THE NUMERICAL HISTORY OF AIRPLANE MANUFACTURING IN XX CENTURY

Yuri V. Kuzmin, Ph. D.
TsAGI: Central Aero-Hydrodynamic Institute, Russia

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Abstract

The database containing information about more than 18000 airplane models, created during XX century, their characteristics and production data is prepared by author. Analysis of this database information gives answers on many questions about the aviation history.

How many airplanes were built during XX century? How did it performances grow? What is common and different in the development of aviation industry of countries? When the rises and falls were happened, were their reasons local, national, or worldwide? Some answers are given in this report.

1. The problem: how to count airplanes

Questions I've been interested, are: how many airplanes were built in the world, in which countries, for what purposes, how did it characteristics grew from year to year, how did their aerodynamic schemes and construction material changes, which countries were technological leaders in different historical periods and so on.

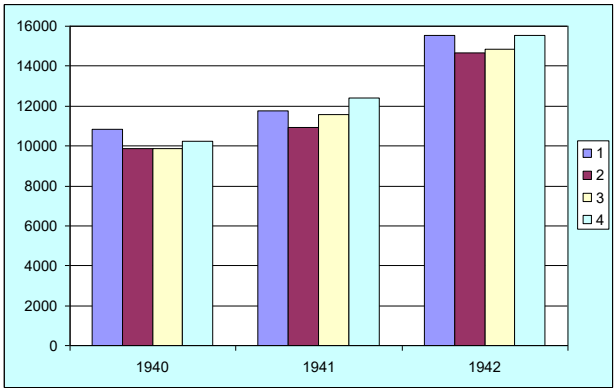
1.1 A lot of different numbers

But wasn't all that answered earlier? The historiography of aviation consists of hundreds thousands articles and many thousands books, and there are a lot of numbers, describing aircraft production and it's characteristics and performances, but the numbers in books and even in official government reports differ from each other.

For example, let ask several known authors how many airplanes were produced in Germany in 1940-1942, and four authoritative authors [1-4] give us very different numbers (see Fig.1).

The distinction between data usually emerges not because of mistakes, but because of different methods of counting even in government reports. Unfortunately very rare the author describes calculation method in details, sometimes these methods are unknown at all.

Fig.1. Aircraft production in Germany during 1940-1942 according to [1-4]



So, readers must be vigilant. For example, in the very informative book [5] 301 Breese Penguins are counted as airplanes. But it were just ground trainers absolutely unable to fly.

Sometimes it is difficult to separate powered airplanes and sailplanes. In many USA books transport gliders and military trainer sailplanes are added to the airplanes. For example, 253 TG-5 gliders often are added to the total amount of Aeronca airplanes. The mix up of calendar and financial years; produced, ordered and delivered airplanes; airframes and completed airplanes also are not rare cases.

1.2 To count plane by plane

The other method to get aggregated numbers is to count starting from the bottom, to count all modifications, produced in the world during the

century. Yes, it's very time consuming activity. But in result one may not only say how many airplanes were produced, but which airplanes, their characteristic and so on.

I've prepared the database using Microsoft Access DBMS and fill it with the information about aircraft producers, designers, models of airplanes, it's qualitative (aerodynamic scheme, used materials, general layout, power plant data and so on) and quantitative characteristics (size, mass, speed, range, armament/ payload etcetera)

When I made previous report [6] there were about 16000 airplane modifications in the database, now it number increased up to 18000 and more than 30000 records about aircraft production (year, model, firm, quantity, the source of information). Only powered, manned heavier than air aircraft with the lift created by fixed wings, built in XX century, were counted. Rogallo-winged, flexible winged aircraft and powered paragliders were not counted. Only fully assembled airplanes counted: it's especially important for such models as Bede BD-4 and BD-5, where I took very conservative estimations, although thousands of hit were sold worldwide.

More than 10000 bibliographic sources were used, including data from Russian state archives, yearbooks like "Jane's all the world's aircraft", "Flugzeugtypenbuch" "Aircraft data yearbook", monographs, magazine articles, reports of aircraft producers, government official reports, FAI data, data of national aircraft registers, and a lot of other. Technical data was taken from official documents (pilot notes, handbooks of operation and so on), producer information or, when it's impossible – from the handbooks and articles. Only unclassified sources were applied.

Also there are data about 16000 events (first flights, certifications, aviations records and so on), 6600 persons, 4600 aviation engines and many more in the database.

I often compared my results with other sources. For example, the difference between NASM and my data about the production of airplanes in USA year by year is less than 1%.

All results represented below received by the author on the basis of information collected in the database.

2. The general view

On my previous report [6] I've published preliminary results: 2,1 millions airplanes were built during XX century. Он this report I've told that, according my estimates, I've counted about 96% aircrafts. The estimation was good enough, during four years the total number grew up to 2,18 millions and, I hope, I've counted about 99% of total world production.

So, in XX century in the world there were produced almost **2,18 millions airplanes**.

2.1. By countries

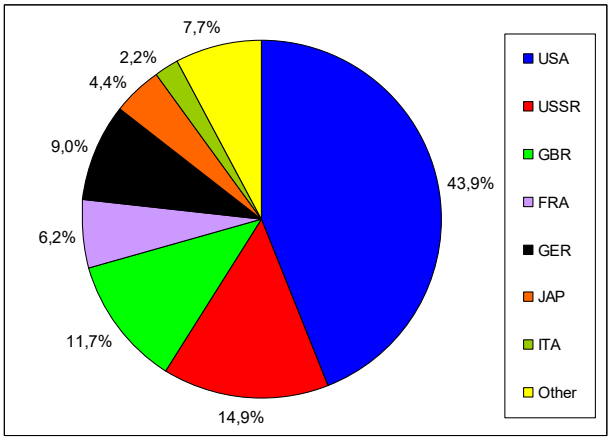
The total production in 20 century is (thousands of airplanes) by countries is:

USA	956
USSR, Russia	324
Great Britain	256
Germany	196
France	135
Japan	97
Italy	48
Other	168

For Germany the airplanes manufactured in occupied countries during WW2 (almost 8000) are not counted, BRD and DDR are counted altogether.

For Great Britain dominion production (Australia, Canada, India, South Africa) is not included, although dominions produced almost 24 thousands airplanes before 1947 year.

