

#DeepTech

#Industry4.0

#NDT

#QA/QC



Transforming industrial quality control

Revealing the invisible: in-line control of 100% of the production

Confidential information



Smart Revolution

Industry 4.0 needs new sensors to help industries to improve decision making in real time, to optimise their production processes and to provide predictive maintenance.

Global Trends

Lightweight Revolution

Regulatory and social pressures push toward CO2 reduction and resource efficiency, accelerating the need for new materials and processes.

PROBLEM

The cost of producing defective parts represents 5% of revenue*.

Hidden costs can be up to 4 times the visible costs.

And the later the detection, the higher the costs!

*Source: AFNOR 2017



01 Problem

02 Solution

03 Market

04 Business model

05 Company

06 Financials

PROBLEM

Common technologies present major limitations for in-line control.



NON-PENETRATING

Machine vision or visual inspection do not reveal internal defects

CONTACT

Typical Ultrasound solutions need to be in contact with the object: accessibility issues, risk of scratches, water/gel continuity medium

HARMFUL

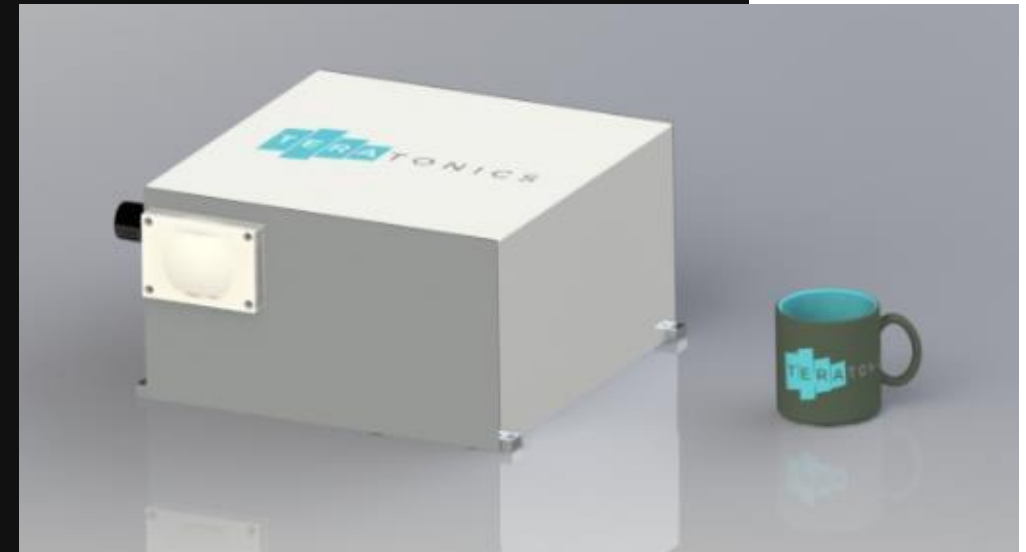
X-Rays require stringent measures and procedures to protect personnel

SLOW

Tomography scans parts in tens of minutes or even hours

02 Solution

Teratronics STRIPP Control Ultrafast Non-Destructive Testing Solution



Teratronics uses ultrashort Terahertz pulses to reveal the invisible inside plastics, composites, assemblies, and coatings



Dimensional control
Defect detection

Contactless
Harmless

Fast

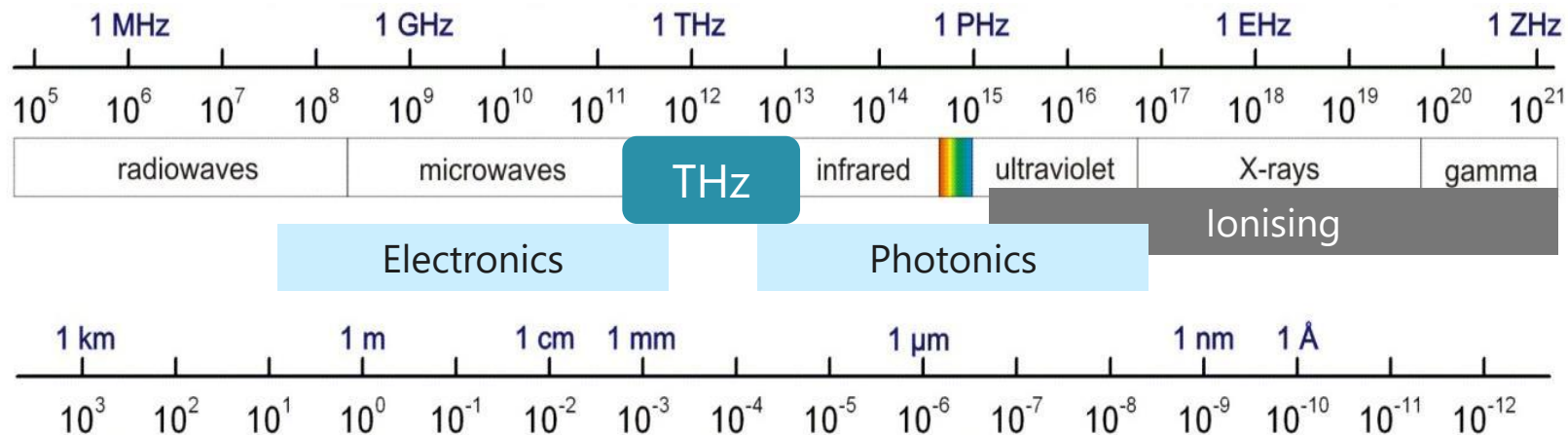
Fully automated

→ **In-line deployment**

TERAHERTZ RADIATION

A new frequency for Non-Destructive Testing (NDT)

Industrial THz sources and detectors were hardly available until the 90s as lying in the gap between photonics and electronics. Motivated by its unique properties, industry now exploits the last unused part of the electromagnetic spectrum.



