ANNUAL REPORT 2018

mvg
Microwave Vision Group

EDITO

> **Spurred by the rollout of 5G and the new monitoring and security issues,** our Group will continue to pursue its growth path over the next few years

With the advent of 5G, our societies are seeing the emergence of new means of communication with unmatched performance. In the not-so-distant future, humans and machines will be connected instantaneously by applications offering connectivity, speed, and reliability. The connected car, the configurable factory, remote medicine and drone taxis herald the emergence of a world, urban or rural, connected by means of communication that will revolutionize the way we live now.

Furthermore, as global warming and geopolitical tensions mount, our planet is being more attentively observed with each passing day, whether via drones, satellites, radar, or other leading-edge technologies, in order to monitor and ensure our safety.

Thus all the major players in the civil telecommunications, aerospace and defense sectors are today spurred on by the rollout of 5G and the new security and monitoring issues.

MVG, which has traditionally depended on these sectors for its development, has already over the last few years been preparing to respond to the new challenges in electromagnetics testing. Our Group is developing the fast, accurate and innovative instrumentation necessary to deal with these issues and support the businesses that have given trust to MVG over several decades. Thus, over the next few years, MVG must accelerate the growth path it has been following since 1996 and strengthen its leading position still further.

Today, our measuring scanners analyze the billions of digital data items generated by modern over-the-air communications. They supply the most accurate data in the market. Together with our signal-processing software, they enable R&D engineers to diagnose in fine detail the devices they are developing. But these engineers are facing a new challenge: the technologies they encounter are ever more sophisticated and generate ever larger volumes of test data. Our aim is therefore to provide them with new analysis tools based on artificial intelligence that can classify and extract from the “big data” the relevant information they need to optimize their products.

With these factors in mind, MVG (a French corporation employing over 350 people of over 36 different nationalities, with a third of them based in the United States), is looking to the future with confidence. In 2019, it is recruiting over 50 engineers across all its subsidiaries, in Philadelphia, Atlanta, San Diego, Hong Kong, Shenzhen, Tokyo, Tel-Aviv, Rome, Paris, Brest,

Munich, Manchester and Gothenburg. All these Group subsidiaries work together on a daily basis to fulfill the demands of their customers. In reality, managing one program typically requires input from no fewer than five subsidiaries!

In this international context, MVG places particular importance on promoting a company ethos conducive to professional development, and has done so since the company's inception. The Group believes that its ability to combine the skills, cultures, training, and talents of its different employees is a valuable resource that contributes to innovation and to the success of its projects. MVG offers a development model based intrinsically on fostering talent and on the willingness to take on and develop new products.

Whatever your nationality, if you are fascinated by the technologies of the future, and if you are ready to play a role in the international rise of 5G, think seriously about joining us and participate in the development of tomorrow's means of communication.

Philippe Garreau
CEO of MVG

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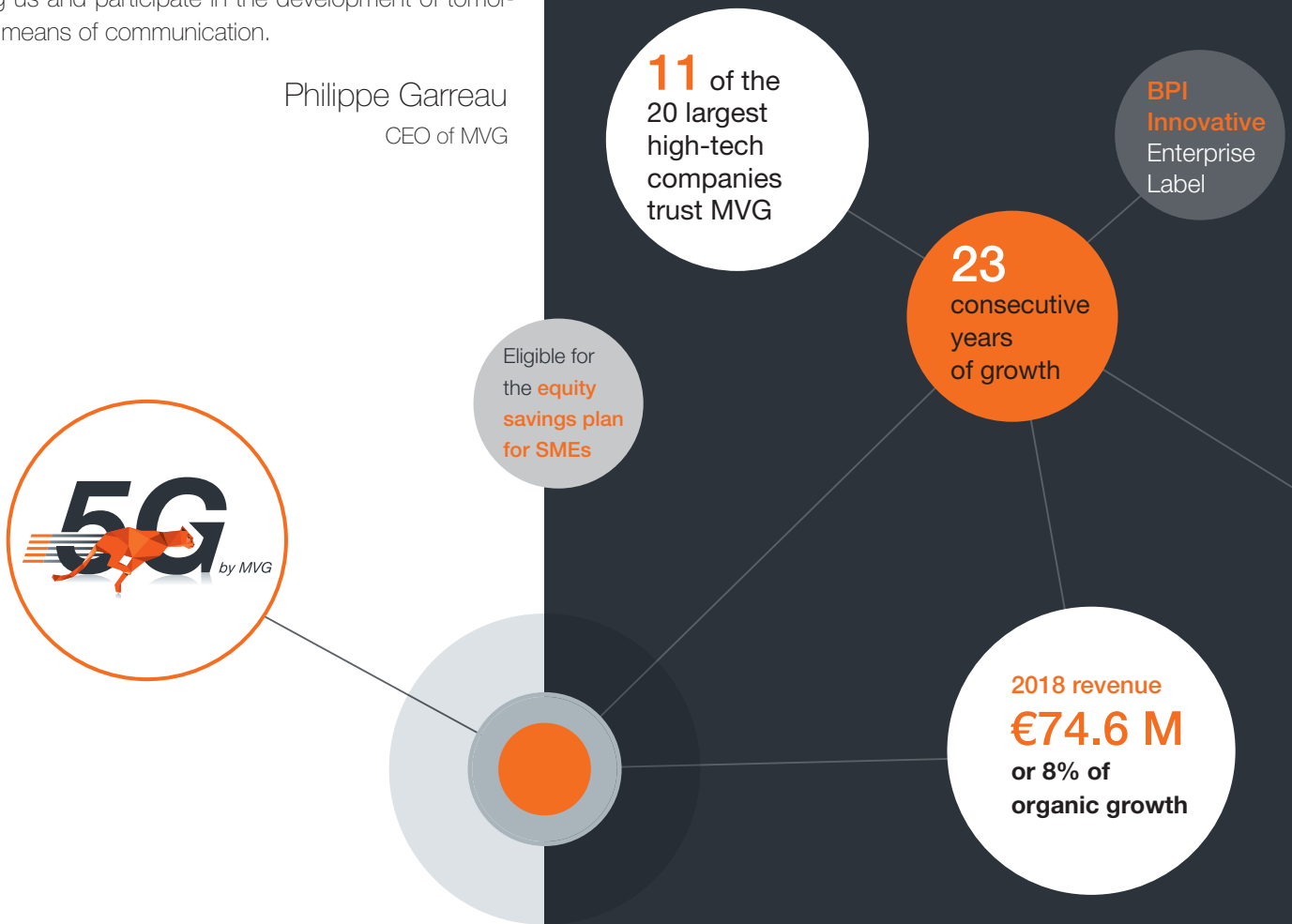


A BIT OF HISTORY…

Since its creation in 1986, MVG's success developed on the international market by combining organic growth based on continuous innovation and the integration of companies opening up new markets. This path of profitable growth has also been made possible thanks to the confidence of its customers, the involvement of its employees, and the support of investors who have accompanied it throughout its development.

1986
- CREATION OF SATIMO, SPIN-OFF OF SUPELEC

1986 1996
- Initially focused on research and prototyping, MVG started as a research firm operating in the field of electromagnetics measurement for the French market

1996 1998
- Change of direction
- Development of a unique technology
- Production of multi-sensor solutions targeting Civil Telecommunications

2003 2004
- **2003:** Innovative Enterprise
- **June 2003:** Siparex and Spef Ventures invest in the company
- New offices: USA (2000), Italy (2001), Hong Kong (2004)

2005
- Significant growth in revenue driven by international sales
- IPO on Alternext

2005 2007
- Continued growth driven by international expansion, large customers, and stronger roots in Automotive, Aerospace, and Civil Telecommunications

2007
- Acquisition of Antennessa, a company in Brittany that designs and manufactures RF dosimeters and SAR measuring benches

2008 2009
- Acquisition of ORBIT/FR, a provider of antenna measuring solutions in Aerospace/Defense
- SATIMO teams up with ORBIT/FR and creates MVG

2012
- Acquisition of Rainford EMC Systems, a manufacturer of Faraday cages

2013 2016
- **2013:** Renewed product line (StarLab, StarMIMO, SG 24)
- **2014:** Development of the EMC branch
- **2014:** €28 M in funds raised

2017
- Launch of the StarLab 50 GHz to respond to the arrival of the 5G

2019
- An order of more than €30 million is booked at the beginning of the year

OUR VALUES

Innovation, technological excellence, team spirit, boldness, involvement, and diversity are the values shared by MVG's employees.

> In the dynamic, complex, changing sectors in which MVG operates, what makes the difference is our human capital, our culture, how we work together, and understanding how our values will best serve our customers.

Philippe Garreau, CEO of MVG

Innovation

MVG's offering consists of highly innovative, distinctive products. This positioning guarantees the Group's margins. These margins allow us to maintain a high level of R&D investment and thus develop new innovative products. It is this virtuous circle of value creation that constitutes MVG's DNA.

Team Spirit

As a team, MVG meets its customers' needs through a commitment to service fed by the diversity of each team member's areas of expertise and knowledge. This team spirit is based on listening, transparency, respect for others and rules, creativity, solidarity in implementing major decisions, and mutual support, particularly in difficult times.

Excellence

Excellence is a cornerstone of MVG's worldwide reputation. It characterizes the Group's ability to transform innovations into robust, scalable, industrialized products and to make every effort to exceed the expectations of its customers.

Boldness

The confidence in our know-how and our capacity to innovate gives us the boldness to undertake, propose, and always consider that a more efficient solution can be found. MVG pushes its managers to delegate particularly large tasks, so that they can develop their own skills even further. The Group encourages those who try, even if it means failing, rather than those who attempt nothing.

Involvement

MVG strives to involve its employees in its corporate strategy, mobilize them around a common culture, and have them contribute to its overall performance. In return, the Group expects high level of involvement from its employees when working with customers and around its strategic projects.

Diversity

MVG hires people of different back-grounds, religions, countries, genders, sexual orientations, physical conditions, and professional careers. The Group believes that mixing the skills, cultures, training, and talents of each individual is an asset and contributes to the innovation and success of its projects.

OUR KEY FIGURES FOR 2018 (€M)

The MVG Group has published excellent results for 2018, with a very strong second half in particular. The Group is reaping the rewards of its innovative product offer, its sales momentum and the measures to optimize productivity undertaken by the management in the last few years. Net income thus increased by a factor of nearly 8 in 2018.

Revenue

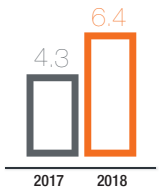
In 2018, Group revenues came in at €74.6 million, an increase of 7.8% at constant exchange rates (+5.0% at current exchange rates), marking a 23rd consecutive year of growth.

