



Dr. Francesco Crivelli
R&BD Industry 4.0 & Machine Learning

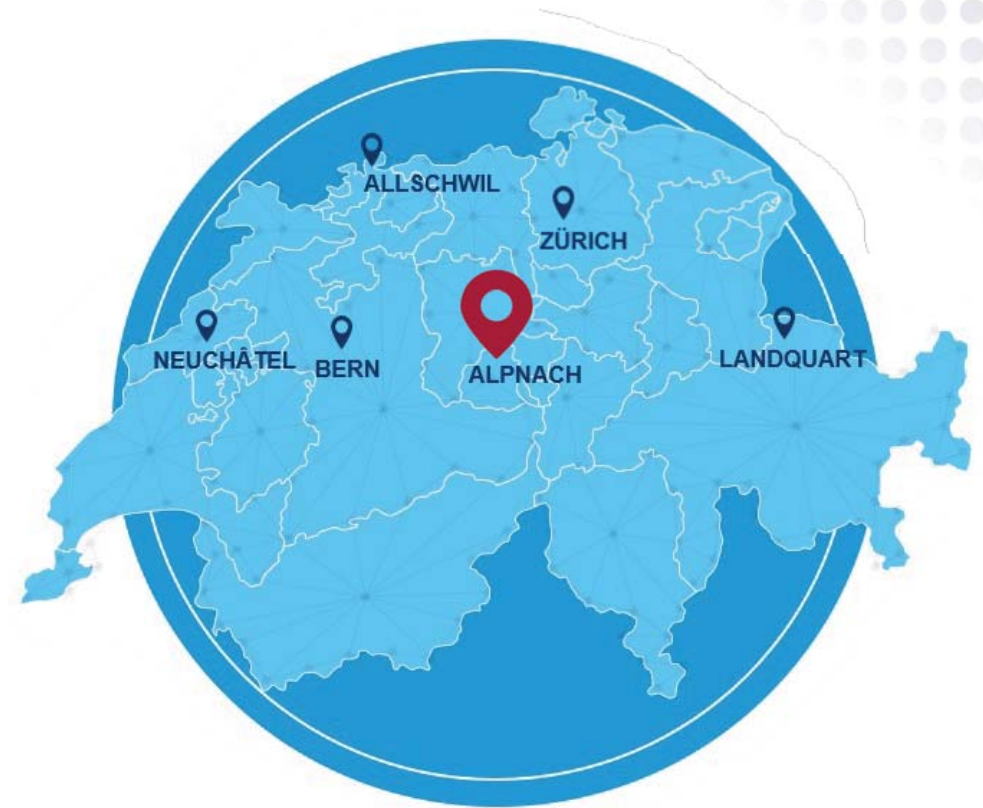
SIAMS, 17.04.2024

PREDICTIVE ANALYTICS WHAT TO DO WITH THE DATA?

CSEM AT A GLANCE

We are a public-private, non-profit Swiss **technology innovation center**

We enable competitiveness by **developing and transferring world-class technologies to the industrial sector**



1984
FOUNDED



600
SPECIALISTS
in 2023



100.4
MIO TURNOVER
in 2022



> 50
VENTURES
since 1984

OUR VISION – TO FACE THE CHALLENGES OF OUR TIME



Together with academia, our clients, and partners.

