



# BELGIAN AEROSPACE

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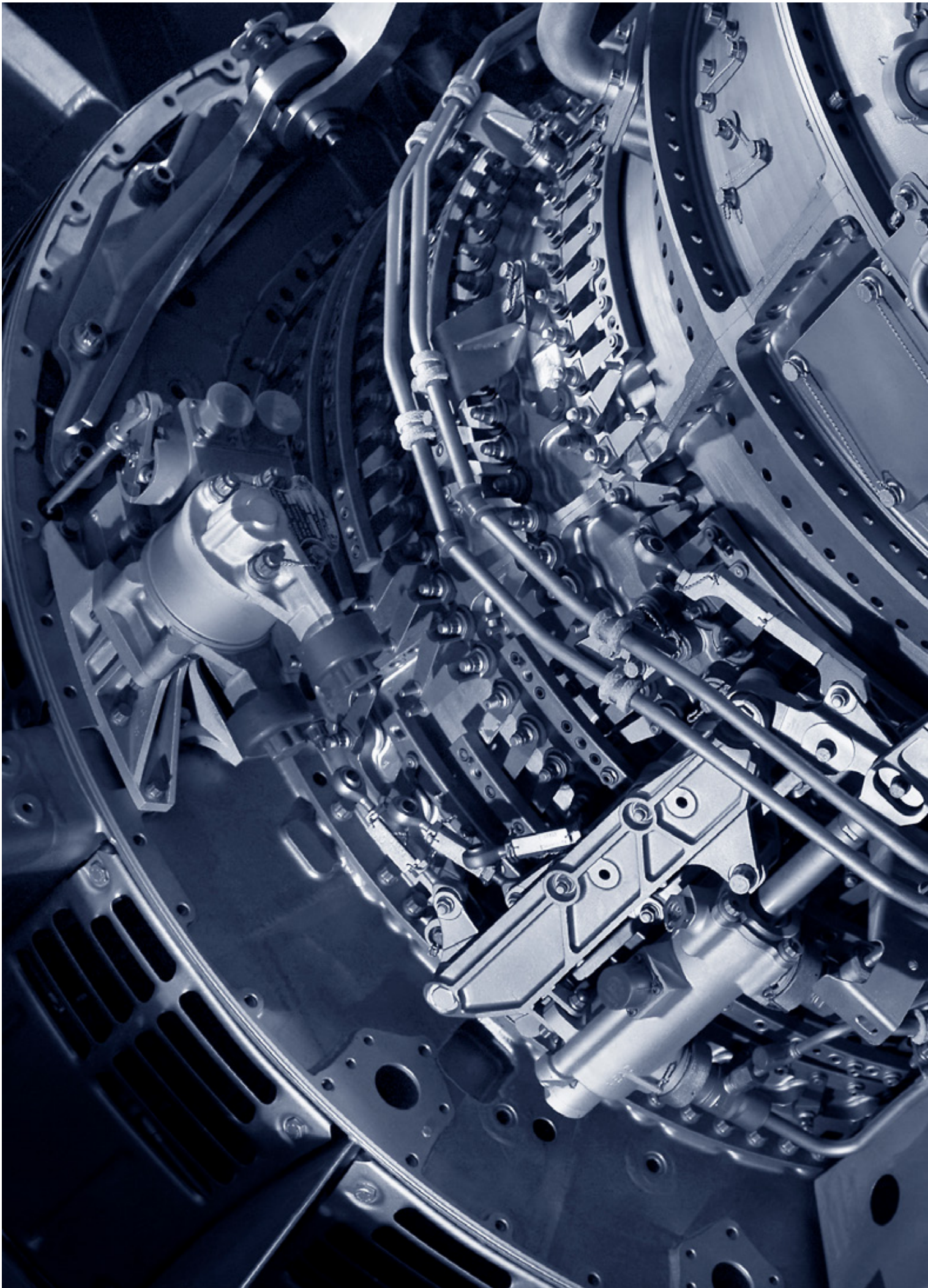
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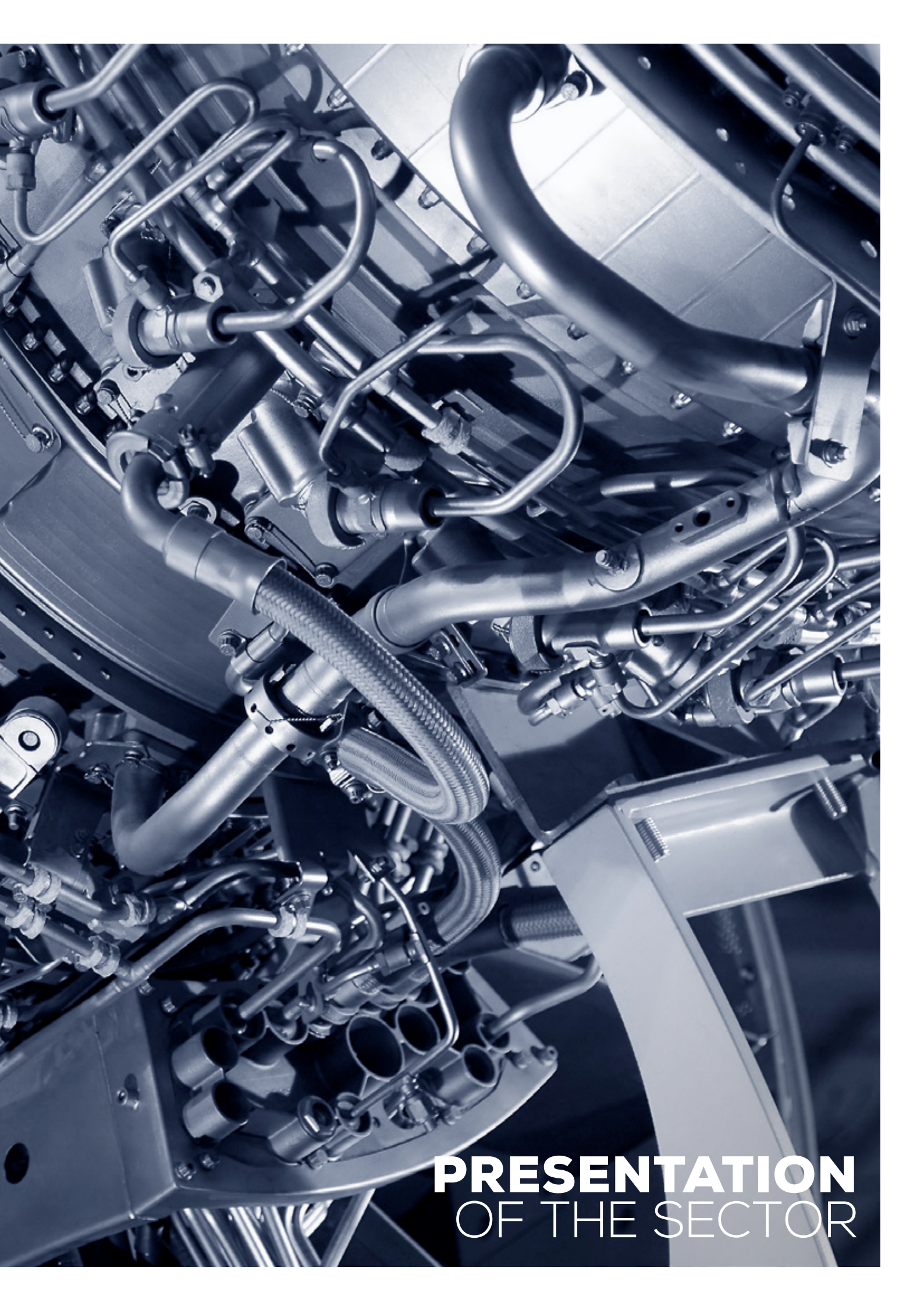
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**PRESENTATION**  
OF THE SECTOR



**SECTION 1**

# BELGIUM AND THE AEROSPACE INDUSTRY

## 1.1 Belgium's long history in the aeronautics industry

Belgium's first involvement in the aeronautics sector was related to military contracts in the twenties. SABCA, Sabena and Fairey, the predecessor of Sonaca, installed offices close to the military airport in Brussels and were awarded several contracts by the Belgian army. Nevertheless, the sector remained small. Two events changed this: the procurement of 116 fighter jets by the Belgian Army, and the Belgian participation in Airbus.

In December 1970, Airbus was founded by Germany and France in order to give some counterweight to Boeing. The Netherlands understood the opportunity for their aeronautics industry and joined the initiative one year later, soon to be followed by Spain. Airbus introduced the A300 in 1974. When the Dutch company Fokker decided not to join in the manufacturing of the next aircraft, the A310, Belgium seized the opportunity to take its place. In November 1978, the Belgian government bought 3% of Airbus shares.

The consortium Belairbus was founded, consisting out of Sonaca, FN Moteurs and Asco. The Belgian companies worked on clearly specified projects such as the slats (Sonaca) and the slat tracks (Asco). It was estimated that their production required about 50,000 working hours per year, divided between Sonaca (79%), SABCA (3%) and Asco (18%). For the A320 production, another Belgian company, Watteeuw, took the place of SABCA and manufactured the racks.

By then, the Belgian government had already decided it would put out to tender 116 F-16 fighter jets for the Belgian army. This deal, still known today as "the contract of the century" not only brought money and employment to the sector, but more importantly, the latest technology and know-how.

The number of fighter jets bought by Belgium exceeded that of any other country at that moment, except for the United States. In total, 1,811 fighters were sold in this batch.

This was good news for the Belgian industry, since there was an agreement between General Dynamics and the European consortium on industrial compensations to the tune of:

- 40% of the purchase value of aircraft ordered by the four European countries;
- 10% of the purchase value of US Air Force aircraft;
- 15% of the purchase value of aircraft ordered by third countries.

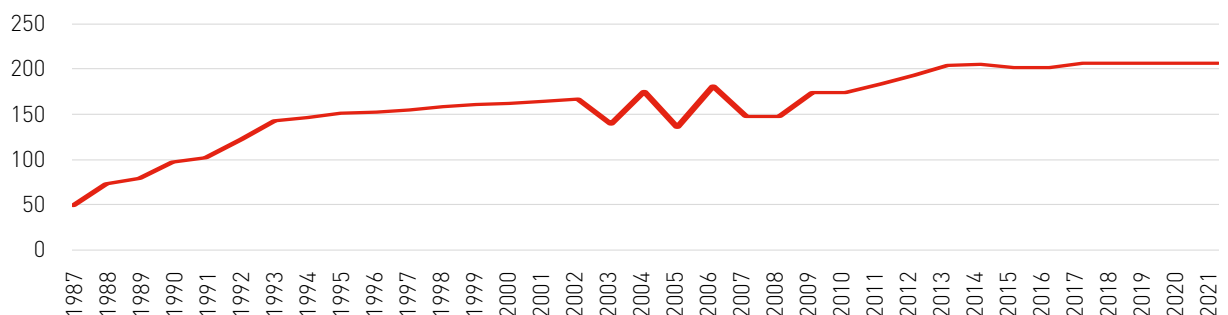
As a result, Belgium obtained a compensation level worth 640 million USD, while it procured aircraft worth 878 million USD. Sonaca, SABCA, FN Moteurs and MBLE (currently Philips) were the Tier 1 suppliers.

More importantly, the companies involved, as well as their suppliers, managed to gain a strong market position, which allowed them to prosper when liberalization of the market set in.

## 1.2 Belgium's long history in the space industry

Belgium was one of the first nations to engage in space policy. It was, both politically and economically (SABCA, FN Moteurs, Alcatel Belgium) involved in the European Launcher Development Organisation (ELDO) and the European Space Research Organisation (ESRO), two organisations preceding the European Space Agency (ESA). This illustrates Belgium's orientation from the very beginning towards European and international cooperation.

**Evolution of the Belgian Space Budget (in million EUR)**



Source: BELSPO



As a result, Belgium played a major role in the creation of ESA, which was decided during a European Ministerial Space Conference in Brussels in 1973. Historically, it has also been one of the major funders of the organisation. Belgium tends to feature in the top 5 when it comes to contributions, after Germany, France, Italy and the United Kingdom. This was also the case in 2017, when Belgium was responsible for 5.8% of the ESA budget.

Belgium has been host to the ESA centre in Redu since 1968. This site, located in the Belgian province of Luxembourg, is part of ESA's ground station infrastructure, and its primary task is to control orbiting (for the most part telecommunication) satellites. Redu is also the main processing centre for data in the field of 'space weather', with a focus on the influence of the sun on the Earth.

In 2014, new responsibilities were given to the site in the field of cybersecurity and education. It opened a laboratory for e-robotics and it has been hosting the Training and Learning Centre of the ESA Academy since 2016. In order to acknowledge the new direction, and to celebrate 50 years of ESA activities in Redu, the centre was renamed European Space Security and Education Centre (ESEC).

Apart from the ESA projects, Belgium is also party to several bilateral agreements, such as with France (for the Earth observation programme SPOT), with Russia (MIRAS and SPICAM) and with Argentina.

### 1.3 The current state of Belgium's aerospace industry

Today, Belgium is a crucial player in the aerospace industry. Its aeronautics sector employs over 10,000 people directly, many more indirectly and is worth about 2.5 billion EUR. This is a combination of estimations provided by Skywin for the Walloon Region (1.4 billion EUR), FLAG for the Flemish Region (about 1 billion EUR) and, taking into account possible overlaps, the remainder within the Brussels-Capital Region.

The Belgian space industry is worth around 600 million EUR, according to estimations by Skywin, VRI and the Belgian Science Policy Office (BELSPO). The market is mostly divided between Wallonia (300 million EUR) and Flanders (240 million EUR). About 3,000 people are active in the Belgian space industry. Two thirds of the turnover derive from ESA programmes.

Belgium has one of the highest space budgets per capita in the world, comparable with the United States, the Russian

Federation, Germany and Japan. Belgium also ranks among the top countries when it comes to R&D in space programmes as a percentage of GDP. According to an OECD report, only the United States and France outperformed Belgium in 2013.

Every year, Flight Global makes a list of the 100 most important aerospace companies by revenue. Traditionally, two Belgian companies occur in this overview: Asco and Sonaca. In Flight Global's next toplist, Asco will no longer appear as a Belgian company, as it was purchased by Spirit Aerosystems in May 2018. In a similar manner, many more Belgian companies are hidden champions.

Foreign companies are very aware of the Belgian expertise in the aerospace industry. As a result, the sector draws large amounts of foreign investment. To Safran Aero Boosters for example, a world leader in boosters, oil systems, test cells and space valves. Other companies attracting foreign investment are OIP, Qinetiq Belgium, SABCA...

At the same time, Belgian aerospace companies are internationally active as well. To name only one recent example, Sonaca bought the US-based company LMI Aerospace, a world-class leader in designing, building and manufacturing aerospace structures, systems and components.

Many companies in the Aerospace Top 100, including almost all top 20 companies, have branches in Belgium. Boeing, Airbus, Lockheed Martin, United Technologies and Northrop Grumman, also known as the top five biggest aerospace companies in the world, hold office in Brussels. The Belgian capital is home to the European Parliament, the European Commission and the NATO headquarters.

But even though most major aerospace companies have found their place in Belgium, the Belgian economy relies first and foremost on a strong, innovative and highly specialized pool of SMEs.

The lack of original equipment manufacturers (OEMs) and system integrators is therefore more than compensated by hundreds of small enterprises working in niches. Belgian companies hold important positions in some of the technologies that are poised to play an ever increasing role in the aerospace industry in the decades to come, such as composite materials, software simulation, additive manufacturing, high-tech critical parts, advanced materials, electrical systems...

Airbus counts no less than 52 Belgian companies on its 'approval suppliers list' of 01 March 2018. This is a particularly high number in comparison to other countries such as the Netherlands (45), Switzerland (31), Denmark (4), Sweden (10), Norway (0), Finland (6) and even Italy (44, including a branch of the Belgian company Solvay).

A smaller OEM such as Bombardier still counts 15 Belgian companies on its 'approved supplier listing' as of 22 January 2018.

The consultancy firm PwC publishes an annual aerospace manufacturing attractiveness ranking. The outcome depends on factors such as cost, labor, infrastructure, industry, geopolitical risk, economy and tax policy. In the latest edition, dating from August 2017, Belgium ranked 20<sup>th</sup>. Conditions specifically related to the aerospace sector scored well. Labor and infrastructure were both considered very good (14<sup>th</sup> and 15<sup>th</sup>), and Belgium turned out to be number 3 when it comes to cost effectiveness, based on operating expense, capital expense, labor productivity and so on. The more general criteria, such as tax policy and economy (GDP, debt as a percentage of GDP...), dragged the final Belgian result down.

fDi Intelligence, a service from the Financial Times, launched the "Aerospace Cities of the Future" index in 2016/17. Brussels appeared on it twice. First as number four in "connectivity" and again as number three for "innovation and attractiveness". The latter was based on, among other indicators, the number of patents in the aerospace sector, the number of aerospace companies as a percentage of overall companies and the number of top 300 universities in engineering – mechanical, aeronautical and manufacturing on the QS University Ranking.

Indeed, despite being a country of only 11 million inhabitants, Belgium sports no less than 6 universities in the top 300 in mechanical, aeronautical and manufacturing of the QS University Ranking. This is far more than comparable countries such as the Netherlands (3 universities), Switzerland (3 universities), Denmark (3 universities), Sweden (5 universities), Norway (1 university) or Finland (1 university). For the third consecutive year, KU Leuven was awarded in 2018 to be the most innovative university in Europe according to the Reuter's ranking.

As a result of its expertise, Belgium is a top exporter in the aerospace industry. An indicator is the product category "Aircraft, spacecraft, and parts thereof". Belgium's exports in the category increased by more than 22% to 1,3 billion EUR in 2017. This is the best result ever noted.<sup>1</sup>

## Belgian exports of the product category "Aircraft, spacecraft, and parts thereof" (in million EUR)

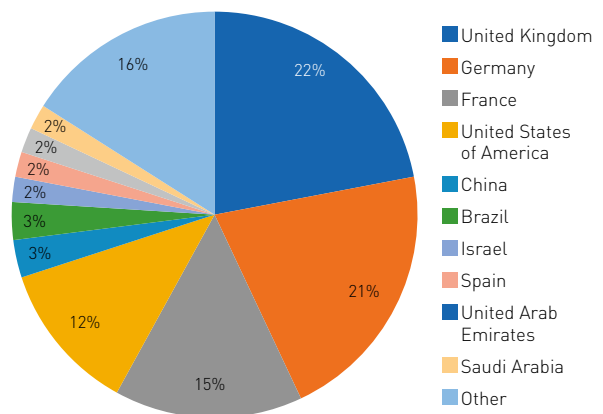


Source: Belgian Foreign Trade Agency

The United Kingdom was the most important client for the Belgian aerospace industry in this product category, with a share of almost 22%. Germany, France and the United States followed. Together, those four countries accounted for 70% of the Belgian exports in the product category.

Belgium's clients remained very stable in the past decade. In 2007 Belgium had exactly the same top 4, together accounting for 72% of the product category "Aircraft, spacecraft, and parts thereof".

## Belgian exports of the product category "Aircraft, spacecraft, and parts thereof" by most important clients in 2017



Source: Belgian Foreign Trade Agency



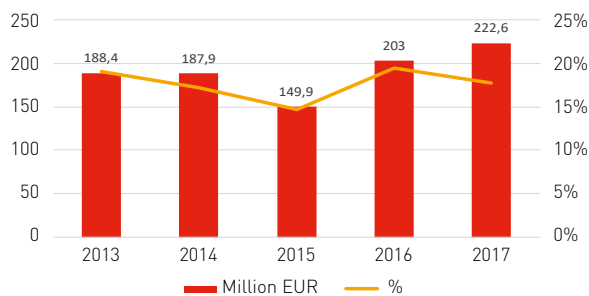


Belgian companies reported exports to 133 countries in this product category in 2017, although to 75 of those countries for less than 1 million EUR.

An estimation of the importance of the space industry in the aerospace exports can be made by separating the product items specifically related to space (parts of spacecraft, satellites, suborbital and spacecraft launch vehicles) from the broader category.

When using this methodology, the importance of the space industry in the overall aerospace exports remained fairly stable in the five last years. It ranged between 14.3% and 19.0% of the overall result of the "Aircraft, spacecraft, and parts thereof" product category.

**Space related exports (in million EUR) and as % of the total product category "Aircraft, spacecraft, and parts thereof"**



Source: Belgian Foreign Trade Agency

It is important to note that the exports of the category "Aircraft, spacecraft, and parts thereof" are only a fraction of the Belgian exports related to the aerospace industry. Most companies active in the aerospace industry have very specific solutions, applicable in various fields. A study by BELSPO found that Belgian companies active in the space industry had a turnover of almost 3 billion EUR in 2015. Only 12.2% of their revenue was a direct result of the space industry. Many companies do not report their exports in the category "Aircraft, spacecraft, and parts thereof" but they may label them under product codes as diverse as "software" or "chemicals".

The Belgian aerospace industry is worth 3.1 billion USD. According to estimates, Belgian aerospace companies export roughly 90% of their products and services. In this logic, aerospace exports should amount to around 2.8 billion EUR. When looking at the product category "Aircraft, spacecraft, and parts thereof", this is only 1.28 billion EUR, or barely 45% of the total aerospace related export.

An example to support this theory are exports to the United States. According to the U.S. Department of Commerce, Belgium supplied in 2017 for a value of 429 million USD to its aerospace sector. This contrasts with the Belgian exports to the United States in the product category "Aircraft, spacecraft, and parts thereof", since those have a value of "only" 150 million EUR (182 million USD). We can therefore assume that this product category accounts for only 40% of the total aerospace-related exports to the United States too.



SECTION 2

THE AERONAUTICS INDUSTRY

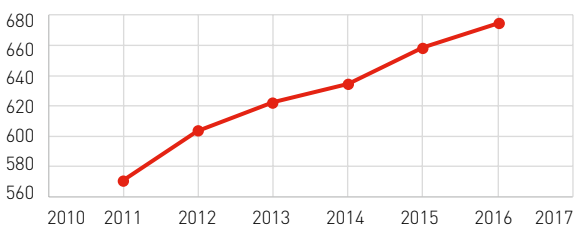
2.1 Recent evolution and current state of the aeronautics sector

The aeronautics sector has done well in the past decades. According to the consultancy Teal Group Corp, the total aircraft market was worth somewhere between 180 billion USD and 210 billion USD in 2017. This includes only the value of deliveries of airplanes and helicopters for the civil and the defense sector. If we include the supply chain, the actual figure could easily be two to three times as large. And when research and MRO are included, the aerospace industry may well have added 700 billion USD to 900 billion USD to the global GDP in 2017.

This estimate is close to the analysis of another consultancy firm, Deloitte. They found that the global aerospace and defense sector revenue amounted to 674.4 billion USD. This is a figure 18% higher compared to 2011. They found that the value of the aerospace and defense sector was in 2016 almost equally divided between commercial and defense purposes with 323.1 billion USD for the former and 351.3 billion USD for the latter.

The vast majority of the aerospace revenue is divided between the United States and Europe. In 2016, they held a share of respectively 60.5% (407.6 billion USD) and 30% (200.4 billion USD) of the sector. An important factor for this gap is the unequal defense spending. Last year, the gap widened again. In the United States, this already vast sector grew by another 3.1% to

Total revenue of the aerospace & defense sector (in billion USD)



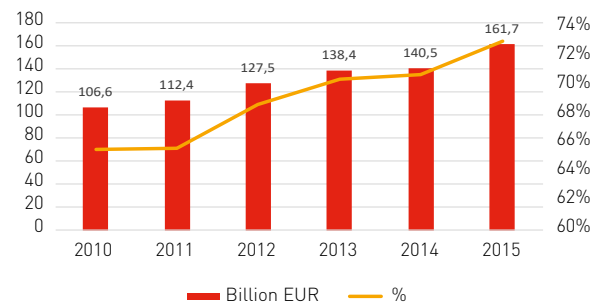
Source: Deloitte 2017 Global aerospace and defense sector financial performance study

235.3 billion USD. At the same time, the much smaller European defense sector only grew by 0.6% to reach 94.9 billion USD.

