The Role of AI and Machine Learning in Modern Day Manufacturing (DAM)

December 5th, 2024 at Barclays Eagle Labs, Cranfield

Presented by David Brown, Senior Business Development Partner at Total Materia AG

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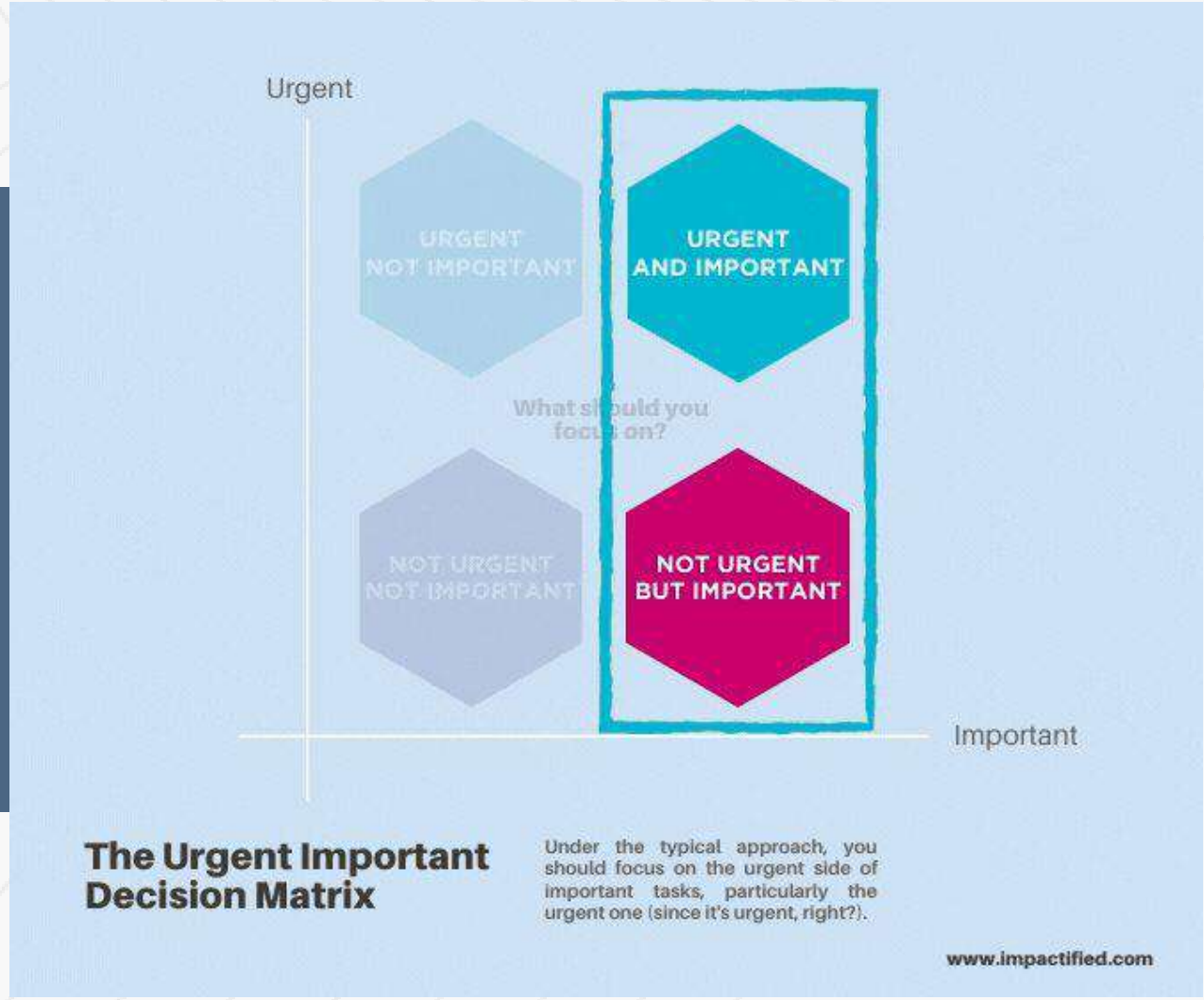
AI and Machine Learning – “so what?”

