

# AVIATION DEVELOPERS WORLDWIDE: CONSTRUCTORS AND AVIATORS (1900–1914)

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**Summary.** Despite speculations long back in history, heavier-than air flight made its breakthrough during the first decade of the 20th century, based on the designs and practical experiments of at first a handful of constructors in Europe and the United States. Already by early 1911, the activities of several thousand aviators, including the constructors of airplanes, attracted not only wide public attention but also the interest of military establishments. The article analyzes significant data – nationality, profession, military rank, date and location of certification, location of airplane operations, domestic and foreign airplane types, and fatalities – for 13 369 constructors and aviators from 51 countries worldwide who were active between 1900 and 1914. Added to this group are the constructors of helicopters, ornithopters, gliders, and other flying apparatuses, resulting in a total of 14 142 individuals.

**Keywords:** airplane construction, early aviation, pilot certification, aviation at the beginning of the 20th century.

## From Aerostats to Airplanes

Ballooning, speculations dated far back in history, became a practical reality only in 1783 with the first ascents of «Montgolfiers» and «Charliers» in Paris, France. During the coming century, despite partly successful experiments by Henry Giffard (1825–1882) in 1852, Gaston Tissandier (1843–1899) and Albert Tissandier (1839–1906) in 1883, and Charles Renard (1847–1905) and Arthur Krebs (1850–1935) in 1884, the breakthrough of motorized aerostatics had to wait until the turn of the century and the constructions of Graf Ferdinand von Zeppelin (1838–1917) in Germany and «Lebaudy Frères» in France [1, 2]. For some years dirigibles attracted the attention not only of the general public but also of the military establishments in Europe. By 1914, over 90 dirigibles

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of various types and sizes were kept in the arsenals of 12 countries together with close to 20 ships used for civil purposes. Dirigibles, many in the military believed, were to play an important role in the war that was expected to be around the corner: the coming war, however, would prove them in many ways wrong [3]. Despite heavy pre-war investments in different dirigible programs, airplanes – comparatively inexpensive craft of far greater operative reliability compared to the aerostats – made strong headways in both civil and military aviation of most major countries.

## Aviation Constructors and Aviators: Biographical Data

Dictionaries about aircraft constructors, aviators, and others involved in the development of aviation vary considerably with regard to scope, personalities to include, and biographical content, as well as what biographical data to observe. Emile-Jean Lassalle, to take one example, in his *«Les 100 Premiers Aviateurs Brevetés au Monde»* (The World's First 100 Certified Airmen) of 1960, presented short biographies for the first 100 certified aviators [4, 5]. William Longyard's *«Who's Who in Aviation History»* of 1991, again, presents biographical data for 524 personalities that since Greek Antiquity had been involved in aeronautics, including the Greek Archytas (428–347 BC), a Swedish polar explorer Salomon August Andrée (1854–1897), an American astronaut Neil Armstrong (1930–2012), and a French aviator Henri Farman (1874–1958). While E. J. Lassalle focused on one specific group, W. Longyard's ambition, stretching over the centuries, entails a highly impressionistic selection of personalities. In Bernard Marck's *«Dictionnaire Universel de l'Aviation»* (Universal Aviation Dictionary) of 2005, to take one more example, the search – the same as W. Longyard's – dates far back in history, observing the legendary King Bladud (883–852 BC), the Greek Archytas, Roger Bacon (1214–1294) in England, Leonardo da Vinci (1452–1519) in Italy and Emanuel Swedenborg (1688–1772) in Sweden; this motley group gets mixed-up with such well-known balloonists as Jean-Pierre Blanchard (1753–1809), Gaspard-Félix Tournachon (1820–1910), and Gaston Tissandier (1843–1899). B. Marck, like W. Longyard, takes notice of the astronaut N. Armstrong, the rocket scientist Wernher von Braun (1912–1977), and the airplane constructor Louis Bréguet (1880–1955) [6]. Radically different from W. Longyard, though, B. Marck's *«Dictionnaire»* (Dictionary) encompasses no less than 2808 entries on 1140 pages, making it one of the most comprehensive biographical dictionaries of aeronautics – rather than aviation as is indicated by its title – published so far.

One major issue that underlies both W. Longyard and B. Marck is their inclusion of flight lighter – as well as heavier-than-air. The same concerns the border-line to space flight, an area that decidedly deserves its own «dictionnaire» unrelated to both aerostats and airplanes. A third issue is the time horizon selected in both cases, which starts out with legends and myths and ends with man's forays into outer space.

One of the earliest registers of airplane operators (pilots), compiled in 1911 by Claude Grahame-White (1879–1959) and Harry Harper (1880–1960), lists 691 aviators who had «learned to fly» airplanes up to early March 1911 [7]. This number, covering a period of some seven years, can be compared to W. Longyard's 524 or even B. Mark's 2808. What it illustrates is the subjectivity inherent in the perceptions of later-day authors relative the importance of personalities in compiling registers underlying biographies. Pointing to the dynamic development of early aviation, C. Grahame-White and H. Harper added that the actual number of aviators most likely exceeded the 691 mentioned: some contemporaries talked about a total of over 3000. This latter number, though, the authors believed to be «too ambitious». In any case, close to 700 aviators were said to have operated 729 airplanes of basically two different types (bi- and monoplanes) from 20 constructors, while 66 aviators had built their own machines.

This begs the question: Who in pre-1914 aviation can be considered important enough for inclusion in a biography? Taking W. Longyard and B. Marck as examples, it is demonstrated that different studies have time and again taken notice of the same more or less inclusive group of personalities. What this in part over-reliance on the works of previous biographers entails, though, is the risk that many *per se* relevant personalities remain unnoticed.

