AEROSPACE SECTOR

AN IN-DEPTH OVERVIEW OF THE AEROSPACE SECTOR IN BRABANT

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Index

Colophon

Brabant, the Netherlands – Aerospace, an Overview /
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DESIGN
Maan identity. design. content. - Ulvenhout

1. INTRODUCTION TO THE STUDY

Aerospace sector in Brabant
An in-depth overview

To the reader

We are the Brabant Development Agency and we are proud to present you the new in-depth study of the Aerospace sector in Brabant.

This study provides a comprehensive overview of the Aerospace activities in Brabant. It includes Brabant-specific facts & figures and profiles key location factors in the Aerospace sector. The study also contains information about national and global trends and developments.

We would like to acknowledge and thank our contributors for the input they provided:
- Luitenant-kolonel de heer D. Trouerbach - Koninklijke Luchtmacht
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- De heer G. van Bakel - KMWE/Duch Aero
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- De heer B. van Tuijl - StandardAero

This document aims to give the reader an accurate profile of what Brabant has to offer. We have strived to make this study as complete and accurate as possible. Still, we would like to hear readers' comments and thoughts, as they are valuable for the future editions of this document and our work. We hope this study will provide new insights and prove to be an interesting read.

With kind regards,

Roland Grimm

Program Manager Maintenance & Services
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Introduction
Method and definition

It is not easy to define the Aerospace Sector in the Netherlands within the standard categorization of businesses. Some companies work exclusively in Aerospace, while other companies are also active in various sectors. Many companies in the High Tech Systems and Materials industry are suppliers of OEMS's in Aerospace, Automotive, Lifesciences, Semiconductors etc. In this study, we have identified the various Aerospace related organizations, by analyzing lists of HTSM companies in Brabant, members of NAG, members of FME, companies with vacancies in Aerospace etc. This data was combined with the register of the companies of the province of Noord-Brabant, that contains information of the actual number of jobs.

In broad perspective, there are two main subsectors to identify in the Aerospace industry of Brabant:

1. Suppliers of High Tech Systems and Materials

2. Specialists in Maintenance Repair and Overhaul

In addition, a major part of the Royal Netherlands Air Force is located in Brabant. The Air Force bases in Woensdrecht, Rijen, Volkel and Eindhoven together accommodate many military systems, including jetfighters, helicopters, transport and tanker aircraft and the special command jet.

Aerospace is a highly innovative and technology driven sector and appointed as one of the top sectors in the Dutch economic and industrial policies, where it is part of the sector High Tech Systems and Materials.

Technologies that underlie the Aerospace Sector include **Aerostructures** (Materials, Engineering), **Engine Subsystems and Components** (Materials, Embedded Systems, Sensoring), **Maintenance Repair and Overhaul** (PHM and Condition Based Monitoring), **Aircraft Systems** (Electronics), **Future concepts** (Composites, IOT, 3D printing).

2. INTRODUCTION BRABANT, THE NETHERLANDS

A. What has Brabant to offer?

The Dutch province of Noord-Brabant is located in the southern part of the Netherlands, strategically situated between Amsterdam Schiphol Airport, Europe's leading seaport in Rotterdam, the Port of Antwerp, Brussels, and the major German economic heartland of the Rhine-Ruhr region. Brabant covers an area of 5,082 km2, making it the second largest province in the Netherlands, and is home to some 2.5 million people spread across 62 municipalities.

- From a geographic perspective Brabant offers easy access to 170 million Europeans within a 500 km (310 mls) radius. Physical and telecommunication infrastructure are best-in-class when it comes to establishing headquarter, marketing & sales, R&D, manufacturing and /or logistics operations.

- Costs-wise, the Netherlands has a favorable corporate tax regime in comparison to most European countries.

- Research, product and process development and manufacturing are in Brabant's DNA. Ranging from primary production in agriculture and the food industry to the manufacturing of semi-finished products all the way up to OEM manufacturing of the most complex electronic, biopharmaceutical, nutraceutical and IT products and equipment, all of these activities can be found in the region in abundance.

- The well-developed industrial and knowledge networks or 'ecosystems' in High Tech Systems, Logistics, Life Sciences & Health, AgriFood, Chemicals, and Aerospace offer opportunities for cooperation at a very high level. Cross-sector cooperation in the region is a given.

B. Brabant's main benefits

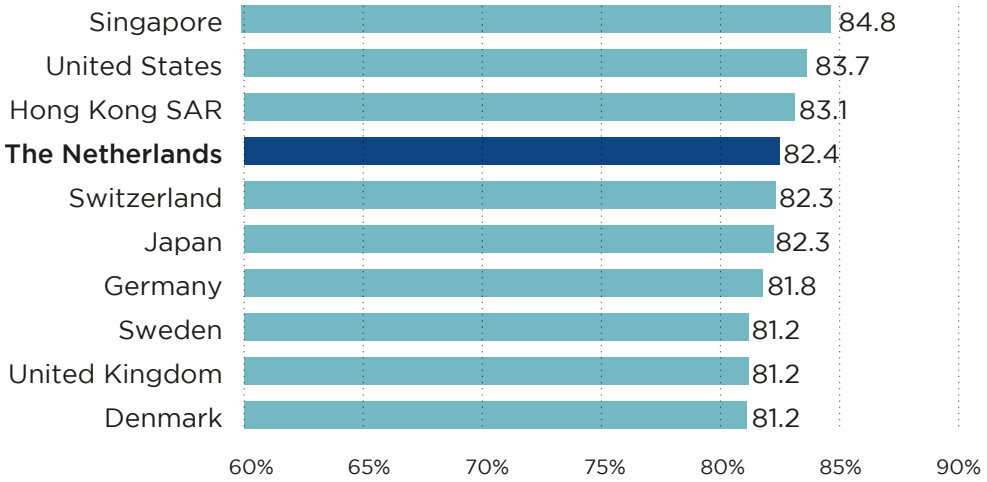
The province of Brabant offers the overall Dutch business-friendly environment and adds a number of favorable geographical benefits:

The Netherlands as a whole and Brabant offer:

- an attractive tax climate, including personal and corporate income tax and value-added tax (VAT)
- a stable economic, political and social climate
- competitive labor costs

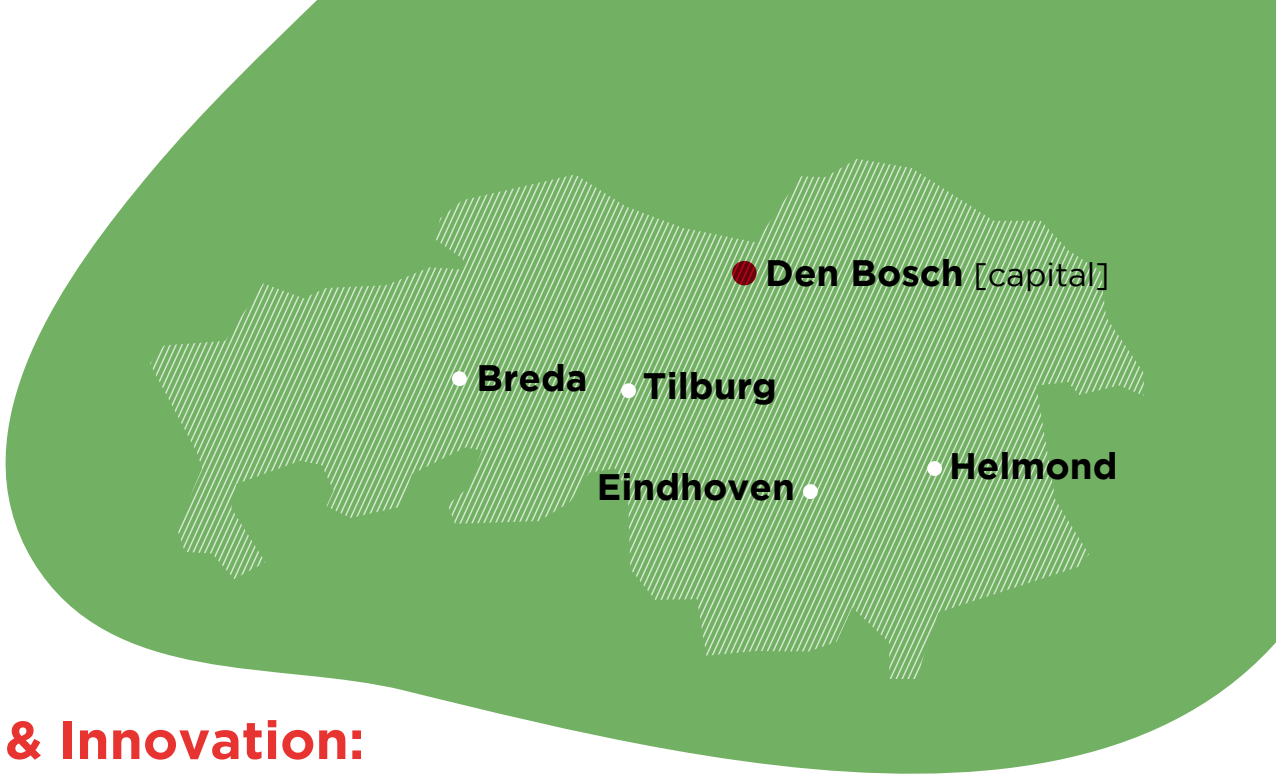
Brabant in particular has a strategic European location, because:

- it is centrally located in Northwestern Europe
- it has good accessibility
- it has excellent infrastructure



C. Brabant's main cities

Covering 5,000 square kilometers (2,000 square miles), almost 15% (2.5 million inhabitants) of the Dutch population lives in Brabant. The capital of Brabant is Den Bosch. The largest city is Eindhoven followed by the cities of Tilburg, Breda, Den Bosch and Helmond.



D. Brabant: Industry, Science & Innovation:

Brabant is a productive, highly industrialized and knowledge-intensive province in the Netherlands and as such an attractive opportunity for companies looking for (cooperation in) industrial innovation and / or state-of-the-art manufacturing.

As a matter of fact, Brabant is the most R&D intensive region in the Netherlands and one of the most innovative regions in Europe as aptly illustrated by the following three facts:

1. **30% of all industrial R&D in the Netherlands is performed in Brabant**
2. **50% of all European patent applications from the Netherlands are generated in Brabant**
3. **In Europe, Brabant is number five in the list of regions with the highest number of patent applications**

Source: BOM, Info & Graphics

With over 34,000 people engaged in R&D activities, Brabant is able to provide the necessary brainpower, readily delivered by its bright people and numerous research and educational institutes. Geographical clustering enables cooperation between businesses, universities and governmental research institutions. Joint R&D results in mutual reinforcement and inspiration and involves sharing technological know-how, sharing expensive research facilities, and collaborating in (European) technology programs. This distinctive collaborative research style holds the secret to significantly advancing R&D and innovation activities.

THE NETHERLANDS AND BRABANT - UNIVERSITIES & PATENT APPLICATIONS

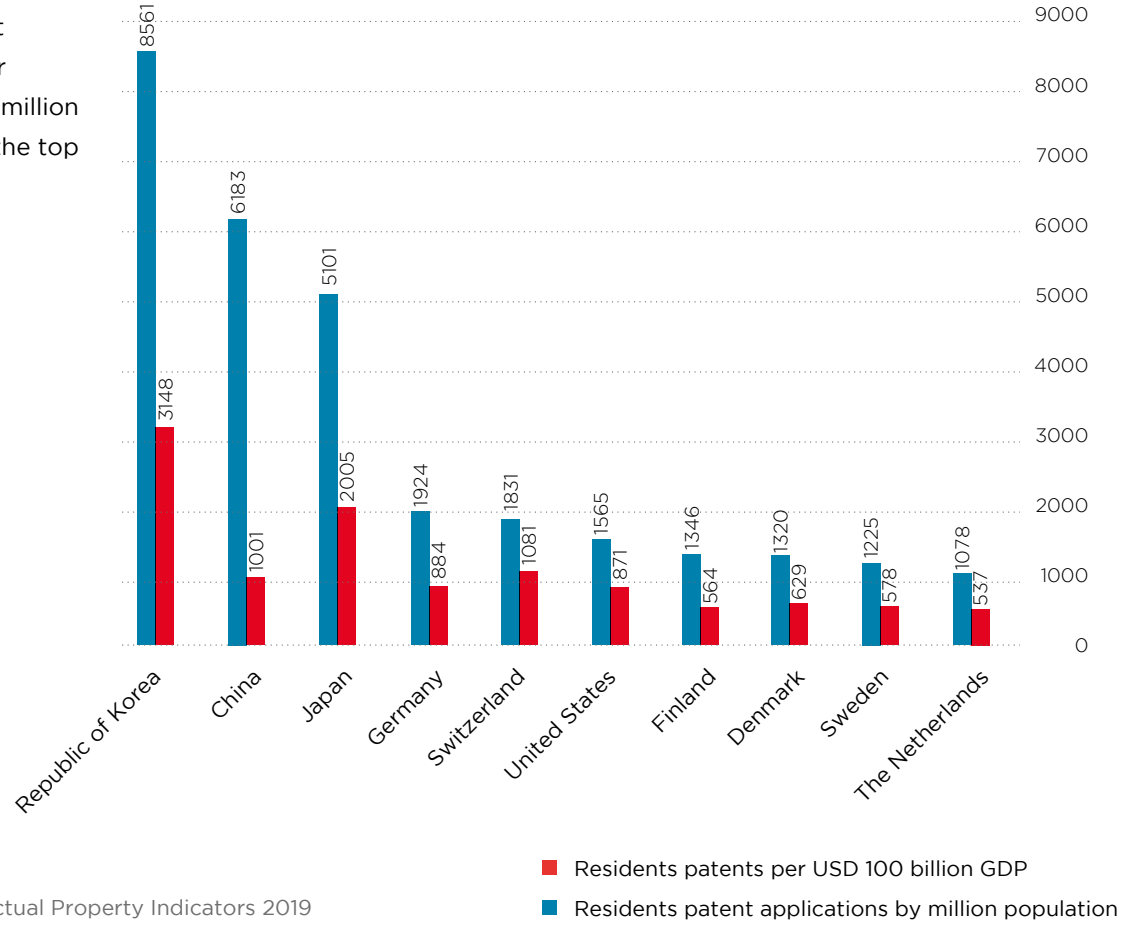
The Netherlands has a high density of high-quality universities and knowledge institutions. As a result the Netherlands takes fourth place in the Global Innovation Index 2019 of the World Intellectual Property Organization (WIPO) and is ranked 10th in the list of countries with highest number of patent applications in relation to GDP and population.

GLOBAL INNOVATION INDEX 2019

1.	Switzerland	67.24
2.	Sweden	63.55
3.	United States of America	61.73
4.	**The Netherlands**	**61.44**
5.	United Kingdom	61.30
6.	Finland	59.83
7.	Denmark	58.44
8.	Singapore	58.37
9.	Germany	58.19
10.	Israel	57.43

THE NETHERLANDS IN WORLDWIDE TOP 10 PATENT APPLICATIONS

Resident patent applications per billion $ GDP & million population for the top 10 origins 2018

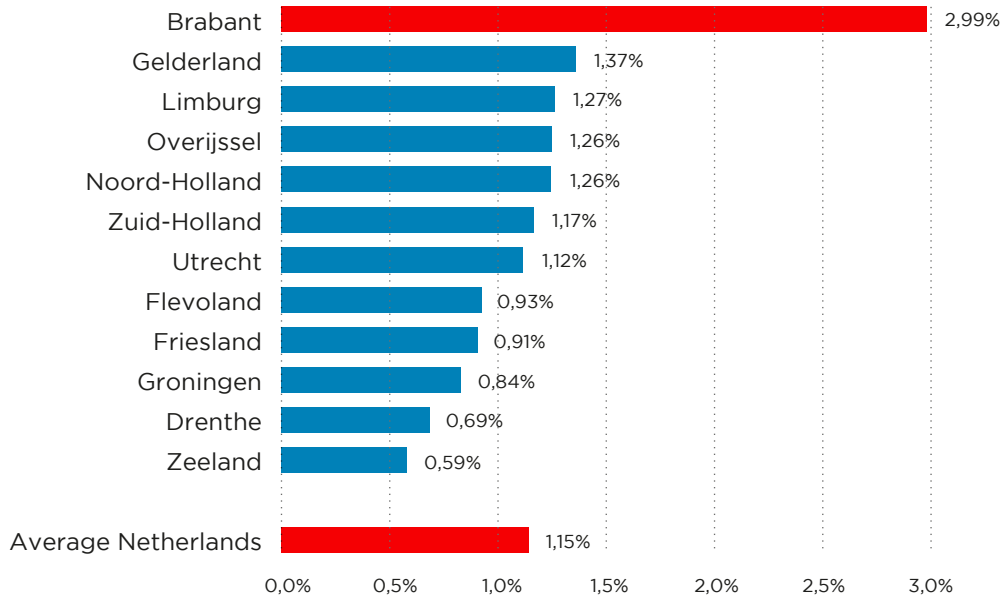


Sources: WIPO (World Intellectual Property Organization) 2019, World Intellectual Property Indicators 2019

HIGH R&D INTENSITY IN BRABANT

Brabant has the highest R&D intensity in the Netherlands. Total R&D expenditure in the private sector in relation to Regional Gross Domestic Product is 2.99 percent: more than double the national average (1.15 percent).

PRIVATE R&D EXPENDITURE IN (PERCENTAGE OF GDP) IN 2017



Source: CBS (2019), edited by Fanion Onderzoek & advies

HIGH-SCORING R&D REGION IN EUROPE

Brabant is known for its high level and strong efforts in industrial R&D. To put that in perspective: in Europe, Brabant is the number five region in the list of regions with the highest number of patent applications.

LEADING EUROPEAN REGIONS IN PATENT APPLICATIONS AT THE EUROPEAN PATENT OFFICE 2018

	Region	Country	2018	Growth
1	Bayern	Germany	8.238	8.8 %
2	Île-de-France	France	6.713	-4.4%
3	Nordrhein-Westfalen	Germany	5.125	3.9%
4	Baden Württemberg	Germany	5.082	2.2%
5	**North Brabant**	**The Netherlands**	**3.582**	**-0.8%**
6	Stockholm	Sweden	2.280	7.7%
7	Hessen	Germany	2.205	-0.5%
8	Greater London	Great Britain	1.943	11.9%
9	Niedersachsen	Germany	1.712	16.6%
10	Rhienland-Pfalz	Germany	1.598	0.9%
11	Vlaanderen	Belgium	1.482	7.2%
12	Hovedstaden	Denmark	1.465	9.8%
13	Lombardia	Italy	1.406	-1.5%
14	Auvergne-Rhône-Alpes	France	1.319	3.0%
15	Vaud	Switzerland	1.192	1.2%
16	Helsinki-Uusimaa	Finland	1.188	-11.4%
17	South Holland	The Netherlands	1.066	3.2%
18	Austria West	Austria	1.023	4.4%
19	Zürich	Switzerland	1.014	7.3%
20	Basel-Stadt	Switzerland	980	3.7%

Source: European Patent Office in Link Magazine (March 2019)

E. Facts & Figures

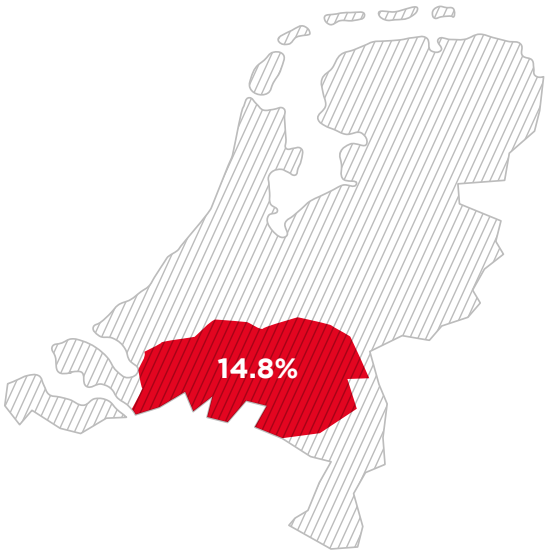
DEMOGRAPHY

Population 1-1-2019
Brabant 2,544,806 14.8%
The Netherlands 17,282,163 100%

Population growth in 2018
Brabant 0.65%
The Netherlands 0.59%

Population density per km²
Brabant 416
The Netherlands 513

Non-Dutch nationals 2019
Brabant 151,254 5.9%
The Netherlands 1,110,859 6.4%



Age groups

	The Netherlands	Brabant
0 - 14	16.1%	15.5%
15 - 64	65.1%	64.9%
65+	18.9%	19.7%
Total	100%	100%

Source: CBS/Eurostat, LISA, BOM, Province of Brabant

ECONOMY

GDP 2018 (in euros, market prices)
Brabant 116,090,000 15%
The Netherlands 774,039,000 100%

Economic growth 2018
Brabant 3.0%
The Netherlands 2.6%

Total own R&D spending as a % of GDP 2017
Brabant 3.06%
The Netherlands 1.98%

Companies
Brabant 231,990 14.2%
The Netherlands 1,630,070 100%

Jobs
Brabant 1,297,560 15%
The Netherlands 8,651,830 100%

Foreign companies 2019
Number of companies in Brabant 1,660
Workforce of Brabant 119,870

Foreign companies 2019
Total available in January 2019 (ha) 1,790
Immediately available in January 2019 (ha) 790

3. INDUSTRY OVERVIEW

Overview

The Chamber of Commerce uses two branches to identify the Aerospace industry activities:

- SBI 3030 Manufacture of aircraft and parts
- SBI 3316 Repair and maintenance of aircraft.

Within these branches, 18 establishments provide 1,000 jobs. This is 13 percent of the establishments and 19.6 percent of the total jobs in the Aerospace industry in the Netherlands. Especially where it concerns the manufacturing of aircraft and parts, Brabant holds a strong position within the Netherlands.

However, Aerospace in Brabant is much broader than this. Many of the activities are included in the defence organization, which is part of the government.

In more detail, 35 establishments with a total of 7,620 employees in Brabant have a direct relationship with Aerospace.

Brabant is also the heart of the High Tech Systems and Materials Industry of the Netherlands. In this sector, another 125 establishments with 11,080 employees in Brabant are linked with the Aerospace industry. These are mainly suppliers of materials and systems, or act as knowledge centres.

In total over 160 establishments and 18,700 jobs are linked to Aerospace.