The civil telecommunications sector was particularly dynamic, driven by the rise in 5G orders, and accounted for 57% of revenues. Geographical distribution remained balanced (US 35%, Europe 34% and Asia 31%).

EBITDA

The Group recorded EBITDA of €10.2 million versus €7.8 million, an increase of 30.8%, reflecting: (i) the constant improvement in productivity; the fact that growth in the year was registered with a very slight increase in the workforce (359 at end-2018 versus 352 at end-2017) and; (ii) rigorous management of current operating expenses. Note that exchange rate fluctuations hardly had any effect on EBITDA. The EBITDA margin thus came in at 13.7% over the year (up 2.7 points).

EBIT

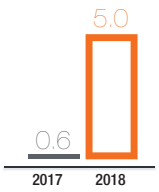


in €M

After accounting for amortization, depreciation, and provisions, current operating income totaled €6.9 million, up 55.8% from December 31, 2017.

Operating income totaled €6.4 million compared with €4.3 million at the end of 2017. It includes a non-recurring expense of €0.4 million related to legal expenses incurred for the buyout of minority shareholders of ORBIT/FR.

Net Income

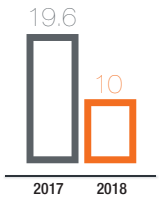


Financial income rose to €(0.6) million compared with €(2.0) million at December 31, 2017. The previous year, the Group had registered a latent exchange loss of €(1.8) million relating to the re-evaluation of intragroup loans following changes in the euro/dollar exchange rate.

In 2018, the Group booked a tax expense of €(0.8) million versus €(1.6) million the previous year. In 2017, the Group had reported a one-off charge of €(0.8) million for the re-evaluation of deferred tax assets.

Consequently, net income came in at €5.0 million.

Cash



Shareholders' equity stood at €68.9 million at December 31, 2018. Self-financing capacity before taxes rose sharply, from €5.8 million at the end of 2017 to €9.6 million, an increase of 65%. WCR posted a significant one-time increase of €9.0 million. This change was due to differences in billing, mainly relating to unfinished infrastructure at certain customers and the impact of the euro/dollar exchange rate. Stocks remained stable over the period. Cash flow thus came out at €(0.7) million versus €5.6 million at December 31, 2017. WCR is expected to improve in 2019.

Investments during the period rose to €8.5 million (including €6.2 million for the buyout of minority shareholders of ORBIT), from €3.0 million at December 31, 2017. The Group had a positive net cash position of €10 million at December 31, 2018.

Order Intake

in €M

The Group begins the year of 2019 with excellent visibility. This strong confidence is based on a high level of new order intake in 2018, €78 million, up 3.5% at constant exchange rates.

The performance is especially remarkable given that it includes no orders of over €5 million, as was the case in the two previous financial years. These new orders confirm MVG's ability to increase and diversify its customer portfolio while continuing to grow its market share internationally.

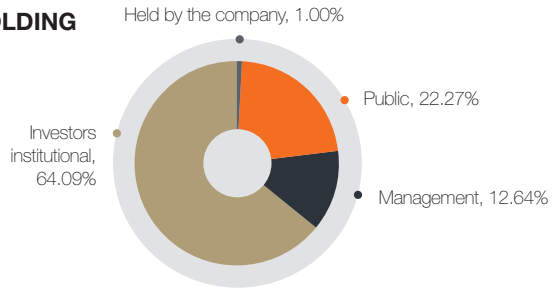
STOCK EXCHANGE & SHAREHOLDING

By investing in MVG's capital, you benefit from the momentum of a hi-tech company whose unique know-how brings the multitude of invisible electromagnetic waves to an unprecedented level of visualization for analysis.

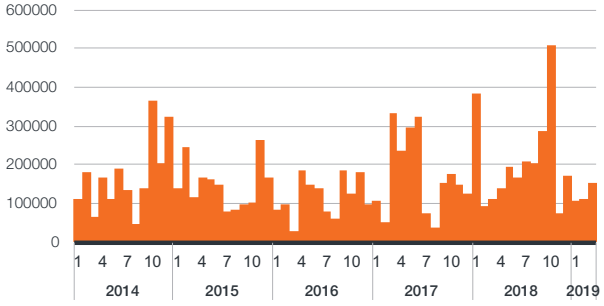
These waves are at the heart of our day-to-day lives. Smartphones, computers, tablets, cars, trains, aircraft – all these devices would not work without them. **By making "the invisible visible"** thanks to its testing and measurement equipment, MVG enables its customers to develop ever more efficient products. Building on this expertise, the Group has risen to the top ranks among its market's global players and has acquired international recognition. MVG employs more than 350 people, has offices in 10 countries, and exports more than 90% of its production.

MVG'S OPENING PRICE SINCE 2014

SHAREHOLDING



MONTHLY MVG SHARE TRADING VOLUME



ANALYST MONITORING
Gilbert Dupont,
Euroland Corporate

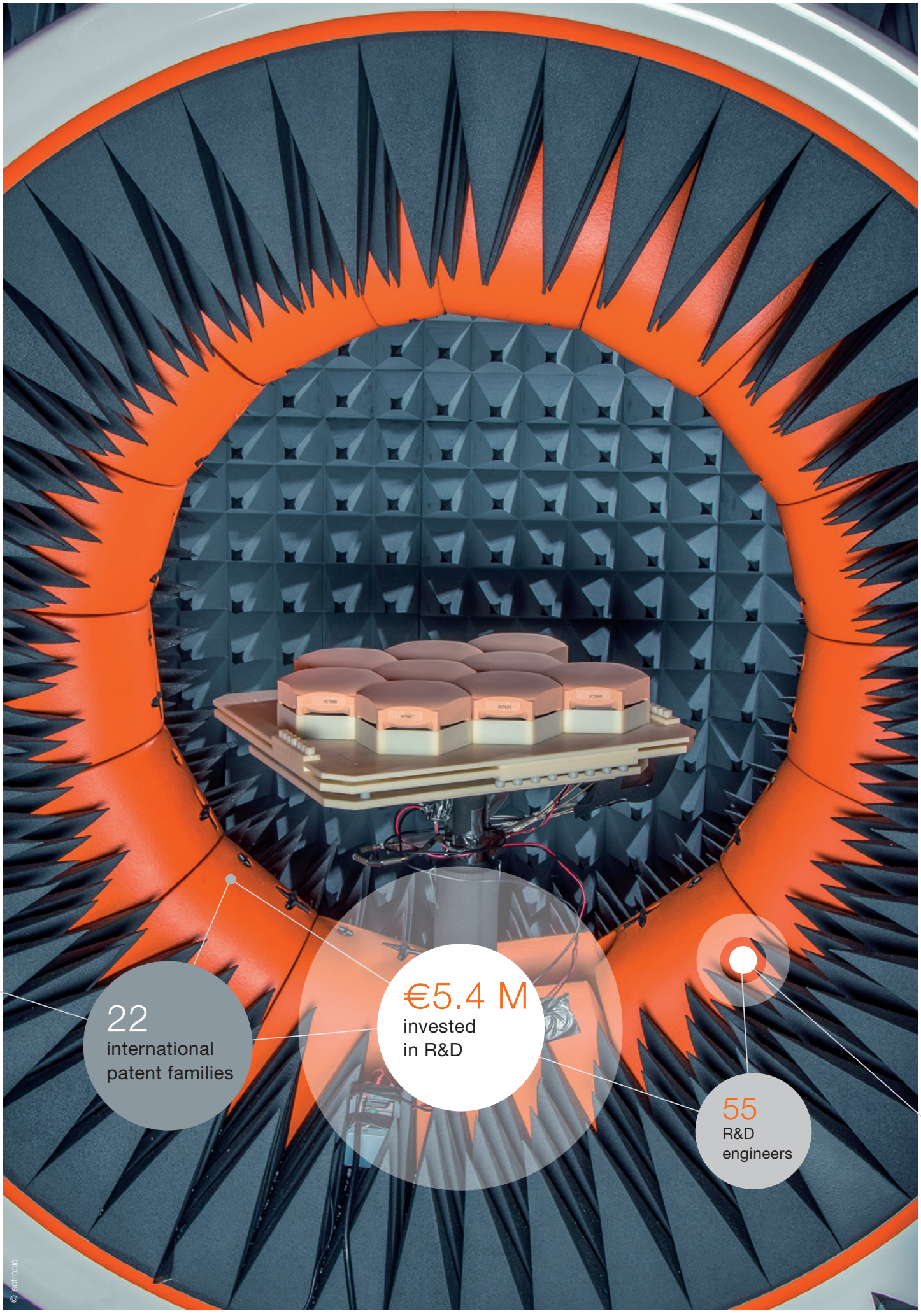
LISTING
- Listed on NYSE Alternext (ALMIC) since 06/29/2005
- Price at 03/29/2019: €11.45
- Market capitalization at 03/29/2019 : ~€72 M
- 2018 average daily volume: 10,012 shares/day (2017 – 8,127 shares/day)

CAPITAL
- 6,282,186 shares
- 8,619,092 voting rights
- 8,545,266 voting rights net
- Share capital: €1,256,433.20

FINANCIAL CALENDAR
HY1 results publication:
September 26, 2019

CERTIFICATION
Bpifrance's "Innovative Enterprise" Certification

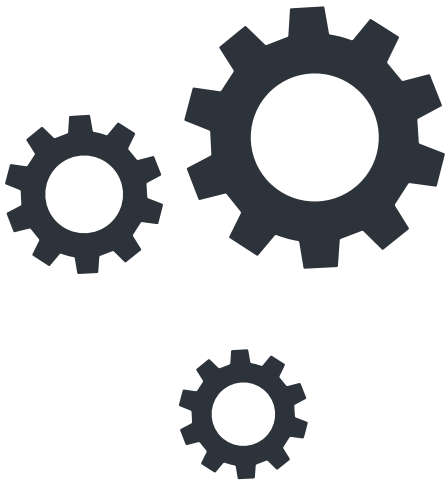
ELIGIBLE FOR THE EQUITY SAVINGS PLAN FOR SMES


22
international
patent families
€5.4 M
invested
in R&D
55
R&D
engineers

UNIQUE TECHNOLOGICAL KNOW-HOW

Making the invisible visible

Similar to MRI scanners used in hospitals to view the inside of the human body, MVG has developed unique technological know-how: scanners that allow electromagnetic waves emitted by an antenna to be viewed, thus making the invisible visible.



