Chapter

Red Wings Proposed by Robert Bartini for Sustainable Aviation

Sergej Težak

Abstract

This chapter is a brief description of aircraft designer Robert Bartini and his role in the development of the military, passenger, and transport aviation. Robert Bartini was educated in Austria-Hungary and Italy, and graduated from Milan Polytechnic Institute. In 1923, he fled Italy to escape Fascism and emigrated in the Soviet Union. After the First World War, the young Soviet Union (USSR) desperately needed new engineers and scientists who would provide the new country with development of modern industry and transportation. At that time, Western European countries had knowledge and experiences, especially in the field of aviation. In addition, the chapter presents Bartini's vision of the sustainable intercontinental and continental high-speed transport, which was the focus in the last years of his work and creation. The term "red wings" in the title of the article is related to his work in the "red" Soviet Union. In Russia, Robert Bartini is very popular as a researcher and developer. There are many books about him in Russian and Italian language, but not in English. Thus, his work is still quite unknown in the West. He was born in Kanjiza (today Serbia) in 1897 and spent his youth in Fiume (Rijeka, today Croatia).

Keywords: Bartini, air transport, aviation, development of aircraft, ekranoplan, ground effect, WIG crafts, Rijeka, Soviet Union

1. Introduction

During the cold war, the superpowers, the United States (USA) and the Soviet Union (USSR), wanted to demonstrate their achievements in the development of military technique and technology. Furthermore, both superpowers wanted to show their best in the field of engineering and technology for military and civil purposes. This competition reflected the conquest of space and the field of aviation, where the former Soviet Union wanted to be presented abroad in the best light. However, the knowledge in this area could not be obtained in a short time, so it was necessary to invest years and years into the development and testing and learning from mistakes. Due to the lack of prior knowledge, both superpowers were hungry for scientists and researchers, mainly from Europe, that contributed an important part in the development of space technology and aviation. Most of the necessary knowledge and human resource superpowers were gained after the Second World War. However, many scientists fled from the unstable pre-war Europe to the United States before the war, rather than the Soviet Union.

After the First World War, the Soviet Union wanted quicker progress in the field of aviation because of the country's vast size. The most famous pioneers in space transportation (Tsiolkovsky) and builders of large airplanes (Sikorsky, Tupolev) came from Russia, but knowledge in Western Europe in the field of aerodynamics made great progress, especially Italy which at that time possessed a superior knowledge in aerodynamics, which was rewarded with a world speed record in aviation in the years 1927–1929 and 1933–1934. Therefore, it is not surprising that Robert Bartini immigrated to Russia in 1923. He was a young Italian aviation engineer and communist proving his skills in the fields of aviation in the next 50 years in the Soviet Union. This case shows a classic transfer of knowledge in the new young Soviet Republic.

His solutions, gained with better knowledge of aerodynamics, have contributed to higher aircraft speed and lower energy or fuel consumption, and at the same time, a longer range of aircrafts was reached. In the historical context, his work has led to the improvement in the sustainability of aviation.

2. Life and work of Robert Bartini in the field of aviation

Robert Bartini was born on May 14, 1897, in Kanjiza (today this is the town in Serbia near Hungarian border), according to his documents from the time he lived in the Soviet Union [1]. When he was 3 years old, he was adopted by the family of rich state official in the town of Fiume in the Austro-Hungarian monarchy (today Rijeka in Croatia). In his youth, his surname was Orosdy [2]. As a young boy, he was very intelligent, and he received additional education by the family teacher in natural science (chemistry, biology), music, and foreign languages [3]. In 1912, he saw an airplane and was fascinated by the air show of Russian aviator Slavorossov in Rijeka. In 1915, he graduated from grammar school in Budapest [2], was drafted and sent to reserve officer school, located in the town of Bystritsa (in Czechoslovakia), and then in 1916, he was sent to Russian-Austrian-Hungarian front where he was captured in June 1916 [4]. He was sent into captivity in the Far East in prison camps in Khabarovsk and Vladivostok. He was released after the First World War, and then he worked as a taxi driver in Shanghai. In 1920, he returned home in Fiume. When working at Isotta-Fraschini facilities, he graduated from Milan Polytechnic Institute in 1922. In the same year, he also graduated from pilot school in Rome. During the captivity in Russia, Bartini came under the influence of communist literature, and in 1921, he became a member of the Communist Party of Italy. In 1923, the Fascists took over the control in Italy, and Bartini was sent to the Soviet Union. When he left Italy over Alps, he vowed, "red planes will always be faster than black" [3]. When he was a member of the Communist Party of Italy, he worked underground and got the nickname "Red Baron," which he kept from the Soviet Union as well.

Since the arrival in the Soviet Union, Bartini served the next 6 years as a mechanical engineer and the head of the department of scientific and test aerodrome (now Chkalovsky). Later, he was transferred to the First Squadron of Naval Forces of the Black and Azov Seas. In 1925, he participated in the national gliding championship in Crimea and together with designer Myasitchev cooperated as a constructor and pilot [1]. In 1928, he became the head of the department of amphibious experimental aircraft design and was appointed as the chief engineer of the Black Sea Aviation. In the following year, he participated in the organization of ANT-4 "Soviet Country" aircraft flight to the United States, servicing in sea

segment of the route. In the Red Army, Bartini reached the rank of a brigadier (Brigadier General).

