

Applus[⊕]

Innovation Review Summary



Together
beyond
standards



Index

01

Letter from the CEO ————— 04

02

About Applus+ ————— 08

2.1 Applus+ at a glance ————— 10

2.2 Our history ————— 12

03

Innovation at Applus+ ————— 14

3.1 Executive summary ————— 16

3.2 Our innovation approach ————— 20

04

Technological sectors and lines ————— 22

4.1 Technological sectors ————— 24

4.2 Technological lines ————— 25

05

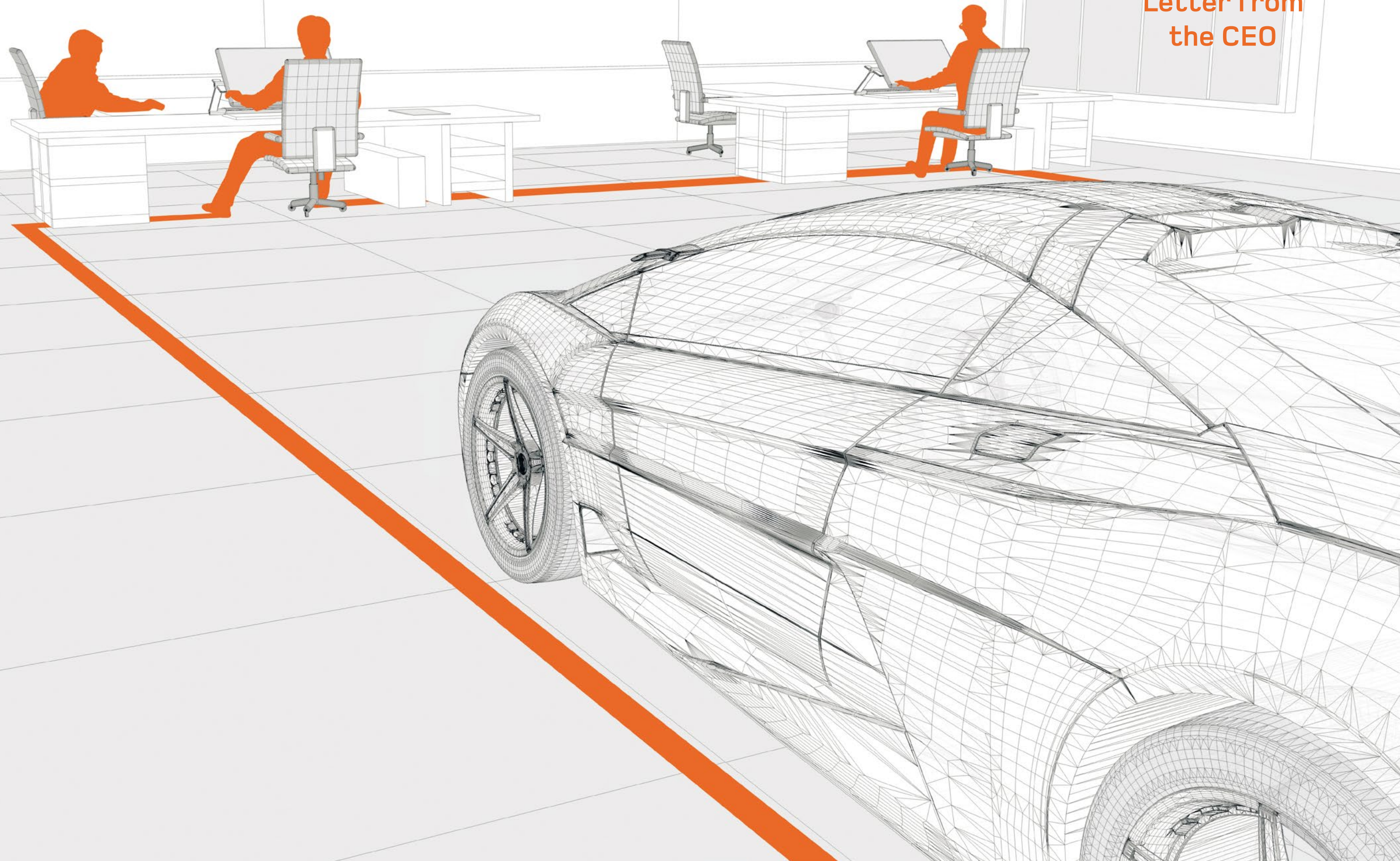
Innovation achievements ————— 26

5.1 Creating value ————— 28

5.2 Success stories ————— 30

01

Letter from
the CEO





Fernando Basabe
Chief Executive Officer (CEO)

Letter from the CEO

Thank you for spending the time to discover the innovative work delivered across our four divisions at the Applus+ Group.

Innovation can have many meanings, make many claims and can even arrive spontaneously. At Applus+, designing, improving and harnessing new technology is in the DNA of our company. Innovation is a systematic approach to developing new services and solutions for clients. This is the challenge our talented engineers, technicians and specialists encounter in their work every day.

In this review, we detail how innovation at Applus+ reaches the Group's goals and objectives, and showcases how the Group generates high quality services for our clients, while embracing digitalisation to improve the effectiveness of our clients' business processes.

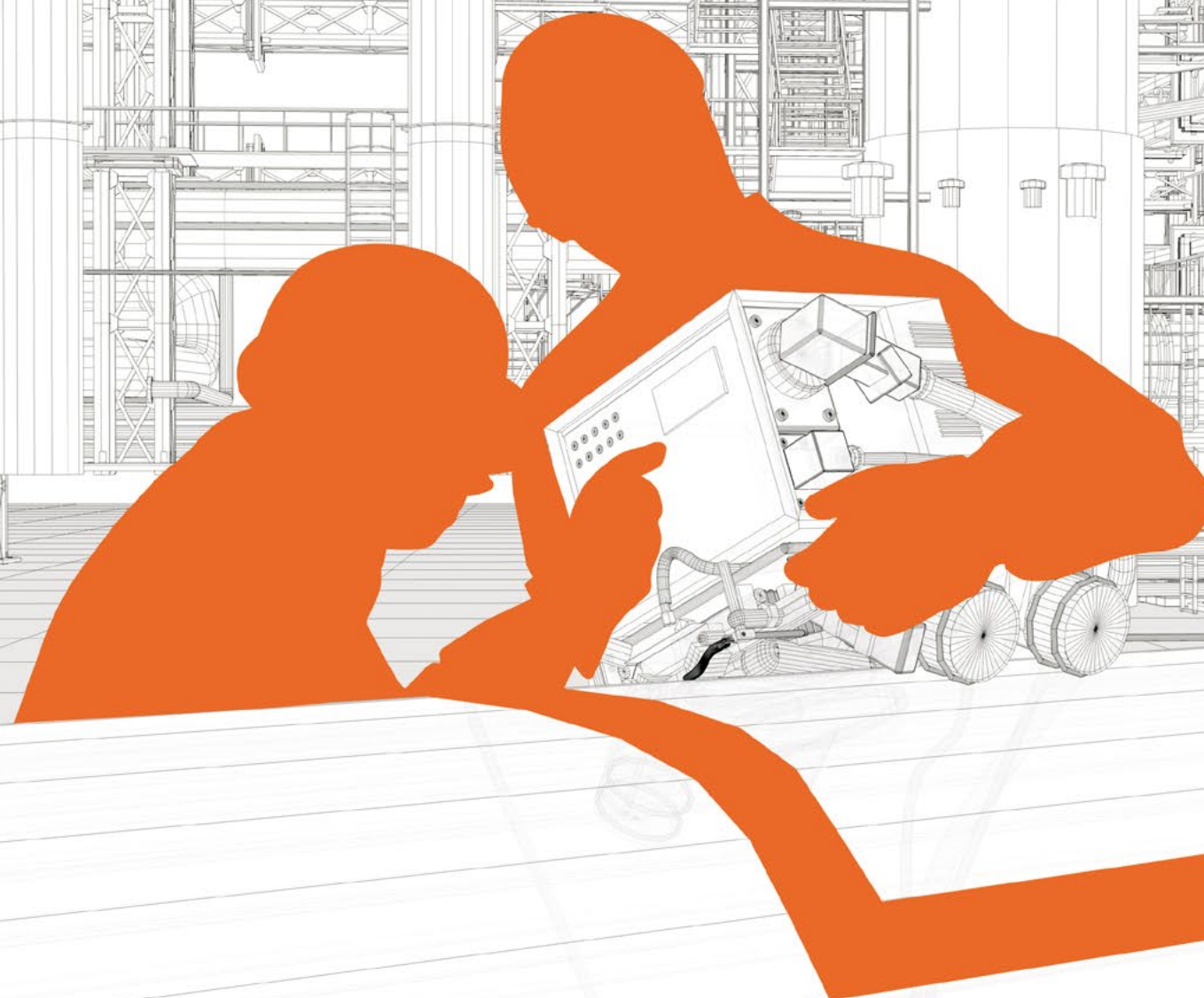
Innovation at Applus+ is driven through our clients and their industries' need to solve critical problems in their operations or sectors. We therefore invest strategically to advance the services required for leadership in our testing, inspection and certification (TIC) markets. Through this dedicated focus, our drive to offer more effective technology or methods also upholds the trust we have built with clients and industry partners.

