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## AVIATION IN LOMBARDY - PIONEER ARTISAN INDUSTRY

### **Introduction**

From the genial intuitions of Leonardo da Vinci in Milan to the first experiments of flight, five century have passed, but only a few years were enough to conquer the space, which begins to be a concrete environment for development for those enterprises which are supported by will, diligence and instinct for business.

The birth of aviation was coincident with the modern development of Lombardy, a region that, in a short period of time, became one of the most powerful industrial areas in Italy and in Europe. The experience and patents of the aeronautical industry of Lombardy are appreciated all over the world and, even today, the technological research achievements of it are considered very strong points of reference

Lombardy is a region in Northern Italy. In this area, the industrial development was started since the beginning of the Nineteenth Century. Here the artisan culture had already spread for centuries, and a rich and active spirit of enterprise was ready for new challenges. That is why the new aeronautical industry could start here so early in the Twentieth Century.

At that time, one important basic resource - technical instruction - was already very well organized in Lombardy. The top school, at University level, was the Polytechnic of Milan, where the first courses of Aeronautical engineering – a specialised branch of Industrial Engineering – were held in 1909. Among the first students graduated in the new specialised branch was Giuseppe Mario Bellanca, who emigrated in the U.S.A. where he set up his own aeronautical company. And it must be considered that the first choice of Charles Lindbergh for his New York to Paris flight was a Bellanca aircraft:

the same which flew non-stop from New York to Berlin with the first transatlantic passenger aboard, only two weeks after Lindbergh's flight.

Several national and international companies; skilled and appreciated specialists considered as a reference for new business development; a large number of employees; and a relevant financial turnover: these represent the main assets of the aerospace industry in Lombardy. Besides the relevant economic results, one has to consider the availability, for the whole Italian community, of an industry characterized by a very high level of technology. In fact, the aerospace industry produces a lot of offsets, which are very valid tools for the development of other advanced national industries in different fields.

One has also to consider the inheritance, the positive memory of an established way of life and prestige that are connected to aviation; and the emotions that aviation has always been able to offer to many people and famous artists who were inspired in their production, from painting to literature.

As regard space we cannot consider only Lombardy because the space research requires a strong support from government and collaboration between foreign countries too.

The first developments of the Italian space industry go back to the period between the two wars when the first experiments with missiles and ballistics were carried out, while the industrialization of the sector was only planned in the following years. The Italian space industry was however only able to develop fully at the beginning of the 1960s, with the start of national and international space programs.

The production, under license, of American armament systems brought about the creation of the first Italian companies, often with the participation of foreign capital.

In this presentation we intend to review the development of the various activities and we will try to explain the causes and effects on the regional development.

## **Development of aviation from the beginning to the end of World War II**

The early aeronautical industry in Lombardy was mainly dedicated to the construction of lighter-than-air vehicles such as balloons and dirigibles. In the early years, those involved in the field of aviation were mainly artisans. Then some small industrial companies started producing under licence: SIAI (Società Idrovolanti Alta Italia) at Sesto Calende was linked to the Belgian FBA producing seaplanes; and Aeronautica Macchi of Varese started building French Nieuport aircraft.

The first aeroplane fully developed in Italy was designed and built by Gianni Caproni, a young engineer from Trento, a city that then was part of the Austrian Empire. In 1910 he set his manufacturing plant at Vizzola Ticino, on the west side of what today is Milan Malpensa International Airport. One not secondary problem of that time was how to find a pilot to fly the new aeroplanes. In fact, Caproni's first test pilot was his horse driver.

The aircraft development and request grew sharply during the First World War. Several small companies became more and more confident in the development of the aircraft, and they increased considerably the number of their workers. Thus the modern aircraft industry was born. Caproni was also the first Italian manufacturer to sell aircraft and production licence abroad. He became famous for his bomber biplanes and triplanes, and when the U.S.A. entered the war, their first bomber was a three-engined Italian-made Caproni Ca 33.

A very unknown fact is that the Italian aeronautical industry, and in particular the one of Lombardy, was instrumental, between 1917 and 1920, in the set-up of the first aeronautical experimental plants at Langley, in the south of Virginia, U.S.A. Here a research organisation was started, that became the National Advisory Committee of Aeronautics (NACA), and later became the NASA.

After WW I the request for aeroplanes was reduced steeply, and several industrial companies and the small artisan enterprises, that were their suppliers and subcontractors, started having financial problems. The number of workers saw a dramatic reduction while the industrial activity was mainly confined to the development of experimental prototypes and some early airliners.

The latter activity was started converting bombers into transport aeroplanes for the first airline companies, which started to operate in the early Twenties. Though, the production of civil transport aircraft never exceeded the tens for any one of the models that reached production. A big effort was dedicated to racing aircraft used for record-setting attempts and national and International competitions such as the Schneider Trophy.