**HIGH PENETRATION OF
DIELECTRIC MATERIALS**

Testing of volumes

**HIGH REFLECTION ON
METALS**

Inspection of hidden, coated
surfaces

**HIGH SENSIBILITY TO
INTERMOLECULAR
INTERACTIONS**

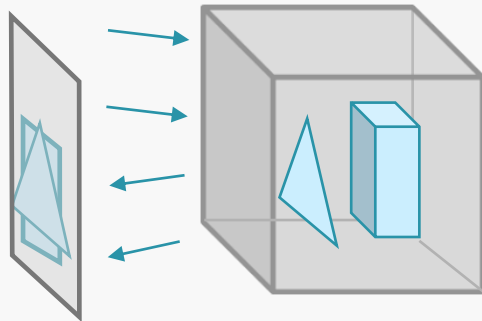
Polymorphism and
polymerisation

**SENSIBILITY TO
POLAR LIQUIDS**

NOT IONISING

In-line control of 100% of the production

CONTINUOUS WAVE THz TECHNOLOGY



2D image

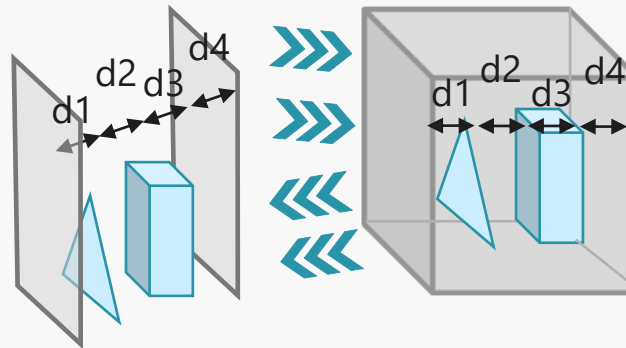
- ✓ Safe (no X-Rays)
- ✓ Contactless (no ultrasounds)
- ✓ Penetrating in electrically insulating materials

Limitations:

- × Low probability for defect detection
- × Overlap of structures
- × Overlap with diffraction pattern



PULSED THz TECHNOLOGY



3D image

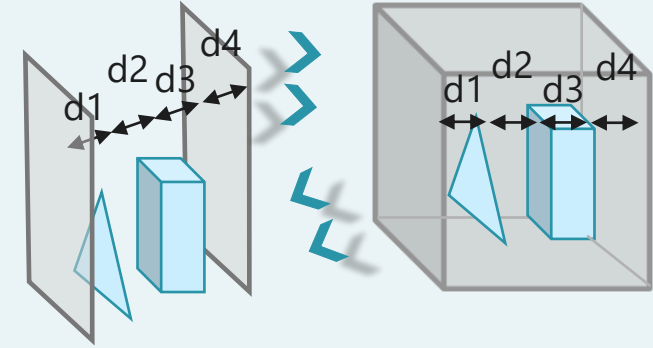
- ✓ Identification of substructures
- ✓ Dimensional analysis with micrometric depth resolution

Limitations:

- × **In-line control just on points, no imaging,** no defect detection, no XY dimensional control
- × Slow: imaging only off-line



TERATONICS SINGLE-SHOT PULSED TECHNOLOGY



10Mio time faster than the state-of-the-art

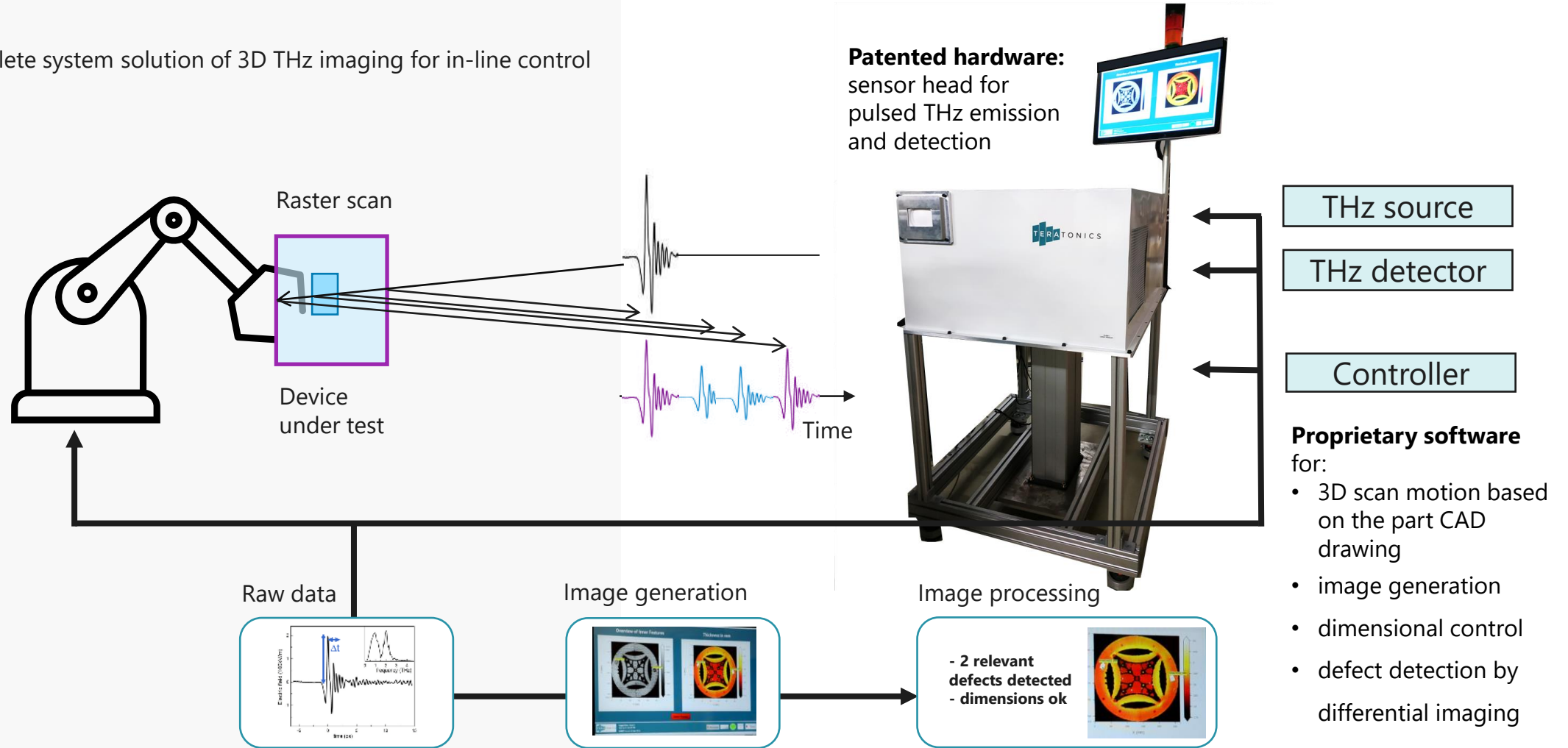
- ✓ **Imaging in the cycle time** of several industries like automotive: 500cm² in <30s (typ.)
- ✓ **Highly automated** analysis
- ✓ **Robotised** scan of **complex 3D shapes** based on their CAD file
- ✓ Immune to heat, light, WiFi, vibrations