Each of the industry sectors we serve operates and requires highly specialised technologies and equipment. Across the Group, our divisions' network of teams create new capabilities from their research and development into testing and inspection. We apply this multi-disciplinary knowledge to customer-focused projects, and this approach to innovation has consistently produced cutting-edge, proprietary technology to solve a diversity of challenges within our TIC markets.

We present here a selection of the groundbreaking technology and novel solutions that we have put into action. We would really welcome your comments on the points of interest you find.

02

About Applus+



Applus+ at a glance

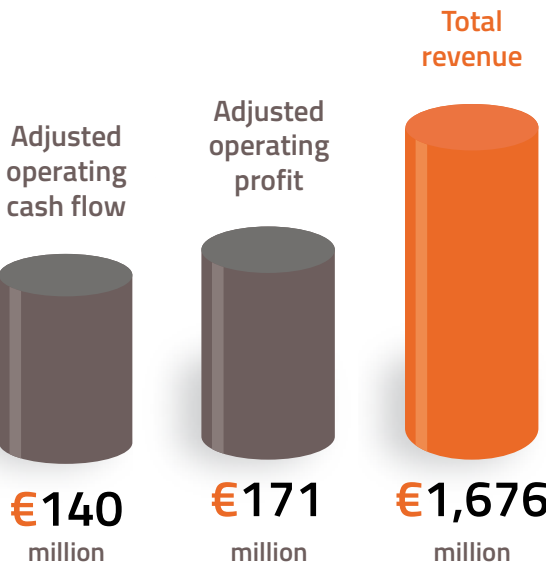
Applus+ is a premier choice in testing, inspection and certification (TIC) services. Across the Group, our divisions provide innovative services to national and multi-national companies in a diverse range of products, services and industry sectors.

A MARKET LEADER IN GLOBAL TIC SERVICES

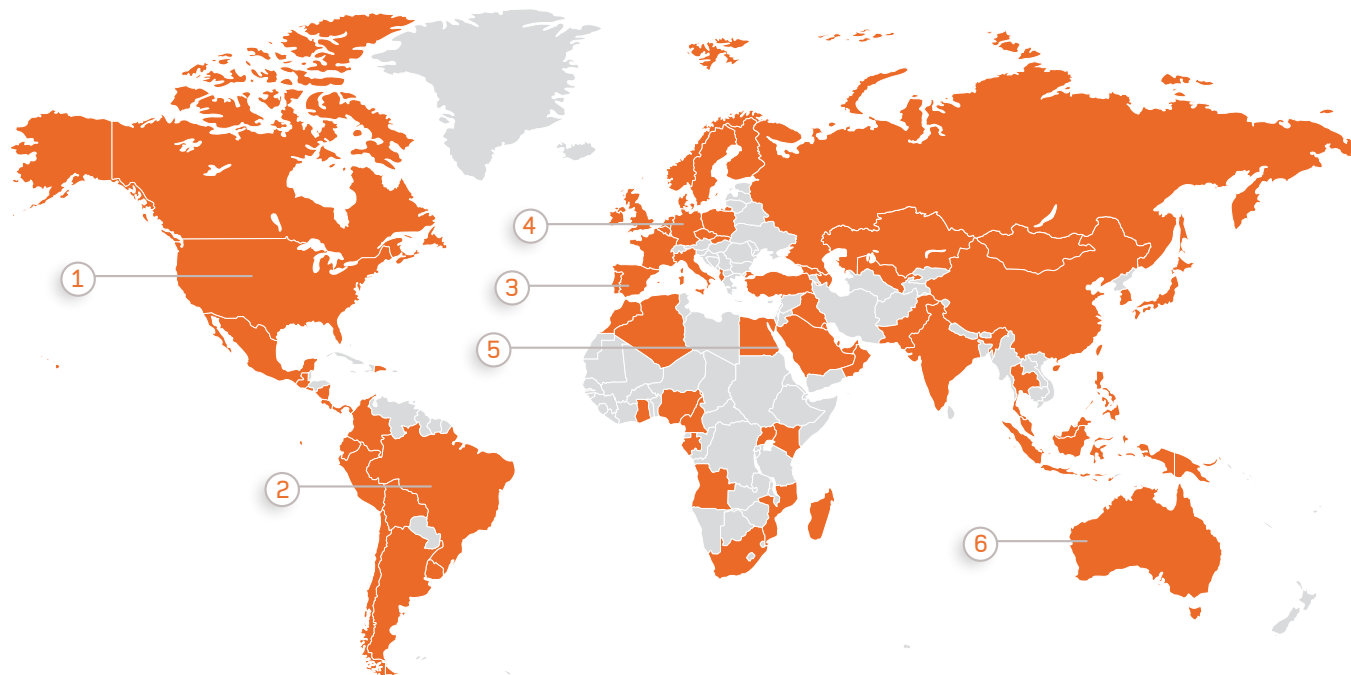
Countries
70+



22,800+
Employees



GLOBAL PRESENCE



1 US and Canada	2 Latin America	3 Spain	4 Rest of Europe (excluding Spain)	5 Middle East and Africa	6 Asia Pacific
2,281 Employees 20% %total revenue in 2018	5,337 Employees 10% %total revenue in 2018	7,523 Employees 22% %total revenue in 2018	3,285 Employees 27% %total revenue in 2018	2,662 Employees 11% %total revenue in 2018	1,764 Employees 10% %total revenue in 2018

OUR DIVISIONS

ENERGY & INDUSTRY DIVISION

Revenue
€1,014M

Employees
14,830



Services: Industrial and environmental inspection, technical assistance, non-destructive testing (NDT), engineering and consulting.

Industries: Oil and gas, power, telecommunications, construction, mining and aerospace.

LABORATORIES DIVISION

Revenue
€77M

Employees
965



Services: Industrial testing laboratories, engineering, certification and metrology services.

Industries: Aerospace, automotive, electronics, information technology and construction.

AUTOMOTIVE DIVISION

Revenue
€371M

Employees
4,538



Services: Statutory vehicle inspection services for safety and emissions.

Industries: Government and public transport agencies.

IDIADA DIVISION

Revenue
€214M

Employees
2,519



Services: Proving ground, design, engineering, testing and homologation services.

Industries: Automotive.