These scanners allow users to:

- **Measure the amount of energy emitted by antennas.** An antenna converts existing electrical quantities in a conductor or a transmission line (voltage and current) to electromagnetic quantities in space (electric and magnetic fields), either in transmission or in reception. This measurement quantifies the efficiency of this conversion.

- **Determine in which directions this energy is radiated in space.** This involves determining the radiation pattern of the antenna. In a smartphone, for example, the manufacturer seeks a radiating pattern that is well distributed throughout all directions in space, because it is not possible to predict from the phone's direction given by the user. However, in the case of a radar, the manufacturer aims to focus maximum energy in one direction in space to measure with the utmost precision where detected devices may be located.

- **Describe the quality of information carried by the transmitted signal.** This involves transmitting data from several directions in space and reducing the level of energy emitted until communication with the device is no longer possible.

- **Test the operation of the device in real environments.** These are MIMO tests. They determine how a device will react in its real environment. Will its performance be deteriorated by or can it take advantage of the barriers and disruptive objects that separate it from emission sources?

These scanners rely on a unique, patented multi-sensor technology: MV-Scan™. Unlike conventional single-sensor technologies, which require long and tedious mechanical movements, MV-Scan™ scanners perform their measurements through numerous sensors equally spaced on an array. These sensors, scanning electronically, drastically reduce the measurement time by limiting mechanical movements. This decrease leads to a much better return on investment for installations equipped with MV-Scan™ than for those equipped with single-sensor solutions.

The MV-Scan™ technology was initially developed for the Civil Telecommunications sector, where it perfectly met a key requirement for speed due to very short product development cycles. For several years, it has also been deployed in the field of Aerospace and Defense, where electronically scanning radars have become imperative and require significant testing.

This technology is covered by several worldwide patents. It allows MVG to offer distinctive products and services to its customers.

A high level of R&D investment

The MVG Group is the leader of a portfolio of technologies, patents, and diversified products, given its desire to constantly strive to develop new value-generating ideas around its foundation patent on the MV-Scan™ multi-sensor technology. To anticipate customer needs, MVG spends nearly €5 million a year on R&D, which allows it to expand not only in its traditional markets, but also to penetrate related markets or conduct medical imaging research projects. In general, the aim of the Research and Development efforts is to prepare the Group for the increased frequency of communication products. The Group is also continuing the development of hardware and software sub-systems for multi-sector technologies to meet the future requirements of its markets. **MVG receives the Research Tax Credit** and also has labels recognizing its innovative profile in France: **Innovative Enterprise and Réseau Bpifrance Excellence.**

The Group Mission

MVG's unique expertise makes it possible to view electromagnetic waves. These waves are at the heart of our day-to-day lives: smartphones, computers, tablets, cars, trains, aircraft – all these devices would not work without them. By making "the invisible visible" thanks to its testing and measurement equipment, MVG enables its customers to develop ever more efficient products. The Group's mission is to extend its expertise and unique electromagnetic imaging technology to all sectors where they can provide high added value, satisfying the "adaptation of technology" against "acceptable market cost" equation.

UPDATE ON NSH (National Security & Healthcare)

Microwave imaging scanner for detection of breast pathologies

Nov. 2018

Start of first clinical trial in women with 30 women who have breast cancers or palpable cysts

Q4 2019

Results of this first clinical investigation in T4 2019

Study of legal options

Security body scanner for sensitive sites (airports, etc.)

Positive results and tests on the experimental prototype (mannequins and targets placed under clothing)

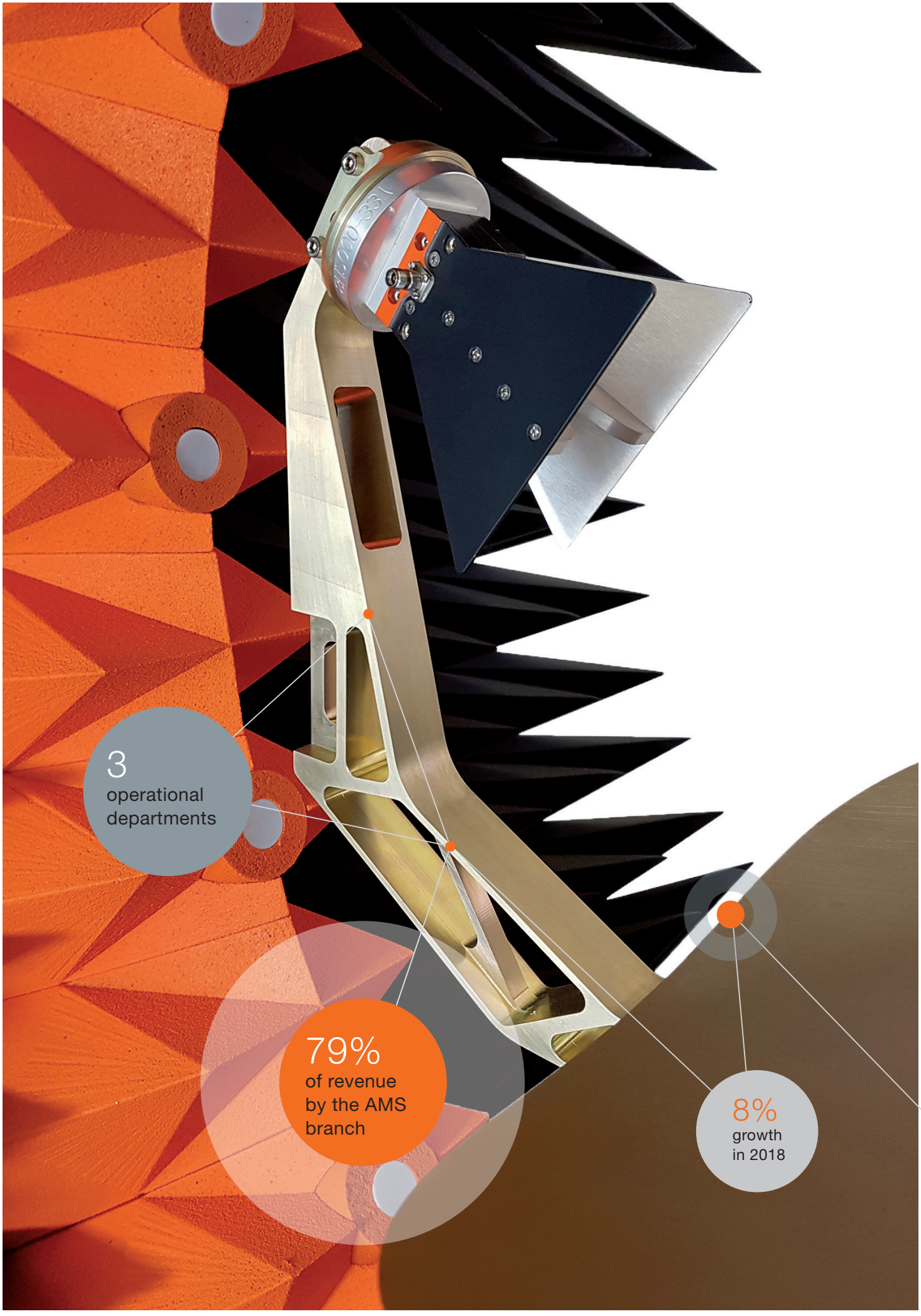
Program frozen

Re-focus on core business

Teams Organized in Project Mode

The Group's R&D, centralized on three sites – two in France and one in Italy – is organized in project mode – meaning that it works on defined themes with dedicated teams, allocated budgets, and deadlines to be met. This organization and the resources allocated to it allow the Group to maintain its technological lead and come up with breakthrough products on its current markets or targeted new markets. The R&D team manages mainly short- and medium-term projects.

Within this team, the NSH (National Security & Healthcare) department is developing a medical scanner, for the detection and monitoring of breast pathologies.
This project addresses specific R&D themes and also serves as a catalyst for the development of sub-assemblies that will be included in tomorrow's antenna measurement systems. The NSH department draws future investments and employs highly qualified engineers in order to succeed in bringing about enhanced value.


3
operational
departments
79%
of revenue
by the AMS
branch
8%
growth
in 2018

IDENTIFIED GROWTH AREAS

Since 2012, MVG has structured its activities into three operational departments: AMS, EMC, EIC. This organization makes it possible to pursue a strategy of creating distinctive added value in each of the branches.

BREAKDOWN OF REVENUE BY BRANCH

AMS

THE AMS DEPARTMENT

(***A**ntenna **M**easurement **S**ystems*)
dedicated to antenna control tests, the Group's historical activity

€59.2 M

EMC

THE EMC DEPARTMENT

(***E**lectro-**M**agnetic **C**ompatibility*)
dedicated to electromagnetic compatibility testing of systems

€13.3 M

EIC

THE EIC DEPARTMENT

(***E**nvironmental and **I**ndustrial **C**ontrol*)
focuses on environmental and industrial control tests, growth drivers for the Group

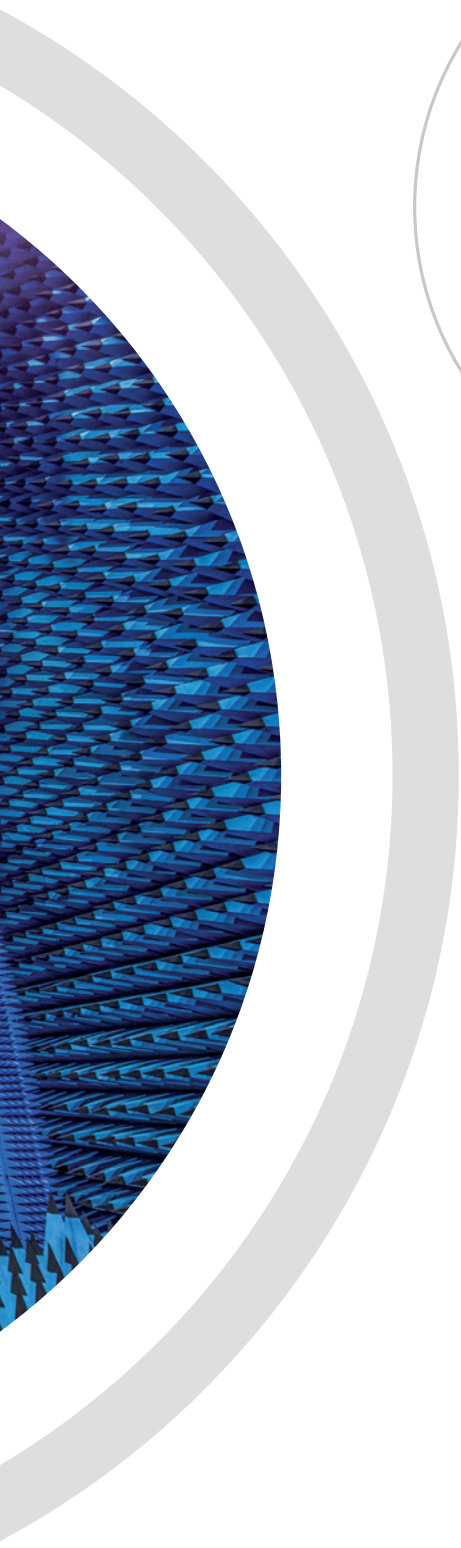
€2.1 M

AMS

The antenna measurement systems departement

Activity & Markets

This is the Group's core business. It brings together MVG's activities in the field of antenna measurement. MVG has acquired a position as technological player of reference in this field at the European and global levels. It addresses two sectors: Civil Telecommunications and Aerospace/Defense.