It is important to note that in Deloitte's overall figures no distinction is made between aeronautics, space and defense. Another report, provided by ASD, a lobby group for the European aeronautics, space, defense and security industries, did make this differentiation in its study published in November 2016.

ASD found that the overall European aerospace and defense sector was worth 222.2 billion EUR in 2015. This number is comparable to the findings of Deloitte (200.4 billion USD in 2016). Aeronautics accounted for almost 3/4th of the entire aerospace and defense industry, up from 2/3rd in 2010. This means European aeronautics was worth 161.7 billion EUR, 48.3 billion EUR of which for military purposes.

European aeronautics industry turnover (in billion EUR; % share of the overall European aerospace and defense sector)



Source: ASD

The scope of ASD is very narrow. The numbers are therefore merely used as an indication that most of the revenue of the aerospace and defense industry indeed flows to aeronautics.

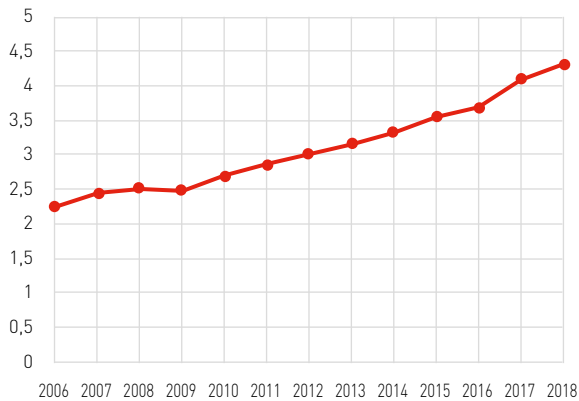
2.2 Commercial aviation

Since 1990, the world fleet of commercial aircraft increased by over 200%. At the moment, Boeing estimates the current world fleet at 23,480 aircraft.

In 1960 all airline companies together welcomed about 100 million passengers on board. In 2018, more than four billion passengers took off according to estimates of the International Air Transport Association (IATA).



**Global commercial airlines passengers per year (in billion passengers)**



Source: IATA

The industry has recovered well from the dip it endured following the 2008 economic crisis and managed to make the jump from nearly 3 billion annual passengers to 4 billion passengers in barely 5 years time. Two main reasons can be highlighted to explain this increase: a growing middle class in emerging countries and lower fares.

- Emerging middle class

The last decades saw an impressive rise of middle class in emerging countries in Asia, the Middle East and the Americas. This gave billions of people the opportunity to take the plane for tourism, to visit family abroad or to undertake business trips.

Compared to 1990, the country with the biggest rise in passengers in proportion to its population is Vietnam. For every Vietnamese person flying in 1990, 425 were travelling by plane in 2016. The Maldives, Rwanda, the United Arab Emirates and Panama also enjoyed strong passenger growth.

**Ratio of global commercial airlines passengers flying in 2016 compared to 1 passenger flying in 1990**

1	Vietnam	425
2	Maldives	149
3	Rwanda	76
4	United Arab Emirates	54
5	Panama	49
6	Qatar	39
7	Equatorial Guinea	32
8	China	28
9	Bhutan	27
10	Ireland	25
11	Turkey	22
12	Vanuatu	15
13	Hungary	15
14	Ethiopia	12
15	Chile	11
16	India	10
17	Lao PDR	10
18	Indonesia	9
19	Oman	8
20	Peru	7

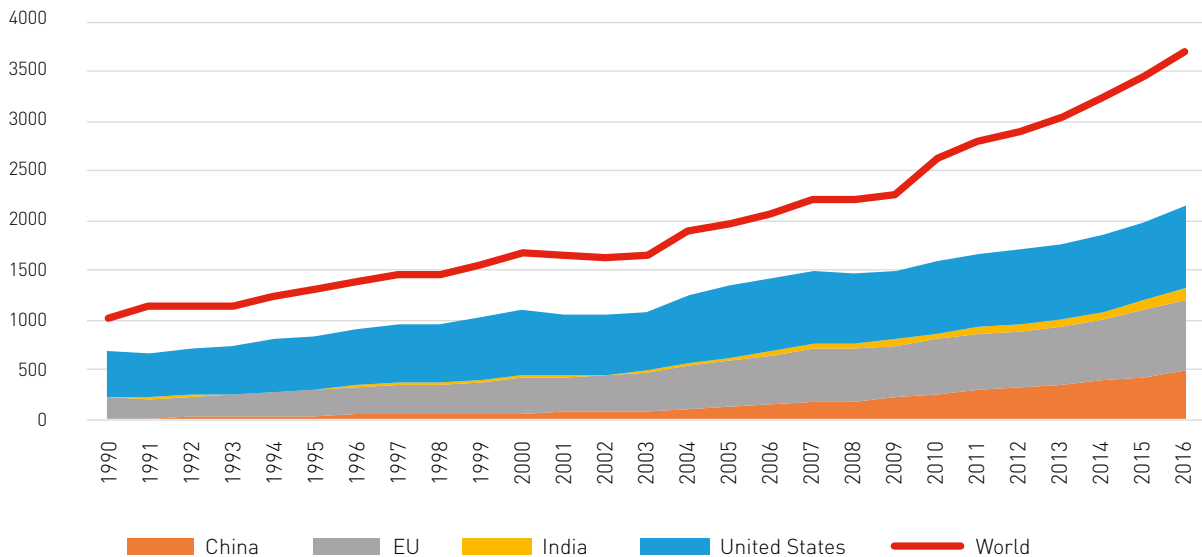
Source: BFTA calculations based on data from the World Bank

In absolute numbers, a ratio of 1 to 32 of Equatorial Guinea pales compared to the 1 to 28 ratio of China. In absolute numbers, Turkey, India and Indonesia are increasingly becoming important markets too. According to Boeing, India is expected to become the third largest commercial aviation market by the early 2020s.

In comparison, the increase in passengers in more saturated markets such as the United States and the European Union is far less pronounced.

Belgium went from 3.1 million passengers in 1990 to 12.5 million passengers in 2016. This growth is bigger than the average of the EU and much stronger than the growth in the United States. Belgium's central role as a hub in Europe, and its proven reputation in connections to Africa, is no doubt an important factor. Belgium hosts Brussels Airlines, headquartered at Brussels Airport, a strong high-end airline.

**Global commercial airlines passengers per region per year (in million)**



Source: World Bank

- Lower airfares

The European country where air travel has been proliferating most is Ireland. There might be a correlation between this achievement and the rising importance of low-cost carrier Ryanair, which is headquartered in Dublin and also operates in Belgium (Brussels Airport and Brussels South Charleroi Airport).

Indeed, Ryanair is a product of the liberalization of the aviation industry since the seventies, as are other low-cost airlines such as Southwest Airlines, easyJet and Air Asia. Open Skies Agreements played their part to lower costs and to enhance accessibility as well.

A direct result of the liberalization and the increased competition are lower ticket prices. The consultancy firm Deloitte noted there has been a 47% decrease (consumer price inflation adjusted) in air fares since 1990. The past 10 years, average airline fares declined by 0.9% per year, according to Boeing.

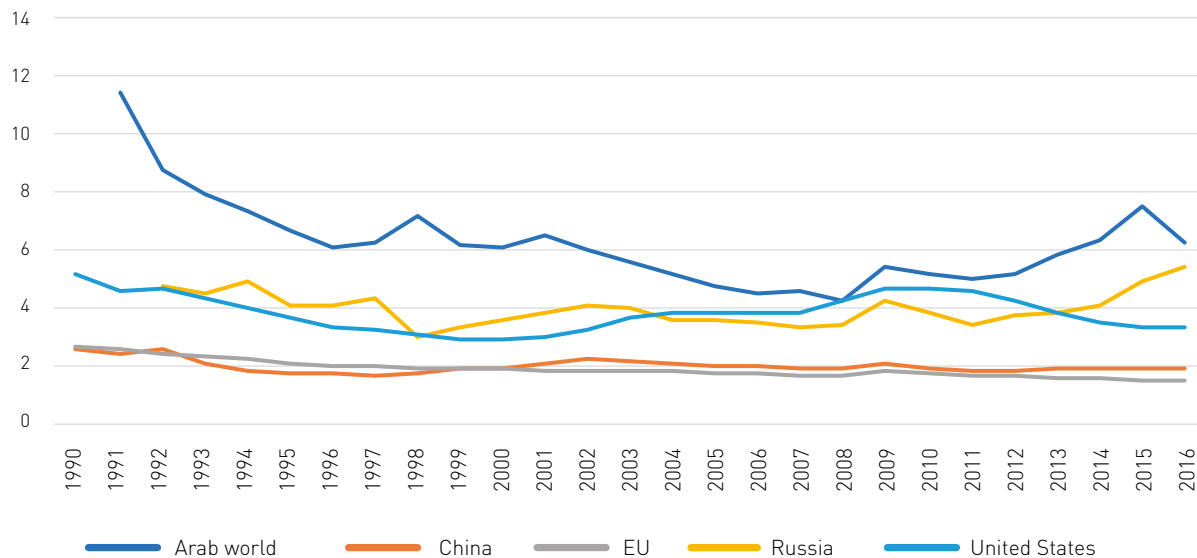
### 2.3 Defense

While commercial aviation posted strong growth figures in the past decades, the military spending went down drastically. World Bank data show that in 1990, 3.2% of the world GDP was foreseen for military expenditures. In 2016, this was down to 2.2%, being a decline of 31%.

When looking more closely at most military powerhouses, only the Russian Federation had a higher military expenditure the early 1990's, as shown on the graph "Military expenditure (as a percentage of GDP)".

Nevertheless, it is likely that defense spending will grow at a higher pace in the years to come. The new administration in the United States places a stronger focus on defense. At the same time, international tensions are rising in different areas around the globe. As a result, more pressure is placed on NATO member states to increase their defense spending.

**Military expenditure (as a percentage of GDP)**



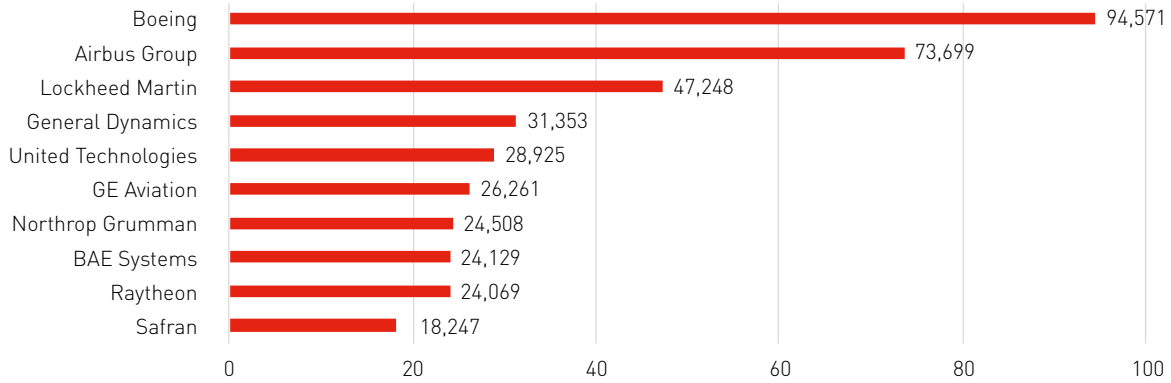
Source: World Bank

**Business jets, helicopters and drones**

Business jets, helicopters and drones are outside the scope of this publication. According to the AlixPartners 2017 global A&D Study, helicopter makers had a revenue of 35 billion USD in 2016, which is 20% less compared to 2014. Business jets went down 16% and were worth 18 billion USD in 2016. On the other hand, a bright future is emerging for a new branch of the aeronautic industry: drones. The International Data Corporation believes spending on drones will have a revenue of 9 billion USD in 2018 and is expecting a compound annual growth rate of 29.8%.

Since 2012, BeUAS represents the interests of all the Belgian enterprises and institutions, which are active in the unmanned aviation sector. BeUAS counts over 100 members. In a bid to act on both the promising future of and the challenges faced by the global drone industry, the innovative company cluster EUKA was recently set up in Flanders. ([www.euka.org](http://www.euka.org)). Skywin integrated the development of innovative applications and systems related to drones in its strategy as well ([www.skywin.be](http://www.skywin.be)).

## Aerospace and defense companies by 2016 revenue (in million USD)



Source: Deloitte 2017 Global aerospace and defense sector financial performance study

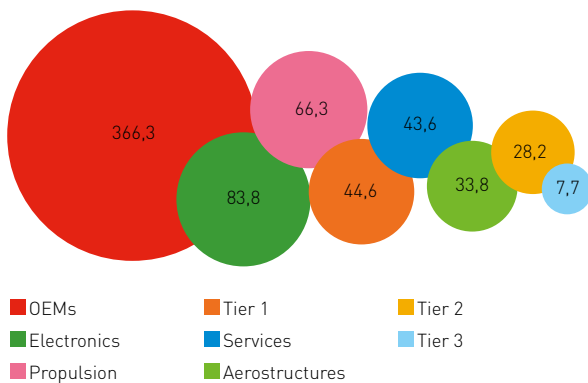
### 2.4 An industry of giant OEMs and specialized SMEs

While most revenues of the aerospace sector are concentrated in a few countries, the same story goes for companies. Seen from the outside, the aircraft manufacturer market seems extremely small. Airbus (located in several European countries) and Boeing (United States) account together for almost 70% of the entire commercial fleet and had revenues of 167 billion USD in 2016. Together, the top 10 companies had revenues of 393 billion USD. This is almost 60% of the entire aerospace industry.

But in fact, a myriad of companies are involved to support the giant OEMs. This goes for both aircraft OEMs such as Airbus or Boeing and Aeroengine OEMs such as GE or Safran.

Traditionally, about 60% of the OEM revenue is outsourced along the supply chain. The Airbus A380 consists of 4 million parts coming from 30 countries.

### Revenue per segment in 2016 (in billion USD)



Source: Deloitte 2017 Global aerospace and defense sector financial performance study

The OEMs generate by far the most revenue. Tier 1 companies supply directly to OEMs. These are generally systems/modules and major structures/components. Tier 2 suppliers provide parts & sub-assemblies, while Tier 3 suppliers usually provide make-to-print parts & components. It can be noted that electronics (avionics) are the largest subsection, while propulsion (for example jet engines) comes third

### 2.5 Prospects for the aeronautics industry

The aeronautics industry continues to have rosy prospects. In Flightpath 2050, Europe's Vision for Aviation, the European Commission believes the global volume of annual traffic will pass the mark of 16 billion passengers by 2050. Airbus foresees a 4.4% global annual air traffic growth rate in the coming 20 years, Boeing is a little more optimistic with a 4.7% increase.

Airbus and Boeing made those assumptions in their respective 2017-2036 forecasts, based on expected improvements in crucial elements such as the GDP, private consumption, employment and population. Since the countries with most margin in those criteria are emerging giants, it does not come as a surprise that both Airbus and Boeing expect that most passengers in 2036 will be from the Asia-Pacific region, mainly China. The emerging countries as a whole are expected to outperform developed countries, gaining a market share of 40% by 2036, up from 29% in 2016.

In order to accommodate all the new passengers, the commercial world fleet would need further expansion. By 2036, it would count 46,950 aircraft according to Boeing, which is almost twice the number of aircraft in use today. Airbus shares the same vision, and expects the fleet will be a little more than twice as big as it is today.

Between 2016 and 2036, many airplanes of the current fleet will be taken out of service. Taking this into account as well, there will be a demand for 34,900 new commercial planes by



2036, according to Airbus and 41,030 according to Boeing. This would represent investments worth over 6 trillion USD.

The vast majority of the planes to be ordered are single aisle. The number of new regional jets is expected to be around 2,400, while freighters remain a fraction of the total number with 920 new orders according to Boeing and 730 according to Airbus.

As passengers statistics suggest, Asia Pacific will become the major client zone for aircraft manufacturers. It would account for 41% of the demand. The United States and Europe together would represent 36%.

Aviation companies have to meet increasingly high environmental standards and are committed to reducing both noise and fuel usage, while raising the bar even more on safety issues. The goals set by the European Commission for the European Aerospace industry illustrate how high the bar is put (see box: goals by the European Commission for 2050). Some

### Goals by the European Commission for 2050

- Non-transport aviation missions have increased significantly and are undertaken by remotely controlled and autonomous vehicles, particularly where missions are simple and repetitive, dangerous or require long endurance.
- Society considers that travel by air is environmentally friendly.
- Streamlined systems engineering, design, manufacturing, certification and upgrade processes have addressed complexity and significantly decreased development costs (including a 50% reduction in the cost of certification). A leading new generation of standards is created.
- In 2050 technologies and procedures available allow a 75% reduction in CO2 emissions per passenger kilometre to support the ATAG target10 and a 90% reduction in NOx emissions. The perceived noise emission of flying aircraft is reduced by 65%. These are relative to the capabilities of typical new aircraft in 2000.
- Aircraft movements are emission-free when taxiing.
- Air vehicles are designed and manufactured to be recyclable.

*Source: Acare flightpath 2050*

of the most important industry trends, such as additive manufacturing, advanced materials, smart automation, digital design & simulation and big data, are discussed in chapter 4: Belgian companies at the forefront of new aerospace trends.

### Supply chain trends

New trends may be emerging in the way the industry is operating. OEMs used to manufacture major parts of the airplanes in house. Bombardier began to disrupt the system in the eighties by reducing the number of direct suppliers. Instead, it placed more faith in a select number of top suppliers, the so-called Tier 1, who became responsible for the major structures and components.

The Tier 1 companies procured on their turn down the supply chain. AeroDynamic Advisory, a consultancy company, discovered that Embraer, a Brazilian OEM, had 350 major suppliers for its EMB 145 aircraft in 1997. When the new 170/190 model arrived in 2004, only 38 major suppliers were directly paid by Embraer. It freed Embraer from the procuring process, and allowed Tier 1 companies to earn high margins while not contributing to the possible losses OEMs could encounter.

Since the Boeing 787 did not turn out to be a success with this supply chain model, OEMs started returning to the early days by having more work done in-house and aiming for vertical integration. Bombardier and Embraer are insourcing wings, while interiors, flight controls and landingsystems may become a part of the OEM portfolio too. AeroDynamic Advisory believes that other segments, such as electronics or propulsion will escape this trend. At the same time, the idea of "focused factories" in which a supplier dedicates its production primarily to an OEM, is making progress.

For the Aeroengines OEMs, GE is currently going furthest in this effort towards in-house production, according to AeroDynamic Advisory. It is able to do so thanks to the fast innovations in manufacturing.



## SECTION 3

# THE SPACE INDUSTRY

### 3.1 Recent evolution and current state of the space sector

The first successful attempt to reach space was made by Germany in 1944. Its V2 rocket was the first to cross the so-called Kármán line which lies at 100 kilometres. In 1957, Sputnik became the first satellite to orbit the Earth. One year later, now 60 years ago, NASA was founded. This was a direct move made in the context of the Cold War, and in response to the space programme of the Soviet Union. Huge advances were made in technology and know-how. Yuri Gagarin became the first human in space in 1961 and Neil Armstrong, carried by the Apollo 11, the first man on the moon in 1969.

In the next decades it seemed as if most innovation was halted. An often cited reason is the so-called "dual use" of space technology. The need to protect the technology because of military concerns trumped the potential productivity gains when more companies were allowed to participate and innovate. This situation created a small inner circle of risk-averse big companies and nations.

A little more than a decade ago, a new era began. Government programs were established to stimulate a commercial space program. Data sets became available to researchers, private investment entered the industry, and companies were allowed to assist governments in the creation and launching of rockets and satellites. As a result, the space industry went through major changes, affecting both the launch market and the satellite market.

Historically, only few satellites were in outer space. Therefore, a malfunctioning satellite could have extraordinary implications. This implied that the creation and launch of a satellite had to be extremely precise, time consuming and, consequently, expensive. Making a satellite, often weighing 20 tonnes, costs around 500 million USD. Because of a growing demand for satellites and technological progress, satellites the size of a shoe-box (nanosatellites, or so-called cubesats), can nowadays be produced for half a million USD. The number of satellites went up 47% between 2012 and 2016, reaching an average of 144 new satellites per year. At the same time, they generally

don't perform as many tasks as the "first generation". This is tackled by connecting them in so-called constellations.

A second game changer of the recent past is the emergence of reusable rockets. Launching a satellite used to cost 200 million USD. Nowadays this can be done for 62 million USD, an amount that is expected to go further down in the near future. While the space shuttle was supposedly also reusable, its costs remained extremely high. As progress remained low, the programme was stopped. Major advances were made thanks to the Ansari X Prize, a space competition for non-governmental organisations to launch a reusable manned spacecraft into space. The first reused rockets are currently operational.

A third major change was the entrance of venture capitalists in the space industry. In 2015 they invested a value twice the size of the entire investment volume in the industry in the 15 preceding years combined. 2017 was an absolute record year, with money flowing in worth 3.9 billion USD, according to Space Angels. Cumulative investments since 2009 are worth 12.8 billion USD. The United States accounted for about two-thirds of funding, the EU came second with little over 2 billion USD.

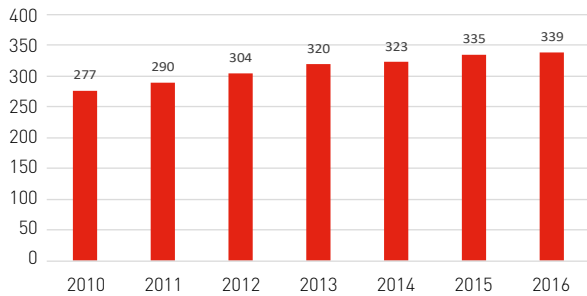
Thanks to those improvements, the space industry is currently worth 339.1 billion USD according to a report by Bryce, a consultancy, on behalf of the Satellite Industry Association. A quarter of this amount can be attributed to the space programmes of various countries. About 50 nations invest in activities related to defense, science, exploration and so on. The remaining part of the space industry revenue derives from commercial space programmes.

A few very small niche industries, such as human space flight, space mining and resource utilisation are emerging. Although they may have enormous future potential, today the revenue of the space industry mostly comes from the satellite industry. This product group accounted for 77% of the entire space industry, according to the Satellite Industry Association.





**Global space economy size (in billion USD)**



Source: Annual state of the satellite industry report 2011 - 2017

In its publication "The Space Economy at a Glance 2014", the OECD estimated the value of the space industry in 2013 at 256.2 billion USD. This included activities in manufacturing and satellite operations, plus consumer activities. Institutional budgets for space activities amounted to 64 billion USD. This amounts to a total figure of 320 billion USD in 2013, comparable to the 2013 estimates of the Satellite Industry Association.

The satellite industry can be divided in four categories. Satellite services, worth 127.7 billion USD, ground equipment for a total of 113.4 billion USD, satellite manufacturing summing up to 13.9 billion USD and finally the launch industry with a value of 5.5 billion USD.

**3.2 Satellite services**

Around 1,500 satellites are currently operating in outer space. In 2016, 126 of them were launched. Final numbers for 2017 are still lacking, but the share of small satellites is certainly growing. No matter the size, all satellites have specific tasks assigned to them.

Roughly one out of every three satellites is used for commercial communications, mainly for consumers. Satellite television had a value of 104.7 billion USD. Over 300 million people, mainly in emerging markets, watch satellite television. An additional 31 million people listen to the radio thanks to satellites, generating revenues worth 5 billion USD. In 2016, 2 million people used satellite broadband. A fast growth is anticipated in this segment (see chapter 4: Belgian companies at the forefront of new aerospace trends).

The three biggest fixed service satellite operators in the world have their headquarters just a few hours' drive from Belgium: SES and Intelsat in Luxemburg, Eutelsat in France.

Several Belgian companies have leading technology in delivering fundamental R&D that will help increase the commercial opportunities of satellite services. **Thales Alenia Space Belgium** is developing an automated factory for solar panels for telecommunication, known as PhotoVoltaic Assemblies, **RHEA** works on cybersecurity, **imec** on microchips while other companies such as **Antwerp Space**, **Delatatec**, **AMOS**, **Vitrociset**, **CSL**, **EHP**, **Spacebel** and **NEWTEC** are also active in this field.

A success story of a commercially viable project with technology delivered by **NEWTEC** is **SatADSL**. The latter is a Belgian satellite television company with a turnover of 3 million EUR in 2017, which represents a significant share of the world market in its niche.