PRODUCT ARCHITECTURE

STRIPP Control

Complete system solution of 3D THz imaging for in-line control



VALUE PROPOSITION

Lower cost of quality

Product and process control

REAL TIME PRODUCT CONTROL FOR LOWER COST OF POOR QUALITY

Quality differentiation.

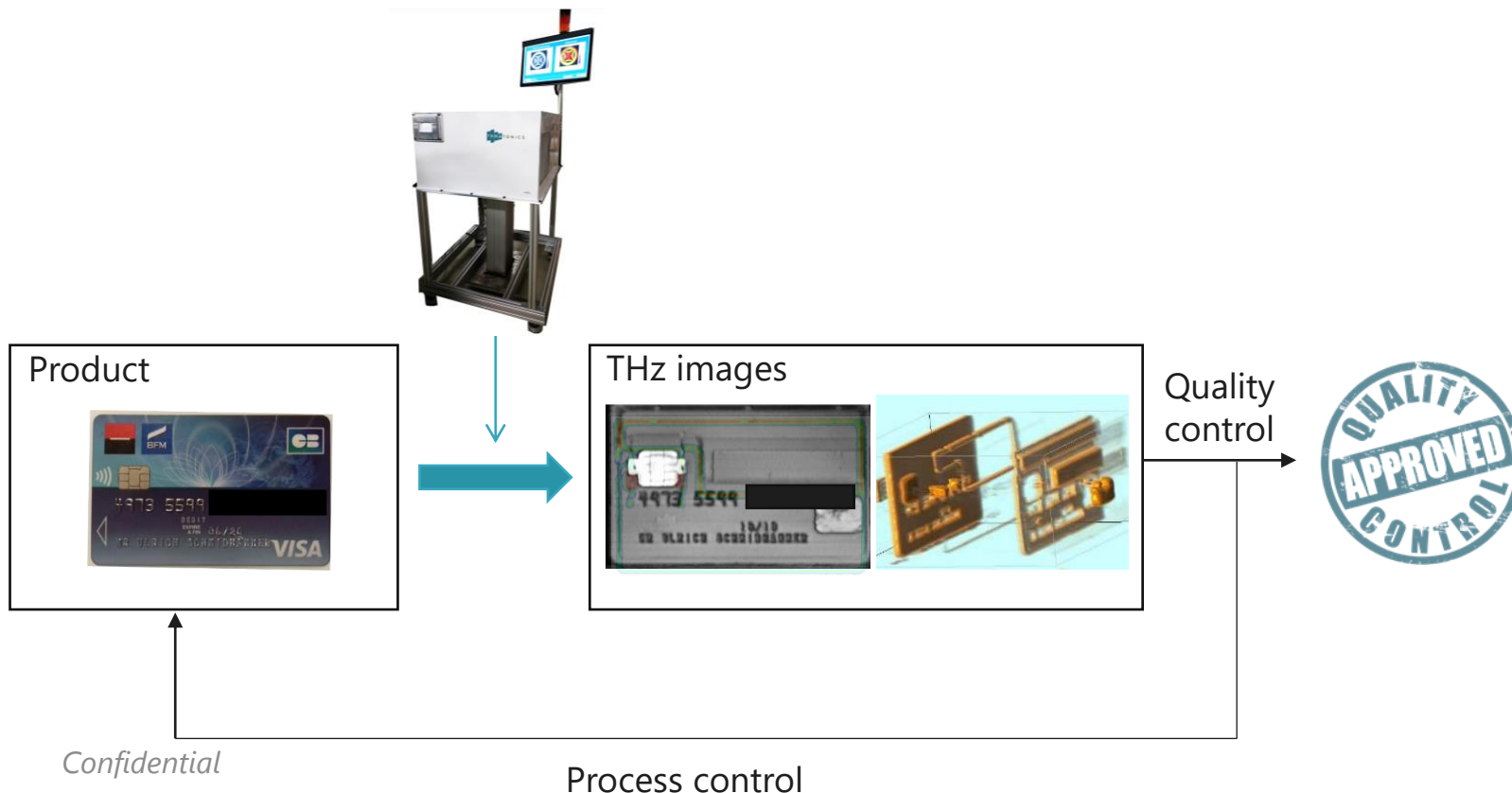
100% control of production:

- no bad parts delivered/integrated
- protection of brand image
- asked by OEM

PROCESS CONTROL FOR LOWER COST OF GOOD QUALITY

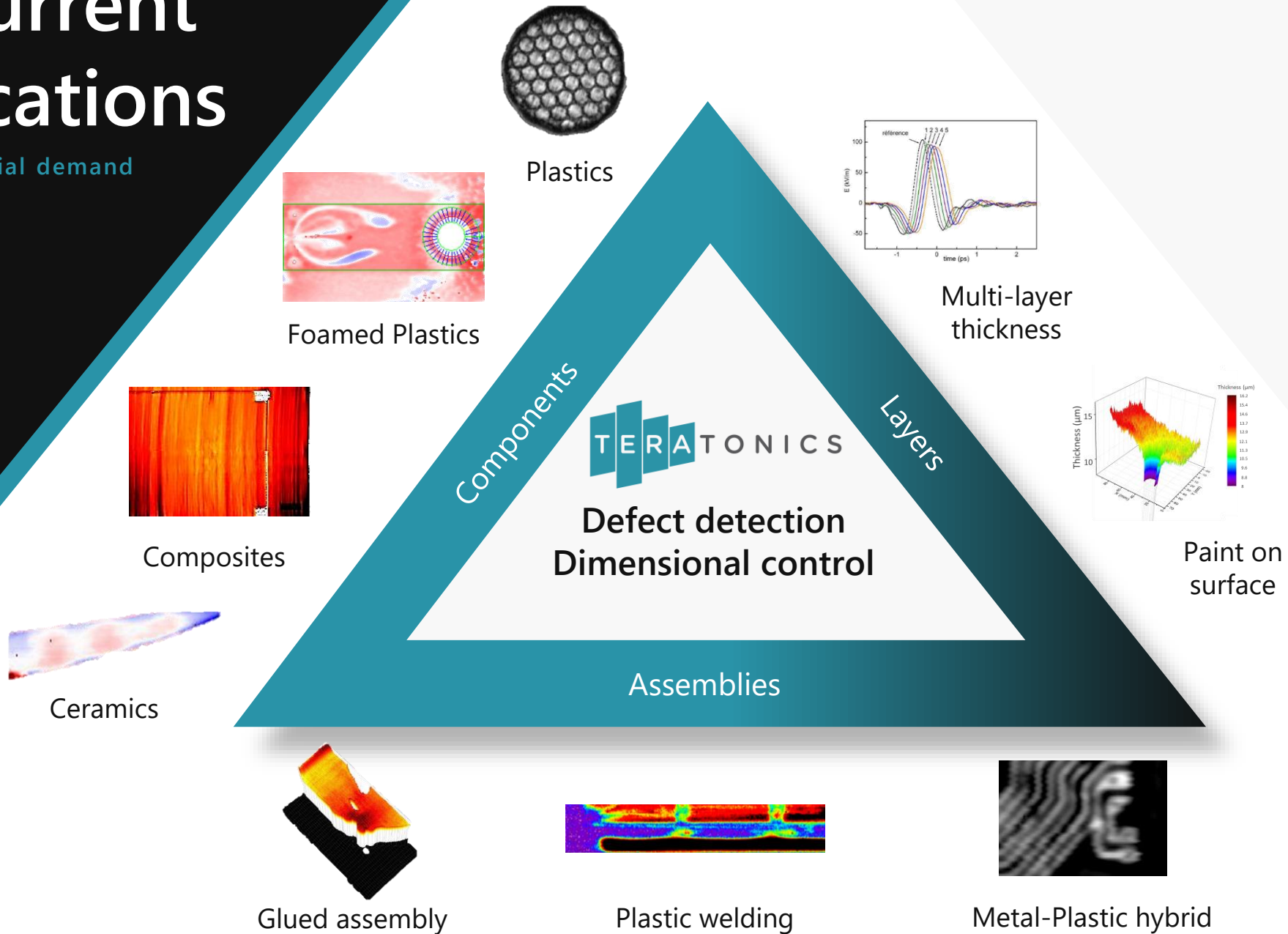
Optimised process.

Reduced faults, waste, raw material consumption, energy thanks to real time production feedback



Our current Applications

Based on industrial demand



Use cases

01

100% control of produced parts.

In-line control by STRIPP enables a switch from a Statistical Control Process to a 100% in-line control for a reduction in poor-quality costs.

02

Light weighting enabler.

STRIPP enables the adoption of lighter materials and processes for a reduction in CO₂ emissions.

100% Control

AUTO TIER 1 LIGHTING BUSINESS UNIT

From PPM to PPB of defective parts

Objective: lower indirect costs of poor quality (image, customer dissatisfaction...): on average 3x direct costs

- 2018 revenues: ~6.000M€ incl. ~3.000M€ for car lights
- 200 production lines i.e. ~15M€/year/line
- **Cost of poor quality (COPQ):** ~5% of revenues i.e. **750k€/year/line**
- **Indirect cost of poor quality (ICOPQ):** $\frac{3}{4} \times \text{COPQ} = \mathbf{562,5k€/year/line}$

→ **The payback is 6,4 months**

COMPARISON WITH XR-CT* OFF-LINE

1 STRIPP Control against 6 XR-CT

If 100.000 parts are to be tested/year

(1 production line with only 1 shift, cycle time of 1 minute)

- **STRIPP Control** controls each part in the cycle time

→ **Only 1 unit needed**

- **XR-CT** scans a part in 30 min i.e. 17.520 parts/year

→ **XR-CT requires 6 units instead of 1 STRIPP Control**

and is much more expensive for medium-sized parts and almost impossible for big-sized parts.

Product application: welding here auto light, international Tier 1 (FR branch)



Aim

- To check the welding line (50-150cm) for:
- mechanical integrity
 - tightness
 - aspect of the welding line

Operational parameters

- Material: PMMA (lens), PC (mask, light guide), PC+ABS (housing)
- Part weight < 2kg
- Part dimensions < 50 x 20 x 20 cm³
- Cycle time: 1-2 min
- Robot speed: typ 3cm/sec (vector scan; 20cm/sec possible)
- Scanning speed: 180cm²/min

Benefits for the Producer

- for lowest defect level, on the ppb scale required by the OEMs
- 100% control of the production
- for a singular offer / stay the technology leader



Our know-how

More than 7 PoCs on welded polymers

ENVIRONMENT VIEW

Saving of more than 3M tons of CO₂ per year

Plastics account for 8% of car weight i.e. ~150kg

If 2/3 of this plastic is foamed, the weight reduction is 10kg/car

- 90 M cars are produced each year

→ **~1M tons of plastic saved** by the auto industry per year

- The production of 1kg of plastic creates ~1,5kg of CO₂

→ **~1,35M tons of CO₂ saved during the manufacturing process**

- 10kg less saves 0,039L of fuel/100km/car

→ **702M L of fuel saved per year (assuming 20.000km/car/year)**

- 1L of gasoline creates 2,4kg of CO₂

→ **~1,7M tons of CO₂ saved per year**

INDUSTRY VIEW

Reducing fuel consumption and CO₂ fines

Auto industry example:

- Reduced CO₂ fine thanks to lighter vehicle (corresponding to 5.6€/kg) for example by enabling more foamed plastic parts instead of compact plastics (~10% weight saving)
- 1kg saved on every Peugeot 5008 (~100.000 units produced/year):

→ **Fine reduced** by 560.000€ and **STRIPP** (300.000€) **payback: 6,4 months**

Aero industry example:

- Ready to pay 2000-4000€/kg for fuel savings
- 10 kg saved on 10 A320 planes, for example with a tighter control of the paint thickness (7% weight reduction)
- Assumption: time to control one airplane: 6 days (same as painting)

→ **STRIPP payback: 3 months**

Product application: foamed plastic here central console, auto OEM (EU branch)



Our know-how

More than 7 PoCs on foamed polymer;
Technology and singularity validated by
a german consortium

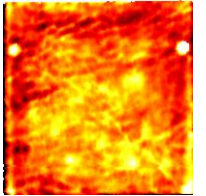
Confidential

Aim

- To visualize the spatial foam density distribution
- To detect, visualize and measure defects:
 - Swelling
 - Surface defects
 - Voids

Operational parameters

- Material: PP
- Part dimensions: 70 x 30 x 30 cm³
- Part weight: <2kg
- Cycle time: <2'
- Robot speed: 18cm/sec
- Scanning speed: 1050cm²/min



Benefits for the Producer

- Direct product control: No bad parts integrated
- Enables new process and product introduction
- Shorter cycle time
- Smaller injection press
- Lower raw material consumption
- Lower molding machine energy consumption

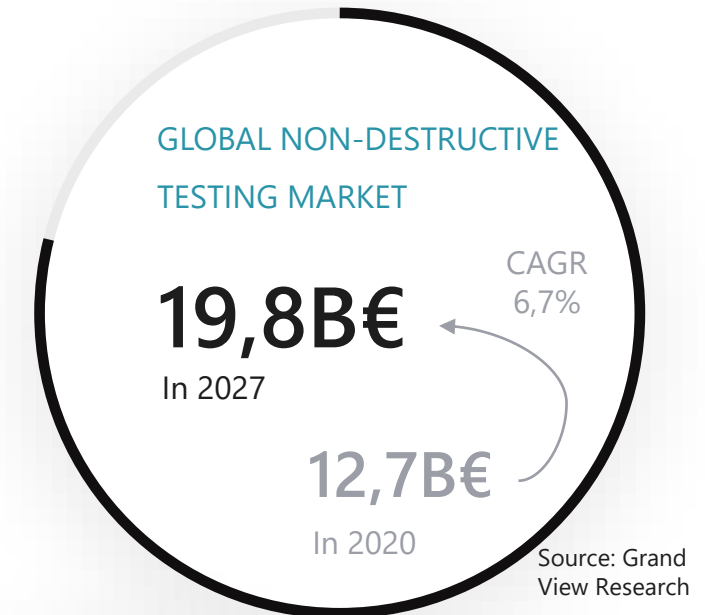
TERATONICS Adressable market

Main drivers:

- Growing use of **technical materials**: composites, coatings, ceramics, assemblies...
- **Industry 4.0** for the reduction of the cost of poor quality
- Stringent **government regulations** regarding public safety & product quality and **continuous advances in electronics, automation, and robotics**

Teratonics:

- Bottom-up: production of automotive headlights with ~670 lines worldwide
- Top-down: **investment** in NDT equipments is ~**1% of sales** for composites + ceramics
- Significantly **larger than XR-CT market** (immobile, expensive, slow etc.)



01 Problem

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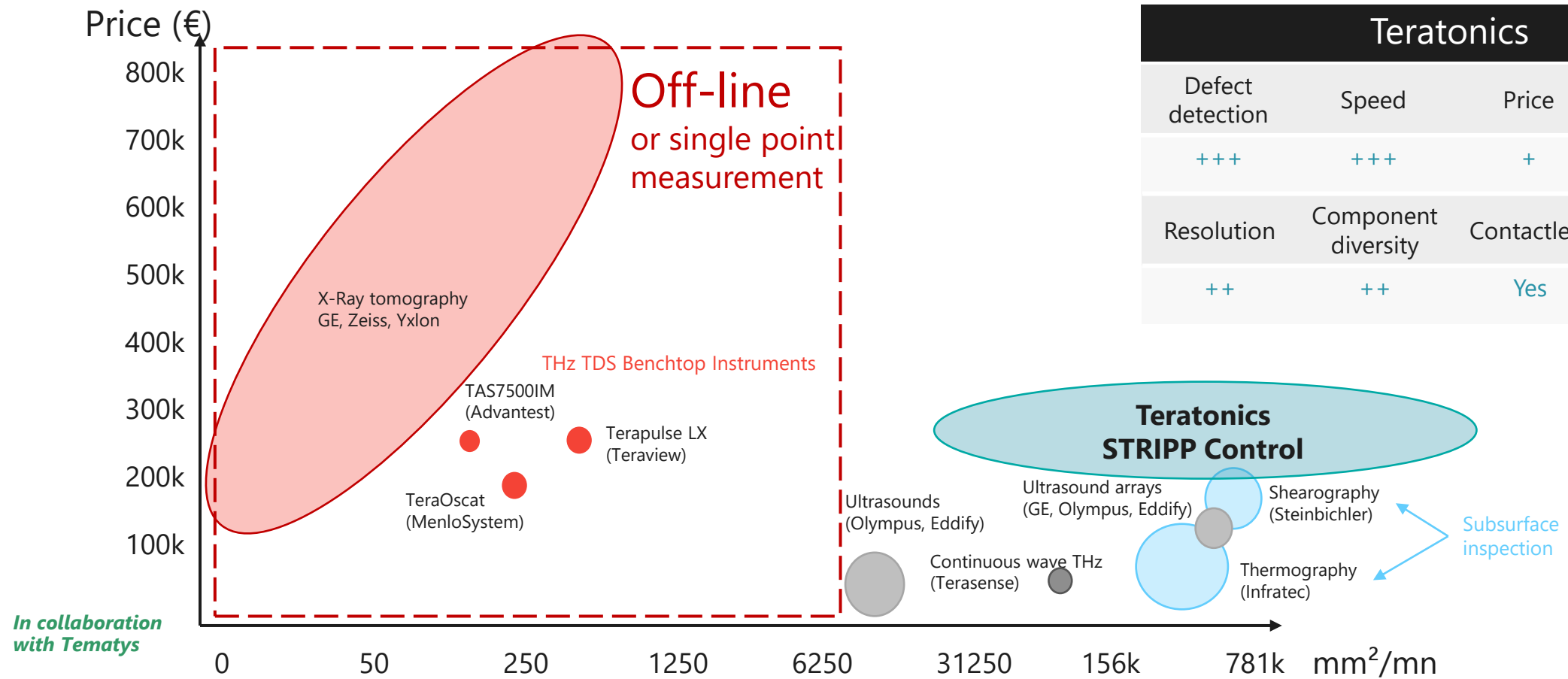
04 Business model