ESTABLISHMENTS AND JOBS IN BRABANT AND NETHERLANDS AEROSPACE INDUSTRY IN 2017

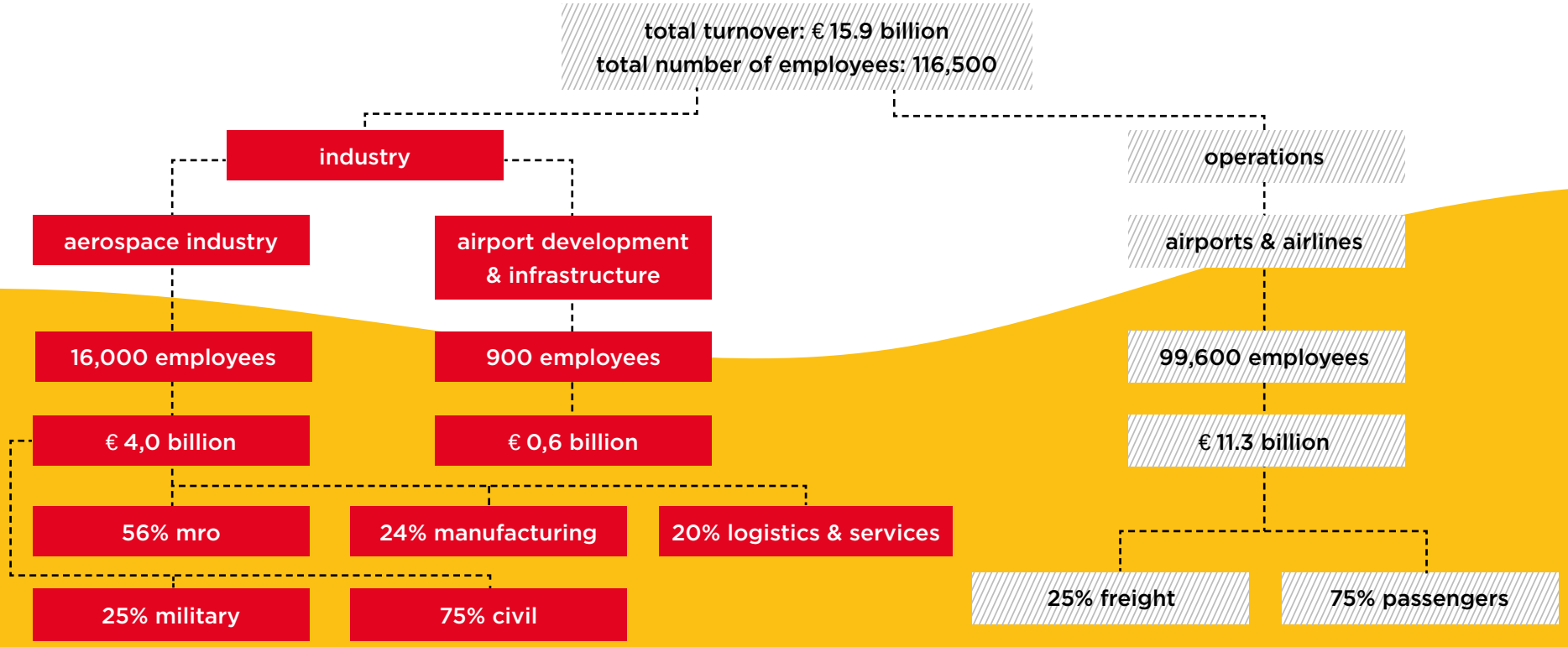
	ESTABLISHMENTS			JOBS		
	Brabant	**NL**	**Brabant's share**	**Brabant**	**NL**	**Brabant's share**
SBI 3030 manufacture of aircraft and parts	10	75	13.3%	940	4.360	21.5%
SBI 3316 Repair and maintenance of aircraft	8	64	12.5%	60	740	8.5%
Total Aircraft industry (narrow definition)	**18**	**139**	**12.9%**	**1.000**	**5.100**	**19.6%**

Source: Vestigingenregister provincie North-Brabant and LISA

The Dutch Aerospace industry

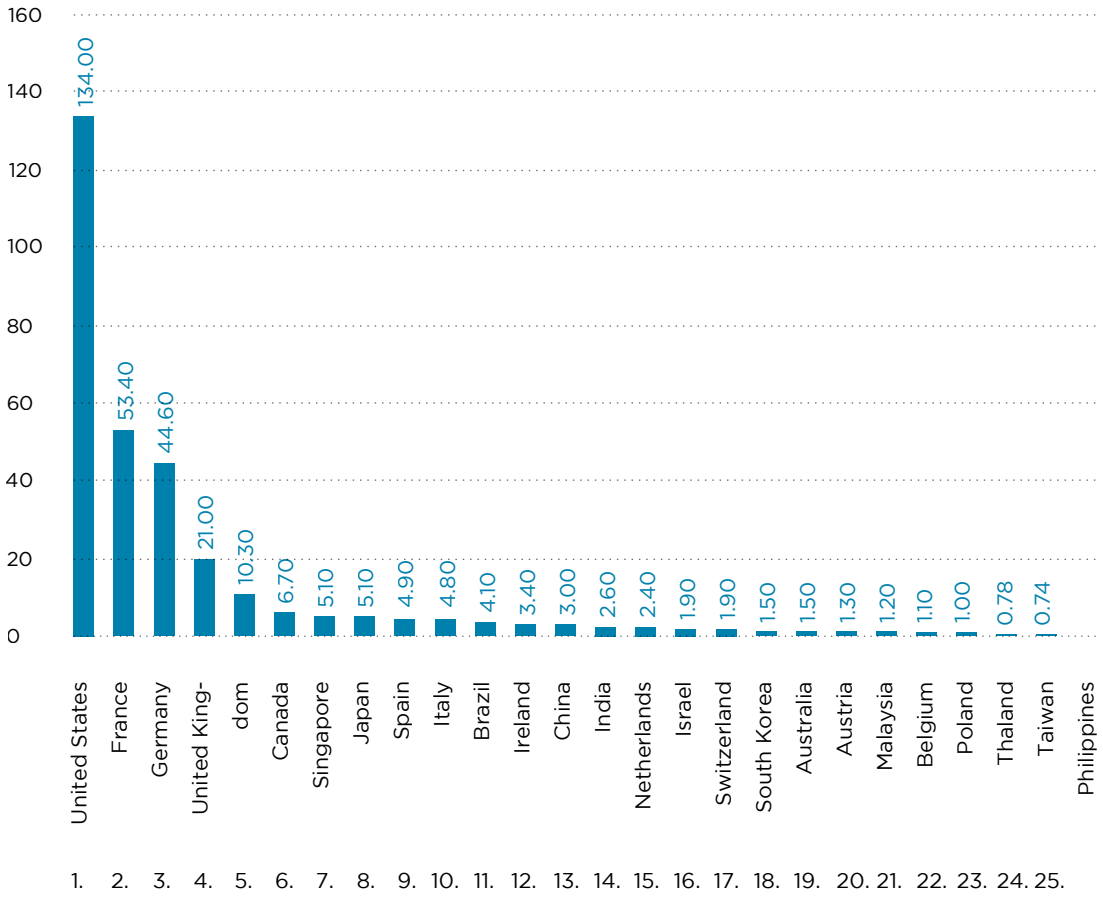
The Dutch Aerospace sector is world's 14th largest and within Europe the sixth largest industry. The annual turnover is € 4.6 billion of which 70% consists of exports. The sector employs 16,900 employees spread over 100 large companies, as well as SME's. Dutch companies are part of the supply chain of almost all aircraft manufacturers (OEMs) worldwide like Airbus, Lockheed Martin, Boeing, Gulfstream, Dassault Aviation and leading aero-engine manufacturers including Snecma, Rolls Royce, General Electric and Pratt & Whitney.

DUTCH AEROSPACE AND AIRPORT INDUSTRY (2016)



Source: NAG, International Brochure 2017

EXPORT VALUE AEROSPACE 2016 BY COUNTRY (IN BILLIONS US $)*



Source: World's Top Exports (http://www.worldstopexports.com/aerospace-exports-by-country/ , The World Factbook, Field Listing: Exports – Commodities, Central Intelligence Agency. Accessed on June 4, 2018. Trade Map, International Trade Centre. Accessed on June 4, 2018

* Based on the 2-digit Harmonized Tariff System code prefix is 88 for aircraft and spacecraft including satellites.

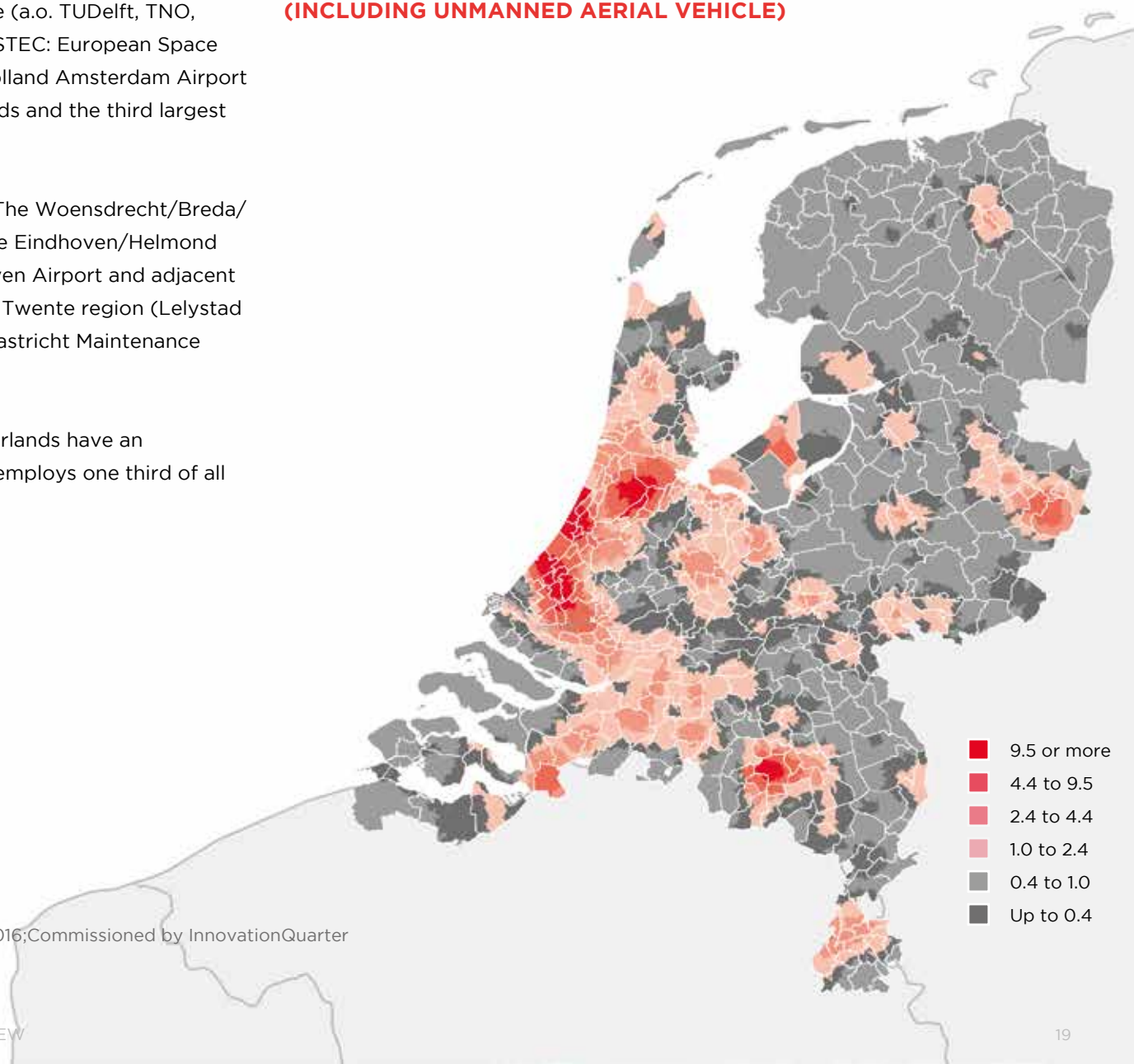
Aerospace hot spots in the Netherlands

The Netherlands has four important Aerospace related clusters. There is a major cluster in Zuid-Holland in the region Delft – The Hague (a.o. TUDelft, TNO, The Hague-Rotterdam Airport) and Noordwijk (a.o. ESTEC: European Space Research and Technology Centre – ESA). In Noord-Holland Amsterdam Airport Schiphol is by far the largest Airport of The Netherlands and the third largest Airport in Europe.

In Brabant, there are two major Aerospace hotspots. The Woensdrecht/Breda/Tilburg region with a focus on Aviolanda/LCW and the Eindhoven/Helmond region with the second largest Dutch Airport: Eindhoven Airport and adjacent HTSM industry. The other hot spots are located in the Twente region (Lelystad Airport) and Limburg (Maastricht-Aachen Airport, Maastricht Maintenance Boulevard and the Aviation Competence Centre).

About one fifth of Aerospace companies in The Netherlands have an establishment in Brabant. It's estimated that Brabant employs one third of all employees working in the Dutch Aerospace industry.

DISTRIBUTION OF AERO-SPACE COMPANIES IN THE NETHERLANDS (INCLUDING UNMANNED AERIAL VEHICLE)



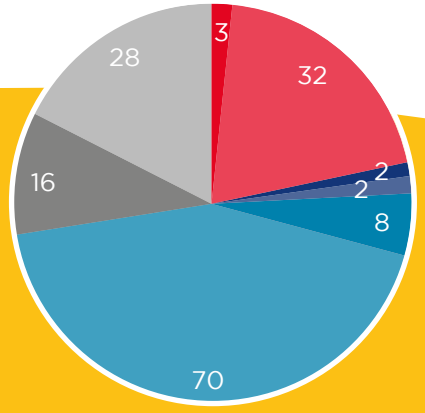
Source: Aerospace cluster in Zuid-Holland, Bureau Louter, 2016;Commissioned by InnovationQuarter

A. Brabant aerospace industry

In this study, we identify branches and companies that are directly involved in the Aerospace industry: HTSM Aerospace, Materials Aerospace, Defence Aerospace, Airports and companies or branches that are indirectly involved like HTSM, Materials, Research and other (consultancy, construction, trade).

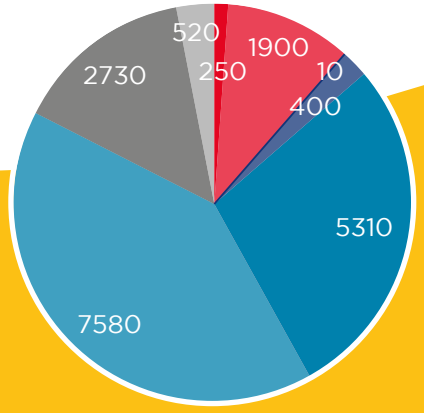
In total, there are over 160 establishments and 18,700 jobs involved in Aerospace in Brabant. About 35 establishments with 7,620 jobs have a direct connection with aerospace. Within this group the Dutch Air Force (5,310 employees) and Aerospace HTSM (1,900 employees) are the largest sectors. In addition, there are 125 establishments with 11,080 employees active in Aerospace as supplier of components, parts, services or knowledge. Of these 125 organizations, 70 establishments and 7,580 employees are active in HTSM and 16 establishments and 2,730 employees in Materials.

ESTABLISHMENTS IN AEROSPACE, DIRECT AEROSPACE AND AEROSPACE RELATED



- Research
- Aerospace HTSM
- Aerospace Materials
- Airport
- Defence Royal Netherlands Air Force
- HTSM
- Materials
- Other

JOBS IN DIRECT AEROSPACE, DIRECT AND AEROSPACE RELATED



- Research
- Aerospace HTSM
- Aerospace Materials
- Airport
- Defence Royal Netherlands Air Force
- HTSM
- Materials
- Other

Source: Vestigingenregister province North-Brabant 2017, edited by Fanion onderzoek & advies

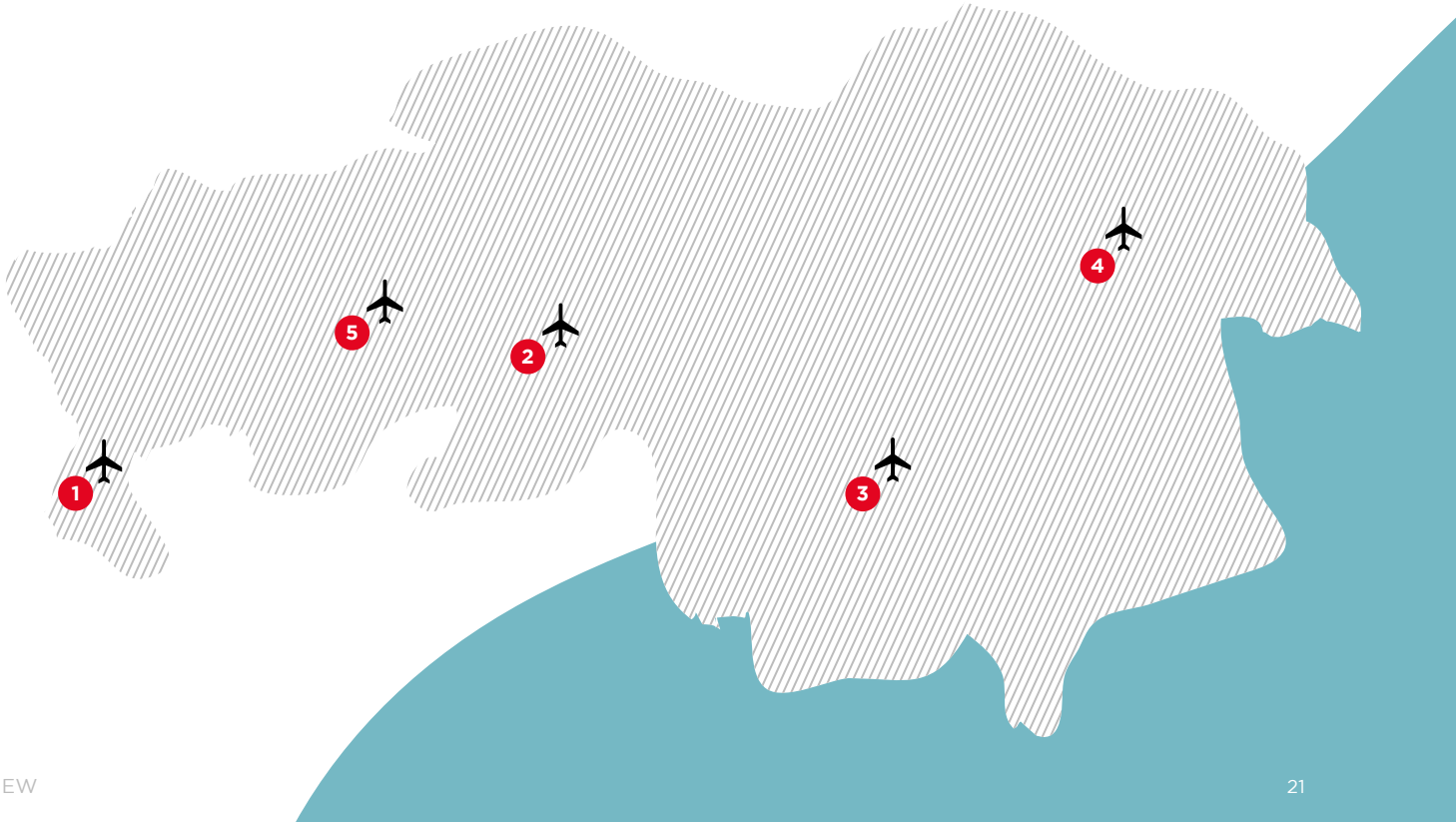
LOCATION AEROSPACE ACTIVITIES IN BRABANT

In general, direct and indirect employment related to Aerospace activities are located in municipalities with an Air Base or Airport, like Eindhoven (Eindhoven Airport) Woensdrecht (Air Base Woensdrecht), Uden (Air Base Volkel) and Gilze-Rijen (Air Base Gilze-Rijen). Meierijstad, Den Bosch, Helmond and Breda hold a strong position in Aerospace related employement.

With regard to direct Aerospace activities, the municipalities of Woensdrecht, Eindhoven, Uden and Gilze-Rijen stand out, followed by Breda. In Woensdrecht, Gilze-Rijen and Uden activities are mainly concentrated directly nearby the Air Bases. In Eindhoven, employment is more widespread over the city, although a lot of employment is concentrated on and around the Airport. The Aerospace activities in Breda can be attributed mostly to the headquarters of The Netherlands Air Force and Breda International Airport (Seppe).

When concentrating on tier one and tier two suppliers of Aerospace related companies in the HTSM sector, a different view appears. The municipality of Eindhoven holds by far the strongest position because of the large HTSM cluster with companies like VDL, Applied Micro Electronics 'Ame' B.V., Teledyne DALSA B.V., Thales Cryogenics B.V., FEI Europe B.V., Adimec, Frencken Engineering B.V. In addition, knowledge institutes like University of Eindhoven, TNO and Holst Centre are located in Eindhoven.

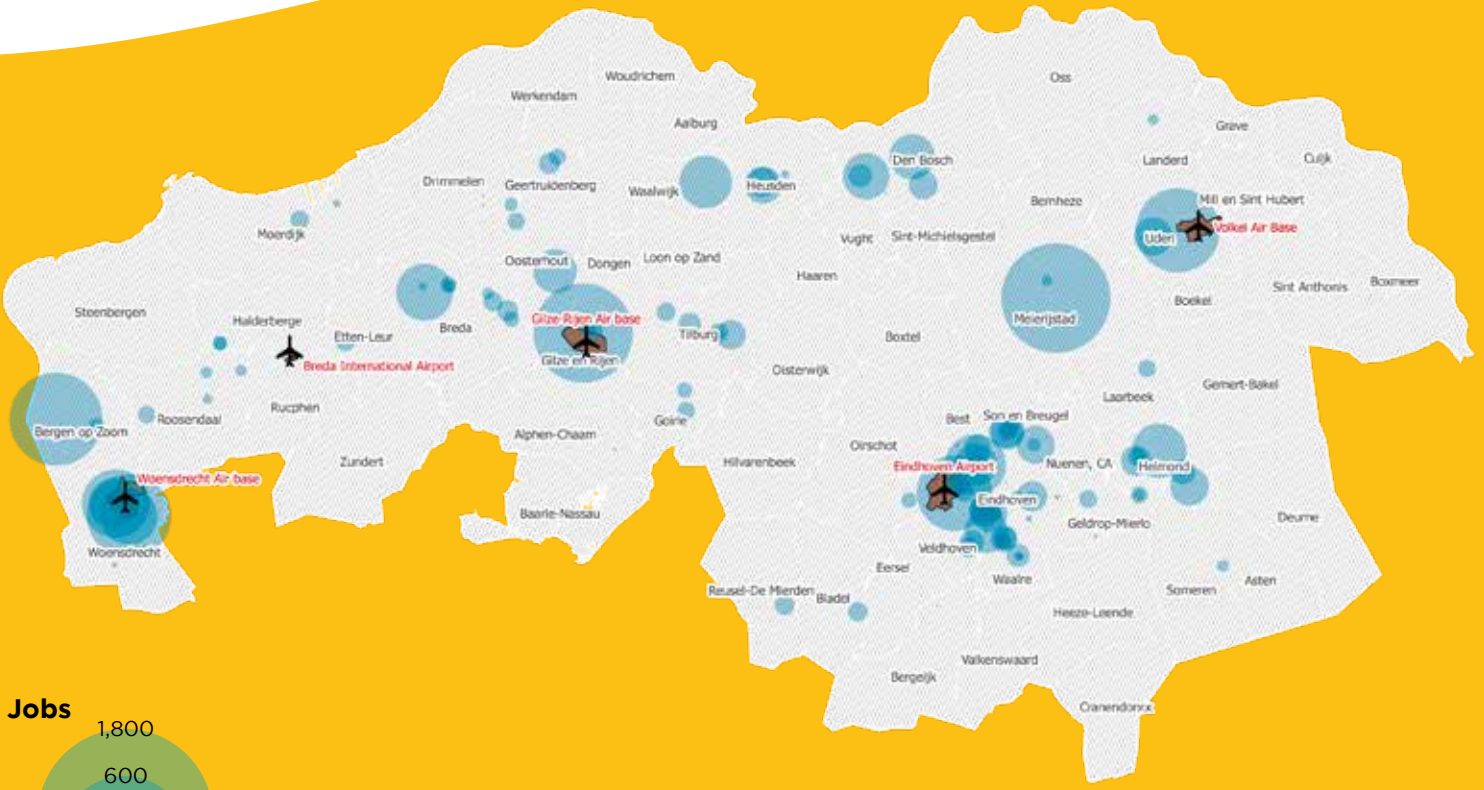
Meierijstad is the home town of Vanderlande Industries, one of the worldwide leading companies in luggage handeling systems for airports. And in Den Bosch the focus lies on suppliers of software (Siemens Industry Software, Dassault Systemes BV).