Applus+ BY INDUSTRY

Oil and gas
Total Revenue

36%

Statutory vehicle inspection
Total Revenue

22%

13%

Automotive testing and engineering
Total Revenue

9%

Power
Total Revenue

4%

Construction
Total Revenue

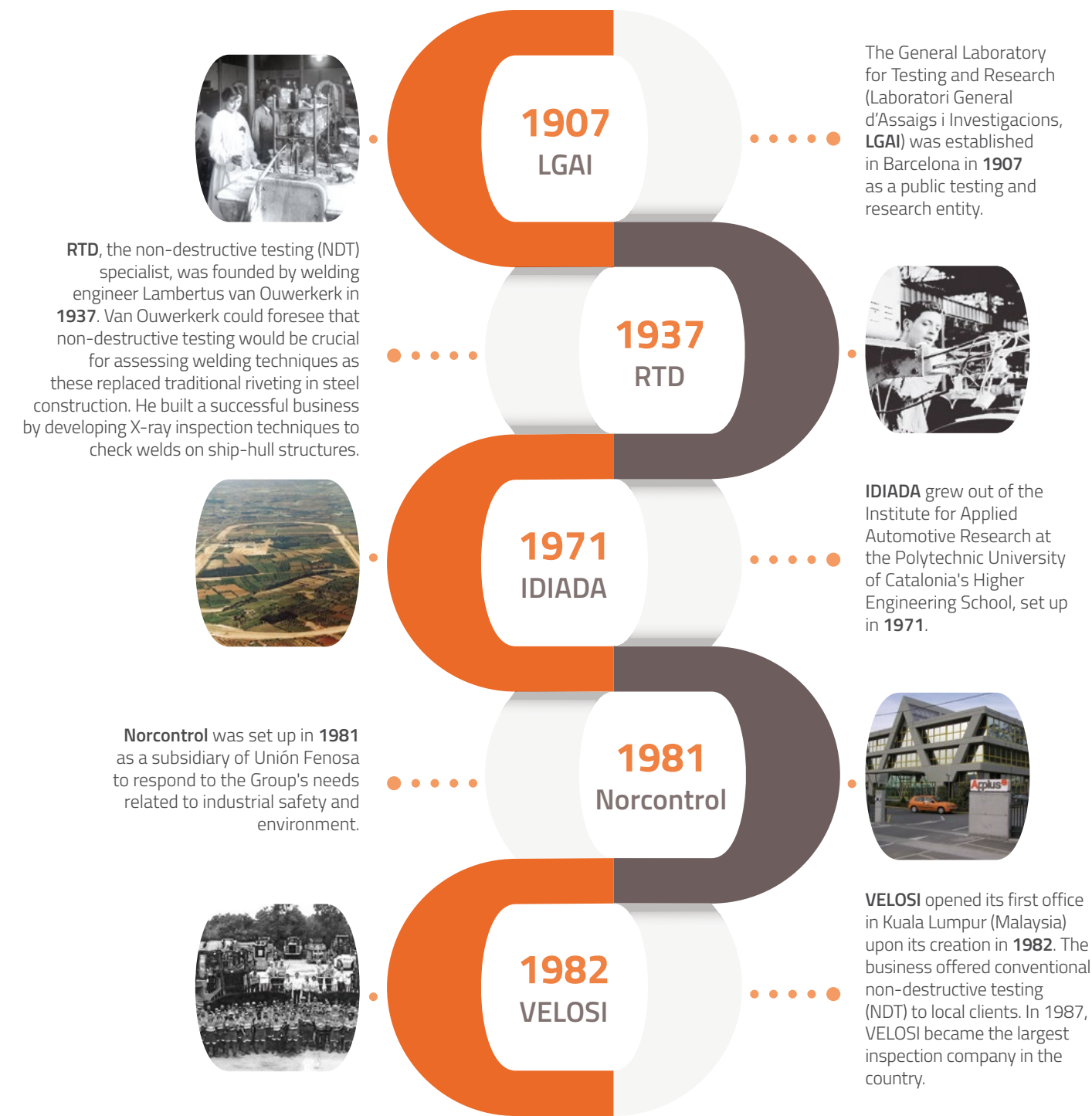
3%

Aerospace
Total Revenue

Others :13% Total Revenue

Our history

THE COMPANY'S ORIGINS



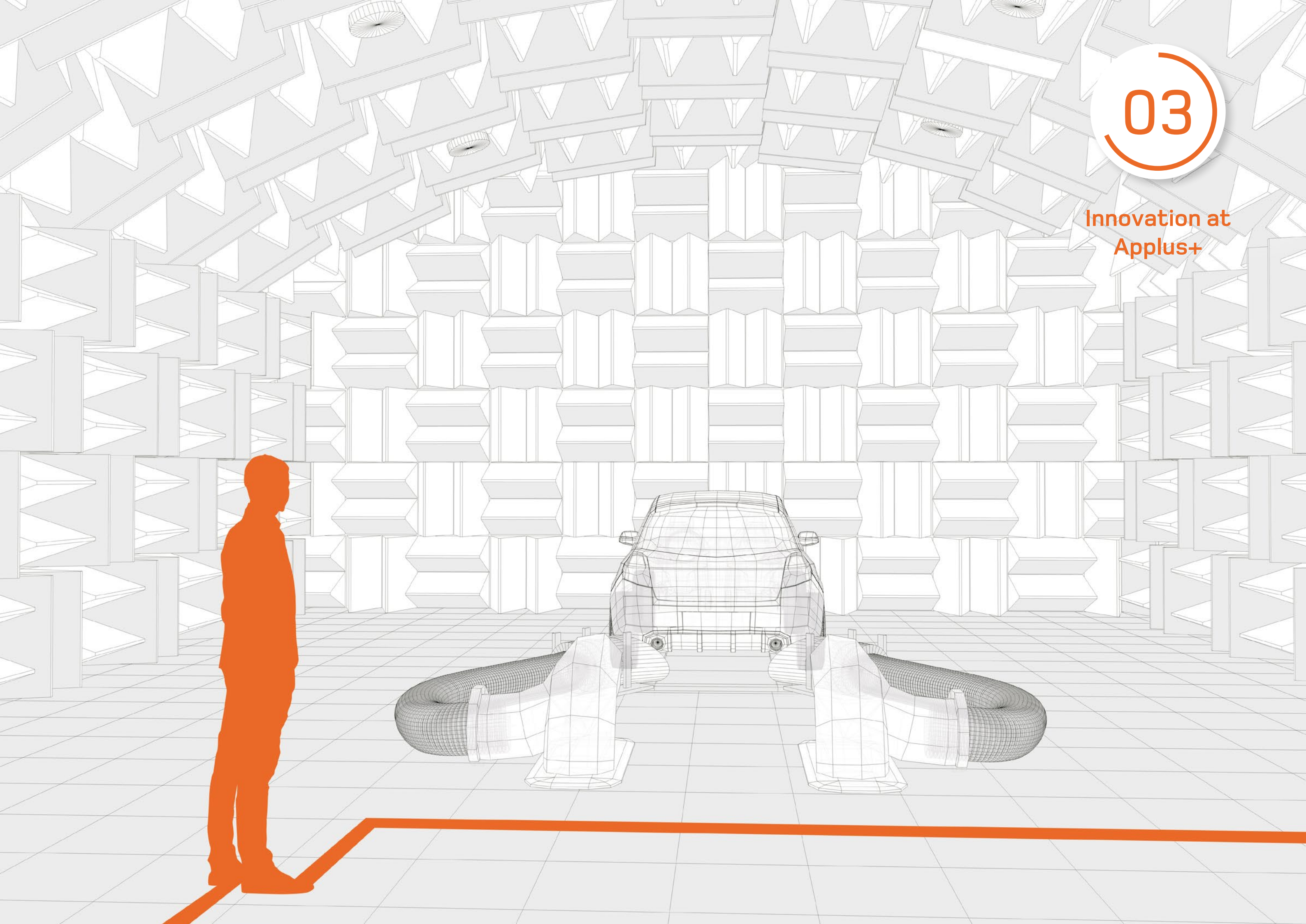
THE Applus+ GROUP'S HISTORY



*Including the subsidiaries of the 11 acquisitions the total number of acquired companies was 19.

