PROJECT "VIRTUAL INTERNATIONAL STUDENT OLYMPIAD AIRCRAFT DESIGN"

ZhiJin Wang*, Anatolii Kretov*, Sergey Mikhaylov†

* Nanjing University of Aeronautics and Astronautics, College of Aerospace Engineering
29 Yudao St. Nanjing 210016, P.R. China
e-mail: kretov-ac@nuaa.edu.cn

† Kazan National Research Technical University named after A.N. Tupolev (KNRTU-KAI),
10, K.Marx St., Kazan, Tatarstan 420111, Russia
e-mail: sergey.mikhaylov@kai.ru

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Abstract. The article is devoted to the aircraft design competition for students with representatives and university teams, providing preparation for students studying in undergraduate and graduate courses related to the aircraft industry. This competition is proposed to be held at NUAA, using many years of experience in holding similar competitions in KNRTU-KAI. The paper deals with the basic organizational and operational points for this event, discusses the competition tasks, and the development of methods of assessing the results obtained with a view to the objective of identifying the winners.

1 INTRODUCTION

In October 4, 1957, the people of planet Earth could see a man-made miracle that moved into space orbit and sent radio signals. It was Sputnik 1, the first man-made satellite. In 2017, we will mark 60 years of this event. In October 2017, the authors propose to organize an international student virtual contest associated with the design of aircraft in celebration of the first space flight. This event will not only reminisce about one of the greatest achievements in the history of mankind, but also will address many important educational tasks and peacemaking.

We all know that the most effective forms of studying disciplines are those that require active participation by the students.

The students are challenged to show originality by providing materials in their presentations, competitive orientation, the practical relevance of disciplines, and the extensive use of modern digital technologies.

Scientific Olympics are characterized by the listed features. On the other hand, any communication between young people, even on a virtual level, will help to push the boundaries of political stereotypes that have developed over decades. Friendship and youth
contacts are a good guarantor of normal civilized relations between nations and peoples. World experience shows that the creation of high-tech projects such as reusable aerospace systems, the international space station, the A-380 and B-787 airliners, future flight projects on the Moon and Mars, and others – cannot be done without the cooperation and joint efforts of many organizations from different countries. To solve the greatest problems that mankind is facing, bright young people who have new engineering thinking are needed, so a large and friendly team of associates is required. The search for young people with the brilliant skills to participate in such projects is a challenge that must be addressed in a variety of ways, including through selection for various competitive events.

It is reasonable to believe that an effective means of attracting young people to the in-depth study any science is for them to participate in student competitions. This practice has been developed for a long time. Among the traditional, well-known and recognized international scientific olympiads are: The International Mathematical Olympiad (IMO, held since 1959), International Olympiad in physics (IPhO, held since 1967), the International Chemistry Olympiad (IChO, held since 1968), International Olympiad in Informatics (IOI, since 1989), and others. Apart from the analysis of the competition’s examples, the process of preparation for the Olympics, and direct participation in them, is recognized as one of the most effective forms of training of future specialists. Many of the competitors may later become influential scientists and renowned designers. These scientific Olympics are conducted mainly in an individual science, rather than focusing on teamwork.

Competition in the field of the aircraft design does not have such a rich history. However, KNRTU-KAI has been conducting such a competition annually since 2009, and this event has shown great potential in the search for future design talent. It is no coincidence that in recent years these Olympics have been overseen directly by P. Sukhoi’s Design Bureau and of Chief Designer of the fighter Su-27 Aleksey Knyshev.

In this regard, the authors of this paper suggest to organize an international student Olympiad on aircraft design in Nanjing University of Aeronautics and Astronautics (NUAA) in October 2017. To hold a traditional competition by gathering all the participants in one place is very difficult due to the high cost of transport and accommodation. However, many of the difficulties could be overcome with good preparation and by using the internet. The boundaries of an Olympiad in such format could be virtually limitless. The wide range of experience gained from holding the All-Russian Olympiads (on designing aircraft) annually (using a real participation format) in the Kazan National Research Technical University named after A.N.Tupolev (KNRTU-KAI).