Fig.2. Shares of leading countries in airplane production in XX century. Here and later USSR means USSR and Russia



To compare countries by number of modifications is more complicated deal, because

there is a question, how do define "modification". Is F-16 Block 5 and Block 50 one model or two? What about hundreds variants, impressed by Bleriot XI at the beginning of 1910s? But evidently the first place (>5000) has USA, the second (>3000) – France, basically for the huge number of varied aircraft built before the Great War. Then Great Britain, USSR + Russia, Germany, Italy and Japan go. We see the same seven countries, but their order is slightly different.

In XX century only few countries played important role in aircraft production, and there was one indisputable leader: USA manufactured about 4/9 of all world production. 90% of world production was made by six leading countries.

Only 11 countries produced more 10000 airplanes each: among seven named before they are Canada (36 K airplanes), Czechoslovakia (32 K), Poland (23 K) and China (about 15 K).

The situation began to change in the end of XX century and later, new important players emerge, at first it's Brazil with EMBRAER, but concentration on market still remains high and even becomes higher, for example, for the passenger airliners. Some manufacturer joins, some, like Fokker and Dornier disappears and it's difficult to obtain now, which tendency: centralization or decentralization will lead in future.

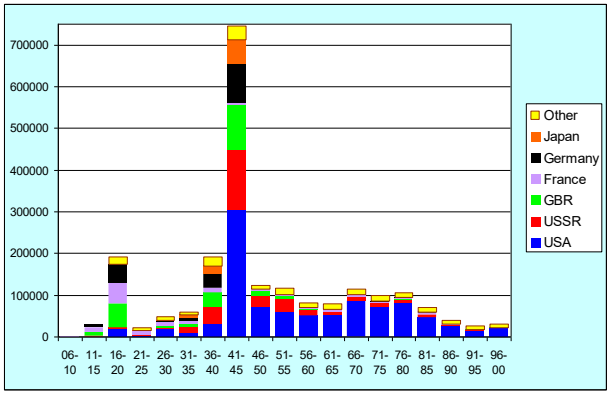
2.2. Production by 5-year periods

It's very difficult task to create full picture of year-by-year world airplane production. For example, the mentioned before mixes of calendar and financial years, of built and delivered airplanes would give sufficient mistakes.

So let us increase the time lag to the five years. With such approach we reduce mistakes sufficiently but still have interesting dynamical picture.

There are two sharp peaks on the graph, corresponding to the Great War and the Second World War: 193 K airplanes in 1916-20 and almost 750 K, it's more, than 1/3 of the century production, during 1941-45. 10% of all airplanes, built in XX century, were manufactured in 1944 year only.

Fig.3. Dynamic of airplane production in XX century

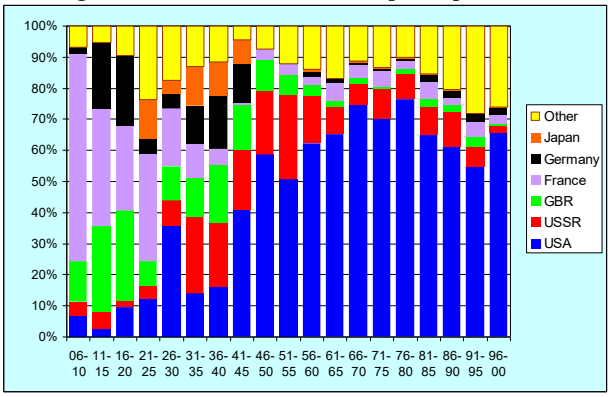


During the Great War the sky was divided between Britain, France and Germany, the airplane manufacturing in other countries was not so sufficient.

The fall in production after the WW1 was much more dramatic, than after WW2: 10 times at the first case and only 6 – in the second.

In 1920s, the USA became the first country, when civil airplane, sold on market, were more numerous than military ones, but in result the Great depression was the real shock for American industry.

Fig.4. Shares of countries in airplane production



In 1920-1930's two other big aircraft industrial complexes arise in Japan and Soviet. But from the 1940 the domination of USA is evident and they keep more than half of airplane market till now.

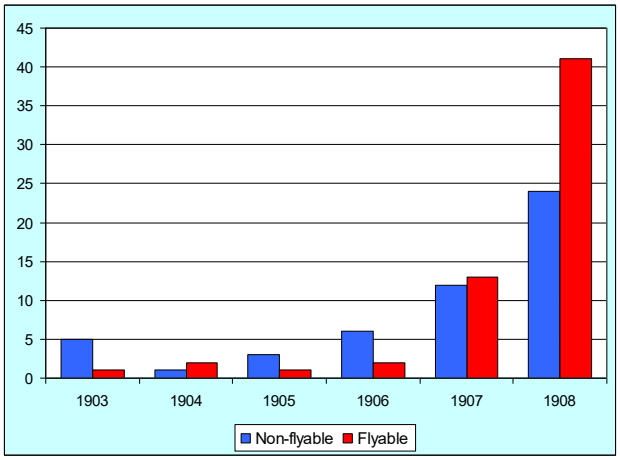
2.3. The beginning

The aircraft production had very fast start, especially in comparison with contemporary practices. 111 different models of airplanes were produced from 1903 to 1908, and more than half, 61, really completed the flight.

A “mass production” also began in this period: Voisin-Standard in 1908 became the first-in-the-world airplane, manufactured on the prepaid conditions (Lilienthal glider was also a serial produced vehicle, but it’s not an airplane).

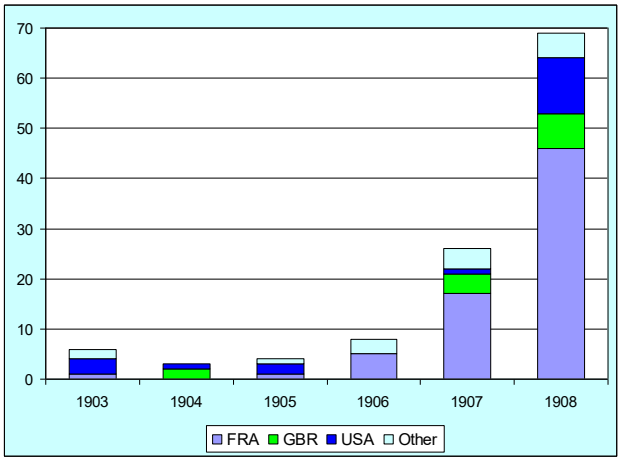
The results are presented in Fig.5 and they are very different from data published by my colleague in [9].