03

Innovation at
Applus+



Innovation at Applus+

EXECUTIVE SUMMARY

Key figures



200+
projects



300,000+
hours

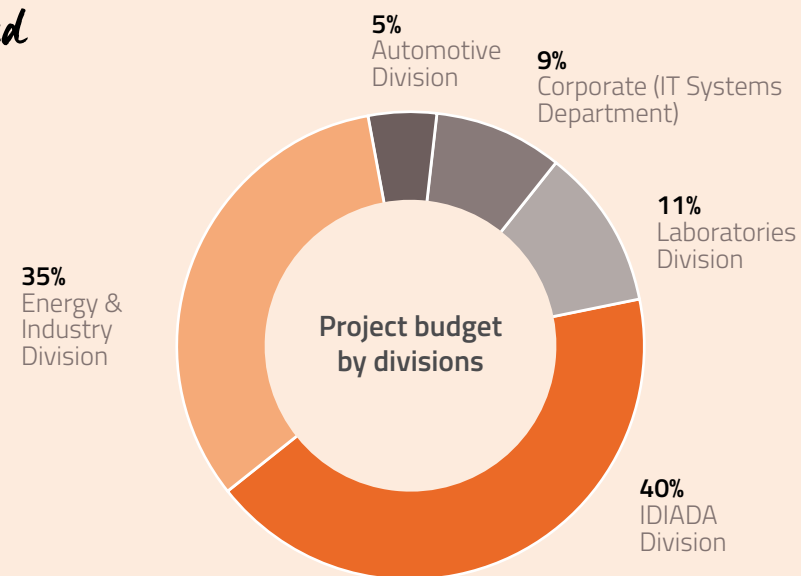


800+
people

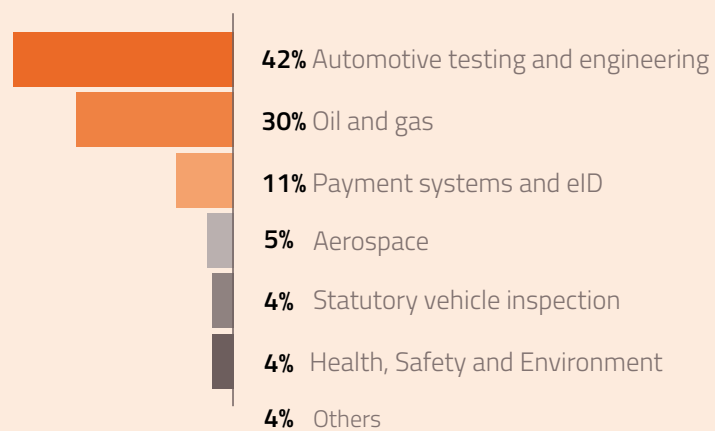


4
R&D poles

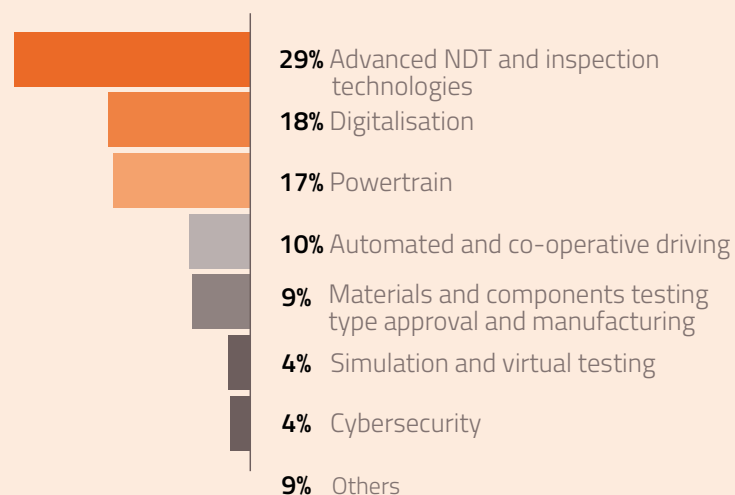
Projects developed



Project budget by technological sectors



Project budget by technological lines



Outcomes

VISIBILITY INDICATORS

300+
Number of participations
in working groups,
committees or forums



85+
Number of speeches
at technical events
related to innovation



55+
Number of technical
papers presented



70+
Number of technological
training sessions by an
Applus+ instructor



BUSINESS INDICATORS

55+
New products or
services generated in
the period 2016-2018



140+
Improvements in the
period 2016-2018



80+
New technologies
acquired/developed in
the period 2014-2018



100+
Prototypes
developed in the
period 2016-2018



KNOWLEDGE AND CAPABILITY INDICATORS

80 granted patents
from **31** families



100+
Number of active
R&D agreements



Relevant events and conference contributions

Advanced NDT and inspection technologies (Energy & Industry Division)



Speeches to industry

- Pipeline Pigging and Integrity Management Conference (Houston, Texas, USA)
- 12th International Pipeline Conference and Expo (Calgary, Alberta, Canada)



Papers

- International Pipeline Conference (Calgary, Canada)
- ASME Pressure Vessel and Piping Conference (Prague, Czech Republic)
- 12th European Conference NDT (Gothenburg, Sweden)
- Welding Journal, 97 (American Welding Society, 2018)



Papers and demonstrations

- First World Conference for Inspection and Maintenance Robotics (Galveston, Texas, USA)



Workshop

- 2nd Workshop on Industrial Safety (Madrid, Spain)

Advanced communications and cybersecurity (Laboratories Division)



Workshop

- How to develop reliable IoT solutions (Bellaterra, Spain). Organised by Applus+
- IT security workshop (Shanghai, China). Organised by Applus+



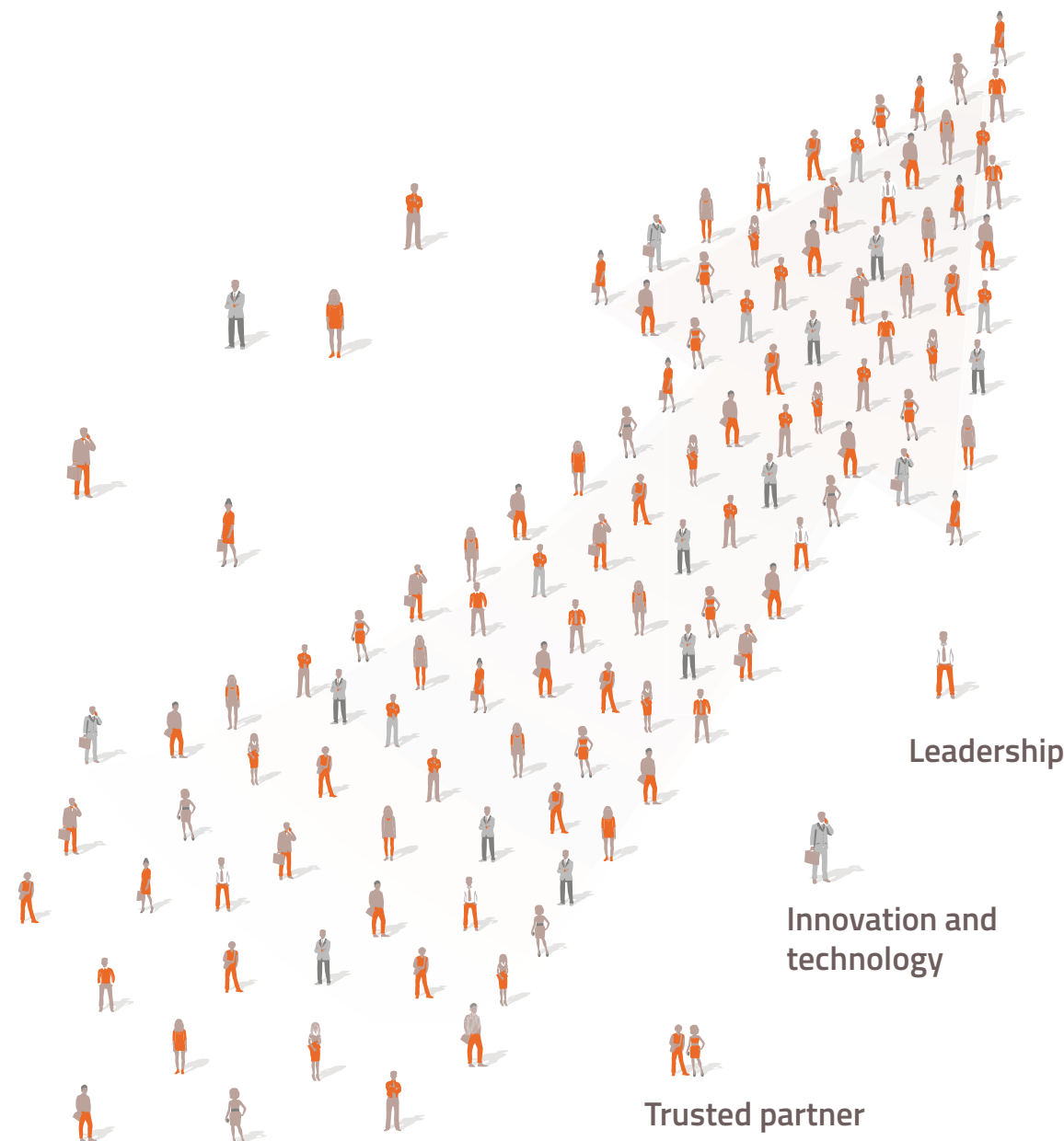
OUR INNOVATION APPROACH

At the Applus+ Group, innovation and technology form the key attributes to both our company strategy and corporate social responsibility.

For our company strategy, we focus on obtaining leadership in our selected markets by prioritising investment in **innovation and technology**, which secures our position as a trusted partner to help solve our clients' challenges.

At a divisional level, this mindset and resource deployment allows us to work closely with the multiple industry sectors we serve, and our engineers and technicians collaborate with our clients and industry partners to **continuously bring groundbreaking technical solutions and delivery high levels of service excellence**.