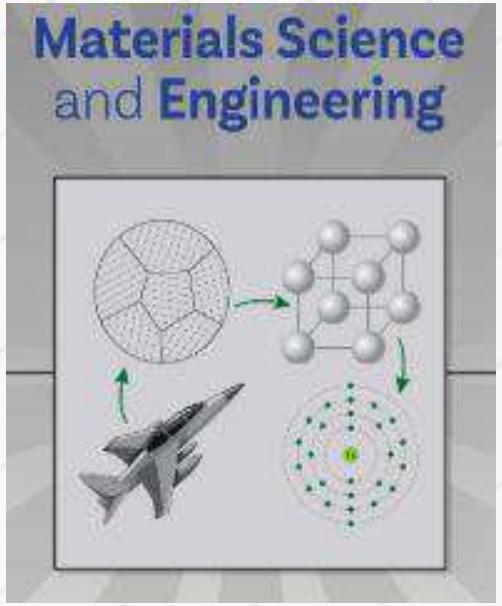
62% say the impact on their job will be positive, helping them **save time** and freeing them up to **focus on more important tasks.**

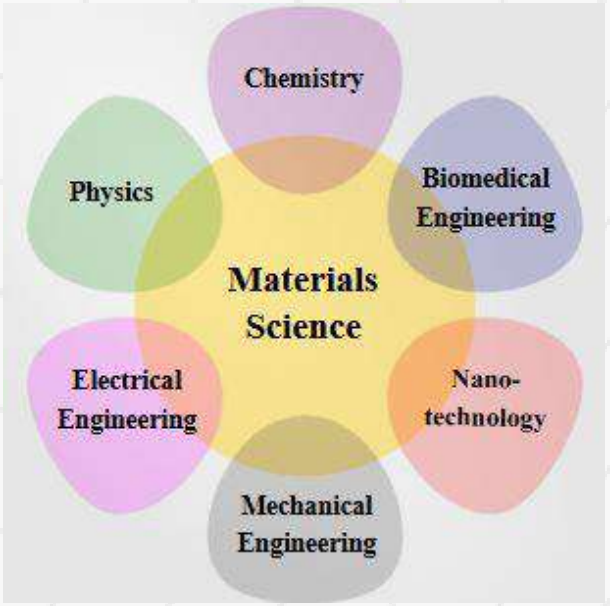


Materials Engineering – an underpinning science

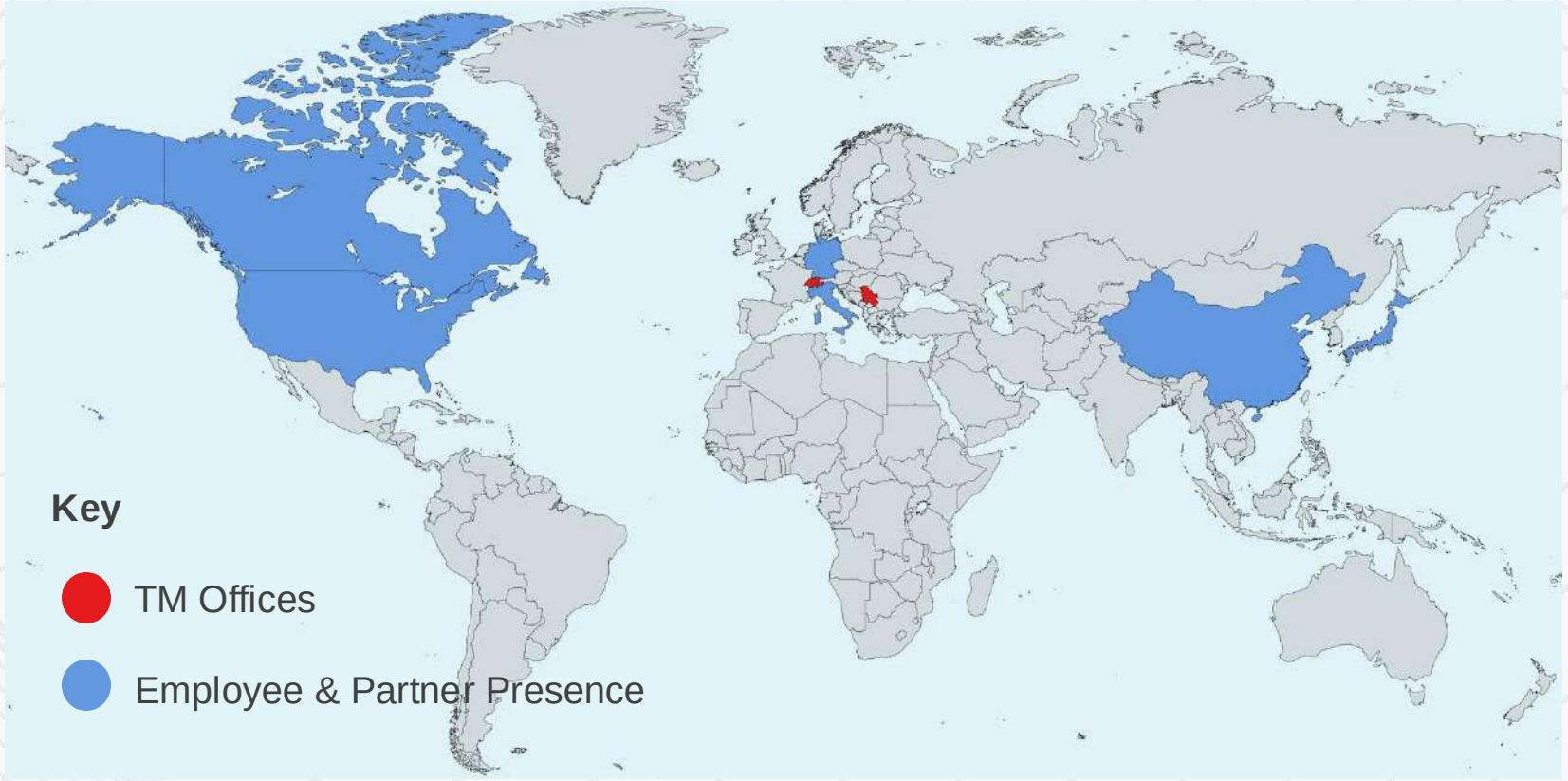
Approx 6.3 million people work in Engineering and Tech occupations in the UK (20%).