Fig.5. Number of new airplane models, 1903-1908



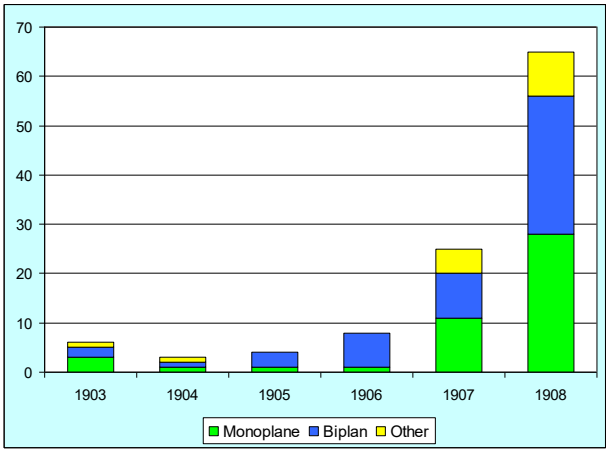
On the Fig.6 is shown that at first period three countries had leading roles: France, UK and USA, but from 1906 the indisputable favorite was France.

Fig.6. Airplanes production by countries till 1908



The Fig.7 shows that although biplane scheme was most often used, probably, because of Chanute and Herring gliders success and, of course, because of Wright brothers, the monoplane, created in motorless form by Lilienthal and Piltcher, also were popular. Different multiplane experiments took share less 15%.

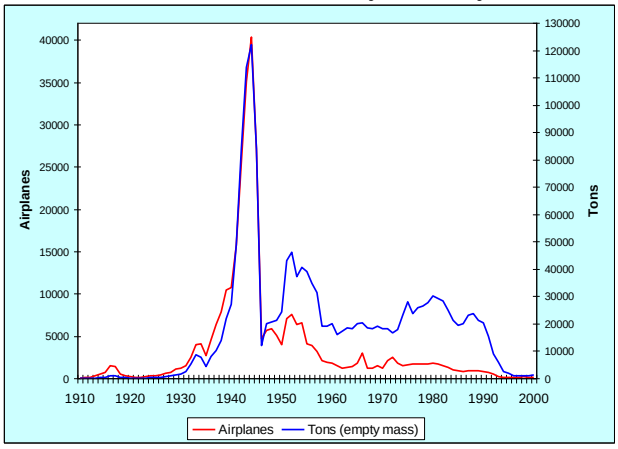
Fig.7. Airplane models by number of wings before 1908



2.4. Russia: year after year

For the airplane production in Russia/USSR more accurate information was collected, so we presented graphs not by 5-year periods but year after year. Preliminary data were published in [7] and [8], but new data, shown on Fig.8, are more accurate.

Fig.8. Airplane production in Russia and USSR and it total mass in metric tons year after year



In XX century Russia/USSR produced more than 324000 airplanes with total mass almost 1,7 million tons. It gives to Russia the second place in the world after the USA.

The total mass of aircraft produced is roughly proportional to the material and labor expenses and it value more correctly corresponds to the power of aircraft industry than just number of airplanes. For example, estimations in tons are constantly used by USA government (see, for example, [10]).

One may see the high rate of industrialization during 1930s, the peak of

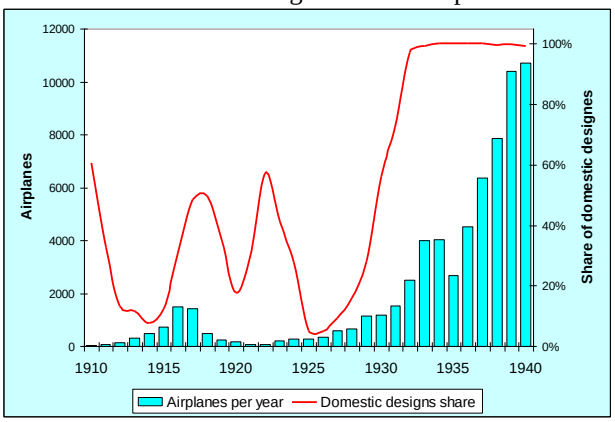
WW2, the second and third peaks, corresponding to the Korean War in the 1950-53 and to the Cold War in the late Brezhnev period.

The number of airplanes built decreases steadily from the middle of 1950s, but the total mass continues to grow. It means that the strength of the airplane production industry grows till the beginning of 1980s.

The fall of 1990s looks very tragic. During last years the aircraft production in Russia began to grow again, but this is beyond the scope of my report.

Collected data give us much more than just information about airplane quantity. For example here is a graph of aircraft production in Russia from 1910 (the beginning of aircraft manufacturing in the country) to 1940. The share of airplanes built according to the designs of domestic designers is also shown. It share in 1917-1918 became high enough: about 1/2, soon after it drops seriously, but in the beginning of 1930s the full turn to the domestic design, corresponded with the grow of total output, also has happen.

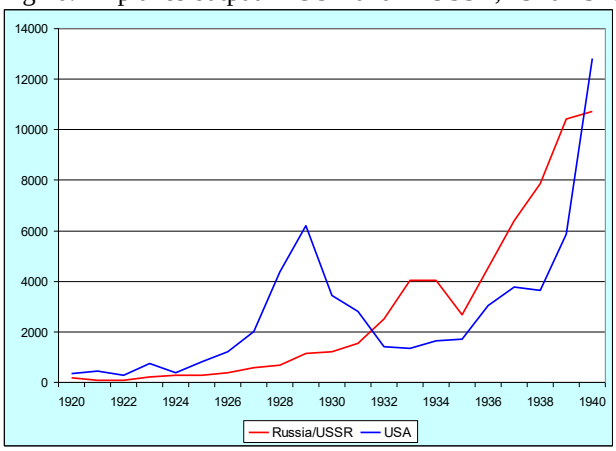
Fig 9. Airplanes production in Russia 1910-1940 and the share of domestic designs in the total production



The next graph shows an airplane production in Russia in the same period in comparison with USA.

We have seen on Fig.3, 4 that the Great depression dramatically influenced the USA production but had no effect in USSR. Backward, it was the period of fast and steady grow. The local minimum in 1935 was happen because to transfer to new types of airplanes, at first, Tupolev SB and Polikarpov I-16. But at the beginning of WW2 USA demonstrated the huge industrial power and overtook the USSR.