Bartini returned to Moscow and worked as a chief designer of his projects in seaplane design bureaus at facilities No. 22 and 39 until August 1930. He was dismissed from the design bureau due to his critical letter to Stalin, but the Air Forces authorities organized a small design bureau for him at facility No. 22. In this office, he began to design a new aircraft, Stal-6 (Steel-6) with an incredible clean contour (**Figure 1**). "I saw an airplane like a beautiful naked girl," said the former test pilot a half century later, when he saw the "top secret" aircraft for the first time [2]. The "Stal-6" aircraft was a monoplane configuration fighter airplane with inventive solutions: full retraction of bicycle landing wheel, a closed cockpit with a transmission gear in elevator control linkage, and an engine evaporative cooling system with cooler-wing tips. The structure and aerodynamics of this aircraft permitted the speed of 420 km/h in 1933 [5] which was 150 km/h more than the best fighters in the Soviet Union at the time. The aircraft had V-12 engine with 630 hp., and it was made of stainless steel "enerzh 6." Two years later (1935), Bartini designed the "Steel-8" fighter reaching the speed of 630 km/h, but it was not selected for the proposed Soviet fighter. If the Soviet Union had chosen this plane for further development, then they would have had a superior fighter for defending "mother Russia" from the Germans by 1941.

In 1934, Bartini began developing the Stal-7 aircraft, which was a twin-engine passenger aircraft, exhibited at the Paris Salon in 1936. In 1939, the aircraft reached a new world record for a distance of 5000 km; it was flying over 5068 km with an average speed 405 km/h. The top speed of this aircraft was 450 km/h. In fact, Bartini's knowledge of aerodynamics was most evident in the development of this airplane. Its special shape increased the pressure under a fuselage, thus enabling additional lift. In this way, the airplane consumed less fuel at higher speeds, which at those times contributed to sustainable aviation. The Stal-7 was ready for the flight around the world, which was prevented by the arrest of the chief designer Bartini. They imprisoned him in 1938 and accused of being Mussolini's agent and participating in the burning of building No. 240, where the aircraft Stal-7 was placed. First, he was sentenced to death and imprisoned in the disreputable NKVD prison. When his plane reached a world record, Stalin "personally" took care that Bartini's sentence was reduced to standard 10 years in prison. Bartini was transferred to secret research and development camp KB (sharaskas) in different towns: Moscow, Omsk, Kazan, and Taganrog. At that time, the Stal-7 aircraft was one of the greatest secrets of the Soviet Union, leaving behind only one short film clip and some photos. Under the leadership of V. Ermolajev and advice of Bartini, the plane began to transform into the long-range Yer-2 bomber, resulting in about 400 Yer-2 aircrafts.

During the Molotov-Ribbentrop pact, the aircraft was intended for attacks on Britain and France and their bases in the Middle East. Instead, the Yer-2 aircrafts

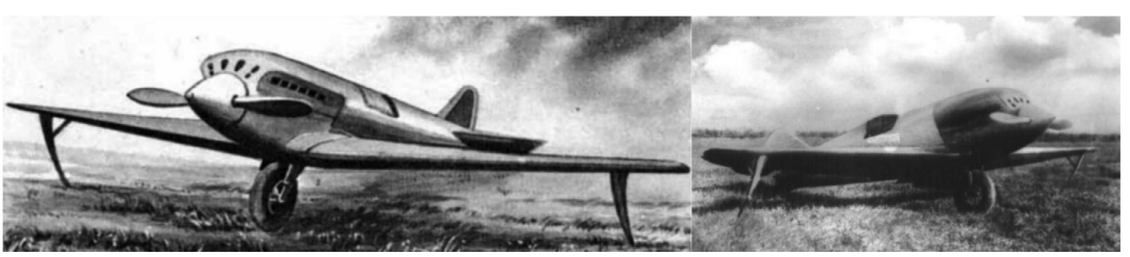

Figure 1.
Aircraft Bartini Stal-6 (Steel 6). Source: http://en.valka.cz/topic/view/102660/Bartini-Stal-6, web source: October 18, 2017.

were engaged in night-time attacks on Berlin at the time when the Germans were sure they were invincible. The first bombing took place already on August 8, 1941. In fact, the Soviets bombed Berlin directly from Moscow. At the beginning, the Germans did not even know what they were dealing with. Their fighters were simply too slow in 1941 (**Figure 2**).

During the period from 1940 to 1943, Bartini's main concern in the custody in Moscow and Omsk was faster-than-sound aircraft with rocket power. The project of his first P-114 (Cyrillic P = R for rocket) interceptor with a swept wing was not realized [4]. The P-114 was designed for speed more than 2000 km/h. At that time (1943), Bartini already knew that the best wing shape for speeds beyond Mach 2 is delta wings.

Then he started constructing the first wide-fuselage (wide-body) transport aircraft T-117 for transport tanks. This was the first aircraft with transport ramp/door at the back of the plane, for easier loading/unloading of cargo (**Figure 3**). The plane was already constructed in Taganrog, but necessary engines were not supplied. Those engines were required for the production of Tupolev Tu-4 bombers, which were a copy of the American B-29 bombers. Stalin said that Russia needed bombers

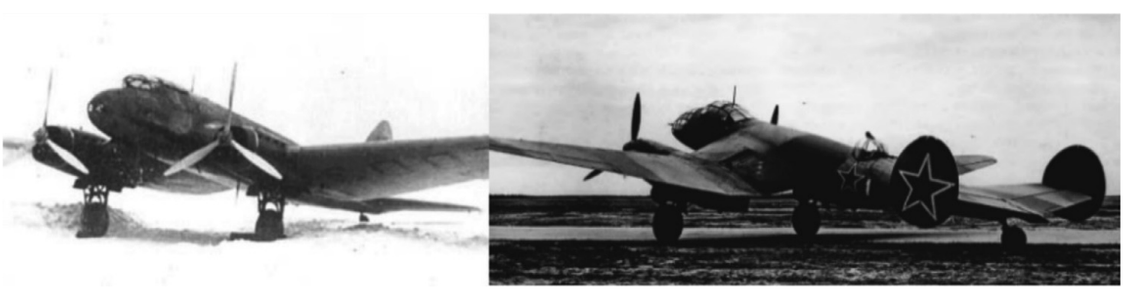

Figure 2.
Passenger aircraft Bartini Stal-7 and bomber Yer-2 (Er-2). Source: http://mig3.sovietwarplanes.com/colors/1945-50-oldtypes/yer2-splinter.jpg, web source: March 16, 2017.

