

ESTABLISHMENT OF THE UNMANNED AERIAL VEHICLE SYSTEM CLUSTER: MISSION, MOTIVATION, VISION, GOALS

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Abstract: *The Unmanned Aerial Vehicles (UAV), or Unmanned Aerial Systems (UAS) are promising tools in solution of many tasks of the public or civil applications. Understanding importance of the UAV applications last year many scientific events were organized devoted to this topic. The scientific conference held by Department of Control for Transportation and Vehicle Systems at Budapest University of Technology and Economics in 2013 took decision about establishment of the cluster involving segments of the Hungarian UAV industry and research groups working separately to have privileges from the cluster. The UAS cluster was found last year and enlarged this year to improve cluster skills and power to reach main goals defined before by cluster founder-members. The purpose of the author is to give a sketch about the cluster so as to bring it closer both to the academic, higher educational, industrial partners, and to the individual experts interested in UAV and UAS technologies.*

Key words: *UAV, UAS, UAS governmental (public) applications, UAS non-governmental (civil) applications, clustering, UAS cluster.*

1. INTRODUCTION

The UAV and UAS technologies applied in both public and civil purposes show strong trend in evolution.

Many applications and tasks covered by UAV flights.

Although many questions in the field of UAV applications are open and still not answered, the future users require new answers for challenges arising both in ground maintenance and in-flight situations.

Most of developed manufacturers provide full-scale maintenance system, and, there is strong guarantee on many items of the unmanned aerial systems.

Understanding importance of UAV applications itself, the European Committee had decided brake the walls in bottlenecks of the applications. First problem to be solved is the airspace management problem.

The present situation is that UAVs mostly fly in segregated airspace clear from any kind and any type of other aircraft. The problem is how to integrate the UAV flights into the airspace, and how to eliminate the need to segregate it.

The European Commission (EC) COM(2014)207 is about to solve the integration problem with that or higher level as conventional aircraft and aviation does.

Starting with the year of 2016 the integration must start for new UAVs and new model aircraft [3].

The second basic document focusing at UAV applications, and focusing on aviation, in general, is the EC's document called Flightpath 2050 – Europe's Vision for Aviation [4].

Chapter 'Prioritising research, testing capabilities & education' in its main goals for 2050 emerges establishment of a network of multi-disciplinary technology clusters created on the basis of collaboration between industry, universities and research institutes [4].

This strategic vision motivated the author to start to organize establishment of the first Hungarian UAV-cluster.

The purpose of the author is to brief the scientific society about this new initiative leading to establishment of the cluster working as virtual lab, and open for all those individuals and legal entities agreeing with the Charta of the cluster.

2. PRELIMINARIES AND RELATED WORKS

A long-lasting preparation of the cluster establishment has been started December 2013. January 2014 is famous for a kick-off meeting organized at Óbuda University.

Parties expressing wish to take part in historical event of establishment of the cluster evaluated the Charta of the cluster inspired and prepared by the cluster founder Prof. Dr. Szabolcsi.

After many readings the final version of the Charta was accepted by participating parties spring 2014. After calling to take part in cluster establishment eight legal entities had agreed to enforce the establishment process.

In UAV airworthiness compliance evaluation Szabolcsi had published a series of papers.

In scientific article [5] Szabolcsi gave new definitions, which can be applied in UAV certification procedures. Due to lack of regulations in the field of UAV airworthiness certification Szabolcsi derived a new concept of the flying and handling qualities of the UAVs applied in measure of compliance procedure [6]. In article [7] Szabolcsi had laid down basic principles applied in airworthiness certification of the automatic flight control systems of the UAVs. In scientific paper [8] Szabolcsi derived flying qualities available for measure of the compliance of the airworthiness of the lateral/directional automatic flight control of the UAVs.

In paper [9] Szabolcsi defined flying qualities available for measure of the compliance of the airworthiness of the longitudinal short period motion of the automatic flight control of the UAVs.

3. SITUATION ANALYSIS LEAD TO CLUSTER ESTABLISHMENT

The strategic document of EC Flightpath 2050 calls participants involved into UAV design and production to unify resources to accelerate penetration of the newest technologies in everyday life. The fundamental challenge appearing is to ensure that level of flight safety of the UAVs as it established for manned aircraft aviation since many decades ago.