The present study, in contrast to the authors mentioned, focuses on one specific and relatively short time period in the development of heavier-than-air flight – the formative years from 1900 to 1914. The overriding ambition thereby was to compile a register of all airplane constructors/aviators active worldwide, observing their country-wise distribution and other personal characteristics.<sup>1</sup> Included on this register are the following:

- civil and military aviators (pilots) of motorized, fixed-wing airplanes;
- holding FAI-based certificates issued by national aero-organizations;
- operating without certificates;
- individual constructors (designers) of airplanes;

<sup>1</sup> This register will be published separately.

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- constructors – pilots of gliders, manned kites, ornithopters, and helicopters;
- manufacturers (firms, companies) of airplanes and engines;
- historical persons of interest in the development of aviation [8, 9, 10].

Excluded are the following:

- constructors – operators of so-called «cyclo-planes», «aero-cycles», «aviettes» [11];
- holders of aero-patents not having taken any practical steps for their realization [12, 13];
- designers of airplanes not having taken any practical steps to realize their projects (a special column «*l'Aéro*», published during 1908–1911 under the headline «*La page des inventeurs*» (The Inventors Page), gave airplane designers the opportunity to present their projects; these proposals were many times combined with requests for financial support in order to enable construction);
- constructors and pilots of aerostats (free-captive balloons, dirigibles);
- suppliers of auxiliary aero-equipment.

Table 1 shows the number of individuals placed on the register, a total of 14 142 from 51 countries. In the following analysis, persons active before 1900, as well as the constructors of ornithopters, helicopters, gliders, etc. have been excluded, leaving a total of 13 369. The categorization according to nationality follows the constellation of powers involved in World War I (Entente & Central Powers); the United States, due to its large civil sector, deserves a category of its own. Other countries in Europe and the rest of the world played subordinate roles and can be sorted under summary categories. The remaining category «other» comprises individuals with the missing data.

Table 1

Constructors/aviators of airplanes and other aircraft active before August 1914

Country	FR	DE	GB	RU	AT	IT	US	EU	World	Other	Total
(A) Constructors/ Aviators to 1900	71	33	60	11	10	16	26	27	22	-	276
(B) Constructors/ Aviators post 1900	3944	1862	1993	769	350	742	2473	917	683	133	13 866
(A+B) Total	4015	1895	2053	780	360	758	2499	944	705	133	14 142
Ornithopter	12	30	19	2	5	2	5	4	1	?	80
Helicopter	20	11	12	4	1	?	13	2	?	?	63
Kite	2	2	2	?	?	?	1	?	1	?	8
Gliders	47	40	77	26	10	4	97	20	17	?	338
Other	4	1	1	?	1	?	1	?	?	?	8
(C) Total	85	84	111	32	17	6	117	26	19	?	497
(B-C) Total 1900-1914	3859	1778	1882	737	333	736	2356	891	664	133	13 369

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It is quite likely that the resulting number 13 369 does not include all constructors/aviators active during the pre-war years. What it does include is the vast majority holding FAI-based aviator certificates, the bulk of military flyers, as well as others having constructed and flown airplanes while being noticed by the editors of aviation journals or the later-day authors of historical accounts. The total number in the underlying worldwide population, however, is difficult to estimate. Nevertheless, today's unbroken interest in the early stages of flight will in time surely uncover more individuals relevant to this period. Data for these 13 369 individuals will be analysed according to the following variables:

- constructors of airplanes and aero-engines;
- airplanes used in civil and military operations;
- location of flight activities;
- professions of civil constructors/aviators;
- ranks of military constructors/aviators;
- certification of civil and military aviators;
- fatalities.

Individual data for the different variables in the dataset in some cases are incomplete. Strictly speaking, therefore, the analysis applies in such cases only for subsets of individuals. However, it is not unreasonable to assume that these subsets, most are of considerable size, are representative of the underlying populations for the different variables in question.

## Sources Used in the Research for Aviation Constructors and Aviators

The following sources were used for compiling the register:

- historical treatises such as Charles Dollfus & Henri Bouché (1932), Gerhard Wissmann (1979), or Charles Gibbs-Smith (1985) [10, 14, 15];
- country-specific studies such as R. Dallas Brett's (1933) for Great Britain or Peter Supf's (1935, 1958) for Germany [16, 17, 18];
- studies of manufacturers such as Christopher Barnes' works for Bristol (1964) or Short (1967) in England [19, 20];
- handbooks, «Taschenbücher», year books, dictionaries, etc.;
- aeronautical bibliographies such as Paul Brockett's two volumes from 1909 and 1921 [21, 22];
- local studies such as Allen Herr's two volumes (2019, 2020) about aviation in California [23, 24];

- data published in aviation journals post-1914;
- online portals such as «Early Birds of Aviation», «*Les débuts de l'aviation militaire française*» (The Beginnings of French Military Aviation), or «Harold E. Morehouse Flying Pioneers Biographies Collection»;
- the most important source constituted by aviation journals published pre-1914, such as the French «*L'Aéro*», the German «*Flugsport*», or the British «*Aircraft*».

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## Constructors of Airplanes and Engines

A distinction should be made between the constructors of airplanes and aero-engines. The challenges faced by the latter group were of a different, technologically more advanced kind, demanding a thorough understanding of both mechanics and the materials used in construction. While some airplanes were constructed by lawyers or students, constructors of engines usually had a background in engineering or came from the automobile industry.

Table 2

Constructors of airplanes and aero-engines

Country	FR	DE	GB	RU	AT	IT	US	EU	World	Total
Constructors and aviators	357	234	173	71	54	53	615	159	79	<b>1795</b>
Airplane constructors	201	152	184	17	31	34	400	44	20	<b>1083</b>
Engine constructors	47	55	14	1	8	20	46	5	?	<b>196</b>
Scientists	5	9	7	4	5	1	3	1	?	<b>35</b>
<b>Total</b>	<b>610</b>	<b>450</b>	<b>378</b>	<b>93</b>	<b>98</b>	<b>108</b>	<b>1064</b>	<b>209</b>	<b>99</b>	<b>3109</b>

The table includes commercial manufacturers of airplanes and engines only in those cases where the firm's owner/director/engineer was also an aviator. Thus, Louis Blériot (1872–1936), H. Farman, and Gabriel Voisin (1880–1973), all three being well-known aviators and successful airplane manufacturers, are included as constructors/aviators and not as owners or directors of companies.