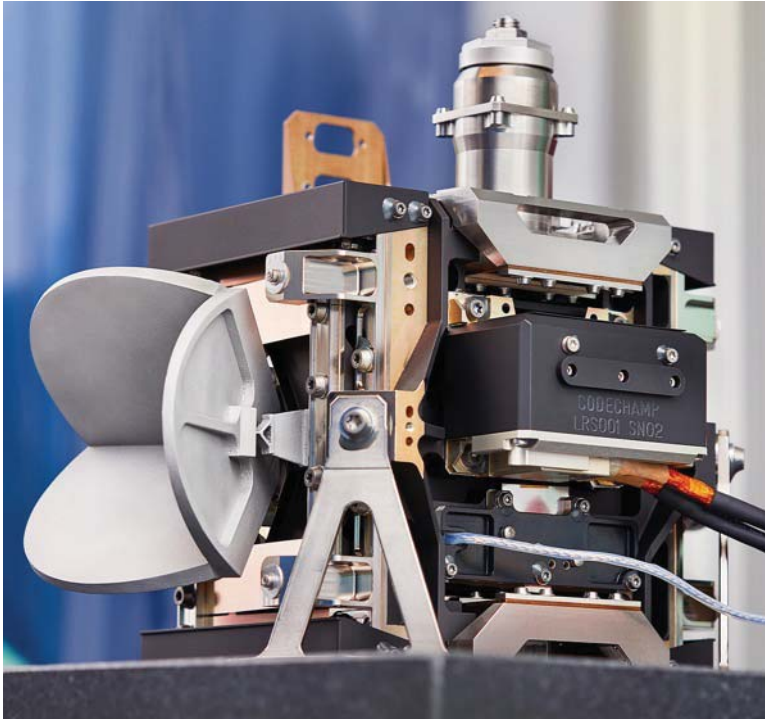
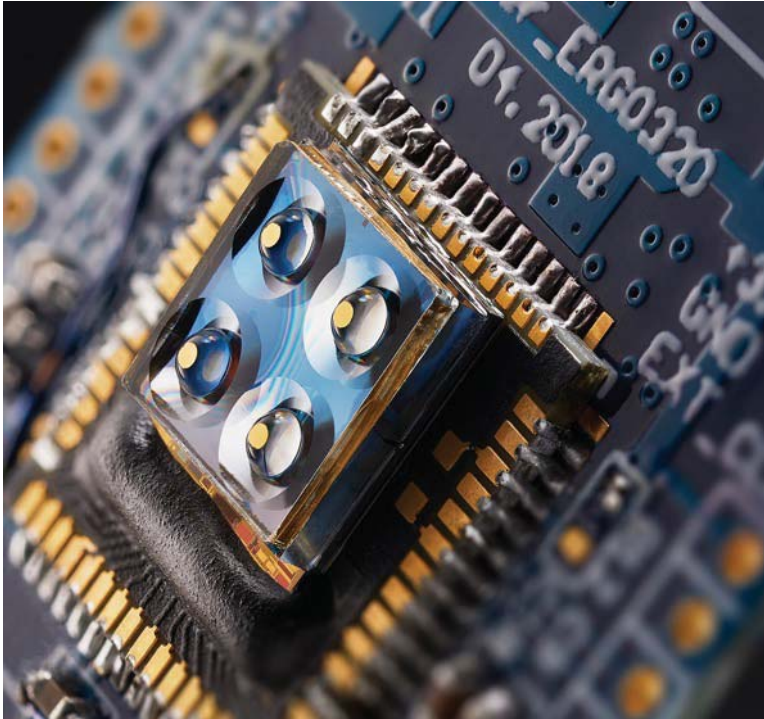
LASTING CUSTOMER IMPACT THROUGH

Applied research: We develop next-generation technologies with the potential to transform industries and improve people's lives

Tech transfer: We customize and develop new products, processes, and services with our clients that address their unique needs