Italy was a main player in these activities, and Lombard industries such as SIAI Marchetti and Macchi built several types of high-performance airplanes. The Macchi red racers were the first in the world to exceed 500, 600 and 700 kilometres per hour; the SIAI Marchettis established many distance and endurance world records; and a Caproni biplane established the altitude world record, its pilot being enclosed in a special pressurized capsule.

In this period several new military aircraft were developed, characterized by advanced aerodynamics and by the use of aluminium alloys and steel in their structures. A strong financial support came from the new, independent air force. Though, the Italian industry was not able to organize itself for a massive production and to develop efficient and powerful engines. In particular, British and American radial engines were built under license, while interesting in-line or v-shaped, liquid-cooled prototype engines developed by FIAT and Isotta Fraschini could not find series production, mainly because of lack of know-how in the production of high-strength alloys.

At the start of WW II, the request of aeroplanes increased quickly and the aircraft industries of Lombardy found themselves in a badly immediate need of many skilled workers. Many of the new entrants were mainly dedicated to the construction of all-metal aircraft. These were mainly fighters and light bombers, as most of the medium bombers and transport aeroplanes had still wooden structures, due to lack of suitable materials.

## **Situation after World War Two and development of a new Italian aircraft industry**

The economic situation of Italy after WW II was very critical. Several companies were forced to reduce the number of employees and to diversify their production in fields different from aviation. Lombard aircraft companies produced cycles, motorcycles, motorized carts, railway cars, and even furniture. Some of them were not able to survive in a very limited market, and were forced to close.

The main problem was that an aircraft manufacturing company is characterized by a large number of non-productive employees who are dedicated to the development of new projects; So either one has a strong economical power or government support (and after WW II this happened only in the winner countries, or in rich countries such as Argentina) to invest money and develop new aeroplanes, or if one needs to diversify its production into lower-technology goods, all those non-productive employees are not useful, albeit they are the main assets for any future possible development or production re-conversion.

On the other hand, the artisans were not suffering the crisis as much, because they were more flexible in their lighter and leaner organization, and therefore they could diversify their production quicker and to introduce new technologies more easily with limited investment. In fact, it is mainly thanks to small artisan companies with the financial support of private investors, that it was possible to restart the aviation industry in Italy.

In this presentation we intend to highlight the role of small enterprises which are not well known, but that were able to prepare very skilled specialised workers and to set the pace for the restart of the aviation industry in Italy. Larger industrial companies are normally more able to obtain financial support from the government, but for the development of new products and in view to become competitive in the new production it was necessary to exploit the skills of many workers and engineers trained while they were working in artisan enterprises.

A classic example is the aeronautical radio produced by famous industries during WW II. It was a very big, heavy and expensive apparatus. Several artisans were able to obtain better results in terms of weight, dimensions and

cost (50 times less) and their solutions are now used by the major industries as well.

A typical example of present times is the development of new general aviation aeroplanes and engines. The investment in new products comes mainly from artisans, while the larger manufacturers are still producing aeroplanes and engines that are over fifty years old. Moreover, many times their products are not very reliable, because these companies have lost their main resource – skilled and experienced workers - and their new workers are no more able to guarantee the traditional production standard which one time was a respected trademark.

## **THE DEBUT OF AVIATION**

The dawning of aviation seems to have coincided with the taking off of Milan and Lombardy, a region that in only a few decades quickly became one of Italy's most efficient industrial centers.

At the end of 1908, Brescia was the first Italian city ever to launch an air show, stirring excitement and enthusiasm everywhere.

The Italian Aviation Society of Milan took over sponsorship of the event and collected the necessary funds from public and private groups, as well as from the Ministries of War, Navy, Industry and Commerce.

The Montichiari moors were chosen as the site of this event, which took place from September 8 to 20, 1909.

On December 9, 1910, the Milan Society of Student Pilots was inaugurated and a hangar for the flying school was built in Milan.

On May 15-16, 1910, the first public air show was held in Mantua.

Lombardy's most spectacular aeronautics event for 1910, the International Air Circuit of Milan, took place at Taliedo between September 25<sup>th</sup> and October 2<sup>nd</sup>.

Twenty-five aviators signed up.

## **CAPRONI AT MALPENSA AND VIZZOLA TICINO, AND THE FIRST FLYING SCHOOLS**

In early April 1910, a new flying enthusiast, then unknown in Italy, had settled at Cascina Malpensa, near Somma Lombardo.

He was Gianni Caproni, from Trento, who after having built and tested a biplane glider with the Rumanian Henri Coanda in France two years before, decided to start his own business.

In a modest workshop and with the help of only three mechanics, Caproni built in a little time his first aircraft, the CA 1 biplane.