Close to one-fourth (3109) of 13 236 individuals in the dataset, scientists excluded, had either:

- built and operated their own airplanes (1795);
- designed or built airplanes without subjecting them to any flight trials (1083);
- designed or built aero-engines (196).

The first group comprises the majority of pioneers active before 1910, men like L. Blériot, H. Farman, or G. Voisin [25]. This coterie often experimented with different designs and models with the intent to turn them into commercially attractive products that could be sold on the international market. In this group of 1795 individuals, one also finds a large number of constructors who built their craft based on home-made designs or using the blueprints of well-known aero firms (in the United States, specialized firms offered blueprints and technical drawings for the construction of airplanes, including types from major firms, such as L. Blériot, Édouard de Niéport (1875–1911) or Robert Morane (1886–1968); see, for example, N. Armstrong, Blue prints and specifications. *Aero*, Vol 3, No 7, 1911, p. 148; in addition, many aeronautical journals regularly included detailed technical specifications and drawings of new airplanes put on the market, data that private constructors could use in their own efforts). No less than one-third (615) of the individuals in this group were active in the United States, followed by one-fifth (357) in France and one-sixth (234) in Germany.

The second largest group consisting of 1083 individuals includes constructors who built their own airplanes without, apparently, having subjected them to any flight trials. However, members of this group might very well have actually flown their craft without any information about these trials having become publicly known.

The third and important group involved in the early development of flight was made up of the designers and builders of aero-engines: in the dataset, this group is represented by 196 individuals who either worked on their own designs or were connected to firms manufacturing engines; some individuals in this group were also engaged in flight operations. 35 scientists have been added for illustrative purposes only.

## Airplanes

After the Wright brothers' first controlled flights in late 1903 at Kitty Hawk, neither the technical development nor the practical implementation of motorized flight took any immediate further steps [25]. The breakthrough occurred only during the second half of the decade when



people like G. Voisin, H. Farman, L. Blériot, or Robert Esnault-Pelterie (1881–1957) stepped forward with machines that involved partly new technology: two memorable events hereby were H. Farman flying the first circle on 13 January 1908 (winning 50 000 Fr in prize money), and L. Blériot crossing La Manche on 25 July 1909 on his Type XI (winning 1000 £).

An aviation meeting held during August 1909 near Reims, «*La Grande Semaine d'Aviation*» – the event attracted 23 airplane constructors and more than half a million spectators, including the French president – and an aviation exhibition organized in Paris during October that same year, «*La Première Exposition Internationale de Locomotion Aérienne*», demonstrated that airplane construction had taken hold of industry and that France was the unquestioned leader in this development [26, 27, 28]. Amongst 271 mostly French exhibitors in Paris' Grand Palais the visitors met not only 34 different constructors of airplanes and 28 of aero-engines but also suppliers of aeronautical equipment such as speedometers, barometers, rubber tires, tissues, hangars, photographic apparatus, or welding equipment. On display there were also the products of suppliers of aerostatic craft, a mode of flight that in France had started to lose its appeal [29].

Table 3

Airplanes: domestic and foreign constructors operating in different countries

Country	Aviators	Airplane Data available	Constructors			Foreign
			Domestic	Foreign	Total	Total (%)
FR	3859	2184	120	10	130	8 %
DE	1778	961	88	12	100	12 %
GB	1882	1337	94	19	113	17 %
RU	737	121	23	25	48	52 %
AT	333	73	27	12	39	31 %
IT	736	325	27	27	54	50 %
US	2356	1156	310	12	322	4 %
EU other	891	360	50	50	100	50 %
World other	664	337	37	32	69	46 %
Other	133	?	?	?	?	?
<b>TOTAL</b>	<b>13 369</b>	<b>6854</b>	<b>?</b>	<b>?</b>	<b>918*</b>	<b>?</b>

\* This number is not the sum of constructors for individual countries, as quite many constructors were represented by their crafts in more than one country.

It is interesting to find out what kinds of airplanes, produced domestically or in countries abroad, were used by the early aviators for their aerial exploits. The data about airplanes used in operations was found for somewhat more than one-half (6854) of all aviators on the register. With some hesitation, this number can be taken to represent the entire population of more than 13 300 aviators, or rather their airplanes. According to Table 3, the relationship of airplanes from foreign constructors relative to the total number of planes in operation differs widely by country, ranging from 4 % in the United States to 52 % in Russia. The lowest exposure to foreign machines, as one could expect, in addition to the United States is found in the aeronautically advanced countries in Europe, that is, France, Germany, and Great Britain, all with percentages below 20.