Strategy

- Provide products and turn-key solutions customized on the basis of standard technological blocks to a diversified customer portfolio
- Maintain its technological lead
- Offer support services (software upgrades, preventative maintenance contracts, relocations of facilities, etc.)

Offering

The market's most extensive range: turnkey antenna measurement systems (near-field and far-field, single-sensor and multi-sensor, radome test, RCS – Radar Cross Section – measurements). Associated software for Equipment control, data acquisition, and post-processing. All solutions are designed, manufactured, marketed, installed, and maintained by MVG.

Price Range

From €100 K to several million euros.

Key achievements

Sustained Aerospace and Defense market demand

- Strong demand in Civil Telecoms with the launch of 5G in Asia and StarLab sales

New launchers, constellations of micro- and mini-satellites, communication and tracking systems, which all involve sophisticated antennas

A global development, starting from the United States and reaching China. More than fifty startups already positioned in this market. **284 billion invested in the production and launch of 2000 satellites over the next 10 years.**

*(*EuroConsult, Nov 2018, « $284 Billion Market for 3,300 Satellites to be Built & Launched Over Next Decade" http://www.euroconsult-ec.com/13_November_2018)*

Structurally growth-geared markets

Satellites, planes, mobile phones, computers or touch tablets, GPS navigators, medical instruments or wireless home technology…

All these increasingly ubiquitous appliances have something in common: they have antennas, designed to convert electrical signals into radio signals. MVG's role is to design and manufacture systems allowing manufacturers to test and measure the radiation pattern of these antennas. MVG markets a range of constantly evolving antenna measurement systems to increasingly diversified markets, supported by strong growth in the space, military, automobile, and civil telecommunications industries:

- the wireless market, stimulated by increasingly sophisticated terminals, integrating multiple communication protocols (4G, WiGig — very high-speed Wi-Fi, 5G in development in several countries, etc.),
- land, space, and air surveillance through radars, drones, etc.,
- newspace,
- internet-of-things,
- connected or self-driving vehicles,
- data protection.

MVG's products, which display electromagnetic waves like waves on water, have won over the biggest names in the aerospace (NASA, ESA), aeronautics (Boeing), automobiles (Renault, BMW), as well as electronics (Ericsson, Nokia, Panasonic, Huawei) industries.

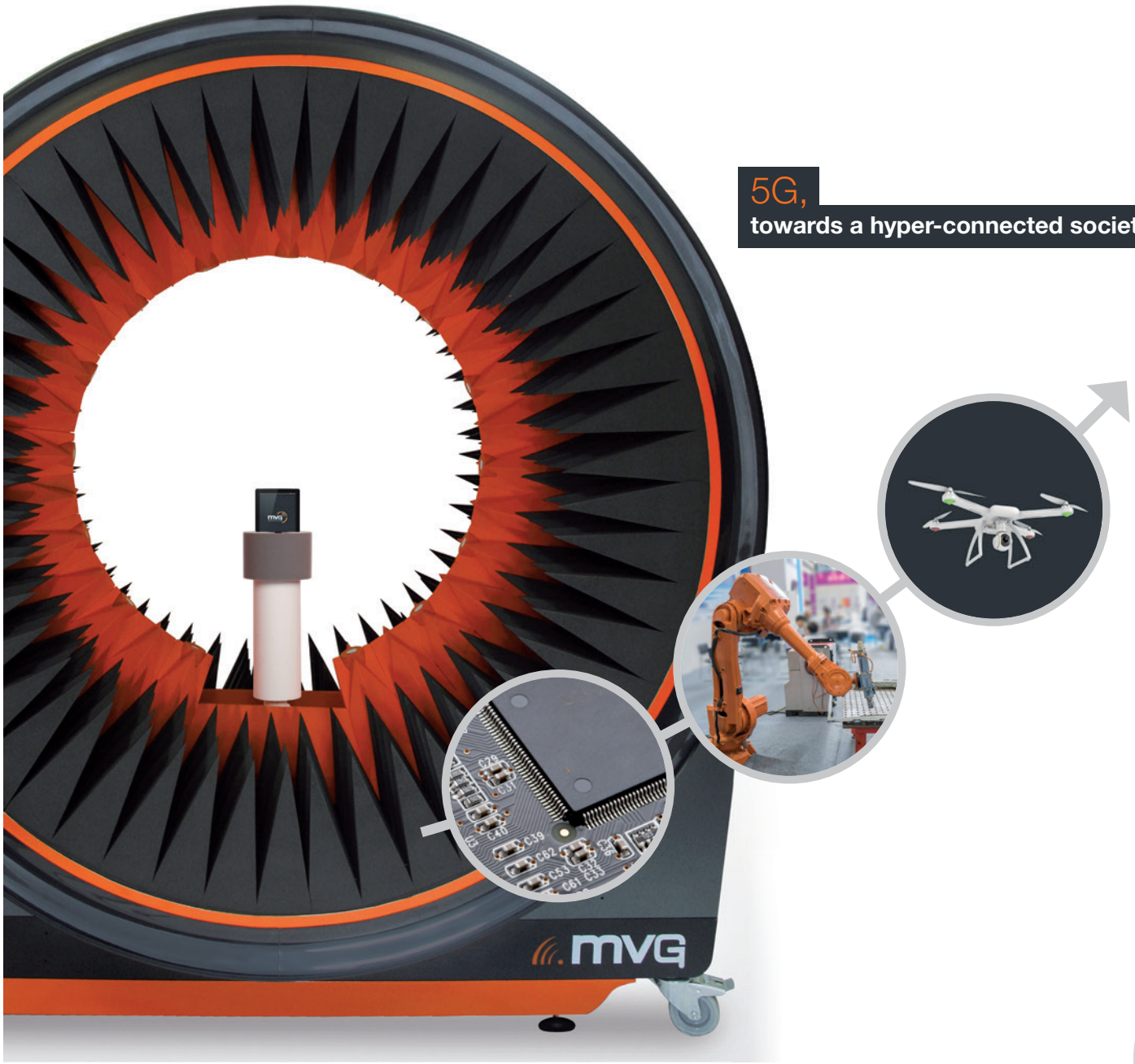
This expertise in electromagnetic wave measurement tools has been a driving force in the company's international growth since its creation. It also encourages MVG to constantly renew its offering to follow the development of protocols and permits diversification to new markets.

DEFENSE
of battlefields

Agile antennas to detect, communicate, and act

The electromagnetic spectrum is an essential – and invisible – part of modern military and civilian life. Military forces use wireless networks to communicate and coordinate their operations, radar and sensors for guidance and to detect enemy forces, and electronic jammers to blind enemy radar or disrupt communications.

5G,
towards a hyper-connected society



In the near future, the arrival of 5G will lay the foundation for a hyper-connected society

A world in which everything that can be online will be. Internet connections will move from computer and smartphone screens to a world of objects that will communicate directly among themselves.

All sectors of society will be profoundly transformed by this technology: from industry 4.0, with smart factories, to the automobile industry, with self-driving cars, not to mention the healthcare sector with remotely controlled robotic surgical procedures, and connected homes, smart cities, etc. There are many examples.

5G is based on three cornerstones. The first is an increase in bandwidth and network capacity to transmit ever greater quantities of data in record times. The second is ultra-reliable wireless connections with low latency allowing critical real-time applications to function securely (self-driving cars, remote surgery, etc.). The last is the deployment of networks that use little bandwidth and energy to prepare for the massive deployment of connected objects.
By making permanent connections possible, the arrival of 5G will be accompanied by massive usage of “cloud

5G IS TRIGGERING A PARADIGM SHIFT ON THE ELECTROMAGNETIC TESTING AND MEASUREMENT MARKETS

Wireless testing (OTA) spans the entire value chain – from components to finished products – from R&D to production lines. It is becoming essential and will gain ground over the next 4 years.

5G will have an impact on all industries

- Anything that can have a connection will be connected wirelessly
- The Internet will be part of every physical object
- A world where not only people, but all objects will be connected to each other

Smart Cities and the Internet of Things

Virtual Reality and Remote Medical Treatment

Industry 4.0 and Big Data

Self-Driving Cars and Transport

© photo : © Courtesy of The Antenna Company / © Fotolia/Pictures news / © shutterstock/asharkyu_p / © shutterstock Digital Genetics / © iStock/jamesteohart / © iStock/ipopba / © iStock/yoh4nn / © iStock/Nadla

computing", which will make it possible to efficiently operate many new services.

The success of many of these services will depend upon wireless connection quality. Wireless connection performance will be a parameter that is difficult to control, as it will be based on both the quality of the networks deployed and on that of the hardware used. To validate performance, tests and measurements of hardware and 5G relay stations must be conducted. They will differ considerably from what is done currently.

In fact, 5G will use higher frequency bands, and compatible hardware will not have physical connectors. Therefore, they will have to be tested exhaustively in wireless mode (OTA), while many tests are traditionally conducted in wired mode. We should there see an increase in the power of OTA tests, in which MVG is the most well-known specialist. MVG is working hard to support the industry in developing a special range of products intended for 5G tests, including systems to help re-create environments in the laboratory that are as close as possible to real life, and thus to test each peripheral and application exhaustively.

The connected car, a wireless technology hub

MVG develops systems dedicated to RF testing of vehicles. These arcs with a diameter of several meters (see photo) measure the wireless receiving and transmission characteristics of various on-board systems in vehicles in a few seconds.

MVG also provides a suite of data post-processing software that extracts the fundamental parameters of vehicles in terms of electromagnetic radiation. These parameters can then be used in third-party software to simulate complex electromagnetic environments. This "virtual drive" makes it possible to verify interactions between a vehicle and other vehicles, infrastructure, and pedestrians around it in different environments – countryside, city, tunnel, wet road, snowy road – all variations that impact the radiation of electromagnetic waves. This unique combination of measurements and simulations enables auto manufacturers to test and optimize the electromagnetic performance of their vehicles. These performances play a fundamental role in the success of the self-driving car, as illustrated below.