In the meantime, Gianni Caproni and Agostino De Agostini formed a partnership in February 1911, which later became the company Ingg. De Agostini & Caproni Aviazione, and which built airplanes and ran a flying school.

An extraordinary event occurred in January 1913: Milan's Rosina Ferrario became the first Italian lady to get a pilot's licence.

A flying school was inaugurated in Taliedo on April 26, 1911, with flying lessons beginning almost immediately.

Flying activities in Taliedo diminished a great deal in 1912 when the military flying school was closed down.

Between October 5 and 9, 1913, the Circuit of the Italian Lakes took place. It was the first international seaplane competition planned by the Milanese Aviation Society.

Fifteen pilots registered for the event but only ten participated: three Italians, five French, one German and one Belgian. Some of them were soon to become famous.

The competition covered 370km, calling at various points on lakes Como and Maggiore, eventually moving inland to Cremona and Piacenza.

## **THE AIRCRAFT INDUSTRIES OF LOMBARDY AND WORLD WAR 1**

The aircraft industry in Lombardy essentially began and was developed in the early 1900s.

In 1912, the company Società Anonima Nieuport Macchi of Varese was formed., with Giulio Macchi as president and Felice Buzio and Enrico Amman as the technical directors.

The company, whose founding was sanctioned on may 1, 1913, was put together by Buzio, an engineer named Corsi, and captain Costantino Biego for the licensed building of aircraft of the French company Nieuport.

Nieuport-Macchi started with seven workers in a hangar rented from Macchi; in the springs of 1915, the company's work force grew to 40.

Activity was intensified after Italy's entry into the war against Austria and Germany.

An Austrian-made Lohner flying boat was captured intact at Porto Corsini during the night of May 27, 1915.

It aroused the interesting of military authorities that charged Macchi with the reproduction of the aircraft. In only 33 days, the aircraft was disassembled, analyzed, redesigned, built and tested at Schiranna (Varese).

Was born the L1, which turned out to be superior not only to the enemy's plane, but also to any other type of military seaplane in service in Italy at that time.

In May 1913, was ( Cav. Domenico Lorenzo Santoni) founded the joint-stock company Società Anonima Costruzioni Aeronautiche "Savoia" for the licensed production of Henry and Maurice Farman biplanes.

The first plant became operative in 1913, in Turro Milanese.

In the second half of 1915, was ( Santoni, with Luigi Capè, owner of a wood-working outfit at Sesto Calende,) founded Società Idrovolanti Alta Italia (SIAI), for the licensed production of the FBA, a French flying boat considered to be one of the best in the World.

In addition to Macchi, SIAI and Caproni other airplane builders in Lombardy also contributed substantially to warplane-production.

Towards the end of 1917, the Società Ernesto Breda plants in Sesto S.Giovanni, with its own airfield, were outfitted for the mass production of Caproni CA 5 bombers.

Together with Fiat and SPA in Piedmont, Isotta Fraschini quickly became one of Italy's leading producers of aircraft engines.

Many of Lombardy's companies interested in the aircraft engine field worked with these three companies during World War 1.

All in all, between 1915 and 1918, Lombardy provided a huge contribution to the production of warplanes: 48% of all airplanes and 21% of all engines produced were supplied by the industries in Lombardy.

## **MILAN AND CIVIL AVIATION**

Lombardy's first attempt at passenger service occurred on 26 June 1919, when a round trip Milan-Venice dirigible flight was inaugurated.

But there were pioneers who were already considering the development of planes for the special purpose of transporting passengers.

Already by early 1917, during the war, Caproni began converting one of his enormous triplane bombers, a CA 41, into a civilian aircraft.

Many other builders besides Caproni took part in aviation experiments related to civilian flying.

For example, the Macchi Company derived the M9 bis from its military version.

SIAI of Sesto Calende was also eager to convert its military flying boats into passenger aircraft.

After a long period of preparation, and with great delay in regards to other European countries, Italian civil aviation was born in the spring of 1926.

Airlines had already appeared in the preceding three-year period, but only in April was the first official route opened between Turin and Trieste, via Pavia and Venice, by flying boats.

In June 1927, the airline Società Anonima Avio Linee Italiane was founded with FIAT capital, and Milan was chosen as the airline's headquarters.

On October 28, 1934, the many national airlines operating domestic and international civil transport flights were grouped under one organization: Ala Littoria.

The only airline to remain independent was Avio Linee Italiane.

In October 1937, the Taliedo airport was abandoned in favor of the Forlanini airport at Linate.

## **AERIAL COMPETITION AND ADVENTUROUS FLIGHTS**

During the 1920s the international flying scene was dominated by the Schneider Cup and marked by the obsessive pursuit of speed, initially achieved using complicated and bulky biplane flying boats (a legacy of WW2), and later using monoplane float-planes with highly streamlined fuselages and floats, with ever more sophisticated and powerful engines to literally thrust the aircraft into the air.