Earth observations were worth 2 billion USD in 2016, an 11% increase compared to 2015. In only 5 years' time, this niche became 54% bigger. The best well-known observation is meteorology, but a growing interest in Earth observations is coming from all kinds of industries.

Belgium attributes 16% of its space budget to Earth observations and has a history dating back to 1979 in this area. In that year, it started collaborating with France in the distribution and exploitation of satellite imagery through the SPOT 1 satellite and its successors.

Later, the VEGETATION-project was added to this SPOT programme. The goal of this project, which besides Belgium and France includes also Italy, Sweden and the European Commission, is to study the state of vegetation at a global level and to track its spatial and temporal evolution. **VITO**, located in Belgium, processes, distributes and archives the data products since the beginning of the project and holds its distribution rights.

**Government budgets in 2016 (in billion USD)**

United States	47.5
China	10.8
Europe	10
India	4.3
Russia	3.6
Japan	3.5
Rest of the world	3.2

Source: Global Space Industry Dynamics, by Bryce



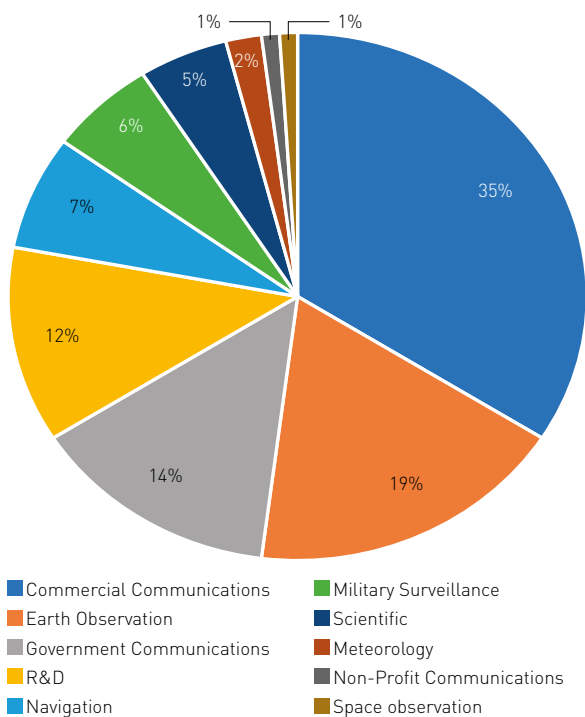
The latest satellite “Made in Belgium”, PROBA-V, has helped, among many other achievements, in containing the devastating forest fires in Portugal in 2017.

Belgium is also an active member within the European programme targeted at Earth observation, called Copernicus. It does so more specifically through STEREO III. This programme benefits from a Belgian financial support of 30 million EUR for the 2014 to 2021 period.

The Belgian main focus is on global monitoring of vegetation and the evolution of terrestrial ecosystems, epidemiology and humanitarian aid and security and risk management. Belgium contributed as a result for example on mapping subtropical forest degradation and its environmental impacts, on detection of invasive plant species, on improving drought monitoring or on industrial potato monitoring on behalf of the Belgian potato-processing sector.

Belgian organisations involved in the Global monitoring of climate variables are **the Royal Belgian Institute for Space Aeronomy (BIRA-IASB)** and **the Royal Meteorological Institute of Belgium (KMI-IRM)**.

**Operational Satellites by Function (as of December 31, 2016)**



Source: Annual state of the satellite industry report 2017

### 3.3 Global Satellite Ground Equipment

The second most important category of the space industry by revenue is Global Satellite Ground Equipment. This segment experienced a 7% growth in 2016 compared to the previous year, mainly thanks to a strong rise in global navigation satellite systems (GNSS). The generated revenues in 2012 were 52.7 billion USD, in 2016 they stood at 84.6 billion USD. At this pace, satellite navigation is set to become the most profitable sector of the space industry in the following years.

In the past few years, satellite navigation has become a household feature for smartphones and vehicles. In the same period, it appeared in an ever increasing amount of industries. GNSS is used to monitor objects and persons, to control machines in the agricultural, constructing or mining sectors and so on. With the Internet of Things knocking on the door, applications will only flourish.

It is important to note that many applications using GNSS devices and chipsets are not included in the above mentioned revenue. This additional downstream is projected to be larger than 100 billion USD.

Other sources of revenue within the Global Satellite Ground Equipment are consumer equipment for satellite television, radio, broadband, and mobile (18.5 billion USD) and network equipment, such as gateways, network operations centres, satellite news gathering equipment, flyaway antennas and very small aperture terminal equipment (10.3 billion USD).

Belgium is one of the most active nations in the Galileo project, the European satellite navigation answer to GPS. It was, along with the United Kingdom, France and Italy, the first to test the Public Regulated Service (PRS) of Galileo. The first tests at sea also took place on a ship provided by the Belgian navy. Belgium is the only European member state with PRS observations dating back as far as July 2013. In 2016, Belgium was also the first country to test specific PRS tasks through Galileo.

The Galileo logistical centre is based in Belgium, in the GALAXIA European Space Applications Park in Transinne. This centre is the go-to point for those managing ground stations and is staffed with highly qualified engineers specialised in robotics, aeronautics and IT. This location is close to ESA’s European Space Security and Education Centre (ESEC) in Redu, where the In-Orbit testing of the PRS signal from the ESA’s ground station takes place.



As a result of its efforts, Belgium has gathered much expertise in GNSS. **Septentrio**, interviewed later in this publication, is a designer and manufacturer of dual-frequency GNSS receivers and played a crucial part in testing and developing Galileo's PRS. Other Belgian partners in the Galileo project are **Gillam** (component manufacturer in timing & synchronization equipment), **Vitrociset**, **AMOS**, **CSL**, **Antwerp Space** and **Thales Alenia Space Belgium**.

Belgian universities are active in this field too, as shown by a Belgian student, Laura van de Vyvere, who won the Galileo's Young Surveyor Prize. She used Galileo's unique four frequency signals to improve positioning in harsh ionospheric conditions. More innovation from Belgium is on its way, as the country organises Geo-IoT in June 2018. This conference gathering hundreds of innovators in IoT, geolocation and analytics will further improve knowledge on location & tracking opportunities.

### 3.4 Satellite manufacturing

Manufacturing satellites has become much cheaper as the technology improved and the production volume went up. A decade ago, in 2008, revenues amounted up to 10.5 billion USD. In 2016, they stood at 13.9 billion USD. This is a rather small increase, even taking into account the fact that 2016 was a bad year (-13% compared to 2015). This is partially the result of the ever decreasing prices. According to Bryce, the fact that government satellites became less expensive had an impact of 650 million USD.

Currently, there are a few dozen satellite manufacturers, most of them from Europe (e.g. Airbus, Thales), Japan (MELCO) but especially the United States. While companies from the United States hold about 40% of the profits in the other space segments discussed in this publication, they take an impressive share of 64% in the satellite manufacturing industry.

Today, more and more attention is going towards small and very small satellites, weighing less than 10 kilograms. The number of launched smallsats doubled in 2013 compared to the previous year and is increasingly gaining critical mass. Manufacturing small satellites only takes days, and requires material that is easily available and cheaply procured. This shrinking size and cost have big implications. It allowed the Indian Space Research Organisation for example to send 104 satellites into orbit with one single rocket in 2017.

Another technique gaining momentum is the use of electric propulsion systems. For a GEO mission, an electric propulsion system is activated once the geostationary transfer orbit is reached, and is designed to empower the final movement that brings satellites to the geostationary orbit. Using this technique can reduce the satellite mass by up to 50%. The idea was applied twice in 2011. 2017 has been the record year so far with the launch of a total of 10 electric propulsion satellites.

The first "Belgian" satellite to be launched was PROBA-1 in 2001, an autonomous satellite designed for Earth observation. **Verhaert** (now **QinetiQ Space Belgium**) was responsible for the satellite integration, while **Spacebel** managed the control and exploitation ground segment and took charge of on board and ground software. On March 2018, ESA announced that PROBA-1 became its longest operated Earth observation mission of all time. Following this achievement, ESA's Director of Earth observation Programmes, Josef Aschbacher, stated the following,

*"Belgium has entrusted Proba-1 to ESA for its operation, for which I am very grateful. The spacecraft has impressed us all, not only for its excellent EO data provided by the CHRIS instrument but also for its longevity. My compliments to Belgium for developing such a robust satellite, but also to my ESA teams for its safe operation over the past 17 years."*

Source: [www.esa.int](http://www.esa.int)

After the success of PROBA-1, ESA approached **Verhaert** (now **QinetiQ Space Belgium**), **Spacebel** and the **Centre Spatial de Liège** for a second project, the PROBA-2 satellite. This was launched in November 2009 with a focus on sun observations. The PROBA-V, where the "V" stands for Vegetation, was launched in 2013. Like PROBA-1, the focus of this satellite is on Earth observation.

Next up for Belgian satellite makers are ALTIUS and PROBA-3. The former, proposed by the **Royal Belgian Institute for Space Aeronomy (BIRA-IASB)**, will monitor the 3D distribution and the evolution of stratospheric ozone with a high vertical resolution. The structure of the satellite will be based on the PROBA-platform by **QinetiQ Space Belgium**, software developed by **Spacebel** and will use an instrument of **OIP**. The latter satellite, PROBA-3, brings together the same players, notably **QinetiQ Space Belgium** (platform) and **Spacebel** (software). The scientific instrument, designed to observe the corona of the sun, is developed by a consortium headed by **Centre Spatial de Liège (CSL)** and including **OIP**.



Even when satellites are not “Made in Belgium”, they tend to have a Belgian embedded in them nevertheless. The Belgian industry has a long-standing history of participating in a wide range of ESA programmes such as Copernicus and its Sentinel satellites and of EUMETSAT programmes on weather and climate monitoring. Several companies active in this field are **AMOS, Antwerp Space, CMOSIS, Centre Spatial de Liège (CSL), EHP, Thales Alenia Space Belgium, M3 Systems, Qinetiq Space, RHEA, Sonaca, Spacebel** and **Vitrociset**.

Belgium is also playing a leading role in the international network of CubeSats for multi-point, in-situ measurements in the lower thermosphere and re-entry research. This international project, called QB50, is managed by the Belgian **Von Karman Institute** and funded by the EU. Two of the 36 CubeSats launched into orbit in 2017 in the framework of QB50 were Belgian, although technically, all satellites were launched under Belgian jurisdiction.

In 2016, OUFTE-1 was launched. Contrary to other satellites built in Belgium, it was not commissioned by ESA and therefore 100% Belgian. OUFTE-1 is a CubeSat weighing 1 kilogram and was developed by students and professors of the **Université de Liège (Ulg)**. It is the world’s first satellite featuring Digital Smart Technologies for Amateur Radio (D-STAR) communications, which allows simultaneous transmission of voice and data (such as GPS data and computer files), full routing over the internet and the possibility of worldwide roaming. Companies collaborating to the project were **Thales Alenia Space Belgium, Spacebel, Samtech, Deltatec, V2i** and **Centre Spatial de Liège (CSL)**.

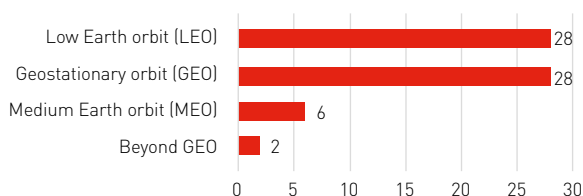
### 3.5 Launch industry

The satellite launch industry was in 2016, as usual, the smallest of the four commercial satellite industries. It grew by 2% to 5.5 billion USD.

In total, 64 commercially-procured launches took place in 2016, which is comparable to 2015 (65 launches). It is important to note that one launch may cover the launch of more than one satellite. 70% of the revenue was attributed to governmental customers.

The United States had 18 commercially-procured satellite launches in 2016, China 20, Europe 11 and the Russian Federation only 2. However, the last two represented the lion’s share of launches in the past decade. Europe’s Arianespace still had 56% of the market in 2016, but the United States is quickly gaining market share, mostly thanks to SpaceX.

#### 2016 commercially-procured satellite launches by Orbit



Source: Annual state of the satellite industry report 2017

The launch costs of certain operators are drastically declining now launchers can be reused.

United Launch Alliance, an alliance between Boeing and Lockheed Martin which have had a sheer monopoly on launches for the United States government for more than a

### Launching under Belgian legislation

Belgium is at the forefront of the space faring countries when it comes to space legislation. This legislation notably allows operators to settle in Belgium and to perform their activities under Belgian jurisdiction (satellite operation, space navigation,...). Such activities are subject to the autorisation of the Minister for Science Policy who may impose specific conditions aiming at ensuring everyone’s safety as well as the interests of all participants.

The revision allowed to better circumscribe the scope of the law by providing a more precise definition of the notions of space object, of operator including in the specific case of non-manoeuverable space objects.

This law also establishes a National Register of Space Objects, which should make it possible for Belgium to register satellites or other spacecrafts of which it would be the Launching State, according to the provisions of the UN space treaties.

Finally, the law organises a system of sharing the liability for damage caused by a space object between the Belgian State and the operator. This system is based on the liability of the operator, limited to a certain amount.

The Belgian law aims particularly at:

- ensuring the legal and material safety of operational space activities performed under Belgian jurisdiction;
- developing an appropriate legal framework for hosting this sector in Belgium.

*Text provided by BELSPO*



decade, is now working on Vulcan, of which the engines will be recovered and reused after every flight, worth two thirds of the value of the booster. ULA is currently cooperating with Blue Origin. The first test is expected in 2020.

Airbus has been working since 2010 on its reusable rocket first-stage project called Adeline, which would be used on ESA's future launch vehicle, Ariane 6 and could recover 20 to 30% of its costs. ESA is also working with Airbus Safran Launchers on another reusable rocket engine program, called Prometheus, with companies from Germany, France, Italy, Sweden and Belgium. Thanks to this trajectory, Europe attempts to hold on to the bulk of the market share for launching.

The company that is most advanced in this matter is SpaceX. The company invested 1 billion USD in its technology and has, after many attempts starting in 2010, reached a point where stage 1 of its Falcon 9 and Falcon Heavy can be easily reused. SpaceX CEO Elon Musk announced that the company is confident to recover the second part as well. Reusing both the booster stage and the fairing would mean an 80% recovery of the launch cost.

About a quarter (23%) of the Belgian space budget is intended for launchers. This is mainly the result of commitments related to the development of Ariane 6 and VEGA. Belgian companies have a strong position in crucial elements such as thrust vector controls (TVC) and avionics and can therefore contribute in all the above-mentioned efforts made by OEMs.

**SABCA** designs and manufactures major structural elements of launchers and is responsible for the TVC of those launchers as well. The company also produces various special interfaces like a quick-release connection for the Ariane 5 ground umbilicals, as well as fairings for the separation from rockets.

**Thales Alenia Space Belgium** is the number 1 supplier of onboard electronics for Ariane 5, designing and manufacturing more than 50% of the electronic systems on each launcher. These systems perform a variety of functions, including onboard electricity distribution, management of the thrust-vectoring nozzles that keep the launcher on trajectory, spatial positioning, separation of the launcher stages and the satellite's protective nose fairing during flight, and safeguard system.

**Safran Aero Boosters** is the European leader in the field of regulation valves for launcher engines and stages. The company's engineering skills cover all fluids used in propulsion systems, from extreme cryogenics to combustion gases (nitrogen, helium, hydrogen, oxygen, hydrazine, nitrogen peroxide, kerosene, Skydrol, etc.).

**ENGIE Axima** has a key role in the construction, maintenance and operation of dedicated air-conditioning systems. At lift-off, the thrust of for example Ariane 6 version 64 (which has four boosters) will be equal to that of over ten A380 super jumbo jets. As a result, effectively cooling the launch area is absolutely essential.

Other Belgian organisations involved in launching systems are **Spacebel**, **Qinetiq Space Belgium**, **Centre Spatial de Liège (CSL)** and **the Von Karman Institute**.

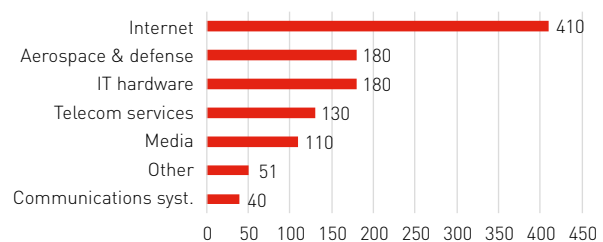
### 3.6 Prospects of the space industry

In a sector as specific and volatile as the space industry, it is hard to make long-term forecasts. In October 2017, two reports tried to put a number on the sector. The American Investment Bank Morgan Stanley believed that the revenue generated by the global space industry will be 1.1 trillion USD, or more, in 2040. This would mean about three times today's size. Another financial institution on the other hand, Bank of America, forecasts the space industry will be worth 2.7 trillion USD by 2047.

Traditional players in the sector such as Boeing, Airbus, Northrop Grumman, Safran for the structures and satellite giants such as SES, Intelsat or Inmarsat will be joined by newcomers. Companies such as Microsoft, Amazon, Apple, SoftBank or Google will have an increasing importance. The latter already has an important stake (around 7.5%) in SpaceX. Amazon and Blue Origin share the same owner.

Despite citing several huge companies, much of the progress in the space industry is expected to come from startups and from emerging countries. This "space democratization" is a direct consequence of lower entry barriers, not only financially. The technological advances that transformed a smartphone from a luxury item to a powerful computer for the masses are the same being applied to turn satellites in so-called "smallsats", or very small satellites, available in abundance and capable of performing many tasks. Belgium is at the forefront of this evolution.

Global space economy in 2040 forecast by Morgan Stanley



Source: Morgan Stanley



## SECTION 4

# BELGIAN COMPANIES AT THE FOREFRONT OF NEW AEROSPACE TRENDS

Historically the main driver of innovation in aerospace has been the military, and more specifically the United States army, which is by far the biggest spender on military R&D. Another great instigator of innovation in the past decades has been the liberalization of the industry. More companies emerged, competing for the same customer by offering better technologies and cheaper solutions.

Since 2009 funds for innovation dried up. According to Deloitte, independent research and development spending declined by 26.5%, while innovation investments coming from the US Department of Defense dropped by 21.1%. The outcomes of this decline are only gradually showing, since it takes about 15 years in the aerospace industry to turn an idea into a product ready to be purchased.

Nevertheless, according to a 2017 survey by Accenture, a consultant, 100% of aerospace and defense executives agree that their organizations must innovate at an increasingly rapid pace to keep a competitive edge. Even more importantly, 78% of aerospace and defense executives agree that the industry is facing from moderate to complete disruption.

Additive manufacturing, advanced materials, automation, increased focus on digital design & simulation and big data: those are some of the major innovations for companies active in the aeronautics and space industries.

The fact that those new technologies are affecting both subsectors is not surprising as many companies are working in both the aeronautics and space industries. The aircraft giants Boeing and Airbus are also among the most important space companies, while smaller SMEs with spe-

cific knowledge combine both. In the directory at the end of this publication, over 70 companies and organisations can be found operating in both fields.

### 4.1 Additive manufacturing

One of the most disrupting technologies in the aerospace sector is additive manufacturing. 3D printing enables companies to design and print parts and components in the finest details. Even though already in use, this technology promises to bring tremendous change to the aerospace manufacturing in the years to come.

The entire supply chain will be affected by additive manufacturing, but companies working on precision components may be impacted most. Not only will additive manufacturing allow companies to produce extremely specialized and low volume parts at a lower cost, it will improve the quality of those parts as well. Products deriving from additive manufacturing tend to be lighter and to achieve higher performance levels and thus help improve fuel efficiency and cost.

Several OEMs are turning to additive manufacturing in an effort to enhance their in-house capacity and to improve their margins. GE announced that it will print up to one third of its new Advanced Turboprop engine for the Cessna Denali. This new strategy would eliminate no less than 845 parts, while only 35 components would remain. This is a direct result of the possibilities brought by additive manufacturing, where separate components can be printed in one piece. GE believes that its additive manufacturing business may bring 1 billion USD in sales by 2020 and reduce costs by 3 billion USD to 5 billion USD over the next decade.

A particularly exciting idea is the potential of additive manufacturing in space. Many structures necessary to keep a satellite working during the bumpy launch are unnecessary ballast once it has reached its place in space. 3D printing in space stations could solve this issue. With raw materials and some components such as sensors, a robot could manufacture its very own satellite.

According to a report compiled by Markets and Markets, the aerospace and defense 3D printing market will grow at a compound annual growth rate of 23.2% over the next five years. This would result in a sector worth 4.76 billion by 2023.

Belgian aerospace companies, such as **Addiparts**, **Any-Shape**, **ASCO**, **Geonx**, **e-Xstream engineering**, **Safran Aero**



**Boosters, BMT Aerospace** and many more work on this topic, supported by companies such as **Materialise, 3D systems** (both KU Leuven spin-offs), **ZiggZagg** and **Voxdale**, all known for their expertise in additive manufacturing.

Following strong interest from the Belgian governments, several Belgian universities are researching in this field, such as the **KU Leuven, UMONS** and **Université Libre de Bruxelles**. Additionally, several broader initiatives are taking place, such as an interdisciplinary “3D Printed Manufacturing” project led by the **Flemish Aerospace Group** and **Sirris**.

#### 4.2 Advanced materials

The aerospace industry is extremely demanding because no margin of error is allowed and the circumstances are unique. All parts and structures of an aircraft have to endure great temperature changes and stress, but the engine may well be the most exposed part of an aircraft. Still, this is nothing compared to the pressure satellites have to withstand during the launch. The material will weigh up to three times as much compared to its state on Earth. But once in orbit, the satellite materials are operating in microgravity, weighing less than they would on the Earth.

Therefore, the material used in the aerospace industry is of the utmost importance. Until the eighties, aluminum was the key material used in the aerospace industry. Up to 70% of an aircraft could be made in this material, while also Sputnik, the first satellite to orbit the world, was made out of an aluminium alloy.

New types of alloys are increasingly tested, such as aluminium-beryllium or Microlattice, “the world’s lightest metal structure”, a nickel-phosphorus alloy. Boeing was directly involved in the research project of the latter. Another strong focus is on heat-resistant super alloys, since temperatures of aerospace engines reach up to 2.100°C. R&D projects are being enrolled involving titanium alloys, nickel alloys, and some non-metal composite materials such as ceramics.

In fact, modern aircraft primary load-carrying structural components consist for more than 50% out of composites. Composites have the potential to make aerospace structures lighter, and thus to save fuel, to lower pollution and to increase speed. Carbon reinforced polymer (CFRP) and glass-fibre-reinforced plastic (GFRP) are now often used. Metal matrix composites (MMC) are popular in the aero-

space industry as well. The aerospace sector is currently the most important client on the composite market.

According to IHS Market, a consultancy, composites were first used by Airbus in 1983. After a hesitant start, at first only the rudder was made up out of composites, ever more parts are being replaced. The Airbus A-380, which performed its maiden flight in 2007, consisted already for over 20% out of composites and Boeing 787 and Airbus 350 have more than 50% composite materials. This reduces weight while also facilitating lower production time and improved damage tolerance.

In reaction to the solutions made possible by additive manufacturing, new materials are being developed too. They can be used in laser sintering and direct metal laser sintering applications. Examples are Monel K500, a precipitation-hardenable nickel-copper (Ni-Cu) alloy that can be used to manufacture among others heat-sink chamber spools and nozzle spools. Another promising example given by Aerospace Manufacturing and Design is the carbon-filled material PEKK CF HT23, which can replace light-duty structural components made from aluminum.

According to Credence Research, a market research and consultancy firm, the global aerospace composites market was worth 15.5 billion USD in 2016, while it would be worth 36.2 billion USD in 2025. The company notes that many players are operating on the composite market, which makes a competitive environment for those wanting to deliver the most value added for the OEMs.

Belgium is a recognized world leader when it comes to advanced materials such as composites and lightweight, high-strength metals. Plastics were introduced by a Belgian, Leo Baekeland, and they continue to be a core element of the Belgian industry. A quarter of the manufacturing industry in Belgium involves chemistry and life sciences. The sector has over 50% of all industrial innovation in Belgium and an R&D budget of 4.4 billion USD.