**Table 4**

Number of airplanes from the five largest constructors  
operated in countries worldwide

Country	Position 1	Position 2	Position 3	Position 4	Position 5	Percentage of all airplanes/ country
<b>FR</b>	Farman/ 477	Blériot/ 398	Deperdussin/ 135	Voisin/ 108	Nieuport/ 83	55 %
<b>DE</b>	Grade/ 122	Rumpler/ 76	Albatros/ 68	Aviatik/ 46	Wright/ 45	37 %
<b>GB</b>	Bristol/ 387	Farman/ 214	Blériot/ 100	Short/ 89	Vickers/ 87	66 %
<b>RU</b>	Farman/ 23	Blériot/ 20	Antoinette/ 8	Wright/ 4	Voisin/ 4	49 %
<b>AT</b>	Bleriot/ 11	Etrich/ 10	Voisin/ 6	Wright/ 3	Farman/ 3	45 %
<b>IT</b>	Blériot/ 117	Farman/ 71	Nieuport/ 26	Caproni/ 23	Voisin/ 12	77 %
<b>US</b>	Curtiss/ 341	Wright/ 132	Blériot/ 51	Benoist/ 40	Thomas/ 30	51 %
<b>EU other</b>	Farman/ 71	Blériot/ 67	Bristol/ 21	Deperdussin/ 18	Voisin/ 14	53 %
<b>World other</b>	Blériot/ 67	Curtiss/ 45	Farman/ 34	Bristol/ 34	REP/ 11	57 %

Another way to illustrate the dominance of European constructors is to look at the five most commonly used airplanes (brands) in the countries involved. France, as shown by Table 4, is thereby represented

with French-made planes only, Germany – by German ones together with some American-made Wrights (manufactured in Berlin), and Great Britain – by three British firms together with French-made Farman and Blériots. In the United States, the only foreign brand of any prominence was a batch of French Blériots. Turning to Russia and Austria, the French dominance in both cases may be observed. In the rest of Europe and the countries overseas, French planes held their ground, supplemented by some Curtiss from the United States and Bristols from Great Britain. It is also interesting to reflect on the dominance of just a few constructors relative to the total number of planes operated in the different countries, whereby the five most common brands reached over 50 % of the market share of all airplanes in most countries except Germany (37 %), Russia (49 %) and Austria (45 %).

The final step in trying to illustrate the situation regarding the exposure of airplane constructors in different countries is to look at the distribution of their products worldwide.

**Table 5**

Top 10 airplane constructors/airplanes represented in different countries worldwide

Constructors	Constructors nationality	Number of airplanes	% of airplanes worldwide	Number of countries
Farman	FR	937	14 %	29
Blériot	FR	843	12 %	34
Bristol	GB	479	6 %	14
Curtiss	US	406	6 %	17
Deperdussin	FR	236	3 %	20
Wright	US	236	3 %	15
Voisin	FR	156	2 %	18
Caudron	FR	151	2 %	13
Nieuport	FR	137	2 %	15
Grade	DE	131	2 %	7
<b>Top-10</b>		<b>3712</b>	<b>54 %</b>	
<b>APL data known</b>		<b>6845</b>	<b>100 %</b>	

Considering the Top 10 constructors, which together supplied 54 % of all 6854 airplanes worldwide, it may be observed that six came from France, one from Great Britain, one from Germany, and two from the United States. L. Blériot operations took place in 34 countries (of 51 in total) followed by H. Farman in 29, and Armand Deperdussin (1864–1924) in 20. Grade from Germany is at the bottom of the list, implying that Grade manufactured mainly for the home market.

In summary, until the outbreak of World War I in August 1914, the worldwide airplane market was dominated by French products, that is,

machines produced by Farman, Blériot, Deperdussin and others who had used an early start in aviation to their full advantage. Glenn Curtiss (1878–1930) in the United States stands out as an exception by having developed products that found customers also outside his large home market. The Bristol firm in Great Britain, again, could rely not only on military orders but also on the demand from other countries in the British Empire. Other constructors, outside this exclusive circle of the Top 10, either focused on their in many cases restricted home markets dominated by the military or were part of the many-faceted crowd of individuals who built their own – at times less successful – machines.

## Locations of Construction and Flight Activities

The design, construction, and operations of airplanes during the early years, based on the current dataset, took place at 1241 different locations in 51 countries. The pairing of constructors/aviators with locations is thereby based on individuals – at specific locations – having attended a flight school, having constructed or tested an airplane, having passed the FAI or other pilot exam, having carried out their first solo flight, or in some other way having had their first practical encounter with flight. For constructors without any flight experience of their own, the location stands for the place of airplane design/construction. Many constructors/aviators, considering the nature of flight, were in the course of their careers active at different locations.

**Table 6**

Constructors/aviators active in countries and locations

Country	Aviators	%	Locations
<b>FR</b>	3859	29 %	<b>137</b>
<b>DE</b>	1778	13 %	<b>132</b>
<b>GB</b>	1882	14 %	<b>174</b>
<b>RU</b>	737	6 %	<b>41</b>
<b>AT</b>	333	2 %	<b>38</b>
<b>IT</b>	736	6 %	<b>60</b>
<b>US</b>	2355	18 %	<b>457</b>
<b>EU other</b>	892	7 %	<b>106</b>
<b>World other</b>	664	5 %	<b>96</b>
<b>Other</b>	133	1 %	
<b>TOTAL</b>	<b>13 369</b>	<b>100 %</b>	<b>1241</b>

Heavier-than-air flight during the short period from 1900 to 1914 took place in a relatively small number of countries: according to Table 7, 1039 of 1241 locations in total, or 84 %, were situated in seven out of 51 countries.

**Table 7**

Constructors/aviators active in limited number of regions worldwide

Regions	Number of countries	Locations
EU majors	<b>6</b>	<b>582</b>
EU other	14	106
US	<b>1</b>	<b>457</b>
World	30	96
<b>TOTAL</b>	<b>51</b>	<b>1241</b>

**Table 8**

Constructors/aviators active at major aerodromes 1900–1914

Aerodrome/site	Country	City	Constructors/aviators
<b>Brooklands</b>	GB	London	425
<b>Johannisthal</b>	DE	Berlin	379
<b>Hendon</b>	GB	London	278
<b>Mourmelon-le-Grand</b>	FR	(military)	271
<b>Buc</b>	FR	Paris	257
<b>Salisbury</b>	GB	(military)	193
<b>Étampes</b>	FR	Paris	179
<b>Pau</b>	FR	Pau	177
<b>Issy-les-Moulineaux</b>	FR	Paris	174
<b>Reims</b>	FR	Reims	167
<b>Chicago</b>	US	Chicago	148
<b>Sevastopol</b>	RU	(military)	147
<b>W-Neustadt</b>	AT	Vienna	141
<b>Juvisy</b>	FR	Paris	105
<b>TOTAL</b>			<b>3041</b>