Fig 10. Airplanes output in USA and in USSR, 1910-1940

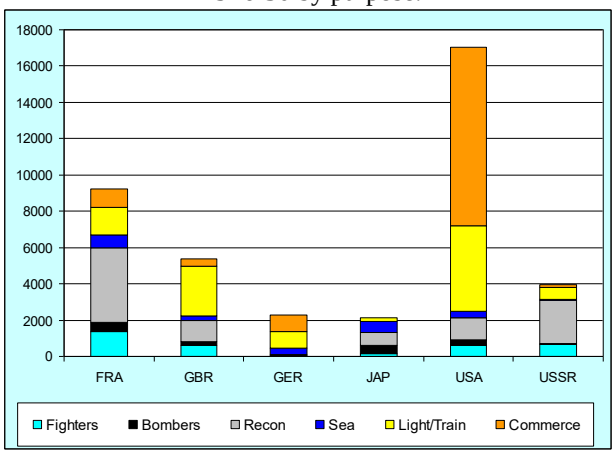


2.5. USA: civil airplanes mass production

The next important question is: which airplanes, for which purposes were built, how this distribution changed with the time. Let us look only on one short, but interesting period: 1926-1930, the industrial boom and the beginning of the Great Depression.

The airplane production by purpose in six leading world powers for these five years is shown on Fig.11. The yellow part joins civil light and sport airplane with one or two seats and military primary trainers, because it's very difficult to separate them. All other civil aircraft: general aviation with more than two seats, passenger, mail, agriculture, ambulance, transport (including military transports) aero-photography and so on joined as "Commerce"

Fig 11. Airplane production in six leading countries in 1926-30 by purpose.



The structure of output is very different. The share of combat aircraft in France, Japan and USSR lies between 70% and 90%, in UK –

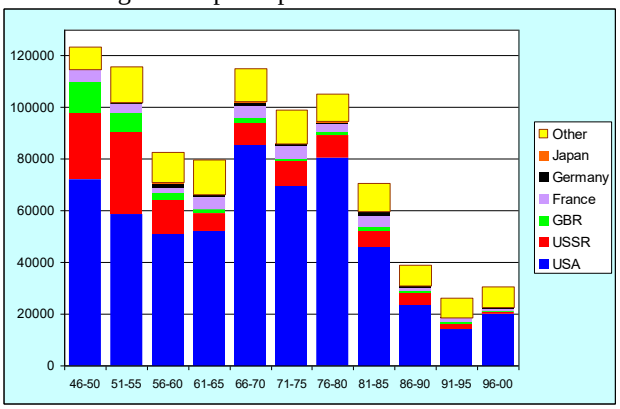
more than 40%, and only two countries look like «doves of peace»: USA and Weimar Germany. But the Germany structure of production is determined by Versailles limitations. Only USA really concentrated on the civil market. Thus policy gave to USA aircraft industry the world priority at the first time: each third airplane during 1926-30 was produced in USA.

The Black Tuesday 29.10.1929 put the end to this idyllic state, the volume of airplane production in USA between 1929 and 1932 decreases at 4,5 times. From the other hand, old world aircraft industries continue to grow because they were oriented mostly on military aircraft production and got finances not from the market, but from the governmental budgets.

2.6. The recession around 1960

Let us look more closely on airplane production after the World War II. After the end of Korean war the production of airplane was sharply decreased. Unexpectedly this recession affected not only military but also the civil aircraft and influenced all airplane-produced countries.

Fig 12. Airplane production after WW2.



Usually this recession is explained by local reasons: in USA – by the end of Korean war (but the Cold War didn't finished and Berlin crisis was just on the edge of 1960s), in UK – by economical difficulties, in USSR – by voluntaristic decisions of the Khruschev's government. But the Fig.12 clearly shows that the reasons of the fall were more deep and that airplane production is affected mainly by some global causes.

The next abrupt change occurred in a quarter of century and we consider this in more detail in the next chapter.

3. The peak of 1970s and shrinking of 1980

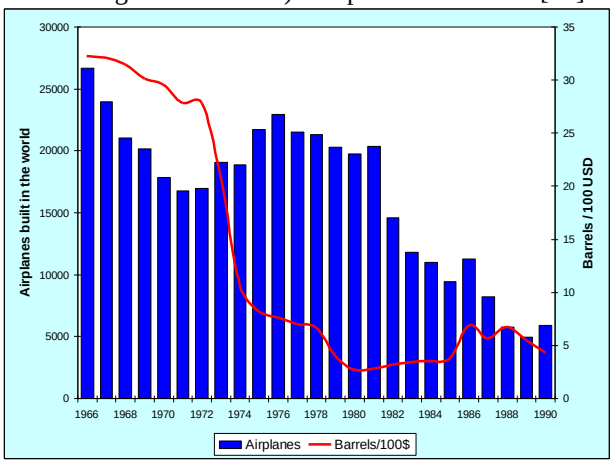
3.1. Not only oil price

In the 1980s the airplane production sharply reduced everywhere (Fig.12). Usually, like in the previous case, it is explained by local reasons: overstrain of the Soviet economics because of the arms race, financial shortage in Europe, new legislations in USA and so on.

The second popular explanation connects the decline in production with the jump of oil prices in the 1973-1974. The both explanations seem to me inadequate.

Fig.13 shows, that the oil prices grew up about 10 years before the decline of the aircraft industry. The red line means inverted average exchange price of oil: how many barrels of oil one can buy for 100 USD. It is evident, that the growth of airplane production continued several years after the oil price jump.

Fig.13. Airplane production in the world versus inverted oil price (how many barrels of oil one can buy on exchange for 100 USD). Oil prices taken from [11]



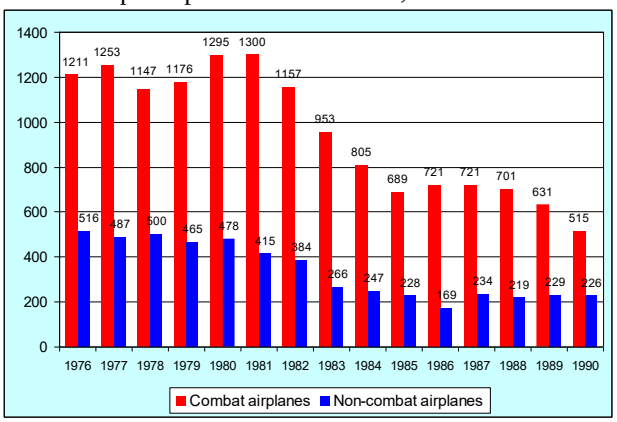
Local reasons seems inadequate because the shortage influenced all aircraft produced countries and both military and civil airplane production, despite a new turn of the Cold War, connected with Soviet-Afghanistan war 1979-1988, and other reasons.

In my opinion the deep reason of this shortage is not clear, we've just demonstrated the phenomenon but it should be yet studied.

3.2. Manufacturing in USSR

Let us take more detailed look on USSR production in 1976-1990. Fig.14 shows that during this period both military and civil aircraft production decreased.