The Belgian company **Solvay** is number 2 globally for composites in aeronautics, even more so since the acquisition of Cytec. But Solvay is just one among many Belgian success stories in this field. CFRP Technology, a competence network by **Agoria** and **Sirris**, counts among others **SABCA Limburg, LMS Samtech** and **Isomatex** among its members. Examples of other successful companies in advanced materials are **Umicore, Safran Aero Boosters, Sonaca, Aleris Aluminium Duffel, Aerofleet, Hexcel Composites, Saint-Gobain Performance Plastics, Précimétal** and so on.



## Off-The-Shelf materials

While the space industry is intensively searching for new superalloys and composites on the hand, a growing number of satellites are assigned for tasks in the Low Earth orbit and for a shorter period than used to be the case on the other hand. Because radiation becomes less damaging in those circumstances, several satellite manufacturers started using materials for terrestrial purposes, or so-called Commercial Off-The-Shelf (COTS) materials. Think for example of computer hardware, cell phone batteries, and GoPro cameras. The Belgian satellite OUF1-1 contains COTS hardware components and even the satellite ESA launched in 2018, GomX-4B, contained off-the-shelf computer parts to be tested.

## 4.3 Smart automation

So far, several highly repetitive tasks in aerospace manufacturing have been replaced by smart automation. An example is Boeing's assembly line, where fastening and drilling is taken over by robots. Other work currently done by robots is riveting, coating and paint removal, welding of aluminum structures and polishing. Robots are also used for sealing applications on aerostructures such as spars, the main load-bearing supports for aircraft wings.

Aerospace companies can have materials savings of up to 50% when painting, sealing and final coating is left to robots, according to FANUC America Corp, a company that sells robots.

At the same time, many parts of the aircraft are extremely complex and specialized and thus can not be manufactured by most robots yet. Therefore, the industry has a strong and renewed focus on precision manufacturing with highly-advanced machinery.

AutomationWorld gives the following example: "Prior to the use of the smart tools, an operator had to closely follow a list of steps and ensure the proper torque settings for each location using the correct tool. The smart tightening tool, however, understands which task the operator is about to perform using vision to process its surroundings and automatically sets the torque. Plus the device can record the outcome of the task in a central database to ensure the location was set properly."

Increasingly, those machines and tools will be part of a factory that is "Industry 4.0 proof". In 2017, almost two out of three aerospace and defense companies reported to have a smart manufacturing initiative, said Capgemini, a consultant. Airbus started in the beginning of the decade with its Factory of the Future project. Drilling, measuring, tightening, and quality data logging were the first targeted core functions. In the future, a mix of CT scanning, digital X-ray, robotics, smart manufacturing dashboards, big data and applications using the Internet of Things will come up.

According to a Markets and Markets report, the aerospace Robotics Market is projected to grow from 1.81 billion USD in 2016 to 4.54 billion USD by 2022. One of the possible growth sectors, according to the Robotics Industry Association, could be a mix of robots and additive manufacturing.

Belgian companies concerned are, to name only a few, **Citius Engineering** which offers key competences in mechatronics, mechanical and electrical engineering as well as in automation, **AMS Belgium** is a leading company and service provider in programming activities for automation projects with the use of robots & PLC systems, **Mubea Systems**, a manufacturer of a complete range of 5-axis CNC machining centers, **Pegard Productics** which is known for its large and precise horizontal boring and milling machines and **Bagaar** delivers innovation as a service and support business optimization through digitalisation by inventing, creating and developing Internet of Things solutions.





#### 4.4 Digital Design, Simulation and Analysis

Application software for simulations and analysis has been around for several decades. But recently, digital engineering improved drastically. Now, simulation is a game changer in both aeronautics space. Not only component design is verified in advanced simulation environments, also production processes are tested and refined before the actual manufacturing and assembly procedures initiated.

Engineers can work on the digital design analysis and verification before starting to manufacture physical models. Increasingly, they will be able to make unlimited and fast analysis, saving a lot of time. And they can do so at virtually no cost. This is a big difference compared to the trial and error process which required tooling and materials, not to mention many tests in a wind tunnel following iterations.

The simulation can be used for a multitude of reasons, such as analysing flow, heat transfer, strength and fatigue issues in the design of a structure, but aid equally in additive manufacturing and the development of composites.

During the additive manufacturing process of metallic structures, high temperature gradients generate unwanted residual stresses which cause shrinkage effects in manufactured designs, explains the Belgian company Materialise. It uses simulations to predict the deformations, residual stresses and temperature evolution in parts during and after the process. In doing so, the quality improves while the risk of failure diminishes.

Composites are becoming increasingly important, but it remains challenging to design weight-bearing structures out of them. Therefore, simulation and analysis is an excellent tool to ensure the breakthrough of those materials. The computer models aids to find the right balance in those structures, allowing a maximum of saved weight and strength to be found.

Examples of Belgian companies with expertise in this field are **NUMECA**, a company highlighted later on in this publication, **LMS Samtech** (part of Siemens PLM software) which provides a complete suite of virtual prototyping and analysis solutions for structure analysis, including composites, thermal analysis and flexible systems simulation for aircraft and airframes, aircraft engines and space, complementary to engineering services activities, **Open Engineering**, a company working on multiphysics behaviour, **AWx**, **(UN)MANNED**, **MatchID**, **GDTECH Group...**

#### 4.5 Big data

During a flight, thousands of parameters are recorded and transmitted. Modern aircraft have embedded sensors to capture data. Boeing estimates that the amount of data generated by an airplane will increase 140 times, to a petabyte in 2030. For example, the Pratt & Whitney's Geared Turbo Fan engine alone has 5,000 sensors that generate up to 10 GB of data per second. This engine is capable of reducing fuel consumption by 10% to 15%, thanks to better prediction of the needs.

This gives an indication of the gains that can be made in maintenance and safety, efficiency and many more. Because what goes for engines, is also true for other parts and structures of an aircraft. Every part can be judged and analyzed in real time under stress sensitive circumstances. Those insights will help engineers to come up with even better solutions.

To name only a few Belgian examples, **IT-OPTICS** provides solutions to obtain precise clinical data in real time with efficient data processing, **Open Engineering** helps understanding and optimising the performances of complex devices to make them more robust, **DELTA TEC** provides easy system configuration and data collection through the IP network, **OSCARS** federates and optimizes the use of data coming from Geographical Information Systems (GIS), and so on.

The same applies to avionics. Traditionally, the systems transfer data at a 12.5KB/s speed, while the new aircraft are working on Ethernet-based networks that achieve a 12.5MB/s speed. In a world where everything can be connected to everything through the Internet of Things (IoT), this may soon turn out to be insufficient still.

Satellites may come to the rescue and bring better access to the internet in the years to come. More than a dozen companies have plans to create a large constellation of artificial satellites orbiting in low-Earth orbit (LEO) in order to provide internet services. SpaceX en OneWeb (in collaboration with Airbus) will start with constellations consisting of thousands improved high-throughput satellites. Those will be capable to offer several terabits per second from much lower orbits than is actually the case. This will result in a lower latency too.

Several Belgian companies mentioned earlier are capable of helping to make this happen.

**PRESENTATION** OF THE SECTOR





**SECTION 5**

# STAKEHOLDERS

## 1 >>

### OFFICIAL PARTNERS

#### FPS Foreign Affairs

The promotion and defense of Belgian economic interests abroad is a top priority of the Federal Public Service (FPS) Foreign Affairs. This is done in a number of ways. FPS Foreign Affairs coordinates Belgium’s ambitious trade and investment protection policy, it monitors market access problems and it provides diplomatic support to Belgian companies abroad. Moreover, FPS Foreign Affairs supports Belgian businesses in their international activities by coordinating the economic missions of HRH Princess Astrid, as representative of His Majesty the King, and through the State visits led by His Majesty the King.

FPS Foreign Affairs also actively promotes Belgium’s international image as a good place to do business, by participating in international forums, such as the International Expositions and the World Economic Forum, by organizing bilateral visits and by ensuring Belgium’s multilateral action in the relevant international organizations.

[diplomatie.belgium.be/en](http://diplomatie.belgium.be/en)



These activities are closely coordinated with other federal and federated stakeholders, and in particular Belgium’s three regional authorities that are competent for export and investment promotion: Flanders Investment & Trade, Wallonia Export-Investment Agency (AWEX) and Brussels Invest & Export (hub.brussels). The regional agencies perform three main tasks:

- To support exporters
- To inform, prospect for and advise potential foreign investors
- To promote their respective region abroad

The regions also grant companies significant financial incentives for recruitment, training, R&D, investment, consultancy and environmental protection.

#### Flanders Investment & Trade

Flanders Investment & Trade (FIT) promotes international entrepreneurship in Flanders in a sustainable way as a key factor in the social and economic development of our region. FIT does so by supporting the international activities of Flemish companies and by attracting foreign investors to Flanders. FIT assists, supports and stimulates companies in international business. FIT offers tailored advice and guidance. Companies can call on its networks of contacts both at home and abroad. And FIT provides financial support and information on a wide range of financial incentives.



Flanders has many assets for ambitious Flemish enterprises and SMEs as well as for interested international companies. For Flemish companies, its region acts as a perfect gateway to global markets. For them, FIT tries to lower the threshold to doing business abroad. FIT promotes its services, provides information and knowledge about export and offers networking opportunities between entrepreneurs and brings them into contact with potential partners abroad.

Flanders is a pole of attraction for foreign companies: thanks to its central location in Europe, its strongly developed infrastructure, its innovative clusters and numerous other strengths. FIT tries to offer them worldwide publicity. FIT adopts a tailored approach to potential investors and convinces them of the opportunities for their company in Flanders. Furthermore, FIT focus on existing investors in Flanders planning to expand their businesses locally. Innovative clusters are of key importance to Flanders as a knowledge region. FIT assists these clusters in their internationalization process and tries to attract foreign investors capable of strengthening the cluster to grow into a major international player.

[www.flandersinvestmentandtrade.com](http://www.flandersinvestmentandtrade.com)



### Wallonia Export-Investment Agency

The Wallonia Export - Investment Agency (AWEX) offers general expertise in international economic relations. This expertise ranges from promoting Walloon exports through to seeking foreign investment (helping find suitable sites, explaining support measures and tax rules, and providing information on recruitment and staff training, project funding, etc). AWEX also provides a range of services to all Walloon businesses seeking to operate at international level. However it is also the partner of choice for all buyers, importers and foreign prospects who are looking for a partner in Wallonia and wanting to find products, equipment, technologies or services in the area.

Outside of Belgium, AWEX can rely on an international network of 93 financial and business attachés, covering more than 120 markets and some 20 international organisations. These representatives are the key contacts locally for any business or public body wishing to develop a business or a partnership relationship with Wallonia or simply wanting to find out about the economic potential of such a relationship.

At Walloon level, AWEX's main partners are the competitiveness and technological clusters in particular.

[www.awex-export.be](http://www.awex-export.be) & [www.investinwallonia.be](http://www.investinwallonia.be)



### Brussels Invest & Export by hub.brussels

As of 1 January 2018, Brussels Invest & Export has merged with Atrium and Impulse to form a single Brussels agency for business support: hub.brussels. A central aim of hub.brussels is to help Brussels businesses to export and to provide foreign investors with assistance in establishing their business in Europe's capital. Our trump cards to help you? A network of 90 economic and commercial attachés all over the world and a tailor-made support : missions, fairs, information about foreign markets and free disposal of a work space for a period of three months.

[www.invest-export.brussels](http://www.invest-export.brussels) & <http://www.investinbrussels.com/>





## 2» AEROSPACE INDUSTRY BODIES

### **Agoria Aeronautics, Space, Security & Defence Industries**

#### **Embracing technology Embracing ambition**

**Agoria** means *progress through technology*. We are paving the way for all technology-inspired companies in Belgium pursuing progress internationally through the development or application of innovations. We believe in a cross-industry approach for technology transfer, from space industry to other enterprises and vice versa. We are proud that more than 1,800 member companies, of which approximately 50 are space-related, place their trust in the three pillars of our services: consulting, business development and the creation of an ideal business environment.

**Agoria Aeronautics, Space, Security & Defence Industries** brings together companies active in the fields of aviation, aerospace, security and defense equipment. These companies are often leading players in niche markets and develop and supply services, products and systems in partnership with national and international groups. They have to keep updating their level of expertise and constantly innovate if they want to remain at the top.

These are the three pillars of services provided:

- Consulting
  - Leading experts answer your questions on — among other topics — innovation, energy matters, the environment and economic development of the space sector and go-to market as well as talent and the labour market, socio-legal issues, well-being at work, taxation, regulations and standardization.
- Business development
  - Our market teams help you promote your offering on the market, identify market opportunities for your products or services, and forge sustainable partnerships both in Belgium and abroad.
- Creating the ideal business climate
  - Working closely with companies, the Agoria Space & Aeronautics Industry team identifies the strategic challenges facing the industry and help you meet them. In particular, by supporting measures contributing to the establishment of a favourable business climate promoting production and process innovation.

Follow us on: [www.agoria.be](http://www.agoria.be)

## BELGOSPACE

BELGOSPACE is the Belgian association of the space industry, gathering the majority of Belgian companies and research centers active in the field of space technology. BELGOSPACE was created in 1962 at the request of the Government to satisfy the need for co-ordination of the ELDO and ESRO activities. Since then, Belgospace has become the industry forum where common business problems are discussed and main options are considered as to the strategy Belgium should adopt in the space domain. BELGOSPACE represents more than 2,000 high-value direct jobs.

Belgospace members are active in the following areas :

- satellites for science, earth observation, telecommunications and navigation.
- launchers and space transportation.
- Man in space
- technological and scientific research



## Belspo

The Space Research and Applications Directorate of the Belgian Federal Science Policy Office (BELSPO), is responsible for managing Belgium's space activities on a daily basis. It manages the contribution of Belgium in the programmes of intergovernmental organizations at European level, mainly the European Space Agency (ESA), but also EUMETSAT, EC-MWF and ESO. It is also responsible for programmes in the framework of agreements at bilateral level (with France, Argentina, Russia and China) and at national level (with the federated entities). A growing attention is also given to the follow-up of the space activities initiated by the European Union. Finally, the directorate is also responsible for Belgium's participation in Airbus aeronautical programmes.

Belgium has been active in the space sector for more than fifty years and was at the origin of the foundation of ESA in 1975. There is a yearly Belgian budget of around EUR 200 million for space activities, 190 million of which is allocated to ESA programmes. Through its commitment, the directorate manages space programmes in all domains, i.e. space science, exploration, earth observation, space transportation, navigation, telecommunications, security, technology and applications.

For this purpose, it is in permanent contact with the industrial and scientific world to ensure its maximum involvement in these different programmes. Special attention is given to the development of products with a high technological value, ensuring a maximum return on investment in terms of our country's financial help.





## **BIRA-IASB**

The Royal Belgian Institute for Space Aeronomy (BIRA-IASB) is a federal scientific research institute. It studies the atmospheres of solar system bodies, and the impact of the Sun, nature and mankind on atmospheric changes. The upper atmosphere and its transition to interplanetary space are among its focus areas. BIRA-IASB scientists strongly depend on space data.

BIRA-IASB is the only Center of Knowledge in Belgium that has the required competences to elaborate all elements of a space mission to perform a complete study of an aeronomic problem. These competences include the formulation of research objectives, the consequent instrument and space mission design, as well as the derivation of satellite data products, their validation and geophysical exploitation, including modeling and service development. The research objectives of BIRA-IASB scientists are the drivers behind the design of instrument prototypes developed by the engineering department. BIRA-IASB collaborates with (Belgian) industry to build the instruments that are designed in-house. B.USOC, the Belgian User Support and Operations Centre, residing in the BIRA-IASB buildings, perform day-to-day operations of space instruments.



BIRA-IASB scientists develop retrieval algorithms to monitor the atmospheric concentrations of important trace gases. Observational data from manned or unmanned airborne and ground-based instruments are essential for the validation of the retrieved satellite products. BIRA-IASB also monitors the space environment using space- and ground-based assets. BIRA-IASB aims at transforming its research into applications and services, to support national and international decision-makers, industry, scientists and the general public with its scientific expertise. The Institute is recognised internationally for its work.

## **EWA - Entreprises Wallonnes de l'Aéronautique, asbl**

As a leading-edge industrial sector, committed to promising new developments, aeronautics is today one of the main development axes of Wallonia, with some major players and a whole network of innovative and technologically advanced SMEs.

The association EWA (Walloon Enterprises of Aeronautics) brings together more than 69 Walloon companies in the aerospace sector (including AMOS, SABCA, SONACA, SAFRAN AERO BOOSTERS, THALES ...).

They are active in the research, development and production of fuselage components, engines, electronic systems and software as well as in the repair, maintenance and modernization of aircraft, helicopters and engines.

The purpose of the association is to maintain and strengthen the professional collaboration between its members and to promote their technological competences to international stakeholders. EWA is also the privileged interlocutor of the Belgian regional and federal authorities for all matters relating to aeronautics.

The 69 EWA member companies represent 5.500 direct jobs (+ 2.000 indirect jobs) and nearly 1.4 billion euros of turnover.

Web: <http://www.ewa.be/>





## Flemish Aerospace Group (FLAG)

The Flemish Aerospace Group (FLAG) is a cluster organization for enterprises active in the aerospace market. Our organization supports the development of aviation and related technologies, improves the visibility of Flemish aerospace globally aiming for a growing market share. We also cater for our members' interests on a political level, facilitate networking between our members and support establishing a triple helix structure for R&D.

FLAG became an official cluster supported by the Flemish Government on April 1, 2017 and has a cooperation agreement with Agoria.

### Added value

- Are you already active in the aeronautical market and want to increase your business potential?
- Are you not involved in the aeronautical market yet, but still looking for a way to enter the complex but fascinating world of aviation?
- Are you wondering how your technology could break into the aeronautical sector?
- Are you somewhat hesitant because aviation is complex and operates under very stringent requirements?
- Are you looking for partnerships in Flanders or seeking to invest in Flanders?

FLAG will help you find your way whether it is market access, insights, technology matching or internationalization. Our peers have decades of experience and will link up with you for joint projects lowering the threshold for your first steps in the aeronautical sector.



## SCK•CEN IN SPACE

Reduced gravity, constant in-door confinement and an increased daily dose of ionizing radiation. Astronauts in space are exposed to extreme circumstances, which provoke stress and a variety of health hazards. Insights in those factors is vital to develop adequate solutions to the challenges space travelers face or will face in the future.

With its pioneering research, the Belgian Nuclear Research Centre (SCK•CEN) aims to enable long-term space missions e.g. to the Moon or Mars. Together with international experts, SCK•CEN supports space exploration by characterizing the composition and dose of cosmic radiation in space, by defining its biological impact and by monitoring astronauts' health (e.g. through blood testing after space missions). Furthermore, SCK•CEN examines how to assure a healthy microbial environment and helps to develop a bio-based waste recycling system allowing oxygen, water and food production in space.

In order to achieve the goal of long-duration human space travel, research is carried out both in space as on earth. SCK•CEN recently sent a first-of-a-kind bioreactor to space to test how to culture an oxygen producing and edible bacteria in space, whereas a co-worker went to Antarctica to gain insights into the impact of extreme living conditions on the human body.







## Skywin

The Belgian aerospace cluster “Skywin Wallonie” is a group of companies, training centers and research units engaged in a public and private partnership and building synergies around common and innovative projects in the Walloon region of Belgium.

Skywin represents some 7.000 direct jobs and more than € 1,6 billion in revenue, exporting 90% of its products. Skywin counts more than 150 members among which one finds more than 90 SME's: a proof that Wallonia is a dense and rich playground for innovation!

As a competitiveness cluster, Skywin's objective is to foster and promote the technological advance of Walloon aerospace companies and therefore supply competitive products and services, which are the mainstay of business development.

Since the redefinition of its strategy, the priorities and strategic orientations of Skywin were updated as follows:

- Composite materials and processes
- Metallic materials and processes (including Additive Manufacturing process)
- Embedded systems (for airplanes, satellites or drones)
- Airport services
- Space or drone applications and systems
- Modeling and simulation (as transverse orientation)

At the end of 2016, Skywin was managing 72 R&D, Investment or Training projects. These projects totalize about 300 contributions from innovation actors in Wallonia, led by Industry (with a strong involvement of our SME's).

The total budget of those projects is nearly 225 M€



## VRI (Vlaamse RuimtevaartIndustrie/Flemish Space Industry)

VRI (Vlaamse RuimtevaartIndustrie/Flemish Space Industry) is the representative grouping of the Flemish space industry and the research organizations.

VRI's goals are threefold: to enhance the collaboration between its members, to represent them with national and international public authorities and to make the industry known to the public at large.

Today VRI has 33 members who are developing a common strategy within the organization based on their respective niches. Some members have instruments for space research and small satellites as their core business. Others have developed control systems for on-board applications whereas another group develops new technologies for telecommunication and navigation. A growing group of members is offering downstream services based on space data.

At European level VRI supports the collaboration between its members and space institutions and foreign companies. VRI is also a member of SME4SPACE, the officially recognized organization of SMEs in the European space sector.

Bringing the Flemish space sector closer to the public and inform the public about the importance of space in society and as a growing industrial sector is another aim of VRI.

Some key figures of the sector in Flanders: since 2002 the space sector in Flanders has seen considerable growth, both in turnover and in work force. The sector provides direct employment to approximately 1,200 people with an overall turnover of EUR 260 million. 1/3 of this turnover stems from ESA, the European Space Agency whereas the remaining 2/3 is coming from other sources, mainly the worldwide commercial space market. Although the importance of ESA has relatively decreased over the past years — at the start of VRI almost 100 % of the turnover came directly from ESA — ESA remains an extremely important partner for our industry.



## Wallonie Espace

Wallonie Espace is an association gathering **36 industries and universities** concerned by Space research and development in Wallonia and Brussels. Its members are actively demonstrating expertise and excellence in various fields and with specific applications of **Space technology**, such as equipment for satellite payloads, launchers, system exploitation, space applications, etc. In 2017, Wallonie Espace represented some 1600 employees and a turnover of 250 M€. The objectives of the association are the following:

- **To promote the valuable know-how of the space sector** in Wallonia and Brussels, towards the public authorities in order to obtain the financial resources required to reinforce its competitiveness at an international level.
- **To stimulate the interest of the general public** and of young people, in particular in the importance of Space systems and careers in the Space sector, thus ensuring a pool of expertise for the future.
- **To favour the exchange of information** in order to optimize the conditions around the development of space activities in Wallonia and in Brussels.
- **To develop a joint prospective view** that goes beyond the immediate needs of each company and every laboratory in the association.

Transcending these various objectives, the final goal is to upgrade the level of excellence and the volume of activities for the space sector in Wallonia and in Brussels. Indirectly, the mission of Wallonie Espace is linked to the economical and scientific development of its members.

Web: [www.wallonie-espace.be](http://www.wallonie-espace.be)







**SUCCESS** STORIES  
IN BELGIUM



INTERVIEW WITH  
**Christian Boas, CEO**

ADVANCED MATERIALS  
& STRUCTURES

COMPANY

**ASCO Industries**

REGION

**Flanders**

Date of foundation: 1954

Location: Belgium (HQ),  
Germany, Canada, Brazil,  
United States and France

Turnover 2017: 387 million EUR

Investments: 10 million EUR  
on a recurrent basis

Start of exports:  
ASCO is an export company and  
invoices most of its turnover in USD

*"Interview took place before  
ASCO Industries was purchased  
by Spirit AeroSystems"*



ASCO is a world leader in the development and production of mechanisms for the movable parts of the wing and complex structural parts. At present ASCO is exclusively operating in the aircraft market, but with the launch of the company in 1954 it sold critical parts for military purposes.

In November 1978 the Belgian government decided to raise the aeronautical industry in Belgium to a higher level with the Airbus status of 'Associated Manufacturer' for the Belgian industry. Besides aircraft engine constructor Fabrique Nationale (FN) and Sonaca, ASCO could also join operations.

**HIGH-FLYER  
IN OPEN COMPETITION**

"That was a fantastic opportunity", says Christian Boas, CEO of ASCO Industries. "We started working on the support arms for the movable parts of the wings for the Airbus A310. Support arms are still indeed our most important product as regards turnover. We used the expertise gained here to de-

*"What will continue  
to distinguish us  
amidst this increasing  
competition is  
our service"*

velop and manufacture other parts such as the engine suspension system and landing gear suspension, the aircraft tail fin support and so on. Each of these are crucial parts, stress-sensitive, and made of high quality aluminium, steel or titanium."