Another way of illustrating this geographical concentration is to look at specific sites (cities, aerodromes, airfields) in the countries involved considering the number of aviators active at those sites. Locations frequented by more than 100 different individual constructors/aviators are shown in Table 8. Among 13 369 constructors/aviators

underlying the analysis, 3041 – close to one-fourth – were active at 14 out of 1241 locations in total. Thereby, 11 sites were situated near major cities including, in addition to Chicago and Reims, four European capitals Paris (4 sites), London (2), Berlin (1), and Vienna (1). Three of the sites were operated by military establishments while Pau in southern France was one of the first aerodromes opened for fixed-wing airplanes, housing a number of flight schools including L. Blériot and Wright and attracting students not only from Europe but also overseas.

## Civil and Military Constructors/Aviators

After the breakthrough of motorized flight during 1908–1909, military establishments and their requirements vis-à-vis the awakening aviation industry started to play an increasingly important role. Demand for airplanes used for civil purposes was by its very nature limited in scope, while actual or expected military orders directly affected investments in new technology and production facilities. As early as 1910, the French military organized a public competition – with sizable prize money attached – in the construction of airplanes suitable for military use, a practice soon adopted also by other countries and kept until the outbreak of the war in 1914 [30, 31, 32, 33]. The design and construction of airplanes by private individuals went in parallel with this development, a trend most clearly seen in the United States where the military aspect, at least until 1914, played a more subdued role.

In the dataset with a total of 13 236 individuals, two-thirds of the constructors/aviators fall into the civil and one-third in the military sector of aviation. Considering individual countries, roughly the same relationships hold for France, Germany, and countries in the category «Europe other» (EU), while the military percentages are clearly higher for Great Britain, Russia, Austria, and Italy, as well as for countries under «World other». The United States is the country that stands out in Table 9 below, where, as mentioned, the civil sector dominated.

**Table 9**

Constructors/aviators active in civil and military aviation in different countries

	FR	DE	GB	RU	AT	IT	US	EU	World	Total
<b>Civil</b>	2567	1059	998	356	150	372	2231	546	362	8641
	<b>67 %</b>	<b>60 %</b>	<b>53 %</b>	<b>48 %</b>	<b>45 %</b>	<b>51 %</b>	<b>95 %</b>	<b>61 %</b>	<b>55 %</b>	<b>65 %</b>
<b>Military</b>	1292	719	884	381	183	364	125	345	302	4595
	<b>33 %</b>	<b>40 %</b>	<b>47 %</b>	<b>52 %</b>	<b>55 %</b>	<b>49 %</b>	<b>5 %</b>	<b>39 %</b>	<b>45 %</b>	<b>35 %</b>
<b>Total</b>	3859	1778	1882	737	333	736	2356	891	664	13 236

## Civil Constructors/Aviators: Professions

Data regarding the individual professions of 8641 civil flyers were available for 1359. Thereby, hardly surprising given the technical nature of flight, two categories stand out – «engineer» and «mechanic» that together constitute close to 50 % of all individuals active in the civil sector. Other professions fall far below these figures, while a wide spectrum, one-fifth of the total, fall into the remaining category «Other».

**Table 10**

Professions of constructors/aviators active in civil aviation

Professions	FR	DE	GB	RU	AT	IT	US	EU	World	Total
<b>Engineer</b>	87	149	58	20	17	25	49	37	21	463
<b>Mechanic*</b>	54	74	10	5	10	6	34	15	2	210
<b>Athlete**</b>	45	?	11	5	3	8	23	19	?	114
<b>Industrialist***</b>	21	4	5	1	5	?	6	2	?	44
<b>Entrepreneur****</b>	3	6	3	?	1	1	16	6	5	41
<b>Academic*****</b>	9	29	17	3	4	3	21	5	4	95
<b>Physician</b>	9	4	?	?	?	?	16	2	2	33
<b>Student</b>	11	50	1	10	2	?	6	4	2	86
<b>Other professions</b>	33	86	35	6	5	10	63	20	15	273
<b>Professions known</b>	272	402	140	50	47	53	234	110	51	1359
<b>Civil total</b>	<b>2567</b>	<b>1059</b>	<b>998</b>	<b>356</b>	<b>150</b>	<b>372</b>	<b>2231</b>	<b>546</b>	<b>362</b>	<b>8641</b>

\* Includes the titles 'technician' and 'machinist'.

\*\* Includes titles 'cyclist', 'car racer', 'motorcyclist', and 'jockey'.

\*\*\* Includes the titles 'boat maker', 'piano manufacturer', 'brewer', 'mill owner', 'distiller', and 'toy manufacturer'.

\*\*\*\* Includes the titles 'merchant', 'show owner', 'hotelier', 'banker', 'car dealer', 'garage owner', and 'shop owner'.

\*\*\*\*\* Includes the titles 'lawyer', 'notary', 'judge', 'architect', 'chemist', 'physicist', 'pharmacist', and 'dentist'.