© Courtesy of Molex CVS

5G

CASE STUDY - PARROT

Parrot

© Courtesy of Parrot Drones

Wireless Connectivity Testing
for the Drones of the future

Year after year, the drones, which for a long time have remained in the realm of science fiction, continue to expand. Whether civilian or military, recreational or professional, their use promises to disrupt entire sectors of our societies. Delivery of packages, medical equipment to underserved areas, monitoring of crops, fire departures, demonstrations, borders, passenger transport - their field of application is expanding day by day. A true concentrate of state-of-the-art technology, they use the latest innovations in mechanics, aeronautics, batteries, artificial intelligence... and of course wireless connectivity. With its innovative electromagnetic wave testing technologies, MVG supports its customers in the development of these unmanned aircraft.

After installation and a day of training, the StarLab immediately became an essential tool in the development and connectivity testing of Parrot drones. We noticed the difference instantly. Thanks to the StarLab, we are now able to give preference to measurements over simulation which optimize the design and the integration of our antennas.

Meryam Abou
El Anouar, Technical Leader,
RF & Connectivity Team at Parrot Drones

THE CHALLENGE

The world's second largest manufacturer of general public drone technology, Parrot Drones, required an antenna testing solution in its development phase which would not only help them meet all relevant testing and operational standards, but would also optimize the performance of its new products for localization, reliability and range.

Space was a key concern, with only a small footprint available for the new testing device. Considered a visionary at the forefront of innovation, Parrot Drones' products and software are renowned for performance and ease of use. With almost 600 employees, the innovator is the only manufacturer of its kind to offer the full suite of equipment, software and services.

The arrival of 4K cameras and the increasing popularity of drones for recreational and commercial use, is driving an industry-wide need for improved range, reliability and speed. Consumers now demand high-quality connection, accurate GPS positioning and HD images as standard in a market-leading drone. To deliver this in a highly competitive market place, Parrot Drones knows that the key lies in accurate visualization of electromagnetic waves during the product development phase.

© Courtesy of Parrot Drones

Drones have severe mechanical constraints and require the use of complex materials. It's no surprise therefore that there are usually numerous design changes during their development. In this context, existing electromagnetic simulation tools do not guarantee the correct operation of the end product, making precise antenna testing essential.

OUR SOLUTION

Historically, Parrot Drones used a 2D antenna measurement system which provided only the main cross-sections of the radiation pattern, but as drone technology became more sophisticated this technology became obsolete and the manufacturer switched to 3D radiation pattern measurements.

Initially, Parrot Drones developed its own 3D measurement solution, based on an anechoic chamber and two axes of rotation, but this solution proved too restrictive and time-consuming at a time when new products were being launched in quick succession. Keen to adopt a highly accurate and compact antenna testing solution, which would accelerate the team's ability to not only measure, but visualize, electromagnetic waves, they turned to the expertise of MVG.

"I knew of MVG and the multi-probe systems they had developed. Ours was only a single-probe solution, so I knew straight away that an MVG system would be at least 10 times faster. However, we didn't have the space for a system of this size.

Upon speaking with MVG's specialists, a solution quickly became clear; StarLab boasted dimensions which were suited to laboratory use, and it offered a perfect level of performance for our requirements. The ease of measurement has changed the way we worked. We used to make many simulations by approximating the characteristics of non-standard materials that make up our drones'.", recalls Meryam Abou El Anouar, Leader of RF and Connectivity at Parrot Drones.

OPTIMIZING ANTENNA PERFORMANCE

Meryam comments on how Parrot Drones uses its new StarLab system: "In the product development process, the StarLab is an asset for us. We use it to refine the connectivity of all our new models, checking that our antenna, or those of our suppliers, comply with our specifications even once they have been integrated into, and therefore affected by, the surrounding structure which modifies their characteristics.

"For GPS antennas, we seek to maximize the visibility of satellites, whilst for the four antennas located in the feet of the drone, we use the StarLab to optimize the gain in the direction of the remote control or the telephone using a Wi-Fi MIMO strategy developed in collaboration with the Signal Processing department".

SATISFYING STANDARDS

Manufacturing products with built-in Wi-Fi means Parrot Drones must meet strict standards regulating the transmission power of each new model. In order to calculate power transmission, they must accurately measure the antenna gain. Meryam continues: *"In previous years, using 2D radiation patterns meant we ran the risk of incorrectly determining the maximum gain, but the StarLab has solved that problem using 3D measurements to work out the gain with a high degree of accuracy. With such reliable readings, we can adjust the transmission power to ensure compliance with all relevant standards. We know this gives us a competitive edge over our competitors who do not have precise 3D measuring tools."*

FUTURE DEVELOPMENT

With a number of exciting new drone technologies in development, Parrot Drones is particularly focusing on professional equipment, such as the Parrot Bluegrass Fields. Drones for commercial use require even higher accuracy of GPS positioning which imposes serious constraints on the antenna. The StarLab proves integral to the development of these new products.

© Courtesy of Parrot Drones

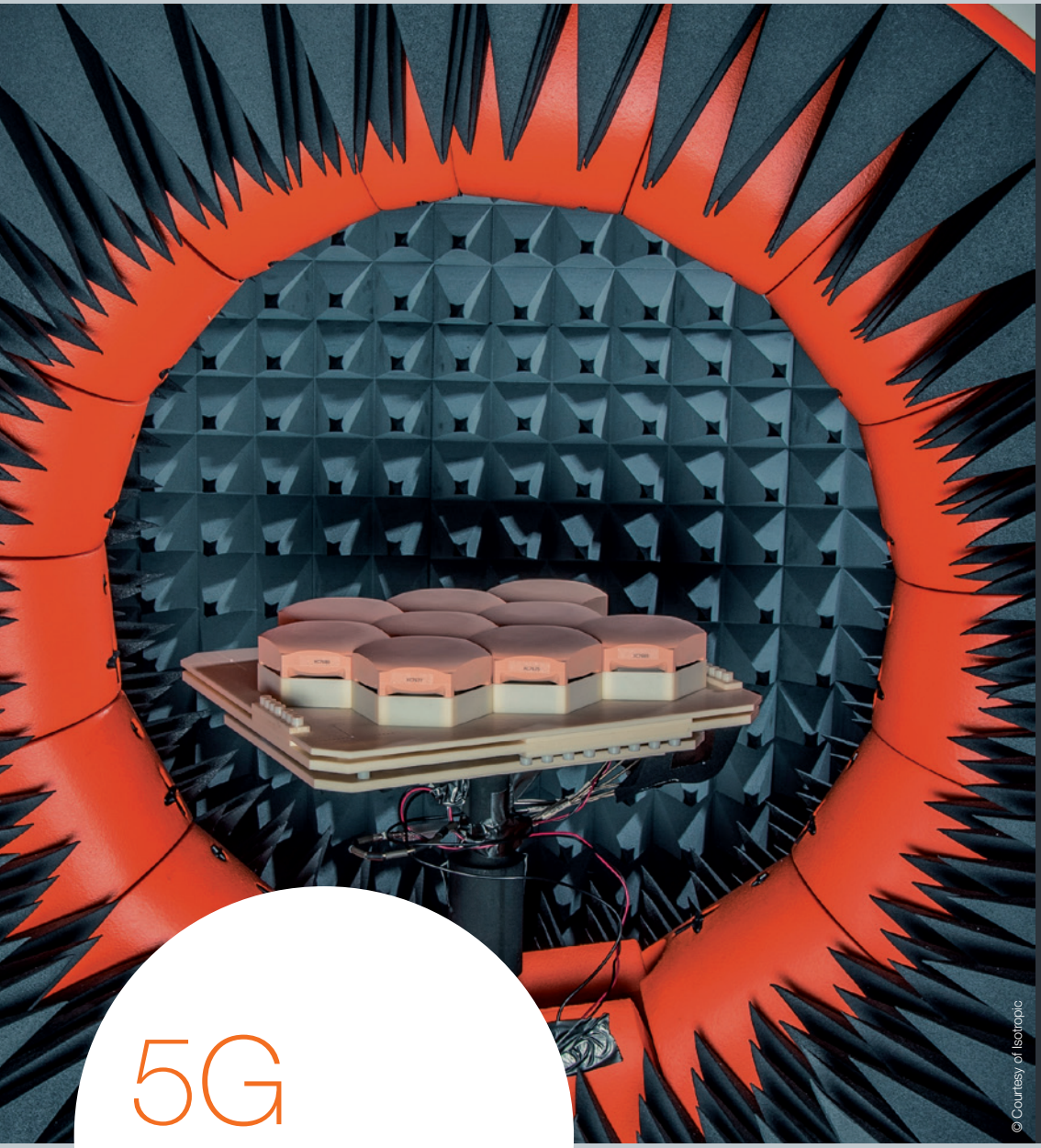
"The StarLab is so simple to use, we are able to post check some products during the production process. We can precisely measure, particularly for GPS, the dispersion of antenna's performances"

Meryam Abou El Anouar
Technical Leader, RF & Connectivity Team at Parrot Drones

Maximum testing, minimal footprint

The StarLab is a compact system specially designed by MVG for antenna pattern measurements in laboratories and production environments where space is limited.

It combines the flexibility of a portable system with the reliability of a laboratory tool able to precisely measure the performances of a product at each stage of its design. It can measure several parameters in the 6 GHz (650 MHz to 50 GHz), 18 GHz (650 MHz to 18 GHz) and 50 GHz (650 MHz to 50 GHz) frequency bands, including: gain, directivity, beamwidth, antenna efficiency, radiation pattern, TRP, TIS, EIRP and EIS. Overcoming the issue of footprint opens the doors for equipment manufacturers, like Parrot Drones, looking to refine their product development processes through the accurate measurement of electromagnetic waves. The measurement result helps deliver to market products offering unrivalled antenna performance.



© Courtesy of Isotropic

For us, MVG's StarLab offered accuracy at a speed which provided a unique opportunity to accelerate our compliance testing well ahead of schedule. It was simple to characterize relevant components and integrate the measurements in our modelization tool - obtaining better modelization and ultimately a better product.

Jeremiah Turpin
Chief Technical Officer for Isotropic Systems

5G

CASE STUDY - ISOTROPIC

isotropic

Validation and Improvement for World's First High-throughput Satellite Terminal

THE CHALLENGE

The exponential growth of wireless technology has launched the aerospace industry into a new era. Private companies, many of them start-ups, are taking the lead in what is now pegged the New Space industry to develop the necessary technology required in meeting an increasing need for the fast transfer information. This demand has been driving research and development in satellite technology, in the areas of quality, capabilities and the associated communications systems. Opportunities are ten-fold for start-ups with innovative ideas, such as Isotropic Systems.

