

Domestic unmanned aircraft retrospective analysis, state of the art and the development trends

© G.A. Kuznetsov¹, I.V. Kudryavtsev¹, E.D. Krylov²

¹Siberian Federal University, Krasnoyarsk, 660041, Russia

²Aviamechanica LLC., Krasnoyarsk, 660079, Russia

The article presents retrospective analysis of model range of the domestic unmanned aerial vehicles, describes the dynamics of their development and industrial production, and includes a list of Russian developers and manufacturers. The domestic unmanned aerial vehicles state of the art is analyzed. On the basis of the analysis results the main trends in the development of Russian unmanned aerial vehicles are formulated. In particular, recently there has been a sharp increase in the number of Russian flying vehicle models, as well as enterprises and organizations engaged in their development and production in the military and civil sectors. A great demand for unmanned vehicles, improving Russia's national security, switching to import substitution under sanctions, budgetary, grant and private financing for the development and production of unmanned aerial vehicles are the reasons for it.

Keywords: *unmanned aerial vehicle, remotely piloted aircraft, unmanned aircraft, unmanned helicopter, multi-rotor unmanned vehicle, pilotless aviation*

REFERENCES

- [1] Ivanov Yu.L., ed. *Bespilotnye letatelnye apparaty: sostoyanie i tendentsii razvitiya* [Unmanned aerial vehicles: state of the art and the development trends]. Moscow, LA Varyag Publ., 2004, 176 p.
- [2] Sukhachev A.B. *Bespilotnye letatelnye apparaty: sostoyanie i perspektivy razvitiya* [Unmanned aerial vehicles. State of the art and development prospects]. Vilkova N.N., ed., Moscow, MNITI Publ., 2007, 60 p.
- [3] Kuznetsov G.A. *Nauchnoe obozrenie — Scientific Review*, 2010, no. 3, pp. 40–45.
- [4] Badekha V.A., ed. *Bespilotnye aviatsionnye sistemy. Sovremennoe sostoyanie i opyt primeneniya* [Unmanned Aircraft Systems. Current state and experience of application]. Moscow, Pero Publ., 2014, 207 p.
- [5] Fetisov V.S., ed. *Bespilotnaya aviatsiya: terminologiya, klassifikatsiya, sovremennoe sostoyanie* [Unmanned aviation: terminology, classification, current state]. Ufa, Foton Publ., 2014, 217 p.
- [6] Ivanov M.S., ed. *Bespilotnye letatelnye apparaty. Spravochnoe posobie* [Unmanned aerial vehicles Reference Manual]. Voronezh, Nauchnaya kniga Publ., 2015, 619 p.
- [7] Matusevich A.N. *Sovetskie bespilotnye samolety-razvedchiki pervogo pokoleniya* [Soviet unmanned reconnaissance aircrafts of the first generation]. Moscow, AST Publ., Minsk, Kharvest Publ., 2002, 48 p.
- [8] Ganin S.M., Karpenko A.V., Kolnogorov V.V., Petrov G.F. *Bespilotnye letatelnye apparaty* [Unmanned aerial vehicles]. St. Petersburg, Nevskiy bastion Publ., 1999, 160 p.
- [9] Kudryakov S.A. ред. *Bespilotnye aviatsionnye sistemy. Obshchie svedeniya i osnovny ekspluatatsii* [Unmanned Aircraft Systems. General information and the basics of operation]. St. Petersburg, Svoe izdatlstvo Publ., 2015, 121 p.
- [10] Pavlushenko M.I., Evstafyev G.M., Makarenko I.K. *Natsionalnaya i globalnaya bezopasnost. Bespilotnye letatelnye apparaty: istoriya, primeneniye, ugroza*