Airport/ Air bases

1. Woensdrecht Air Base
2. Gilze-Rijen Air Base
3. Eindhoven Airport
4. Volkel Air Base
5. Breda International Airport

GENERAL OVERVIEW OF LOCATIONS FOR DIRECT AEROSPACE AND AEROSPACE RELATED ACTIVITIES



Jobs

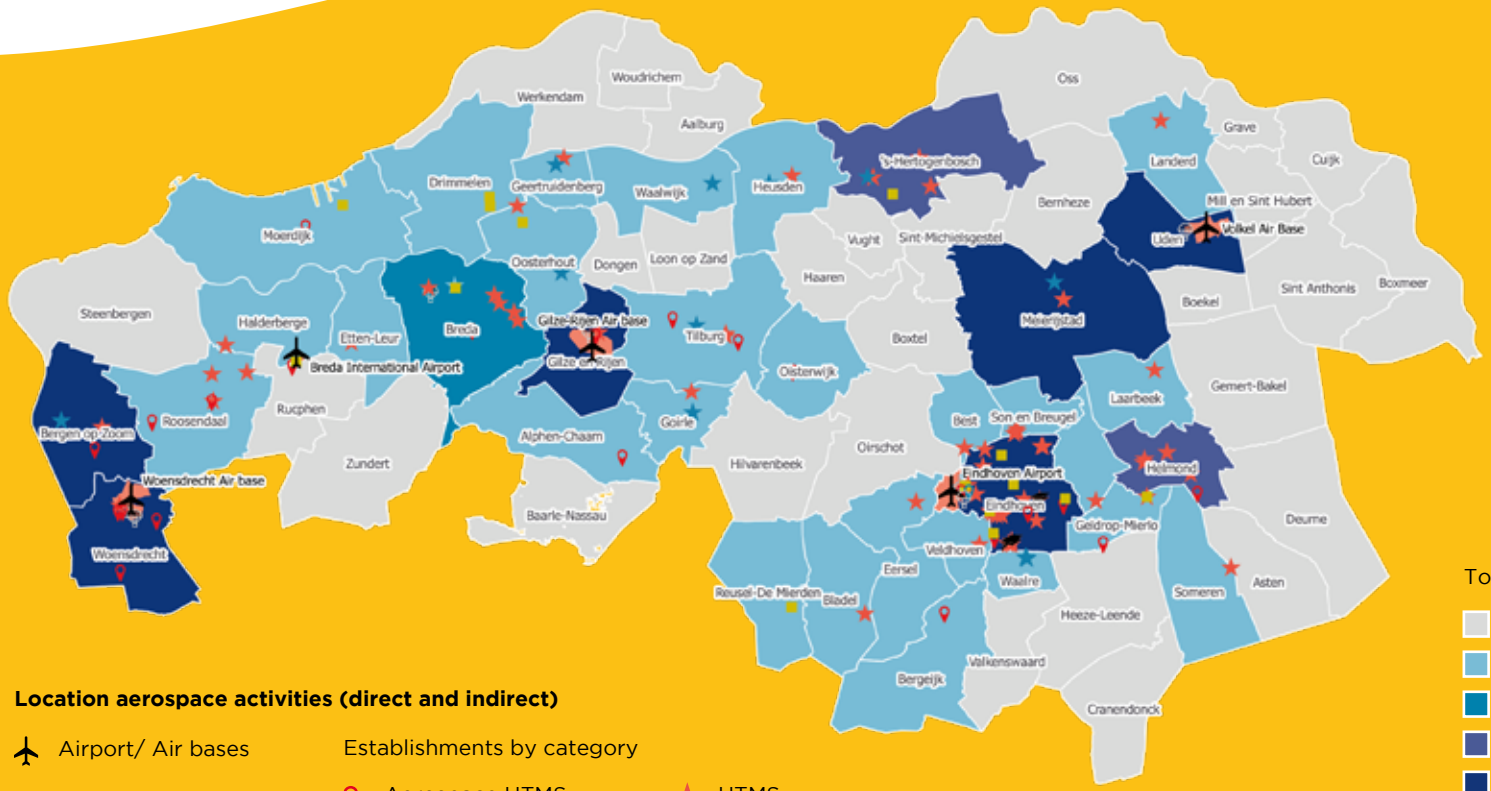
1,800

600

200

Source: Vestigingenregister Noord-Brabant, edited by Fanion onderzoek & Advies

OVERVIEW OF LOCATIONS FOR DIRECT AEROSPACE AND AEROSPACE RELATED ACTIVITIES BY TYPE OF ACTIVITY AND TOTAL NUMBER OF JOBS BY MUNICIPALITY



Location aerospace activities (direct and indirect)

Airport/ Air bases

Establishments by category

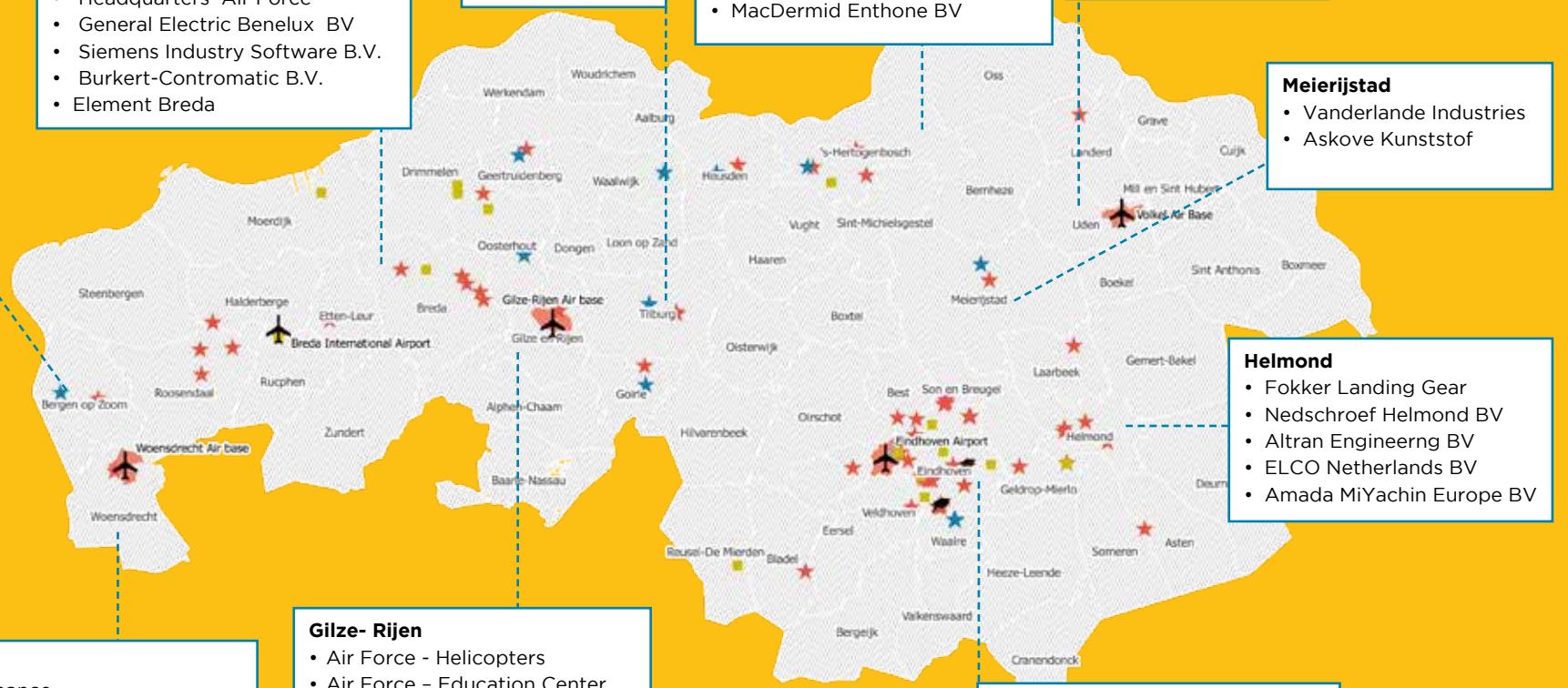
- Aerospace HTMS
- Aerospace Materials
- Airport
- Defence
- HTMS
- Materials
- Other
- Research

Total jobs Aerospace

- None
- < 500 jobs
- 500 to 750 jobs
- 750 to 1,000 jobs
- More than 1,000 jobs

Source: Vestigingenregister Noord-Brabant, edited by Fanion onderzoek & Advies

OVERVIEW MAJOR AEROSPACE OF AEROSPACE RELATED COMPANIES BY MUNICIPALITY



Bergen op Zoom
- Sabic
- FMI Precisie

Breda
- Headquarters Air Force
- General Electric Benelux BV
- Siemens Industry Software B.V.
- Burkert-Contromatic B.V.
- Element Breda

Tilburg
- Chromalloy
- Standard Aero
- Naaykens

Den Bosch
- TE Connectivity Nederland B.V.
- Dassault Systemes B.V
- Siemens Industry Software B.V.
- MacDermid Enthone BV

Uden
- Air Base Volkel (F16)

Meierijstad
- Vanderlande Industries
- Askove Kunststof

Helmond
- Fokker Landing Gear
- Nedschroef Helmond BV
- Altran Engineerng BV
- ELCO Netherlands BV
- Amada MiYachin Europe BV

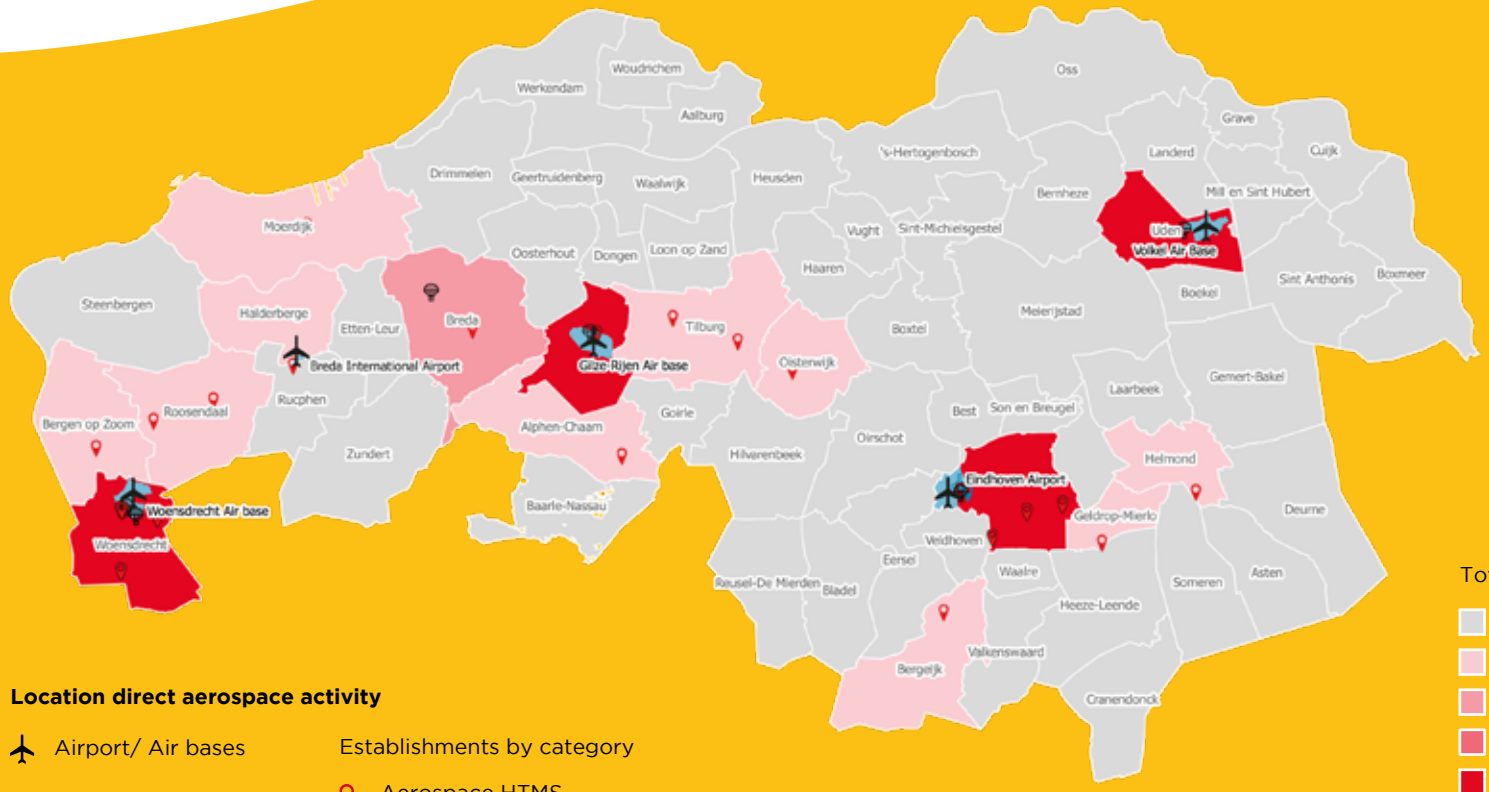
Woensdrecht
- Air Force - Maintenance
- Air Force - LCW
- Air Force – Education Center
- Fokker Elmo
- Fokker Techniek
- Aircraft Maintenance & Training School B.V.
- Aviolanda

Gilze- Rijen
- Air Force - Helicopters
- Air Force – Education Center
- Daedalus Aviation Services Inc.
- Gate 2
- Kin Machinebouw
- Rotary Wing Training Center

Eindhoven
- Air Force (Cargo)
- VDL (ETG/Enabling Technology GL Precision)
- Airport Eindhoven
- KMWE/ Dutch Aerop
- Applied Micro Electronics
- Teledyne DALSA B.V.
- ORION ENGINEERING BV
- Thales Cryogenics B.V.

Source: Vestigingenregister Noord-Brabant, edited by Fanion onderzoek & Advies

OVERVIEW OF LOCATIONS FOR DIRECT AEROSPACE ACTIVITIES BY TYPE OF ACTIVITY AND TOTAL NUMBER OF JOBS BY MUNICIPALITY



Location direct aerospace activity

Airport/ Air bases

Establishments by category

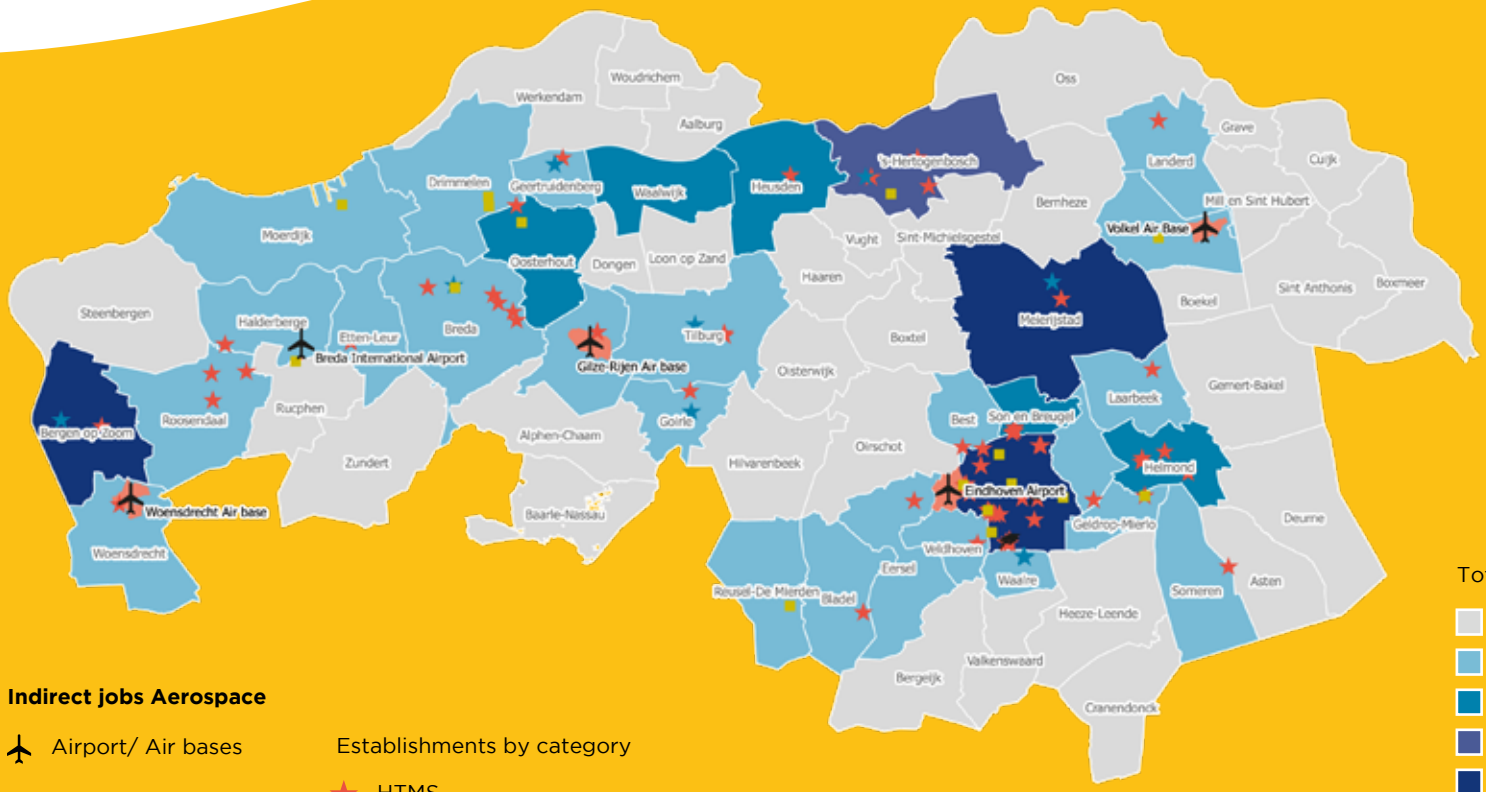
- Aerospace HTMS
- Aerospace Materials
- Airport
- Defence

Total jobs Aerospace

- None
- < 250 jobs
- 250 to 750 jobs
- 750 to 1,000 jobs
- More than 1,000 jobs

Source: Vestigingenregister Noord-Brabant, edited by Fanion onderzoek & Advies

OVERVIEW OF LOCATIONS FOR AEROSPACE RELATED ACTIVITIES BY TYPE OF ACTIVITY AND TOTAL NUMBER OF JOBS BY MUNICIPALITY



Indirect jobs Aerospace

Airport/ Air bases

Establishments by category

- HTMS
- Materials
- Other
- Research

Total jobs Aerospace

- None
- < 500 jobs
- 500 to 750 jobs
- 750 to 1,000 jobs
- More than 1,000 jobs

Source: Vestigingenregister Noord-Brabant, edited by Fanion onderzoek & Advies

Brabant Aerospace sector

In Brabant 137 companies are identified that are active or can be linked as supplier to the Aerospace industry. As shown in the table, the majority of the companies in aerospace are small: 77 establishments have fewer than 50 jobs, which accounts for 56% of all firms in the sector.

Five establishments provide more than 1,000 jobs and the 3 that are directly Aerospace related are all part of The Netherlands Air Force: Air Base Gilze-Rijen (Defence Heli command), Air Base Volkel and Logistics Centre Woensdrecht. The largest Aerospace related companies are VDL and Vanderlande Industries (both HTSM) in Eindhoven and Sabic (Materials) in Bergen op Zoom.

In **Aerospace HTSM** the largest companies, with more than 100 employees are Fokker Elmo B.V. and Fokker Techniek (Hoogerheide), KMWE Precision B.V./DutchAero (Eindhoven), Fokker Landing Gear (Helmond) and Chromalloy Holland B.V. (Tilburg).

In **Aerospace Materials Aviation** Cosmetics in Eindhoven and Specto/ Airborne, services in Hoogerheide are very specialized firms.

The two major companies active in **Airport activities** are located at Eindhoven Airport: Viggo Eindhoven Airport B.V. (Airport operations) and Eindhoven Airport BV (Corporate).

In **HTSM** (indirectly Aerospace related) the largest companies are VDL Embedded Technology & ETG Projects(Eindhoven), Vanderlande Industries (Veghel), Nedschroef Helmond (Helmond), TE Connectivity Nederland BV (Den Bosch), Dassault Systemes B.V. (Den Bosch), Applied Micro Electronics 'Ame' B.V., Neways Industrial Systems and Technologies B.V. (Son en Breugel), Altran Engineering BV (Helmond), Siemens Industry Software (Den Bosch).

In **Materials** (indirectly Aerospace related) the largest companies are Sabic Innovative Plastics (Bergen op Zoom/Raamsdonksveer), Desso BV (Waalwijk), Tata Steel Nederland Tubes BV (Oosterhout), Sapa Profiles (Drunen), LDM Non Ferro B.V. (Drunen), MacDermid Enthone BV ('s Hertogenbosch).

COMPANIES DIRECTLY AND INDIRECTLY RELATED TO AEROSPACE BY SIZE

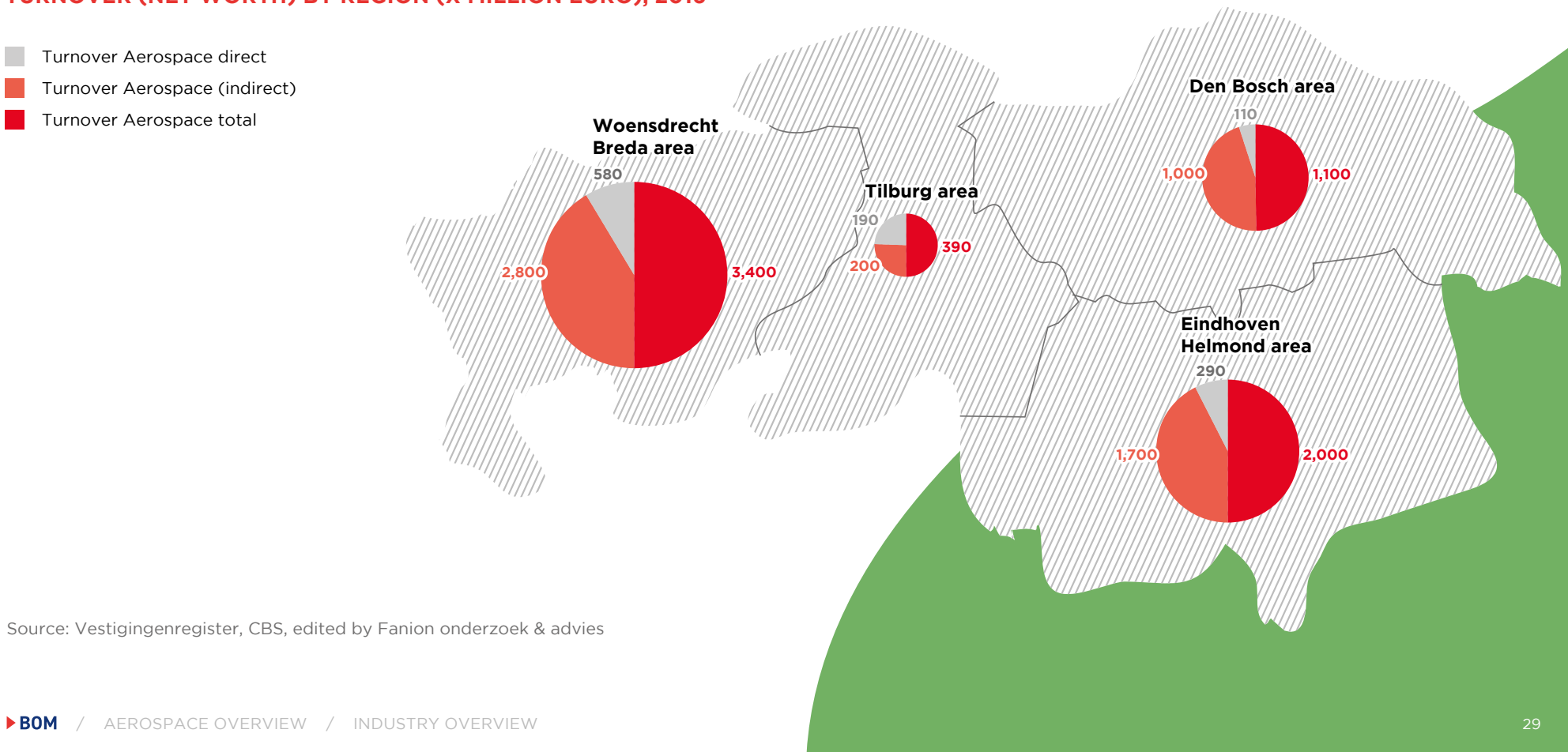
	Directly Aerospace						Aerospace Related						Overall	
Size class jobs	Aerospace HTSM	Aerospace Materials	Airport	Defence	Total	Share	HTSM	Materials	Other	Rese-arch	Total	Share	Total	Share
Less than 10	15	0	0	1	16	45.7%	6	1	10	0	17	16.8%	33	24.3%
10-50	3	1	0	0	4	11.4%	32	4	3	1	40	39.6%	44	32.4%
50-100	2	0	1	0	3	8.6%	14	4	1	1	20	19.8%	23	16.9%
100-500	4	0	1	2	7	20.0%	13	4	2	1	20	19.8%	27	19.9%
500-1,000	1	0	0	1	2	5.7%	2	0	0	0	2	2.0%	4	2.9%
1,000 and more	0	0	0	3	3	8.6%	1	1	0	0	2	2.0%	5	3.7%

Source: Vestigingenregister province North-Brabant 2017, edited by Fanion onderzoek & advies

Turnover (net worth)

In 2016, the turnover (net worth) of Aerospace related activities in Brabant represents an estimated value of 6.8 billion euro. The direct Aerospace activities represent a net turnover of almost 1.2 billion euro and the companies related to Aerospace as second Tier of third Tier represent a turnover of in total 5.7 billion euro. The Woensdrecht/Breda area has the largest turnover of in total 3.4 billion euro, followed by the Eindhoven region with a turnover of 2.0 billion euro.