Innovator of next-generation integrated satellite terminal technology, Isotropic Systems needed a lab-based testing system to test the performance of its products and fine tune its numerical predictions during the componentry development phase.

Named one of the "10 hottest companies in satellite" according to Via Satellite Magazine*, Isotropic Systems turned to the antenna testing expertise of Microwave Vision Group (MVG) which could offer a zero-CAPEX solution for highly-accurate testing and measurement.

Isotropic Systems is a satellite technology start-up, known for the development of the world's first multi-beam high throughput terminal. This terminal is infinitely scalable to precise scanning requirements, while removing the bottleneck created by other technologies, to unlock limitless bandwidth.

Delivering exponential power reduction compared to phased-array antennas for a cost which is 70-95% lower than both conventional phased-array and flat panel technology, Isotropic Systems' revolutionary transformation optics-based technology caught the eye of investment superpower, Boeing HorizonX Ventures, at the beginning of 2019.

THIRD-PARTY VALIDATION FOR A NEW TECH START-UP

Even with 'world-first' technology which has captured the attention of key defense, maritime, and telecommunications giants amongst others, third-party validation of numerical predictions is crucial for a start-up business proving its capabilities in a rapidly evolving industry landscape, such as in NewSpace.

Reaching new markets is challenging with never-seen-before, unvalidated technological innovation. Isotropic Systems needed access to technology that would enable them to offer investors like Boeing Horizon X Ventures, and of course potential customers, the security of third-party validated measurements to prove the performance and quality of their products, while also ensuring improvements upon numerical modelisations during product development.

Accurate testing of each categorizable antenna component and verification of numerical predictions being integral to the component and eventual product development of its satellite terminals, Isotropic Systems needed to defer the required CAPEX investment during this early stage of the company's development journey, but still reap the rewards of highly accurate testing.

OUR SOLUTION

"The measurement services offered at our antenna testing facility at MVG, Inc. in Georgia enabled MVG to meet Isotropic Systems' needs without them having to commit to a purchase upfront. With their periodic measurement requests, MVG was able to accommodate short intervals whereby their lead engineer could work out of our Georgia facility, using our onsite StarLab technology to produce 3D patterns, and test and characterize each component as required," explains Jim Acree, Antenna and Measurement Services Engineer at MVG.

Understanding that time-to-market is crucial for start-up businesses, MVG supported the Isotropics team in completing their testing phase in a timely fashion, fuelling rapid progress in the development of their terminal.

© Courtesy of Isotropic

As a solutions-focused manufacturer, this ethos extends to how we work with our customers, not just how we design our measurement systems.

By extending measurement services in our own test facilities to customers, we help solve logistical and investment challenges. They benefit from the use of our infrastructure and assets and state-of-the-art measurement technology, as they gain time and reduce expenses in R&D.

Measurements at the MVG test facility, with the latest StarLab technology, enabled Isotropic Systems to offer potential customers and investors the security of third-party validated measurements that not only proved the performance credential of their products, but also led to improvements in the accuracy of their original numerical predictions; getting similar results both ways, the measurement system and electromagnetic models effectively validated each other.

Jeremiah Turpin concludes: "In the early development stages of such revolutionary products, it has been reassuring to have MVG on our side. With technical experts based in Georgia, we not only had access to StarLab testing technology, but to a wealth of expertise too, enabling us to exchange ideas. MVG produced a number of reports for us, in our own in-house style, and is on-hand with technical advice whenever required; it has been an outstanding addition to our research and development supply chain."

THE BENEFITS

Being able to defer the required CAPEX investment but still reap the rewards of highly accurate testing was of enormous benefit to Isotropics in the early stages of their company growth, who were able to offer potential investors and customers the security of third-party validated measurements. Thanks to the accuracy and speed of the StarLab, they were able to accelerate their compliance testing well ahead of schedule, characterizing relevant components and integrating the measurements into their modelization tool, which ultimately led to the development of a better product.

FUTURE PLANS FOR ISOTROPIC SYSTEMS

Focused on expanding the company through strategic hiring of skilled innovators, engineers and sales professionals, Isotropics is dedicated to creating a reliable and lean supply chain and internal workforce.

In turn, this will lead to the development of formal product lines designed to unlock the ever-expanding market opportunities for HTS.

EMC

The electromagnetic compatibility department (EMC)

Activity & Markets

The MVG-EMC division was created in 2012, thanks to the unique combination of AEMI's expertise in absorbing materials and Rainford's expertise in Faraday cages. The EMC division provides solutions to test the ability of devices to operate in electromagnetic environments and avoid generating disruptions themselves. This activity also extends to the EMC certification of electronic devices, protection against strong fields (data, people), and protection against eavesdropping.

Strategy

Integration of the value chain through strategic acquisitions, positioning as a supplier of turn-key systems.

Price Range

From €10 K to several million euros.

Offering

A range of EMC test chambers, mode-stir chambers, shielded rooms (control rooms, embassies), shielding for data centers, and shielding for MRI installations.

- EMC test chambers
- Absorbing materials
- Antenna measurement chambers
- Faraday cages
- Doors
- Accessories (masts, positioners, controllers, etc.)

The EMC division also provides project management, maintenance, certification, reinstallation, and installation upgrade services.

Key achievements

Continued sustained production in Europe

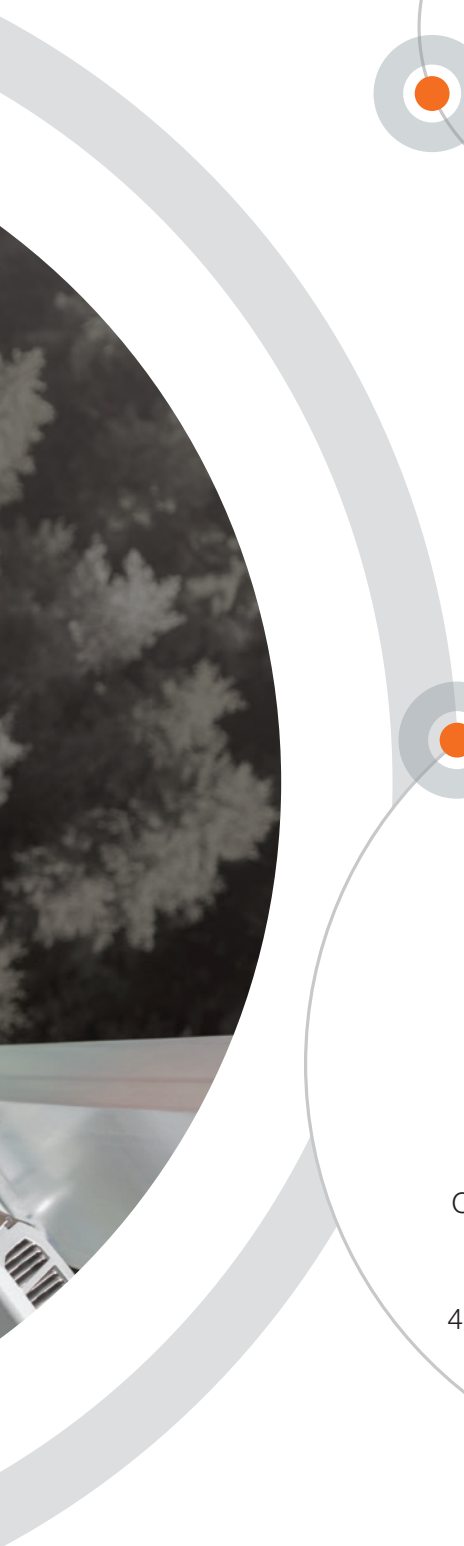
- Significant orders in the US

EIC

The environmental and industrial control department

Activity & Markets

The EIC division brings together the devices used for monitoring electromagnetic waves, quality control on production lines, and the NeptuLink *by MVG* dedicated to Internet connectivity in coastal environments.



Price Range

From €350 to €180 K.

Strategy

Go from “follower” to “challenger” by relying on a modernized portfolio of distinctive products.

Offering

A wide range of products:

- Portable RF exposure meters (EME Guard, EME Guard XS, EME Spy)
- Fixed RF exposure meters (FlashRad)
- Software for 3D simulation of exposure to electromagnetic waves (EMF Visual)
- Control system for rock wool and glass wool on production lines (Dentro)
- 4G modem to optimize land/sea connections (NeptuLink by MVG)

Key achievements

Maintenance of positive momentum in sales generated by EME Guard XS-type products


10
countries with
sales offices
2 major
production
centers
90%
of revenue
abroad

KEY ASSETS

Since 1996, the year that marked an industrial turning point for the Group when it decided to move forward by turning its unique design office into an industrial manufacturer, MVG has developed two main assets:

- a solid business model, including a high proportion of recurring revenue,
- a multi-country/multi-sector positioning.

A solid business model

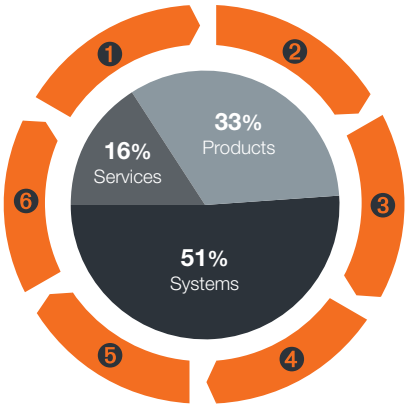
MVG proposes systems with high added value, designed from standardized technological blocks, guaranteeing controlled margins. Its know-how extends from the analysis, sales, and design stages to production, integration, installation, and support. These systems accounted for 51% of new orders in 2018.

Alongside these systems, MVG develops, manufactures, and markets off-the-shelf products, such as the SG 24 and the StarLab 50 GHz (see page 18).

These projects require little adaptation from one customer to another and can be put into service quickly. They represented 33% of new orders in 2018. Lastly, the Group offers engineering and maintenance services. These represented 16% of orders. Service, engineering, and maintenance contracts, associated with the products, represent 49% of sales and are not significantly affected by adverse market conditions. This solid business model is reinforced by a diversified customer portfolio: the top customer accounted for 7% of the Group's 2018 revenue and the top five customers accounted for 23%.