2 BASIC PROVISIONS OF THE VI SOAD OLYMPIAD

Virtual International Student Olympiad on Aircraft Design (VISOAD) is an individual and team competition in the field of the aircraft design using a videoconferencing format. It is to be organized for students from different countries, carried out in order to identify the most talented, capable and advanced students.

Given the methodological, political and intellectual importance of this event, the Olympiad is scheduled to be held under the auspices of the Ministry of Education of China and the Ministry of Education and Science of the Russian Federation.
Let us dwell on the key points that should form the basis of the future Regulations on holding VISIOAD Olympics.

1. General questions.
1.1. The objectives of the Olympiad:
- Formation of students' deeper professional knowledge and professional competences in the field of aviation;
- The development of creativity and independent thinking;
- Identification of gifted students for the formation of personnel potential of enterprises;
- Attracting more entrants to the specialty related to the design;
- Attracting interest from companies in the process of training;
- Strengthening the links between universities and enterprises;
- Improving the quality of teaching of disciplines associated with the design;
- Improving forms of teaching;
- Establishing international cooperation at all levels (students, teachers, universities, companies);
- Reinforce the skills of the English language (for the students of non-English speaking countries);
- Instilling teamwork skills in the future graduates.

1.2. Organizing and managing the work of the Olympiad.
1.2.1. Institute of Design NUAA aircraft (Institute of Aircraft Design Technology of NUAA) is the initiator of the misuse organizer VISIOAD Olympiad.
1.2.2. To organize and manage Olympics Organizing Committee formed VISIOAD.
1.2.3. Organizing Committee (OC) of the Olympiad and provides training directly to its implementation.
1.2.4. Vice-Rector (Director of International Cooperation Office) heads the Olympics Organizing Committee of VISIOAD.
1.2.5. The OC develops Regulations and Rules of the Olympiad.
1.2.6. The OC creates online NUAA page dedicated to the organization and holding of the Olympiad.
1.2.7. The OC sends the announcement of the Olympiad for all potential participants.
1.2.8. The OC provides an operational link with the Olympics participants, informs team leaders on all matters relating to the organization and holding of the Olympiad, it forms the basis of these tasks, prepares accounting documentation on the results of the Olympiad, posts information on the results of the Olympiad on the Internet, prepares Olympiads awards.
1.2.9. The OC members may be included employees of NUAA and other universities, representatives of enterprises and companies that contribute to the Olympiad.
1.2.10. The OC forms the jury of the Olympiad.
1.2.11. The jury of the Olympiad are to be invited, and should include well-known scientists from the field of design and designers from China and other countries.
1.2.12. The jury are to develop the challenges, including taking into account proposals received from universities whose representatives will take part in this event.
1.2.13. The jury estimates the results of the tasks of the Olympiad, ranks the results,
obtains the results for the OC.
1.2.14. The OC forms a Credentials Commission (CC);
1.2.15. The CC verifies the credentials of the Olympiad participants, conducts encryption and decryptions of the authors of works, checks the conditions of the Olympiad according to develop Provisions.
1.2.16. The AC forms the Appeals Commission (AC).
1.2.17. The AC decides all disputes that may arise as a result of work on the part of members of the jury. The Commission's decision will be final.

1.3. Participation in the competition.
1.3.1. Students studying in areas of training undergraduate and graduate programs related to the aircraft industry can take part in this competition.
1.3.2. Participants are admitted to the Olympiad in accordance with the University application submitted to the Organizing Committee in the period, according to the Rules.
1.3.3. Any university in the world, dealing with training in areas of aviation, may enter only one team.
1.3.4. The application shall include the team leader from among the teaching staff, through which there is an interaction with the organizing committee, and a list of commands with the composition up to 4 people.
1.3.5. Given that the competition can participate many different countries, and given the lack of uniform requirements and common educational standards, the Organizing Committee offers universities and other parties to submit questions in the following sections of the Olympics:
   – Aerodynamics and flight dynamics of the aircraft;
   – The strength of the aircraft;
   – Technology of production of aircraft;
   – Construction and design of aircraft.
1.3.6. On the day of registration, the CC shall issue to each registered participant and each team identification number to ensure confidentiality in the process of checking and summarizing the competition.