The most interesting aspect of the Schneider Cup after 1919 is that Italian participation was almost entirely backed by companies from Lombardy.

While Macchi was the company that most actively sponsored the Schneider Cup, Caproni focused mainly on breaking altitude records.

SIAI specialized instead in multi-seat seaplanes for long-distance flights. In 1923 the company presented a bizarre-looking flying-boat with two parallel hulls, cantilever wings, tail units supported by two booms, and a power plant consisting of two tandem-arranged engines on a special trestle above the wings. Its name was S55.

The S55 was also exported to and used in the United States and the Soviet Union.

In addition to these successful military and record-breaking endeavors, SIAI strengthened its position in the production of civil aircraft for airline companies (the S71 and S73 three-engined monoplanes with a fixed landing gear, and the S75 and S83 with retractable undercarriage, as well as the S74 four-engined monoplane with a fixed landing gear, were all introduced and widely used by Italian and foreign airlines).

In 1934 came the S79 trimotor bomber.

Caproni experienced its moment of glory during the Ethiopian War with the Ca101, Ca133 and Ca148 bomber and transport trimotors, as well as the single-engined Ca111.

At the same time, the company developed the Campini-Caproni with a reaction engine, which in 1940 became the World's second aircraft to fly with a new propulsion system, namely the jet engine.

With regard to the companies Breda and Machhi, by the mid 1930s they had both decided to abandon the use of wood in favor of all-metal aircraft structures.

This favourable situation of Lombardy's aircraft industries was generated by the bond narrow between banks and aeronautic firms.

When Mussolini took power in Italy, there were many improvements in military policy and in commercial policy. In fact, Mussolini improved relations between aircraft industries and State power.

The fascism "sponsored" the big crusades and the flight accrosses.

### **LOMBARDY'S INDUSTRIAL EFFORT DURING THE WAR**

During the 1930s the aircraft industries of Lombardy, basically the companies Breda, Caproni, SIAI, Macchi and Agusta for airframes, and Alfa Romeo and Isotta Fraschini for aircraft engines, experienced tremendous growth.

The industrial output for this sector in Lombardy amounted to roughly 50% of the entire production capacity of Italy, without taking into account the contributions from many companies located outside the region but directly or indirectly connected with the companies in Lombardy.

With regard to the technology used, it is worth nothing a few important aspects. Both Caproni and SIAI-Marchetti continued their traditional use of a mixed construction system, that is the production of aircraft featuring wooden wings and a welded-tube fuselage frame covered with fabric and/or plywood, whereas Breda and Macchi had already switched to all-metal constructions, though not yet on a fully rationalized basis.

As for aircraft, SIAI-Marchetti specialized in the production of three-engined bomber and/or transport monoplanes, among which stands out the SM82, one of the best aircraft ever made by the company, which also aroused Germany's interest.

Meanwhile, the already famous SM79 for its exceptional results at the international level was chosen as the standard airplane of the Royal Italian Air Force.

Having abandoned the construction of wooden seaplanes, Macchi switched to all-metal constructions by specializing in fast, maneuverable single-seat fighter monoplanes.

The company started off at a disadvantage with the MC200 because of inadequate engine power and a modest armament, but the company from

Varese gradually made a turnaround with the MC202 and MC205 by increasing their engine power and strengthening their armament, whereby, at least from a qualitative standpoint, a direct comparison could be made with the aircraft of the rival British and American air forces.

The company Caproni specialized in reconnaissance planes with a long series of Ghibli – which proved effective in the Libyan Desert – and Libeccio (from Ca310 and Ca314) bimotores, for which no appropriate use could be found.

For its part, the company Breda, after the doubtful results obtained with its Breda 65 assault plane, and after the abysmal failure of its Breda 88 twin engined combat plane, opted for a licence to build Macchi fighters and became the main builder of the MC200 and MC202, which were also built at the plant based in Umbria of Società Aeronautica Italiana.

When comparing Italian airplanes with those of rival powers at that time, the situation was quite troubling.

The SM79 could do miracles, especially when used as a torpedo-bomber over the Mediterranean; the MC200 stood up to the Hurricane, as did the MC202 when compared to the Spitfire of the Royal Air Force.

But, the limited quantities of these aircraft in the Italian Air Force, coupled with the problem of spare parts, replacements, repairs and refueling turned out to be more and more serious, especially on the African front, as ww2 dragged on and the enemy forced surpassed the Italians in terms of quantity and quality.

This exposed the enormous handicap of the Italian aircraft industry in particular, and of the armament industry in general: reduced production capacity.

Thus, during first two years of the conflict, Italian aircraft plants were able to work under relatively easy conditions, without enemy attacks. But, the situation soon changed drastically and irreversibly when American air, naval and land forces took control of the Mediterranean.