Innovations and technological engineering at Applus+ also sets industry best practice in the sectors we serve. This improves the efficiency of our services and creates strong **technological partnerships** with clients and industry-sector bodies.



Our **innovation** activity for sustainable development at Applus+ focuses mainly on **reducing environmental pollution** and the impact derived from industry, energy and transport sectors. For our clients, innovations within their operations, products and processes cover **reducing CO₂ emissions** from transport activities, **lowering energy consumption**, creating **safe and sustainable mobility**, increasing **cybersecurity in transport and industry**, and improving **human health and safety**.

Complementary to this approach, **digitalisation** is also driving our innovation activities. Applus+ has been addressing this challenge for many years, and we have developed specific solutions to digitalise operational processes, improve client experience or, in some cases, develop completely new services.

Applus+ has gone one **further step** by addressing digitalisation as a **global challenge** across the whole of the Applus+ Group. We have launched **dedicated initiatives** to manage and foster this digital transformation and **embed innovation projects into**

our operations. This drives our teams to investigate and provide solutions to technical problems or to develop new services in a diverse range of technological and business areas.

In the progress reported here, we present our **transversal overview of innovation within Applus+**. We detail our advances within our **target industry sectors and along our main technological lines**, according to the diverse, cross-functional nature of the business activities across our four divisions and geographical areas.

Our innovation **success stories** present the skills, technology and breakthroughs required to go beyond standards, and we demonstrate the contribution innovation makes to our CSR values covering the environment, safety and sustainability.

Innovation for Applus+ underpins and drives our continuous and systematic effort to create new value-added solutions, ideas and methods. This brings significant challenges, and we believe meeting these delivers value to our clients and shareholders.

Main technological hubs

North America

- 💡 5% projects
- ⌚ 4% hours
- 💰 8% budget (€)

Mediterranean

- 💡 83% projects
- ⌚ 85% hours
- 💰 65% budget (€)

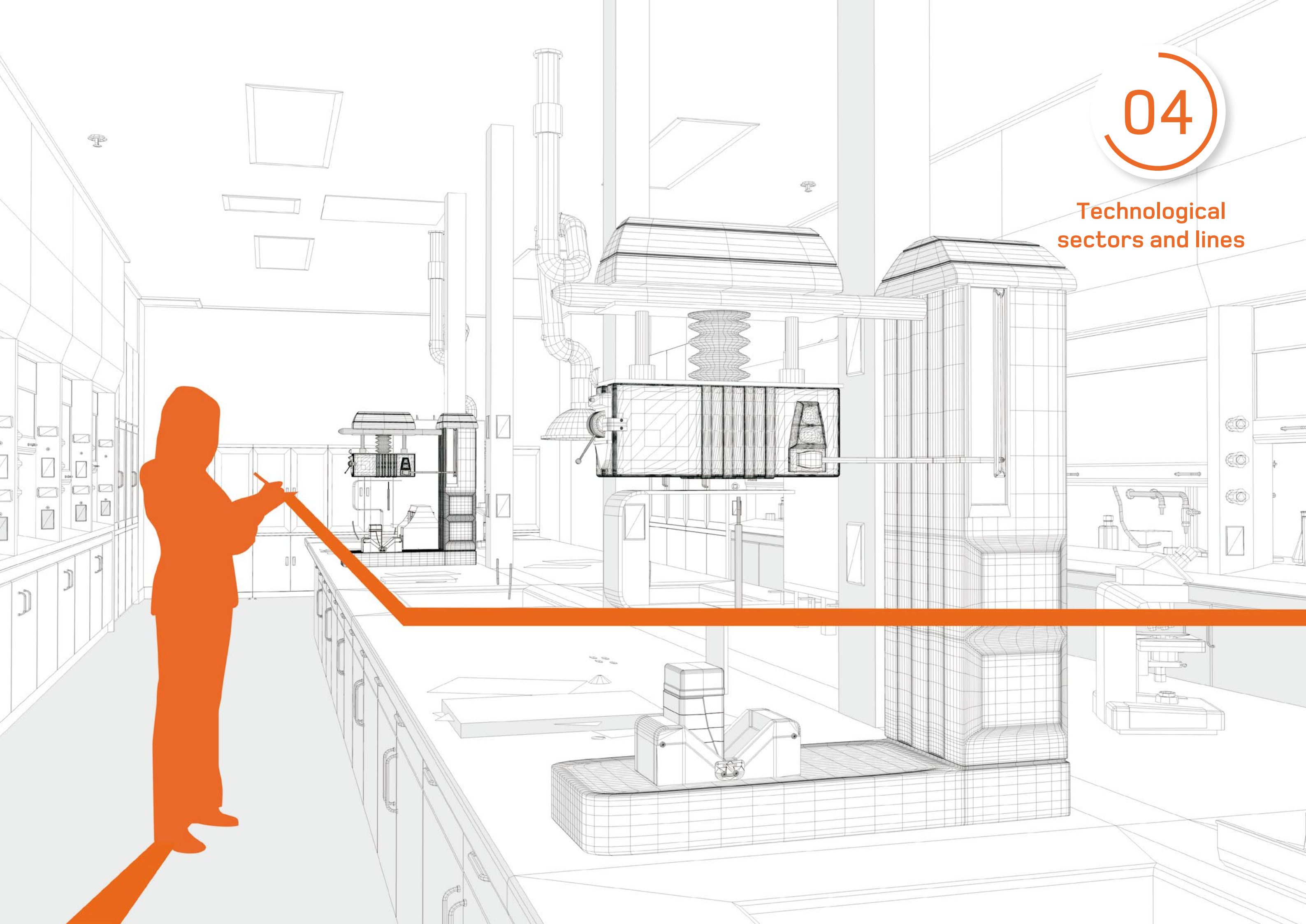
Northern Europe

- 💡 4% projects
- ⌚ 5% hours
- 💰 15% budget (€)

Oceania

- 💡 8% projects
- ⌚ 6% hours
- 💰 12% budget (€)





Technological sectors and lines

TECHNOLOGICAL SECTORS

The Applus+ Group works across a range of sectors and disciplines, with a significant presence in the following **sectors**:



Automotive testing and engineering



Oil and gas



Payment systems and eID



Aerospace



Statutory vehicle inspection



Health, Safety and Environment (HSE)