WE SERVE INDUSTRY NEEDS WITH A FOCUS ON DEEP TECH



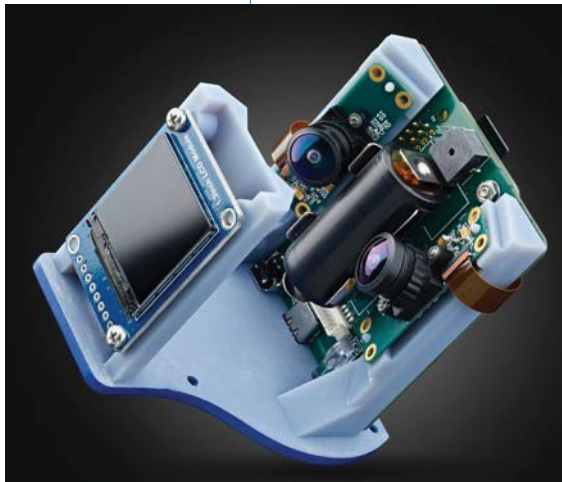
OUR DNA COMES FROM OUR WATCHMAKING ROOTS

Small & precise

Complex

Ultra-low power

Multidisciplinary



OUR USP #1: CUSTOMER CENTRICITY

Staff with industry experience

Long-term support
(80% of staff on permanent contract)

Processes with built-in confidentiality



Industrial equipment
(clean rooms, characterization labs)

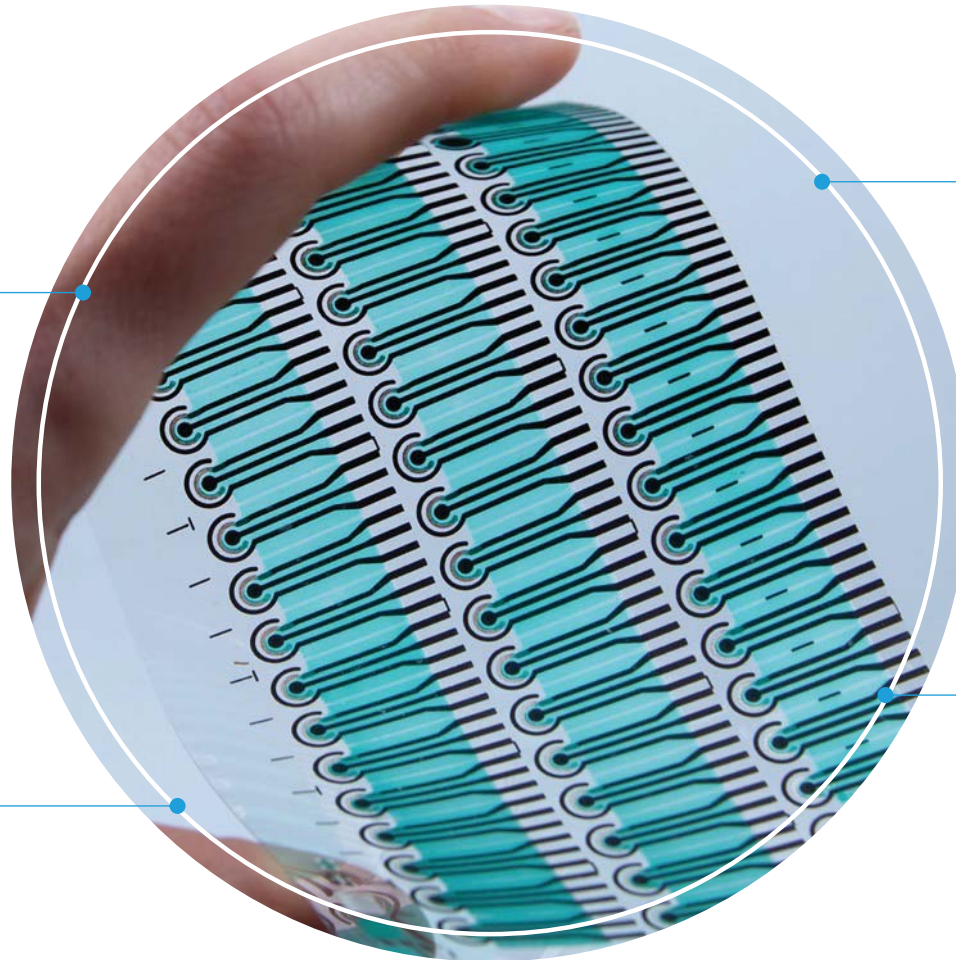
Proven project management methodology
(300 projects/year)