Without a doubt, the “turning point” of this situation came in the fall of 1942, when the first heavy raid hit Milan in October; the ensuing attacks in 1943 and 1944, progressively struck all the larger armament production centers in northern Italy.

At the end of the war, Italy ranked last among the six nations involved in ww2 in terms of aircraft produced.

## **THE POST-WAR RECONSTRUCTION**

At the end of ww2 the aircraft industry in Lombardy was left in shambles. Factories and plants were destroyed or seriously damaged, airports unusable, no more orders coming in, and the future looked bleak.

Several companies, such as Agusta and Macchi, were able to convert part of their production to motorcycles, three-wheelers, trolleys, train wagon and buses.

Nevertheless, Caproni did manage to build a light twin-engined touring plane, the Ca 193, by 1949, and a small two seat single-jet touring and training aircraft, the F5.

A lot of guts and perseverance, but also far-reaching ideas, are the distinguish features of the Aermacchi president at that time, Paolo Foresio.

After struggling for many years to keep the glorious Aermacchi on its feet, the president decided to bet everything on a jet trainer, entering the world market at the right time with just the right plane, the MB-326, which contributed more than any other aircraft to the international acclaim of this company from Lombardy.

The career of this plane is a continuous success story full of achievements and victories.

Another entrepreneur, Domenico Agusta, played a prominent role in the post-war reconstruction of the Italian aircraft industry. He was the only person in Italy to have faith in an unusual flying machine – the helicopter – which, in 1952, after an agreement with Larry Bell was signed, was still largely unknown, so much so that it was greeted with “skepticism” BY THE MAYOR aircraft builders. So the company focused entirely on helicopters.

After the war the company SIAI-Marchetti also returned to its former activities in the production of aircraft primarily for civil use.

Major companies were not the only ones to respond to the post-war crisis: in Lombardy, numerous small, private businesses were started up between the late 1940s and the early 1950s.

One cannot underestimate the serious problems that commercial air travel faced; but with the signing of the peace treaty in the spring of 1947, which returned full independence to Italy, commercial traffic resumed a regular rhythm, and many smaller airlines sprouted up alongside the more famous Alitalia and Avio Linee Italiane.

## **THE WINGS OF LOMBARDY INTO THE FUTURE**

The story of the men and machines that have made the aircraft industry of Lombardy famous the world over does not end here.

On the eve of the year 2000, despite an economic and industrial crisis not only in Italy but around the globe, the aircraft industry in Lombardy – both builders and service providers – continues to show vitality, proving that it possesses an all-around and exceptional ability to interpret the needs of today's ever changing times.

The company Aermacchi is one of the most well-established and modern companies in the field of jet airplanes for training purposes and light tactical support.

The company has placed a great deal of attention on research and test studies, applying its results to technology and end products.

The “gem” of the Agusta group, the A109 helicopter, which appeared at the beginning of the 1970s after the company from Cascina Costa had acquired priceless experience in the field of licensed manufacturing, became the image and symbol of a new course marked by State holdings in 1973.

The A109 has been flown all over the world for some twenty years now. The production went on with the plucky A129 “Mangusta”, used by the Italian Army, and the greatest helicopter of all, the EH101, built in conjunction with the British company Westland for the Italian and British Navies, as well as for the Canadian Navy.

Meanwhile, changes of ownership that, at a certain point, occurred in almost all Italian aircraft firms, affected Caproni-Vizzola as well, with Agusta taking a majority share in company.

SIAI was eventually integrated within the Agusta group but, before the number of its employees was greatly reduced, SIAI proposed a new project, the S211. Now SIAI is integrated with Aermacchi group.

In Lombardy there is a small company called General Avia, founded by an aircraft engineer. In the post-war years, the engineer designed many beautiful prototypes of touring airplanes. The latest is the Pinguino, a two-seat trainer with aerobatic capabilities.

And who can forget the days when another great company was located near Forlanini airport? Nardi obtained the license to build American Huges helicopters.

The areas around Milan, and in general in Lombardy, have witnessed the birth and growth of many companies engaged in the development of airplane equipment and instrumentation, for it is all too true that the successful outcome of any flying mission depends on these devices.

The increase in Milan's air traffic in the last twenty years has been the main link between Italy and Europe, as befits its current economic power, its geographic position and, in particular, its history.

With its airports, Milan is expected to be one of the most rapidly developing areas in Europe. If we consider that international air traffic through Milan has exceeded domestic traffic at a growing pace for many years now, it's obvious just how much of the increasing burden of Italy's international traffic is taken on by Milan's airports.

## **ARTISAN AND SMALL INDUSTRIES**

The success of industrial initiative in Lombardy is mainly due to hard working capabilities of the population and due to presence of many artisans. Artisans are able to offer a valid support for new project development defined from big industries. We intend to present a small description of some artisans and small industries.