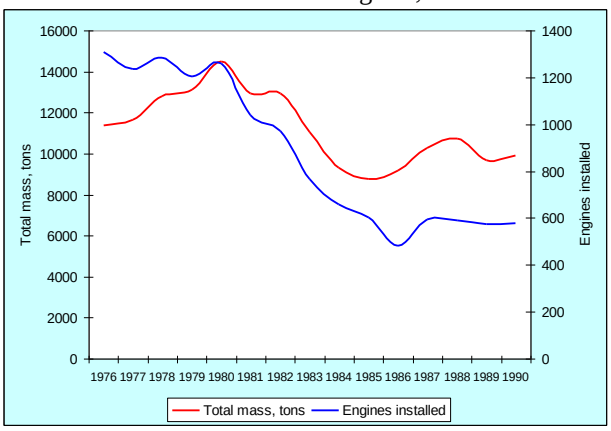
Fig 14. Combat and non-combat (incl. military transport) airplane production in USSR, 1976-1990



The total mass and even total number of engines, installed in new airplanes, also steadily falls from 1981 till 1986 (Fig.15).

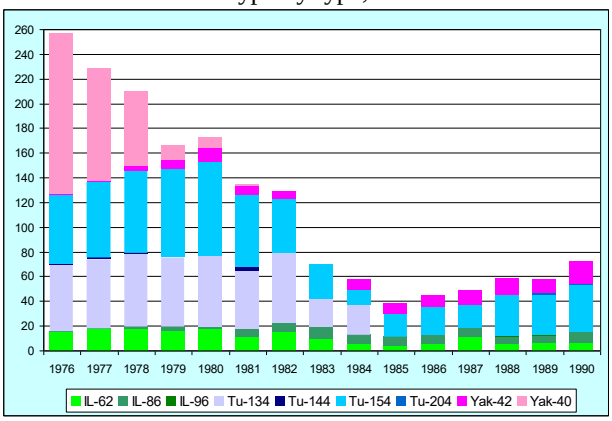
Suddenly, the decrease is not directly connected with Soviet "Perestroika" 1985-1991 years, it begins much earlier. Conversely, during "Perestroika" the rate of production in pieces and tons was approximately constant and this 5-year period divides the recession of the fist half of 1980s and the collapse of the first half of 90s.

Fig 15. Total mass of airplanes manufactured in USSR and the number of their engines, 1976-1990



There are attempts to explain this recession by transfer to production of new types of airplane. But it is also inadequate. Let us see on Fig.16, shown the production of jet passenger airplanes in USSR.

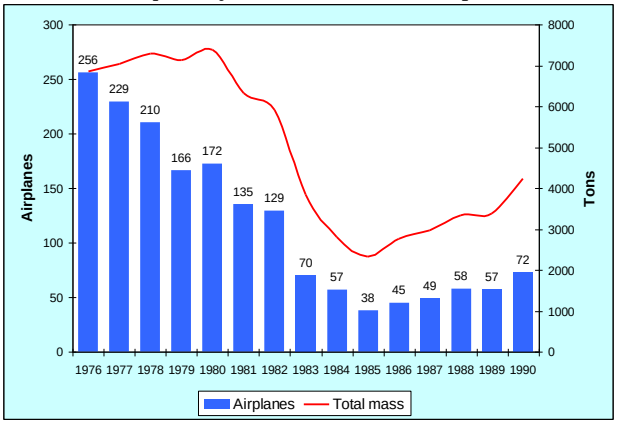
Fig.16. Manufacturing of jet passenger airplanes in USSR type by type, 1976-1990



During these years the production of Tu-134 and Yak-40 was finished. But the rate of production of other types was also decreased.

Fig.17 shows, that not only number of jet passenger but also their total mass greatly reduced at the first half of 1980s and grew slightly at the second half of the decade.

Fig.17. Manufacturing of jet passenger aircraft in USSR: total quantity and total mass of airplanes

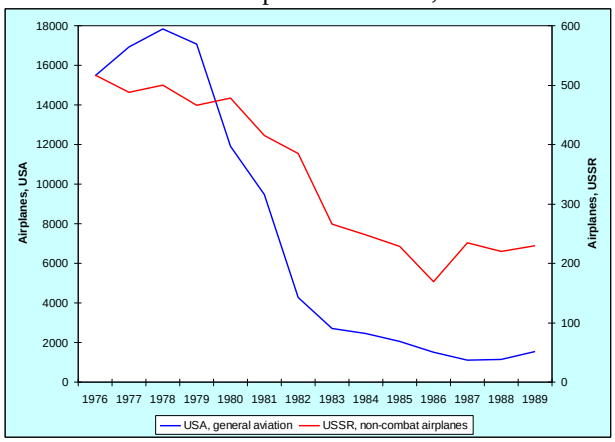


So, new facts are: at the beginning of 1980 s the airplane production in USSR halved, and it was before the "Perestroika". This fall coincided in time with the recession in the aircraft industry in the world, so it reasons can't be localized just inside the USSR.

3.3. Three waves of reduction

We have seen that recession of 1980s influenced all airplane produced countries. But had this recession some fine time structure? The red line on Fig.17. represents the output of non-combat aircraft in USSR (author data) and the blue one - the output of general airplanes in USA [12].

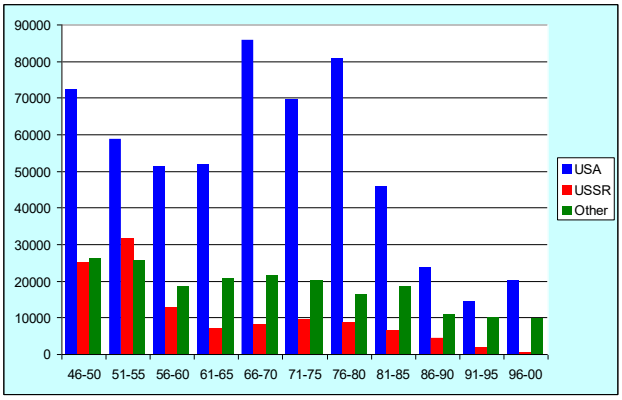
Fig 17. Manufacturing of general airplanes in USA [12] and non-combat airplanes in USSR, 1976-1990



One see that the recession in USA has began a bit earlier than in USSR and was more harsh

Fig.18 represents the airplane production in USA, USSR and in the all other world. It's interesting, that during 1946-1955 USSR manufactured more airplanes than all countries excluded USA. But look on the right columns: the recession in "other world" has begun later, than in USA and USSR.