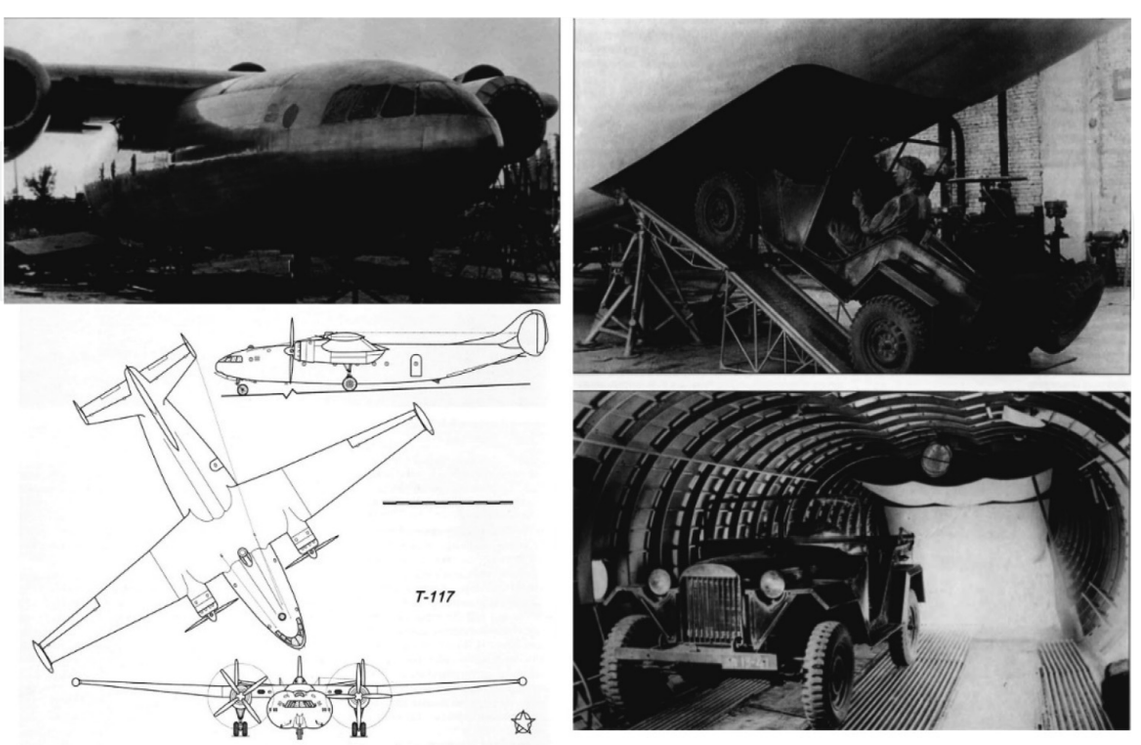

Figure 3.
First wide-body aircraft: Bartini T-117. Source: Jakubovich [5].

instead of transport aircrafts. In addition, new invented aircraft T-117 did not flight, so the project was laid off. T-117 aircraft drawings were sent to Antonov's company in Kiev. Many of Bartini's designs were later used on Antonov aircrafts. In 1946, Bartini was released, and his design bureau in Taganrog was closed; the T-117 plane was destroyed and cut. Antonov design bureau was the first wide-body transport aircraft constructed a decade later.

After the release, Bartini decided to continue the work in Taganrog, and he designed even more T-200 and T-210 transport aircrafts, but the realization of the projects failed to occur. In 1952, Bartini moved to Novosibirsk where he began to research and made aerodynamic calculation for the optimum shape of wings for supersonic speeds. Based on these investigations, he designed T-203 project—variable sweep wing with aerodynamic twist. For complex calculations, he used a computer BESM-1, the first Russian computer that was developed by S.A. Lebedev. Therefore, he began to develop the plans for strategic bombers A-57 and A-55 at speeds of 2200–2500 km/h with the possibility of landing on the water. At that time, Soviet bombers did not have sufficient range to reach the coast of the United States and return to the Soviet Union. Bartini found an innovative solution for aircraft landing on the water, where Soviet submarines could supply fuel to the aircraft. However, Soviet authorities refused the project in favor of the development of ballistic missiles. The results of Bartini's research and results about wings for large aircrafts in supersonic speeds were sent to the Tupolev design bureau. These solutions were used there to design the supersonic Tu-144 passenger aircraft, and the Concorde aircraft had the same wing design, too.

3. Bartini's vision of the sustainable intercontinental high-speed transport

Bartini was completely rehabilitated in 1957, and he returned to Moscow, where he worked in a small Kamov construction bureau. During this time, he began to study and compare the various forms of the transport and determine the most energy corresponding type to a certain speed.

Bartini developed a "Theory of intercontinental transport on Earth," which was completed in the 1960s. This sustainable theory takes into account the entire planet Earth for the implementation of transport services for ships, planes, helicopters, railways, etc. In addition, the interdependencies between the various criteria are considered: the amount of load, speed of delivery, the weather conditions, and the area required for various operations (stopping and moving vehicles, facilities for loading and unloading, etc.). He came to the solution that the most optimal and sustainable vehicle can fly just above the surface; it can take off and land vertically and can be applied on all surfaces—snow, water, earth, ice, and sand [6].