Mr. Secondo Mona, a gifted self-made engineer, who opened a shop for the sale and repair of bicycles and motorcycles, founded secondo Mona in 1903. Attracted by the rising adventure of modern aviation, in 1913 Secondo Mona starts with the repair & overhaul of aero-engines installed on the first aircraft flying from the nearby field of Malpensa and gradually develops and produces fuel equipment of own design.

The Company, still owned and operated by the same family, is today the oldest Italian aerospace company and an industry leader in the design, manufacture and maintenance of Aerospace equipment and systems for fuel, hydraulics and actuation both for military and commercial applications. Similar equipment is developed also for Land and Naval applications.

Secondo Mona diverse product range includes Complete Fuel Systems, Braking Systems, Pressure Refueling Systems Engine Fuel and Lube Oil Equipment, Engine Control Equipment, Fuel, Lube Oil, Hydraulic and Pneumatic Equipment.

Secondo Mona products are currently installed on the European fighter aircrafts EF2000 Typhoon and Tornado, on the Aermacchi trainers, on the AgustaWestland helicopters, aircraft of Alenia and on business jets such as the Piaggio P180 or the Indian commuter Saras.

Aeronautica Lombarda started its activities as Aeronautica Bonomi, the group produced the first Italian gliders in the 20th thanks to the dedication and personal investment of Mr. Bonomi. It created even a flying school and many famous Italian pilots were trained in his school located in Cantù, even some American pilots were trained in the Cantù School in the period before the Second World War. The company was operative until the 50ies and many famous designers like Ing. Silva, Ing. Preti, Ing. Frati started they career working in this company.

The first attempt of muscular flight was done in this company.

Bestetti Company was founded in 1917; this company began by repairing the Niuport Bebes. The company then specialized in aircraft production, including some by company design, like a twin engine and a small Canard for general aviation. Mussolini began a pilot's course on the company airfield and in this company Ing. Bazzocchi started working as designer, later he becomes the technical Director of Aermacchi.

Pasotti was a woodworking industry in Brescia that had an early interest in aviation during the pioneering years (1909) and in 1918 got the licence to produce Caproni bombers. In the early 1950ies the production of F-4 Rondone two- seaters was taken from Aeronautica Lombarda, it produced the prototype of F-7 Rondone II three seater, the F-6 Airone light bimotor and the F-9 Sparviero, all designed by Stelio Frati.

Arpini Gino was a genial artisan, he realized the prototype of F-4 Rondone that won the world speed record thanks to innovative solution introduced in the realization. He participated to the production of different prototypes (car, aeroplanes, boots) and finally he specialized in the interiors of aeroplanes and boots. His company is still active and under control of family Arpini.

Procaer company was founded from Rico Neef, it debuted in 1959 with its three-seater sport plane, the F-15 Picchio designed by Stelio Frati, which featured an original ply-wood structure covered in aluminium plating; it was also produced in various versions, the last one made in aluminium. The company also produced the Frati designed F-400 Cobra jet, an advanced twin engine jet for general aviation. The investment of Mr. Neef was considerable, several solutions adopted were really innovative, but the company was not able to enter in massive production.

Ing. Stelio Frati started his activity in general aviation as designer for various companies, in the seventies he founded the General Avia. A number of interesting light aircraft prototypes were built, starting in 1971 with the F-20 Pegaso twin engine and up to the last F-22 Pinguino trainer in 1989. On the order from the Belgian company Promavia, General Avia developed in 1987 a primary jet trainer under the designation of F-1300 Jet Squalus.

Frati aeroplanes are famous around the world and still in production, SF-260 by Aermacchi and F-8 Falco is sold in Kit form by an American company. He is the most significant aviation designer in Italy and is considered one of the 50 most important persons of the past century in Aviation field. I had the honour to be the Technical Director of General Avia, the company is now close for financial problems and we are now working in order to start again the production of F-22.

Felice Gonalba was the founder of SSVV, he realized in his company many wooden gliders and he was able to restore in flying conditions many old aeroplanes. The Caproni CA-100, the oldest floating plane in the world in flying condition, was restored in SSVV Company. Many gliders produced by SSVV are still in flying conditions and many restorations are present in the important museums, even in Japan museum is on display a copy of SVA aeroplane that flew from Roma to Tokio in the 20ies.

BMA Company was founded in 1950 from Piero Bosio, Bosio was the first artisan to take care of USA made general aviation engines overhaul in Brescia. He was Lycoming and Bendix distributor too. The company is still active and it is working in engines and aircraft overhauling. BMA

collaborated in the development of many new engines and aircraft projects in General Aviation and in the 90ies he was the responsible of the development of a new general aviation aeroplane, the SD-27 SIVEL.