## Military Constructors/Aviators: Ranks

Military aviation, which in Europe started developing around 1909–1910 (military aeronautics dates back to the 1880s) was in the case of the terrestrial armies operationally based on the holders of foremost three military ranks: captains, lieutenants, and non-commissioned officers. In the dataset, which shows the ranks for over eight-tenths of all military personnel, these three categories include nine-tenths of all 3512 military flyers. Corporals and privates played a somewhat

more pronounced role only in France. This lopsided distribution, which excluded more or less everybody above captain – Great Britain being an exception with 25 officers holding the rank of major – can be partly explained by considering the nature of flight where the physical characteristics of individuals (eyesight, reflexes, courage, etc.) played a major role. The following personalities can be mentioned amongst those holding higher ranks – together with a small number of colonels, the French general Bonnier (French brevet 187), the German Prinz Heinrich von Preussen (German brevet 28), and two British generals Henderson (British brevet 118) and Baden-Powell; the latter had not obtained any brevet. This in turn was accentuated by the promise of faster promotion, with sergeants, lieutenants, and captains trying to step out of their traditional career ladders by voluntarily joining the newly formed air services. Some military aviators, not to forget, like the well-known British captain John Dunne, also designed and constructed airplanes.

**Table 11**

Ranks of military aviators (army)

<b>Army</b>	<b>FR</b>	<b>DE</b>	<b>GB</b>	<b>RU</b>	<b>AT</b>	<b>IT</b>	<b>US</b>	<b>EU</b>	<b>World</b>	<b>Total</b>
<b>Major and higher</b>	5	6	33	6	1	3	2	3	4	63
<b>Captain</b>	130	25	132	67	10	47	9	55	22	497
<b>Lieutenant</b>	576	349	344	191	116	184	58	188	146	2152
<b>Non-comm. officer</b>	288	70	80	10	3	70	9	15	32	577
<b>Corporal</b>	19	7	3	1	8	2	1	2	3	46
<b>Private</b>	109	4	51	2	5	2	3	1		177
<b>Rank known</b>	1,127	461	643	277	143	308	82	264	207	3512
<b>Rank not known</b>	118	200	47	80	19	35	13	43	53	608
<b>Army total</b>	<b>1245</b>	<b>661</b>	<b>690</b>	<b>357</b>	<b>162</b>	<b>343</b>	<b>95</b>	<b>307</b>	<b>260</b>	<b>4120</b>



Table 12

## Ranks of naval aviators

Navy	FR	DE	GB	RU	AT	IT	US	EU	World	Total
<b>Higher ranks</b>		5	7				1		1	14
<b>Captain</b>		2	6			1	1	4	1	15
<b>Lieutenant</b>	23	50	127	12	20	18	18	29	35	332
<b>Ensign/ cadet</b>	13		1		1	1	9	5	5	35
<b>Non-comm. officer</b>	11	1	30	12		1				55
<b>Seaman</b>			23				1			24
<b>Rank known</b>	47	58	194	24	21	21	30	38	42	475
<b>Navy total</b>	<b>47</b>	<b>58</b>	<b>194</b>	<b>24</b>	<b>21</b>	<b>21</b>	<b>30</b>	<b>38</b>	<b>42</b>	<b>475</b>

Aviation  
Developers  
Worldwide:  
Constructors and  
Aviators  
(1900–1914)

In the case of naval aviation, a service that with some delay started to go operative first after aviation was introduced in different armies, basically the same distribution of aviators according to rank can be observed. Thus, more than nine-tenths of all individuals was either lieutenants, naval ensigns or non-commissioned officers. Higher ranks, the same as in the case of army aviation, played no significant roles. Like in the case of army aviation, some few officers with equivalent ranks to colonels can be found amongst the higher ranks. The First Lord of the Admiralty W. Churchill, a strong supporter of British naval aviation, can be added to this motley group; W. Churchill had not obtained any brevet. In the paper «Churchill Conducts aero Experiments» on 23 February 1914, W. Churchill was reported to have made two flights from Spithead (together with an airman as a passenger), trying to locate submarines [34, 35]. One country that in terms of absolute numbers stands out from the rest is Great Britain and its Royal Navy, a service that contributed close to four-tenths of all lieutenants and more than five-tenths of all non-commissioned officers in the dataset. This hardly surprises considering the standing of this service vis-à-vis the rest of the country's military: in July 1914, British naval authorities even succeeded to found an air arm separate from the Royal Flying Corps, the Royal Naval Air Service. Like in the case of army aviation, some naval flyers, like the French lieutenant Jean-Louis Conneau (pseud. André Beaumont; 1880–1937) also designed and constructed airplanes.

The distributions of aviators according to their professions can be compared to an analysis carried out in 1912 in Germany for 211 flyers [36].

Professions and military background of aviators 1912

<b>Professions</b>	<b>Total</b>	<b>%</b>
Professions unknown	74	35 %
Professions known	137	65 %
<b>Civil</b>	<b>77</b>	
Engineers	27	
Pilots*	9	
Students	8	
Academics**	8	
Mechanics***	7	
Merchants	6	
Others	12	
<b>Military (officers)</b>	<b>600</b>	
Army	43	
Navy	9	
Reserve	8	

\* This appears to refer to professional pilots.

\*\* The group includes architects and lawyers.

\*\*\* The group includes «technicians».

## Certification of Civil and Military Aviators

### FAI-based brevets

Flight with motorized aircraft, dirigibles and airplanes alike, was an activity that entailed dangers no one could neglect. This involved not only pilots and ground personnel but also third parties, be it spectators at airfields or people simply walking on the street. Frequent accidents, often with fatal outcome, became headline news (not much has changed in this respect, airplane accidents in whatever part of the world still create breaking news in all channels). It is hardly surprising, therefore, that attempts were made from early on to try to regulate flight, the initial focus being set on the proficiency of pilots. Airplane technical standards and the regulation of the airways had to wait until the launch of the first international air treaty in 1919 [37].

The first organization to introduce aviator licenses was the «*l'Aéro-Club de France*» (founded 1898), a club that in January 1909, presented its brevet No 1 to L. Blériot. L. Blériot was followed by another 16 aviators that year, among them three Americans – Glenn Curtiss (1878–1930) and the two Wright brothers [38, 39, 40]. In 1911,

aero organizations in other countries followed the suit, applying regulations (in force from Feb 1911) that had been adopted by «*Fédération Internationale de l'Aéronautique*» (International Federation of Aeronautics; founded 1905) in October 1910 [41, 42]. These regulations, amended over the years, remained in force until the outbreak of World War I [43]. Regulatory initiatives from governments, despite attempts by lawmakers in France, Germany and other countries, had to wait until the promulgation of the 1919 air treaty [44, 45, 46, 47].