Similar research about the efficiency of the different means of the transport was launched by Von Karman in the 1950s of the last century. He noted that the "hydroglider" had the highest efficiency; in those times, this was probably the original term for the WIG vehicle or ekranoplan (Russian term). The term WIG vehicle or ekranoplan is used for vehicles that use ground effect—wing-in-ground effect (WIG effect) (**Figures 4** and **5**).

The optimum flight is just above the flat surface where vehicles can take advantage of ground effect. Vehicles using ground effect achieve up to 30% more lift than normal planes at the same wing surface. Therefore, the ground effect enables less surface of the wings for the same lift force. Moreover, it has less drag, which is best

seen in the diagram. Vehicles using WIG effect are sustainable because they have lower energy or fuel consumption, and therefore they can reach longer range (**Figure 6**).

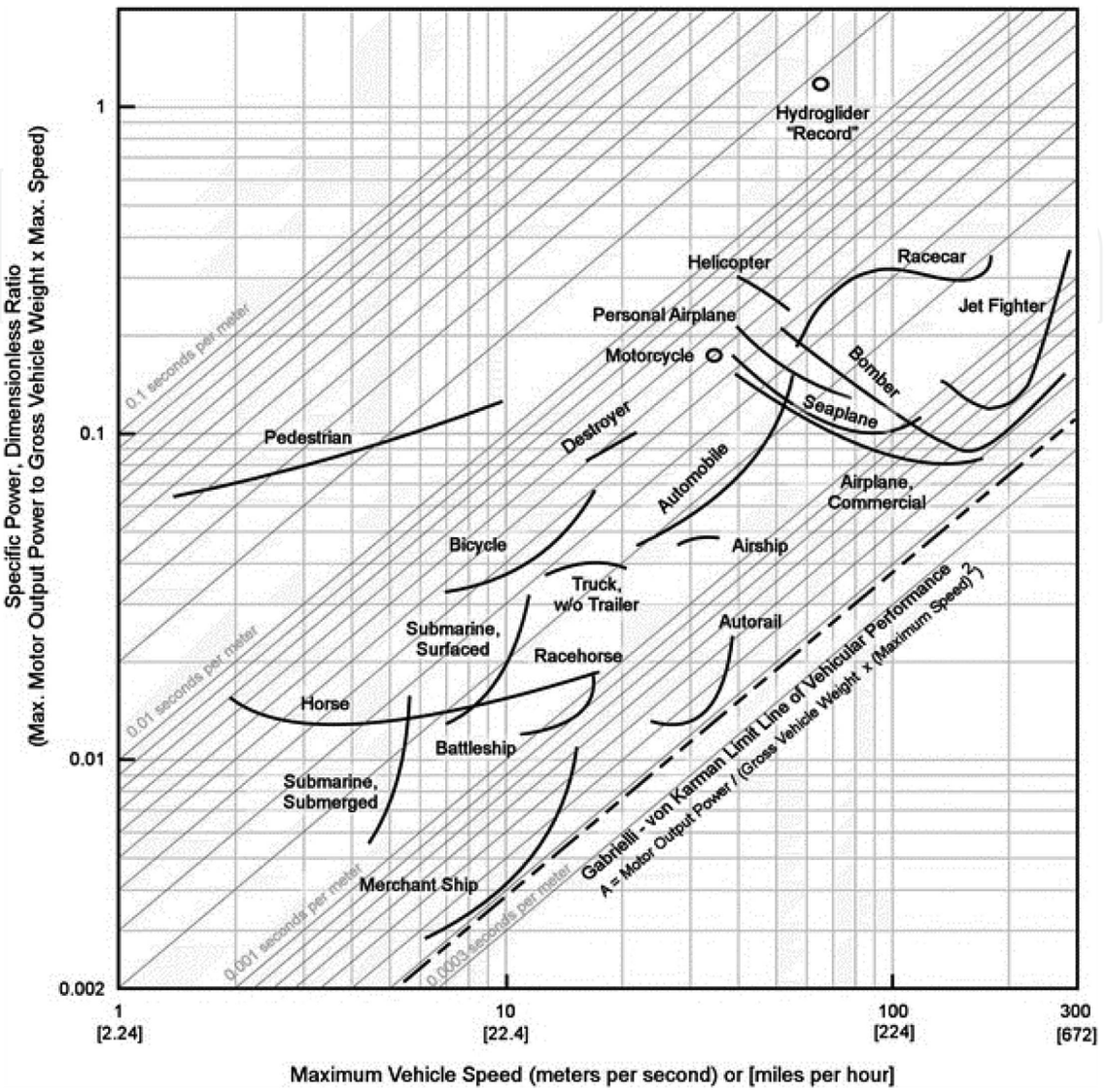

Figure 4.
Transport efficiency diagram for different means of transport. Source: Trains and boats and planes, https://trainsnboatsnplanes.wordpress.com/2010/01/07/the-price-of-speed/, web source: March 16, 2017.

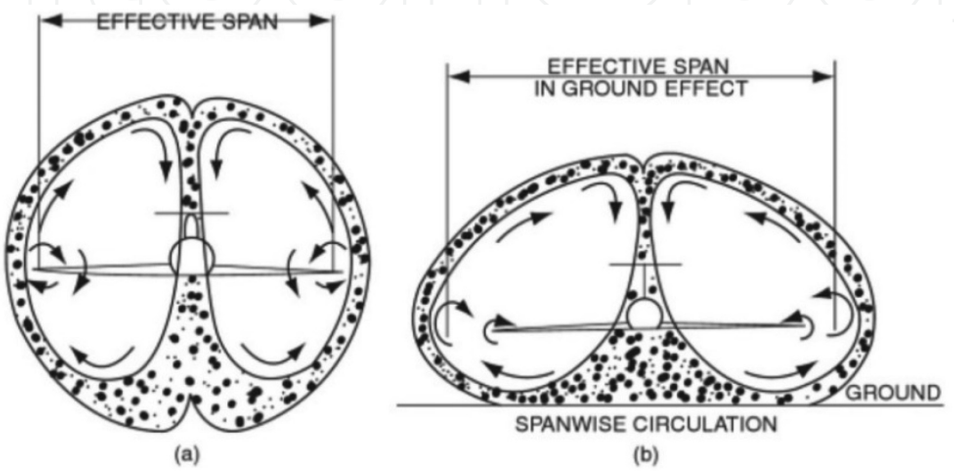

Figure 5.
Airplane in normal flight (a) and in fight with WIG effect (b). Source: Lun et al. [7].