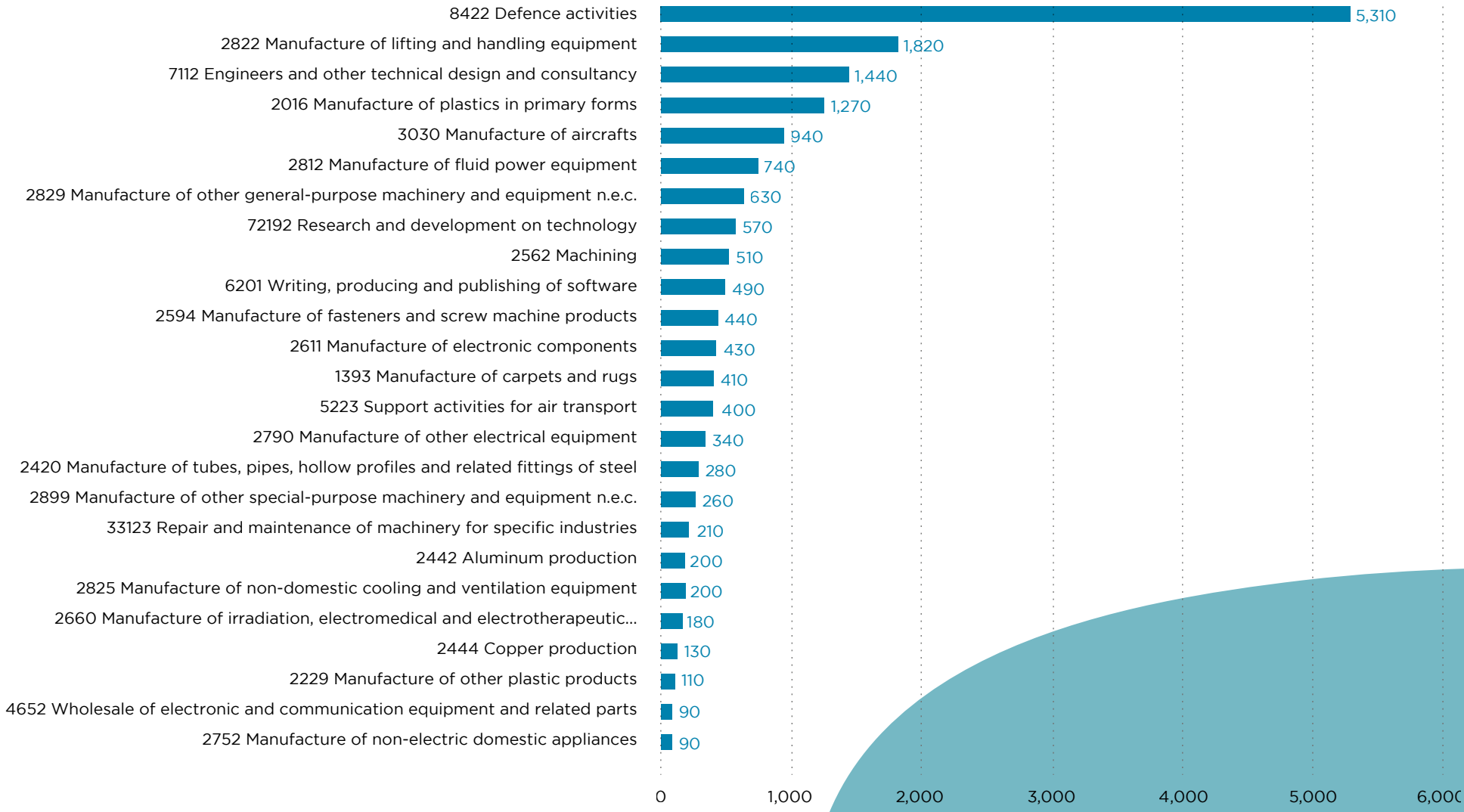
TURNOVER (NET WORTH) BY REGION (X MILLION EURO), 2016



Source: Vestigingenregister, CBS, edited by Fanion onderzoek & advies

Specialization of the Brabant Aerospace sector

LARGEST BRANCHES IN DIRECT AEROSPACE AND RELATED TO AEROSPACE, IN TERMS OF JOBS IN BRABANT, 2017



Source: Vestigingenregister province North-Brabant 2017, edited by Fanion onderzoek & advies

B. Largest Aerospace companies per category

HTSM AEROSPACE

Name	Place	Activity	size	country
Fokker Elmo B.V.	Hoogerheide	Electrical systems/cabling	500-799 jobs	United Kingdom
Fokker Techniek B.V.	Hoogerheide	Maintenance, Repair, Overhaul, VIP interiors	200-499 jobs	United Kingdom
KMWE Precision B.V.	Eindhoven	Aerostructure parts	200-499 jobs	Netherlands
Dutch Aero	Eindhoven	Engine parts		
Fokker Landing Gear	Helmond	Landing gear	200-499 jobs	United Kingdom
Chromalloy Holland B.V.	Tilburg	Maintenance, Repair, Overhaul	100-199 jobs	USA
Standard Aero B.V.	Tilburg	Maintenance, Repair, Overhaul	50-99 jobs	USA
Aerospace Propulsion Products (A.P.P.) BV	Klundert	Igniters/gasturbines	50-99 jobs	Netherlands
Bradford Engineering B.V.	Heerle	Satellite control systems	20-49 jobs	USA
Daedalus Aviation Services Inc.	Rijen	Maintenance, Repair, Overhaul	20-49 jobs	Netherlands
Aircraft Maintenance & Training School B.V.	Hoogerheide	Training in Maintenance, Repair, Overhaul	10-19 jobs	Netherlands

DEFENCE/AIRPORTS

Name	Place	Activity	size	country
Air base Gilze-Rijen / Defense Heli Commando	Rijen	Airforce	> 1,000 jobs	Netherlands
Logistics Center Woensdrecht	Hoogerheide	Airforce	> 1,000 jobs	Netherlands
Royal Air Force Air Base Volkel	Volkel	Airforce	> 1,000 jobs	Netherlands
Air base Eindhoven	Eindhoven	Airforce	800-999 jobs	Netherlands
Headquarters Command Air Forces	Breda	Airforce	200-499 jobs	Netherlands
Royal Military School Air Force Air Base Woensdrecht	Hoogerheide	Airforce	200-499 jobs	Netherlands
Viggo Eindhoven Airport B.V.	Eindhoven	Airport services	200-499 jobs	Netherlands
Eindhoven Airport N.V.	Eindhoven	Airport corporate	50-99 jobs	Netherlands

HIGH TECH SYSTEMS

Name	Place	Activity	size	country
Vanderlande Industries B.V.	Veghel	Luggage handling systems	> 1,000 jobs	Netherlands
VDL Group	Eindhoven/Hapert	Mechatronics/Engineering/Precision parts	> 1,000 jobs	Netherlands
Bosch Rexroth BV	Boxtel	Motion systems/hydraulics/linear motion technology	500-799 jobs	Germany
FEI Europe B.V.	Eindhoven	Electronic optics	500-799 jobs	USA
Nedschroef Helmond BV	Helmond	Fasteners	200-499 jobs	Netherlands
Neways Industrial Systems B.V./Neways Technologies BV	Son en Breugel	Industrial systems	200-499 jobs	Netherlands
TE Connectivity Nederland B.V.	's-Hertogenbosch	Connectors	200-499 jobs	Switzerland
Dassault Systemes B.V	's-Hertogenbosch	Embedded software	200-499 jobs	France
Applied Micro Electronics 'Ame' B.V.	Eindhoven	Sensor technology, Power conversion	200-499 jobs	Netherlands
Siemens Industry Software B.V.	Den Bosch/Breda	Embedded software	100-199 jobs	Germany
ALTRAN ENGINEERING B.V.	Helmond	Engineering	100-199 jobs	France
Teledyne DALSA B.V.	Eindhoven	Hightech camera's	100-199 jobs	Canada
Thales Cryogenics B.V.	Eindhoven	Coolers	100-199 jobs	France
ELCO NETHERLANDS B.V.	Helmond	Printed Circuit Boards	50-99 jobs	Italy
A.O. Smith Water Products Company B.V.	Veldhoven	Watersystems	50-99 jobs	USA
Adimec	Eindhoven	Industrial camera's	50 - 99 jobs	Netherlands
Kin Machinebouw B.V.	Rijen	Machinery and equipment	50-99 jobs	Netherlands
General Electric International Benelux BV	Breda	Machinery and equipment	50-99 jobs	USA
IAI industrial systems B.V.	Veldhoven	Laser precision	50-99 jobs	Sweden
Parker Hannifin Manufacturing Netherlands	Etten-Leur	Hydraulics	50-99 jobs	USA
AHC Benelux B.V.	Eindhoven	Surface treatment parts	50-99 jobs	Netherlands
IFS Netherlands B.V.	Eindhoven	Embedded software	50-99 jobs	Sweden
BKB Precision	Son en Breugel	High tech plastics machining	50-99 jobs	Netherlands
Naaykens' Luchttechnische Apparatenbouw B.V.	Tilburg	Air handeling equipment	50-99 jobs	Netherlands
DH Industries (Stirling Cryogenics/Cryozone)	Son en Breugel	Testing	20-49 jobs	Netherlands

HIGH TECH SYSTEMS

Name	Place	Activity	size	country
SABIC Innovative Plastics B.V.	Bergen op Zoom/ Raamsdonksveer	Plastics	> 1,000 jobs	Saudi-Arabia
Desso BV	Waalwijk	Carpeting, interiors	200-499 jobs	France
Tata Steel Nederland Tubes B.V.	Oosterhout	Steel	200-499 jobs	India
Sapa Profiles NL B.V.	Drunen	Aluminum parts	200-499 jobs	Finland
LDM B.V.	Drunen	Non-ferro parts	100-199 jobs	Netherlands
Goodyear (Nederland) B.V.	Tilburg	Tires	50-99 jobs	USA
MacDermid Enthone BV	's-Hertogenbosch	Coatings	50-99 jobs	USA
Goudsmit Magnetic systems	Waalre	Magnetic materials	50-99 jobs	Netherlands
Pekago Covering Technology	Goirle	Plastics/Aircraft interiors	20-49 jobs	Netherlands
Element Breda	Breda	Testing	20-49 jobs	United Kingdom
Askove Kunststof Industrie B.V.	Veghel	Plastics (Ground support equipment)	10-19 jobs	Netherlands

Largest aerospace companies per category

CHROMALLOY (TILBURG)

Siriusstraat 55
Tilburg 5015 BT
The Netherlands

Employees: 130
Turnover in Tilburg: € 32.5 million (estimation)

Chromalloy is an independent company that specializes in overhauling / repairing gas turbines. The most important markets are civil aviation and the energy market.

CAPABILITIES IN TILBURG

ENGINEERING

Reverse Engineering, Advanced Surfacing, Solid Modeling, CAD/ CAM Services, Metallurgical Laboratory including SEM and EDS, NDT (FPI, Eddy current (automated and manual), Ultrasonic inspection (automated and manual), MPI, X-ray), CMM

COATINGS

Lance Plasma, High Velocity Oxygen-Fuel (HVOF), Atmospheric Plasma Spray, Wire Arc Plasma Spray, Flame Spraying, CoNiCrAlY Overlay Coating, Diffused Aluminide Coating, Vapor Phase Aluminide Coating, Low Temperature Coatings including SSA12, Spray Coatings + Molydag, Abradable coatings, Chrome Plating

MACHINING

3/4-Axis Horizontal Milling, 3/4/5-Axis Vertical Milling, Horizontal/Vertical Turning, Horizontal/ Vertical Mill-Turn 5-Axis, Creep-Feed 3/5-Axis Grinding, EDM (Manual Plunge, CNC Plunge 4-Axis, Hole, Wire Cutting, Grinding), LBMR (Laser Drilling), CNC wire EDM

JOINING TECHNOLOGY

CAB Braze Alloy Process, Welding (Electron Beam, Low Heat Input, Manual, Semi & Fully Automatic TIG), Brazing, Heat Treating (Vacuum, Inert Gas, Air)

THERMAL PROCESSING

CAB Braze Alloy Process, Brazing, Heat Treating (Vacuum, Inert Gas, Air)

CHROMALLOY

FOKKER TECHNOLOGIES (GKN)

FOKKER LANDING GEAR
Grasbeemd 28, 5705DG Helmond

FOKKER TECHNIEK AND FOKKER ELMO
Aviolandalaan 33, 4631RP Hoogerheide

Employees
Landing Gear: 220
Techniek: 360
Elmo: 690

Turnover (estimation)
Landing Gear: € 45 million
Techniek: € 74 million
Elmo: € 142 million

FOKKER LANDING GEAR
Fokker Aerostructures is a recognized, first-class specialist in the design, development and production of lightweight structures, modules and landing gear for the aerospace and defense industry. Fokker landing Gear will produce the drag brace for the F35 JSF.

FOKKER TECHNIEK
Fokker Techniek is an integrated, knowledge based services organization that partners with manufacturers, owners and operators of aircraft in the continued competitive operation of their fleet by increasing technical dispatch reliability (TDR) and passenger comfort while reducing direct operating cost (DOC).

FOKKER ELMO
Fokker Elmo is a leading player in design, manufacturing and support of Electrical Wiring Interconnection Systems (EWIS) for Aerospace and Defense programs. Their tools and processes support their customer's aircraft, engine and defense programs.

KMWE/DUTCH AERO

KMWE
Croy 11, 5653 LC Eindhoven

DUTCHAERO
Zwaanstraat 1, 5651 CA Eindhoven

Employees: 280
Turnover (aerospace only)
KMWE: € 15 million
DutchAero: € 20 million

KMWE/Dutch Aero is specialized in high precision machining, casting, welding and deformation of metals. Mostly low volume, high quality and complex products.

KMWE
Tier 1 for Aerospace Structures KMWE's product portfolio ranges from single parts manufacturing to 'ready to install' parts and (sub)assemblies.
A typical KMWE's product range in this market segment is currently:

- Airframe structures (Alu, Ti, Steel)
- Actuation systems (mechanical, electrical, hydraulics/pneumatics)
- Environmental Control Systems
- Flight Controls and movables
- Landing Gear Systems

DUTCHAERO
DutchAero is a Tier 1 for engine parts. Core capabilities include design for manufacturing, prototyping, and manufacturing aero-engine and airframe parts for military and civil applications. DuchtAero produces nozzles for jet engines. It does so for the F16 and in the future it will produce the nozzles of the F35 JSF.

STANDARDAERO

Kranenberg 2, 5047 TR Tilburg

AIRFORCE BASE WOENSDRECHT
Kooiweg 40, 4631 SZ Hoogerheide

Employees: 50
Turnover: € 17.5 million (estimation)

TILBURG
StandardAero's European Service Center is located in Tilburg, Netherlands. StandardAero's EASA 145 Approved Maintenance Organization (also holding FAA and TCCA approvals) in the Netherlands provides:

- Full maintenance and repair (Service Center)
- Field service support for PW100, PT6A, PW600, CF34 series and T56 series
- QEC capability for PW125B, PW127B, as well T56
- Full in-house repair capability on PW100 and PT6A fuel, air and oil accessories
- Rental and storage solutions for PW100, PT6A, PW150, CF34 and CFM56 engines
- Program management for long-term contracts for government and civil operators

StandardAero

- Extensive experience with supporting Governmental and Military operators, in addition to regional airline operators and aircraft OEMs, our Service Center has
- Repair capabilities on modules of the Rolls-Royce Gem 42 turboshaft engines of the Westland Lynx helicopters for German Bundeswehr since 1991
- Repair capabilities on modules of the Rolls-Royce T56 engine and the Propeller for the C-130 for Royal Netherlands Air Force (RNAF) since 2013

WOENSDRECHT
StandardAero Defense Services Europe is located at the Woensdrecht Air Base in Hoogerheide, the Netherlands. The engine MRO facility at this Air Base was established by the Royal Netherlands Air Force (RNLAF) and is in operation since 1953. In 1981 it started with the overhaul of Pratt and Whitney F100 engines and since then has overhauled more than 3,000 F100 engines.

Since 2011, the F100 maintenance activities are performed in a Public Private Partnership (PPP) between StandardAero Defense Services Europe and the Royal Netherlands Air Force.

The PPP is operated under a GOCO construct (Government Owned, Contractor Operated). StandardAero works closely together with the

Netherlands Ministry of Defense in a Government Owned Contractor Operated arrangement.
The required Technical Assistance Agreements are in place.

The MRO facility is MLE-145 approved. The MLE 145 is the military equivalent of the EASA 145 certification. StandardAero offers the following services for the F100 engines, modules and components.

- F100-220/220E I-level repair
- F100-220/220E D-level repair
- State-of-the-art component repair facility
- Full F100-220/220E engine test capability
- Full logistic support for the MRO process
- Engineering Support and Configuration Management
- Customer Service Engineering

C. Profile of the Brabant Aerospace industry

After the bankruptcy of Fokker in 1996 the Aerospace industry in The Netherlands no longer had an Aerospace OEM company. However, a lot of the knowledge of Fokker and its supplier base continued to develop and expand. This together with the strong HTSM industry, Brabant has al lot to offer to the global Aerospace industry.

The Brabant Aerospace industry consists of two important sectors: HTSM and Maintenance, Repair and Overhaul.

The first group is based on the strong High Tech cluster in Brabant. In fact there is almost no machine that cannot be built in Brabant. The whole value chain for HTSM manufacturing is present, from processing raw materials to High Tech OEM's like ASML, Philips Healthcare, DAF and VDL busses.

Brabant has a strong profile in Tier 1, Tier 2 and Tier 3 that work together in an open innovation structure.

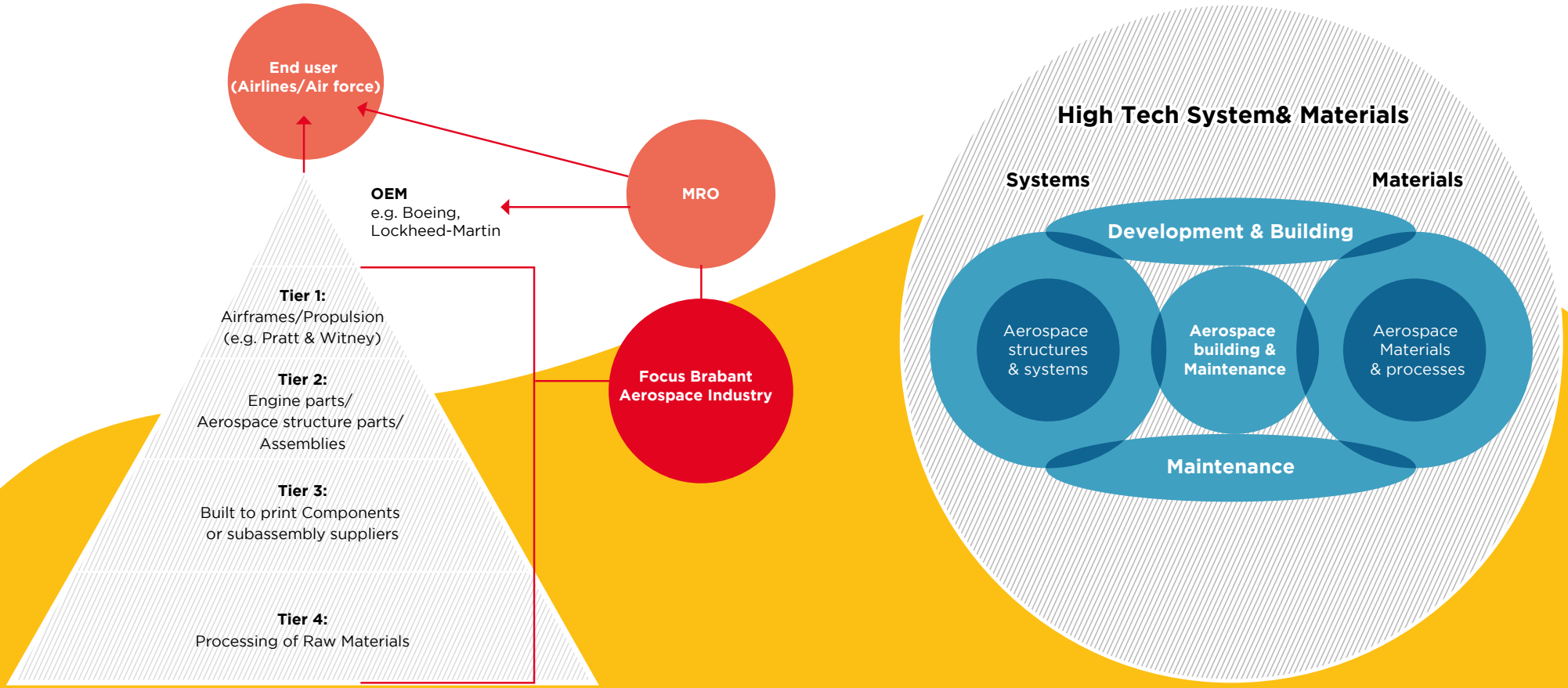
Relevant for the global Aerospace industry are Brabant's Tier 2 companies that are specialized in machining, CNC milling, deep drawing, bending of high quality precision parts etc. These companies deliver small and large volumes of high complex products at low costs and within a low lead-time. These companies also work for different end markets in various sectors, like Semiconductors, Automotive, Lifesciences and of course Aerospace. For Aerospace, these companies provide engine parts and aerospace structure parts and assemblies.Than there are companies in Brabant that are Tier 1 suppliers for system integration, robotics, control systems, cryotechnology, etc. They supply semi-finished products and modules.

Within HTSM there is a number of Tier 1 and Tier 2 towards OEM's like for example Boeing, Airbus, Lockheed Martin, Pratt & Withney and Rolls Royce.

The second group in Brabant are HTSM companies that focus on Maintenance, Repair and Overhaul. Most of these activities are clustered in the area around The Netherlands Air Force bases in Woensdrecht and Gilze-Rijen, where maintenance to aircraft is performed and where there is also a focus on training and education. In Tilburg Chromalloy is an important player for the MRO of gas turbine engines of civil aircraft from all over the world.

Next to these two main groups there are specialized companies that are active in Aerospace, for example: Vanderlande Industries is one of the leading companies in the world on luggage handling systems and Desso is producer of carpets but also active in airplane covering.

BRABANT FOCUS AREAS: SUPPLY OF SYSTEMS & MATERIALS AND MRO ACTIVITIES



4. REGIONAL STRENGHTS

The following strengths of the Brabant region with regard to the sector Aerospace are:

Competitiveness of the economy of The Netherlands;

Concentration of a broad variety of companies and crossovers with other topsectors;

High R&D intensity;

Labor market;

Infrastructure and logistics advantages;

Business locations;

Strong presence of The Netherlands Air Force.