Materials science, Engineering and related fields





Total Materia AG: A Global Company



- Over 1000 companies using Total Materia including more than 5200 contracted users in 106 countries.
- Turnover over 6M USD
- 30% share of turnover in R&D spending

- Founded in 1999
- HQ is in Zurich, Switzerland; main development office is in Belgrade, Serbia.

- 80+ SDOs and over 55,000 standards in use.
- Over 70 employees & partners globally.
- Direct support offered in 13 different languages

Departments and People We Help

Supply Chain
Finding material suppliers

Materials Engineer
Subject Expert

CAE Simulation Specialist
Material property simulators

Purchasing
Interpret requests from engineering

Compliance & Sustainability
Monitor legislation, validate compliance, and find greener alternatives

Sales & Applications Engineer
Bridge between customers and engineering teams, assuring customers of capability

Quality
Quality assurance and control

CAD/Manufacturing
Validate product & process capability

Pop Quiz

Which creature can carry up to 50x its own body weight?

Onthophagus taurus, also known as the bull-headed dung beetle, is one of the strongest insects in the world. These beetles are known for their incredible strength, being able to pull weights up to 1,141 X their own body weight.

What % of products being launched today have new materials in their base?

70%

Example: The cost impact of not capturing errors early

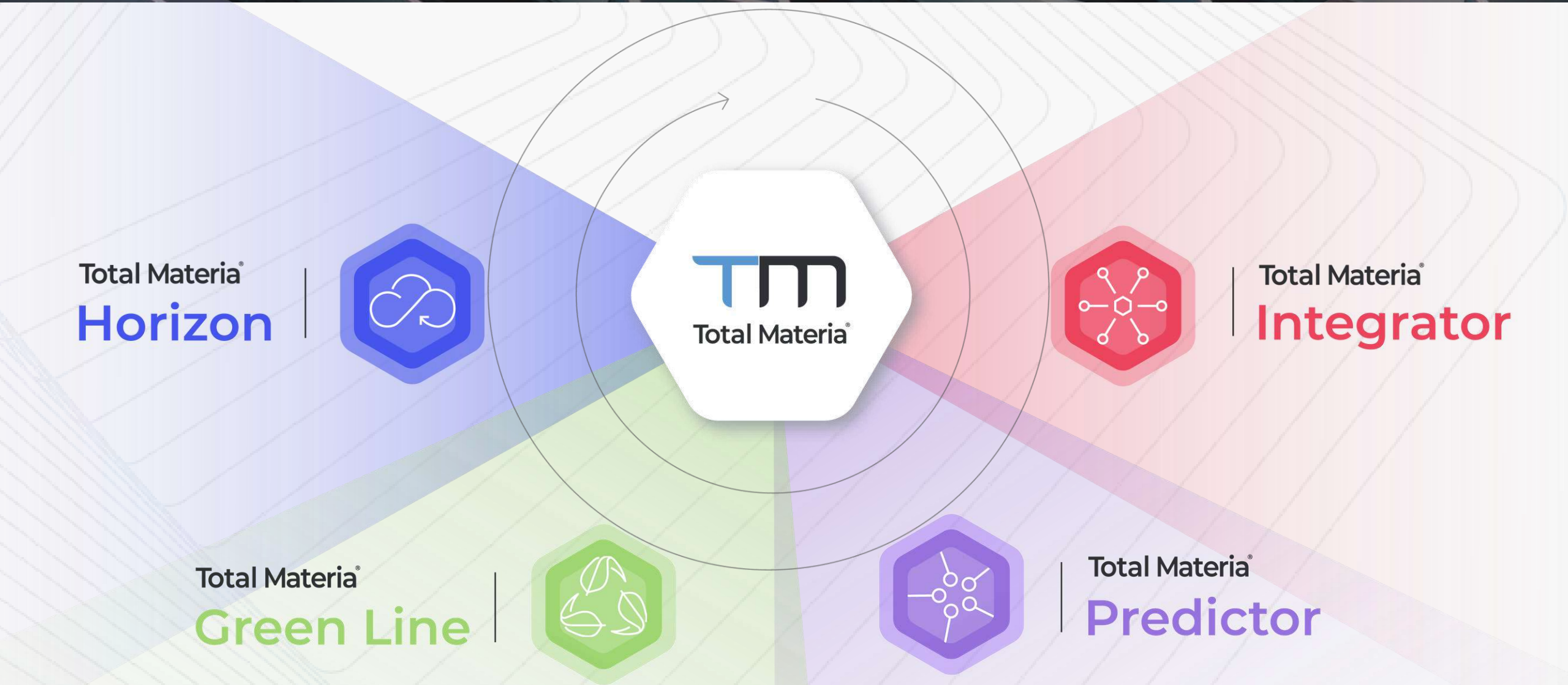
The grounding of the entire Boeing 737 MAX fleet (2019) following two fatal crashes