In the 1960s, Bartini began to develop the VVA-14 prototype aircraft, an amphibian plane in order to prove his theory. This plane could land on all possible surfaces: sea, earth, ice, and sand. It had an option for vertical takeoff and landing or conventional takeoff and landing from both airports and water surfaces.

More importantly, WIG flight could save enough fuel for the vertical takeoff or landing of the aircraft. The plane was made in the Beriev factory. The first test flight was carried out in 1972, but 14 engines needed for vertical takeoff were never delivered. The plane made a series of test flights, took off on land and water in the conventional way (without testing vertical takeoff and landing). However, further development was not approved.

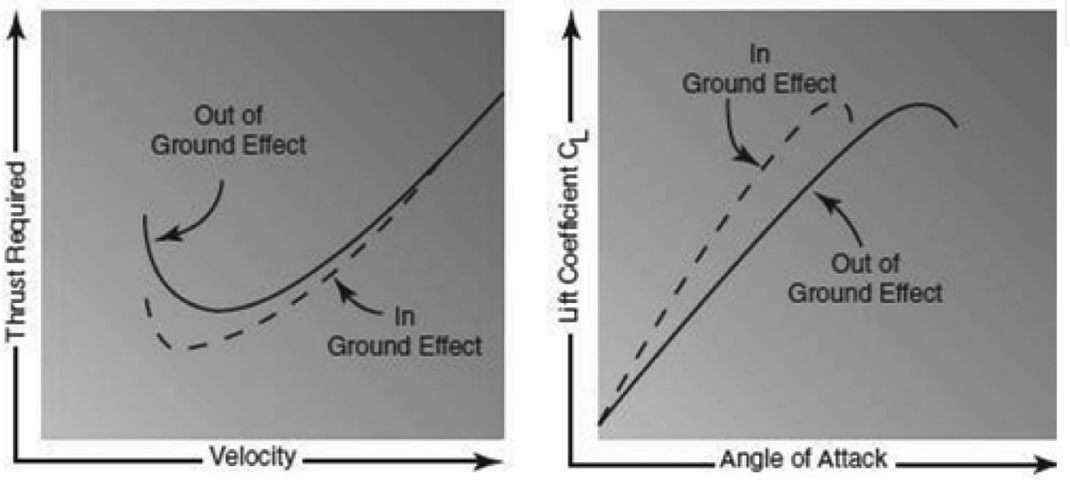

Figure 6.
Wing-in-ground effect flight changes drag and lift. Source: Aerodynamics in flight—Airplane ground schools, http://airplanegroundschools.com/Flight-Aerodynamics/index.html, web source: December 1, 2017.

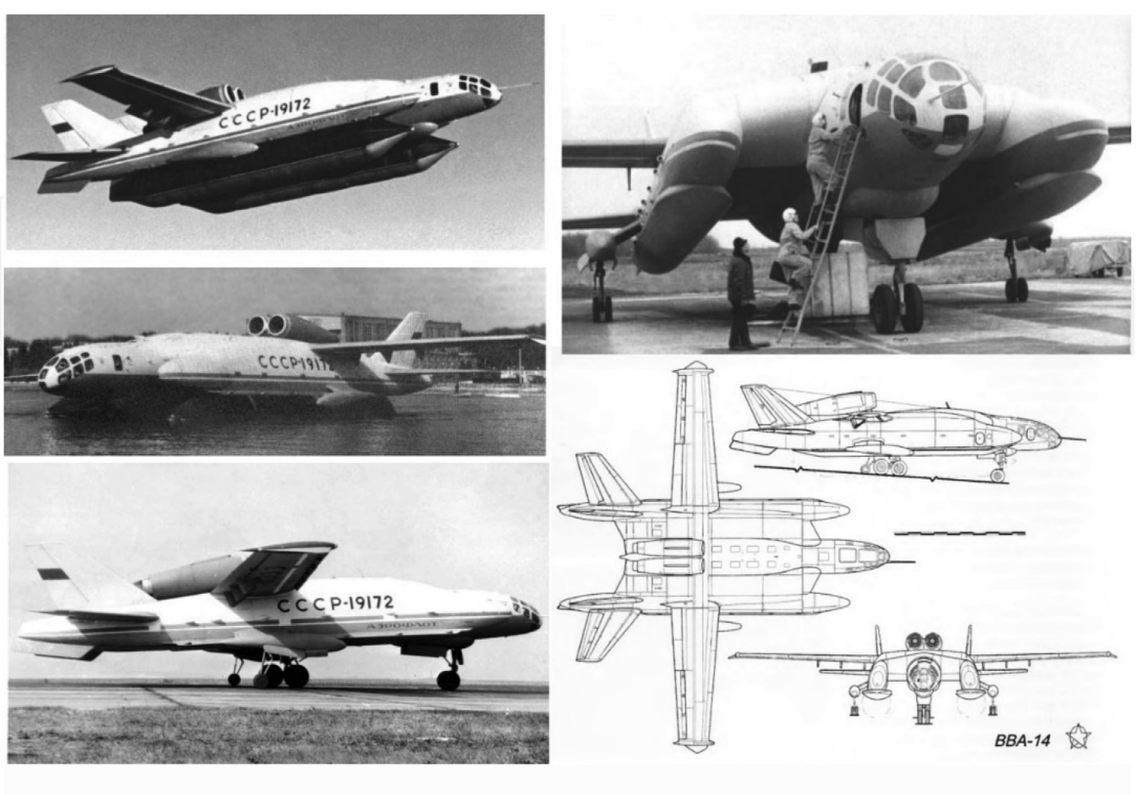

Figure 7.
Amphibian airplane Bartini-Beriev VVA-14. Source: Jakubovich [5].