In compiling the register, 4795 holders of the FAI-based brevet could be identified, a total made up of 2483 civil and 2312 military flyers: thus, close to three-tenths of all civil and five-tenths of all military pilots in the dataset had passed the stipulated theoretical and practical exams set by the FAI before receiving their brevets. Overall, the lowest proportion of flyers holding the FAI-based brevet is found in the United States, where a mere 241 civilians out of a total of close to 2000 thought it necessary to acquire a license that many apparently believed was of little practical value. In general, the highest proportions of brevet-holders, except for Germany and Russia, are found in the military sector, amongst the lieutenants, non-commissioned officers and others recruited to the air services of different countries.

Table 14

Civil and military aviators holding the FAI-based brevet

	FR	DE	GB	RU	AT	IT	US	EU	World	Total
<b>Civil aviators</b>										
<b>Brevet</b>	735	555	311	160	53	100	241	192	136	2483
	29 %	52 %	31 %	45 %	35 %	27 %	11 %	35 %	38 %	29 %
<b>Military aviators</b>										
<b>Brevet</b>	664	228	557	136	126	242	51	193	115	2312
	51 %	32 %	63 %	36 %	69 %	66 %	41 %	56 %	38 %	50 %
<b>TOTAL</b>										
<b>Brevet</b>	1399	783	868	296	179	342	292	385	251	4795
	36 %	44 %	46 %	40 %	54 %	46 %	12 %	43 %	38 %	36 %

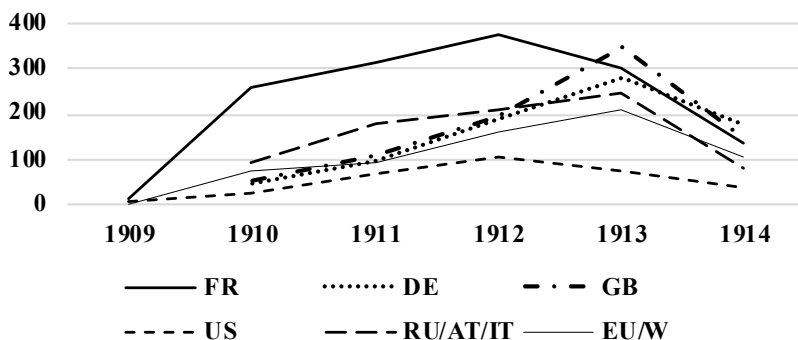
## Other certificates

In addition to the FAI brevet, a number of other aviator certificates were in circulation pre-1914, issued by civil aero-organizations and military establishments and often based on more stringent requirements compared to the ones stipulated by the FAI:

- the FAI brevet was often a prerequisite for obtaining military certification: FR [48, 49, 50], DE, RU, AT, IT, US [51], BE, NL, ES, RO, AR, CL;
- hydroplane certificates: FR, DE, AT, IT, US [52, 53];
- special brevets: GB [54, 55], US [56], IT;
- some aviators were also certified for aerostats:
  - dirigibles: FR, DE, GB, AT, US, RU;
  - balloons: FR, DE, GB, AT, US, RU, ES, AR.

## Certification/Non-Certification

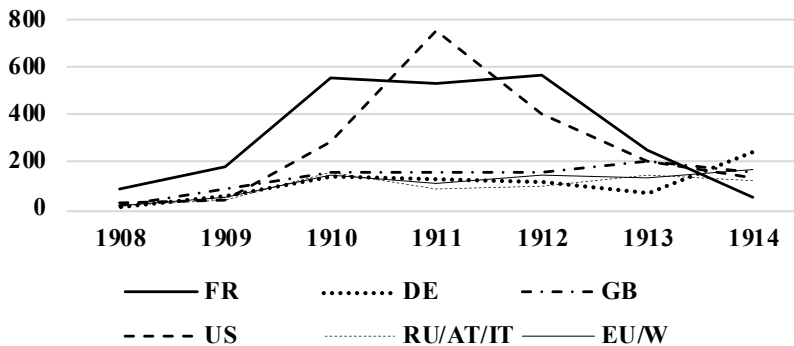
Graphs 1 and 2 show the distribution of aviators having obtained the FAI-based brevet during different years pre-1914, as well as aviators having started to fly airplanes during different years without being certified.



**Graph 1.** The number of aviators having received the FAI-based brevet/year.

France, as shown by Graph 1, took an early lead in certification, starting with 13 brevets in 1909 issued by the Aero Club de France and reaching a top of 376 in 1912 (the maximum for all countries). Included in these numbers are more than 400 foreign nationals who had trained in France and received their brevets from the Aero Club de France.

Certification in other countries got started in 1910 with the entering into force of the FAI regulations. Many of the aviators holding brevets had begun to fly airplanes long before certification; in the analysis, the certification year underlies the year-based categorization. Certification in France was surpassed only in 1913 by Great Britain, the year when all countries (groups of countries) except for the United States reached their highest marks (Russia, Italy, and Austria have for the sake of clarity been placed into one group; the same goes for the rest of the European countries, which have been placed in one group together with countries overseas (except the United States)). For the years 1910 to 1913, a steady increase of certifications in all countries except, as mentioned, the United States could be observed. The sharp decrease in 1914 was caused by the outbreak of war in early August that year and the cessation of civil certification in Europe.



