previous works. The main reason for such errors was a lack of careful and thorough approach to the competition documentation, in particular to the requirements for filling out forms. In addition, there was an undeveloped description of the roadmap to carry out research, and the scientific and methodological means used. We detected cases when in the columns of the form, instead of the description, there were instructions from the leaders of the research team of the form: "Michael, please write a couple of sentences concerning the development of the research field ... I will read them and revise if necessary" or simple symbols like "-" or "0."

C. *Analysis of the effectiveness of the course. Calculation of criteria*

The last row of Table 2 (Proposals Count, Accumulated) shows the cumulative total of the number of applications in which, errors of one, two or more types were made simultaneously (such applications did not contain formal errors). For example, the number of proposals without errors was 14, with not more than one type of error – 124, and not more than two types of errors – 257, etc. It means that the number of proposals that contained at least two types of errors was 337 – 124 = 213. Taking into account the above estimates of the probability of rejecting proposals with errors of a given type, then the maximum probability of not rejecting proposals with two types of errors is (1.0 – 0.6) * (1.0 – 0.7) = 0.12. We have selected two types of errors, which can lead to a proposal being rejected with the lowest probability: 60% (L&SE) and 70% (DE). Therefore, the related rates (0.6 and 0.7) were included in the formula. In other words, the probability of a proposal being rejected with two types of errors is more than 0.85. To calculate the value of criterion C1, we take into account the number of proposals with FRE errors that would have no chance of winning. Thus, we get the number of proposals, the probability of rejection of which will increase at least five times, 213 + 276 = 489. Hence, we have the value of the criterion C1 = 489 / 613 ≈ **79.8%**.

TABLE I. DISTRIBUTION OF PROPOSALS WITH DETECTED ERRORS OF A GIVEN TYPE (FRE, … , L&SE)

Error's Type	**FRE**	**CSE**	**TS&SBE**	**DE**	**SIE**	**L&SE**
Proposals containing detected Error	**276**	94	238	306	312	233

TABLE II. DISTRIBUTION OF THE NUMBER OF APPLICATIONS CONTAINING ERRORS (BY THEIR NUMBER), INCLUDING ACCUMULATION

Errors Types Count	**0**	**1**	**2**	**3**	**4**
Proposals Count	14	110	133	62	18
Proposals Count (Accumulated)	14	124	257	319	337

Among the applications of the training teams, 117 won. Without giving scientific teams "as you go" training in verifying proposals, the win rate would significantly decrease. Assuming that the proposal, without errors or with one error, would not have been rejected, then instead of 117, only 117 * (1 – 0.798) + 117 * 0.798 * 0.12 ≈ 35 proposals would win. The first sum determines the number of proposals, which do not have a high value (more than 0,85). The second sum determines the number of proposals with a high level of probability of rejection. In other words, the loss of winnings would be C2 = (1 – 35/117) * 100% ≈ **70.09%** – more than two-thirds. Such a failure would be a significant demotivating factor in further participation in competitions.

D. *Discussion*

Let us analyse the results based on the calculated values of the criteria C1 and C2, which answer questions Q1 and Q2, respectively.

Question Q1. We showed that a proposal containing at least two types of errors has a high probability of rejection (more than 85%) relative to applications that do not have errors. We added the number of such applications (213) with the number of applications with formal violations (276) and received 489. We mentioned above that proposals with formal violations have a 100% probability to be rejected. The last value is 79.8% of the total number of proposals (613) whose authors took the course. This percentage shows the proportion of proposals that would have a high probability of rejection if their authors were not trained in our course. Thus, we have the answer to question Q1 – 79.8% (more than three quarters).

Question Q2. Having an estimate of the percentage of rejected proposals in case the authors did not take the course, we have evaluated that the number of applications that are won will be reduced by more than 70% (answer to question Q2). Let us assume that all proposals without detected errors during the course (14 proposals) were found to win. In this case, the percentage estimate of unsuccessful proposals is reduced to 58%. In our opinion, there are no other reserves for reduction the part of non-winning bids. At the same time, the percentage itself remains very high.

Based on the above-mentioned findings, we can assert that the lack of our course leads to a significant share of the number of proposals with a high risk of rejection (more than 85%): about 80%. Moreover, in the same situation, the university may significantly lose the number of winning proposals. Our minimum loss estimate for winning bids is 58%. Such losses lead not only to financial but also painful reputational damage. Thus, the need for "as you go" training is beyond doubt.

V. CONCLUSION AND FUTURE WORKS

The success of participating in scientific and academic competitions is one of the most important foundations of the financial stability of a university. Therefore, universities need to organize assistance for research teams in participating in such competitions. This paper proposes an advanced training course for members of research teams. The course aims to increase the quality of writing and submission of grant

proposals not only in the formal plane, but also in terms of the content and competence of research teams. The structure of the course, its content, learning outcomes, and demand were prepared and presented in the form of an X-Matrix. The practical part of the course is "as you go" training: the scientific teams train while writing and submitting grant proposals to real competitions.

The effectiveness of this course was evaluated based on the analysis of proposals submitted by research teams for the period from 2011 to 2021. The analysis was carried out according to the number of identified errors of six types: from violations of formal requirements to poor-quality presentation of the content and competence of the team. Two criteria were put forward: the percentage of proposals, whose probability of rejection, according to experts will increase at least five times (C1), the percentage of reducing the number of winning proposals (C2). The criteria were considered in the absence of appropriate training activities. After the collection of information and the corresponding calculations, the following criteria values were obtained: C1 ≈79.8%, C2 ≈70.09%. In other words, if the course had not been conducted, then the effectiveness of participation in competitions would have been significantly reduced.

In the future, the authors plan to carry out a separate analysis in scientific fields (Computer Science, Physics, Chemistry, etc.), as well as in cross-cutting technologies (Machine Learning, Bigdata, Quantum Physics, etc.). Such an analysis is necessary to identify the specifics of the relevant competitions and to actualise the course. It is also planned to introduce a portfolio of research teams, which includes detailed descriptions of their skills and qualifications. Due to this, the possibility of designing specific team and individual learning paths will be added to the course.

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