Power



Construction



Telecommunications



Electrical and Electronic



Other industries

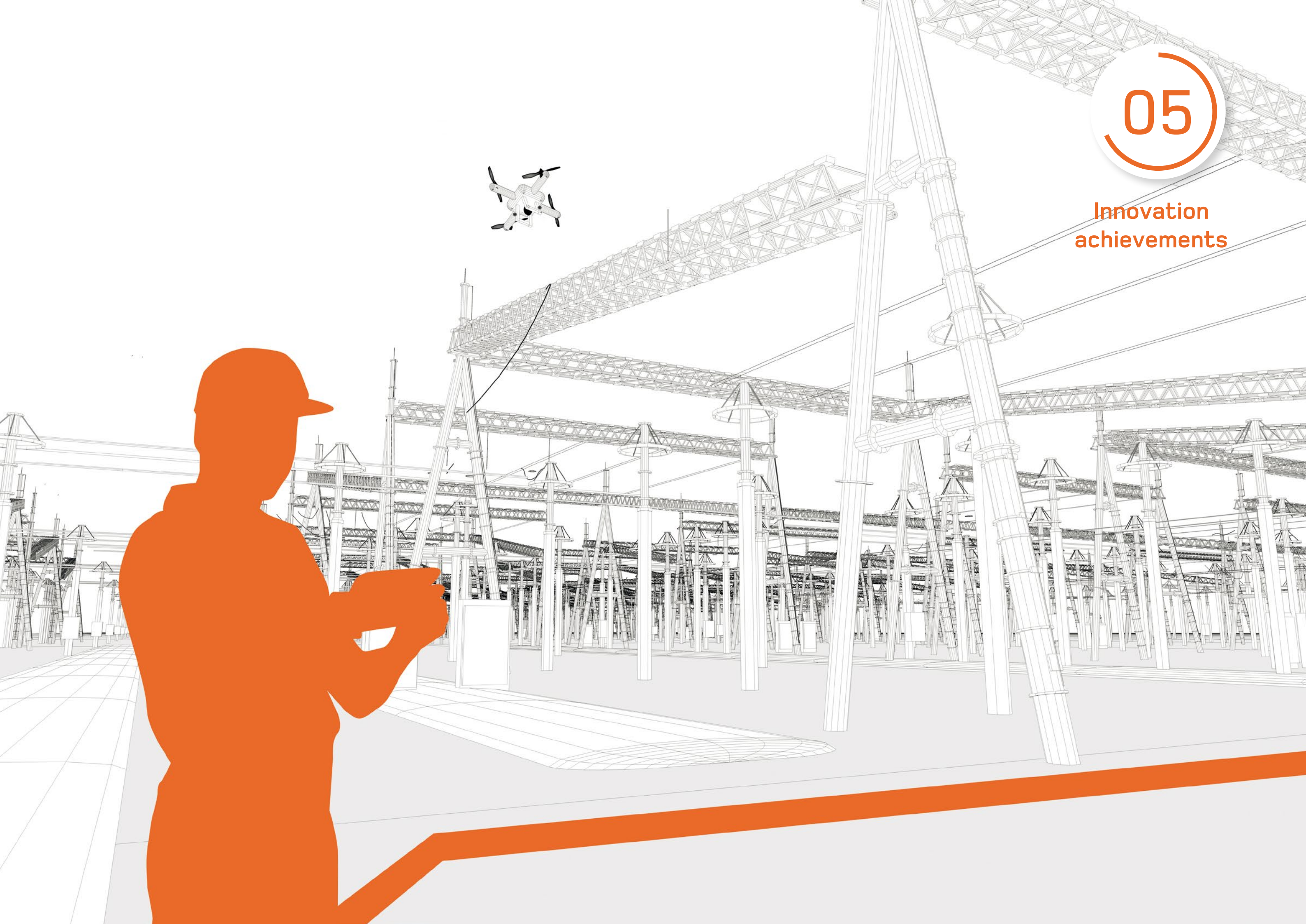
TECHNOLOGICAL LINES

The key **technological lines** in which the company works are:

ADVANCED NDT AND INSPECTION TECHNOLOGIES	Application of new communication, data processing and imaging technologies to NDT inspections. New advanced UT-based developments. Improvements to digital X-Ray and UT systems. Specific developments for difficult to inspect components. Aerial inspection with drones.
DIGITALISATION	IT and web-based tools developed for different purposes (testing and inspection management, mobility solutions, web portals for client loyalty programmes, data management and processing, organisation management, etc.). Implementation of advanced digital technologies (machine learning, advanced analytics, IoT and virtualisation) in testing and inspection services.
POWERTRAIN	Reduction of emissions, electric and hybrid vehicles, alternative fuels (gas, H2 and dual-fuel).
AUTOMATED AND CO-OPERATIVE DRIVING	Autonomous driving, connected vehicles, and their related support technologies and developments.
MATERIALS AND COMPONENTS TESTING, TYPE APPROVAL AND MANUFACTURING	Composites, metallic materials, process development. Component design and simulation. Testing (structural, NVH - noise, vibration and harshness -, durability, etc.). Automotive components type-approval procedures. Brake testing.
SIMULATION AND VIRTUAL TESTING	Vehicle dynamics, NVH, materials and components testing.
CYBERSECURITY	Mobile and smartcard payment systems (functionality, interoperability and security tests). HCE and TEE. Cybersecurity in connected vehicles and internet of things (IoT).
INTEGRATED SAFETY	Passive safety and active safety technologies for automotive vehicles.
ADVANCED COMMUNICATIONS	Wireless communications and IoT: radio, NFC, automotive communication systems, ADAS and e-call.
TEST BENCH, INFRASTRUCTURES AND INSPECTION SYSTEMS	Customised test benches, automated inspection systems, automotive proving grounds.
CHEMICAL SYNTHESIS AND ENVIRONMENTAL ANALYSIS	Synthetic routes development under GMPs for scalable production of medical and pharmaceutical products. Development of analytical techniques for environmental analysis (water and air).
ENERGY EFFICIENCY	Technical assessment and implementation to improve energy efficiency, deploy evaluation tools and provide certification.

05

Innovation
achievements



Innovation achievements

CREATING VALUE

Innovation at Applus+ is advancement with a purpose. Our talented engineers, technicians and sector specialists work closely with clients to delivery new approaches to their challenges by designing solutions and utilising technical advances and insights from other non-related sectors.

This is especially true with the new developments in digital technologies, where our teams take advantage of technical leaps to redesign new methods, equipment and processes. Our success at deploying these creative and innovative insights is delivering huge strategic and competitive advantages:



New products and services
brought to market



New solutions to improve our clients' **productivity and safety, to reduce environmental impact** or **to generate significant cost savings**



Expansion into **new sectors** or **geographical areas**



Awards and other recognitions for **innovative projects or technical excellence**



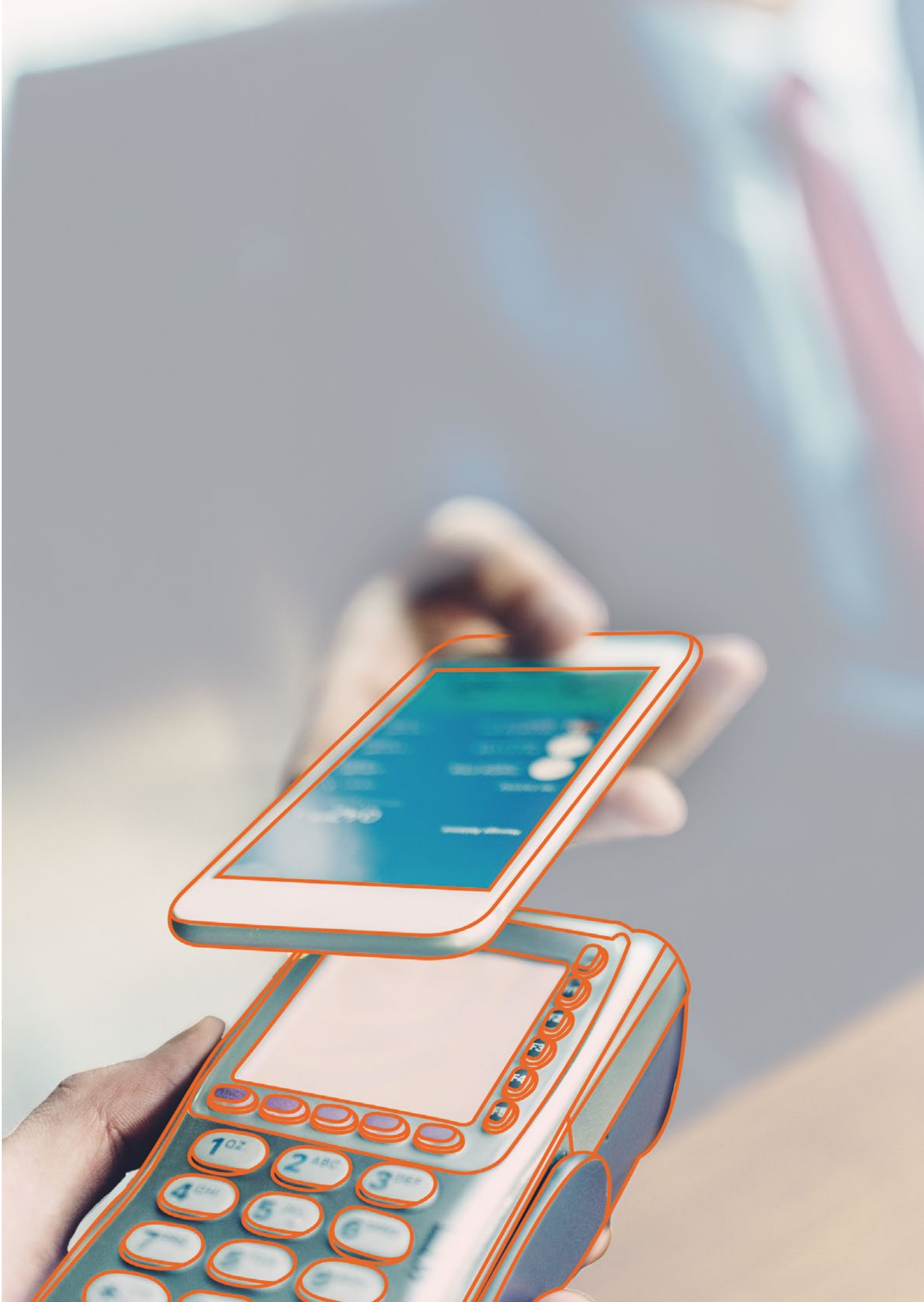
High added-value services thanks to our **knowhow and expertise**



New contracts with **major clients**



Improvements in our divisions' **operational performance**

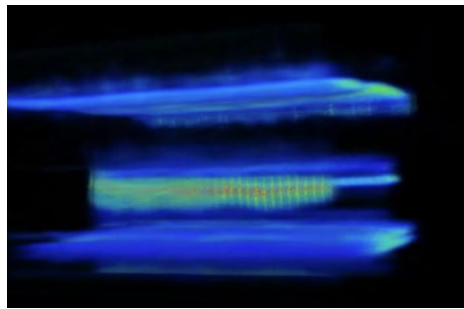


SUCCESS STORIES



Oil and Gas

RTD IWEX INSPECTION SOLUTION – DELIVERING NEW TECHNOLOGICAL APPLICATIONS



Technological line: Advanced non-destructive testing

Technicians at Applus+ continue to reengineer the proprietary **RTD IWEX solution to deliver bespoke advanced NDT applications on customer-driven projects**, such as, a US Department of Transportation project, developed to precisely detect for stress-corrosion cracking and fabrication flaws along seam welds on legacy pipelines within the oil and gas industry.