05 Company

06 Financials

MARKET ANALYSIS

Competition landscape



Teratonics			
Defect detection	Speed	Price	Penetration depth
+++	+++	+	++
Resolution	Component diversity	Contactless	Non hazardous
++	++	Yes	Yes

01 Problem

02 Solution

03 Market

04 Business model

Focus on sectors using **high-end materials**
and/or with **CO₂ reduction targets**

Product lifecycle: production, quality,
maintenance, R&D

05 Company

06 Financials



3 complementary commercial offers

Lab Service

1.680€

/engineer + instrument/day

To support our clients' development of new products and optimisation of processes.

Today, the first step to sell a product.

On-site Inspection

1.680€

/engineer + instrument/day
+ related costs

Service for maintenance.

Installation of new prod. lines, product proving.

Demonstration close to the field.

Sale of Equipment

From 220k€

Unit Price

Available through channels for a worldwide coverage and support.

BUSINESS MODEL

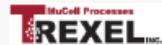
Go-to-market strategy

In-lab and On-site Analysis Services

- Direct sales via prospection, conferences and trade shows, website, multipliers
- Local - EU



Sales of Equipment & Maintenance

- Indirect sales / direct marketing through
 - Integrators: by applications of our technology (injection molding, other plastic processes, welding, gluing, composites, ceramics, coatings)
 - Distributors: by geography
- International footprint
- Distribution agreement for plastic injection moulding with 

channels



INDUSTRIAL PARTNERS

Lean product development



Quali Control (2017)

German consortium led by KIMW (multiplier)

Contract value: 30k€

SAM: 110M€

Product Control of (foamed) injection molding: confirmation of USP + robotised analysis for enabling/extension of foamed plastics



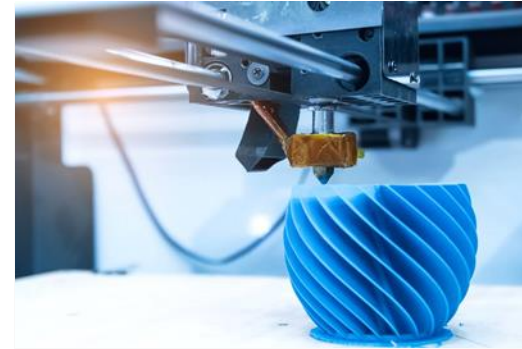
Innov'up (2018-2019)

Auto Tier 1

Contract value: 100k€

SAM: 110M€

Automated in-line control of plastic welded parts.
Feasibility demonstrated.



Q3DP (2021-22)

French-German project

Contract value: 195k€

SAM: 62M€

Among the 3 members, a future distributor for control of 3D printing in D A CH region
In situ quality control of 3D printing, fiber coupled THz Head to decrease raw material and production time



CORAC, DGAC* (2021-23)