The common aviation is famous for staffs keeping norms and regulations very strict. The question is how to make the participants of the UAV-aviation to keep and to follow the written, and many times, the unwritten norms, rules, regulations, and, pattern of behaviour.

These days represent the beginning of the new era famous for historical events in development of the UAV-aviation. Last year in October EASA interviewed all those experts ready to answer the complex set of questions starting with main principles and finishing with deep, sophisticated questions of airspace management, type- and airworthiness certification of the UAVs, flying and handling qualities of the UAVs, and, also many items of the education and training were evaluated.

The Federal Aviation Authority (FAA), U.S. had published first set of new regulations related to UAS 15 February 2015.

The basic regulatory document now is open for discussion. Being highly motivated FAA started to regulate following segments: operational limitations of the UAV, operator certification and responsibilities, aircraft requirements, and, finally, the model aircraft. However, there are many open items waiting for discussions, and decisions. Due to complexity of the problems and tasks to be solved, a single organization or a single company rarely can solve them in short time with limited resources, successfully. It is better to start to think in clusters, or in virtual labs to maximize effectiveness of the activity in UAV design and development. Hungary has long-lasting experiences in UAV design and development. The early 90's was the era of the development of the 'Bat' UAV. At the end of 90's the joint Czech-Hungarian UAV development program had been started and run to design new 'Soyka' reconnaissance UAV.

The Czech party had run his own project till 2010. The 2008 year is famous for starting development of the new UAV at Bonn Hungary Electronics Ltd., with participation of Technical University of Budapest, Óbuda University, and Institute for Computer Science and Control at Hungarian Academy of Sciences, as well.

The same year the Military started to use METEOR UAV for training of GBAD units in Poland. Gaining experiences from those years, 2013 is famous for using first time UAV coded METEOR 3MA for aerial targets during shooting drill in Ustka, Poland. After calling to take part in cluster establishment, following four founder-organizations triggered the new initiative and 26 June 2014 signed the Charta of the Unmanned Aerial Vehicle System Cluster (UAS_C) [1]:

- Institute of Mechatronics and Vehicle Engineering at Óbuda University;
- Electronics, Logistics and Property Management Co. at Ministry of Defense;
- BHE Bonn Hungary Electronics Ltd.;
- Hungarian Aviation Industry Foundation.

22 January 2015 the cluster had been enlarged with following four founder-member organizations [2]:

- Institute for Computer Science and Control at Hungarian Academy of Sciences;
- John von Neumann Faculty of Informatics at Óbuda University;
- Department of Control for Transportation and Vehicle Systems at Budapest University of Technology and Economics;
- Department of Aeronautics, Naval Architecture and Railway Vehicles at Budapest University of Technology and Economics.

All founder-members have large-scale experiences in UAV design, production, development, innovation, research and education promising effective achievement of the main goals outlined in the Charta of the cluster. The Board of the Cluster (BoC) made following statements in Charta of the cluster:

- the UAV and UAS systems are used worldwide in large-scale applications including both public and civil applications;
- the increasing need from the users of so high-technology products and other joint services is the motive of establishment of the UAS_C focusing on unmanned aerial vehicle systems with a broad spectrum of joint robotic initiatives;
- the existing economic demand on the accessible UAS services motivated founders to unify human resources, research and development infrastructure, teaching and training activities to develop products that are identified, designed, prototyped, engineered, produced, marketed, and sold by cluster members;
- there is the indisputable trend when UAV and UAS research and development go ahead to the regulations;
- ensuring high level of the flight safety of the UAV and UAS systems must be the key point of the research, development and production of the unmanned aerial vehicle systems.

4. FUNDAMENTAL PRINCIPLES OF THE UNMANNED AERIAL VEHICLE SYSTEM CLUSTER

The cluster-founders had agreed on establishment of the Board of the Cluster (BoC) leading the cluster members to achieve its goal.