Fig 18. Airplane production after WW2 in USA, in USSR/Russia and in the other countries



Of course, the phenomenon of 1980s in airplane industry requires additional study, but the first conclusions are: it was worldwide, it has some deep international reasons, not connected with the jump of oil prices and national government decisions, and it has the "fine structure": at first the recession began at USA, almost immediately afterwards – in USSR, and later in other countries.

4. Development of aerodynamic and construction of airplanes

Let us now talk not about the total output of airplanes, but how did airplanes changed with time with the help of the information collected in the database.

4.1. By scheme

Fig.19 shows the part of monoplanes, biplanes and multiplanes, including triplanes. During the first decade of XX century monoplane successfully competes with biplanes, but soon after the era of biplanes has begun. This era was ended before the WW2. It's interesting that biplanes have found their own market niche and are still being manufactured in notable quantities

Fig 19. Monoplane and biplane shares in total airplane output in the world by 5-years periods

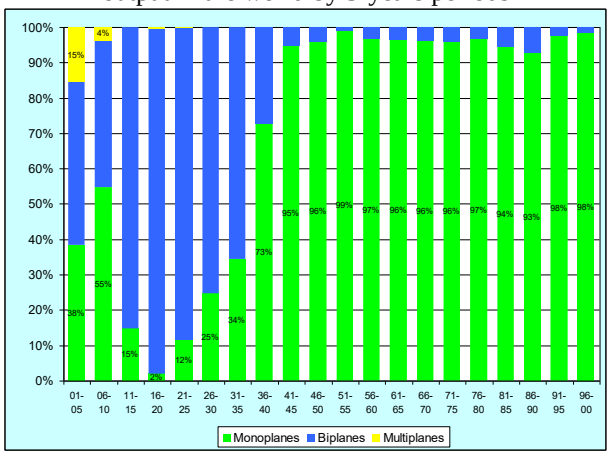


Fig.20 shows what aerodynamic schemes were used for airplanes in the world. The abbreviations are:

TB – truss (girder) biplanes, like Farman-IV;
FB – fuselage biplanes (usually tractors);
RB – biplanes with retracted gears;
BM – brace or strut monoplanes, fixed gears;
CM – cantilever monoplanes, fixed gears;
RM – monoplanes with retracted gears;
SW – swept winged monoplanes with retracted gears;
DW – delta winged monoplanes;
VG – variable geometry airplanes.

Contemporary fighters with "integrated layout" like F-22 or Su-27 counted as "delta winged".

Fig 20. Airplanes by aerodynamic schemes, worldwide. Abbreviations are described above in the text

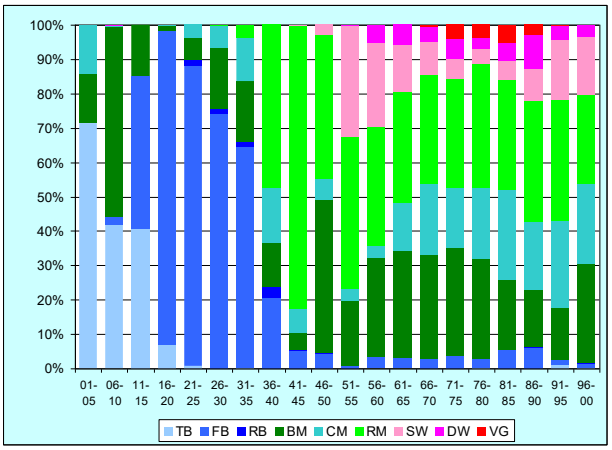
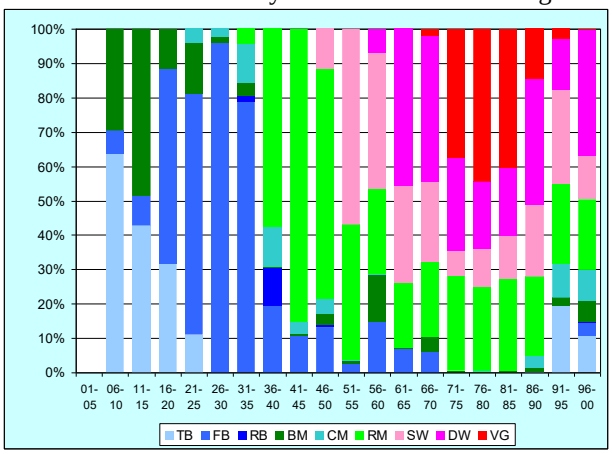


Fig 21. Airplanes by aerodynamic schemes, Russia and USSR only. Abbreviations as on Fig.20



The graph on Fig.20 consists of two very different but overlapping periods. The first one, from the beginning to the 1960-s, is the period of fast progress. Girder biplanes vanishes and are replaced by fuselage biplanes, the last are soon replaced by monoplanes, than the era of cantilever monoplanes with retracted era begins. The new technology almost replaces the old one.

The peak of fixed gear monoplanes in the late 1940s arises because of cutback of military production and reviving of civil market after the WW2.

The second period begins at 1950s. It feature is not displacement, but coexistence of old and new schemes. Each scheme has found the own market niche, and this demonstrates the transition of aircraft technology to the new state: from "developing" to the "mature". This transition was not simultaneous: in USSR this happens about 10 years later than in USA. There are several reasons for this fact, at first it is the bigger share of combat aircraft in USSR production, but the detailed discussion is beyond the scope of the report.

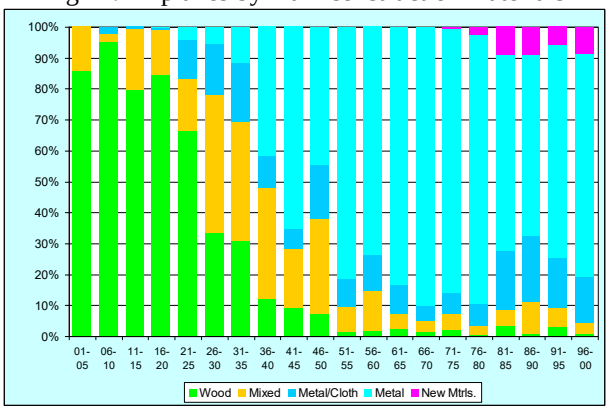
The graph for Russia/USSR (Fig.21) seriously differs from the world-wide one: there is noticeable reversal (devolution) in 1920s, more late transfer to the second period and very big share of contemporary technologies – sweep wings, delta wings and, especially, airplanes with variable geometry. One of main reasons for this difference is the big share of military aircraft in the total output.