Our engineers have also re-designed the RTD IWEX solution to work in other extreme conditions and complex environments, delivering a tailor-made solution for a world-leading energy company as part of their system for inspecting emergency pipeline repairs (EPRC). In this case, the application allows technicians to inspect under sub-marine pressures, which simplifies the handling of the inspection equipment. Our technicians can now inspect more safely to greater depths, while providing higher quality inspections and more reliable data from the RTD IWEX solution.

Inverse Wave field Extrapolation (IWEX) is a method for measuring ultrasonic signals and reproduces both 2D and 3D images in real time by generating the scan's data with an RTD IWEX algorithm. Previously unattainable, the accurate, real-time availability of the images is allowing operators to better discriminate between injurious and non-injurious anomalies in images, which allows to identify pipeline-failure threats immediately.

ULTRASONIC TESTING EQUIPMENT COMPLETES PILOT IN SOUTH AFRICA

Technological line: Advanced non-destructive testing and inspection technologies

The RTD INCOTEST (INSulated Component TESTing) of Applus+ has been developed to find a more reliable way to survey ferrous pipes and vessels through their thermal insulation and protective coatings.

This advanced electromagnetic inspection technology is now in permanent use and upgraded in multiple-inspection services, such as guided ultrasonic-testing surveys. The technology maps for corrosion across an asset and, with this increased information feedback, our clients reduce the costs of insulation-removal previously associated with this highly specialised testing.

The technology was first deployed by our non-destructive testing team in Oman in 2018, and our technicians have engineered the tool's **capabilities to be operated in more challenging temperatures and material conditions** during this pilot scheme.

We are now deploying the RTD INCOTEST inspection technology along more than 217 miles (350 km) of pipelines in South Africa.

NEW REMOTE VISUAL INSPECTION SYSTEM: REPURPOSING TECHNOLOGY FOR INDUSTRY-CRITICAL INSPECTIONS



Technological line: Advanced non-destructive testing and inspection technologies

Working with one of world's largest petroleum and chemical producers, the technicians at Applus+ has surpassed the challenge set by our client to design our **CU24 inspection crane** to detect the industry-specific problem of asset corrosion called corrosion under insulation (CUI).

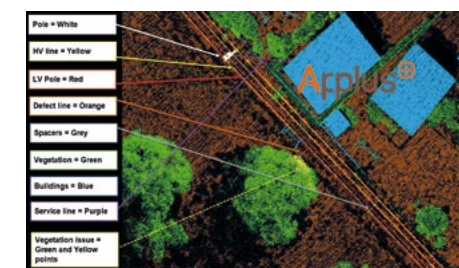
Until our innovation, these types of inspections required a disproportionately amount of time and cost, and our technicians' work involved considerable risk to visually inspect the asset using either rope access or scaffolding. Our solution was to equip a mobile crane unit with HD and IR cameras, which are weather resistant and operated remotely.

The Applus+ system won a commercial success award from our client after achieving cost savings of between 50% and 80% on conventional visual inspections. In addition to improving our employees' safety at work, the new system can identify problems more effectively to reduce asset failure and avoid unscheduled maintenance and facility disruptions.



Power

REACHING NEW HEIGHTS BY EQUIPPING DRONES WITH LiDAR TECHNOLOGY



Technological line: Advanced non-destructive testing and inspection technologies

Across the Energy & Industry Division, our engineers and technicians are developing systems to combine **laser imaging detection and ranging (LiDAR) technology with drone-based inspections** that can produce high-resolution 3D interactive models of assets across many industry sectors.

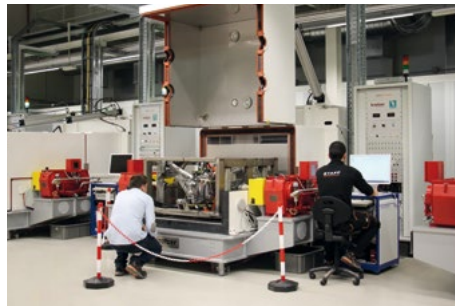
These models can be used to make a large range of measurements and to create CAD models, and the collected data has a high level of detail and accuracy. This combination of applied technology has innovated the inspection process and minimised rope access, scaffolding, working at heights and shutdowns.

The Energy & Industry Division in Australia is deploying the technology to inspect approximately 1,429 miles (2,300 km) of power lines for a major gas and electricity distribution company, collecting field data through our technical team in Australia and analysing the results in Spain.



Automotive testing and engineering

E-MOTOR LAB: NEW ENGINEERING AND TESTING SERVICES FOR ELECTRIC VEHICLES



Technological line: Powertrain

The rapid introduction of electric and hybrid vehicles is driving our engineering teams to develop new tests required by manufacturers and legislators. To meet this technical demand, the IDIADA Division in Spain has opened a new laboratory to test traction units and battery packs on the next generation of powertrains being developed by the world's leading automotive manufacturers.

This state-of-the-art laboratory features seven independent test benches with new capabilities to test electric traction units and motors, including tests at multiple power levels up to 1000V/1400A/400kW and under temperatures ranging from -40°C to +120°C.

Our highly qualified test engineers and technicians **can simulate real driving situations in both positive and negative torque capacities, unique to electric vehicles**, and our analysis and reports contribute to product development and the validation process for this growing market segment.

MULTI-CAR COLLISION AVOIDANCE (MuCCA) SYSTEMS: AUTONOMOUS VEHICLE TECHNOLOGY

Technological line: Autonomous driving

Working with a renowned specialist car manufacturer and a UK university, our engineers at IDIADA Division are leading a project to develop **Multi-car Collision Avoidance (MuCCA) systems to reduce road-traffic accidents and personal injury on motorways**.

The project, funded by a government programme, draws from the IDIADA Division's innovations in artificial intelligence, vehicle-to-vehicle communications, high-performance graphic processing and satellite positioning. The technology and testing simulates motorway conditions and demonstrates how accidents can be avoided at high speed by deploying technology to record the exact causes of accidents.

Their work will culminate in a trial with up to five MuCCA-equipped connected vehicles and a number of human-controlled vehicles. This project will contribute to increase the **road safety**, especially by addressing **autonomous driving** challenges.