SIVEL srl is a company based in Brescia (Lombardy) owned by Mauro Balzarini, the company was founded with the purpose to develop new low cost engines and aeroplanes for general aviation and training. The production and certification activities of SD-27, the first Italian aeroplane certified following the new JAR-VLA requirement, was performed by this company totally funded by Mr. Balzarini and with the participation of Com.te Andrea Canetto as test pilot. I have the honour to be Technical Director of this company and to participate to the development and certification of the new SD-27 and, as SIVEL collaborator, to have taken care of the KTX-1's development and certification in Korea.

Silvercraft Company was founded in 1962 by Ing. Silvestri with the purpose to produce light helicopters, he was successful with the helicopter type SH-4, powered with Franklin engine 200 HP that was certified in 1968 and this is the first helicopter fully developed in Italy. Silvercraft produced 20 SH-4 mainly sold to foreign countries. In 1977 a second prototype flows, unfortunately the company closed due to the death of Ing. Silvestri.

Dragon fly started as private adventure of two filmmakers, the Castiglioni brothers, with the support of many skilled specialists in helicopter field. Purpose of the company was the development of a low cost helicopter two seater. The ultralight version was competed successfully in a short time and 70 helicopters were produced, the certified version is under development and a dedicated certification requirement called JAR-VLR, was prepared from Italian certification agency.

Tema Company was founded in 1944 and its activity was dedicated to the development of new components to satisfy the specification of clients and to supply accessories for the big aircraft and helicopter industries. TEMA is also producing the engine control lever and cooling fan for the new Agusta Helicopters and actuators for RPV control system.

In 1970 Pariani Co. was born aiming to design and produce instruments, control panels and special electro-mechanical components for commercial and military aerospace industries.

Since then, Pariani Co. has maintained its feature of being flexible, conjugating this core quality with expertise and efficiency, for its re-engineering business processes. The company is specialized in Opto-Electronic equipment, and it has a wide range of products which meet various industry needs from Avionics to designer interior lighting. Present and future strategies include special maritime and rail illuminated equipment, together with new technology advances in the production of emergency luminous landing systems, which do not require maintenance, have low power consumption and increased safety.

Gemelli Company started the operations in 1947, the goal was to design and manufacture radio-transceiver dedicated to both aeronautical and naval civil/military applications. During 60's Gemelli turned his production to aircraft intercommunication systems, many Italian aircrafts and helicopters were equipped by Gemelli communications systems. In 1998 the company specialized in Active Noise Reduction Technology and now it can offer the most effective solution for any aircraft where clear communication is required in high noise ambient.

Elettronica Aster (EA) was founded in 1945, following the end of the Second World War, to design and manufacture radios for Fiat, Lancia and Alfa Romeo that are Italian cars Company. In the Fifties (1950) EA entered the Defense market, when the Italian aeronautical companies were allowed to design and manufacture aircrafts, by producing electronic devices for transmission and control applications, waveguides, radar antennas and inertial components. In the Nineties (1992) EA acquired the Italian Company Nardi, which was a major producer of hydraulic systems, entering the field of hydraulic components.

Since 1862 Testori has been supplying textiles to hotels, railways, passenger liners and luxury dwellings throughout the world. In 1957 Testori began to supply the aviation market.

Testori offers also a comprehensive industrial design and a corporate image service for airlines, aircraft interior designers and aircraft

operators, thanks to in house CAD facilities. Testori laboratories perform all necessary test according to aeronautical certifications JAR/FAR 25.853 (flammability, heat release, smoke emission and toxicity)."

Ernesto Valtorta consulting company started in the 90ies and was mainly working in supporting the development of new general aviation programs for small aeroplanes as SIVEL SD-27, AERIKS 200, F-22, ICP ulm, and helicopter as Dragon fly. The company collaborated for the development of aeroplanes for big companies too like K-8 in China and P-180 in Italy.

Since 1962 LOGIC has been studying, developing, producing and selling Electronic Aerospace Equipment.

Benefiting from decades of experience and familiarity with the latest technologies, LOGIC meets not only requirements but achieves standards of excellence.

Highly professional engineering skills and techniques ensure perfection is reached throughout all phases of the project – Design, Development, Qualification, Production and In-Service Support.

LOGIC has Qualified Supplier status with the world's major manufacturers of fixed-and rotary-wing aircrafts.

There are many others companies dealing with aviation, we try to present the most interesting, all this activities generated a strong experience in the various fields and many innovative solutions. The artisan companies produced a strong contribution to the development of many important projects developed from big aeronautical companies and others companies too that were able, thanks to the availability of experienced artisans and the experience gained in aeronautical field, to develop superior quality products. Famous in the world are the furniture and interior for aeroplanes and ships produced in Lombardia and the motorcycle produced in MV-Agusta and Aermacchi was the world champions for many years.