Root cause: material and design flaws in the MCAS (maneuvering characteristics augmentation system)

When the single angle of attack (AOA) sensor failed, the MCAS acted erroneously.

$85,000,000,000

The Total Materia Platform



Material Selection and Test Process

Identify Design requirements

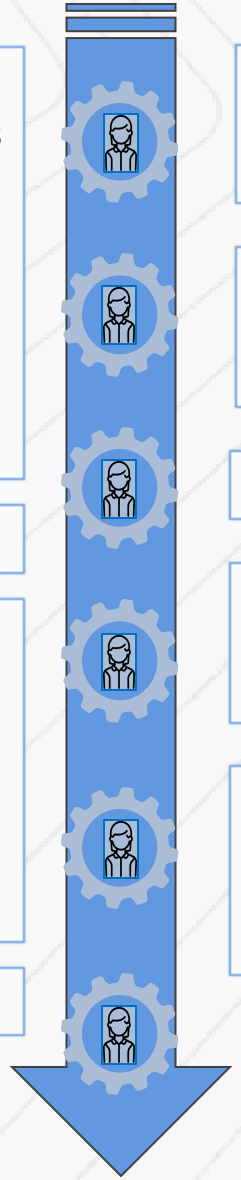
1. **Mechanical properties**: strength, ductility, hardness, toughness etc
2. **Physical properties:** density, thermal conductivity, electrical resistance etc
3. **Chemical properties**: Corrosion resistance, reactivity etc
4. **Cost and availability:** budget constraints and material availability
5. **Sustainability:** environmental impact and recyclability

Identify Candidate requirements

Evaluate Candidate requirements

1. **Performance testing**: assessing material performance under service conditions
2. **Prototype testing**: Creating prototypes to test material performance under real world scenarios
3. **Simulation and modelling**: using CAE tools to predict materials behaviour

Select Materials



Define Testing requirements:

1. **What properties need to be tested:** tensile strength, fatigue resistance etc.

Select Testing methods:

1. **Destructive:** tensile, impact, hardness
2. **NDT:** ultrasonic, radiographic, magnetic particle

Perform Testing on materials

Analyse Testing data on materials:

1. **Compare:** against required specifications (int and ext)
2. **Validate:** sign off against required criteria & compliance