A. Competitiveness of the economy of the Netherlands

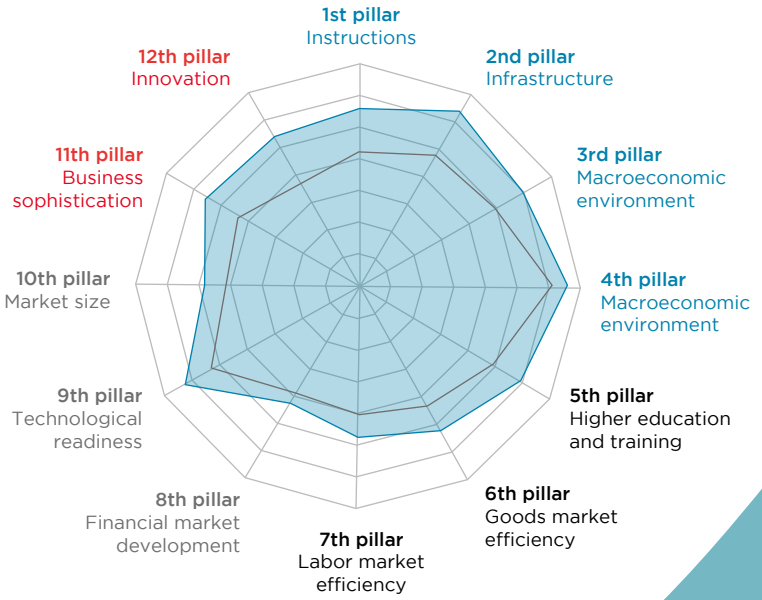
The Netherlands is one of the most competitive countries of the world
According to the World Economic Forum the Netherland is the fourth most competitive country of the world. Since 2008 The Netherlands has always been in the top 10. The Global competitiveness index is based on 110 variables, which are divided over 12 pillars.

The Netherlands scores particularly high on infrastructure, health & primary education, higher education and training and technological readiness.

TOP 10 MOST COMPETITIVE COUNTRIES IN THE WORLD 2017-2018[1]

Ranking	Country	Global Competitiveness Index
1.	Switzerland	5.86
2.	United States	5.85
3.	Singapore	5.71
4.	Netherlands	5.66
5.	Germany	5.65
6.	Hong Kong	5.53
7.	Sweden	5.52
8.	United Kingdom	5.51
9.	Japan	5.49
10.	Finland	5.49

SCORES THE NETHERLAND ON 12 PILLARS FOR THE GCI[2]



Sources:

[1] The Global Competitive Report, World Economic Forum 2018

[2] The Global Competitive Report, World Economic Forum 2018

B. Broad variety of companies & cross-overs with other topsectors

Brabant holds a strong position on several top sectors. Where the regular share of Brabant within the total number of jobs and establishment in The Netherlands is about 15 percent, Brabant stands out in the top sectors and has a much higher share.

About one fifth of the companies in chemicals & plastics, HTSM and Agrifood are located in Brabant. The same goes for the production value and number of jobs in HTSM and Agrifood where the share of Brabant is also about 20 percent. For Life Sciences & Health the share of Brabant is even higher, 62 percent of the production value and 29 percent of the total jobs in Brabant.

These branches are in a large extent entangled with each other. Chemicals & Plastics is an important supplier to Agrifood and HTSM. And a large part of the HTSM companies are supplier of machines and installations for Agrifood.

Brabant is famous for its open innovation concept. Companies cooperate on innovation challenges, where knowledge of production processes is shared for mutual benefits. These companies are convinced that it's the only way to withstand international competition. Of course, knowledge institutions are closely involved in this process.

Top 3

Number of Companies

Share in Brabant

CHEMICALS 21%

HTSM 17%

AGRIFOOD 17%

Production Value

Share in Brabant

LIFE SCIENCES & HEALTH 62%

HTSM 29%

AGRIFOOD 19%

Added Value

Share in Brabant

LIFE SCIENCES & HEALTH 29%

HTSM 20%

AGRIFOOD 19%

Source: BOM Info & Graphics

C. High R&D intensity

Brabant is well known for its relatively high expenditures on R&D, especially within the private sector. In 2015, Brabant accounts for 20% all R&D efforts in The Netherlands and spends 2.8% of the regional GDP on R&D, which is the highest in The Netherlands.

Brabant accounts for 31 percent of the total private R&D in The Netherlands and has the highest score on R&D conducted by businesses. This high private share leads to a higher applicability of innovations compared to other regions with mainly public funded R&D.

The branches that invest the most in R&D in terms of both expenditures and working years are the Machine industry, Electrotechnical industry, Chemical and plastics industry and Electrical equipment industry, which all have strong connections with Aerospace.

In addition to the number of innovative companies with their own R&D departments, there are also many World Class research and knowledge institutes in Brabant. These include Eindhoven University of Technology (TU/e), TNO, Tilburg University, the Polymer Research Platform and the Jheronimus Academy of Data Science (JADS). But for Aerospace Delft University of Technology and Netherlands Aerospace Center (NLR) are important. Those knowledge institutions are only a half to one-hour drive away.

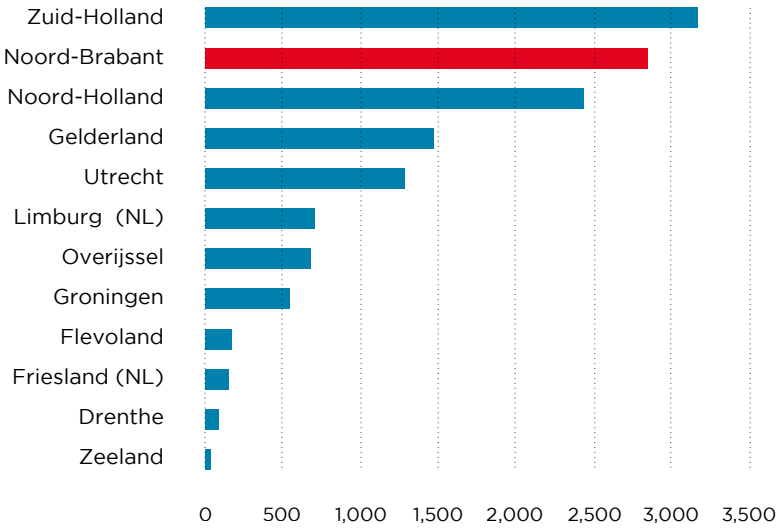
The Netherlands and Brabant in particular, are also known for their culture of open innovation. This means that, with a common interest, they share R&D facilities and knowledge on key technologies that can be used in the different application areas.

Examples of open innovation hotspots for Aerospace in Brabant are:

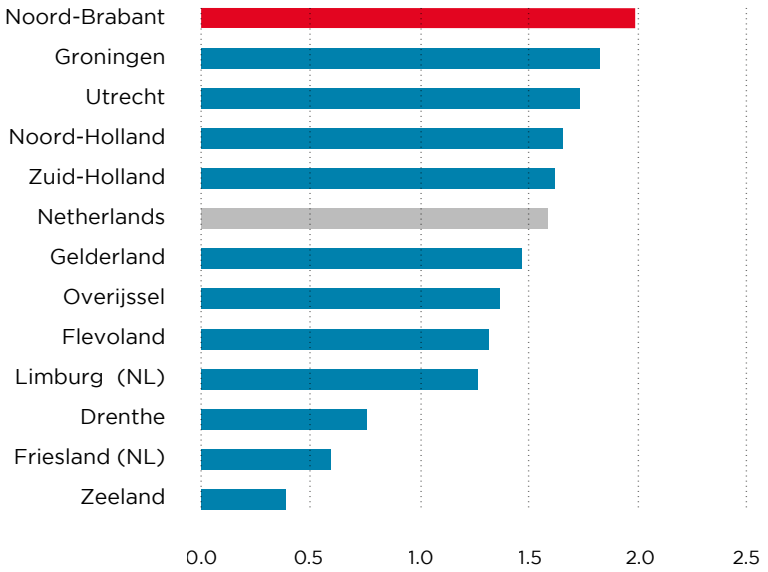
- Gate2;
- Aviolanda;
- DPI: The Polymer Research Platform;

But also smaller initiatives, where companies work together on innovations with their buyers.

R&D EXPENDITURES (IN MILLION EURO), 2015[1]



R&D PERSONNEL AND RESEARCHERS AS PERCENTAGE OF TOTAL EMPLOYMENT (IN FTE), 2015[2]

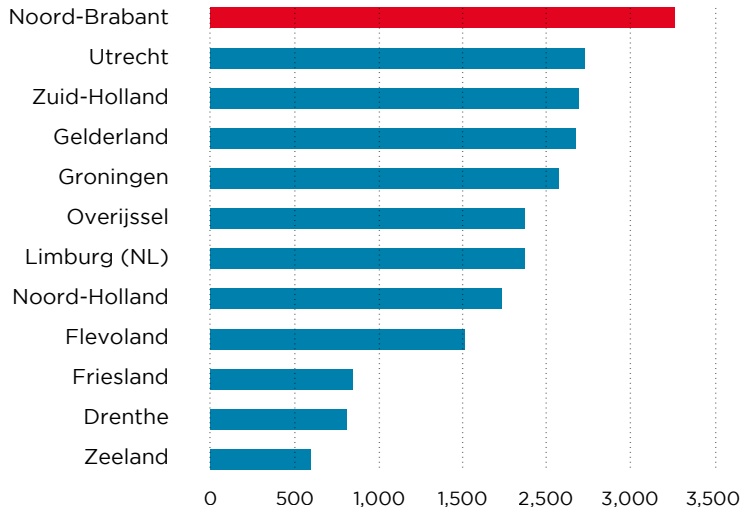


Sources:

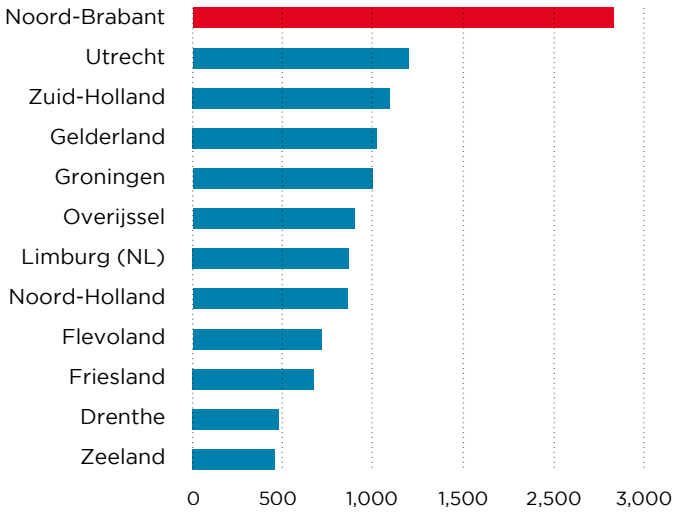
[1] Eurostat, 2018

[2] Eurostat, 2018

R&D EXPENDITURES AS PERCENTAGE OF THE REGIONAL GDP, 2015[1]



R&D EXPENDITURES BY ENTERPRISES AS PERCENTAGE REGIONAL GDP, 2015[2]



Sources:

[1] Eurostat, 2018

[2] Eurostat, 2018

D. Labour market

The following sources of personnel are available for aerospace in Brabant. In the first place the current working force in Aerospace. The second important sources are of course students and graduates of the different educational institutions. The last source is direct available people that are looking for a new job with a technical profession or background that suits the aerospace industry.

WORKFORCE

In 2017 there were in total 7,620 people working working in a branche that is part of aerospace activities. Of this group 44% is high educated, 41% has a medium education and 15% has a lower education. On top of that there are 11,040 jobs that are related to aerospace along to other branches. In that group 19 percent has al lower education, 44 percent is secondary educated and 37.1% is highly educated.

EDUCATION

There are both educations at a higher level and a medium level present in Brabant. At a higher level Eindhoven University of Technology provides Bachelor and Master courses at an academic level. Fontys and Avans are both Universities of Applied Science that have specialized programs that matches Aerospace requirements which deliver 500 graduates every year.

At the medium level 6,270 students have graduated from an education that matches the requirements of aerospace. Most of these students will continue their studies at a higher level.

ROC Tilburg and ROC West-Brabant both provide specialized courses for Technician avionics and Aircraft maintenance.

DIRECT AVAILABLE PERSONNEL

Over 2017, an average of 5,040 people with a technical profession where directly available for another job.

WORKFORCE AEROSPACE EMPLOYMENT BY EDUCATION LEVEL

	Lower education level	Medium education level	High education level	Total
Aerospace direct	1,110	3,110	3,390	7,620
Aerospace related	2,110	4,830	4,100	11,040
Total aerospace	**3,220**	**7,940**	**7,490**	**18,660**

	Lower education level	Medium education level	High education level	Total
Aerospace direct	14.6%	40.8%	44.5%	100.0%
Aerospace related	19.1%	43.8%	37.1%	100.0%
Total aerospace	**17.3%**	**42.6%**	**40.1%**	**100.0%**

Source: CBS, Vestigingenregister Noord-Brabant 2017, edited Fanion onderzoek & Advies

STUDENTS IN TECHNICAL STUDIES AT UNIVERSITY LEVEL

At Eindhoven University of technology 11,370 students were educated in 2017, of which 7,180 students followed a bachelor program and 4,190 students studied for their master's degree. In 2016 1,080 students graduated for their bachelor title and 1,290 graduated for their master degree.

At Eindhoven University of Technology there is no program specifically for Aerospace. But there are several programs that are relevant for aerospace. At a bachelor level: Data Science (joint degree), Technical Innovation Sciences, Electrical Engineering, Embedded Systems, and at a masters level: Electrical Engineering, Systems and Control, Innovation Management, Human-technology Interaction, Innovation Sciences, Operations Management and Logistics.

TECHNICAL STUDENTS AND GRADUATES AT HIGH EDUCATION LEVEL, AT EINDHOVEN UNIVERSITY OF TECHNOLOGY

	2013	2014	2015	2016	2017
Students					
HTSM Bachelor	5,120	5,630	6,110	6,670	7,180
HTSM Master	3,260	3,580	4,010	4,090	4,190
Technological designers(Pdeng)	290	300	270	nb	260
PhD's	1,210	1,280	1,370	nb	1,440
Graduates					
HTSM Bachelor	820	910	1,010	1,080	nnb
HTSM Master	1,080	1,120	1,320	1,290	nnb
Technological designers(PDEng)	110	110	140	130	110*
PhD graduates	220	240	230	220	280*

TU/e Technische Universiteit Eindhoven University of Technology
Where innovation starts

* = forecast

nb = not known

nnb = not known yet

STUDENTS IN A FOR AEROSPACE RELEVANT COURSE AT EINDHOVEN UNIVERSITY OF TECHNOLOGY[1]

	2013	2014	2015	2016	2017
Bachelor					
B Data Science (joint degree)	0	0	0	50	80
B Technical Innovation Sciences	270	360	420	470	490
B Electrical Engineering	440	520	680	720	770
M Embedded Systems	80	100	150	150	170
Masters					
M Electrical Engineering	200	250	260	260	260
M Systems and Control	50	60	80	110	120
M Innovation Management	180	170	190	180	190
M Human-technology Interaction	60	70	80	100	120
M Innovation Sciences	70	70	70	70	60
M Operations Management and Logistics	260	300	350	380	380
Total	**1,610**	**1,900**	**2,280**	**2,500**	**2,640**

GRADUATES IN COURSES THAT ARE OF USE WITHIN AEROSPACE AT EINDHOVEN UNIVERSITY OF TECHNOLOGY[2]

	2013	2014	2015	2016	2017
Bachelor					
B Technical innovation sciences	30	30	50	50	80
B Electrical Engineering	40	30	60	70	100
M Embedded Systems	40	30	30	50	50
Masters					
M Electrical Engineering	50	70	90	100	100
M Systems and Control	10	10	10	20	30
M Human-technology Interaction	20	20	20	30	20
M Computer Science and Engineering	50	60	60	70	50
M Innovation Sciences	20	20	20	20	20
M Operations Management and Logistics	90	80	100	130	120
Total	**330**	**340**	**430**	**530**	**590**

Source:

[1] DUO, 2018

[2] DUO, 2018

TU Delft, only a half hour drive away from Brabant, offers both a bachelor program as a masters program in Aerospace engineering. On a yearly basis 250-290 students graduate at the bachelor level, and over 300 students get their master. As you can see the number of students in aerospace engineering has grown fast over the last 5 years. At the moment the inflow of new students is limited by numerus fixus.

GRADUATES IN COURSES THAT ARE OF USE WITHIN AEROSPACE AT DELFT UNIVERSITY OF TECHNOLOGY

	2012	2013	2014	2015	2016
B Aerospace engineering (Bachelor)	290	340	280	250	260
M Aerospace Engineering(Master)	180	240	240	300	370
Total	**470**	**580**	**520**	**550**	**630**

Source: DUO, 2018

STUDENTS AND GRADUATES EDUCATION IN HTSM AT UNIVERSITIES OF APPLIED SCIENCE IN BRABANT

There are two large, broad Universities of Applied Science in Brabant: Fontys and Avans, and there is a more specialized UAS that focuses on some specialized market: NHTV/Breda University of Applied Science.

In total in 2016 2,840 students at the UAS followed a course for a HTSM related profession. Within this group there were at Fontys UAS 940 students in courses that can be of importance for Aerospace and at Avans UAS 2,290 students.

In 2016 there were 1,770 graduates in HTSM courses of which 530 that have a link with Aerospace. At Fontys there were 290 graduates, at Avans 170 and at NHTV 70.

STUDENTS IN HTSM STUDIES

University of Applied Science	2012	2013	2014	2015	2016
Avans	1,020	1,050	1,150	1,240	1,280
Fontys	890	900	1,010	1,160	1,230
NHTV	160	190	240	260	340
Total	**2,070**	**2,140**	**2,400**	**2,660**	**2,840**

Source: DUO, 2018

STUDENTS AT FONTYS (UAS), COURSES THAT ARE RELATED TO AEROSPACE

Fontys UAS	2013	2014	2015	2016	2017
Ad Electrical Engineering	0	0	0	0	10
B Man and Technology	170	200	210	200	210
B Electrical engineering	500	470	420	410	390
B Logistics Engineering	180	160	160	140	140
B Informatics	160	150	150	160	190
Total	**1,000**	**980**	**940**	**910**	**940**

STUDENTS AT AVANS (UAS), COURSES THAT ARE RELATED TO AEROSPACE

Avans UAS	2013	2014	2015	2016	2017
Ad Informatics	0	0	0	0	20
B Man and Technology	140	180	210	230	230
B Electrical engineering	440	440	480	470	470
B Technical Informatics	200	220	220	250	310
B Informatics	770	840	890	1,090	1,260
B International Maintenance Management (joint degree)	<10	10	<10	<10	<10
Total	**1,550**	**1,690**	**1,800**	**2,040**	**2,290**

GRADUATES IN HTSM STUDIES

University of Applied Science	2012	2013	2014	2015	2016
Avans	440	440	560	630	630
Fontys	650	670	790	930	960
NHTV	50	60	100	130	190
Total	**1,140**	**1,170**	**1,450**	**1,690**	**1,770**

Source: DUO, 2018

GRADUATES IN COURSES THAT ARE OF USE WITHIN AEROSPACE AT UAS INSTITUTES IN BRABANT

AVANS UAS	2012	2013	2014	2015	2016
B Electrical Engineering	70	60	70	100	70
B Informatics	80	100	120	110	140
B International Maintenance Management (joint degree)	0	0	0	10	0
B Man and Technology	10	20	20	20	40
B Technical Informatics	30	40	30	30	30
Total	**200**	**200**	**240**	**260**	**290**

FONTYS UAS	2012	2013	2014	2015	2016
B Electrical Engineering	90	60	90	60	80
B Informatics	20	30	30	30	20
B Logistics Engineering	30	40	30	30	30
B Man and Technology	20	20	10	40	40
Total	**150**	**140**	**160**	**160**	**170**

NHTV UAS	2012	2013	2014	2015	2016
B Creative Media and Game Technologies	50	60	80	120	180
B Logistics Engineering	30	30	50	50	50
M Game Technology	0	0	20	10	10
Total	**70**	**60**	**70**	**100**	**70**

Source: DUO, 2018

VOCATIONAL EDUCATION AT A MEDIUM LEVEL

GRADUATES SECONDARY EDUCATION LEVEL, TECHNICAL EDUCATION IN 2017

HTSM	MBO	Havo	VWO	Total
Breda region	460	440	540	1,440
Tilburg region	320	280	360	960
Den Bosch region	510	460	700	1,670
Eindhoven/Helmond region	770	630	810	2,210
Brabant	2,050	1,800	2,420	6,270

ROC WEST-BRABANT

The regional education center (ROC West-Brabant) for vocational secondary educations offers in Breda and Bergen op Zoom courses for the benefit of the chemical and process industry. The following courses are taught:

location Markiezaat, Air base Woensdrecht

- Technician avionics
- Aircraft maintenance (Technician mechanics)
- Aircraft maintenance (First fitter)
- Aircraft maintenance (avionics technician)

ROC TILBURG

The regional education Center Tilburg offers educations in aircraft maintenance, these are the following:

- First mechanic aircraft Maintenance
- Technician Aircraft Maintenance
- Technical manager
- Airline Service provider steward/stewardess

Source: CBS, DUO, 2018

DIRECT AVAILABLE PERSONNEL HTSM, AVERAGE 2017

In 2017 there were 5,040 people directly available for the labor market (average over the year) with a technical profession that could be relevant for Aerospace. 46% has a low education level, and 24% has a medium education level, and 30% a high education level. Most unemployed with a profession that suits aerospace are to be found in the Eindhoven region (35%).

Profession	Breda region	Tilburg region	Den Bosch region	Eindhoven/Helmond region	Brabant
High education level	390	260	380	490	1,520
Engineers (no electrical engineering)	80	50	70	100	300
Technicians of construction and nature	180	110	170	160	620
Software and application developers	90	80	110	170	450
Electrotechnical engineers	40	20	30	60	150
Medium education level	**410**	**210**	**260**	**310**	**1,190**
Electricians and electronic mechanics	200	100	140	180	620
Machine technicians	210	110	120	130	570
Low education level	**630**	**390**	**470**	**840**	**2,330**
Assembly workers	170	90	100	310	670
Metal workers and construction workers	190	150	160	210	710
Welders and sheet metal workers	150	80	100	230	560
Plumbers and pipe fitters	120	70	110	90	390
Total	**1,430**	**860**	**1,110**	**1,640**	**5,040**

Source: UWV, 2017

E. Business costs

INTERNATIONAL COMPARISON OF BUSINESS COSTS

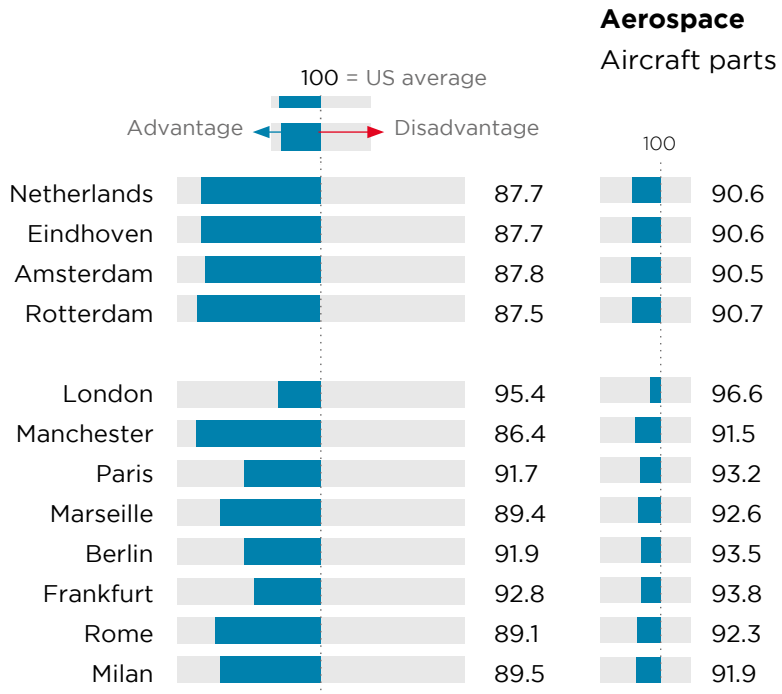
Total business costs are expressed as an index, with the baseline index of 100.0 being assigned to the United States. Countries with business costs lower than the US baseline have a cost index <100, while countries with business costs higher than the US baseline have a cost index >100.