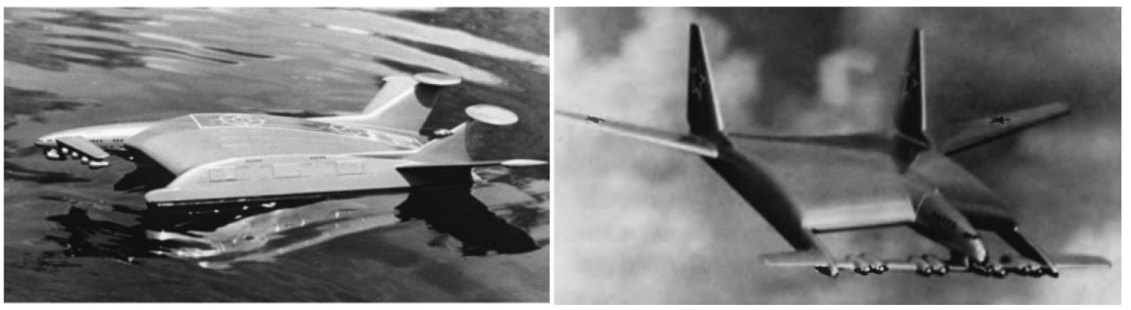

Figure 8.
Model of the WIG aircraft carrier and ekranoplan T-500. Source: Slavin [8].

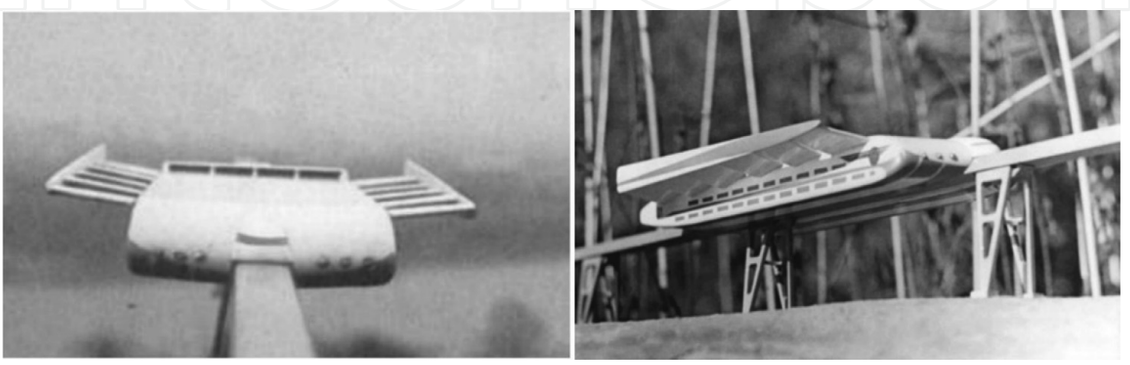

Figure 9.
Model of the future transport system (magnitoplan or ekranohod). Source: On Accasion of 110th Jubilee of Robert Bartini [4].

Bartini imagined a vehicle with greater utilization of ground effect, which could be used at high speed in transcontinental freight and passenger transport. Such ekranoplans would be more efficient than today's airplanes; they could transport more passengers and cargo and could actually still work in "friendlier" environment such as height above 10 km (**Figure** 7).

Bartini's design of WIG vehicles is probably the most efficient because the catamaran design with an open space between the floats, which accumulates compressed air, provides additional lift.

He continued with his ideas and designed an ekranoplan with weight of 2500 and 5000 tons, serving as an aircraft carrier and operating at speeds of 500 km/h. In such high speeds, aircrafts do not need a long runway for takeoff from the aircraft carriers. Aircraft carrier would travel at the same speed as the airplane (**Figure 8**).

Bartini was also considering quick continental transport. In the 1960s, he imagined a monorail vehicle traveling at high speed. Its performance is based on the compressed air such as hovercraft (ekranohod) [3] or on magnetic levitation (magnitoplan) [1]. The project was presented to the minister of transport B.P. Beschev and was also approved, but never realized. Bartini constructed additional aerodynamic surfaces at the sides of the vehicle to increase the lift or to control the correct distance of vehicle from the track (**Figure 9**).

4. Bartini's work in other fields of creation

In today's Russia, Robert Ludvigovich Bartini is described as a misunderstood genius whose ideas were ahead of his time, comparing him with Nikola Tesla. He is

portrayed as the aircraft designer, physicist, astronomer, philosopher, painter, musician, and polyglot (he spoke seven languages and read nine).

He cooperated many times in his life with Sergei Korolev. When Sergei Korolev was appointed as the head of the Russian space program, he requested Robert Bartini as his mentor twice. Before this, Korolev often called Bartini his teacher. Firstly, Bartini was a head of Korolev for the first time before the Second World War, when he worked in Bartini's design bureau. Secondly, they cooperated in captivity (sharaska) when Bartini developed the rocket interceptor P-114. Sergei Korolev personally took care at the Soviet authorities about Bartini's project of the supersonic strategic bomber A-57. Korolev and Bartini also worked together on solutions to increase the range of the Myasishchev M-4 strategic bomber. Neither the presence nor the role of Bartini in advising the Soviet space program is yet fully known. In the last years of his life, he was primarily engaged in the exploration in physics, cosmology, and philosophy.