SYSTEM SALES CYCLE

Distribution of orders in 2018



1 Analysis
- Development of the site and installations
- Analysis of solutions
- Discussions

2 Design
- Project planning
- Analysis of the chamber configuration
- System specifications
- Diagrams
- Power/error budget
- RF and mechanical simulations

3 Production
- Production planning
- Quality control

4 Integration
- Development of interfaces
- Integration and testing

5 Installation
- Equipment installation
- Testing
- Calibration
- Certification

6 Support
- Support and maintenance (on-site and remote)
- Periodic calibration
- Updating and reconditioning

An International Group

MVG exports more than 90% of its production. The Group spans Europe, Asia, and America through 20 locations in 10 countries.

In 2015, a reorganization resulted in a centralization of its mechanical production in Israel, an almost fully sales and service-oriented structure in the United States, and ultimately a more productive, more efficient Group focused on the future. It currently consists of two large major production centers: one in France, focusing on electronics and multi-sensor technology, and one in Israel, focusing on mechanics and single-sensor technologies, working in perfect synergy. These two production centers rely on three skill satellites: one that produces Faraday cages (Rainford - England), one that produces absorbing materials (AEMI - USA), and one that designs reference antennas necessary for system acceptance (MVG - Italy). With its local offices, the Group is closer to customer cultures and is therefore better able to follow through with customer needs and with higher understanding, in turn limiting travel and transport expenses.

MVG IS PRESENT IN 10 COUNTRIES, THROUGH 20 SITES, INCLUDING 2 MAJOR MANUFACTURING FACILITIES

A multi-country/multi-sector positioning

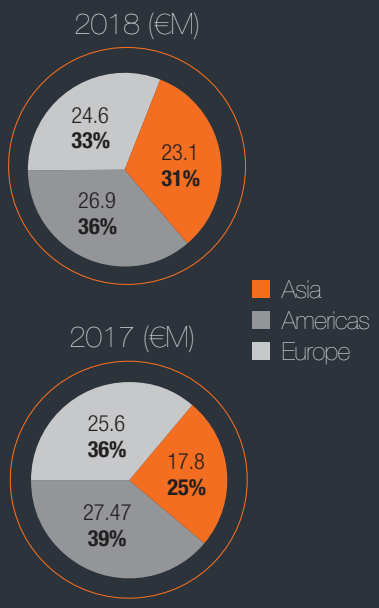
The Group is strengthened by a diversified and balanced sector and geographic presence. From a sector perspective, it works in the Aerospace/Defense and Civil Telecommunication sectors. The sectoral breakdown of the activity is as follows: 57% in Civil Telecommunications, marked by an increase in Asia with the growing 5G market and 43% in Aerospace & Defense. The geographical distribution of revenue remains balanced with 36% in North America, 33% in Europe and 31% in Asia (last year Asia accounted for 25% of 2017 revenue).

A diverse customer base that protects the Group from any dependency on its main customers

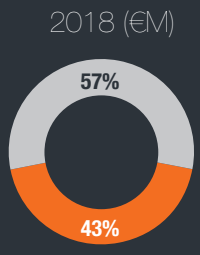
MVG's business model relies on a diversified customer portfolio. From year to year, the share of the top customer and the top five customers remains contained. The top customer's share in the Group's 2018 is thus only 7% and the top five customers accounted for 23% of the revenue for the year.

Share of revenue in €K	2013	2014	2015	2016	2017	2018
No. 1 customer	3,790	5,665	4,480	5,970	2,782	5,061
Top 5 customers	10,942	15,149	10,534	13,464	10,130	16,925

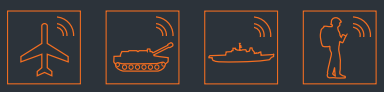
BREAKDOWN OF REVENUE BY GEOGRAPHICAL REGION 2017 AND 2018



Civil Telecommunications AMS

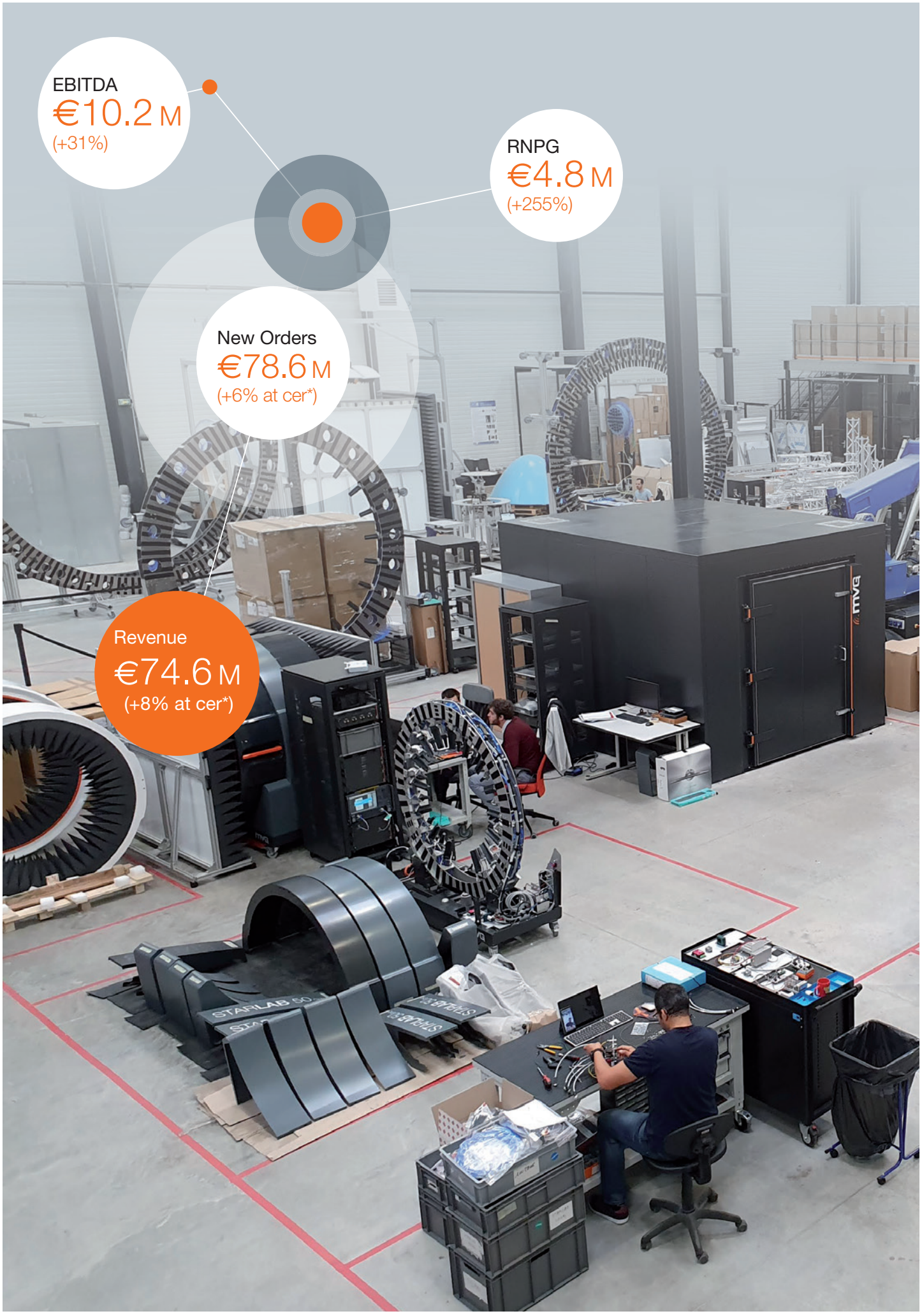


Aerospace and Defense AMS



Renewed sites to support the Group's growth

Within 36 months, the Group has pursued an active policy of renewing its various sites. MVG has moved 7 of its sites, including four production sites. The sites in Manchester, Munich, San Diego, Philadelphia, Atlanta, Paris and Brest are more modern, bright, functional and in optimal working order to support the Group's growth over the coming years. The relocation of one of the Group's major production sites to Tel Aviv is under study and should be completed in 2021. The impact on the accounts of these moves has been minimized. Thus, the overall rental budget for the Brest and Paris sites remains the same before and after the move, while both sites benefit from more modern premises that are perfectly adapted to their needs. The Parisian site, with a production hall whose ceiling height reaches twelve metres, is now able to assemble and test the large arches under the best possible conditions, which it then installs at its customers' premises around the world. Its new, carefully designed premises are also an effective communication tool, strengthening the MVG brand, and an attractive factor in attracting the talent the Group needs to continue its growth.



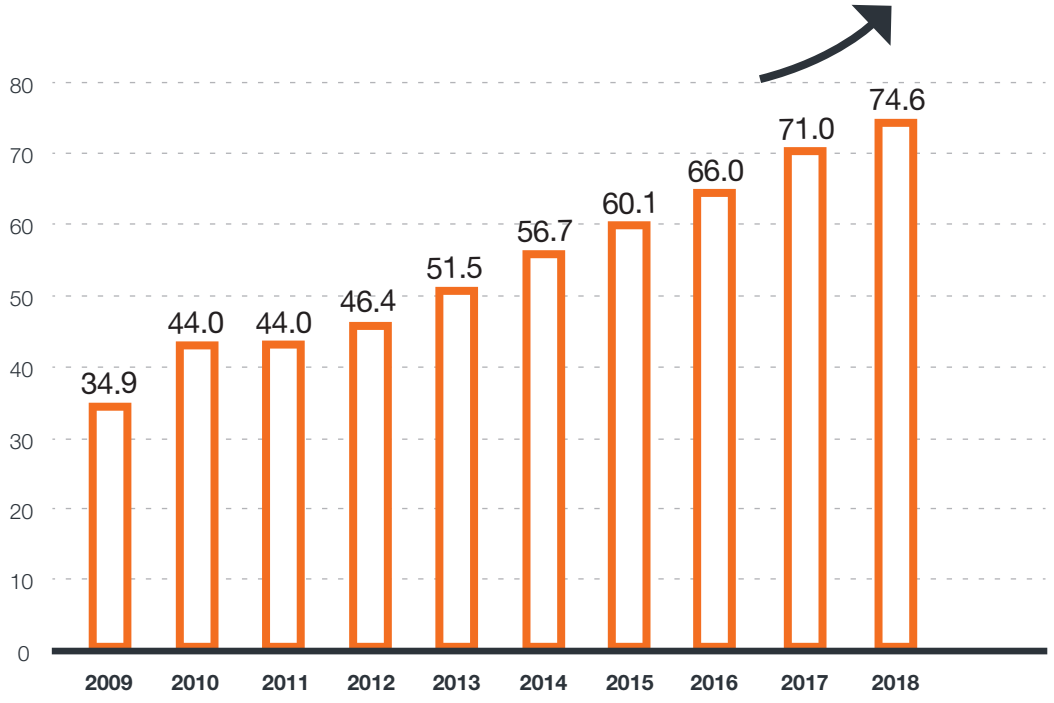
*cer : constant exchange rates

RESULTS AND PERSPECTIVES

The MVG Group has published excellent results for 2018, with a very strong second half in particular. The Group is reaping the rewards of its innovative product offer, its sales momentum and the measures to optimize productivity undertaken by the management in the last few years. Net income thus increased by a factor of nearly 8 in 2018.