KPMG Competitive Alternatives measures the combined impact of 26 key cost components that vary by location, over a 10-year analysis horizon starting in 2016.

Overall the business costs in The Netherlands are 13.3 points lower than in the United States (=100). In Eindhoven the costs are at the national average.

For Aircraft parts the business costs are 9.4 points lower than in the United States (=100). Compared to other European cities, the Dutch cities have a favorable index for business costs, which are lower than elsewhere in Europe.

OVERALL RESULTS



Source: KPMG Competitive Alternatives 2016

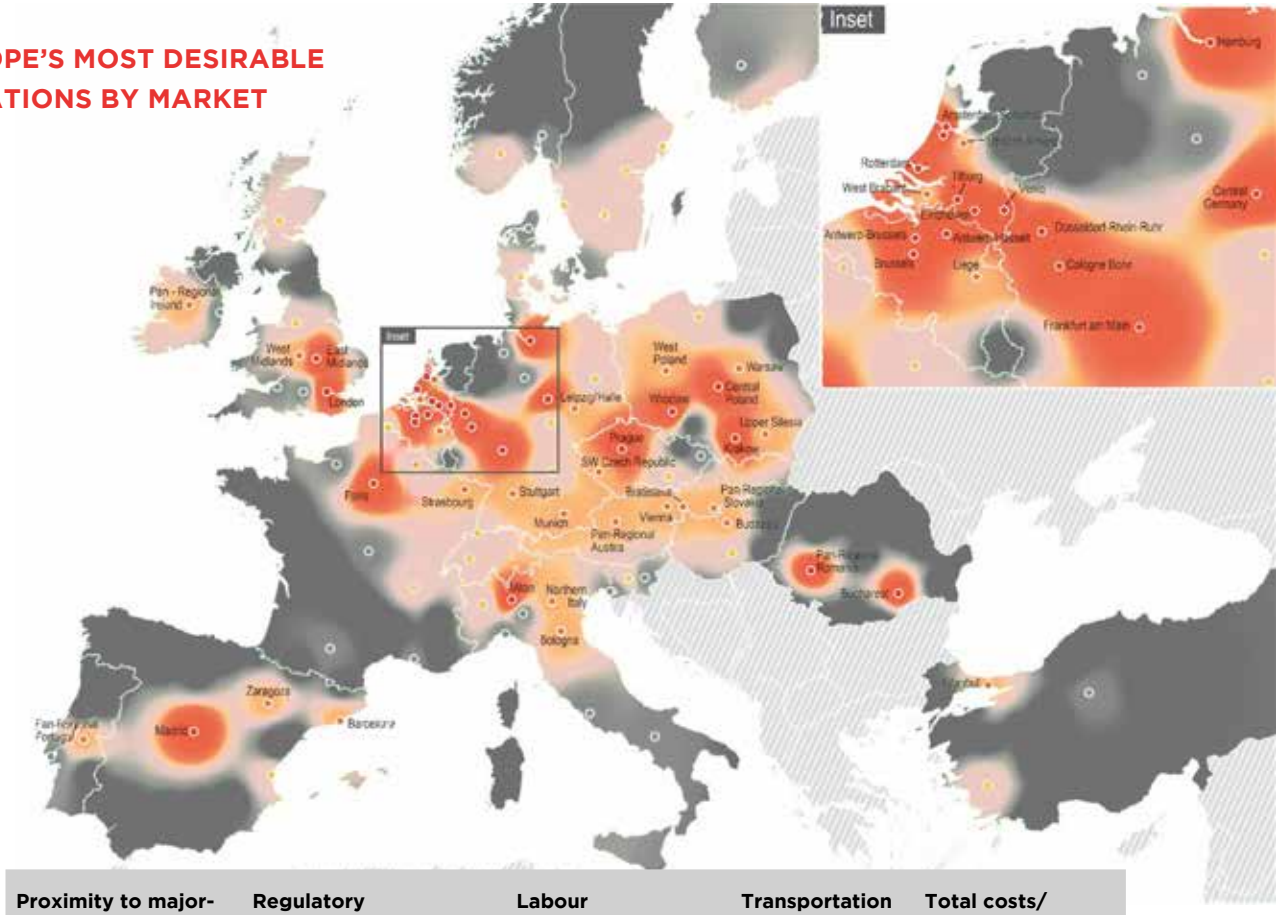
* US average = 100

F. Logistic advantages

The Netherlands is a very important logistic hub for Europe, because of its very favorable central location, the internationally renowned harbor of Rotterdam and an infrastructure of the highest level. On top of that The Netherlands is surrounded by huge consumer markets, has a favorable regulatory environment and a very good labor market. In other words, The Netherlands provides the best Cost/ Value proposition.

The most important logistic hotspots in Brabant are the Woensdrecht/Breda area, Tilburg area, Den Bosch area and the Eindhoven/Helmond area.

EUROPE'S MOST DESIRABLE LOCATIONS BY MARKET



Proximity to major-consumption centres	Regulatory Environment	Labour Availability	Transportation Infrastructure	Total costs/ valueproposition
1. Germany	1. Netherlands	1. Poland	1. Netherlands	1. Netherlands
2. Netherlands	2. All other cee	2. Netherlands	2. Germany	2. Poland
3. Belgium	3. Poland	3. All other cee	3. Belgium	3. All other cee
4. United kingdom	4. Germany	4. Germany	4. France	4. Germany
5. France	5. United kingdom	5. Belgium	5. Poland	5. Belgium

MARKET QUARTILE

- Quartile 1 (Top Rank)
- Quartile 2
- Quartile 3
- Quartile 4

Note: Only quartile 1 and 2 labeled

Source: Prologis, Europes most desirable logistics locations

Logistic hotspots in the Netherlands 2020

1. Tilburg-Waalwijk
2. West-Brabant (Oosterhout-Breda-Roosendaal-Bergen op Zoom-Moerdijk)
3. Almere-Lelystad-Zeewolde
4. Venlo-Venray
5. A12 corridor (Lansingerland-Zoetermeer-Zuidplas-Waddingxveen)
6. Twente (Almelo-Hengelo-Enschede)
7. Rivierenland (Tiel-Geldermalsen-Zaltbommel)
8. Oss-Veghel-'S-Hertogenbosch
9. Zuid Limburg (Maastricht-Heerlen-Sittard-Geleen)
10. Keyport Midden-Limburg (Roermond-Weert)
11. Utrecht (Lage Weide)-Nieuwegein-Vianen
12. Drechtsteden
13. Eindhoven-Helmond
14. Arnhem-Nijmegen
15. IJsseldelta (Zwolle-Kampen-Meppel-Hasselt-Nieuwleusden)
16. Liemers (Duiven-Westervoort-Zevenaar-'S-Heerenberg)
17. Schiphol
18. Hoogeveen
19. Delfzijl-Eeuwshaven
20. Maasvlakte I & II
21. Vlissingen-Terneuzen
22. Rotterdam-Nieuw Reijerwaard
23. Stedendriehoek (Apeldoorn-Deventer-Zutphen)
24. Noordzeekanaalgebied (Havengebied Amsterdam-Westas)
25. Emmeldorp
26. Heerenveen-Drachten
27. Alkmaar-Enkhuizen
28. Dryport Emmen-Coevorden

Cross border e-fulfilment hotspot nr. 1

Nationale e-fulfilment hotspot nr. 1 En Nationale distributie hotspot nr. 1

Source: www.logistiek.nl

DISTANCES FROM BRABANT TO EUROPEAN CITIES

Source: Bom Info & Grapics

HIGHWAY NETWORK IN NORTHWESTERN EUROPE

Source: Bombase

G. Business Locations

Three business locations in Brabant play a significant role in the Aerospace ecosystem of Brabant. Aviolanda Aerospace in Woensdrecht which is located next to the Woensdrecht Air Base (LCW), Aeropark Gilze-Rijen/Gate 2 which is located at Gilze-Rijen Airbase and the Eindhoven Airport area which includes Brainport Industries Campus and will be the new location for KMWE, DutchAero and other HTSM companies. The fourth important Aerospace location is Breda International Airport.

Aviolanda Aerospace

Aviolanda Aerospace (Business Park Aviolanda) is part of the Maintenance Cluster Woensdrecht, the military and civilian Aerospace Innovation Hub for community building and market development, where Logistic Centre Woensdrecht, the main support base of The Netherlands Royal Air force, works closely together with Business Park Aviolanda B.V.

At the Maintenance Cluster Woensdrecht more than twenty companies are present, generating jobs for about 2,600 FTE. Aviolanda Aerospace is the Dutch one-stop-shop for innovative aerospace maintenance and knowledge exchange, located in a sustainable business park adjacent to the Woensdrecht Air Base. Within this sustainable, spatial and economic area, much attention is given to education, innovation and research. It has excellent accessibility and facilities such as the long runway, park management, modern hangars and facilities, fieldlabs and internationally certified quality standards. Business Park Aviolanda is also a real-estate area, maintaining a portfolio that entails 60,000 m² of BVO buildings on a site consisting of approximately 30 hectares. Part of the strategy is to gradually redevelop parts of the existing property in collaboration with current and new tenants. Some buildings will be preserved, others will be restructured and new state of the art facilities for innovative maintenance purposes will arise.

GROUND MAP OF THE MAINTENANCE CLUSTER WOENSDRECHT, AVIOLANDA AEROSPACE AND LOGISTIC CENTRE WOENSDRECHT

Source: www.aviolanda.nl

THE CAPABILITIES AT MAINTENANCE CLUSTER WOENSDRECHT

AVIOLANDA AEROSPACE OFFERS THE FOLLOWING CAPABILITIES

Capability	Explanation
Civil & Military aircraft and helicopter maintenance	The Royal Netherlands Air Force concentrates its maintenance at Woensdecht Air Base as its main support base. Aviolanda is home for maintenance of both civil and military aircraft
UAV Demo Site	Testing location for Unmanned Air Vehicle and drones
Aircraft Redelivery	Conversion of the (VIP) interior and exterior of aircraft on behalf of lease companies
Aircraft Spray Painting	Repaint or restore painting and lettering of aircraft
Composite Maintenance	Restoring and repairing composite aircraft structures and components
Component Maintenance	Repair or replacement of new or refurbished components, combined with back-end logistics. At Fokker Techniek, many of these services are realized in so-called back shops; small, specialized departments, each dealing with their own component (avionics, moving mechanics, interior, motor, etc.).
Aircraft Maintenance & Training School (AMTS)	Training of Maintenance engineers

Source: www.aviolanda.nl

COMPANIES AT MAINTENANCE CLUSTER WOENSDRECHT

Source: www.aviolanda.nl

AERONAMICS SERVICES (EXPECTED 2019)

Aeronamic wil be responsible for the manufacturing, production, final assembly, testing and R&O of the Forward Module as part of the F-35 Power & Thermal Management System (PTMS), which will take place in the company's main facility in Almelo, The Netherlands.

The JPO (Joint Program Office) for the F-35 program selected The Netherlands – Aeronamic as the PTMS Sustainment Center for the F-35 Europe and Asia-Pacific based fleet. The sustainment activities will be performed by Aeronamic Services and located at Aviolanda in Woensdrecht. Activities are estimated to commence in 2019.

FOKKER TECHNIEK

Fokker Techniek is an integrated maintenance organization, with knowledge-based services and organizations that partner with manufacturers (OEM's), owners and operators of aircrafts in the continued competitive operation of their fleet, by increasing technical dispatch reliability (TDR Technical Dispatch Reliability) and the comfort of the passengers, while reducing direct operating costs (DOC, Direct Operating Cost) of their customers.

Today, Fokker Techniek has earned its position as a unique and valuable partner for the global aviation industry by supporting a large fleet of different types of aircrafts.

FOKKER ELMO

Fokker Elmo's mission is to become the leading business in the design, production and support of electrical systems and solutions for the aviation and defence industry. Its core activities are design, integration, production and support of electrical wiring linking systems (EWIS), including flight testing and instrumental cabling systems. Fokker Elmo offers affordable and competitive manufacturing in strategically important regions and supports our customers with participation in the industry.

AERONAMIC AIRCRAFT SUBSYSTEMS

FOKKER TECHNOLOGIES

FOKKER ELMO

Source: www.aviolanda.nl

4REPAIR

4Repair is a specialized company known for its structural repairs and modifications during base maintenance, line maintenance and AOG repairs. 4Repair offers customers experienced and structured specialization, including tools, materials and fasteners. 4Repair is able to professionally analyze damaged areas (continuously keeping contact with the engineering department) and consequently inspect and carry out the repair.

TIAT EUROPE B.V.

TiaT Europe B.V. provides a complete professional package for training in Non-Destructive Research. The training courses are tailored to the needs of the customer and can be given to the customer on location if desired. The training to level one or level two inspector / researcher is completed with an exam according to the requirements as described by the ASNT SNT-TC-1A, EN-4179, NAS-410 and / or ISO 9712.

AIRLINE TECHNICAL SUPPORT (ATS)

Airline Technical Support (ATS) is specialized in providing technical experts line/base maintenance and re-delivery. ATS's services include performing various tests, physical inspections of the aircraft and maintenance tasks for companies with EASA 145 approval. Besides this, Airline Technical Support maintains an open dialog with graduates from the Aircraft Maintenance Academy & Training School, essentially creating more opportunities for their clients and develop the students into future assets.

Source: www.aviolanda.nl

ACRATS TRAINING SERVICES

ACRATS is specialized in developing and providing courses and training in manufacturing, reparation of composite parts and other lightweight structures such as aluminum sheet metal, sealing compounds and corrosion control. An optimal learning environment is created by linking practical assignments to realistic work practices. In addition, the necessary skills and competences are instilled, which makes the expert even more valuable in their daily work performance.

AIRBORNE SERVICES

Airborne Services provides maintenance and repair services for composite structures, specifically specializing in helicopter rotor blades. The company mainly focuses on shortening the “turn around time” and works closely with the Woensdrecht Logistics Center of the Dutch Air Force. The business unit is part of the Airborne International Group, which has been a specialist in the design and production of advanced composites for the aerospace industry for over 20 years. (note: Specto acquisition).

STANDARDAERO

StandardAero is based at the Woensdrecht Air Base and together with the Woensdrecht Logistics Center forms a public-private partnership with aircraft engine maintenance. The primary product StandardAero will offer is maintenance, repair and overhaul activities on military aircraft engines.

Source: www.aviolanda.nl

AAR

AAR is a leading provider of airline services to the global commercial space and government and defence industry. AAR combines a close-by-customer business model with an array of opportunities to help customers. This allows them to help them work more efficiently, to achieve lower costs and to maintain a high level of quality, safety and service. AAR is a financially stable, dedicated partner with a permanent commitment to innovation, execution, continuous improvement and value for the customer.

AIRCRAFT MAINTENTANCE & TRAINING SCHOOL (AMTS)

Under its EASA Part 147 certification for Basic and Type Training, AM&TS tackles sector specific issues. The main focus here is to educate qualified staff, develop the curriculum and expand innovative educational concepts. Because of this, AM&TS has become an important and indispensable link between Aircraft maintenance education and the demands of businesses. To realize this mission, AM&TS collaborates with businesses, education and (local) government. As a result, interconnections are created that help contribute to innovation and (educational) renewals.

Source: www.aviolanda.nl

Innovation in maintenance and developments

AT AVIOLANDA THE FOLLOWING INNOVATION PROJECTS ARE INITIATED:

Development Center of Maintenance or Composites

- Research and development new techniques on testing and repair composites
- Consortium of Fokker Technologies, Airborne, NLR and TU-Delft

Smart (additive) manufacturing

- 3D (metal) printing for aerospace MRO
- Field lab in collaboration with Additive Industries

PTMS (gas turbine) knowledge center

- Field lab for the development of a digital twin
- Civil-military cooperation
- Integral part of the establishment of Aeronamic at Aviolanda

LR Systems

- Manufacturer of laser coating removal robots
- Certification in progress (SWI)
- Assemblage robots by NTS group

Aeroparc/Gate 2

Aeroparc, formerly known as the Ericsson site, is located in a prime location, right next door to Gilze-Rijen Air Base. Aerospace and maintenance form the foundation of the park, hence the name Aeroparc. Aerospace & Maintenance is one of the social innovation spearheads of the province of Noord-Brabant and the network organization Midpoint Brabant and is expected to generate both economic and social added value for the region.

Aeroparc is conveniently located on the N282, the provincial road connecting Tilburg and Breda, and is within easy reach of the A27 and A58 motorways, and Gilze-Rijen railway station. The business park at the Ericssonstraat is no less than 130,000 m^2 in size and boasts numerous green areas and free parking. Aeroparc forms an important part of the development of the Gilze en Rijen railway area.

GROUNDMAP OF THE AVIOLANDA BUSINESS PARK

Source: www.aeroparc.eu

GATE 2

Gate2 is located at Aeroparc Gilze- Rijen and offers professional housing to companies in the Smart Industry cluster, with originally a strong focus on the aviation and maintenance. Now Gate2 offers a full range of smart and flexible technologies: pilot training, world class maintenance, composites, big data, Internet of Things, 3D printing, sensor technology, adaptive robots, augmented & virtual reality, interactive avatars.

All activities, capabilities and companies at Gate2 can be classified in two main spearheads:

1. Simulation
2. Production Technology

Source: www.gate2.nl

Simulation

The activities in simulation are the following:

AIR MOBILITY TRAINING CENTER (AMTC)

At Gate2 the Air Mobility Training Center (AMTC) has been developed for the training of air force pilots for the KDC10 and C130. Simulator trainings can no longer be ignored by the operational world. The simulators in rows are of the so-called D-type, the highest class. The crew can replace flying hours by simulator hours . This means that an hour on the simulator is equivalent to an hour of training in a flying device. The simulators are scheduled twice a day for crews.

ADRENALINE CONTROL

Adrenaline Control combines cutting edge sport science services, state-of-the art simulator technology, a unique training approach through a driver maturity model and a professional infrastructure into a blended one-shop training organization for open wheel and GT motorsport individuals and teams.

Trainees who train at and with adrenalin Control have one common goal: improve and Excel on peak performance on demand and under pressure.

BLUETEA

Training of aircraft maintenance engineers by virtual training simulations and serious games. Real situation are brought to life to increase the competence for carrying out specific work, creating awareness for existing risks and dangers, striving for maximum safety and preventing mistakes / damage in practice.

Aircraft Maintenance & Training School
Easa Part 147: NL.147.7174.

ADRENALINE CONTROL
OPTIMIZING DRIVING PERFORMANCE

BLUETEA
WHERE KNOWLEDGE COMES ALIVE

Source: www.gate2.nl

HELIOS (HELICOPTER INSTRUCTION & OPERATIONAL SUPPORT FLIGHT TRAINING CENTER)

Provides specialized helicopter training for both civil and military aviation. Helios uses simulators and an innovative training system in which pilots are trained by means of advanced simulation flights in a sustainable, noise-friendly and cost-efficient way.

MERLIN AVIATION

Merlin Aviation builds and sells professional static aircraft simulators. Especially the Boeing 737 and the Airbus series are very popular among the pilots; according to them the simulators are indistinguishable from the real aircraft. Because of the 180 degree view, reality is as good as matched. Both the panels, electronics and software are designed by Merlin Aviation.

VROOM TRAINING

VROOM Training is specialized in immersive virtual reality, where you are immersed in the virtual world. It is used to train mechanics and engineers in real live situations.

DAF TECHNOLOGY LAB

The DAF Technology Lab provides high-tech facilities for students, researchers, and the business community. The combination of technology and behavioral sciences expertise offers unique possibilities for innovative teaching and research. The DAF Technology Lab consists of two spaces: the Experience Room and the Research Room.

Source: www.gate2.nl

Production technology

The activities within production technology are the following:

3D PRINTING LAB

3D printing and additive manufacturing
Innovate together on the future manufacturing industry. That is the power of 3D print Lab. It provides SMEs with a 3D printing facility so that companies and institutions with a low investment can get the 3D print & additive manufacturing technique in-house. 3D Print Lab gives its members access to know-how, the experiment lab and the production space.

CAMPIONE

The CAMPIONE project is a Fieldlab project, with participants from the chemical/process industry from all over the Netherlands. Several companies and institutions from central Brabant are also connected and play an important role in the project. The goal of the project is to make maintenance 100% predictable through advanced techniques at the cutting edge of condition based maintenance and big data. In this field, new products and services will be created from the Fieldlab, with export potential.

3D Print Lab

smart industry

CEC Composite Expertise Center

Source: www.gate2.nl

DAEDELUS AVIATION GROUP

Daedalus is working worldwide within the Maintenance Repair and Overhaul (MRO) sector. The company focuses in particular on deploying on-site support teams for the execution of first and second-line maintenance, component maintenance, depot maintenance, modifications and upgrade programs in the military aviation sector. Daedalus has a flexible database of fully qualified and certified maintenance technicians, all of whom have the required security clearances. The vast majority of their technicians have at least 20 years of experience in the field of MRO, especially for the F-16 weapon system, Apache AH-64, Chinook CH-47 and Cougar AS-532 helicopter.

THE CARBON SPECIALIST

The Carbon specialist is specialized in the repair of carbon applications. They are the first and currently only company in the Benelux that focuses on the repair of carbon applications for the private market with a Boeing repair certificate. Our specialty is in the field of repairing high-end racing and ATB frames, but we also have extensive experience with other carb applications such as car parts. Carbon recovery gives a lifetime guarantee on their repair.

GLUE ACADEMY

Glue academy strives for cooperation between research centers, education, branch organizations and companies, active in the distribution and processing of glue and glue-related products. It does all sorts of activities to promote the field. Presentations at symposia, participation in trade fairs and the development and support of educational packages for the benefit of the Basic and Secondary Education.

Source: www.gate2.nl

MATINSPIRED

MATinspired gives customers more technical insight into the materials of their product. The company does this by means of advice, damage research, workshops, material research, analyzes and development of test kits.

TIAT EUROPE

Threshold Inspection & Application Training Europe B.V. (TiaT Europe B.V) has its root in the aviation sector in the Netherlands. TiaT Europe B.V. is specialized in the field of Non Destructive Research (NDT).

VAN KEMPEN ENGINEERING & CONSULTANCY (KEC)

Van Kempen Engineering & Consultancy offers leading consultancy, project & interim management for players in innovative, high-tech markets. Aerospace is one of the markets KEC is operating in.

Source: www.gate2.nl

Brainport Industries Campus

THE FACE OF THE HIGH-TECH MANUFACTURING INDUSTRY - THE FACTORY OF THE FUTURE

On the Brainport Industries Campus, the most innovative and successful companies and institutes from the Brainport region come together as one. The campus is the place where the innovative and competitive strengths of the high-tech manufacturing industry is taking shape.

Leading knowledge institutes and renowned companies work together on Brainport Industries Campus to realize ideas and develop business cases. Here the next generation of professionals in the high-tech manufacturing industry is trained in a state-of-the-art working and learning environment. Brainport Industries Campus is the place to be for far-reaching partnerships between suppliers, specialist companies and innovative education and knowledge institutions.

Brainport Industries Campus is the very first location where high-tech suppliers innovate and produce together. Here the most successful companies share high-quality facilities, such as cleanrooms, flexible production areas, warehouses and advanced facilities. Here they present themselves together as one showcase to their (inter-) national customers.

Brainport Industries Campus

BRAINPORT INDUSTRIES CAMPUS NOW

- More than 20 companies
- 2,000 high-level staff
- 1,500 students
- 105,000 m2
- 6,000 m2 shared facilities
- 6,000 m2 shared logistics

A selection of the current tenants: KMWE, Siemens, Yaskawa, Ceratec, Brainport Industries, Fujitsu, Anteryon, Festo, Procureon, Hightech Software Cluster

Breda International Airport (Seppe)

GENERAL

Breda International Airport has become a landmark at highway A58. It can be easily reached by exit 21. With sufficient parking availability, it is a unique location for business lunches or meetings in one of their meeting rooms. Located at the Terminal are several aviation related companies and companies that use aviation as a mode of transport. Breda International Airport is still developing, which offers new settlers a lot of chances and possibilities. The vision and ambition of the airport are to improve the quality of the aircraft movements, not to increase the quantity. In this way, the latest GPS technology is used to work on procedures to reach the airport in bad weather conditions. Furthermore, there is a glass fiber network at the airport.