QMS & certifications
(ISO 9001 & 13485: Medical devices)

OUR USP #2 : FLEXIBILITY

Private company

Short decision-making paths



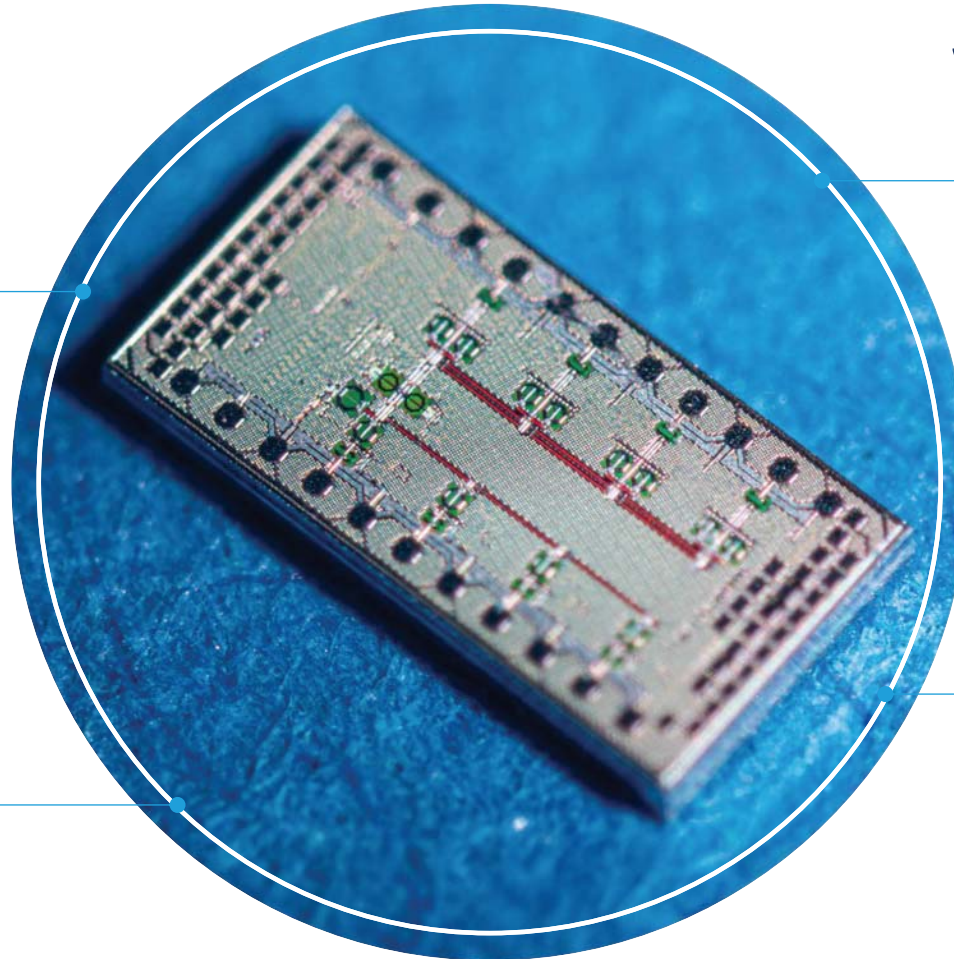
Ability to fast-track ideas and start projects

Responsive technical, IP and legal teams

OUR USP #3 : EXCELLENCE

External Scientific
Advisory Board

Close collaboration
with leading industry
partners



Strong ties with academic
partners worldwide

Part of HTA alliance
(VTT, LETI, Fraunhofer)