The analysis of the database data gives us interesting conclusions not only about the airplane production but also about dynamic of qualitative characteristics of airplanes.

4.2. By materials

Fig.22 shows changes in construction of airplanes during XX century. Here "wood" aircraft means that at least wing and fuselage have wooden framework, the skin may be cloth, plywood or other. "Mixed" means that the airplane's framework the wood and the metal are both widely used. "Metal" means only airplanes with metal stressed skin.

Fig 22. Airplanes by main construction materials



Like in the section 4.1, one can see fast changes of technologies, partial devolution after the WW2 and "niche markets" for old technologies from 1960s. Composite technology took notable part of the 1970s but till the end of XX century it share was small enough.

4.3. By purpose

In the section 2.5 there was shown that structure of airplane production sufficiently depends on the country. The database gives the possibility to analyze it in details, country by country, period by period, but here only the summary graph is given (Fig.23).

Here "Special" means experimental and record aircraft, fire fighters, SAR, aerial cartography, glider tugs, flying targets, flying tankers and some other categories.

AWACS, EW, command & control aircraft are treated as Reconnaissance. Multipurpose airplanes of 1920s-1930s, like Breguet XIX, Hawker Hart or Audax and Polikarpov R-5, are also categorized as "Recon".

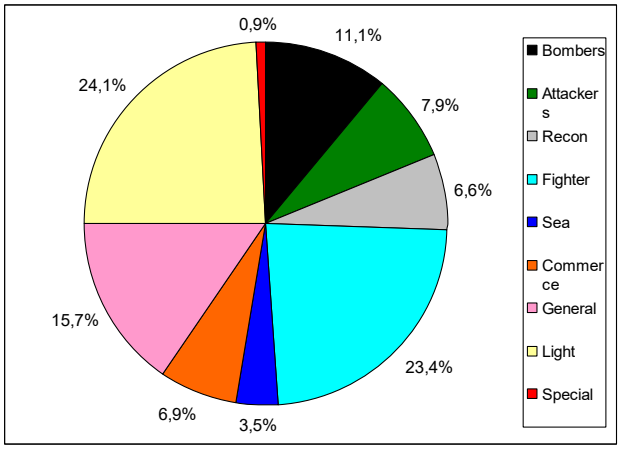
Sea aircraft are mostly base and deck patrol aviation, deck fighters and attackers are in "Fighter" and "Attack" categories respectively.

«Transport» category unites passengers, cargo, mail and agriculture airplanes. It includes military cargo planes.

"Light" category includes light, sport and tourist airplanes with one or two seats, light liaisons and primary trainers. Training-fighting airplanes and advanced military trainers are in the "Attack" category.

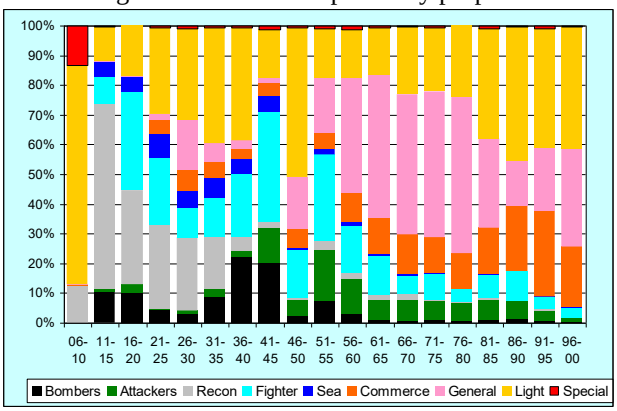
Of course, database gives possibility to rearrange categories. Fig.23 shows that slightly more than half airplanes built in the XX century were a combat ones.

Fig.23. Worldwide airplanes by purpose



The dynamic of this distribution is very interesting. Like many other technologies, the airplane was born for joy and knowledge, but very quickly it became the weapon. More than 85% airplanes built in 1916-1920 were combat ones, most of remaining – military primary trainers. Between wars the share of combat aircraft also was high, about the half.

Fig.24. Worldwide airplanes by purpose



Then one may see two big peaks, corresponding to WW2 and Korean war: about 60% of airplanes, produced in these periods, were combat ones! It means that world powers consider the Korean conflict very seriously and this could have serious consequences for the whole world.

But after this, happily, the share of combat aircraft constantly decreases and now airplanes serve first of all for transport and joy purposes.

The small increasing of the share of combat airplanes in 1980s connected with the total recession discussed here in the chapter 3.

5. A couple of interesting examples

The database provides a huge amount of data for the analysis. Here are only two examples of this, and other may be prepared by request.

5.1. Technological leadership between World Wars

There were several periods of the very fast airplane and airplane manufacturing technologies improvement. At the first decade of XX century the airplane learned to fly confidently and first aircraft manufactories appear, in the 1930s the metal construction, retracted gears, cantilever monoplane scheme again change the aviation sufficiently, the mass production methods and scientific design

methods were used widely, and in 1950s there was a fast improvement of jet engines and sub- and supersonic aerodynamic.

Let us look on the second period, called "the golden age of aviation", and find out which country was the technological leader at airplane (not in airplane manufactory) field at that date.

Three new features were mentioned: monoplane scheme, retracted gears and all-metal construction, included the stressed skin.

The share of such advanced aircraft: monoplanes, airplanes with retracted gears and metal airplanes with the stressed skin in the total output of USSR/Russia, Germany and USA between 1921 and 1945 years is shown on the Fig. 25 – Fig.27.

Fig.25. Share of monoplanes in total airplane output between World Wars

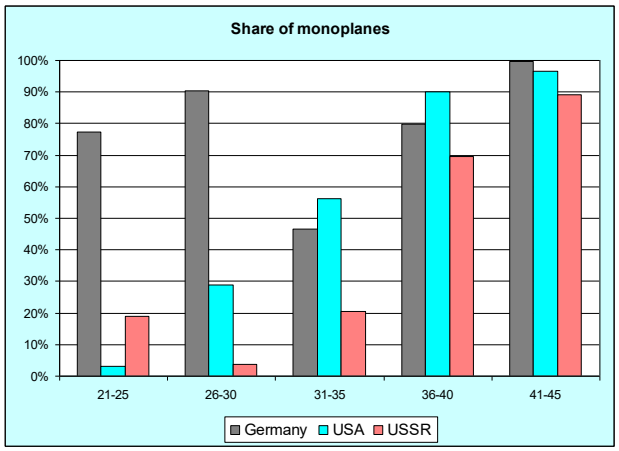


Fig.26. Share of airplanes with retracted gears in total airplane output between World Wars