BUSINESS UNITS

All business units consist of an average of 600 m^2 of office space, 600 m^2 of hangar and the necessary parking space. The hangars have direct access to the airport. They are linked to the office units and form the 'garages' of the business premises, all of which have a beautiful view location on the A58. A beautiful green strip with water features will be laid between the business premises and the A58. The accessibility is also well organized. Each business unit has sufficient parking space and can be reached from the Bredasebaan, the parallel road along the A58. This connects directly to the nearby entrances and exits of the A58.

BREDA INTERNATIONAL AIRPORT
Seppe 1949

Companies at the airport

BREDA AVIATION

Several activities like flight training, sightseeing flights.

MASTENBROEK AEROSKILL B.V.

Mastenbroek Aeroskill B.V. is an aviation maintenance organization with EASA Part-145 Maintenance Approval, specialized in the maintenance and repairing of aircrafts.

SKYDIVE ENPC

Skydive ENPC is the oldest parachute association in The Netherlands. Here, you can do anything related to parachute jumping; tandem jumps, follow a training or book a demonstration.

FLYING CLUB SEPPE (VLIEGCLUB SEPPE)

Members of flying club Seppe are aviation enthusiasts who want to (learn to) fly. The flying club has their own aircrafts, which can be rented.

GO4MOBILITY

Go4Mobility is an important importer and distributor of mobile hardware solutions for aviation and other industries. Go4Mobility offers appropriate hardware solutions which are required or enhance your work.

QMOSS

QMOSS is a Go4Mobility partner that repairs damaged devices in a specially equipped service and repair centre.

Source: https://en.breda-airport.eu/

AEC MEDICALS B.V.

AEC is a medical centre that can conduct all medical exams for EASA (classes 1, 2 and 3), FAA (classes 1, 2 and 3), Transport Canada and South Africa. AEC has NEN and ISO 9001-2000 certificates.

FORUM GROUP B.V.

Forum Group is a real estate investment fund for public real estate and operation bound real estate. After the acquisition of Breda International Airport in 2008 there have been intensive investments in aviation enterprises.

SOUTHERN CROSS INTERNATIONAL B.V.

Southern Cross International is an aviation service provider in ferry flights, test flights, Special Mission Operations, consultancy and support in flight operations.

PBSIM B.V.

PBSIM B.V. invests, develops and delivers modern systems such as screens and instruments for flight simulators for Airbus, Boeing and military markets with systems for the Hawk, A-10 and F-16.

BOS AVIATION SERVICES

Bos Aviation Services combines decent knowledge of aviation with expertise in accountancy, legal advice and tax advice. They use benchmark data, key figures and critical indicators from aviation to advise customers pro-active.

GLIDER EQUIPMENT

Glider Equipment sells all possible equipment for gliders. They also rent out maintenance areas with all tools necessary for specific maintenance.

Source: https://en.breda-airport.eu/

CNE AIR

Promote your company, campaign or personal message with aerial advertising.

ORANGE AIRCRAFT B.V.

Orange Aircraft is specialized in engineering and production of fuselages of UAV's, GA aircrafts and aerobatic aircrafts. They are a well-trusted partner for (inter)national business customers that want to outsource their engineering and production.

AEC AIR SUPPORT B.V.

AEC Air Support is specialized in supporting private and governmental institutions. AEC Air Support supports in operational settings and during trainings with tactical air support and airborne sensing.

APS EUROPE

The Aviation Performance Solutions (APS) team has been focused on addressing aviation safety issues associated with Loss of Control In-flight (LOC-I) for two decades.

TTC SEPPE

Test and Training Centre Seppe is an Advanced Flight Training Organization. They are passionate about giving training to professional pilots who are interested in improving their knowledge and skills regarding Loss of Control In-Flight (LOC-I).

BRAINCAP SOFTWARE & SERVICES

Braincap Software & Services is an IT and software service provider. From their location at Breda International Airport, they focus on Aviation Logistics and avionic producing companies. Other location are used for other branches. Please click here for more information.

Source: https://en.breda-airport.eu/

H. Strong presence of Royal Netherlands Air Force

The Royal Netherlands Air Force has chosen Brabant as the main region of presence. Four main air bases are located in Brabant: Eindhoven, Gilze-Rijen, Volkel and Woensdrecht. Also the national command center of the Royal Netherlands Air Force is established in Brabant, in Breda.

This means that there is a lot of mass in military aerospace activities with Royal Air Force as an important end user.

The Royal Netherlands Air Force is also more and more open for business development and partners from outside the Armed Forces.

At the end of 2017 the Dutch government introduced a plan for 'Adaptive Armed Forces'. This is a plan of approach for the step-by-step transition to a military that is more flexible and cooperates sustainably with companies and organizations.

This more flexible operational management has the advantage that the Defense organization can better absorb peak loads, that the continuity can be increased relatively quickly and that they no longer have to have every specialism permanently 'in the house'.

The Air Force is currently implementing this through the creation of the Aero Space Cluster, collaboration with various educational institutions, public private partnerships in the area of engine maintenance, partnerships with Aviolanda and the recruitment of reservists based on specific knowledge and / or skills.

This opens up opportunities for innovation, smart industry concepts and new business for companies that supply the Royal Netherlands Air Force.

Koninklijke Luchtmacht

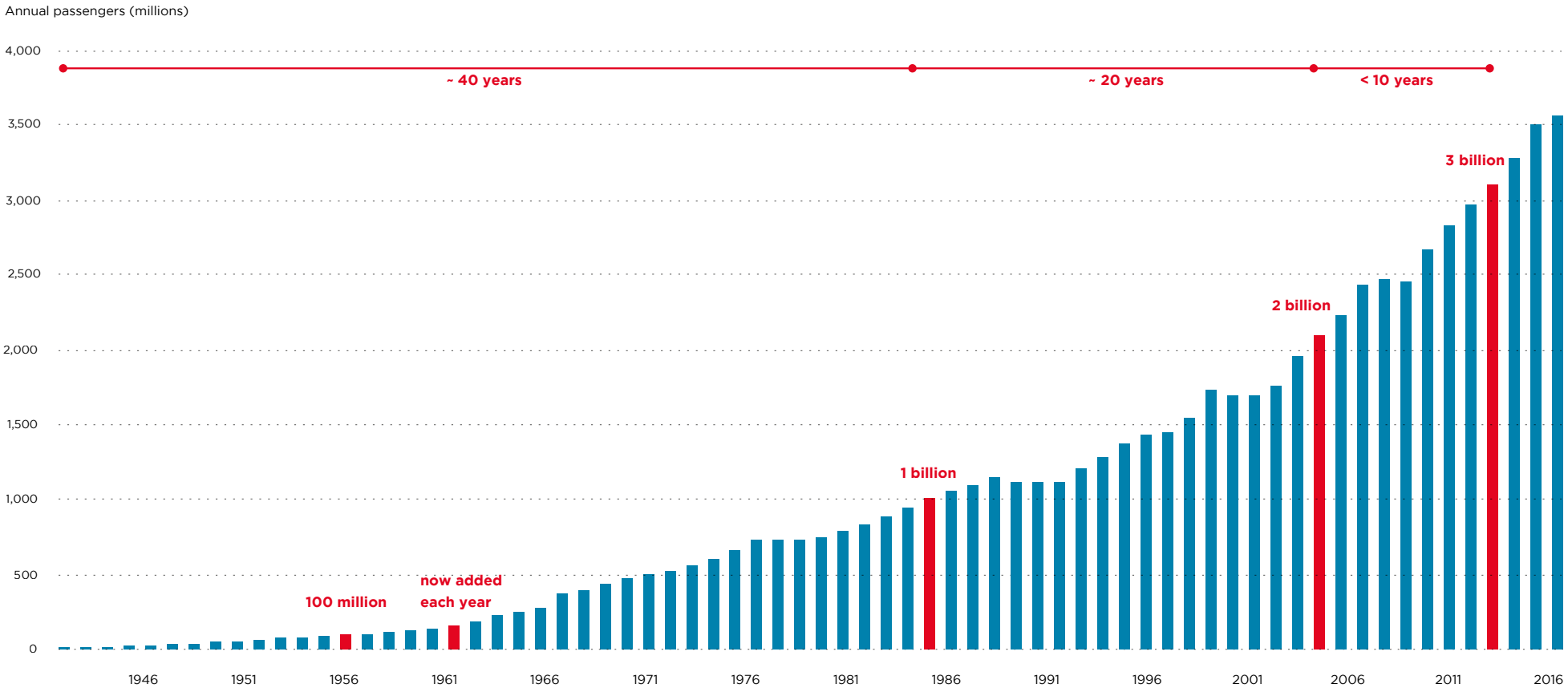
5. TRENDS & DEVELOPMENT

A. Market trends

The number of passengers has strongly been growing the past decades and will be growing the next 20 years 4.7 percent a year. Especially in Asia the growth will be strong. Also the world-wide fleet will grow, and on top of that older airplanes will be replaces by new more clean and more economical airplane. The aerospace industry has proven to be a resillient industry with good perspectives.

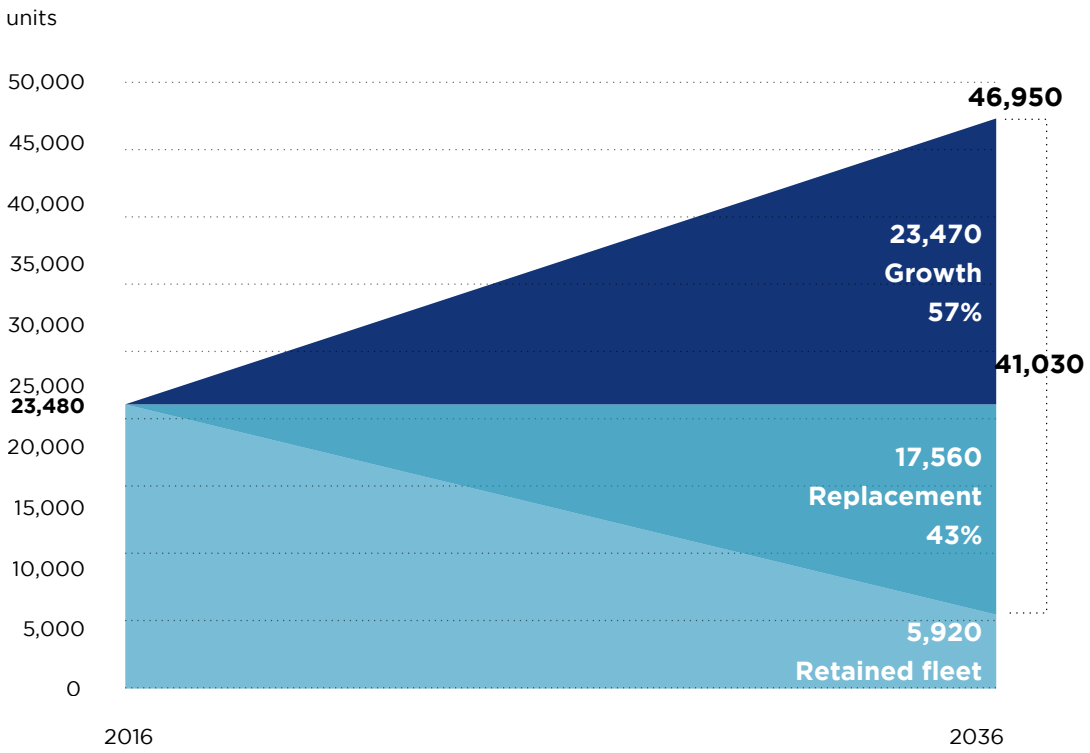
Also in The Netherlands the number of passengers has strongly grown. Amsterdam Schiphol is by far the largest airport with 68 million passengers in 2017. Eindhoven Airport comes secondly with 5.7 million passengers in 2017. Eindhoven Airport is the fastest growing major airport in the Netherlands. Between 2010 and 2017 the number of passengers grew with over 150%. With exemption of Maastricht/Aachen Airport which has chosen to focus on transport of cargo all other Dutch major airports grew with 50 percent or more.

DEVELOPMENT NUMBER OF PASSENGERS WORLDWIDE

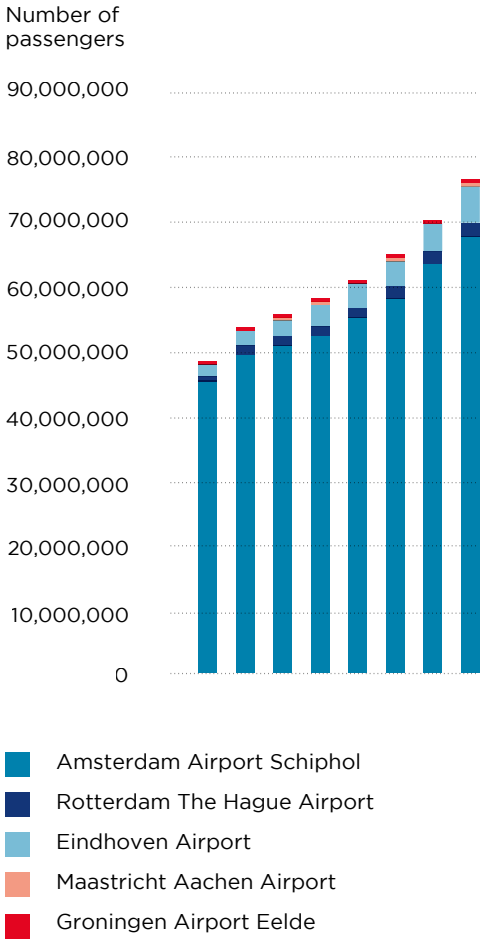


Source: ICAO/IATA in Boeing (2017) Current Market Outlook 2017-2036

NEW AIRPLANES REPLACE OLDER TYPES[1]



NUMBER OF PASSENGERS FIVE MAJOR AIRPORTS THE NETHERLANDS[2]



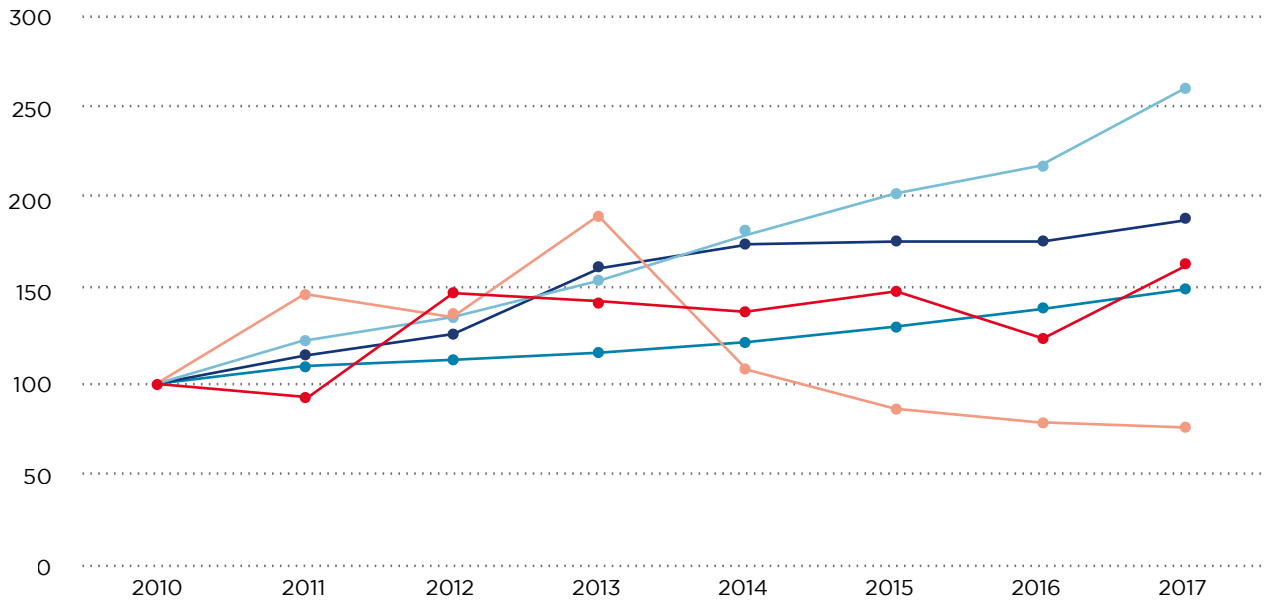
Sources:

[1] Boeing (2017) Current Market Outlook 2017-2036

[2] CBS

INDEX GROWTH NUMBER OF PASSENGERS 2010 – 2017, FIVE MAJOR AIRPORTS

Index number of passengers
(2010 = 100)



- Amsterdam Airport Schiphol Rotterdam The Hague Airport
- Eindhoven Airport
- Maastricht Aachen Airport
- Groningen Airport Eelde

B. Technological trends

The Dutch government has identified nine Topsectors. One of the most important Topsectors is High Tech Systems and Materials.

Within the topsector HTSM 15 roadmaps are developed, of which 6 on key technologies: advanced instrumentation, electronics, embedded Systems, high tech materials, nanotechnology and photonics and 9 on areas of application: aeronautics, automotive, healthcare, lighting, printing, security, semiconductor equipment, smart industry and space.

In the Roadmap Aeronautics 2018 – 2025 (NLR) the general trends and challenges are described.

DUTCH AEROSPACE INDUSTRY IDENTIFIES FOLLOWING TRENDS

PROTECTING THE ENVIRONMENT AND THE ENERGY SUPPLY

The world has to find an answer to climate change and has to reduce farmhouse gasses like CO2 and NOx. This is even more challenging as the demand for air travelling is growing. Other drivers to reduce fuel consumption is the cost of fuel and noise hindrance around flight paths and runways of airports.

ENSURING SAFETY AND SECURITY

Although flying is the safest form of transport, there are still improvements to be made. The further minimization of human errors or failure of aircraft is an important area of attention in civil aviation. Within military aviation safety and security is even a main concern. To develop and built aircraft that can protect us and keep the world peace and simultaneously provide the highest efficiency remains a constant challenge.

MAINTAINING AND EXTENDING INDUSTRIAL LEADERSHIP

The Dutch Aerospace industry wants to maintain their leading position on innovation and Smart production at high level standards, while emerging economies are developing there Aerospace industry and level of production capabilities as well. The market demands ever-shorter cycles for technology integration with, at the same time, aggressive pricing. A major challenge is to significantly reduce the development leadtime and non-recurring cost and increase manufacturing flexibility, for which automation and digitization are key technologies that need to be embraced.

PRIORITIZING RESEARCH, TESTING CAPABILITIES & EDUCATION

The Netherlands invests in top research, test and education facilities. This is necessary to keep ahead of competition and to make the right decisions for future marketing.

Source: Lucht en Ruimtevaart Nederland (2018) Roadmap Aeronautics 2018 – 2025

Focus areas in aerospace industry development

Dutch Aerospace industry focuses on the following key activities

AEROSTRUCTURES

The Dutch Aerospace sector holds a strong position on tail sections, wing boxes, movable wing parts, landing gears and other structural parts. It has excellent capabilities in designing and manufacturing composite and fibre metal laminate components and structures and has a solid reputation as global supplier of advanced materials and coatings.

ENGINE SUBSYSTEMS AND COMPONENTS

The Netherlands holds a strong industrial position on subassemblies for high-pressure compressors, Auxiliary Power Units (APUs) and parts (blisks, impellers, casings, seals, shrouds, turbine blades, and engine starters). The knowledge infrastructure offers key expertise on the aircraft and the powerplant integration and offers therefore optimization opportunities.

MAINTENANCE REPAIR AND OVERHAUL

The Dutch MRO activities are ranging from overhaul of aero engines to composite repair, new concepts to reduce life cycle costs, corrosion, (prognostic) health monitoring from components and systems up to complete aircraft, utility and VIP conversion activities.

AIRCRAFT SYSTEMS

The sector has an excellent position on aircraft interconnection systems and aircraft interior systems.

FUTURE CONCEPTS

Next generation (self-healing, multifunctional) materials and new aircraft integration and certification (thanks to Fokker heritage in aircraft manufacturing, presence of DNW and many second tier suppliers with a worldwide customer base), Remotely Piloted Aircraft Systems (RPAS, with Dutch companies selling and operating RPAS worldwide), Unmanned Aerial Vehicles (UAVs), roadable aircraft and (hybrid-) electric aircraft are strong points for Dutch industry.

Source: Lucht en Ruimtevaart Nederland (2018) Roadmap Aeronautics 2018 – 2025

C. Opportunities in the Aerospace industry in Brabant

The Brabant Aerospace industry seizes opportunities in the following promising developments:

1. **3D PRINTING AND ADDITIVE MANUFACTURING;**
2. **NEW MATERIALS;**
3. **SIMULATION;**
4. **ENGINE MRO;**
5. **INTERNET OF THINGS, BIG DATA EN SMART SENSORING;**
6. **DIGITAL/VIRTUAL TWINS.**

1 3D PRINTING AND ADDITIVE MANUFACTURING

3D printing and additive manufacturing are very promising technologies for aerospace. The following advantages can be identified:

- Speed of development: new designed products can be quickly produced;
- Single step manufacturing: the product is made in one single step, limited or no extra handling is necessary;
- Cost: there is less loss of materials, the production process can be shortened;
- Risk mitigation: The risk of development errors is smaller;
- Complexity and design freedom: more complex structurers can be developed;
- Customization: designs can be more easily edited;
- Ease of access: the number of 3D printers has increased and they are more sophisticated
- Sustainability: less loss of materials.

3D Printing is a very promising technology but is currently not yet the standard. Most 3D printed products cannot yet meet the high standards and strict certification requirements that are necessary in Aerospace.

2 NEW MATERIALS

In various industrial sectors such as aerospace, maritime and high-tech, increasingly large scale of new alloys and composites are applied. For example VDL Fibertech (Automotive), KMWE (Aerospace components) and Polyproducts (Maritime). The market for maintenance of these new materials is relatively new, but growing. This maintenance requires new knowledge and expertise of maintenance engineers, but also developers of maintenance techniques and tools.

Design for Maintenance, New MRO Methods and Circular Economy is an important theme in Brabant in this matter.

For example, a specific composite component can lead to a stronger and lighter system, enabling better performance in use. But in the design phase choices can also be made for simpler, safer and cheaper maintenance of a system. In both the design and operational phase maintenance techniques can be developed with the same goals tailored to the specific properties of new materials. Of course maintenance managers and engineers should be trained in the use of it.

New materials can also have an impact with regard to the circular economy. The decisive factor here is to what extent a composite component or module can be maintained, repaired, replaced or reused.

3 SIMULATION (VR/AR)

Simulation is also one of the spearheads in Aerospace in Brabant. Aircraft pilots are trained more and more in simulators. Not only to learn them the basics of handling the aircraft, but also to train them for more complex missions.

But simulators will have broader application possibilities. Maintenance personnel can also be trained with virtual and augmented reality technology to experience real life situations. The big advantages of simulations are: forecasts can be made regarding uncertain situations, enabling trainers to get better insight in reactions to a lot of different scenario's and feedback for necessary engineering modifications. All this against low costs, in a perfectly safe environment for the mechanics and engineers and less nuisance and load for the environment.

4 ENGINE MRO

Brabant aims to be the European Engine MRO shop for the F-35 in Europe. StandardAero and Aeronamic are two of the companies that have or will set-up an MRO shop at Woensdrecht Logistic Center.

5 INTERNET OF THINGS, BIG DATA AND SMART SENSORING

Next to the four main strategic choices IoT, Big Data and Smart Sensors are another major technological trend in Aerospace.

Aircraft and the components within aircraft are filled with sensors that are able to communicate and generate loads of data. These data can be analyzed and lead to improved designs and products. For MRO activities this is also a major development because all these data can be used to built models. The models can predict the maintenance schedule of aircraft components and parts. In this way maintenance can be better predicted and planned, which leads to improvements in the supply chain and eventually lower costs.