The collaboration between the big industry and artisans is several time difficult and need to be organised taking care of mutual benefits. For artisan company is easier and less expensive produce small parts, the production of complete aircraft or helicopter is more suitable to a big industry. For a big industry it is more easy to obtain the certification now required to be active in aeronautical field (DOA, POA), a small company usually does not have

enough persons to cover all the necessary requirements. The work necessary to obtain financial support from government organisations is big and usually a small organisation has not the capabilities to perform this activity, in conclusion usually only big industries are able to obtain financial support even for work performed from small artisan.

In the history of aeronautic in Lombardia we have several examples of small companies that accepted big work commission from industries, some time not in aeronautical field, and signing the contract, that apparently was very good, they signed the closure for bankruptcy.

## **SPACE RESEARCH IN ITALY**

The first Italian contribution to space flight was in 1914 with the publication on a newspaper of an article describing the technical aspects of space navigation and with the analysis of the possibility to use nuclear power to move space ship.

Some year later a new engine was experimented in Brescia and in 1923 the study were published in a book describing the application to space ships.

In 1926 started the systematic research on space and the first article was published from researchers. In these years the first experiments with rockets was performed and in Milano a researcher tried to make gliders fly with rocket propulsion.

In the 30ies these studies made no progresses and only in the 50ies started again the space research in the university of Rome. The first course about missiles development was organized.

In 1959 the first financial support for the research arrived and several new rockets with liquid propellants and water propellant too were developed.

The major effort was made in the 70ies with the development of the ALFA type rocket that could have been a starting-point to obtain a launcher with solid propellant able to orbit small satellites.

On 15 December 1964 Italy was able to orbit the first satellite, San Marco 1: this satellite was the result of collaboration between Italy and USA and was the first European satellite to be orbit. The only responsible for this work was the university of Rome.

The activities in the Space fields caused the development of a new industrial and cultural world never seen before. The Universities and the research centers were the first one to be activated and the “San Marco’s” program got a foothold in the university of Rome without any collaboration from the industries.

Only at the end of the 60ies the situation started to change, the first concrete step was the start of Aeritalia, a new company with the dimensions and capabilities to work in space field; then, in 1971, Selenia, a company leader in electronic field, started a cooperation with the American company Hughes for the development of satellites for telecommunications.

In this period started to be operative the Laben Company (located in Lombardy) for the development of electronic control systems and BPD for the propulsion. The Sirio program, a new satellite for telecommunication, started as the first industrial program developed in Italy. As to communication via satellite in 1961 Telespazio Company was founded. A significant step as to production activities related to space was obtained in 1983, when Selenia decided to divide the activities related to space and found Selenia Spazio, the first Italian company fully dedicated to space activities. In the same time Aeritalia found the “Gruppo Sistemi Spaziali” and merged with Selenia Spazio in 1990, the new company Alenia Spazio was born.

Laben Company too started to be very involved in the space, but decided to maintain a collateral activity in the nuclear electronic (still operative).

In these years others industries related to space was born, like Officine Galileo for the construction of sensors, FIAR specialized in power systems developments, Microtecnica for environmental control systems, Gavazzi Space and Siemens for electronic components.

As to formation’s field of new technicians in the space technology, a Polytechnic of Milano was very active: the research founded a strong

support in CNR (National Centre of Research), where the numbers of laboratory and research centres increase.

Several new research centers appeared and new-dedicated wind tunnels were developed. In 1990 was created the Italian Space Society (ISS), a organization dealing with the organization of seminars and meetings finalized to the development of space culture; the location of ISS is in Milano, in the “Leonardo da Vinci’s” museum.

### **Lombardy activities in the space field**

In Lombardy are located several companies active in space field like Laben (now part of Alenia Spazio), Fiar (now part of Galileo avionica), Carlo Gavazzi Space (part of the Fuchs German group), the universities like Politecnico di Milano, Politecnico di Brescia and Università Statale di Milano are very active in the research and in producing instrumentation. There are also minor companies, like Centrotecnica srl that operate in vibration and shock testing, companies dedicated to mechanical productions skilled in the preparation of sub assembly parts like Centrotecnica sas, Paravati, ReFraschini and Media Lario, a company dedicated to the production of special mirrors for X-ray telescopes.

Even typical aeronautical companies are used to cooperate in space programs. For example Aermacchi that produces structural parts for Ariane vector.

Since 1989 up to 1992 the Aermacchi wind tunnel department took part to the European HERMES Shuttle Program with design and production of several HERMES models.

These models, mainly manufactured in high tensile stainless steel, were used for force, heat flux and pressure measurements at hypersonic, supersonic and transonic speeds.

A number of Insulated models (ceramic and composite materials) were developed for the purpose of making heat transfer measurements with correct simulation of surface temperatures.