Document and data storage & reference

1. Testing process
2. Results

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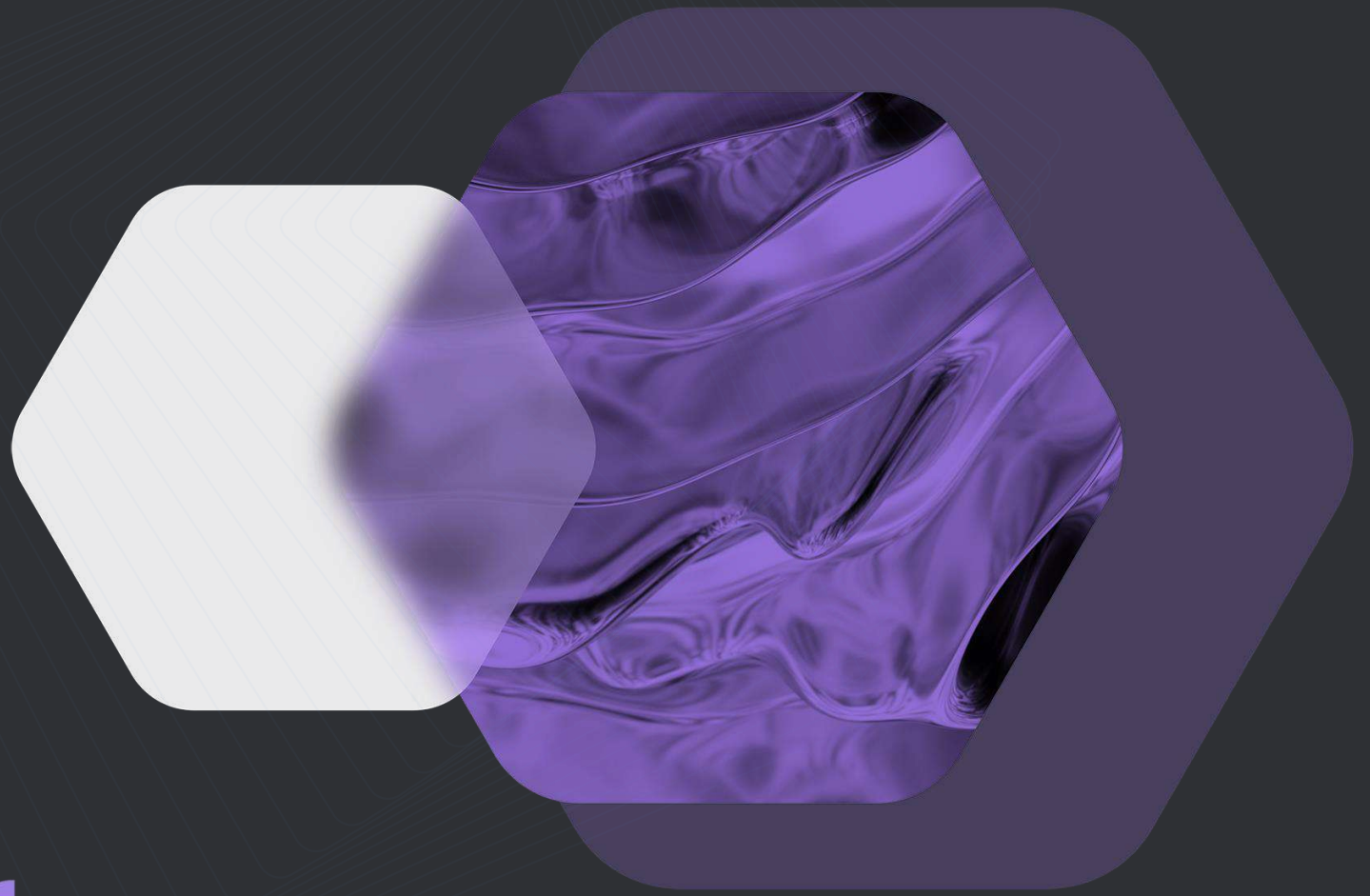
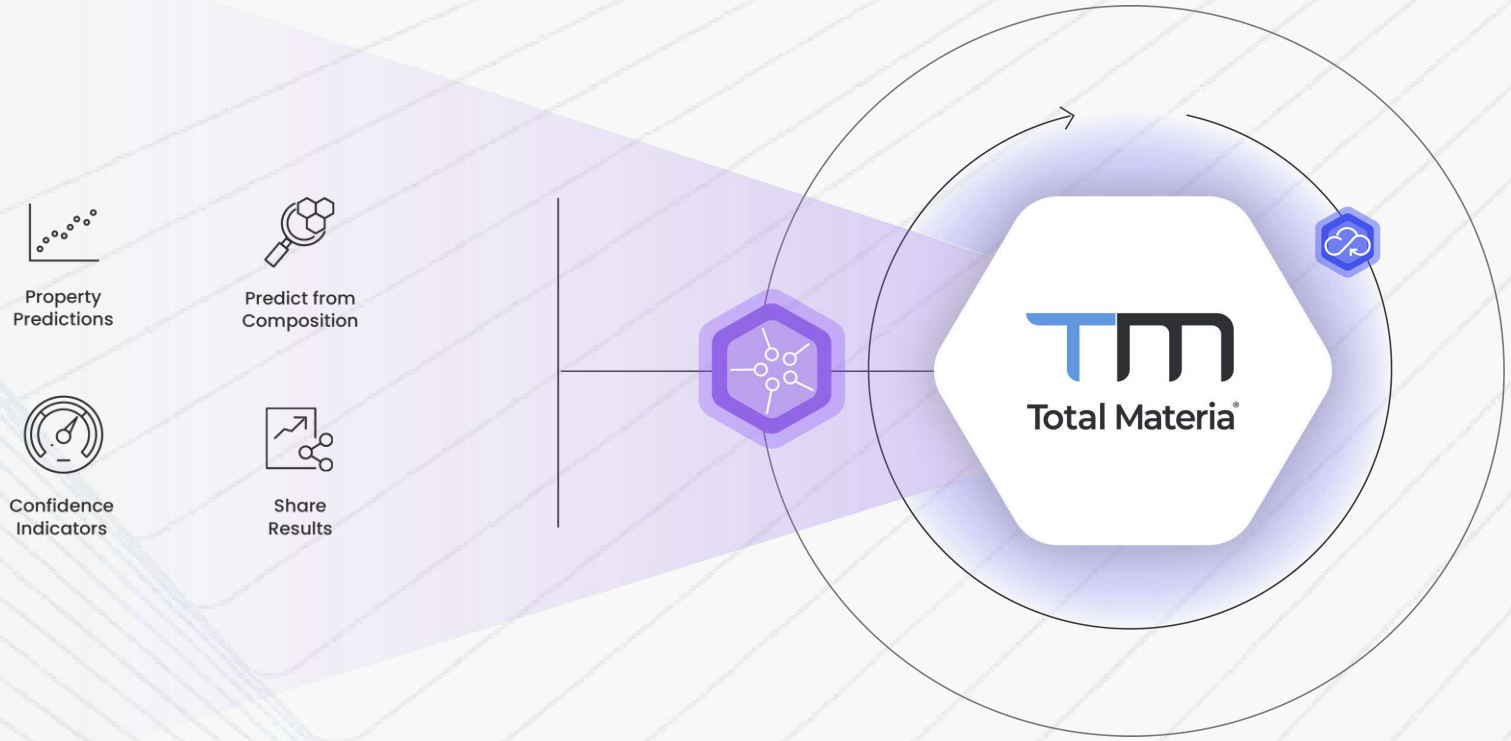
Predictor