Since 2009 an aircraft equipped with ASCO parts has been taking off or landing every second. The successful contracts at Airbus were followed by projects from other companies such as Boeing, Bombardier, Embraer, Gulfstream, Dassault, Lockheed Martin and more.

Orders are awarded after a competition phase, explains Boas. "ASCO succeeds in securing contracts time and time again because of open competition and quality being the criteria for selection."



### DISTINCTION BY SERVICE

"The supply chain in aviation is becoming increasingly international. There have always been competitors from the United States and Europe", says Boas, "and now India and the Middle East have a larger presence, while aircraft construction is also starting to develop at pace in China. What will continue to distinguish us amidst this increasing competition is our service." Many companies only offer "Build to print". They manufacture according to the client's drawings. ASCO can also work in this way, but it is mainly recognised for going a step further with the development of parts.

"Our engineering office is able to create a design using the client's general specifications. We are then given a place in the aircraft within which we must fulfil a certain task. The space, the interfaces with the aircraft itself, the forces that must be transferred or accommodated, the function and the maximum weight comprise the input. We then create a design and start manufacturing. A new aircraft usually means a new design. Different materials, different stress calculations and so on can be required depending on the type and size of the aircraft. Behaviour in the air is indeed completely different with each aircraft", says Boas.

### GLOCALISATION

To excel in its field ASCO can fall back on its experience on a wide range of platforms, being the aircraft types on which work is done, and a wide client base. The company also puts a lot of

effort into Research & Technology. Approximately 7% of the turnover is spent on research and development each year. This largely takes place in Belgium. "The biggest advantage of Belgian aerospace is the technology cluster, including cooperation with universities and other manufacturers, and with the Flemish government and institutions such as Flanders Make, SIRRIS and the Flemish Aerospace Group (FLAG)", explains Boas. The latter has for example joined with Flemish industry to set up a network to develop 3D technologies.

*"Lower emissions, less noise, and a lower cost price. These are some of the important expectations for the future"*

It is not only ASCO's Research & Technology that is largely concentrated in Belgium, other aspects include industrialisation and IT. Nevertheless, ASCO has a number of foreign establishments.

"We try to have production take place where it is most rational", clarifies Boas. "Proximity to the client is very important. In 1990 we launched commercial activities abroad to secure contracts for production in Belgium, before setting up a presence in Canada and then the US. We now have four production sites with a total surface area of 140,000 square metres." Christian Boas calls this Glocalisation, the global and local aspects supporting each other.

ASCO is fully oriented towards exports. The company mainly exports to the United States, the United Kingdom, Germany, France, Canada, China and indirectly to Brazil. In the meantime, Asian countries and Russia have also been working on new types of aircraft. "If these countries are to start selling internationally, they will inevitably be purchasing internationally as well when production starts", predicts Boas. "That is why we also have a marketing presence among these emerging players."

### 2025

Even without taking account of these potential new clients, there is pressure across the whole aircraft construction industry to move up another gear. Both Airbus and Boeing have full order books and expect a production increase from all their suppliers. The first task is accordingly to act upon these evolutions, signals Boas. But parallel to this, ASCO is also setting its sights on further horizons.

"Lower emissions, less noise, and lower cost. These are some of the important expectations for the future", says Boas. "This is also why we are investigating the possibilities of composite alternatives, of 3D printing, we are investing in automated factories, etc." The first results can already be seen. For the Airbus A380, for example, ASCO developed a method to greatly reduce noise, turbulence and fuel consumption with the extension of the wing.

"Today, we are fully concentrating on the solutions of tomorrow to further strengthen the company's position on the market", Boas assures us.



INTERVIEW WITH  
**Marc Dubois,**  
*Commercial Director*

ADVANCED MATERIALS  
& STRUCTURES

COMPANY

Sabca

REGION

Brussels

Date of foundation: 1920

Location: head office in Brussels and sites in Wallonia, Flanders and Casablanca (Morocco)

Number of employees: a total of 1,100

Turnover: in 2016, just over EUR 200 million

Growth (2017): 3 to 5% per year over the last ten years

Export: 85%



The Société Anonyme Belge de Constructions Aéronautiques, SABCA, was founded in 1920. Situated in Haren in the suburbs of Brussels, Sabca designed and constructed aircraft for both civil and military air transport, an emerging industry in Belgium at the time. Following World War II, Sabca was actively involved in most programmes to modernise and maintain Belgian military aircraft. Thus in 1955 the company opened its second factory in Charleroi, adjacent to the runway, the ideal place to carry out its activities. In the 1990s, Sabca opened a third site in Limburg, focussed on composites, with the objective of becoming a centre of excellence in these technologies. Finally, Sabca is setting up its fourth factory in Casablanca, Morocco, to concentrate manual assembly activities there in the interests of economic efficiency. Today, Sabca is one of the oldest companies in aeronautics, as it will soon be celebrating its 100th anniversary in 2020.

EUROPEAN LEADER IN  
ACTUATION SYSTEMS

Sabca is positioned around 3 major markets: civil aviation, space and defence. 55% of the company's activities are devoted to civil aviation, while the space sector accounts for 25% of its

*“We are considered the European pole of excellence for actuation systems, that is to say the systems that direct rockets”*

activities and defence for 20%. Activities related to civil aviation involve the construction of structures such as parts of fuselages and wings as well as the development of mechatronics equipment used in braking systems. The company works mainly on commission for major companies such as the French companies Airbus and Dassault and the American company Gulfstream.

The second major activity of the company concerns the manufacture of structures and flight control systems for European launchers. “We are considered the European pole of excellence for actuation systems, that is to say the systems that direct rockets”, says Marc Dubois, Commercial director of Sabca. Among its main customers in the space sector are the Ariane group - for which the company manufactured part of the booster rockets and the actuation systems of Ariane 5, the Italian group Avio (Vega launcher)







and the European Space Agency, with which Sabca has already had the opportunity to carry out many development programmes. Currently, Sabca is strongly involved in the development of the Ariane 6 and Vega C actuation systems.

The third largest market for Sabca covers the maintenance, repair and modernisation of military aircraft, mainly carried out at the Gosselies site, due to its proximity to the runway. "We have maintenance contracts with the Belgian, Dutch, Danish, American and other national air forces to maintain their fleet. We also have modernisation contracts concerning the updating of aircraft avionics", says the Commercial Director. Sabca is also active in the "regeneration of aircraft" in the defence sector, that is to say, it refurbishes old aircraft that their customers send them to serve as "targets" in pilot training.

In addition, the company recently began prospecting for a fourth market involving UAS (Unmanned Autonomous Systems). Sabca wants to be able to position itself as an integrator of applications in drones, that is to say, to adapt and develop drones according to the applications that they must incorporate and to qualify them. These drones can be used for functions ranging from transporting organs or blood bags from one hospital to another to monitoring power lines or crops, etc. "There is a market developing very strongly in which our skills in other areas can be used to optimise customer needs", says Marc Dubois.

### LOOKING FOR THE GREATEST ADDED VALUE

The company is currently undergoing a transformation plan that will enable it to identify the activities that generate the highest added value for its customers so as to focus on these. In order to increase this added value, Sabca intends to move towards "state of the art" solutions in relation to different technologies. It illustrates this through various projects such as the integration of Industry 4.0. in its factories or the introduction of 3D printing in its activities thanks to the support of the Brussels region through Innoviris. Thus, activities that produce less added value will in principle be outsourced externally, either to its location in Morocco or to other smaller companies that are capable of being more competitive than Sabca in their field of activity.

### A LONG-TERM INDUSTRIAL STRATEGY IN BELGIUM

It should also be noted that Belgium has played an important role in the development of the Belgian space sector. Returns to Belgian industry are based on investments made at the federal level in the different budgets of the European Space Agency (ESA). In addition, the country ensures a long-term industrial strategy for the space sector, allowing the industry to align with it and create a long-term strategic plan. Sabca also maintains regular contacts with various Belgian universities to involve

them in their R&D activities, while orienting research according to the company's objectives.

### SEVERAL FUTURE PROJECTS

The future still has great prospects for the development of Sabca. While the aerospace sector tends towards electric aircraft, competition seems to be moving towards the Asian countries, where the aeronautical industry is continuing to develop. "The aviation market is no longer so overwhelmingly centred in Europe but rather in Asia and the United States. We are thinking of different scenarios to increase our presence in these countries (partnerships, new locations etc.).

Regarding the space sector, the strong institutional approach in Europe is being challenged by competition from both the United States and Asian countries. "We need to be much more international and not limit ourselves to the European market so that we can also position ourselves vis-à-vis our centres of excellence."

As regards defence, Sabca also plans to break into the African market using its platform located in Morocco. "The African market will probably become a very buoyant market in 10-15 years' time", says Marc Dubois.

Also, the company intends to forge a place within the drone sector. "Ultimately, we think that this could even become a very significant activity, requiring partnerships with companies or research institutes specialised in this field."



INTERVIEW WITH  
**Bernard Delvaux, CEO**

ADVANCED MATERIALS  
& STRUCTURES

COMPANY

**Sonaca**

REGION

**Wallonia**

Date of foundation: 1978

Locations: head office at Charleroi in Belgium in addition to locations in Romania, Brazil, the United States, England, Germany, Canada, Mexico, China and Sri Lanka

Number of employees: 4,474 worldwide including around 1,500 in Belgium

Turnover: approx. 720 million EUR in a full year

Investments (2017): the American company LMI was bought for 450 million USD + industrial investments in the order of 70 million USD are made each year

Export: 100%

Presence abroad: supplier to nearly 100% of aircraft manufacturers worldwide

Awards: Airbus: "Best Supplier" in aerostructure for supply quality and performance for four consecutive years  
Boeing: gold excellence prize for performance in 2014  
Embraer: "Superior Customer Satisfaction" and "best supplier" in 2008, 2009 and 2014  
Similar recognitions from Bombardier, Spirit and MHI



The story of Sonaca goes back 40 years, to 1978 when the Fairey company went bankrupt and ceased its activities in aeronautics. "We can say that we came from the F-16 contract of the century and then from the development of the European economic interest group Airbus", explains Bernard Delvaux, CEO of Sonaca. As part of the still very "political" Airbus project, Sonaca was tasked with developing the leading edges for Airbus. Subsequently, the company gradually developed as a commercial entity on the basis of several contracts concluded first with Airbus and then with other commercial customers. Sonaca's core business is the design, manufacture and assembly of aircraft bodywork. The company develops complex aviation structures for markets as diverse as space, defence and civil aviation.

**SONACA, SPECIALIST IN AEROSTRUCTURE**

In the aeronautics field, this Belgian multinational is especially recognised for its expertise in wing skins and the mobile surfaces of wings since it is world leader in this area. Situated in the world's top 7 in terms of size, the

*"Sonaca supplies its products to almost all aircraft manufacturers in the world"*

company is also active in the development and production of complex fuselage elements as well as in the manufacture of a series of parts or subassemblies for aircraft worldwide. Indeed, Sonaca supplies its products to almost all aircraft manufacturers in the world, including Airbus, Boeing, Bombardier, Embraer, Spirit AeroSystems and many others. In addition, the company even manufactures its own aircraft, the Sonaca 200, which will soon be certified and will be sold throughout Europe.

**FINDING THE RIGHT BALANCE**

"In the space industry, we manufacture the mechanical structure of satellites, which has to withstand huge temperature differences", says the CEO. In the space sector, the combination of weight and cost is a determining factor in the competitiveness of the final





product. This is because lightness is essential for a product intended for space but it must also be resistant, while maintaining a competitive price. In addition, it is necessary to combine different materials to find the right combinations of them and this balance is verified by calculations, prototyping and qualifications. Sonaca has developed a series of technologies that make it possible to combine, for the same product, so-called "traditional" metals such as aluminium or titanium with new materials such as composites and in particular those reinforced with carbon fibre. "I consider our solutions are competitive in the first place because they are reliable, we have a history of extraordinary reliability, we deliver on time, we have no quality problems and, in our business, this is very important. In addition, we have a product that, from a weight point of view, is very competitive, and we also manage to set very competitive sales prices, which have been reduced over time".

### STRONG SUPPORT FROM BELGIUM IN THE FIELD OF AERONAUTICS

The support from Belgium and from the Walloon Region have played a major part in Sonaca's further activities. In point of fact, the aeronautical programmes for Airbus qualify for repayable advances from the Federal State while the Region makes available these same repayable advances for the aeronautical programmes with other customers. "With this kind of programme, we cannot spend tens of millions of euros at risk without having public support (...) so it is a support for the entire Belgian industry; all companies in the sector benefit from the same conditions if they make similar programmes". According to the CEO,

*"We have a history of extraordinary reliability"*

Belgium stands out today thanks to the experience it has accumulated over many years and it is thanks to this experience that Sonaca has the ability to improve its products and processes continuously.

### TOWARDS MORE COMMERCIAL COMPETITION IN THE SPACE INDUSTRY

According to Bernard Delvaux, the aeronautics sector is developing on an increasingly global scale, since not only customers but also competitors have become global players. Sonaca describes its manner of functioning as that of a worldwide supply chain that varies depending on the location of its customers. A part may be manufactured in Brazil, only to be sent back to Belgium for assembly, and the finished product may subsequently be delivered in the United States. "Everything crosses in all directions and it is based on a centralised management system

(Enterprise Resource Planning - ERP) that always means we have the right order of parts and the right stock in the right place, to optimise transport etc.", explains Mr Delvaux. In a sector where there are many consolidations and where giants are being formed, competitiveness is essential.

By contrast, the space sector is still a less mature market from an economic point of view. Being smaller in size, this sector is still relatively protected at the political level since it is heavily subsidised by individual states and by Europe. This protection will not last forever, according to the CEO of Sonaca, since the arrival of players such as Elon Musk with SpaceX and other private developments of the Newspace movement announces real competitiveness for prices and costs and a reduction of subsidies in the future. "A real change is happening, moving towards much more commercial competition, with a fall in prices and costs that is natural since it is a safeguarded sector. Of course, when it loses a little of this protection, prices fall automatically and so I consider that the space sector is one that will sooner or later become much more open to a model similar to that of aeronautics."





INTERVIEW WITH  
**Gilles Rigon, CEO**

PLATFORMS &  
EMBEDDED SYSTEMS

COMPANY

**ACB**

REGION

**Flanders**

Date of foundation:  
1988 (by Wim Perdu)

Location: Dendermonde (Belgium)  
and Malville (France)

Number of employees: 117 employees  
in Belgium and 60 in France

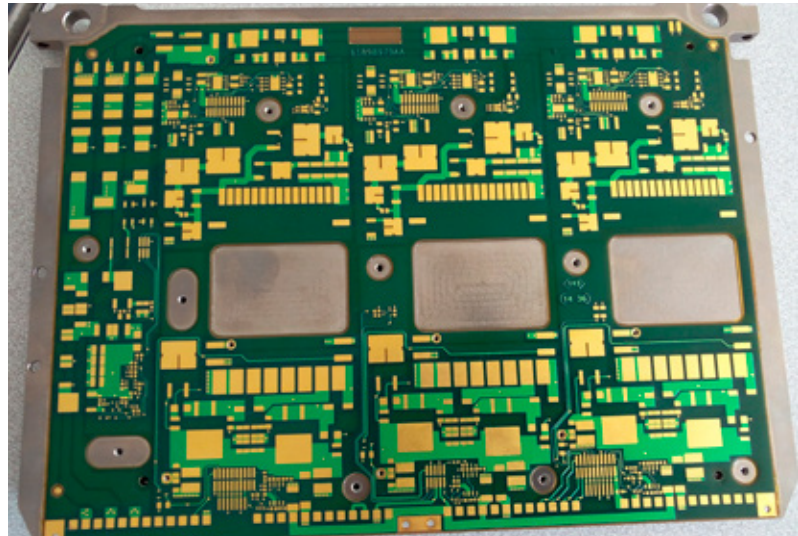
Turnover: 18 million EUR at Dendermonde  
and 6 million EUR at Malville

Growth: fairly stable growth  
of around 2-3% per year

Export: 88% of turnover

Certification: IS9001 and AS/EN9100,  
UL NADCAP

Partners in development projects:  
Imec (BE), Thales (Ipitech/Euripides),  
IWT Belgium (ISEE project)



Advanced Circuit Boards (ACB) is one of the European leaders in the field of printed circuit board (PCB) manufacturing with short lead times. At its outset, the company progressed with the GSM market and then turned to the military and aeronautics markets. Currently, 32% of ACB production is accounted for by the military sector, 28% by civil aviation and 11% by aerospace. 2-3 years ago, production for the aerospace sector amounted to just over 1% for the company. ACB has made significant progress in this area, mainly thanks to the support of one of its major customers, Airbus Defence and Space.

**EUROPEAN LEADER IN  
HIGH TECHNOLOGY  
AND HIGH RELIABILITY  
PRINTED CIRCUITS**

Today, ACB is able to offer its customers highly reliable rigid, flex-rigid and flexible multilayer printed circuits. This infallibility is, indeed, an indispensable factor given the harsh environments that the various products offered by the company have to face. "It takes an average of 300 basic oper-

ations to make a PCB. It is an alliance between chemistry, mechanics and electronics", explains Gilles Rigon, CEO of ACB.

The company specialises in short runs, 70% of which are delivered in standard lead times and 30% in very short lead times (between 5 to 10 days).

At present, the company works as a subcontractor for large groups such as Airbus, MBDA, Thales, Barco, Safran, and many others. ACB is a player in a European market worth around 400 million EUR in the field of high reliability. "It's a small volume, high-tech market, with high reliability in harsh environments", says Mr. Rigon. Apparently, the company is among the 10 largest producers in sectors as diverse as the military, aeronautics, space, medical and oil & gas branches. "Globally today in Europe, you still have 200 European producers but you have only about 40 who have a turnover greater than 10 million EUR", says the CEO. The firm is mainly export-oriented, with 88% of its production going abroad.

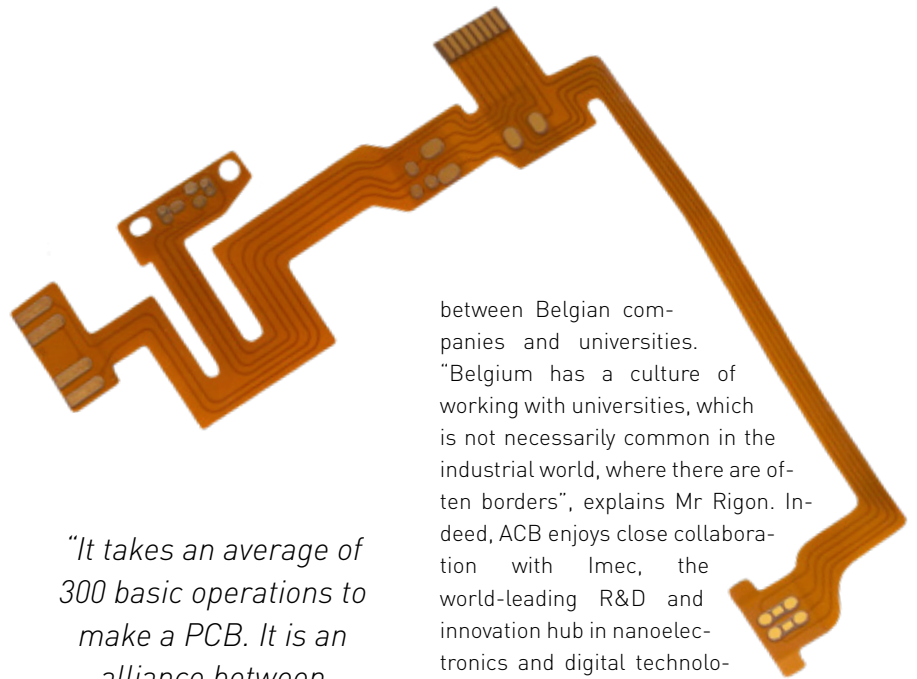


## VERY HIGH RELIABILITY

ACB enjoys several competitive advantages within its sector. First, the company cites its team of development engineers who work together with clients to define products. "This technical support provided to our customers is above average", says the CEO. In addition, the firm is able to combine the manufacture of highly technological products with very short manufacturing cycles: on average, taking only 4 to 6 weeks between receipt of the customer's order and delivery.

However, the CEO of ACB insists more on the reliability they are able to guarantee to their customers. "It is the combination of both (high technology and high reliability) that differentiates ACB, because the technological aspect alone is not enough. PCBs as complex as those found in a smartphone are sometimes made, but these PCBs have conditions of use that require greater reliability given the extreme conditions they face."

In addition, the CEO highlights the traceability of his products. "We live in a world where traceability is very important because in the event of a technical failure on a satellite, an on-board computer in an aeroplane or elsewhere, it is important to be able to



*"It takes an average of 300 basic operations to make a PCB. It is an alliance between chemistry, mechanics and electronics"*

trace the history of the product."

In order to be able to offer this range of high-tech products, the company invests approximately 10% of its turnover every year for the purchase of new equipment as well as for the maintenance and updating of existing equipment.

## BELGIAN HERITAGE, AN ADVANTAGE IN THE BUSINESS WORLD

According to Mr Rigon, Belgium has an essential asset in the business world: its European culture. "Belgium is lucky to have understood historically that its domestic market is Europe: it is a fundamental asset", he explains. Belgians' mastery of European languages, their ability to adapt to the culture of their customers and, more generally, their openness to Europe, are elements which, according to him, represent Belgium's greatest assets. In addition, the CEO also notes the collaborations that are being created

between Belgian companies and universities. "Belgium has a culture of working with universities, which is not necessarily common in the industrial world, where there are often borders", explains Mr Rigon. Indeed, ACB enjoys close collaboration with Imec, the world-leading R&D and innovation hub in nanoelectronics and digital technologies. This allows them to support technological innovations and to have access to structures and means that are inaccessible without this association.

## FUTURE PROJECTS

In view of the growth of its activities in the aerospace sector, ACB sees a stronger position for itself in this field in the future. In addition, the company would like to develop further in the medical and oil & gas sectors. "These are two areas in which ACB still has room for improvement", the CEO explains.

"ACB is actively seeking possible external growth. Its ambition is to double the size of the company and reach a turnover of between 40 and 50 million EUR."

*"It is the combination of both high technology and high reliability that differentiates ACB"*





INTERVIEW WITH  
**Charles Hirsch,**  
President



**Marc Tombroff,**  
General Manager

PLATFORMS &  
EMBEDDED SYSTEMS

COMPANY

**Numeca**

REGION

**Brussels**

Date of foundation: 1992

Location: Brussels, with subsidiaries in Wallonia, Flanders, United States, India and China, and licences and agents in other countries

Number of employees: 150 worldwide and approx. 100 in Belgium

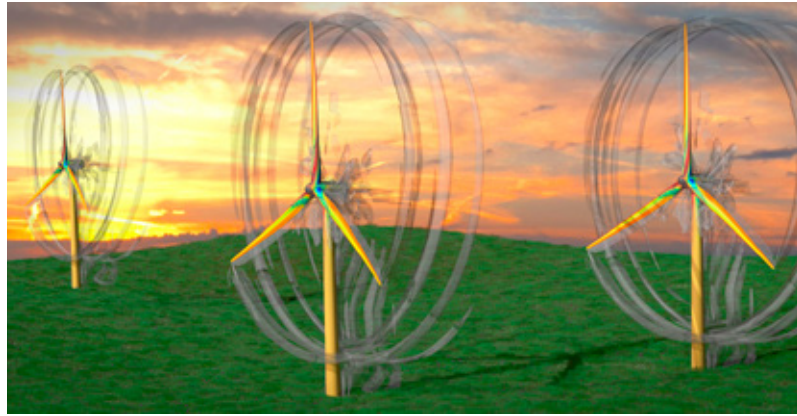
Turnover (2017): 18 million EUR (1/3 from Europe)

Growth (2017): 12%

Export: 90%

Patents/licences: recent patent for their latest product, OMNIS

Awards: "Grand Prix Entreprendre", "Prix de la société la plus innovatrice", "Brussels Best Exporters" in the category "goods".