The BoC credo is in following principal pillars of the cluster:

- the UAS_C is a non-governmental organization working as a virtual lab;
- the UAS_C is an autonomous organization;
- the UAS_C activity is morally and intellectually independent of all political authority;
- the UAS_C rejects intolerance in all mean of it, and always open to dialogue;
- the UAS_C emphasises personal and corporate social responsibility of the members in promotion of the development of the UAV and UAS technologies;
- the UAS_C underlines freedom in research, development, teaching and training activities;
- the UAS_C is an organization of those legal entities and individual persons able and ready to work together to reach synergies to maximize effectiveness of theirs activities;

- the UAS_C will
 - integrate partners working in the research and development areas of the main scope of the cluster;
 - unify resources;
 - systematize and share knowledge;
 - share experiences and best practices;
 - propagate results in the field of UAV and UAS research and development, production, and maintenance;
 - establish synergies between cluster members;
 - trigger new initiatives in the field of UAV and UAS research and development;
 - establish, enlarge and widen international co-operations in the knowledge-triangle;
 - provide presentation of the cluster members both domestically and internationally;
 - cooperate with governmental organizations in legislation, certification and other areas in order to speed up the development of the Hungarian UAS industry;
- the UAS_C believes that this form of co-operation equipped well-enough so as to develop it by research and innovation;
- the participating students are entitled, able and willing to enrich their minds with that knowledge provided by the cluster members and co-operating corporates and other partners.

The cluster is open for all individuals and legal entities agreeing with those principles and goals outlined in the Charta of the cluster.

The first indisputable result of the cluster establishment is the conversation between cluster-members sharing information, knowledge, end experiences gained in the past years.

5. THE MEANS ENSURING ACHIEVEMENT OF THE MAIN GOALS OF THE CLUSTER

To attain main goals of the UAS_C by following such principles defined above the cluster calls for effective means, suitable to present conditions:

- the membership in UAS_C is the volunteer one;
- the wish for UAS_C membership can be signified by agreeing with goals and norms of this Charta via signing it;
- recruitment of new members to join the UAS_C to present resources for reaching its main goals is the mission of the cluster;

- the BoC:
 - o consists of representatives of the eight founder-member organizations and the Cluster Founder;
 - o sessions two times per a year to establish annual working plans, to evaluate results, to get lessons learned from activities carried out by cluster members;
 - o decides about membership in UAS_C;
 - o establishes centres to reach goals of the cluster;
- the UAS_C creates and runs a website to reach maximum of publicity;
- the UAS_C establishes a new series of scientific conferences organized 2-yearly;
- the UAS_C establishes and starts an international peer-reviewed scientific journal with two volumes per a year.

6. CONCLUSIONS AND FUTURE WORK

The cluster now is established and started to work out basic regulations needed for carry out mains tasks of the cluster. 22 January 2015 the BoC agreed on plan of activity for the first half year of 2015. A proposal by the cluster founder was made on establishment of the following centers but not limited to:

- Research, Development, and Innovation Center;
- Education & Training Center;
- Production & Repair Center;
- Service & Maintenance Center;
- Regulatory Center;
- Customer & Marketing Center.

The cluster establishment serves as a unique opportunity for cluster members, and non-members but interested in, individuals and legal entities in the fields of UAV design and application to create value useful for society.

The new era of the wide-range UAV applications is knocking on the door. The global trends in UAV and UAS design and production requires new methods to be a partner in the joint development programs.

The UAV-aviation future in military missions is undisputable. The single UAV sent to war theatre minimizes the threat of loss of the pilot, or any crew of the conventional aviation.

However, there might be arise new challenges when UAV pilot staff member is leaving the Military after his contract is inactive: to recruit pilots for the next, new rotation so as not to lose skills and administrative certification is very challenging today. Physical and mental overload of the UAV-pilots is threatening the success of the selection process.

The public UAV-aviation can appear although in disaster relief missions, or in firefighting missions. The information provided by UAVs can affect very much effectiveness of the execution of the given task put for disaster relief teams.

The UAV-aviation in civil applications will be extended for segments unbelievable before. Delivering small weights, goods, products under 0,5 kgs (i.e. pizza, chocolate, jewelry, gifts, perfumery etc.) can be the typical field of the new UAV-applications.

Many new possible applications are shown in agriculture, movie shooting industry, building industry, public and private transport, entertainment, food industry.

The question today how international (ICAO, EASA, DoT FAA, NATO etc.) and domestic regulations support these new UAV-applications, or, if the regulations conflict, how to understand regulating rules and norms, how to prioritize regulating norms.

The lead-nations and countries go ahead in regulating activities well, so those countries, legal entities following the main stream have basics and preliminaries in the establishment of the domestic regulations.

The years we face are promising if to take part actively in rule-making process, in establishment of the new sub-systems needed for safe UAV-aviation.

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