2. The procedure for the Olympiad.
2.1. General provisions
2.1.1. Official language of communication - English.
2.1.2. The competition is held in the form of an online videoconference. During the whole time of the competition, each team should be in an office at the university equipped for videoconferences. Jury members monitor the work of each team in the online mode of NUAA.
2.1.3. The Olympiad is held according to the received rules in individual and team competition with evaluation of the results in three categories:
   –" The Best Project of Flight Vehicle";
   –" Best Team";
   –"The Best Participant".
2.1.4. The Olympiad is held in the terms stipulated regulations, and relevant orders Confirmed.
2.1.5. Team members during the Competition may use any source of information. It is necessary to give a link to each source used.

2.2. The content of the competition days.
The Olympiad is held on the circuit shown in Fig. 1.

![Figure 1: Schedule of competition VISOAD](image)

2.2.1. Day 1 (NUAA) - Jury develops practical task for the competition for the "The Best Project"
Sample task for practical competition.
At the level of the technical proposal to develop a conceptual design for an unmanned aircraft for remote sensing of the northern sea routes on the track motion convoys in the area of the Arctic Ocean. Specifications:
weight target load - kg; range - km; speed - m / s. Special requirements: to provide for the possibility of launching from ships and landing on a ship, trapped in a net system.

2.2.2. Day 2 (NUAA) - CC sends the task of the contest "Best LA Project" team leaders who have passed electronic registration.

2.2.3. Day 2 (universities) - the team are to commence competition for the "Best Project" in accordance with the Regulations. At the end of the time allotted for the contest, teams send their work performed in the address of the Credentials Committee.

2.2.4. Day 2 (NUAA) - Credentials Committee, having performed works and encrypting the sender transmits materials of the Jury, which proceeds to an analysis of solutions.

2.2.5. Day 2 (NUAA) - The jury will be preparing competitive tasks for the individual competition of the theoretical "best party" on the individual sections of design:
- Aerodynamics and flight dynamics of the aircraft;
- Strength;
- Production Technology;
- Construction and design.

The samples were targets for the divisions.
"Aerodynamics" section.
In the linear range of the polar angle of attack aircraft approximated dependence
\[ C_{xa} = C_{xa0} + A \times C_{ya} \]
where \( C_{xa0} \) = const (subsonic flow), \( A \) = const.
Find \( K_{max} \) \( C_{xa i} \) and \( C_{xa i} \).

Section "Strength"
How to distribute the shear force \( Q_i \) between the walls of the wing spars between the first and second longerons? The height of the spars \( H_1 \) and \( H_2 \).

Section "Production Technology"
Features riveting and test for leaks.

The section "Construction and Design"
Design an algorithm of forming the structure that provides the perception and transmission of a given production load – Fig. 2:

![Figure 2: Example of specifying the section "Design and Engineering"](image)

2.2.6. Day 3 - (NUAA) CC sends the task of the contest "The best participant of" team leaders, which brings information to each team member.
2.2.7. Day 3 (universities) - team members begin to carry out the competition for the "best party" in accordance with the Regulations. At the end of the time allotted for this competition, team members send their work performed to the address of the Credentials Committee.
2.2.8. Day 3 (NUAA) - CC, having performed works, reports to the Jury, which proceeds to an analysis of the presented solutions.
2.2.9. Day 4 (NUAA) - CC together with the Jury proceeds to the evaluation of the winners in the categories
- "The Best Project of Flight Vehicle";
- "Best Team";
- "The Best Participant".

3. Rules for sending jobs to university.
3.1. Prepared by the jury and approved by the OC, assignments are made in the form of a text file.
3.2. After the online broadcast, CC is satisfied that the team gathered and stored in a room designated for the Olympic Games, the team members have the appropriate badges, and the premises are no outsiders, it sends the heads of each team competition tasks.
3.3. After getting acquainted with the tasks of all the participants, each manager announces the start of the competition, from which the countdown begins.