Filling the Gaps: Predicting Material Properties

Filling the Gaps: Predicting Material Properties



Properties Covered:

- Mechanical and physical properties
- Stress-strain curves
- Fatigue data points

- Single and multi-point predictions from 160+ ML models across 300,000 materials
- Predict 20+ properties
- Predict properties and behaviors from chemical composition
- Share results with reports internally and externally

Creating and Executing the Models

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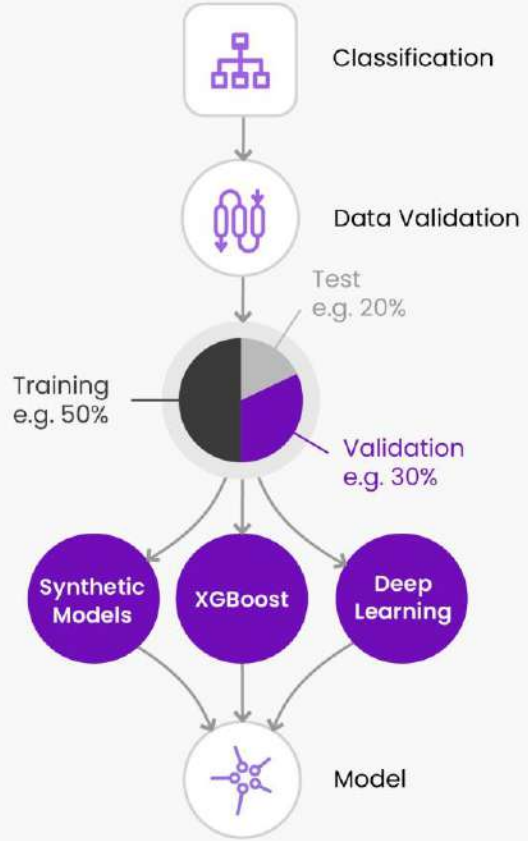
Horizon



Total Materia AI
Synthetic Models

Total Materia AI
XGBoost

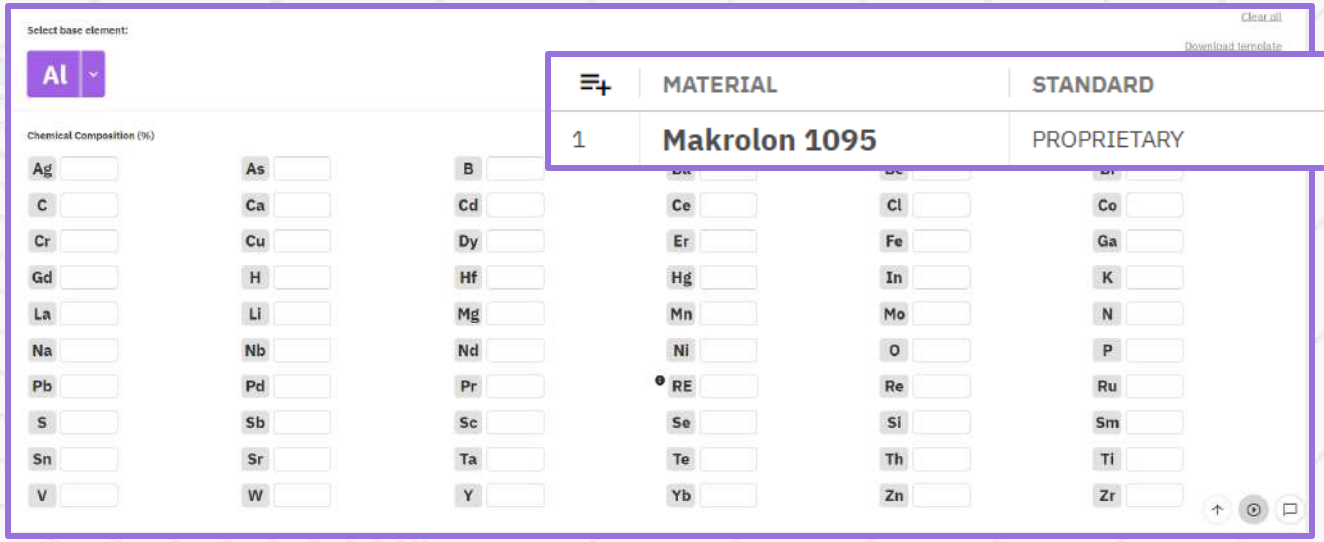
Total Materia AI
Deep Learning (TabNet)