The history of NUMECA began in 1992 as a spin-off from the fluid mechanics department of the Vrije Universiteit Brussel (VUB), being directed at the time by Professor Charles Hirsch, who is currently the president of NUMECA. In the late 1980s, Professor Hirsch and his team received their first contract from the European Space Agency to develop new software simulating the re-entry of space capsules. Following this contract in partnership with the Swedish Aerospace Institute, Professor Hirsch was prompted to create NUMECA because of the many requests from industry to use the developed software. NUMECA's customers are as varied as they are renowned in fields as diverse as aeronautics, the marine industry, cars or industrial processes. We find, for example, big names such as Airbus, Safran, SpaceX, Boeing or General Motors.

CREATOR OF  
NEW TECHNOLOGIES

NUMECA develops and markets high reliability simulation software in fluid mechanics, multi-physics and optimi-

zation. In addition, the company also provides advice in fluid, thermal and acoustics analysis. NUMECA is today the European leader in the digital simulation of fluid flows relying on its research & development team, which represents nearly half of the workforce in Brussels. NUMECA is today the most innovative company in its sector as demonstrated by the performance of its software. Indeed, NUMECA's software has very competitive simulation times and the company adapts their functionalities according to the particular physical phenomena to be recorded. "This is reflected in the productivity in engineering offices, which can perform more simulations at lower costs and thus obtain better quality products faster", says Marc Tombroff, General Manager of NUMECA.

In order to verify and guarantee the quality of its software, NUMECA validates it with experimental data obtained in different environments (laboratory, microgravity etc.). "We are one of very few companies - if not the only one - to provide a single software platform consisting of a very broad range of



*"We are one of very few companies - if not the only one - to provide a single software platform consisting of a very broad range of technologies that can process flows of very different natures"*

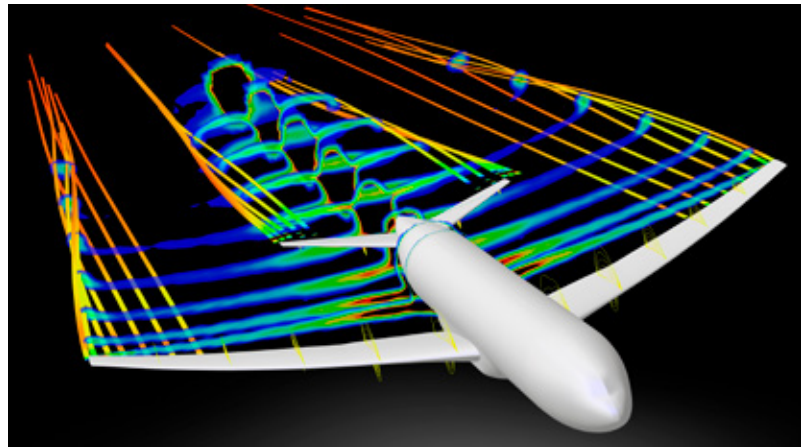
technologies that can process flows of very different natures; from multiphase flows in porous environments to supersonic flow around an aircraft”.

### BELGIUM, AN IMPORTANT PLAYER IN THE AEROSPACE INDUSTRY

Like NUMECA, many Belgian companies have evolved from initial university developments in the field of software to industrial levels. From the outset, Belgium has been a favourable country for the development of NUMECA. The company was supported from its very beginning by the Brussels Region, which played a very important role in the development of the first generation of industrial advanced products. Today, the company also relies on the support of the Walloon Region to be more competitive. Indeed, besides the fact that the company has many Belgian partners, the country also has a strong culture in technological and scientific fields. The company currently has a very close network of partnerships with mostly Walloon universities but also with others in Brussels and Flanders. In addition, Belgium’s contribution to the budget of the European Space Agency is one of the great strengths of the country because this budget is largely ploughed back into Belgian aerospace companies.

### AN INTERNATIONAL PRESENCE

90% of NUMECA’s turnover is generated from export. The company has a multiple presence abroad: NUMECA subsidiaries are present in the United States, Japan, India and China, in addition to independent agents working from Germany, Holland, France, Italy, Spain, Russia and Eastern European countries such as Poland. These subsidiaries are important for the group as



*“NUMECA is developing what could soon be called “new generation” software.”*

they allow for better local presence in terms of sales strategy and investment management. It should be noted that the growth of the company depends mainly on the availability of human resources. Nearly twenty different nationalities are working within the company, which is keen to recruit abroad. “A local presence is essential because a sale in our sector takes a very long time, from 9 to 12 months or more. We must be able to show that our software is reliable and the customer almost always asks us to demonstrate this reliability, particularly on their own products”, explains Marc Tombroff. The aerospace sector is in continuous growth and its evolution seems to be marked by a growing number of initiatives coming from the private sector. Indeed, with the emergence of US companies such as SpaceX or Blue Origin, software use is ever-increasing, and this is expanding the sector of NUMECA into a strategic industrial sector. Similarly, new products are now being developed in digital form (simulation) even before a single part has been

manufactured. This is one of the reasons why the use of simulation software will grow strongly in future years. “We hope - and trust - that Belgium will seize this enormous potential growth, given the Belgian simulation software culture; we hope that this is something that Belgium will focus on to a greater extent”. Parallel to European research projects, NUMECA is developing what could soon be called “new generation” software. This software will have a higher level of precision and will make it possible, for example, to simulate phenomena related to turbulence much more reliably. “To our knowledge, we are still the only industrial software company developing this kind of programme and we expect to release the first versions very soon”, says Charles Hirsch, president of NUMECA. In addition, the company is actively researching opportunities in the oil & gas industry, which conceals a very major market thanks to petroleum research, and the company has already made major investments in the sector. “Our goal is to be number one worldwide in the field of simulation. We have a little way yet to catch up with number two, but in terms of technology and innovation we have a lead we want to transform, and for this we are planning strategies to accelerate sales growth”.



INTERVIEW WITH  
**Emmanuel Terrasse, CEO**

PLATFORMS &  
EMBEDDED SYSTEMS

COMPANY

Thales Alenia  
Space

REGION

Wallonia

Date of foundation: 1953

Location: sites at Charleroi and  
Louvain (soon also at Hasselt)

Number of employees: 650

Growth (2017):  
40% over the last 3 years

Investments (2017): a new factory  
built at Hasselt (20 million EUR)

Export: almost 100%

Presence abroad: Europe (France,  
Germany, Italy), United States,  
Latin America, Russia, Asia.



The Belgian subsidiary of Thales Alenia Space has dual origins: on the one hand, from Belgian industrial history through the large group ACEC (Ateliers de Construction Electrique de Charleroi) from the Charleroi Region, which had activities in electronics at the time and, on the other hand, from the European group Thales Alenia Space which the company is part of today. Thales Alenia Space Belgium is now 55 years old and looks back with pride at this dual heritage, which has enabled it to acquire its expertise in the field of space electronics.

A HEART OF  
ABSOLUTE RELIABILITY

The activities of Thales Alenia Space Belgium revolve around the design and production of electronic equipment for use on satellites and launchers. "Every year we manufacture more than 300 sets of highly sophisticated equipment", explains Emmanuel Terrasse, CEO of Thales Alenia Space Belgium. Highly export-oriented, with nearly 100% of its turnover generated abroad, the company now offers two types of product lines to its customers. The first line concerns the satellite sector, including one of their flagship products, the "electric heart" of the satellite. This "electric heart" is the equipment de-

signed to receive electrical energy from the solar panel and the battery and redistribute it to all the satellite equipment. "It's obviously a key piece of equipment for the satellite because, without power, it would not work."

The second line is for launchers, an area in which the company excels since it is the leader in electronics for European launchers. "50% of the electronics on board the European launcher Ariane 5 is from Thales Alenia Space. Whenever a launcher leaves Kourou in French Guiana, electronics made in Belgium are on board." Indeed, whether it be for observatory, scientific or communication missions, a multitude of satellites are now equipped with Thales Alenia Space products.

As a supplier to various satellite and launcher manufacturers, Thales Alenia Space in Belgium must offer products that are absolutely reliable, given the critical and decisive function that these devices must fulfil on board space structures. "If the equipment does not work, the whole mission of the satellite

*"Whenever a launcher  
leaves Kourou in  
French Guiana,  
electronics made in  
Belgium are on board"*



or the launcher is endangered. That is what makes the heart of the added value of the crucial quality of our activities for our customers”, explains Mr Terrasse.

## THALES, CREATOR OF A NEW GENERATION OF PRODUCTS

Like the large international group Thales, the company's DNA is strongly imbued with investment in R&D, accounting for almost 20% of their turnover.

Indeed, R&D is a key element for the company, illustrated by a recent investment of nearly 20 million EUR in a project to create a new factory at Hasselt. This new location will host the automated production of photovoltaic panels for the space sector, thereby confirming its pioneering position in terms of digital innovation. “It will really be the 4.0. laboratory of our industry, the factory of the future.” This pilot project will deploy a whole series of techniques that will then be deployed in turn throughout the company's activities.

In addition, it is from these investments in R&D and innovation that the company has been able to develop a new generation of products that are both more efficient and more competitive. “Today, thanks to our products, the satellites can now reach their orbit with a new mode of propulsion, known as “electric or plasma propulsion”, says the CEO. The company was the first to develop this mode of power supply for plasma propulsion motors, thus positioning it among the world leaders in this field. Another example of innovation is illustrated by the integration of digital micro-solutions in equipment manufactured by Thales Alenia Space. This will entail greater flexibility with a consequent gain in competitiveness. “In the space environment, we work mainly in analogue and, today, the introduction of

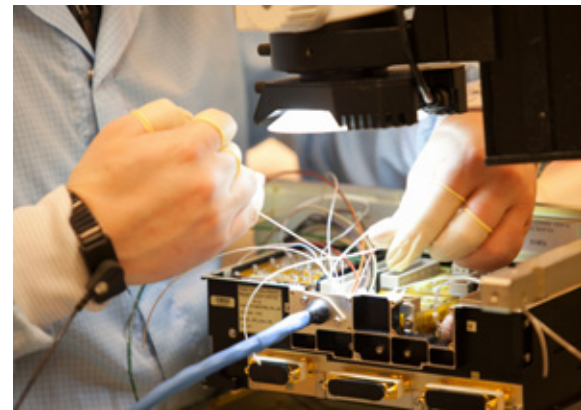
digital and IT is a technological breakthrough for the sector”, explains Emmanuel Terrasse.

## BELGIUM, AN ADVANTAGEOUS ECOSYSTEM FOR THE SPACE INDUSTRY

It is thanks to its Belgian and Walloon heritage that Thales Alenia Space Belgium has been able to develop its various competitive advantages over the past 55 years. In addition, the company also values the ecosystem in Flanders, particularly at Louvain and Hasselt. “Our goal is to be part of this very dynamic ecosystem of skills that exists not only in microelectronics in Louvain but also in photovoltaic technologies in Limburg”. A member of several professional space industry associations, Thales Alenia Space Belgium also enjoys strong support from various Belgian institutional players.

*“The company was the first to develop this mode of power supply for plasma propulsion motors”*

“Belgium has many advantages in the field of aerospace”, says Emmanuel Terrasse. On the one hand, the country can avail itself of a high level qualified workforce that represents a determining factor for the development of the company. On the other hand, the Belgian context is very favourable for research in the space environment, which is perfectly in line with the company's strategy based on investment in R&D. “It is obviously very important to have an environment of this kind and the support that we can have for R&D, including on the regional level. These are key elements that allow us to develop



new generations or new products, products that we could not supply without this support and without this environment.”

## A SPACE SECTOR IN MUTATION

The company's future projects include not only the start of the production of photovoltaic panels on the site of the new Hasselt plant but also the development of electronics dedicated to the new Ariane 6 European launcher project. “It is a matter of pride for us to be able to continue to make a strong contribution to the adventure of European launchers. We have been working on European launchers since the beginning, so we have a great historical legacy.”

The strategy of Thales Alenia Space Belgium remains focussed on positioning the company in the space sector. “This is a sector that offers many opportunities and today has a very large number of initiatives in progress. We are very successful in this market.” This sector is not only growing but also changing: the arrival of Newspace has led to the entry of new competitors who have strongly questioned the way the sector operates. “We fully expect to be a major player in this coming Newspace”, concludes Emmanuel Terrasse.



INTERVIEW WITH  
**Didier Bennert, CEO**

SERVICES & APPLICATIONS

COMPANY

**EMIXIS**

REGION

**Brussels**

Date of foundation: 1984

Location: Brussels

Number of employees: approximately 35 employees in total

Turnover (2017): 4 million EUR

Growth (2017): 6%

Investments (2017): 750,000 EUR for development costs (approx. 20% of the turnover)

Export: over 30%



Emixis is the result of the merger in 2013 of two Belgian companies, BF Engineering and Mobile Token, both of which active in the field of geo-positioning. Emixis works essentially with companies in the construction sector but also supplies its solutions to companies active in technical services, logistics, public or semi-public services and vehicle hire companies.

**EMIXIS, PIONEER IN TECHNOLOGIES FOR SECURING VEHICLES**

Emixis has been developing and marketing geo-positioning solutions for more than 20 years in the international markets. In the early 1990s, commercial use of GPS was made possible by the opening of the US Army signal. Emixis, which was marketing alarm systems, had the idea of taking advantage of this signal and embarked on protection via satellite. The first line of services was "Stolen Vehicle Recovery", a service that protects vehicles against theft and can give their position immediately. "We were among the pioneers in Europe to offer a protection

*"We were among the pioneers in Europe to offer a protection system for vehicles via satellite."*

system for vehicles via satellite", says Didier Bennert, the CEO of Emixis. Understanding the high potential of the GPS signal, Emixis started developing a solution enabling companies to manage their fleet of vehicles using the satellite signal. "We were the first in Europe to offer real-time geo-positioning, and to know at any time, thanks to the GPRS, where a vehicle is, what it is doing, who is on board, if it needs maintenance, if it is being used appropriately etc.". Today, the Fleet Management System service accounts for nearly 70% of the company's total business. Finally, the third activity of Emixis is related to field staff management, which not only allows monitoring of the activities carried out but also allows staff to be allocated missions via smartphone. "This is the area of activity that is growing most strongly and it is also the most recent one", says Didier Bennert.





### EMIXIS, DEVELOPER OF TAILOR-MADE SOLUTIONS FOR ITS CUSTOMERS

"We are one of the few companies in our sector that still has complete mastery of the entire software and hardware chain from A to Z, which is our great strength. It gives us greater ability to develop tailor-made solutions for our customers", says the CEO. Indeed, the company develops and manufactures, in Belgium, its own GPS beacons and its own interface to manage these beacons and use the information.

"There are many ways to obtain an asset position, however, and it is becoming increasingly important for our customers to have a convenient interface enabling them to process information and to communicate only what is important. Today, we have 30,000 equipped vehicles that send a position about every minute, which means millions of information points. Therefore, the real importance today is the quality and simplicity of our software platform". To deliver this quality, Emixis relies on its R&D team which represents nearly half of its workforce. Emixis develops both hardware (development of the beacons) and software solutions, meaning all the applications that the company develops and markets for its customers.

### MAJOR SUPPORT FROM THE BRUSSELS-CAPITAL REGION:

Emixis has been able to benefit from many forms of support provided by the

Brussels-Capital Region, particularly with regard to development and export costs, and also in relation to subsidised business trips outside Europe, such as economic missions. "It is clear that the support from the region is one of the elements that help us to enter foreign markets successfully but also to develop technology".

*"For us, economic missions are certainly part of our development strategy."*

### 30% OF THE TURNOVER FROM EXPORT

Half of Emixis' exports go to Germany, Switzerland and Austria, while the other half goes to numerous African countries such as Ivory Coast, the Democratic Republic of Congo and Rwanda as well as many others. "We are very active in trying to develop these African countries because, while they are relatively difficult in terms of commercial development, the market needs there are huge". To do this, the company requires the support of a local distributor given the technical installation required on each vehicle to be equipped.

The company also took part in one of the Belgian economic missions organised by the Belgian Foreign Trade Agency and the Regions in Ivory Coast, which allowed it to gain a large number of very varied contacts in just a few days. In addition, Emixis also benefits

from the positive momentum of meetings with other Belgian companies that took part in the mission. "For us, economic missions are certainly part of our development strategy".

### WILL GEO-POSITIONING SOON BE AVAILABLE FOR OTHER OBJECTS AS WELL?

At present, geo-positioning is still focused on large objects such as vehicles or containers. Thousands of objects and tools are not geo-positioned and the CEO of Emixis sees a great development opportunity here. According to him, in the construction sector, nearly 10% of a company's equipment is stolen every year and 30% of this equipment is nowhere to be found. This is why Emixis is trying to offer its customers geo-positioning solutions that can also be applied to tools and equipment. "I think that one of the elements of future market growth and innovation is to offer geo-positioning solutions that can geotag things that are less valuable, such as tools", explains Didier Bennert. Today, Emixis is also interested in leveraging the power of mobile phones and tablets to track and manage mobile staff better. "For me, it's amazing to be able to know at a specific moment where someone or something is, and we are still in the early stages of the potential uses of geo-positioning and what it can provide in terms of helping our customers focus on their core competencies in the best way possible".



INTERVIEW WITH  
**Jan Van Hees,**  
*Business Development Director*

SERVICES & APPLICATIONS

COMPANY

**Septentrio**

REGION

**Flanders**

Date of foundation: 2000

Locations: Office in Los Angeles since 2006, offices in Shanghai, Tokyo and Hong Kong, and staff in Australia and the Netherlands.

Number of employees: just over 100, 80 of which are working in Belgium

Turnover: 25 million EUR/ 30 million USD

Growth figures: 25%-30%

Start of exports: 2000



Septentrio manufactures localisation technology for use in industrial applications based on American (GPS), European (Galileo), Russian (Glonass) and Chinese (Beidou) satellite systems, collectively referred to as GNSS (Global Navigation Satellite Systems). Septentrio's applications are based on three strengths: accuracy, robustness and reliability. Thanks to these properties, Septentrio's technology is used in a wide range of solutions, from farmers efficiently planting potatoes to NASA recording "the time".

**LOCATION, LOCATION, LOCATION**

Septentrio's positioning has an accuracy to within one centimetre, which is roughly 250 times more accurate than a GPS on a mobile phone. When it is impossible to determine the position with such accuracy, for example between large buildings, Septentrio's technology indicates what the error margin is. This is all the more important when the technology directly controls machines.

The robustness of Septentrio's systems means undesired interference signals do not affect performance. "GPS is in fact a weak signal hidden under a lot of noise", explains Jan Van Hees, Business Development Director at Septentrio. "Not only are there increasingly mobile devices that can interfere with the signal, ever more people are wilfully

trying to do exactly this with a jammer. If they plug a jammer into their vehicle the signal is disrupted, and they can escape a road toll payment, for example. A jammer not only disturbs the signal around the vehicle in question, its effect continues for hundreds of metres. We have designed special technology to circumvent this interference", says Van Hees.

Septentrio is also a specialist in building this technology in solutions with very low power consumption so lightweight solutions can be offered. This also explains why the Belgian company has such a strong position in the emerging drone market where weight is an important factor." In the last three years the focus in the drone market has switched from the flying itself to flying to generate data and incorporate it in workflows. We have replaced the first wave of GPSs on drones, because in combination with cameras or other appliances they were not accurate or robust enough against interference for high-performance measurement and inspection observations. Last year our growth in this segment amounted to more than 300%, and we only see this trend continuing", says Van Hees.

Septentrio counts on the microchips it has developed itself, also called ASICs, to achieve the performance level it now has for accuracy, robustness and low power consumption. This ASIC is the critical central component to convert a satellite signal into a measurement





that can be used to calculate a position. The microchips are built into modules to realise complete satellite navigation receiver modules. "If you connect an antenna to these receivers you can determine the position", says Van Hees. Septentrio's customers connect these receiver modules to computers and control systems. Software is then added to create complete solutions.

### ON EARTH AS IN HEAVEN

"Few companies are able to do what we can", says Van Hees. "We operate in a sector with a relatively high entry threshold because getting everything out of the signal requires great expertise and intellectual property that you won't find in books." Septentrio can count on imec, one of the most important R&D centres in the world in the field of microchips, to realise the ASICs that form the heart of the system. The company also draws much expertise from the many projects for the European Space Agency (ESA). Septentrio itself was launched as a spin-off of imec when the project to prepare the launch of the European Galileo navigation system was started in the nineties.

In the meantime, ESA has continued to be an important Septentrio customer. This offers the opportunity to develop technology, further strengthen Septentrio's reputation and secure stability through long-term commitments. The company has also built up a strong reputation in the scientific sector. This includes Septentrio being a market leader in defining "the time" in the world. "A number of super-accurate clocks at different institutes across the whole world run synchronously with GPS technology. We serve institutions such as NASA and the American National Institute of Standards and Technology and the Royal Observatory of Belgium which all define the standard time", explains Van Hees.

*"Last year our growth in the drone market amounted to more than 300%, and we only see this trend continuing"*

Besides these scientific applications, Septentrio has also looked at commercial options right from the start. Industrial customers account for the majority of Septentrio's turnover today. "One of our first customers was an agricultural business", recalls Van Hees. "They were already working on automation and self-driving tractors for more efficiency gains at the start of this century." Agriculture is still one of the main subsectors, together with drones, maritime applications and construction. Today GPS has become so familiar that more and more people are seeing opportunities in their professional environments.

### CUSTOMERS ACROSS THE WHOLE WORLD

The constant expansion of the market means Septentrio's volumes are also increasing and R&D costs are recovered more quickly. That also benefits exports. Belgium is an important market with its world-leading dredging companies that use Septentrio products, but most of the sales are international. Van Hees estimates that 50% to 60% of the turnover still comes from within Europe. "Belgium is still seen as the centre of Europe, and we are also the only European player with this advanced technology. We are often asked by European partners to form part of international consortia", says Van Hees.

Septentrio is also slowly but surely making a name for itself beyond Europe. The office in Los Angeles was opened in 2006. The start was not easy,

as it is the home market of some important competitors and the place where GPS originally started, but over the past three years the American market has really boomed for Septentrio. "Entering the lion's den is not something to take on lightly, but we have acquired a number of important reference contracts in recent years. We have also secured other projects in its slip stream", continues Van Hees. Now the United States accounts for a quarter of the group's turnover.

### ONLY GETTING STARTED

Now the United States is up and running, Septentrio is looking further afield. New offices have been established in Shanghai and Tokyo to further bolster existing business in Asia, along with the start of prospecting in Latin America. Septentrio was able to secure a reference contract for the Brazilian mining giant Vale, with many other opportunities beckoning in mining. Oceania is also being further explored. In this push for expansion, the company is supported at financial/logistic level by a number of organisations such as FLAG and FIT.

Jan Van Hees has every confidence in the future. "The development of smart algorithms and the extensive availability of data means GPS can be used in places where this was not possible before. Examples include GPS-controlled guidance for the blind and partially sighted. And GNSS is the only technology we have today that enables absolute positioning anywhere in the world based on infrastructure (satellites) that is already there. That is why it will continue to play a central role in everything to do with location-based services, and it will be extended with other technologies in the Internet of Things. We are still only at the start of tapping into the vast range of possibilities."