Activity

EVOLUTION IN REVENUE (€M)



+8%
growth at constant exchange rates

23rd year of growth

The MVG Group has posted revenue of €74,6 M versus €71,0 M last year, up 7,8 % at constant exchange rates (+5,0 % at current exchange rates).

From a sectoral viewpoint: 57% in Civil Telecommunications, marked by an important increase in Asia with the 5G market and 43% in Aerospace & Defense.

Geographically, the Group continues to demonstrate its ability to seize opportunities in its main markets. With 36 % in North America, 33% in Europe and 31 % in Asia (As a reminder, last year Asia contributed 25% of 2017 revenue).

Significant improvement in the main financial indicators

Consolidated data - IFRS - €k

SIMPLIFIED STATEMENT OF COMPREHENSIVE INCOME	2017	2018	% variation
REVENUE	**71,072**	**74,637**	**+5.0%**
Purchases consumed	(26,204)	(26,459)	
GROSS MARGIN	**44,868**	**48,178**	**+7.4%**
Marge	*63.1%*	*64.5%*	
Other external expenses	(12,681)	(12,809)	-
Payroll expenses	(23,653)	(24,176)	-
EBITDA	**7,801**	**10,201**	**+30.8%**
Marge	*11.0%*	*13.7%*	
RECURRING NET OPERATING INCOME	**4,405**	**6,863**	**+55.8%**
Marge	*6.2%*	*9.2%*	

The gross margin rose from €48,2 M versus €44,9 M on 31 December 2017, an increase of 7,4 %. The gross margin rate increased to 64,5 % versus 63,1 % last year (+1,4 points), under a favorable product mix leaning towards "all electronic".

The Group recorded EBITDA of €10.2 million versus €7.8 million, an increase of 30.8%, reflecting: (i) the constant improvement in productivity; the fact that growth in the year was registered with a very slight increase in the workforce (359 at end-2018 versus 352 at end-2017) and; (ii) rigorous management of current operating expenses. Note that exchange rate fluctuations hardly had any effect on EBITDA.

The EBITDA margin rate thus came in at 13.7% over the year (up +2.7 points).

Consolidated data - IFRS - €k

SIMPLIFIED STATEMENT OF COMPREHENSIVE INCOME	2017	2018	% variation
RECURRING NET OPERATING INCOME	**4,405**	**6,863**	**+55.8%**
Marge	*6.2%*	*9.2%*	
Non-current operating expenses	(152)	(477)	
NET OPERATING INCOME	4,253	6,386	+50.2%
Net finance costs	(2,022)	(592)	
Income tax	(1,580)	(824)	
NET INCOME	**652**	**4,970**	**+662%**
NET INCOMEGROUP SHARE	**1,343**	**4,762**	**+255%**

After accounting for amortization, depreciation, and provisions, **current operating income totaled €6.9 million, up 55.8% from December 31, 2017.**

Operating income totaled €6.4 million compared with €4.3 million at the end of 2017. It includes a non-recurring expense of €0.4 million related to legal expenses incurred for the buyout of minority shareholders of ORBIT/FR.

Financial income rose to €(0.6) million compared with €(2.0) million at December 31, 2017. The previous year, the Group had registered a latent exchange loss of €(1.8) million relating to the re-evaluation of intragroup loans following changes in the euro/dollar exchange rate.

In 2018, the Group booked a tax expense of €(0.8) million versus €(1.6) million the previous year. In 2017, the Group had reported a one-off charge of €(0.8) million for the re-evaluation of deferred tax assets.

Consequently, **net income came in at €5.0 million compared with €0.6 million at December 31, 2017.**

Financial position remains sound

Shareholders' equity stood at €68.9 million at December 31, 2018. Self-financing capacity before taxes rose sharply, from €5.8 million at the end of 2017 to €9.6 million, an increase of 65%.

Consolidated data - IFRS - €k

	SIMPLIFIED BALANCE SHEET	12/31/2017	12/31/2018
ASSETS	**NON-CURRENT ASSETS**	**29,247**	**28,904**
	CURRENT ASSETS	**44,551**	**52,590**
	- of which, inventories	10,526	10,213
	- of which, trade receivables	28,751	36,358
	CASH ASSETS	**25,236**	**14,676**
	TOTAL	99,034	95,873
LIABILITIES	**EQUITY CAPITAL**	**69,800**	**68,891**
	- of which non-controlling interest	1,629	-
	NON-CURRENT LIABILITIES	**5,631**	**1,126**
	- of which non-current financial debts	4,735	172
	CURRENT LIABILITIES	**23,605**	**25,856**
	- of which current financial debts	924	4,546
	- of which trade payables	11,131	11,801
	TOTAL	99,034	95,873

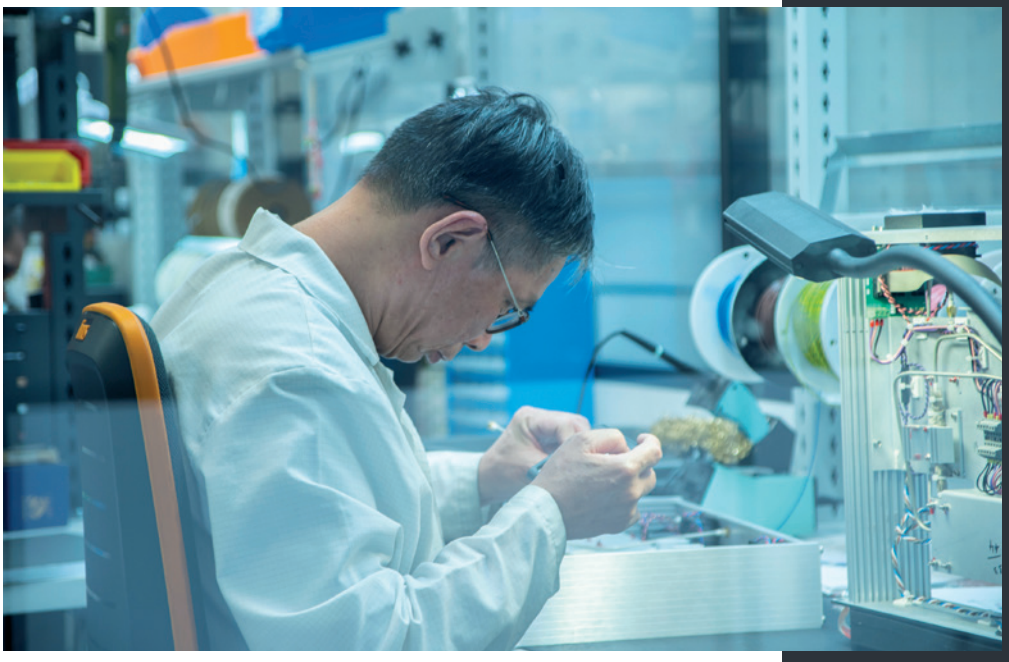
WCR posted a significant one-time increase of €9.0 million. This change was due to differences in billing, mainly relating to unfinished infrastructure at certain customers and the impact of the euro/dollar exchange rate. Stocks remained stable over the period. Cash flow thus came out at €(0.7) million versus €5.6 million at December 31, 2017. WCR is expected to improve in 2019.

Positive net cash position of €10 million

Investments during the period rose to €8.5 million (including €6.2 million for the buyout of minority shareholders of ORBIT), from €3.0 million at December 31, 2017. The Group had a positive net cash position of €10 million at December 31, 2018.

Consolidated data - IFRS - €k

CASH FLOW TABLE	2017	2018
Consolidated Net Income	652	4,970
Group share of net profit	1,343	4,762
Operating cash flow before financecosts and taxes	5,789	9,553
Change in WCR related to operations	1,482	(9,009)
NET CASH FLOW FROM OPERATIONS	**5,650**	**(658)**
Net cash flow from investment	(3,040)	(8,493)
Net cash flow from financing	(1,748)	(1,615)
Impact of currency fluctuations	91	(512)
CHANGES IN CASH POSITION	**862**	**(10,767)**
OPENING CASH POSITION	**24,886**	**25,236**
CLOSING CASH POSITION	**25,236**	**14,676**



Heading towards a major change in size for the MVG Group

The Group begins the year with excellent visibility. This strong confidence is based on: (i) the high level of new orders recorded in 2018 (€78 million, up 3.5% at constant exchange rates), taking the order backlog for the next 12/18 months to €73.41 million, i.e. one year of revenues in the backlog, but also; (ii) the fulfillment of an historic order for the Group of more than €30 million.

This new contract in the Aerospace/Defense sector will last for three years, and will begin with a study phase. The Group expects it to contribute around €5-6 million to revenues in 2019 (i.e. 20% of the total contract), with the balance spread over the years 2020 and 2021.

The Group also aims to further improve its EBITDA in 2019.

The MVG Group is continuing to develop innovative products to better meet the new needs emerging on its target markets. From this year, the Group will launch a highly anticipated new 5G product to respond to the major challenges of this market of the future.

MVG plans to cement its position as leader in measurement systems, and now more than ever has all the assets necessary to bring about a change in size over the next few years.

About MICROWAVE VISION GROUP

Since its creation in 1986, The Microwave Vision Group (MVG) has developed a unique expertise in the visualization of electromagnetic waves. These waves are at the heart of our daily lives: Smartphones, computers, tablets, cars, trains and planes -- all these devices and vehicles would not work without them. Year after year, the Group develops and markets systems that allow for the visualization of these waves, while evaluating the characteristics of antennas, and helping speed up the development of products using microwave frequencies. The Group's mission is to extend this unique technology to all sectors where it will bring strong added value. Since 2012, MVG is structured around 3 departments: AMS (Antenna Measurement Systems), EMC (Electro-Magnetic Compatibility), EIC (Environmental & Industrial Control). MVG is present in 10 countries and generates 90% of sales from exports. MVG has over 350 employees and a loyal customer base of international companies. The Group generated revenues of € 74.6 million in 2018. MVG has received the BPI «Innovative Enterprise» award, and is illegible for PEA-PME.

Euronext : ALMIC | Euronext Growth, code ISIN FR0004058949 | For more information: http://www.mvg-world.com

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