Bartini always tried to encourage innovative solutions. He gave an interesting answer to the question about what to do if the class filled with young professionals is given a problem, which should be solved in an innovative way. "Class must be extended," he responded. This means that many experts with their ideas from different fields of activity are more capable to get a better solution. Bartini was considering formulating mathematical method or model to determine the success of the idea or the patent. He developed a method AND-AND, which was based on recognized search solutions, which had already been used and therefore could predict the success of a given patent/idea for a new problem. He developed the method already in the 1930s, and it was called a method for the detection of talents. A similar but more general method was developed over 20 years later by Genrich Altshuller, who became famous with the TRIZ method. TRIZ method was spread to Western countries with the disintegration of the Soviet Union and is now quite well known.

The whole time of working in the Soviet Union, Bartini was solving problems in aerodynamics in a special way. He said that mathematics was the most exact science, and there was no doubt in it, whereas physics is derived science and the physical findings change over the centuries. He most doubted about physical constants, which he considered to be dependent of the specific "time and space." In 1965, he published an article on this subject, entitled "The relation between physical constants" [9]. The English version of the article was published in 2005 [10]. He claimed that the universe takes the form of six-dimensional torus—three dimensions of space and three dimensions of time. Dimensions of time include the first dimension as a length of time (the duration of the existence of the object), the second dimension of time as the width of time (number of cases/copies/images of body (parallel worlds)), and the third dimension as height of time (the speed of time is different in each of the worlds) (**Figure 10**).

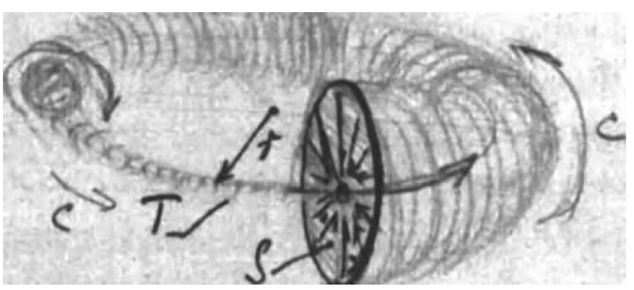

Figure 10.
Graphic presentation of the six-dimensional universe (Original Bartini's sketch). Source: Maslov [11].

The six-dimensional universe by Bartini is parallel streaming of times [1]. Of course, such revolutionary ideas caused him great problems, and they did not want to publish his article (he basically was not a physicist and was quite unknown in the world of science). However, Bruno Pontecorvo advocated for Robert Bartini and his article. Bartini gave to this article great importance; he signed as the author with the full name Robert Oros di Bartini [12]. It is interesting that the article even promised the proof of author's theory, but he soon died. Bartini used this physical theory to deal with his aerodynamic problems and came to excellent solutions. What is more, Bartini developed an entire philosophy on his physical theory of time. Therefore, his six-dimensional universe was named Bartini's universe. The second part of the article presents a table, a kind of periodic system of physical quantities expressed with the potentials of time and space, which Bartini developed together with Kuznetsov [13]. The most interesting part of this table is that some parts were an introduction into unpublished physical quantities such as the surface of time and the volume of time [14].

Bartini drew pictures in his lifetime; some were on the walls of his apartment for his well-being and better concentration at work. He had three children, two sons and a daughter and three grandchildren [15]. The first son Gero was a climber and died in 1959; the second son Vladimir lives in Taganrog and is an engineer. In 1967, Bartini got the Order of Lenin for his life achievements. In 1957, he got the Order of October Revolution.

Quite speculative and almost incredible or unbelievable but very interesting claims or mysterious stories appeared about the life and work of Robert Bartini in Russia [2]:

- Bartini in the 1920s and 1930s founded and headed a secret group ATON which members were renowned Soviet writers (sci-fi) and scientists.

- Bartini was as a prototype for Woland from the novel *The Master and Margarita*, since its writer Bulgakov was also a member of the ATON. The novel was written at a time when Stalin put in prisons and killed the "blossom" of Soviet intelligence (writers, engineers, scientists, officers), and during this time, Bartini was imprisoned as well.

- Bartini was also the prototype for the book *The Little Prince*. A writer Antoine de Saint-Exupéry and Robert Bartini met in their youth and both were impressed by aviation.

- Bartini was mentioned as the mysterious aircraft designer "Dunaev" that constructed the invisible plane.

- The whole story of Bartini's youth was invented, so the NKVD was very suspicious about him.

- Altshuller summarized the ideas of Bartini to develop his own method of TRIZ, as they were in contact.

- Robert Bartini and Leo Szilard—a physicist who discovered a chain reaction—were sitting at the same table in high school in Budapest.

- Before his death, Bartini wrote a will in which he demanded that his manuscripts are sealed and opened in 2197 (at 300th anniversary of his birth).

5. About the origin of the Robert Bartini

It is still quite unclear today where exactly was Robert Bartini from and who exactly his parents were. The official version from his biography in the book of Igor Chutko from 1978 [3] is that he spent his youth in Fiume and his father was vice-governor of Fiume Baron Lodovico Oros di Bartini, one of the richest and most distinguished people of the Austro-Hungarian Empire. His mother was a young barely 17-year-old girl, an orphan, who had an origin in a poor and impoverished Hungarian noble family from Miskolc. When she gave birth to her son, they told her that the baby died at birth, which was not true. In fact, Robert was secretly sent to a peasant family. The young woman did not believe and 6 months later she found her son. She wanted to show him to his father, the young Lodovico. However, when she came to Fiume with a child, she found out that her boyfriend had already married. She returned home at night, left her son and drowned at dawn. The child was again given to the same farmer family. Later, the farmer who adopted the child went to work as a head farmer at the residence of the vice-governor Lodovico Bartini, the child's father. His wife Paola could not have children, and she wanted to adopt the young 3-year-old Robert, but then the gardener suddenly escaped with a child. She was persistent, so she hired a detective and realized that the child's father was her husband. Later they adopted the child and raised him with all the love. Robert had his own teacher at home, family doctor Dr. Baltazar, who taught him natural science (chemistry, biology), music, and foreign languages.