1. Designation or Composition
2. Select Model
3. Define Parameters Temperature Dependency
4. Results with Confidence Parameters

How do we classify material groups?

Metallic Materials

Classified using chemical composition data



Non-Metallic Materials

Classified in generic material groups, fillers and densities provided

	MATERIAL	STANDARD	COUNTRY / PRODUCER	CLASSIFICATION
1	**Makrolon 1095**	PROPRIETARY	Covestro AG (former Bayer MaterialScience AG)	Polymers / (PC) Polycarbonate plastics

Selected material: Makrolon 1095 (PROPRIETARY)

Filler

15% glass fiber reinforced

Density (kg/dm³)

1.29

Problems We Solve

Materials / Simulation Engineer

Subject Expert

Why don’t I have the properties I need?

- The information is not published by a material producer or standard.
- Change in chemical composition % notified by supplier.
- The scenario is too specific.
- A testing program will take too long and cost ‘000s

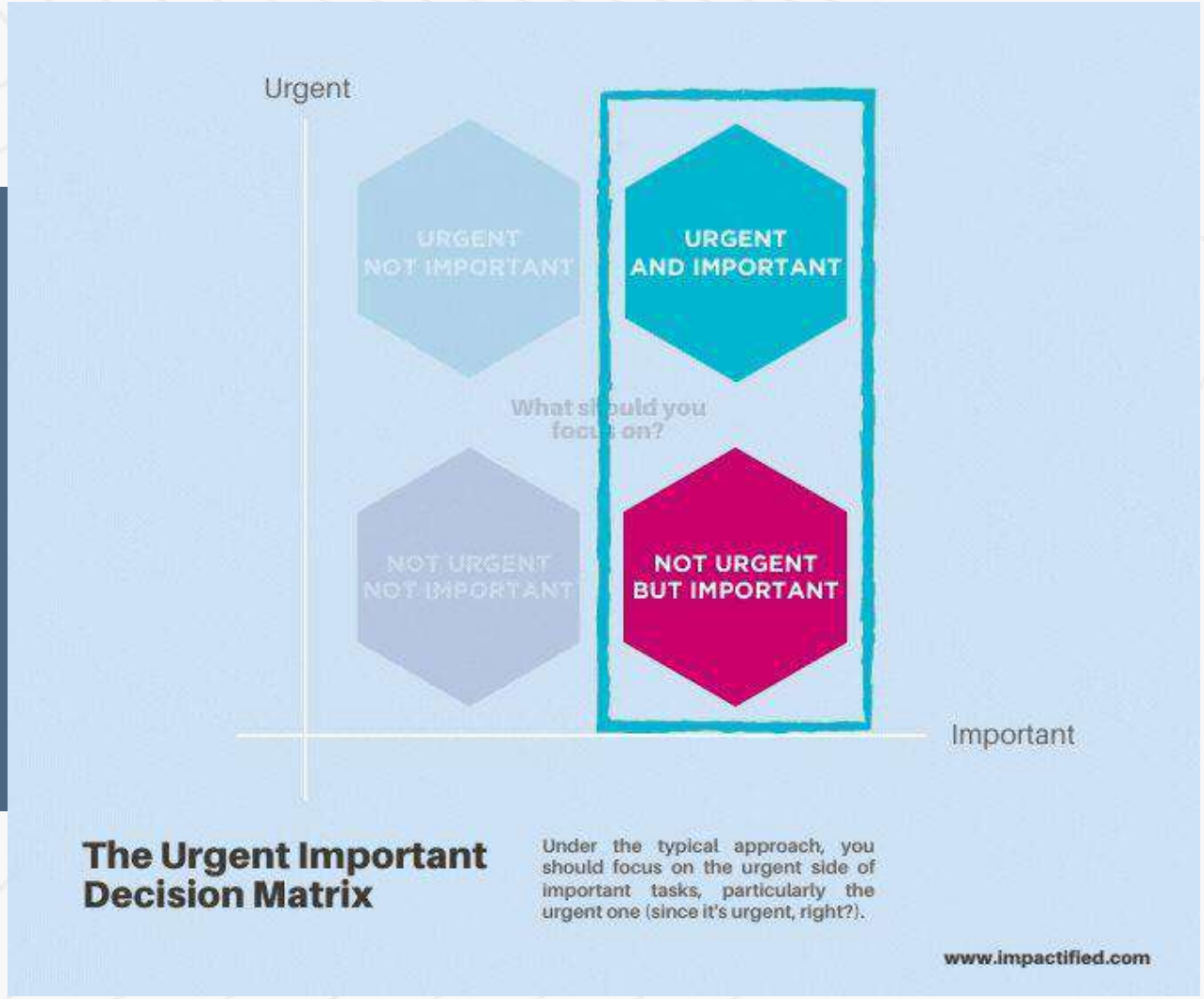
Predictor understands material designation or composition