MAKING HISTORY: SOME WORLD FIRST

1967



Quartz
wristwatch

1997



UMTS
demonstrator –
3G is born

2007



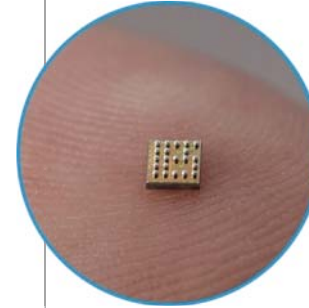
Thermo-
compensated
silicon
hairspring

2014



Pure white and
colored photovoltaics
panels

2017



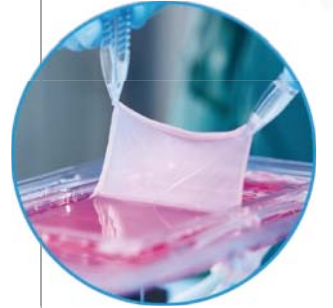
Smallest
Bluetooth chip

2018



Cuffless optical
blood pressure
monitoring

2021



Machine for
bioengineering
personalized
skin

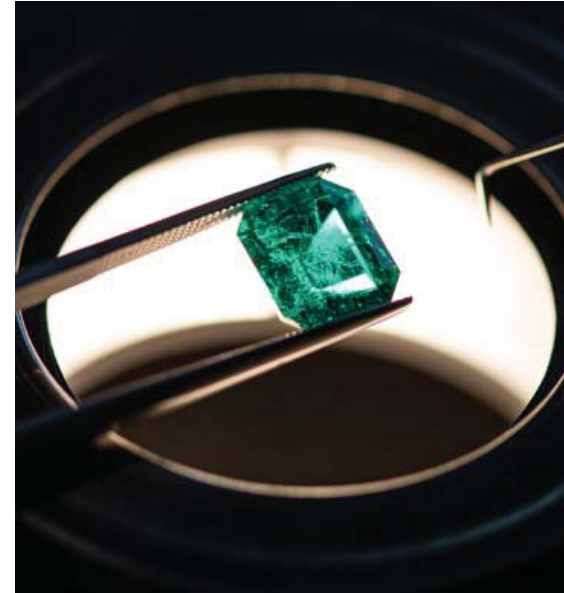
IMPACT THROUGH INDUSTRY PROJECTS, WITH START-UPS, SME AND MULTINATIONALS



T-Touch Connect Solar:
connected, secured,
autonomous, and long-lasting



AI platform for diagnostic trains
to determine and plan track
maintenance



High-performance AI
authentication solution to
determine Gemstones for
Gübelin Gemlab



Automated machine to
bioengineer personalized skin

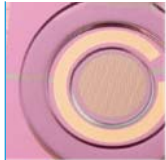
AND THE CREATION OF OVER 50 START-UPS, WITH SEVERAL SUCCESSFUL BUYOUTS

Xemics (1997)
acquired by
Semtech Corp.

2005



2009



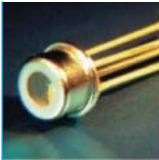
Neroxis (2009)
acquired by
Veolia Water technologies

CSEM Instruments (1998)
acquired by
Anton Paar

2013



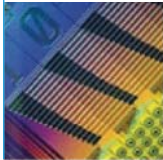
2013



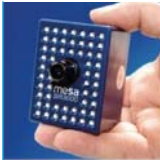
Avalon Photonics (2000)
acquired by
II-VI Inc.

Colibrys (2001)
acquired by
Sagem (Safran)