However, researchers Olga and Sergei Buzinovsky discovered that this story has shortcomings. They wrote three books about Bartini after the fall of the communist system [1, 2]. They found that Bartini himself mentioned that his real mother's surname was Fersel (Fertsel), his real father was Austrian Baron Formaha, and he was born in Kanjiza. This information was obtained by the NKVD from Bartini, who was questioned in 1938 when he was imprisoned.

In their research, they got help with data from the Embassy of Croatia in Moscow and the workers of the city archives in Rijeka [2]. The director of the archive Goran Crnković reported that in September 1912, Russian pilot Chariton Slavorossov really flew in Fiume. It is possible that the famous pilot and young Robert Bartini actually met as stated in the biography [3]. However, the vice-governor until 1902 was Francesco Vio, who was then appointed as the Governor and vice-governor became Andrea Bellen. Information about people named Bartini, Formaha, and Fersel was not found in the archive, but they found another trail. Near Fiume there was the estate of Baron Phillippe (Fülöp) Orosdy, Italian born, large landowner, and deputy of the upper house of the Hungarian Parliament. The Baron was also in the list of honorary members of the Hungarian Aero Club. He had a brother Lajos (Italian, Ludovico; German, Ludwig) in Budapest. So who was the father of Robert? Is it Baron Phillippe or his brother Lajos? Probably Lajos, because Robert was bearing his name (Robert Ludvigovich Bartini). He spent his youth with his uncle in Rijeka and probably attended high school (gymnasium) in Budapest and lived there with his father. This is most likely so, because when Robert Bartini was in sharaska, in 1939, Karl Szilard recognized him there. Karl was a distant relative of the nuclear physicist Leo Szilard [16]. It turned out that as a child Robert Bartini was sitting at a desk in the classroom with Leo Szilard, famous physicist [2].

Another researcher is Giuseppe di Ciampaglia, who wrote a book *La vita e gli aerei di Roberto Bartini* [17]. In 2015 [14], he wrote that Robert Bartini was the adoptive (and perhaps natural) son of Lajos Orosdy, the captain of the Hungarian border police in Fiume, later the doctor and the advisor of the governor. He moved to Rome after the annexation to Italy. The restless but excellent high school student

Robert patented a "stabilizer" at the age of 18. On August 16, 1915, the governor of Fiume István Wickenburg recommended to the Honvéd (defense) minister to transferred Robert Bartini to aviation. He stayed in the infantry on the Russian front and finished in the prison in Siberia.

In October 2017, Croatian President Kolinda Grabar-Kitarović, during her visit to the Russian President Vladimir Putin, highlighted two important people from Croatia who helped developing Russia in the past. The first was Robert Bartini, aviation designer, scientist, and visionary; the other was Matija Zmajević, Admiral of the Baltic Fleet of the Emperor Peter the Great.

Who was Robert Bartini? Hungarian, Italian, Austrian, Russian, Croat, or Serb? He himself answered the question, "If every particle in the human body is replaced every few years, then I am surely the Russian, since I have been living in Russia for decades" [2].

6. Conclusion

The story of Robert Bartini is very interesting because he was unlike any other European scientists and researchers working in the Soviet Union. It is even more amazing that he was a son of powerful and rich Baron, and he decided for communism. Otherwise, the stormy first half of the twentieth century with two World Wars in Europe was not lenient to the fate of the people who are mutually intertwined in the most unusual combinations.

Early in his career, Bartini had luck and was rapidly promoted in the army and in the construction of aircraft, supported by his patron Marshal Tukhachevsky, former leader of the Soviet Armed Forces (Red Army). When Tukhachevsky, Bartini, and other officers were arrested before the Second World War, Bartini was lucky to survive. Since then, the authorities in Moscow did not support him any longer. After the war, he was able to realize only one idea—a prototype of the VVA-14 aircraft. With his work, Bartini was the most competitive of all his colleagues—Russian aircraft constructors. He was full of new ideas, so they were jealous, and probably Soviet authorities could not allow their planes to have an Italian name.

Most of his ideas contributed to better aerodynamics of aircrafts resulting in lower energy and fuel consumption. In this way, his airplanes could achieve higher speeds. His theory of intercontinental transport on Earth also took into account the smallest needs of transport infrastructure. His "red wings" significantly contributed to sustainable aviation.

As a designer, he managed to make fly only four aircraft prototypes; nevertheless, his ideas and solutions were used by other aircraft designers. Like many other geniuses, he was not suitable for the implementation of mass production of aircrafts, but he was always looking for something new. His work includes about 60 aircraft designs and ideas for about 200 aircrafts. As a genius, Bartini had similar characteristics to Nikola Tesla, namely, he formed his devices in his head and then just draw what he saw in his mind. Above all, he was acclaimed as a very good teacher, because he was happy to share his knowledge with younger Soviet designers, who later created very successful aircrafts such as Beriev, Korolev, Simonov (chief designer of Su-27), and others.

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Author details

Sergej Težak
Faculty of Civil Engineering, Transportation Engineering and Architecture, University of Maribor, Maribor, Slovenia

*Address all correspondence to: sergej.tezak@um.si

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