Costs a fraction of the cost of materials testing

Performs several calculations per day instead of waiting for weeks

Constantly being enhanced with models and learning experience

AI and Machine Learning – “so what?”



Contact Me to Book a Demo

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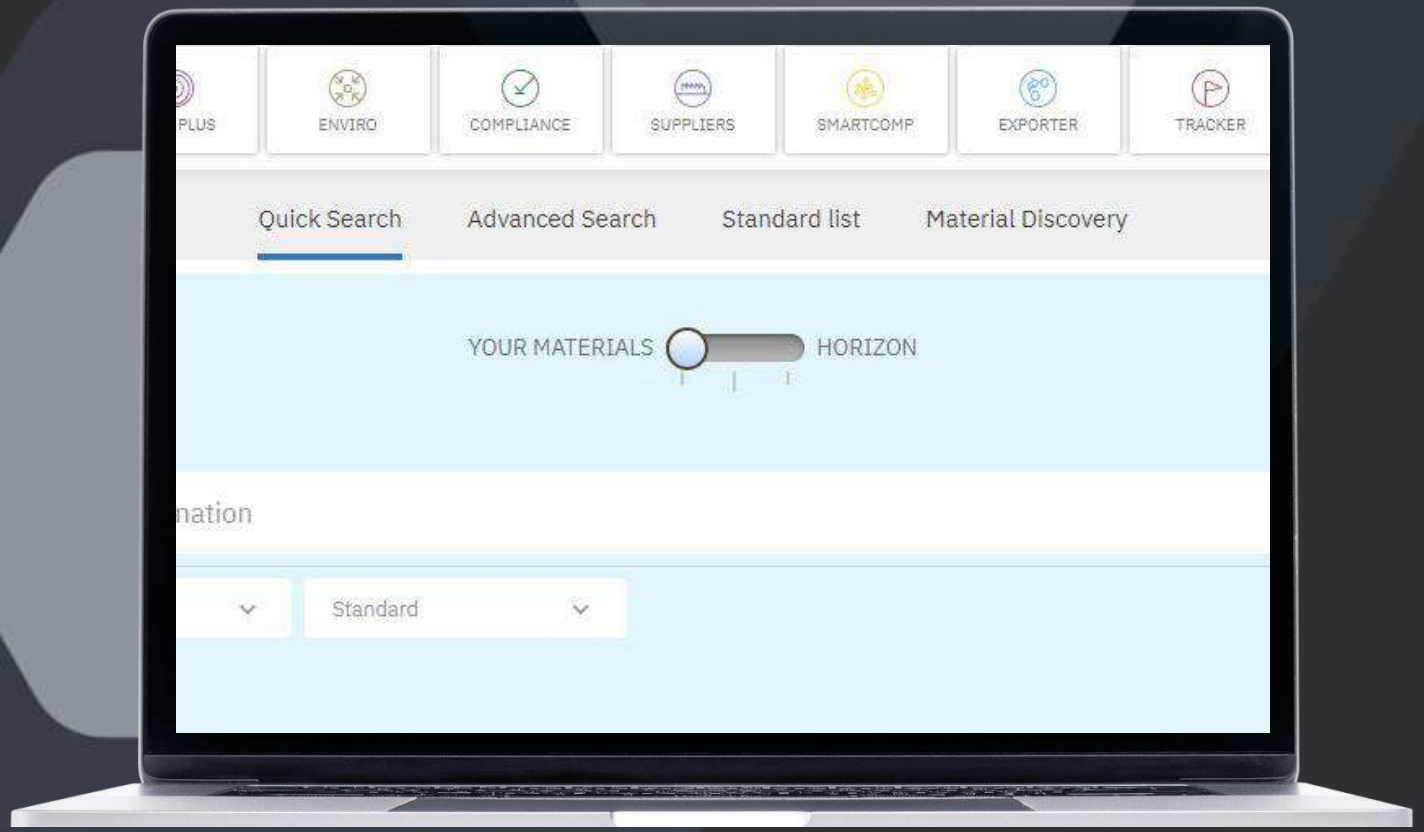

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