**Graph 2.** Number of aviators without brevet carrying out first flight/year.

With the exception of the year 1911, when it was surpassed by the United States and its multitude of non-certified aviators, France took the lead also regarding aviators having started to operate airplanes without holding any brevet (underlying categorization was the data about the year of first flight or year of airplane/engine construction; these data are in some cases inexact and subject to confirmation). From 1910 onwards, the annual numbers of non-certified aviators starting to fly in other countries stayed constant at around 100–200. The graph, it must be noted, also includes a number of constructors of airplanes and engines not having operated any airplane in flight.

## Fatalities

During the pre-war years, aviation was largely characterized by a trial-and-error approach. Untested technology and operational practices, the breakdown of equipment, be it airframes or engines, lack of proper instrumentation, the hazardous influence of winds and other weather phenomena, insufficiently prepared ground facilities: in short, flight operations, up to the year 1910 and beyond, were marked by so-called «learning by doing».

Therefore, it should not come as a surprise that during that short period, more than 630 aviators worldwide were involved in fatal flight accidents, a rate of 6 % relative to 13 369 flyers in total. The rates for different countries, both for civil and military aviators, vary between 3 % to 7 %; the only higher rates are found for Russia's military (73 %) and for military aviation in the United States (16 %); in the case of Russia, lack of data influenced this exceptionally high figure.

After August 1914, many aviators of the pre-war years continued flying in their respective country's military, thereby causing sharp increases in fatality rates throughout the world. In total, considering the entire period 1900–1918, fatalities rose from 634 (until the end of 1913) to 1574, or 12 % of the total number of 13 236 aviators; rates for individual countries vary between a high of 26 % for Russia (tentative) and a low 6 % for the United States. These numbers, it must be noted, are at best indicative and include only aviators that had started to fly before January 1914. The actual number of military pilots killed in battle or in other ways having lost their lives during the war years 1914–1918 was far greater. According to Morrow, aviation casualties for the three main combatants on the Western Front alone during 1914–1918 were as follows:

- France: 7255 (2872 killed);
- Germany: 16 054 (5953 killed);
- Great Britain: 16 223 (6166 killed) [57].

**Table 15**

Civil and military flight fatalities in different countries  
during 1900–1913, and 1900–1918

<b>1900–1913</b>	<b>FR</b>	<b>DE</b>	<b>GB</b>	<b>RU</b>	<b>AT</b>	<b>IT</b>	<b>US</b>	<b>EU</b>	<b>World</b>	<b>TOTAL</b>
Fatalities civil	98	68	30	11	7	24	86	39	18	381
	4 %	6 %	3 %	3 %	5 %	6 %	4 %	7 %	5 %	4 %
Fatalities military	93	47	17	30	6	12	20	17	11	253
	7 %	7 %	2 %	73 %	3 %	3 %	16 %	5 %	4 %	6 %
<b>Fatalities total</b>	<b>191</b>	<b>115</b>	<b>47</b>	<b>41</b>	<b>13</b>	<b>36</b>	<b>106</b>	<b>56</b>	<b>29</b>	<b>634</b>
Aviators total	3859	1778	1882	737	333	736	2356	891	664	13 236
	5 %	6 %	2 %	10 %	4 %	5 %	4 %	6 %	4 %	5 %
<b>1900–1918</b>	<b>FR</b>	<b>DE</b>	<b>GB</b>	<b>RU</b>	<b>AT</b>	<b>IT</b>	<b>US</b>	<b>EU</b>	<b>WORLD</b>	<b>TOT</b>
Fatalities up to 1913	191	115	47	41	13	36	106	56	29	634
Fatalities 1914–1918	268	258	168	61	27	34	47	45	32	940
<b>Fatalities total</b>	<b>459</b>	<b>373</b>	<b>215</b>	<b>102</b>	<b>40</b>	<b>70</b>	<b>153</b>	<b>101</b>	<b>61</b>	<b>1574</b>
Aviators total	3859	1778	1882	737	333	736	2356	891	664	13 236
	12 %	21 %	11 %	26 %	12 %	10 %	6 %	11 %	9 %	12 %

## CONCLUSIONS

In his research focused on civil and military aviation at the beginning of the 20th century (1900–1914) worldwide, which includes numerical data on airplane constructors and pilots, the author identified individuals from 51 countries including the great European powers and the United States. Thereby, he specified the number of pilots operating with and without certificates in the different countries, their nationality, age, civil professions and military ranks. In the case of certified pilots, their certification number, location and date of examination, and airplane type used in the examination is added. Specially noted are airplane fatalities. Information regarding individual aircraft constructors and airplane companies complete the study.

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*Guenther Sollinger*

### **Konstruktori un piloti – pasaules aviācijas attīstības veicinātāji (1900–1914)**

Pacelties spārnos, pārvarot Zemes pievilksnās spēku, un lidot ir bijis sens cilvēku sapnis, kas īstenojās 20. gadsimta pirmajā desmitgadē, pateicoties dažu Eiropas un ASV konstruktoru projektiem un praktiskiem eksperimentiem. 1911. gada sākumā vairāku tūkstošu pilotu, tostarp lidmašīnu konstruktoru, darbība piesaistīja ne tikai plašu sabiedrības uzmanību, bet arī militāro iestāžu interesi. Rakstā analizēti nozīmīgi dati par 13 369 konstruktoriem un pilotiem no 51 pasaules valsts no 1900. līdz 1914. gadam – valsts piederība, militārais rangs, sertifikācijas datums un vieta, lidmašīnu ekspluatācijas vieta, iekšzemes un ārvalstu lidmašīnu tipi, bojā gājušo skaits utt. Šai grupai pievienoti helikopteru, ornitopteru, planieru un citu lidojošo aparātu konstruktori, apzinot 14 142 personu datus.

**Atslēgvārdi:** lidmašīnu būvniecība, aviācijas pirmsākumi, aviācijas konstruktori, piloti, pilotu sertifikācija, aviācija 20. gadsimta sākumā.