INTERVIEW WITH  
**Thierry du Pré-Werson,**  
*Managing Director*

SERVICES & APPLICATIONS

COMPANY

Spacebel

REGION

Wallonia

Date of foundation: 1988

Location: headquarters in Liege (Belgium),  
 a site in Brussels (Hoeilaart - Belgium),  
 subsidiaries in Toulouse (France)  
 and Warsaw (Poland)

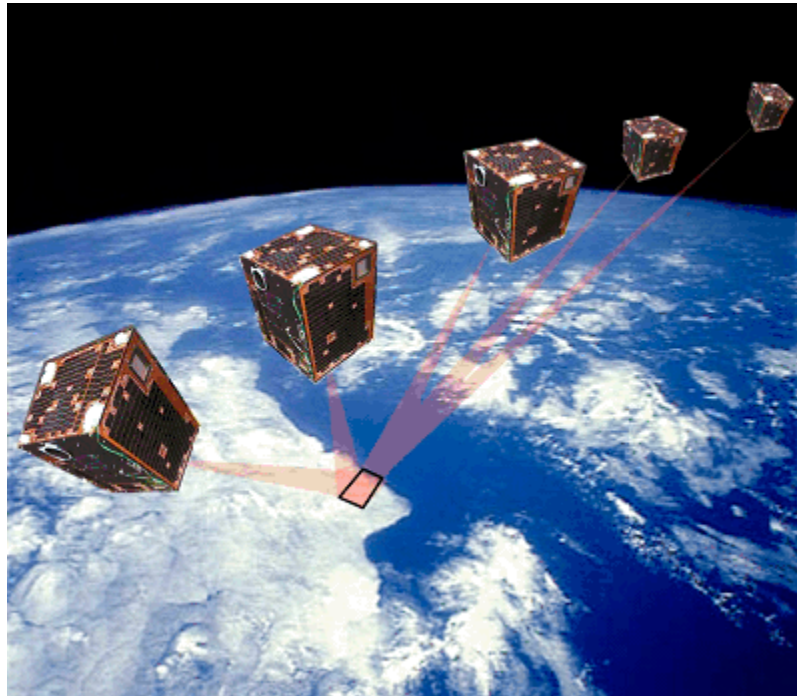
Number of employees: 100

Turnover (2017): approx. 12 million EUR

Growth (2017): 3 to 4% a year  
 on average over the last 5 years

Export: 95% of the turnover  
 (11.4 million EUR)

Awards: La Marianne de Cristal 2007,  
 Agoria - Bravo l'industrie 2009,  
 ESA Group Achievement Award 2011,  
 Cité des Métiers Label 2014,  
 Trends Gazelles 2018



© Spacebel

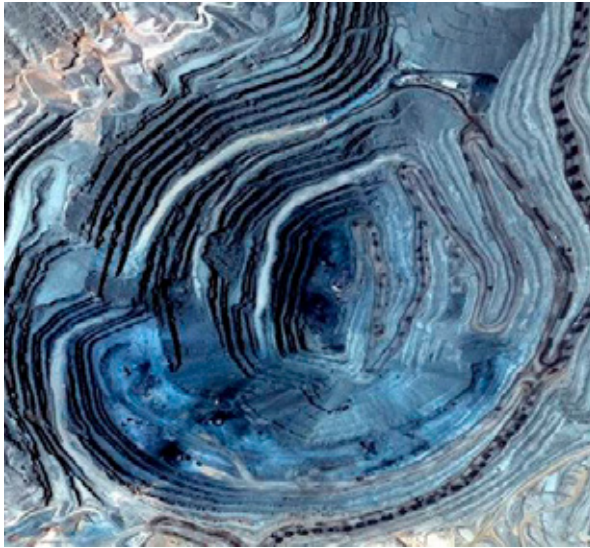
Spacebel was founded in 1988 by a group of Belgian and French shareholders gathering the French Matra Marconi Space (the current Airbus group), the Belgian company Informabel (formerly the Telfino group) and the Belgian Société de Développement Spatial (SDS). Three decades later, and after several reshuffles, the shareholding of the company is now 100% Belgian, combining public authorities and private investors.

From the outset, the core business of Spacebel has been focused on software development for space infrastructures such as satellites, launchers, probes, control and mission centres. Over a period of thirty years, the company has brought its know-how to about forty space missions. 17 years ago, in cooperation with the Flemish company QinetiQ Space, Spacebel made a major contribution to the oldest satellite of the European Space Agency (ESA) still in operation: the Earth observation PROBA-1 minisatellite "made in Bel-

gium". Subsequently, Spacebel has gradually concentrated on the field of space applications. At present, 95% of the company turnover is generated from exports. Major national and international space agencies, in particular ESA and CNES (France), feature among its main customers. Spacebel is also serving prime aerospace companies - e.g. Airbus, OHB, Thales, QinetiQ, ... - European institutions, various administrations and ministries as well as the commercial sector.

**SPACEBEL,  
 A KEY PLAYER  
 IN THE APPLICATIONS  
 SECTOR**

Already very active in the field of Earth observation satellites thanks to its innovative IT solutions, Spacebel extended its area of activity to the enhancement of satellite images at the end of the 1990s. The Earth observation services and applications offered by Spacebel aim, for instance, to support



© Spacebel



© Spacebel

forest management, natural hazards management such as floods and ground movements, agriculture, environmental quality management and mining.

The collected data are transformed into so-called “accessible” data, then re-worked before being sent to the various end-users: farmers, foresters, bankers or decision-makers within an administration.

Thierry du Pré-Werson, Managing Director of Spacebel, explains: “Spacebel is not skilled in all different application domains. That is why we rely on a network of experts who advise us in the development of our geospatial information systems and services.”

Thanks to the mastery of the entire value chain, Spacebel stands out in its field and has the ability to offer a tailor-made solution to each of its customers. The company understands the needs of its customers and formalises them into “system” constraints.

### APPLICATIONS, A SECTOR OF THE FUTURE

The boom in the field of applications looks very promising. That is why Spacebel is getting more and more involved in it. Belgium has engaged in the European Union’s Copernicus programme for real-time Earth observation and monitoring. It relies mainly on the Sentinel satellites, which provide sustainable, very high-quality data cov-

*“Belgium is one of the leading countries in the European space industry”*

ering the entire globe every week. Belgium thus hopes to boost its economy in the sector of applications.

“In the coming years, the space applications sector is likely to grow thanks to the constant availability of these data”, points out the Managing Director of Spacebel. “This will allow European companies and Belgian companies in particular to develop their exports by selling services worldwide.”

### BELGIUM: A COUNTRY MOST ACTIVE IN SPACE

At its founding, Spacebel was established in Belgium because the country was already investing significantly in the space sector at the time, while offering solid training in space technologies. “Belgium is one of the leading countries in the European space industry”, states Mr du Pré-Werson. With an annual funding of about 200 million EUR, Belgium has been for several years the 5<sup>th</sup> largest contributor to ESA behind France, Germany, Italy and the United Kingdom. “This major investment has enabled Belgian space companies to become market leaders in Europe.” In

addition, Belgium stands out for its long-term commitment to the space sector, which our country considers as a growth sector with a bright future.

### MAJOR FUTURE PROJECTS

In order to enlarge its offer, Spacebel aims to achieve external growth, particularly in the field of Earth observation and hence the space applications sector. “We hope to double our turnover by 2025. Given the specific characteristics of the sector, we have to diversify which means that we should acquire new skills and companies”, says Mr du Pré-Werson. In addition, the company is targeting another strategic axis for accelerating its expansion: the integration of satellite equipment.

Along with the geolocation and telecommunications industries, Earth observation is about to enter the era of commercialisation, according to the Managing Director of Spacebel. This introduction into the commercial market could be game-changing for the space sector in general given the exponential speed at which technologies advance when it comes to achieving business objectives.

The advent of satellite constellations, a sector in which Spacebel definitely intends to play a role, is a perfect example: the huge number of “identical” satellites forces us to rethink the design and manufacturing processes from A to Z.

3:05

C1

On T

On T

4:20

C19

On T

11:00

C6

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1:35

D7

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10:35

D1

On T

2:35

C9

On T

10:20

D5

On T

7:30

C12

Boar

On T

8:00

D7

On T

D4

T





This directory is not exhaustive. For more information please contact Flanders Investment & Trade (FIT), Brussels Invest & Export by hub.brussels, Wallonia Export - Investment Agency (AWEX) or the Belgian federations (see Chapter 1, Section 4)

ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
3M BELGIUM	1831	Diegem (Machelen)	Flanders	<a href="http://www.3m.be">www.3m.be</a>		•			
A.C.B. - ADVANCED CIRCUIT BOARDS	9200	Dendermonde	Flanders	<a href="http://www.acb.be">www.acb.be</a>			•	•	
A.E. PETSCHÉ BELGIUM	2300	Turnhout	Flanders	<a href="http://www.aepetsche.com">www.aepetsche.com</a>			•	•	
A.R.W.A.C.	1050	Ixelles	Brussels	<a href="http://www.arwac.be">www.arwac.be</a>	•	•	•		
ACTE	4430	Ans	Wallonia	<a href="http://www.acte-sa.be">www.acte-sa.be</a>			•	•	
ADB	1930	Zaventem	Flanders	<a href="http://www.adb-airfieldsolutions.com">www.adb-airfieldsolutions.com</a>				•	
ADDIPARTS	6040	Jumet	Wallonia	<a href="http://www.addiparts.com">www.addiparts.com</a>		•		•	
ADVANCED COATING	4000	Liège	Wallonia	<a href="http://www.advanced-coating.com">www.advanced-coating.com</a>		•		•	
ADVIONICS	8020	Oostkamp	Flanders	<a href="http://www.advionics.be">www.advionics.be</a>		•	•	•	•
AE VALVES	4800	Petit-Rechain	Wallonia	<a href="http://www.ae-valves.com">www.ae-valves.com</a>			•		•
AERIANE	5030	Gembloux	Wallonia	<a href="http://www.aeriane.com">www.aeriane.com</a>		•		•	
AERO CONSULTING & TRADING COMPANY	9940	Evergem	Flanders	<a href="http://www.actc-aero.com">www.actc-aero.com</a>				•	
AERO SIMULATORS GROUP	9111	Sint-Niklaas	Flanders	<a href="http://www.aerosimulators.com">www.aerosimulators.com</a>	•				
AEROCIRCULAR®	8400	Oostende	Flanders	<a href="http://www.aerocircular.green">www.aerocircular.green</a>				•	
AEROFLEET	4630	Soumagne	Wallonia	<a href="http://www.aerofleet.be">www.aerofleet.be</a>		•		•	
AERO-SENSE	8800	Roeselare	Flanders	<a href="http://www.aero-sense.com">www.aero-sense.com</a>	•			•	
AETHIS	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.aethis.com">www.aethis.com</a>	•				•
AIRCRAFT TRADERS BELGIUM	4680	Oupeye	Wallonia	<a href="http://www.atbelgium.com">www.atbelgium.com</a>			•	•	
AIR-CRAFTGLASS PRODUCTION	2300	Turnhout	Flanders	<a href="http://www.air-craftglass.com">www.air-craftglass.com</a>		•		•	
AKKA BENELUX	1140	Evere	Brussels	<a href="http://www.akka-technologies.com">www.akka-technologies.com</a>		•	•	•	
AKKA BENELUX	1420	Braine-l'Alleud	Wallonia	<a href="http://akka-benelux.eu">akka-benelux.eu</a>		•	•	•	•
ALTRAN BELGIUM	1150	Woluwe St-Pierre	Brussels	<a href="http://www.altran.com">www.altran.com</a>	•			•	
ALX SYSTEMS	4460	Grace-Hollogne	Wallonia	<a href="http://www.alxsys.com">www.alxsys.com</a>			•	•	
AMOS	4031	Angleur	Wallonia	<a href="http://www.amos.be">www.amos.be</a>		•	•		•
AMS BELGIUM	3740	Bilzen	Flanders	<a href="http://www.ams-innovation.com">www.ams-innovation.com</a>				•	

ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
AMT-TITASTAR	9880	Aalter	Flanders	<a href="http://www.amttitastar.com">www.amttitastar.com</a>		•		•	
ANTWERP LION OIL WORKS	2000	Antwerpen	Flanders	<a href="http://www.lionoil.be">www.lionoil.be</a>				•	
ANTWERP SPACE	2660	Antwerpen	Flanders	<a href="http://www.antwerpSPACE.be">www.antwerpSPACE.be</a>		•	•		•
ANY-SHAPE	4400	Flémalle	Wallonia	<a href="http://www.any-shape.com">www.any-shape.com</a>		•		•	
APS - AGENCE PREVENTION ET SECURITE	6900	Marche-en-Famenne	Wallonia	<a href="http://www.aps-marche.be">www.aps-marche.be</a>	•				•
ASCO INDUSTRIES	1930	Zaventem	Flanders	<a href="http://www.asco.be">www.asco.be</a>		•		•	
BAGAAR	2018	Antwerpen	Flanders	<a href="http://bagaar.be">bagaar.be</a>				•	
BALTEAU NDT	4681	Hermalle sous Argenteau	Wallonia	<a href="http://www.balteau.com">www.balteau.com</a>		•		•	
BAM CONTRACTORS	1120	Neder-Over-Heembeek	Brussels	<a href="http://www.bamcontractors.be">www.bamcontractors.be</a>			•	•	•
BARCO SILEX	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.barco-silex.com">www.barco-silex.com</a>			•	•	•
BELGIAN ADVANCED TECHNOLOGY SYSTEMS	4031	Angleur	Wallonia	<a href="http://www.bats.be">www.bats.be</a>	•			•	
BELGIBO	2000	Antwerpen	Flanders	<a href="http://www.belgibo.be">www.belgibo.be</a>				•	
BELGIUM ENGINE CENTER (BEC)	4041	Herstal	Wallonia	<a href="http://www.bec.eu.com">www.bec.eu.com</a>		•		•	•
BMT AEROSPACE INTERNATIONAL	8020	Oostkamp	Flanders	<a href="http://www.bmtaerospace.com">www.bmtaerospace.com</a>		•		•	
BODAIR	4681	Oupeye	Wallonia	<a href="http://www.bodair.com">www.bodair.com</a>		•		•	•
BRACQUENÉ LEGAL CONSULTING	3001	Leuven	Flanders	<a href="http://www.bracquene.be">www.bracquene.be</a>					•
BRIDGESTONE AIRCRAFT TIRE (EUROPE)	7080	Frameries	Wallonia	<a href="http://www.bridgestone.be">www.bridgestone.be</a>		•		•	
BRITTE-MUSTAD	4683	Vivegnis (Oupeye)	Wallonia	<a href="http://www.britte.be">www.britte.be</a>		•		•	•
BRUSPACE	1030	Schaerbeek	Brussels	<a href="http://www.agoria.be/en/bruspace">www.agoria.be/en/bruspace</a>	•				•
BRUSSELS SOUTH CHARLEROI AIRPORT	6041	Gosselies	Wallonia	<a href="http://www.charleroi-airport.com">www.charleroi-airport.com</a>	•			•	
CADALTRO	2230	Herselt	Flanders	<a href="http://www.cadaltro.com">www.cadaltro.com</a>				•	
CAE CENTER BRUSSELS	1820	Melsbroek (Steenokkerzeel)	Flanders	<a href="http://www.cae.com">www.cae.com</a>				•	
CAELESTE CVBA	2800	Mechelen	Flanders	<a href="http://www.caeleste.be">www.caeleste.be</a>			•		•
CAPPAUL	4700	Eupen	Wallonia	<a href="http://www.cappaul.be">www.cappaul.be</a>		•		•	
CARPENTER TECHNOLOGY EUROPE	1435	Mont-Saint-Guibert	Wallonia	<a href="http://www.carttech.com">www.carttech.com</a>		•		•	
CEGELEC	6041	Gosselies	Wallonia	<a href="http://www.cegelec.be">www.cegelec.be</a>	•			•	•
CENAERO	6041	Gosselies	Wallonia	<a href="http://www.cenaero.be">www.cenaero.be</a>	•	•		•	•
CENTRE SPATIAL DE LIÈGE (CSL)	4031	Angleur	Wallonia	<a href="http://www.csl.ulg.ac.be">www.csl.ulg.ac.be</a>	•	•	•		•
CETIC	6041	Gosselies	Wallonia	<a href="http://www.cetic.be">www.cetic.be</a>	•		•	•	•
CEVEMA SURFACE TREATMENTS	3560	Lummen	Flanders	<a href="http://www.cevema.be">www.cevema.be</a>		•		•	
CISSOID	1435	Mont-Saint-Guibert	Wallonia	<a href="http://www.cissoid.com">www.cissoid.com</a>			•	•	•
CITIUS ENGINEERING	4040	Herstal	Wallonia	<a href="http://www.citius-engineering.com">www.citius-engineering.com</a>	•	•		•	•
CMI INDUSTRY	4100	Seraing	Wallonia	<a href="http://www.cmigroupe.com">www.cmigroupe.com</a>		•		•	
CMOSIS BVBA	2600	Antwerpen	Flanders	<a href="http://www.cmosis.com">www.cmosis.com</a>			•		•
COEXPAIR	5020	Namur	Wallonia	<a href="http://www.coexpair.com">www.coexpair.com</a>		•		•	
CONDORCET (HAUTE ECOLE PROVINCIALE DU HAINAUT)	7000	Mons	Wallonia	<a href="http://www.condorcet.be">www.condorcet.be</a>		•	•	•	

ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
CONSOLIDATED PRECISION PRODUCTS (CPP) BELGIUM	4040	Herstal	Wallonia	<a href="http://www.cppcorp.com">www.cppcorp.com</a>		•		•	
CRA-W	5030	Gembloux	Wallonia	<a href="http://www.cra.wallonie.be">www.cra.wallonie.be</a>	•				•
CRC (CENTRE DE RESSOURCES DU CYCLOTRON)	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.cyc.ucl.ac.be">www.cyc.ucl.ac.be</a>			•		•
CREACTION	6747	Saint-Leger	Wallonia	<a href="http://www.creaction.be">www.creaction.be</a>	•				•
CRIBC	7000	Mons	Wallonia	<a href="http://www.bcrc.be">www.bcrc.be</a>		•		•	•
CRM GROUP	4000	Liège	Wallonia	<a href="http://www.crmgroup.be">www.crmgroup.be</a>		•		•	•
DARDENNE	4682	Heure-le-Romain	Wallonia	<a href="http://www.dardenne-meca.com">www.dardenne-meca.com</a>		•		•	
DEJOND	2610	Wilrijk	Flanders	<a href="http://www.dejond.com">www.dejond.com</a>		•		•	
DELTA SERVICES INDUSTRIELS	7503	Froyennes	Wallonia	<a href="http://www.deltabeam.net">www.deltabeam.net</a>		•		•	•
DELTATEC	4430	Ans	Wallonia	<a href="http://www.deltatec.be">www.deltatec.be</a>			•	•	•
DEPICON	9870	Zulte	Flanders	<a href="http://www.depicon.com">www.depicon.com</a>	•			•	
DEUFOL BELGIË	3300	Tienen	Flanders	<a href="http://www.deufol.com">www.deufol.com</a>				•	
DH CONSULTANCY BVBA	3000	Leuven	Flanders	<a href="http://www.dhconsultancy.com">www.dhconsultancy.com</a>					•
DONCASTERS SETTAS	6040	Jumet	Wallonia	<a href="http://www.doncasters.com/manufacturing-facilities/europe/doncasters-settas/">www.doncasters.com/ manufacturing-facilities/europe/ doncasters-settas/</a>		•		•	
DRONE VALLEY	6800	Libramont	Wallonia	<a href="http://www.drone-valley.com">www.drone-valley.com</a>	•			•	
DRONEMATRIX NV	3590	Diepenbeek	Flanders	<a href="http://www.dronematrix.eu">www.dronematrix.eu</a>	•			•	
DRONEPORT NV	3500	Hasselt	Flanders	<a href="http://www.droneport.eu">www.droneport.eu</a>				•	
DUMOULIN AERO	4432	Alleur	Wallonia	<a href="http://www.dumoulin-aero.com">www.dumoulin-aero.com</a>		•		•	
DYNALI	1402	Thines	Wallonia	<a href="http://www.dynali.com">www.dynali.com</a>		•	•	•	
E.S. TOOLING	3600	Genk	Flanders	<a href="http://www.estooling.eu">www.estooling.eu</a>		•		•	•
ECOLE ROYALE MILITAIRE - KONINKLIJKE MILITAIRE SCHOOL	1000	Brussels	Brussels	<a href="http://www.rma.ac.be">www.rma.ac.be</a>	•	•	•	•	•
ELCOS	2240	Massenhoven	Flanders	<a href="http://www.elcos.be">www.elcos.be</a>				•	
ELSYCA	3018	Leuven	Flanders	<a href="http://www.eslyca.com">www.eslyca.com</a>				•	
EMIXIS	1130	Haren	Brussels	<a href="http://www.emixis.com">www.emixis.com</a>	•	•	•		•
ENTREPRISES WALLONNES DE L'AERONAUTIQUE (EWA)	1300	Wavre	Wallonia	<a href="http://www.ewa.be">http://www.ewa.be</a>	•	•	•	•	
EREM	6001	Marcinelle	Wallonia	<a href="http://www.ere.be">www.ere.be</a>			•	•	•
EROLEC	5650	Chastres	Wallonia	<a href="http://www.erolec.be">www.erolec.be</a>		•		•	•
ESNAH	6900	Marche-en-Famenne	Wallonia	<a href="http://www.skyliberty.com">www.skyliberty.com</a>	•			•	
ESPACE D (ESPAEDRONE)	1435	Corbais	Wallonia	<a href="http://www.espacedrone.be">www.espacedrone.be</a>	•			•	
ESTERLINE BELGIUM	8500	Kortrijk	Flanders	<a href="http://www.esterline.com">www.esterline.com</a>			•	•	
ETIENNE BONNE FORTUNE	4460	Grâce-Hollogne	Wallonia			•		•	
EUKA	3500	Hasselt	Flanders	<a href="http://www.euka.org">www.euka.org</a>	•			•	
EURAMEC	9220	Hamme	Flanders	<a href="http://www.euramec.com">www.euramec.com</a>			•	•	

ENTITY NAME	ZIP	CITY	REGION	WEBSITE						SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
EURO HEAT PIPES (EHP)	1400	Nivelles	Wallonia	<a href="http://www.ehp.be">www.ehp.be</a>										
EURO SPACE CENTER	6890	Transinne	Wallonia	<a href="http://www.eurospacecenter.be">www.eurospacecenter.be</a>										
EUROPEAN FEDERATION FOR DEVELOPMENT OF CIVIL DRONE	1060	Saint-Gilles	Brussels	<a href="http://www.efdc.com">www.efdc.com</a>										
EUROPEAN FUTURE STRUCTURES	3960	Bree	Flanders	<a href="http://www.veldemangroup.com">www.veldemangroup.com</a>										
EUROPEAN METROLOGY SYSTEMS	4041	Milmort	Wallonia	<a href="http://www.ems.be">www.ems.be</a>										
EUROPLASMA	9700	Oudenaarde	Flanders	<a href="http://www.europlasma.be">www.europlasma.be</a>										
EUROSENSE BELFOTOP NV	1780	Wemmel	Flanders	<a href="http://www.eurosense.com">www.eurosense.com</a>										
EWA-ENTREPRISES WALLONNES DE L'AERONAUTIQUE	1300	Wavre	Wallonia	<a href="http://www.ewa.be">www.ewa.be</a>										
E-XSTREAM ENGINEERING	1435	Mont-St-Guibert	Wallonia	<a href="http://www.e-xstream.com">www.e-xstream.com</a>										
FERONYL	7700	Mouscron	Wallonia	<a href="http://www.feronyl.com">www.feronyl.com</a>										
FIXAR	3580	Beringen	Flanders	<a href="http://www.fixar.eu">www.fixar.eu</a>										
FLAG	1030	Brussels	Brussels	<a href="http://www.flag.be">www.flag.be</a>										
FLYGGER	6870	St-Hubert	Wallonia	<a href="http://www.air-english.com">www.air-english.com</a>										
FLYING CAM	4681	Oupeye	Wallonia	<a href="http://www.flying-cam.com">www.flying-cam.com</a>										
FN HERSTAL	4040	Herstal	Wallonia	<a href="http://www.fnherstal.com">www.fnherstal.com</a>										
GDTECH ENGINEERING	4432	Alleur	Wallonia	<a href="http://www.gdtech.eu">www.gdtech.eu</a>										
GEONX	6041	Gosselies	Wallonia	<a href="http://www.geonx.com">www.geonx.com</a>										
GEVEDIMO GROUP BELGIUM	1070	Anderlecht	Brussels	<a href="http://www.gevedimo.com">www.gevedimo.com</a>										
GILLAM	4000	Liège	Wallonia	<a href="http://www.gillam.be">www.gillam.be</a>										
GIM	3001	Heverlee	Flanders	<a href="http://www.gim.be">www.gim.be</a>										
	5032	Gembloux	Wallonia	<a href="http://www.gim.be">www.gim.be</a>										
GRAFE	6200	Chatelet	Wallonia	<a href="http://www.e-grafe.be">www.e-grafe.be</a>										
GRANDO	1400	Nivelles	Wallonia	<a href="http://www.grandogroup.com">www.grandogroup.com</a>										
GRIMONPREZ TRANSMISSION GEARS	7711	Dottignies	Wallonia	<a href="http://www.grimonprez.com">www.grimonprez.com</a>										
H.S.H. AEROSPACE FINISHES	1731	Zellik	Flanders	<a href="http://www.hsh.be">www.hsh.be</a>										
H.T.M.S.	2800	Mechelen	Flanders	<a href="http://www.hightechmetalseals.com">www.hightechmetalseals.com</a>										
HAUTE ECOLE DE LA PROVINCE DE LIEGE	4100	Seraing	Wallonia	<a href="http://www.provincedeliege.be/hauteecole">www.provincedeliege.be/hauteecole</a>										
HEXCEL COMPOSITES	4840	Welkenraedt	Wallonia	<a href="http://www.hexcel.com">www.hexcel.com</a>										
HIGH TECH METAL SEALS	2800	Mechelen	Flanders	<a href="http://www.htms.be">www.htms.be</a>										
HIPPEROS	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.hipperos.com">www.hipperos.com</a>										
HONEYWELL	1831	Diegem (Machelen)	Flanders	<a href="http://www.honeywell.com">www.honeywell.com</a>										
IEMANTS	2370	Arendonk	Flanders	<a href="http://www.iemants.com">www.iemants.com</a>										
IE-NET INGENIEURSVVERENIGING	2018	Antwerpen	Flanders	<a href="http://www.ie-net.be">www.ie-net.be</a>										
ILIAS SOLUTIONS	1130	Haren	Brussels	<a href="http://www.ilias-solutions.com">www.ilias-solutions.com</a>										
I-MAGE CONSULT	5002	Saint-Servais	Wallonia	<a href="http://www.i-mage.be">www.i-mage.be</a>										

ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
IMEC	3001	Heverlee	Flanders	<a href="http://www.imec.be">www.imec.be</a>		•	•	•	•
INCIZE	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.incize.com">www.incize.com</a>			•		•
ISOMATEX	5032	Gembloux	Wallonia	<a href="http://www.isomatex.com">www.isomatex.com</a>		•		•	
ISSEP	4000	Liège	Wallonia	<a href="http://www.issep.be">www.issep.be</a>	•				•
IT-OPTICS	7000	Mons	Wallonia	<a href="http://www.it-optics.com">www.it-optics.com</a>	•	•		•	
JD'C INNOVATION	4460	Grace-Hollogne	Wallonia	<a href="http://www.jean-delcour.be">www.jean-delcour.be</a>		•		•	
JOSÉ VANCOILLIE	8560	Moorsele	Flanders	<a href="http://www.jose-vancoillie.be">www.jose-vancoillie.be</a>		•		•	
KARL HUGO	4770	Ambleve	Wallonia	<a href="http://www.karlhugo.com">www.karlhugo.com</a>		•		•	
KU LEUVEN	3000	Leuven	Flanders	<a href="http://www.kuleuven.be">www.kuleuven.be</a>		•	•	•	•
L EN D JET TECHNIEK	3290	Diest	Flanders	<a href="http://www.lendwaterjet.be">www.lendwaterjet.be</a>		•		•	
LA NITRURATION MODERNE	4000	Liège	Wallonia	<a href="http://www.lanitruration.be">www.lanitruration.be</a>		•		•	
LAMBDA-X	1400	Nivelles	Wallonia	<a href="http://www.lambda-x.com">www.lambda-x.com</a>			•		•
LASEA	4031	Angleur	Wallonia	<a href="http://www.lasea.eu">www.lasea.eu</a>		•		•	•
LAYERWISE	3001	Leuven	Flanders	<a href="http://www.layerwise.com">www.layerwise.com</a>		•		•	•
LEBRUN	7020	Nimy (Mons)	Wallonia	<a href="http://lebrun-nimy.be">lebrun-nimy.be</a>	•			•	
LESCAV	4000	Liège	Wallonia	<a href="http://www.lescav.be">www.lescav.be</a>		•		•	
LGM BELGIUM	4000	Liège	Wallonia	<a href="http://www.lgm.eu">www.lgm.eu</a>	•			•	
LIEGE AIRPORT	4460	Grace-Hollogne	Wallonia	<a href="http://www.liegeairport.com">www.liegeairport.com</a>	•	•	•	•	
LUCIAD	3001	Leuven	Flanders	<a href="http://www.luciad.com">www.luciad.com</a>	•			•	•
LUFTHANSA TECHNIK BRUSSELS	1820	Melsbroek (Steenokkerzeel)	Flanders	<a href="http://www.lufthansa-technik.com">www.lufthansa-technik.com</a>	•	•	•	•	
M3 SYSTEMS BELGIUM	1300	Wavre	Wallonia	<a href="http://www.m3systems.net">www.m3systems.net</a>	•		•		•
MACHINIMMO	9160	Lokeren	Flanders	<a href="http://www.machinimmo.com">www.machinimmo.com</a>				•	
MAEX PRECISION PRODUCTION	3520	Zonhoven	Flanders	<a href="http://www.maexnv.com">www.maexnv.com</a>		•		•	
MAGICS INSTRUMENTS	2400	Mol	Flanders	<a href="http://www.magics.tech">www.magics.tech</a>			•		•
MANGOGEM	1090	Jette	Brussels	<a href="http://www.mangogem.com">www.mangogem.com</a>	•			•	•
MATCHID	9031	Gent	Flanders	<a href="http://www.matchidmbc.com">www.matchidmbc.com</a>				•	
MATERIA NOVA	7000	Mons	Wallonia	<a href="http://www.materianova.be">www.materianova.be</a>		•		•	
MATERIALISE	3001	Heverlee	Flanders	<a href="http://www.materialise.com">www.materialise.com</a>		•		•	
MAXESS	1180	Uccle	Brussels	<a href="http://www.maxessconsult.com">www.maxessconsult.com</a>	•				•
MC TECHNICS	4600	Visé	Wallonia	<a href="http://www.mctechnics.com">www.mctechnics.com</a>		•		•	•
MECASOFT	5537	Anhee	Wallonia	<a href="http://www.mecasoft.be">www.mecasoft.be</a>		•		•	
MECASPRING	4040	Herstal	Wallonia	<a href="http://www.mecaspring.be">www.mecaspring.be</a>		•		•	
METAL FORMING	4400	Flemalle	Wallonia			•		•	
MICROMEGA - DYNAMICS	5380	Fernelmont	Wallonia	<a href="http://www.micromega-dynamics.com">www.micromega-dynamics.com</a>		•			•
MICROTHERM	9100	Sint-Niklaas	Flanders	<a href="http://www.microtherm.be">www.microtherm.be</a>		•		•	
MOCKEL	4837	Baelen	Wallonia	<a href="http://www.mockel-precision.be">www.mockel-precision.be</a>		•		•	
MOSS COMPOSITES	9160	Lokeren	Flanders	<a href="http://www.mosscomposites.be">www.mosscomposites.be</a>		•		•	

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MSC SOFTWARE BELGIUM (EX-FREE FIELD TECHNOLOGIES)	1435	Mont-Saint-Guibert	Wallonia	<a href="http://www.fft.be">www.fft.be</a>	•	•	•	•	•
MUBEAS SYSTEMS	7700	Mouscron	Wallonia	<a href="http://www.mubeasystems.com">www.mubeasystems.com</a>	•	•	•	•	•
MULTITEL	7000	Mons	Wallonia	<a href="http://www.multitel.be">www.multitel.be</a>	•	•	•	•	•
MUSTAD BELGIUM	4700	Eupen	Wallonia	<a href="http://www.mustad.be">www.mustad.be</a>	•	•	•	•	•
NADIN MOTOR	4020	Liège	Wallonia	<a href="http://www.nadin-mathonet.be">www.nadin-mathonet.be</a>	•	•	•	•	•
NANOCYL	5060	Auvelais	Wallonia	<a href="http://www.nanocyl.com">www.nanocyl.com</a>	•	•	•	•	•
NETALUX	3550	Heusden - Zolder	Flanders	<a href="http://www.netalux.com">www.netalux.com</a>	•	•	•	•	•
NEWTEC	9100	Sint-Niklaas	Flanders	<a href="http://www.newtec.eu">www.newtec.eu</a>	•	•	•	•	•
NITTO EUROPE	3600	Genk	Flanders	<a href="http://www.nittoeurope.com">www.nittoeurope.com</a>	•	•	•	•	•
NOORDZEE HELICOPTERS VLAANDEREN	8400	Oostende	Flanders	<a href="http://www.nhv.be">www.nhv.be</a>	•	•	•	•	•
NRB	4040	Herstal	Wallonia	<a href="http://www.nrb.be">www.nrb.be</a>	•	•	•	•	•
NUMECA INTERNATIONAL	1170	Watermael-Boitsfort	Brussels	<a href="http://www.numeca.com">www.numeca.com</a>	•	•	•	•	•
NUMFLO	7000	Mons	Wallonia	<a href="http://www.numflo.eu">www.numflo.eu</a>	•	•	•	•	•
NYCO-STPC	7503	Froyennes	Wallonia	<a href="http://www.nyco.fr/la-societe/site-de-production/">www.nyco.fr/la-societe/ site-de-production/</a>	•	•	•	•	•
OPTIMAL AIRCRAFT DESIGN (OAD)	5020	Namur	Wallonia	<a href="http://www.oad.aero">www.oad.aero</a>	•	•	•	•	•
OIP SENSOR SYSTEMS	9700	Oudenaarde	Flanders	<a href="http://www.oip.be">www.oip.be</a>	•	•	•	•	•
ONSEMI BVBA	9700	Oudenaarde	Flanders	<a href="http://www.onsemi.com">www.onsemi.com</a>	•	•	•	•	•
OPEN-ENGINEERING	4102	Seraing	Wallonia	<a href="http://www.open-engineering.com">www.open-engineering.com</a>	•	•	•	•	•
OPTIMAL COMPUTING	7034	Saint Denis (Mons)	Wallonia	<a href="http://www.optimalcomputing.be">www.optimalcomputing.be</a>	•	•	•	•	•
OPTIMAL DESIGN	1050	Ixelles	Brussels	<a href="http://www.optimaldesign.com">www.optimaldesign.com</a>	•	•	•	•	•
OPTIMUM CPV	3520	Zonhoven	Flanders	<a href="http://optimumcpv.com/">optimumcpv.com/</a>	•	•	•	•	•
OPTRION	4031	Angleur	Wallonia	<a href="http://www.optrion-tech.com">www.optrion-tech.com</a>	•	•	•	•	•
ORBAN MICROWAVE PRODUCTS	3018	Leuven	Flanders	<a href="http://www.orbanmicrowave.com">www.orbanmicrowave.com</a>	•	•	•	•	•
OSCARS BELGIQUE	5300	Andenne	Wallonia	<a href="http://www.oscars-sa.eu">www.oscars-sa.eu</a>	•	•	•	•	•
PEGARD PRODUCTICS	5300	Andenne	Wallonia	<a href="http://www.pegard.com">www.pegard.com</a>	•	•	•	•	•
POLMANS	4600	Visé	Wallonia	<a href="http://www.polmans.be">www.polmans.be</a>	•	•	•	•	•
PRECIMETAL	7180	Seneffe	Wallonia	<a href="http://www.precimetal.com">www.precimetal.com</a>	•	•	•	•	•
PROMAT - MICROTHERM	9100	Sint-Niklaas	Flanders	<a href="http://www.promat-industry.com">www.promat-industry.com</a>	•	•	•	•	•
PRONOVEM	4020	Liège	Wallonia	<a href="http://www.pronovem.com">www.pronovem.com</a>	•	•	•	•	•
Q3S	1400	Nivelles	Wallonia	<a href="http://www.q3s.com">www.q3s.com</a>	•	•	•	•	•
QINETIQ SPACE	9150	Kruikeke	Flanders	<a href="http://www.qinetiq.be">www.qinetiq.be</a>	•	•	•	•	•
Q-SQUARE AEROSPACE	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.qsquare.be">www.qsquare.be</a>	•	•	•	•	•
RAYTECH	8200	Brugge	Flanders	<a href="http://www.raytech.be">www.raytech.be</a>	•	•	•	•	•
REDU SPACE SERVICES	6890	Transinne	Wallonia	<a href="http://www.redspaceservices.com">www.redspaceservices.com</a>	•	•	•	•	•
RHEA GROUP	1300	Wavre	Wallonia	<a href="http://www.rheagroup.com">www.rheagroup.com</a>	•	•	•	•	•



ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
RIDGETOP EUROPE	8200	Brugge	Flanders	<a href="http://www.ridgetop.eu">www.ridgetop.eu</a>				•	
ROGERS CORPORATION	9940	Gent	Flanders	<a href="http://www.rogerscorp.com">www.rogerscorp.com</a>		•		•	
ROVI-TECH	6250	Presles	Wallonia	<a href="http://www.rovitech.com">www.rovitech.com</a>		•		•	
SABCA	1130	Brussels	Brussels	<a href="http://www.sabca.be">www.sabca.be</a>	•	•	•	•	•
	3560	Lummen	Flanders	<a href="http://www.sabca.be">www.sabca.be</a>		•	•	•	•
	6040	Gosselies	Wallonia	<a href="http://www.sabca.be">www.sabca.be</a>	•	•	•	•	
SABENA AEROSPACE ENGINEERING	1930	Zaventem	Flanders	<a href="http://www.sabena-aerospace.com">www.sabena-aerospace.com</a>	•	•		•	
SAFRAN AERO BOOSTERS (EX TECHSPACE AERO)	4041	Milmort (Herstal)	Wallonia	<a href="http://www.safran-aero-boosters.com">www.safran-aero-boosters.com</a>		•		•	•
SAGITA	4020	Wandre	Wallonia	<a href="http://www.sagita.be">www.sagita.be</a>		•	•	•	
SAINT-GOBAIN INNOVATIVE MATERIALS	2550	Kontich	Flanders	<a href="http://www.saint-gobain.com">www.saint-gobain.com</a>		•		•	
SANKYO TATEYAMA EUROPE (STEP/G)	2570	Duffel	Flanders	<a href="http://www.step-g.com">www.step-g.com</a>		•			
SATADSL	1000	Brussels	Brussels	<a href="http://www.satadsl.net">www.satadsl.net</a>	•				•
SCK-CEN	2400	Mol	Flanders	<a href="http://www.sckcen.com">www.sckcen.com</a>	•	•	•		•
SEA AND SPACE EXPLORATION	1050	Ixelles	Brussels	<a href="http://www.seaandspace.com">www.seaandspace.com</a>	•			•	•
SECO TOOLS BENELUX	1420	Braine-l'Alleud	Wallonia	<a href="http://www.secotools.com">www.secotools.com</a>		•		•	
SEPTENTRIO	3001	Heverlee	Flanders	<a href="http://www.septentrio.com">www.septentrio.com</a>	•		•	•	•
SETTAS	6040	Jumet (Charleroi)	Wallonia	<a href="http://www.doncasters.com">www.doncasters.com</a>		•			•
SHUR-LOK INTERNATIONAL	4800	Petit-Rechain	Wallonia	<a href="http://www.shur-lok.eu">www.shur-lok.eu</a>		•		•	•
SIEMENS (LMS) SAMTECH	4031	Angleur	Wallonia	<a href="http://www.plm.automation.siemens.com">www.plm.automation.siemens.com</a>	•	•		•	•
SIEMENS (LMS) SAMTECH	3001	Leuven	Flanders	<a href="http://www.plm.automation.siemens.com">www.plm.automation.siemens.com</a>		•	•	•	
SIMONIS PLASTIC	4430	Ans	Wallonia	<a href="http://www.simonis-plastic.be">www.simonis-plastic.be</a>		•		•	
SIMTECH	7503	Froyennes	Wallonia	<a href="http://www.simtech.be">www.simtech.be</a>		•		•	
SIRRIS	4102	Ougree	Wallonia	<a href="http://www.sirris.be">www.sirris.be</a>		•		•	•
	1030	Brussels	Brussels	<a href="http://www.sirris.be">www.sirris.be</a>				•	
SKYANGELS	7160	Chapelle-lez-Herlaimont	Wallonia				•	•	
SKYWASH	2800	Antwerpen	Flanders	<a href="http://www.DrywashAC.com">www.DrywashAC.com</a>		•		•	•
SKYWIN	1300	Wavre	Wallonia	<a href="http://www.skywin.be">www.skywin.be</a>	•	•	•	•	•
SOBELCOMP	4431	Loncin	Wallonia	<a href="http://www.sobelcomp.be">www.sobelcomp.be</a>		•		•	
SOLVAY SPECIALTY POLYMERS BELGIUM	1120	Brussels	Brussels	<a href="http://www.solvay.com">www.solvay.com</a>		•		•	
SONACA	6041	Gosselies	Wallonia	<a href="http://www.sonaca.com">www.sonaca.com</a>		•	•	•	•
SPACE APPLICATION SERVICES	1932	Zaventem	Flanders	<a href="http://www.spaceapplications.com">www.spaceapplications.com</a>	•		•		•
SPACEBEL	4031	Angleur	Wallonia	<a href="http://www.spacebel.com">www.spacebel.com</a>	•		•		•
	1560	Hoeilaart	Flanders	<a href="http://www.spacebel.be">www.spacebel.be</a>			•	•	•
TCR INTERNATIONAL	1820	Steenokkerzeel	Flanders	<a href="http://www.tcr-group.com">www.tcr-group.com</a>				•	
TEC4JETS	1930	Zaventem	Flanders	<a href="http://www.tec4jets.be">www.tec4jets.be</a>	•			•	
TECHNICAL AIRBORNE COMPONENTS (TAC)	4041	Milmort	Wallonia	<a href="http://www.tecairco.be">www.tecairco.be</a>		•		•	
TECHNIFUTUR	4102	Seraing	Wallonia	<a href="http://www.technifutur.be">www.technifutur.be</a>	•			•	



ENTITY NAME	ZIP	CITY	REGION	WEBSITE	SERVICES AND APPLICATIONS	ADVANCED MATERIALS & STRUCTURES	PLATFORMS & EMBEDDED SYSTEMS	AERO	SPACE
TECHNOCHIM	7822	Ghislenghien	Wallonia	<a href="http://www.technochim.eu">www.technochim.eu</a>	•			•	
TECNOLON WORKS	7700	Mouscron	Wallonia	<a href="http://www.tecnolon.com">www.tecnolon.com</a>		•		•	
TELEVIC GROUP, NV	8870	Izegem	Flanders	<a href="http://www.televic.com">www.televic.com</a>	•			•	
THALES ALENIA SPACE	3001	Heverlee	Flanders	<a href="http://www.thalesgroup.com">www.thalesgroup.com</a>		•	•		•
	6032	Mont-sur-Marchienne	Wallonia	<a href="http://www.thalesgroup.com">www.thalesgroup.com</a>			•		•
THALES BELGIUM	1480	Tubize	Wallonia	<a href="https://www.thalesgroup.com/en/homepage/belgium">https://www.thalesgroup.com/en/homepage/belgium</a>			•	•	
TIMELINK MICROSYSTEMS	1040	Brussels	Brussels	<a href="http://www.timelinkmicro.com">www.timelinkmicro.com</a>			•		•
TRESCAL	2600	Antwerpen	Flanders	<a href="http://www.trescal.com">www.trescal.com</a>				•	
UMICORE	1000	Brussels	Brussels	<a href="http://www.umicore.com">www.umicore.com</a>		•		•	•
	2250	Olen	Flanders	<a href="http://www.umicore.com">www.umicore.com</a>		•	•		•
UNIVERSITE CATHOLIQUE DE LOUVAIN	1348	Louvain-la-Neuve	Wallonia	<a href="http://www.ucl.ac.be">www.ucl.ac.be</a>	•	•	•	•	•
UNIVERSITE LIBRE DE BRUXELLES	1050	Brussels	Brussels	<a href="http://www.ulb.ac.be">www.ulb.ac.be</a>	•	•	•	•	•
UNIVERSITE DE LIEGE	4031	Liège	Wallonia	<a href="http://www.ulg.ac.be">www.ulg.ac.be</a>	•	•	•	•	•
UNIVERSITE DE MONS HAINAUT	7000	Mons	Wallonia	<a href="http://www.umons.ac.be">www.umons.ac.be</a>	•	•	•	•	•
UNIVERSITE DE NAMUR	5000	Namur	Wallonia	<a href="http://www.unamur.be">www.unamur.be</a>	•		•	•	•
UNIFLY	2100	Deurne	Flanders	<a href="http://www.unifly.aero">www.unifly.aero</a>	•			•	
UNIVERSITEIT ANTWERPEN	2000	Antwerpen	Flanders	<a href="http://www.uantwerpen.be">www.uantwerpen.be</a>				•	
UNIVERSITEIT GENT	9000	Gent	Flanders	<a href="http://www.ugent.be">www.ugent.be</a>				•	
UPMTEC	3500	Hasselt	Flanders	<a href="http://www.upmtec.com">www.upmtec.com</a>		•		•	
V2I	4031	Angleur	Wallonia	<a href="http://www.v2i.be">www.v2i.be</a>		•		•	•
VANÉFLON	9220	Hamme	Flanders	<a href="http://www.vaneflon.be">www.vaneflon.be</a>		•		•	
VANHULEN	4040	Herstal	Wallonia	<a href="http://www.vanhulen.be">www.vanhulen.be</a>	•	•		•	
VENYO EUROPE	6041	Gosselies	Wallonia	<a href="http://www.venyo.aero">www.venyo.aero</a>	•			•	
VERHAEGHE AEROSPACE - (UN)MANNED	8310	Brugge	Flanders	<a href="http://www.unmanned.aero">www.unmanned.aero</a>			•	•	
VERHAERT	9150	Kruikeke	Flanders	<a href="http://www.verhaert.com">www.verhaert.com</a>			•		
VITO - VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK	2400	Mol	Flanders	<a href="http://www.vito.be">www.vito.be</a>	•			•	•
VITROCISSET BELGIUM	6890	Transinne	Wallonia	<a href="http://www.vitrocissetbelgium.com">www.vitrocissetbelgium.com</a>	•		•		•
VLAAMSE RUIMTEVAARTINDUSTRIE (VRI)	3001	Leuven	Flanders						•
VLOC - VLAAMS LUCHTVAARTCENTRUM OOSTENDE - BRUGGE	8400	Oostende	Flanders	<a href="http://www.vloc.eu">www.vloc.eu</a>				•	
VON KARMAN INSTITUTE FOR FLUID DYNAMICS	1640	Sint-Genesius-Rode	Flanders	<a href="http://www.vki.ac.be">www.vki.ac.be</a>		•		•	•
VOXDALE	2110	Wijnegem	Flanders	<a href="http://www.voxdale.be">www.voxdale.be</a>	•				•
VRIJE UNIVERSITEIT BRUSSEL	1050	Elsene	Brussels	<a href="http://www.vub.be">www.vub.be</a>				•	
WALLONIE SPACE	4102	Seraing	Wallonia	<a href="http://www.wallonie-espace.be">www.wallonie-espace.be</a>	•	•	•		•
WALOPT	4053	Embourg	Wallonia	<a href="http://www.walopt.com">www.walopt.com</a>		•		•	
WALPHOT	5100	Namur	Wallonia	<a href="http://www.walphot.com">www.walphot.com</a>	•				•

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WAN	6041	Charleroi	Wallonia	<a href="http://www.wan.be">www.wan.be</a>	•			•	
WINNER	1457	Walhain-Saint-Paul	Wallonia	<a href="http://www.winnerhelico.com">www.winnerhelico.com</a>		•	•	•	
WORLD DRONE-ACADEMY	1090	Jette	Brussels	<a href="http://www.wd-academy.eu">www.wd-academy.eu</a>	•	•		•	
WSL LUX - ESA BIC REDU	6890	Transinne	Wallonia	<a href="http://esa-bic.be">esa-bic.be</a>	•				•
X-AIRSERVICES	4460	Grâce-Hollogne	Wallonia	<a href="http://www.xairservices.com">www.xairservices.com</a>				•	
XENICS	3001	Leuven	Flanders	<a href="http://www.xenics.com">www.xenics.com</a>			•		•
X-RIS	4040	Herstal	Wallonia	<a href="http://www.xris.eu">www.xris.eu</a>		•		•	
ZIGGZAGG	9880	Aalter	Flanders	<a href="http://www.ziggzagg.be">www.ziggzagg.be</a>		•		•	







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YOU

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