4. Rules for execution of tasks and their references.
4.1. After receiving their identification numbers and files with job conditions, contestants perform them within the allotted time, the Regulations of the Olympiad.
4.2. Any response must contain the reasoning and decision algorithm, without which the final result of the decision of the Jury is not considering setting.
4.3. When assignments are allowed to use reference books and software products.
4.4. Decorated solutions jobs before the time the tour is sent to the representative of the CC, which transmits them to the jury for evaluation.

5. Evaluation of the results and conclusions.

5.1. General provisions.

5.1.1. Every contest section (problem, issue), the jury assigns a maximum score $M_i$, in accordance with the level of complexity.

5.1.2. Evaluation of the $i$-th response $j$-th participant/team carried out according to the formula

$$S_{ji} = k_j M_i,$$

where $S_{ji}$ is the number of points earned by the participant on the task $i$; $M_i$ is the highest possible score for the $i$-th task; $k_j$ is the coefficient of completeness of response, which is defined by the jury for the following reasons:

- $k = 1.0$ – absolutely correct and fully reasoned response;
- $k = (0.8 \div 0.9)$ – the right, but not reasoned response;
- $k = (0.6 \div 0.7)$ – correct, but little reasoned response;
- $k = (0.5 \div 0.6)$ – the answer is correct, but without sufficient justification;
- $k = (0.4 \div 0.5)$ – incomplete answer;
- $k = (0.2 \div 0.3)$ – response errors;
- $k = (0.2 \div 0.1)$ – wrong answer, but the right move solutions;
- $k = 0$ – absolutely wrong response or lack of response.

5.2. Evaluation of results of competition on the "Best Project".

Project evaluation is performed for each of the sections of the formula

$$S_{pi} = k_{ji} M_i,$$

where $j$ is command number; $i$ is number of section of the project, $i = 1, 2, .., N$. We propose content of the project to consider five sections ($N = 5$):

- $i = 1$ – the general concept of the aircraft;
- $i = 2$ – aerodynamics and flight dynamics of the aircraft;
- $i = 3$ – the strength of the aircraft;
- $i = 4$ – production technology;
- $i = 5$ – construction and design of FV.

The overall assessment of the project of the $j$-th team $S_{Pj}$ is determined by summing the results for each section of the project

$$S_{Pj} = \sum_i S_{pi}.$$

5.3. Evaluation of the results of the contest the "Best Participant".

Overall estimation $S_{ij}$ determined by summing the results of each participant, on all dialed 4th divisions of competition: aerodynamics and flight dynamics of the aircraft; FV strength; production technology; construction and design of FV

$$S_{ij} = \sum_i S_{ij}.$$

5.4. Evaluation of the results of the contest "The Best Team".
In calculating this competition assessment $S^T_j$ account the results of the first team competition and added to them the results of the three best participants of team scored in the individual competition

$$S^T_j = S^p_j + \sum_k S^I_{jk}.$$  

5.5. After checking the jury sends the results to the CC, which carries the decoding of the authors of all works.

5.6. Preliminary results are brought together representatives of the OC and the jury in the allotted time limits.

6. Completion of the Olympics.

6.1. According to the results of the Olympic Games are determined winners in three categories.
- 3 prizes for "The Best Project";
- 3 prizes in the competition - "The Best Participant";
- 3 prizes in the competition - "The Best Team".

6.2. The organizing committee is preparing a report that exposes the results of the Olympiad on the site and sends the information to all the participants.

6.3. In case of disagreement with the results of the Olympiad participants estimate they may appeal to the Appeals Committee after the announcement of the results. Commission working time is determined by the Rules of the Olympiad.

6.4. After the approval of the results of the Olympic Games its winners are awarded with diplomas and prizes.

4 CONCLUSION

1. The proposed methodology of the Olympic Games can be adjusted and supplemented taking into account the specificity of each participating university Olympiad.

2. Of great importance to ensure the required level of the Olympiad will be attended by companies and firms associated with the design and production of the aircraft.

3. After the Olympics on its results it is recommended to conduct a methodical seminar on which a detailed analysis of the results achieved will be made, and made relevant amendments.

4. This method with the corresponding corrections can be used for the competition in other areas of study.

REFERENCES