6 DIGITAL/VIRTUAL TWIN ENGINES

Digital or Virtual twins is a combination of VR/AR, Internet of Things and Engine MRO. A new development is that an aircraft engine gets a digital twin that follows the same load and duration as the real engine. Based on data the virtual engine can be checked on wear and tear and malfunction of parts. It is easier to examine and run test on the virtual engine than on the real one, which is much more cost efficient.

6. KNOWLEDGE INSTITUTES & NETWORKS

Knowledge institutes & networks

Brabant offers an excellent environment for R&D and manufacturing activities. There is a high level of basic research in the region, embodied by the Eindhoven University of Technology. In addition, the Universities of Technology of Delft, Leuven (Louvain) and Aachen are nearby. Other nearby knowledge institutes that are involved in Aerospace are Fontys UAS, Holst Centre and Jheronimus Academy of Data Science.

This chapter provides more info of the relevant knowledge & research institutes related to Aerospace.

EINDHOVEN UNIVERSITY OF TECHNOLOGY (TU/E)

The TU/e in Eindhoven is one of four technical universities in the Netherlands. The TU/e has distinguished three strategic areas: Energy, Health and Smart Mobile. The various top research groups that the TU/e distinguishes work within the context of these strategic areas.

For Aerospace the departments of chemical engineering and chemistry, Mechanical Engineering, Applied Physics, Industrial Engineering & Innovation Sciences and Mathematics and Computer Science are the most relevant.

- Elsevier's Higher Education Review ranked TU/e as the best University of technology in the Netherlands in 2017, for the fifth time in a row.
- TU/e is ranked 141th in the Times Higher Education World University Rankings 2017.
- The Shanghai Academic Ranking of the World Universities placed TU/e 54th in the field of "Engineering/Technology and Computer Sciences", the best showing by a Dutch university in the field.

http://www.tue.nl

Source: TU/e, edited by Fanion research & consultancy

Technische Universiteit Eindhoven University of Technology

STRATEGIC AREAS

ENERGY
Fusion energy (nuclear fusion)
Built environment
Energy conversion
Future fuels

HEALTH
Smart environment
Smart interventions
Smart diagnostics (IST/ e program)

SMART MOBILE
Sensible (commuication/logistics)
Durable (better vehicles)

RESEARCH INSTITUTES WITH TU/E PARTICIPATION

- InnoEnergy
- EIT ICT Labs
- FOM institute
- Solliance
- Dutch Polymer Institute (DPI)
- Embedded Systems Institute (ESI)
- M2i (High-Tech Systems & Materials)
  Nanolab@TU/e

TOP RESEARCH GROUPS

- High Tech Systems Center (HTSC)
- Complex Moleculair Systems (ICMS)
- Data Science center Eindhoven (DSC/e)
- Material Technology (MATe)
- Intelligent Lighting Institute (ILI)
- ICT Onderzoek (EIRICT)
- Fotonica (COBRA)
- Katalyse (NRSC-C)
- Eindhoven Multiscale Institute
- Robotics Research
- Centre of Wireless Technology (CWTe)
- Imaging Science & Technology (IST/e)

Source: TU/e, edited by Fanion research & consultancy

RELEVANT DEPARTMENTS AND RESEARCH GROUPS EINDHOVEN UNIVERSITY OF TECHNOLOGY FOR AEROSPACE

Department	Research groups	Relevance for Aerospace
Chemical engineering	Molecular systems and materials chemistry	New materials: polymers, multi-materials
Mechanical engineering	Polymer Technology Mechanics of Materials	New materials
	Energy Technology Multiphase and Reactive Flows	Cleaner and more economical engines Combustion technology
	Control Systems Technology Dynamics and Control	Steering systems, pilot support, controls
Applied Physics	Advanced Nanomaterials and Devices (AND) Center for Quantum Materials and Technology Eindhoven Molecular Materials and Nanosystems (M2N) Physics of Nanostructures (FNA) Transport in Permeable Media (TPM)	New materials
	Photonics and Semiconductor Nanophysics (PSN)	High capacity photonic chips: steering, systems and controls.
Industrial Engineering & Innovation Sciences	Future everyday	Interaction humans and technology Simulating and gamification
Mathematics and Computer Science	Section Algorithms and Visualization (A&V) Section Information Systems (IS) Section Model Driven Software Engineering (MDSE) Section Security and Embedded Networked Systems (SENS) Section Security and Embedded Networked Systems (SENS)	Data analysis Prediction models maintenance Embedded systems

Top research groups at Eindhoven University of technology

On top of the research groups that are connected to a single department Eindhoven University of Technology had has the following interdisciplinary research groups that are relevant for Aerospace.

MATERIALS

INSTITUTE FOR COMPLEX MOLECULAR SYSTEMS (ICMS)[1]

The institute for Complex Molecular Systems was founded in 2008 and brings together mathematics, physics, biology, chemistry and engineering to stimulate education and research on complex molecular systems.

The scientific agenda of ICMS consists of three lines of research:

- Functional molecular systems
- Bio inspired engineering
- Complexity Hub

MATERIAL TECHNOLOGY[2]

The Materials Technology Institute is an interdepartmental institute that hosts the Computational and Experimental Mechanics group from the Department of Mechanical Engineering and the Biomechanics and Tissue Engineering group from the Department of Biomedical Engineering and comprises six main research sections:

- Polymer Technology
- Mechanics of Materials
- Soft Tissue Biomechanics & Engineering
- Cardiovascular Biomechanics
- Orthopedic Biomechanics
- Microsystems

HIGH TECH SYSTEMS CENTER[3]

Focus on system synthesis and design of complex equipment, instruments, robotic and manufacturing systems and systems-of-systems.In next-generation high-tech and mechatronic systems, extreme functionalities and performance requirements will be realized by using a model-based multi-physics systems approach. New sensing technologies and actuator designs for multi-physics processes (forces, flows, temperatures, acoustics, and optics) will need to be integrated with and used by distributed on-line model-based control and optimization tools. The control systems are adaptive, auto-tuned, are implemented in optimized hardware and software architectures, and use effective (wireless) communication.

Sources:

[1] https://www.tue.nl/en/research/research-institutes/top-research-groups/institute-for-complex-molecular-systems/

[2] https://www.tue.nl/en/research/research-institutes/top-research-groups/materials-technology/

[3] https://www.tue.nl/en/research/research-institutes/top-research-groups/high-tech-systems-center/

COBRA RESEARCH INSTITUTE[1]

COBRA is recognized worldwide as a leading research institute in the field of optoelectronic materials, devices and communication systems technology. A number of research ideas that originated at COBRA have been adopted by the international research community, and some have led to widely used applications.

TU/E: PHOTON DELTA, PHOTONIC ICS

The COBRA Photonic Integration Phi group at the Eindhoven University of Technology in the Netherlands is performing world-leading research into the advanced photonic Components, lasers and ICs, are making advances in the key enabling technology, and taking components and circuits through to application level.

The photonic chip is not based on silicon like ordinary chips but on Indium Phosphide (InP) or Gallium Arsenide (GaAs) which can be found in the III and V column of the periodic table.

The Photonic chips have a future in Aerospace because it has a high performance and a next step in miniaturization. One photonic chip can replace other systems and leads to aircraft that are lighter and more economical.

At NanoLab@TU/e established on the campus, TU/e has its own III-IV Clean Room and Wafer stepper at its disposal. This is an important asset in order to arrive at the integrated photonic chip.

SIMULATION AND TRAINING

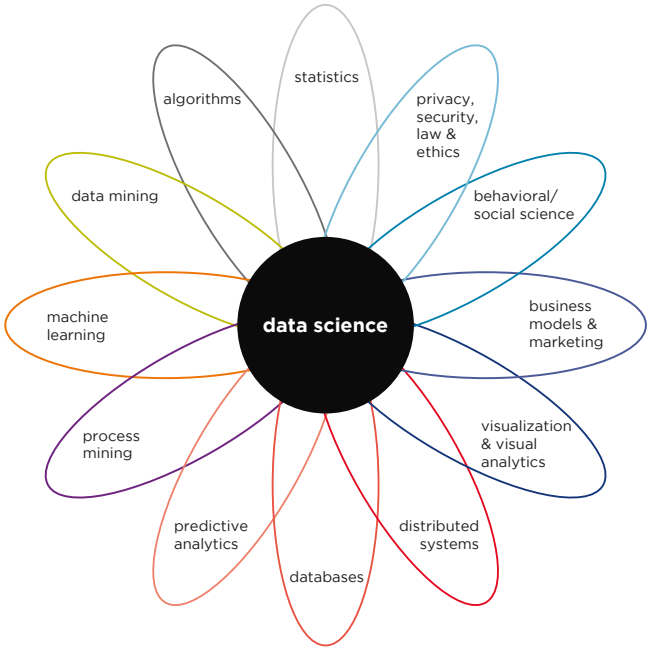
CENTER FOR HUMANS & TECHNOLOGY[2]

The research Center for Humans & Technology (Center H&T) at TU/e focusses on the relationship between people and technology, and how one transforms the other.

SENSORING, DATA, PREDICTION

DATA SCIENCE CENTER EINDHOVEN (DSC/E)[3]

The TU/e has identified a set of twelve core competences relevant to data science which are depicted in the ‘data science flower’. Many of these competences are associated with one or more research groups. The DSC/e combines both scientific and technological depth with multi-disciplinary width.



Sources:

[1] https://www.tue.nl/en/university/departments/electrical-engineering/research/research-centers-institutes-labs/research-institute-cobra/

[2] https://www.tue.nl/en/research/research-institutes/top-research-groups/center-for-humans-technology/

[3] https://www.tue.nl/en/university/departments/mathematics-and-computer-science/research/research-institutes/data-science-center-eindhoven-dsce/

DPI: THE POLYMER RESEARCH PLATFORM[1]

DPI is an industry-driven international collaboration platform for pre-competitive research in the field of polymers. Participating in DPI is a cost-effective way for companies to meet their ongoing research needs while at the same time addressing challenges that extend beyond their individual research and innovation portfolios. By pooling resources they can jointly work on research topics of common interest, both within and across value chain segments. DPI research projects are carried out by leading polymer science groups across the world.

POLYMER TECHNOLOGY GROUP EINDHOVEN BV (PTG/E)[2]

Polymer Technology Group Eindhoven BV (PTG/ e) was established in 2004 as an independent research institute. PTG/e is fully equipped to carry out research in the field of polymers, plastics and hybrid materials. These studies are carried out in their own labs at the TU/e Science Park and using the infrastructure of the TU/e as daughter company of the TU/e Holding.

At PTG / e work currently fifteen employees, each with their own expertise. They have also have an extensive network of specialists that they can use.

DPI
The Polymer
Research Platform

PTG
EINDHOVEN

Sources:

[1] http://www.polymers.nl/

[2] https://www.ptgeindhoven.nl/nl

TU/E INNOVATION LAB: ILAB

TU/e Innovation Lab offers starting businesses from outside the university a gateway to the knowledge and infrastructure that are present in Eindhoven. TU/e Innovation Lab can help entrepreneurs to realize an innovation or new concept by utilizing the knowledge and infrastructure of the Eindhoven University of Technology. The staff at TU/e Innovation Lab will gladly put companies in touch with the right researchers within the university to address their questions regarding innovation, and can assist in setting up a partnership.

FACILITIES

The TU/e Science Park offers businesses laboratory and office space at the campus of the university, a vibrant innovative environment, with knowledge at hand and plenty of community amenities.

The laboratories are modern and well-equipped workspaces and have the necessary basic services such as three-phase power and emergency power, exhaust, compressed air, CO^2 and waste water drainage.

SERVICE

TU/e Innovation lab advises entrepreneurs and puts them in touch with the right researchers within the university with regards to questions about an innovation. Research at the Faculty of Chemical Engineering and Chemistry focuses two thematic areas: Advance materials and chemical and process engineering.

Source: http://www.chemielink.nl/en/locations/tue-innovation-lab/

HOLST CENTRE

Holst Centre is an independent R&D center that develops technologies for wireless autonomous sensor technologies and flexible electronics, in an open innovation setting and in dedicated research trajectories. A key feature of Holst Centre is its partnership model with industry and academia based around roadmaps and programs. It is this kind of cross-fertilization that enables Holst Centre to tune its scientific strategy to industrial needs.

Located on High Tech Campus Eindhoven, Holst Centre benefits from, and contributes to, the state-of-the-art on-site facilities. Holst Centre has over 200 employees from some 28 nations and a commitment from more than 40 industrial partners. Holst Centre focuses on the following innovation areas:

- OLED Technology
- Perceptive Systems for the Intuitive Internet of Things
- Flexible OLED Displays
- Wearable Health Solutions
- Smart Flexible Systems
- Photovoltaics Technology

The relationship with aerospace focuses on the development of new, high performance materials (particularly plastics) that meet the high requirements and flexible electronics,

TILBURG UNIVERSITY

Tilburg University has the following departments: Tilburg School of Economics and Management, Tilburg Law School, Tilburg School of Social and Behavioral Sciences, Tilburg School of Humanities and Digital Sciences, Tilburg School of Catholic Theology.

Most of the schools and institutes at Tilburg University have little to do with aerospace, but the following do:

Tilburg School of Humanities and Digital Sciences

The department of humanities and Digital Sciences does research on communication and the way human brain processes information. This knowledge is used in simulators, where the human factor within a technological environment is researched.

Tilburg School of Economics and Management: Supply Chain Management

The research focuses on the question of how interorganizational chains and networks, within which no player has complete control, can effectively coordinate their behavior. There is particular attention to technical, innovation-driven sectors (such as electronics, aerospace, telecom, process industry and the maritime sector), but also to the health sector and public infrastructure.

The research focuses on interactions between the actual operations in the workplace and the customer questions, and what role management information and cognitive limitations play in this. This extends from the process of new product development to that of conservation and overhaul. To gain insight into these complex issues, Tilburg University develops system dynamic simulation models of empirical business situations.

JHERONIMUS ACADEMY OF DATA SCIENCE

Jheronimus Academy of Data Science (JADS) is a collaboration between Eindhoven University of Technology and Tilburg University that started in 2016. JADS intends to become a center of knowledge and activity where future-proof, real-world solutions are developed, and that will improve the region's competitive position. The Academy is a high point in a tradition of collaboration in the areas of social and technical innovation.

The following research at Jads is relevant for Aerospace:

- Smart services and (data science) propositions
- Decision making processes based on data
- Knowledge discovery in data (innovation & creativity)

Other knowledge institutes outside Brabant

DELFT UNIVERSITY OF TECHNOLOGY – DEPARTMENT OF AEROSPACE ENGINEERING

TU Delft is not located in Brabant, but only half an hour drive away. At the department of Aerospace Engineering research in Aerospace and Space is done. TU Delft has the following research groups and research institutes that are relevant for aerospace.

RESEARCH GROUPS

AERODYNAMICS

The Aerodynamics group is engaged in both fundamental and applied research related to the understanding and control of aerodynamic flows. The group's strengths lie in the development of new experimental and computational techniques and their application to the design of transport systems.

The Aerodynamics group is a member of the Burgerscentrum Research School for Fluid Mechanics and the Delft Centre for Computational Science and Engineering. It is also an active partner in collaborative projects with industry and other research institutes.

FLIGHT PERFORMANCE AND PROPULSION AND POWER

The FPP section embeds flight performance and propulsion and power expertise and focuses on advanced / innovative aircraft configurations and novel and possibly disruptive propulsion and power concepts. Hence, aircraft engine integration is also an important topic. These research areas are highly relevant if we want to contribute to the ambitious targets for the environmental impact of aviation, proposed by the Advisory Committee for Aeronautics Research in Europe (ACARE).

CONTROL & SIMULATION

Integration, development and testing of net theories on control, autonomous and cognitive systems.

Source: www.tudelft.nl

AIRCRAFT NOISE & CLIMATE EFFECT

Accurate modeling of the impact of noise and emissions for more sustainable aviation.

AIR TRANSPORT & OPERATIONS

Sustainability and safety in air transport performance and airline and airport operations.

AEROSPACE STRUCTURES & COMPUTATIONAL MECHANICS

Research on the following topics: Buckling of Aerospace Structures, Crashworthiness of Aeronautical and Automotive Structures, Smart and Aeroelastic Structures, Design Oriented Analysis of Composite Structures, High-Fidelity Analysis Towards Virtual Testing, Testing of Aerospace Structures.

NOVEL AEROSPACE MATERIALS

Research on the following topics: Metals by Design, Self-healing Materials, Polymers, Smart Materials, Structural integrity & composites.

STRUCTURAL INTEGRITY AND COMPOSITES

The mandate of the Structural Integrity & Composites group is to pursue research which will enable the aerospace products of tomorrow to meet rising performance demands by exploiting the potential synergy of Material Science, Structural Design, and Production Technologies. This goal requires the integration of various engineering disciplines and mixture of both fundamental scientific and practical engineering approaches to research.

ASTRODYNAMICS AND SPACE MISSIONS

The section Astrodynamics and Space Missions is one of the two sections comprising the Space Engineering department. Our section focuses on satellite orbits, mission analysis and applications, space propulsion, ascent and re-entry systems and solar system exploration.

SPACE SYSTEMS ENGINEERING

The section of Space Systems Engineering provides unique and recognized education, research, and engineering of end-to-end space systems. Focus areas within Space Systems Engineering are Miniaturization and Distributed Space Systems.

Source: www.tudelft.nl

Research Institutes

ADHESION INSTITUTE

Research in adhesion- and adhesive technology.

SPACE INSTITUTE

The space institute had the following main research subjects:

SENSORING

Sensing from Space is one of three focal themes of TU Delft Space Institute. Better sensors and smarter measuring strategies are crucial for monitoring the earth and exploring the wider universe. Sensors are of critical importance to any spacecraft. Amazing progress has been made in this field, due to miniaturization and the development of new technologies.

SPACE ROBOTICS

To sense, to plan and to act: that is the essence of robotics. Space Robotics has enabled mankind to reach places where humans can't go. The TU Delft Space Institute develops and flies state-of-the-art robotic systems. Mechatronics is an important research domain within Space Robotics. TU Delft has already successfully demonstrated space mechatronics systems in the Delfi nano-satellite missions.

DISTRIBUTED SPACE SYSTEMS:

Small satellites working together as a team are a major trend in spaceflight. Multiagent systems can be cheaper and more robust than single spacecraft: if one component fails, the others go on. Distributed Space Systems is a focal theme for TU Delft Space Institute. Flight control, communication and decision making are the main challenges in this field.

KOITER INSTITUTE DELFT (KID)

The Koiter Intitute carries out four main lines of research: Computational mechanics, Mechanics of Materials, Engineering Dynamics and Structural Dynamics.

FIBRE METAL LAMINATES CENTRE OF COMPETENCE (FMLC)

The FMLC is an independent international Centre of Competence of FML knowledge for manufacturing, design and application. The mission of the FMLC is to enlarge and combine all possible knowledge on fibre metal laminates. The FMLC offers theoretical and practical support with the development and introduction of new FML products.

The FML materials have a unique set of properties. The alternating structure of fibre layers and metals ensures the potential for tailoring the material to its application. FML has the following advantageous properties: High strength, Fatigue resistant, Damage tolerant, Impact and blast resistant, Fire resistant.

Research facilities

On top of these research institute, the Delft University of Technology has the following Research Facilities:

HIGH SPEED WIND TUNNELS

The high speed wind tunnels offer the capabilities of testing in the transonic and supersonic regimes. The following types of wind tunnels are present: TST-27 Trans/Supersonic wind tunnel, HTFD Hypersonic wind tunnel, ST-15 Supersonic wind tunnel, ST-3 Supersonic wind tunnel, Low Speed Wind Tunnels, Open Jet Facility, Low Turbulence Tunnel, W-Tunnel, Vertical Low Turbulence Tunnel, M-Tunnel, Boundary Layer Tunnel.

SIMONA RESEARCH SIMULATOR

The Simona Research Simulator can realistically simulate all types of aircraft, helicopters and even cars. The simulator was specially built for TU Delft and is used as a laboratory for education and research in the fields of flight simulation technology and human-machine interaction.

LABORATORY AIRCRAFT CITATION II (PH-LAB)

The Cessna Citation cabin can be converted to a classroom where students can experience real time the motions of the aircraft.

Partial-Zero-G Facility: Parabolic flights with the Cessna Citation-II
Laboratory: Testing of new flight displays, testing of flight control laws, Experiments with additional sensors and equipment.

AEROSPACE ENGINEERING CLEANROOM

There is an ISO 8, class 100,000 cleanroom as an Aerospace Engineering facility.

Source: www.tudelft.nl

NETHERLANDS AEROSPACE CENTER

The Netherlands Aerospace Center is located in Amsterdam but is involved in activities at Woensdrecht/Aviolanda.

The institute has the following research programs:

FUTURE SKY

Future Sky Safety is an EU-funded research program which focuses on four main topics:

- Building ultra-resilient vehicles and improving the cabin safety
- Reducing risk of accidents
- Improving processes and technologies to achieve near-total control over the safety risks
- Improving safety performance under unexpected circumstances

CLEAN SKY

Integrated Technology Demonstrator (ITD) projects 'Smart Fixed Wing Aircraft', 'Systems for Green Operations', Green Rotor-Craft' and 'Eco-Design' and the Technology Evaluator.

SESAR

Single European Sky ATM Research: NLR works on Air Traffic Management (ATM) in both national and European context.

nlr Dedicated to innovation in aerospace

Source: www.nlr.org

NLR offers the following facilities:

ANALYSIS & DESIGN

Data Analytics Centre, High Performance Computing, Wind Tunnels

DEVELOPMENT & STIMULATION

Flight simulators, ATC simulators (Radar & Tower)

TESTING & EVALUATION

Aircraft, Drones/RPAS, Systems, Structures, Wind Tunnels

PROTOTYPING & MANUFACTURING

Advanced Composites, 3D printing, Wind Tunnel Models

QUALIFICATION & CERTIFICATION

System Testing

TRAINING

Drones/RPAS, Fighter 4-Ship

OPERATIONS

BattleLab, Flycatcher

MRO/SUSTAINMENT

Depot repair

TNO

TNO, the Netherlands Organization for applied scientific research.TNO, was founded by law in 1932 to enable business and government to apply knowledge. As an organization regulated by public law, TNO is independent: not part of any government, university or company. TNO has several locations, also in Eindhoven, but the departments that are most relevant for aerospace are established in The Hague and Delft.

TNO has many fields of expertise. One of the focus area concerns Defence, Safety & Security. In this field the following expertise groups are present:

- Intelligent Imaging
- Distributed Sensor Systems
- Acoustics and Sonar
- Weapon Systems
- Explosions, Ballistics and Protection
- Chemical, Biological, Radiological and Nuclear (CBRN) Protection
- Energetic Materials
- Human Behaviour and Organizational Innovation
- Networked Organizations
- Training and Performance Innovations
- Perceptual and Cognitive Systems
- Military Operations
- Modelling, Simulation and Gaming
- Electronic Defence

Another focus area is Industry, one of groups within that spearhead is space & systems engineering. The Space & Systems Engineering expert group develops and supplies optomechatronic instruments and systems for aerospace, ground-based astronomy and scientific research. The demands placed on these systems are generally challenging the limits of technology. Creating such instruments therefore calls for a thorough project organization, in which experts in the fields of optics, mechatronics, manufacturing and testing work together in a multidisciplinary setting to achieve the desired result.

TNO innovation for life

Source: https://www.tno.nl/

BRABANT DEVELOPMENT AGENCY (BOM):
READY TO CONNECT YOU!

Based in Tilburg, BOM Foreign Investments & International Trade is part of the Brabant Development Agency (BOM). Our BOM Foreign Investments team assists new and existing foreign companies to make optimal use of the opportunities offered by Brabant as a business location. We can offer you our support when it comes to finding sites or real estate, building and environmental permits, labor market analysis, talent acquisition, matchmaking for logistics, employment regulations, fact-finding missions, incentives, and relevant networks in the regional private and public sector.

Our BOM International Trade specialists provide hands-on support to companies in Brabant in growing their business abroad. We offer valuable contacts in foreign countries and provide targeted information on markets and available funding. Our international trade specialists also promote the successful economy of Brabant and its thriving ecosystems to foreign companies around the world.

We offer a range of free services and support designed to provide you with the information and network you need to explore new (business) opportunities.

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