- rasprostraneniya i perspektivy razvitiya* [Unmanned aerial vehicles: history, application, threat of proliferation and development prospects]. Moscow, Prava cheloveka Publ., 2005, 610 p.
- [11] Bychkov V.N. *Letopis aviatsii i vozdukhoplavaniya* [Annals of Aviation and Aeronautics. Moscow, Academia Publ., 2006, 816 p.
- [12] Yankevich Yu. *Obshcherossiyskiy nauchno-tekhnicheskiy zhurnal «Polet» — All-Russian scientific and technical journal “Polet” (Flight)*, 2000, no. 3, pp. 25–31.
- [13] Makarov Yu.V. *Letatelnye apparaty MAI* [MAI aircrafts]. Moscow, MAI Publ., 1994, 256 p.
- [14] Yankevich Yu., Ermakov A. *Dvigatel — Engine*, 2000, no. 2, pp. 35–37.
- [15] Vasilyn N.Ya. *Bespilotnye letatelnye apparaty* [Unmanned aerial vehicles]. Minsk. Popurri Publ., 2003, 272 p.
- [16] Yerokhin E. *Vzlet — Take-off*, 2017, no. 11–12, pp. 20–23.
- [17] Kuznetsov G.A. *Bespilotnye letatelnye apparaty s porshnevnyimi dvigatelyami. Komponentki i konstruksii* [Unmanned aerial vehicles with piston engines. Layouts and structure]. Moscow, Sputnik+ Publ., 2010, 194 p.
- [18] Zavalov O.A. *Sovremennye vintokrylye bespilotnye letatelnye apparaty* [Modern unmanned rotorcrafts]. Moscow, MAI PRINT Publ., 2008, 196 p.
- [19] Drushlyakov V. *Vzlet — Take-off*, 2008, no. 1–2, pp. 18–31.
- [20] Novichkov N.N., ed. *Bespilotnye letatelnye apparaty mira. Spravochnik* [Unmanned aerial vehicles of the world. Reference book]. Moscow, IA ARMS-TASS Publ., 2012, 456 p.
- [21] *Bespilotnye letatelnye apparaty* [Unmanned aerial vehicles]. Available at: <http://www.bp-la.ru> (accessed February 16, 2018).
- [22] *Nezavisimye bespilotnye sistemy* [Fully autonomous unmanned systems]. Available at: <http://www.ruvs.com/catalog> (accessed February 16, 2018).
- [23] *Rossiyskie bespilotniki* [Russian unmanned aircrafts]. Available at: <https://russiadrone.ru/catalog/bespilotnye-komplekсы/> (accessed February 18, 2018).
- [24] *Portal po aviatsii № 1* [The aviation portal no. 1]. Available at: <http://avia.pro/blog/bespilotnye-letatelnye-apparaty-drony-istoriya> (accessed February 28, 2018).
- [25] Shibaev V., Shnyrev A., Bunya V. *Aerokosmicheskiy kuryer — Aerospace courier*, 2011, no. 1, pp. 55–57.
- [26] Yerokhin E. *Vzlet — Take-off*, 2017, no. 9–10, pp. 30–34.
- [27] Yerokhin E. *Vzlet — Take-off*, 2017, no. 9–10, pp. 12.
- [28] Barbasov VK, Grechishchev A.V. *Inzhenernye izyskaniya — Engineering survey*, 2014, no. 8, pp. 27–31.
- [29] *Bespilotnye letatelnye apparaty NPP “Avtonomnye aerokosmicheskie sistemy Geo Servis”* [Unmanned aerial vehicles of the research and production enterprise “Autonomous aerospace systems Geo Service”]. Available at: <http://www.uav-siberia.com/catalog/uavs> (accessed February 16, 2018).
- [30] Ageev A.M., Popov A.S., Makarov I.V. *Bespilotnye letatelnye apparaty. Raboty po sozdaniyu nauchno-issledovatel'skogo bespilotnogo letatel'nogo apparata v VUNTs VVS VVA* [Unmanned aerial vehicles. Work on the creation of a research unmanned aerial vehicle at the Military Training and Research Center of the Air Force, the Air Force Academy]. *Perspektivy razvitiya i primeneniya kompleksov s bespilotnymi letatel'nymi apparatami. Sbornik statey i dokladov po materialam ezhegodnoy nauchno-prakticheskoy konferentsi* [Prospects for the development and application of complexes with unmanned aerial vehicles. Collection of articles and reports on the materials of the annual scientific and practical conference]. Kolomna, 2016, pp. 10–16. Available at: http://mil.ru/files/morf/Sbornik_dokladov_konferentsii_bla.pdf (accessed February 16, 2018).

- [31] Yerokhin E. *Vzlet — Take-off*, 2016, no. 6, pp. 20.
- [32] Krylov E.D., Karzhaev A.S., Khoroshko A.Yu. Puti sozdaniya gibridnykh silovykh ustanovok s vysokimi udelnymi kharakteristikami [Ways to create hybrid power plants with high specific characteristics]. *Aktualnye voprosy issledovaniy v avionike: teoriya, obsluzhivanie, razrabotki. Sbornik nauchnykh statey po materialam dokladov IV Vserossiyskoy nauchno-prakticheskoy konferentsii "Aviator"* [Actual problems of research in avionics: theory, maintenance, development. Collection of scientific articles on the materials of reports of IV All-Russian scientific and practical conference "Aviator"]. Voronezh, VUNTs VVS VVA Publ., 2017, pp. 70–75.
- [33] Smirnova I.R., Titkov O.S., Chabanov V.A. *Aviatsionnye sistemy — Aircraft Systems*, 2018, no. 1, pp. 9–23.
- [34] Linnik S. *Otechestvennaya bespilotnaya aviatsiya* [Domestic unmanned aircrafts]. Available at: <https://topwar.ru/137169-otechestvennaya-bespilotnaya-aviatsiya-chast-1.html> (accessed March 30, 2018).
- [35] Bondar M.S., Bulatov O.G., Zhernakov A.B. *Voennaya mysl — Military thought*, 2017, no. 5, pp. 41–44.

Kuznetsov G.A., Cand. Sc. (Eng.), Assoc. Professor, Department of Design and Technological Support of Machine-Building Productions, Siberian Federal University. Research interests: aeronautical engineering, unmanned aerial vehicles авиационная техника, piston engines. e-mail: gkuznecov@mail.ru

Kudryavtsev I.V., Cand. Sc. (Eng.), Assoc. Professor, Department of Applied Mechanics, Siberian Federal University. Research interests: aeronautical engineering, unmanned aerial vehicles, piston engines. e-mail: kudrilya@rambler.ru

Krylov E.D., Director, Aviamechanica LLC, Research interests: aeronautical engineering, unmanned aerial vehicles, piston engines. e-mail: krylov@uav-siberia.com