Consortium project with a key end-user of aerospace sector

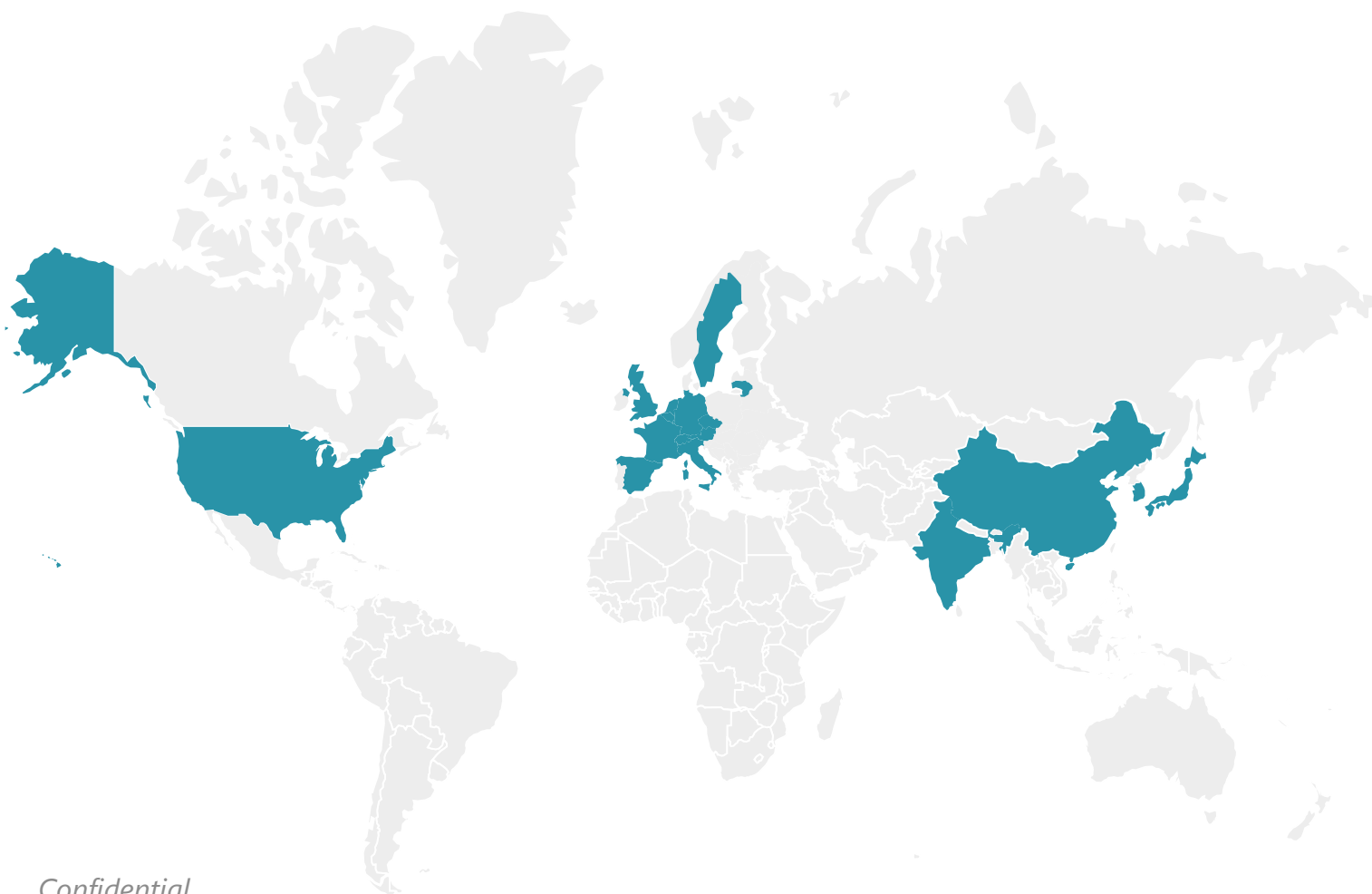
Contract value: 120k€

SAM: 55M€

Sealant in aerospace, fiber coupled THz head and high energy to scale up production and control speed (x4-10)

* French Civil Aviation Authority

CNRS “THz” patent with the broadest international protection



Exclusive patent granted to Teratronics

Inventors and authors:

De Waele Vincent, Schmidhammer Ulrich

Patent owners:

CNRS, Université Paris-Saclay (former Paris-Sud)

- 2007: Patent filed in France N°07/60296
Procédé et dispositif de mesure monocoup de la biréfringence transitoire induite par une perturbation appartenant au domaine des fréquences térahertz
- 2008: PCT patent filed, PCT/FR2008/001783
- 2010: Extension to China, Europe, India, Japan, South Korea, USA
- 2018: Nationalisation to 12 European countries

COMPANY TALENTS

Our management team



Uli Schmidhammer, PhD
CEO

Ludwig-Maximilians Uni. Munich
Incuballiance, Wilco

- Co-inventor of THz patent, technical and business development, setting up of THz team, BM in interplay with externals, responsible for 4 engineers and equipment at LCP, CNRS – Uni Paris Saclay
- Free Lance (Clark-MXR, HORIBA, Patev)
- Leader of interdisciplinary projects on photonic instrumentation and application at LMU Munich



Xavier Neiers
CTO

Ecole Centrale Marseille
Incuballiance, Wilco

- Conversion of a lab prototype into an industrial product, management of a 3 persons team
- THz lab applications and technical development in response to the industrial needs, LCP, CNRS – Uni Paris Saclay



Marco Cavallari, PhD
CCO

Politecnico di Milano & Ecole Polytechnique

Strong track record of multimillion EUR of sales contracts in the deep tech sector:

- Optical sales engineering manager at Nortel
- EMEA market development director at Opnext
- Operations and business development director at Bertin Technologies

05

COMPANY MILESTONES

Towards an industry 4.0 leader



More than 40
POCs and
analysis services

2006-16

Tech+Team Dev,
Bus Plan

Lab de Chimie Physique
CNRS – Uni Paris-Saclay
International patent



2017

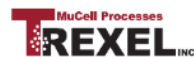
Company
Foundation



2018

First Distributor

Non-exclusive distribution
agreement for injection
molding with



Prizes:



2019

First transportable
STRIPP Control
Seed Round

Invested by:



Identified as high potential
Deep Tech start-up by:



2020

Highly automated
STRIPP Control

For parts held by robots or
moving on conveyors

Prizes:



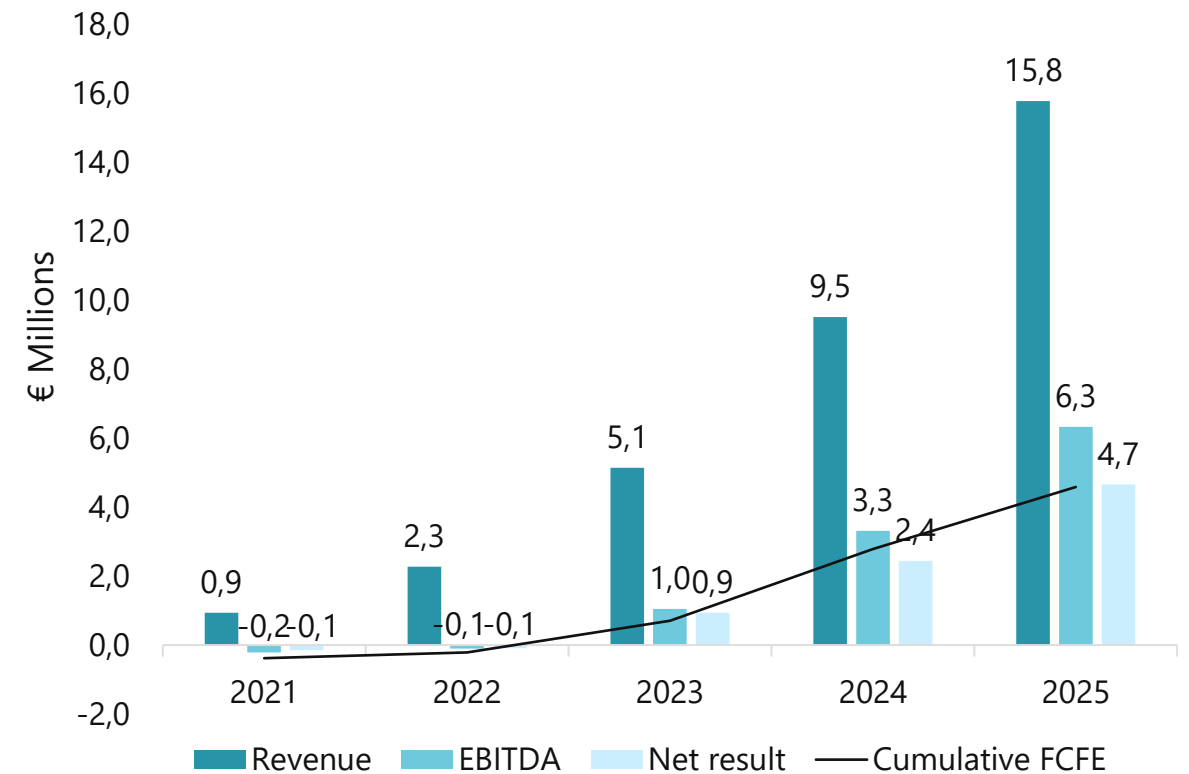
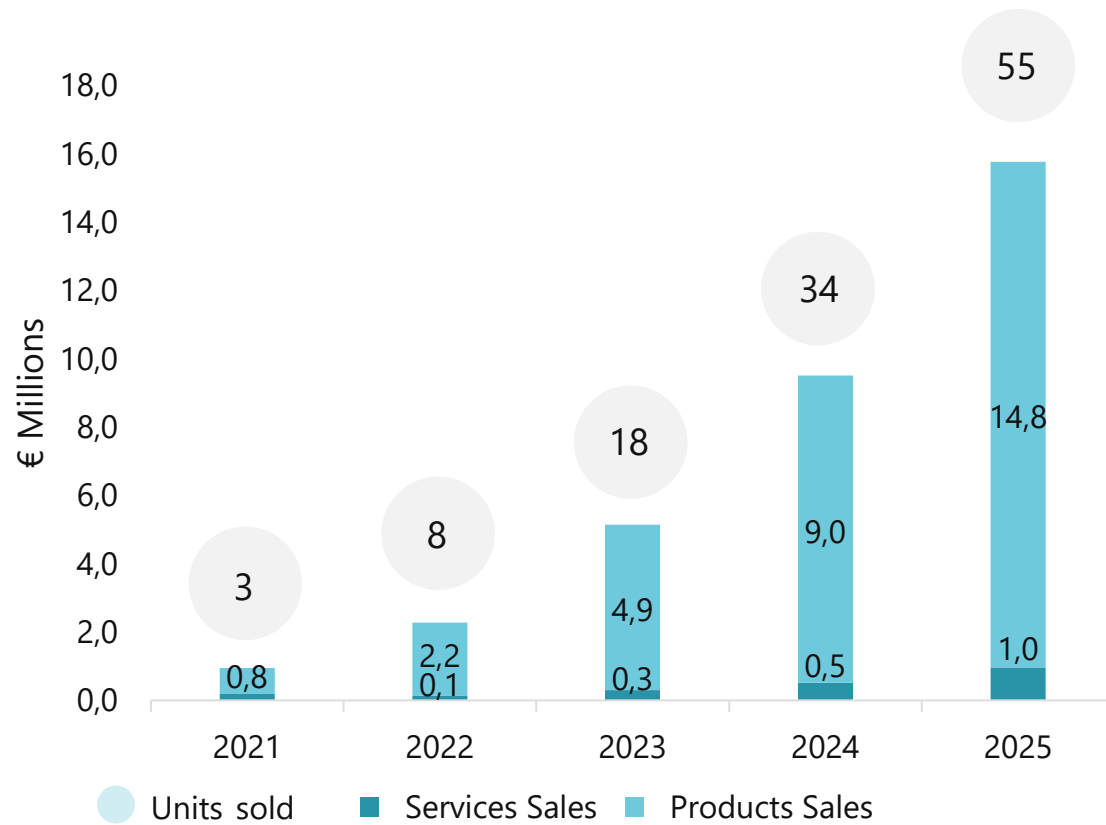
DEVELOPMENT PLAN

2021-25 Scale-up

	2021	2022	2023	2024	2025
Employees*	10	18	26	35	53
Units sold	3	8	18	34	55
Product release		HW: Fiber coupled THz Head (coatings, 3D print)	HW: High power fiber coupled THz Head SW: Update on Automatic defect detection, release 2 with Machine Learning (AI) applied to 3D THz data		
Marketing strategy	Public demos in show rooms, injection molding 10 (virtual) trade shows / workshops	Public demos in show rooms, e.g. plastic welding 12 trade shows / workshops	Partnership with a distributor for 3D printing control following the French-German project 14 trade shows	15 trade shows/ workshops	15 trade shows/ workshops

FINANCIALS

Business growth projections



FINANCIAL ASK

We are raising € 2,0 Mio to support our growth

€940k

SALES & MARKETING

€620k

PRODUCT DEV.

€320k

R&D

€120k

ADMIN + REAL ESTATE

- **2nd product line** based on a robot-mounted THz head
- **Artificial Intelligence** for automated analysis upgrade
- STRIPP Control systems **for demos, loan and spare**
- **Commercial recruitments**
- Offices and production facility

Teratonics shareholders

	Current shareholder	Actions	Valeur nominale	%
1	Ulrich SCHMIDHAMMER	3 800	38 000,00 €	85,72%
2	Xavier NEIERS	211	2 110,00 €	4,76%
3	Marco CAVALLARI	211	2 110,00 €	4,76%
4	SOCOMORE VENTURES	208	2 080,00 €	4,69%
5	Bernard LE TURDU	1	10,00 €	0,02%
6	Daniel JAVED	1	10,00 €	0,02%
7	Alain MORETTI CARTAILLAC	1	10,00 €	0,02%
	Total	4 433	44 330,00 €	100,00%

We would like **Industrya** to be a shareholder thanks to :

- the unique **fit** with your foci on **energy transition and sustainable transport, new materials** and **industry 4.0**
- the direct **support by Thibaud** whose international experience in managing high tech companies is impressive
- possible **synergies with John Cockrill**

Thank you

Contact us

Advanced Terahertz Photonics
for Enhanced Productivity and Reliability



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