Statutory vehicle inspection

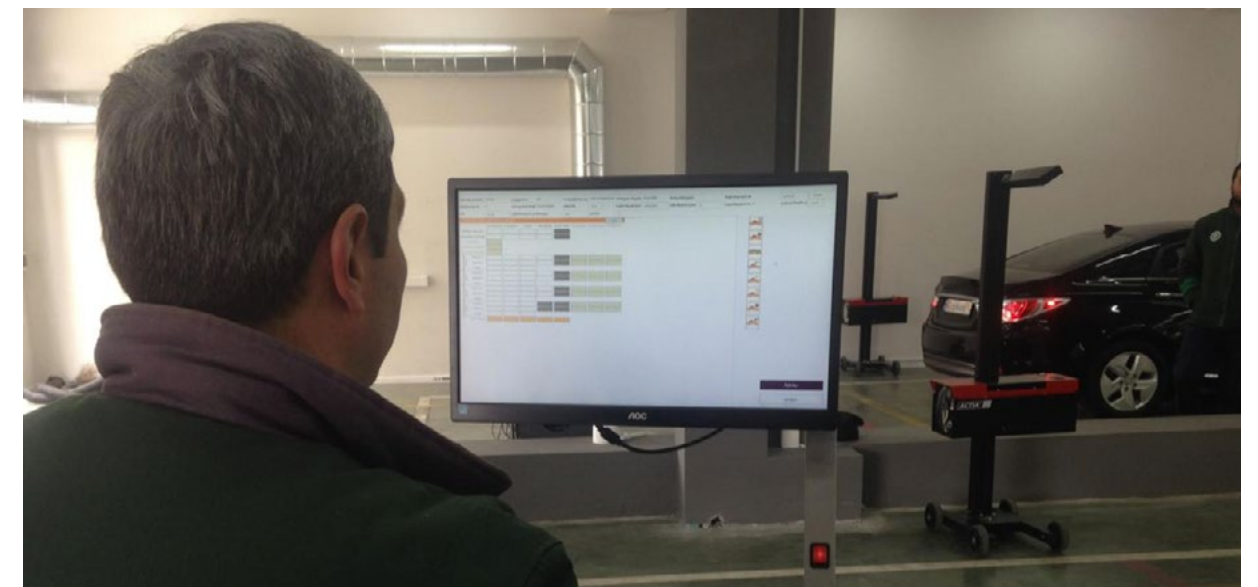
IMPROVING VEHICLE MANAGEMENT PROGRAMMES FOR STATUTORY VEHICLE INSPECTION

Technological line: Digitalisation

The Automotive Division has designed and developed a new vehicle information system (IVIS) to manage the statutory vehicle inspection systems used by vehicle inspection operators.

This programme has been implemented in Georgia, where the Automotive Division has expanded our presence. The IVIS was created **thanks to our own experience in the development of our vehicle management programmes**.

Georgia is the first country in which the IVIS programme has been installed, and this highly adaptable system will be installed at centres in Spain and India in the first of a planned roll-out in other countries and regions.



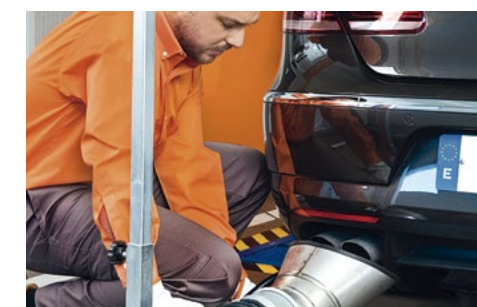
DEVELOPING ENGINE MANAGEMENT DIAGNOSTIC SYSTEMS FOR EUROPEAN UNION ENVIRONMENTAL LEGISLATION

Technological line: Digitalisation

To meet the latest requirements for European Union directives on vehicle emissions, Applus+ in Spain began a pilot study on an **on-board diagnostic system (OBD)** that monitors **potential engine malfunctions related to excessive pollutant emissions**.

This OBD allows technicians of statutory vehicle inspections to verify that an engine's electronic management system is managing emissions to the legislated levels for Euro 5 and Euro 6 vehicles. Our technical team researched and analysed different vehicles produced by the world's vehicle manufacturers to design and develop this essential emissions' control tool, and the Division successfully introduced the technology in September 2018 when mandatory testing using OBD came into law.

Through this system, Applus+ is spearheading quality and service levels for government statutory vehicle inspection programmes and assisting in improving air quality in towns and cities.





Aerospace

A+ GLIDE FORMING: APPLIED ENGINEERING IN COMPOSITE MANUFACTURING PROCESSES FOR AEROSPACE

Technological line: Materials and components testing, type approval and manufacturing

During the last two decades, the aerospace industry has been investing heavily in composite technology to harness the huge weight-efficiency and environmental benefit of advanced materials.

Large composite aircraft panels, such as fuselages, have reinforced structural elements with complex geometries called stringers. Aerospace original equipment manufacturers and Tier 1 suppliers are looking for new stringer manufacturing processes to overcome the major drawback of existing technologies.

To meet this challenge, the Laboratories Division conceived, designed and engineered an innovative technology called A+ Glide Forming, **an automated process delivering high quality stringers with lower investment.** Following this development, the Laboratories Division has secured several patents in different countries for this technology.

Applus+ is also supporting the aerospace industry to move to new types of composite materials and, we are currently reengineering the A+ Glide Forming process to adapt this technology to thermoplastics, which offer better performance and cost-efficiency.



Multiple sectors

INTERNET OF THINGS (IoT) HUB – NEW IoT TESTING AND CERTIFICATION SERVICES

Technological line: Advanced communications

When developing new IoT solutions, manufacturers face connectivity, security and market access challenges. To help manufacturers respond, the Laboratories Division has launched our IoT Hub, a platform offering a wide range of services to support IoT project development, from proof-of-concept to testing and certification.

Through our knowledge of wireless technologies, cyber threats and regulation, we develop **customised test plans to validate the reliability, functionality and cybersecurity resilience of IoT solutions.** Tested IoT solutions can achieve the voluntary 'Applus+ IoT Certified' mark, a guarantee of quality for the end-user.



WELD DISTORTION SIMULATION TOOL BASED ON ARTIFICIAL INTELLIGENCE

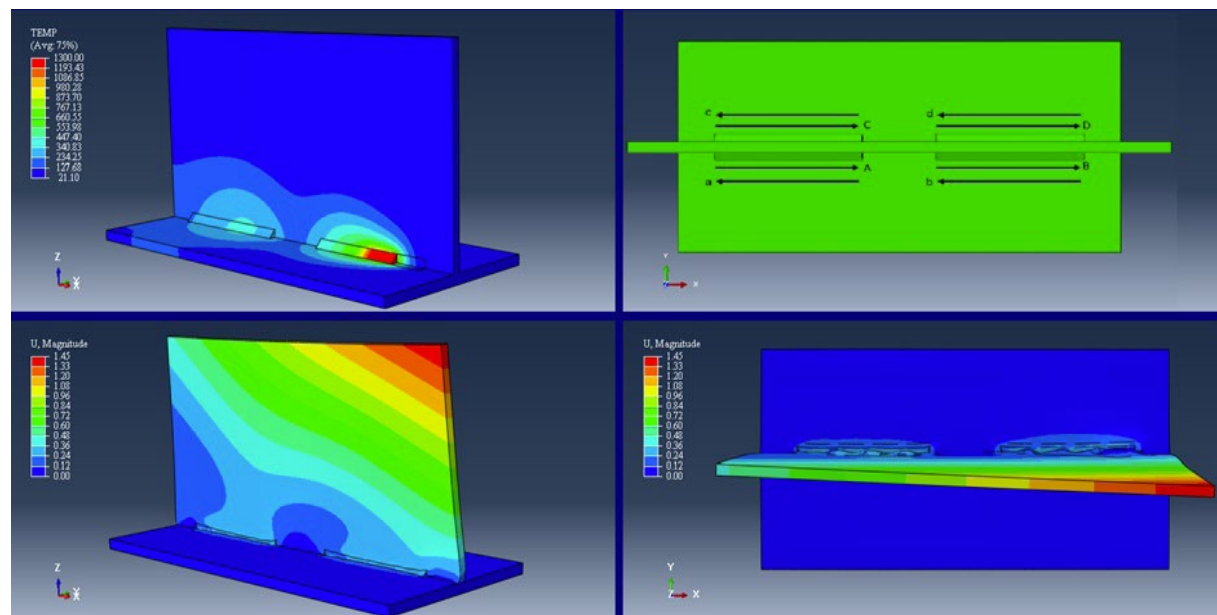
Technological line: Advance non-destructive testing, simulation and virtual testing

The Energy & Industry Division in North America has received a Federal Grant through the Canadian Industrial Research Assistance Program (IRAP) to develop a **weld-distortion control planner based on simulation and artificial intelligence**.

Distortion is a challenging problem during the fabrication of **welded structures** and causes residual stress that can affect the integrity of the weld and service life of the asset. A usual mitigation approach involves setting an intermittent weld sequence – a process that is extremely difficult to define.

Drawing on our expertise in computational engineering, the Applus+ solution overcomes this problem by defining the best weld sequence based on **sequential rigidity calculation using simulation tools**, such as finite element analysis (FEA).

Our technique can efficiently select the optimal pattern, and this new capability enables the designer to optimise complex weld designs without relying on intuition or their experience of similar weld fabrications. Following this breakthrough, we have filled a provisional patent for our weld-sequence design simulation method and tool.





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