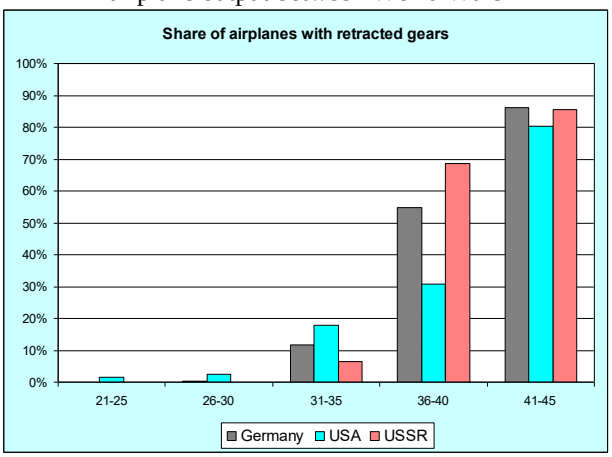
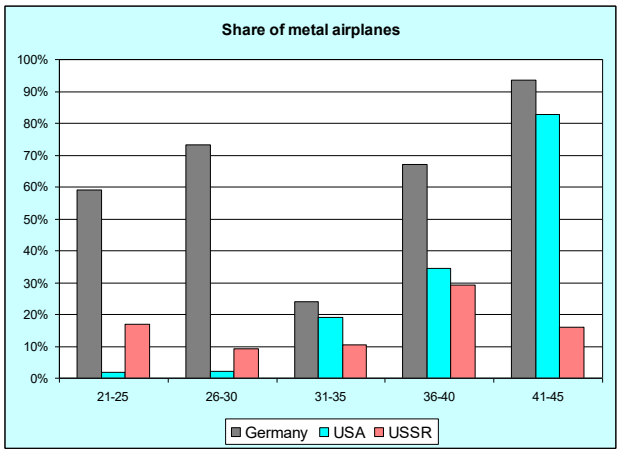


Fig.27. Share all-metal airplanes in total airplane output between World Wars



Suddenly we see the leadership of German aircraft builders in all three fields. Here we count not designs and not record attempts, but the real manufacturing, the real output.

In Germany after the WW1 it was forbidden to build military airplanes and airplanes with high characteristics. In result German aviation specialist built airplanes in Britain (British Klemm), Denmark, Italy, Netherland, Sweden, Swiss, USSR; the passenger liner Junkers F.13 during several years was the most successful civil aircraft on the world market, and the German technologies have significant impact on the development of the airplanes in the old world.

So, the numerical approach to the aircraft industry history, which becomes possible by using quantitative information, stored in the database, gives us new knowledge and new view on the historical process.

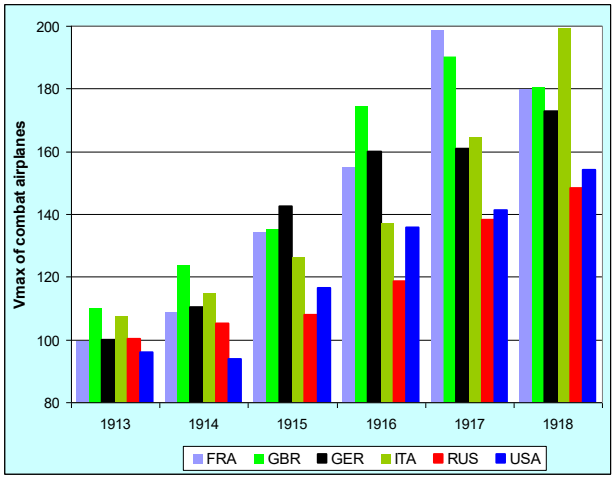
5.2. Overstrain of economics during Great War

In Chapter 4 the dynamic of qualitative airplane characteristics was analyzed. Now let us give one example of the analysis of quantitative characteristics. On the Fig.28 the average speed of manufactured during the Great War combat airplanes is represented. The speed, of course, is not the only important virtue of the combat aircraft, but it is one of cardinal.

We excluded from analysis training aircraft because high maximal speed is not important for them and sometimes is even

harmful because it has bad influence on take-off and landing characteristics.

Fig.28. Average maximal speed of combat airplanes (without trainers, sport and transport) during WW2



This graph may tell a lot about state of economy in countries, participated in the War. European countries-winners demonstrate the steady and fast grow from the beginning to the 1917 year (Italy – till the end of the war). The reason of decline in 1918 year for France and Britain is the reducing of fighters share in the total output, because the air supremacy was just achieved.

Germany shows very fast grow at the first period and even leadership in 1915 (the golden time of formidable "Eindeckers"), but from 1916 the growth became weak. It means that the nation economy becomes overstrained and than even exhausted.

USA shows the fine pace of the growth, but it absolute results are extremely low in comparison with European leaders. It reflects the fact that USA long time was far from war and explains, why USA bought a lot of airplanes from European allies.

The Russian data are very interesting. In the revolutionary 1917 and in the first year of the Civil War the growth of characteristics of manufactured airplanes continues (although there was a collapse in quantity in 1918). But unlike all other European powers, the growth at the first period of the war is extremely slow, two years have been just lost without any benefit. This gives us an argument in support the point of view, that Russia fell from the war not only because of revolutions, but because of the systematic shortcomings of economics of the Russian Empire, which manifested itself since the beginning of the war.

So, the database gives us new knowledge not only about history of aircraft manufacturing, but also about some moments of general history.

6. Conclusions

Fig 29. The first successful aircraft ury is well-known, it's Wright Flyer. Here is the last new airplane model of XX Century: the first S-18 Stinger II performed the first flight 9 December 2000. Photo: Dave Mangham

The quantitative approach to the history of airplane manufacturing tells as a lot not only about aviation, but about the general history, riddles of war and peace, about technology development laws.

In many cases it turns out, that phenomena, treated as local by historians, have worldwide nature, like recession of airplane manufacturing in 1980s. The general laws of the aviation technology development also became more evident, and a lot of myth disappears. Some examples of results, got with the help of the database, are given in this report.

The quantitative approach to the history, especially to the history of the technology, is very fruitful, but request a lot of work: the data were collected during 20 years. The investigation continues and, probably, presented data will be slightly corrected.

The author would be glad to tell colleagues about his experience, about difficulties in this way, to share results and to give quantitative information about airplane history of XX century.

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Contact Author Email Address

mailto: ykuzmin@rambler.ru

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