2013



2015



Mesa Imaging (2006)
acquired by
Heptagon

Snap Sensor (2011)
acquired by
Analog Devices

2016



2016



Heptagon (1993)
acquired by
AMS

ViDi Systems (2012)
acquired by
Cognex

2017



Oct 28, 2020, 06:02pm EDT |



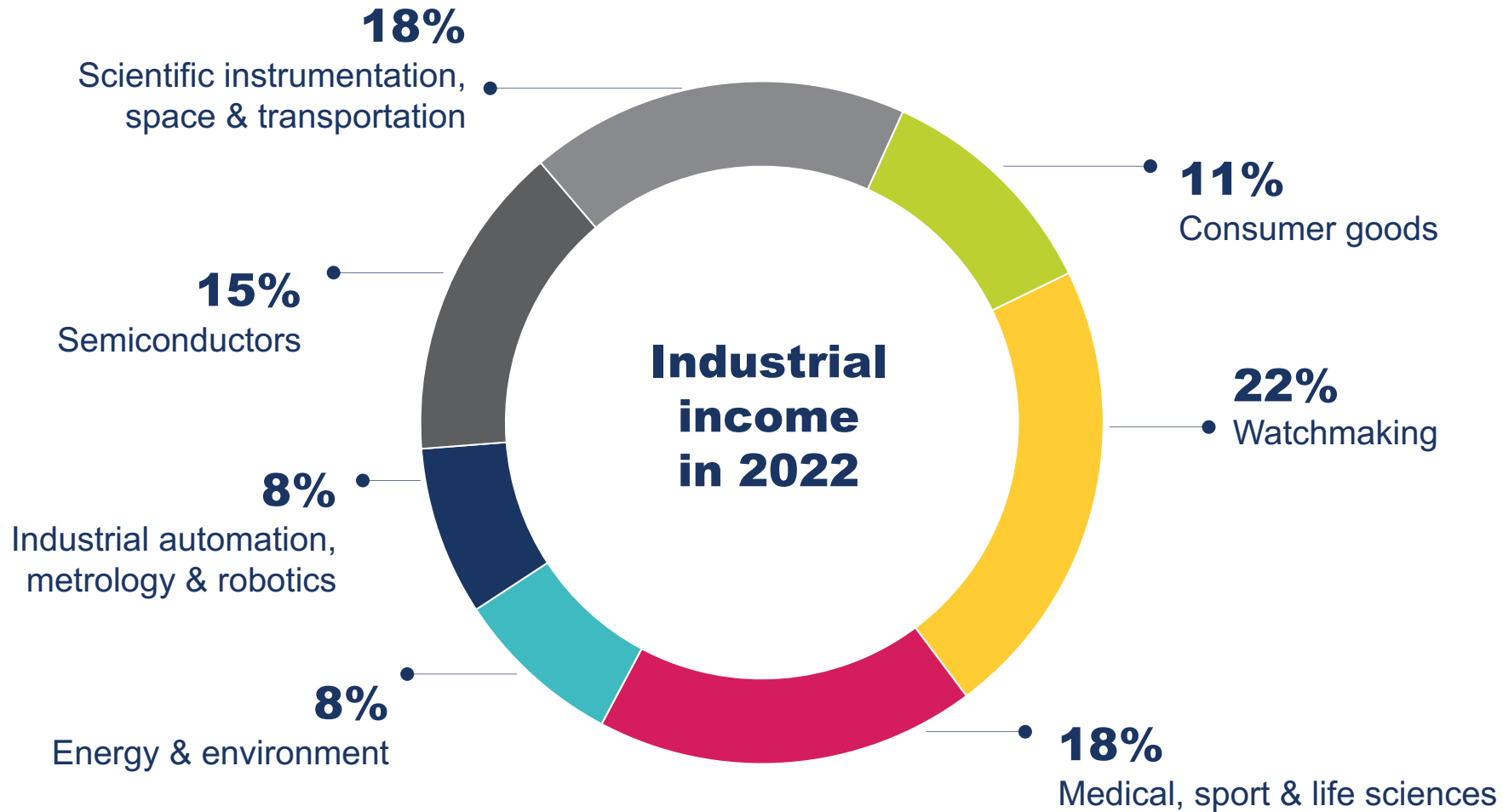
**This Startup Wants You To
Change How You Measure
Blood Pressure**

Jan 27, 2021, 04:16am EST |



**How A Small Startup Beat The
World's Tech Giants To Launch
Blood Pressure Game-Changer**

EXPERTISE SERVING SEVERAL MARKETS



230
INDUSTRIAL
CLIENTS / YEAR

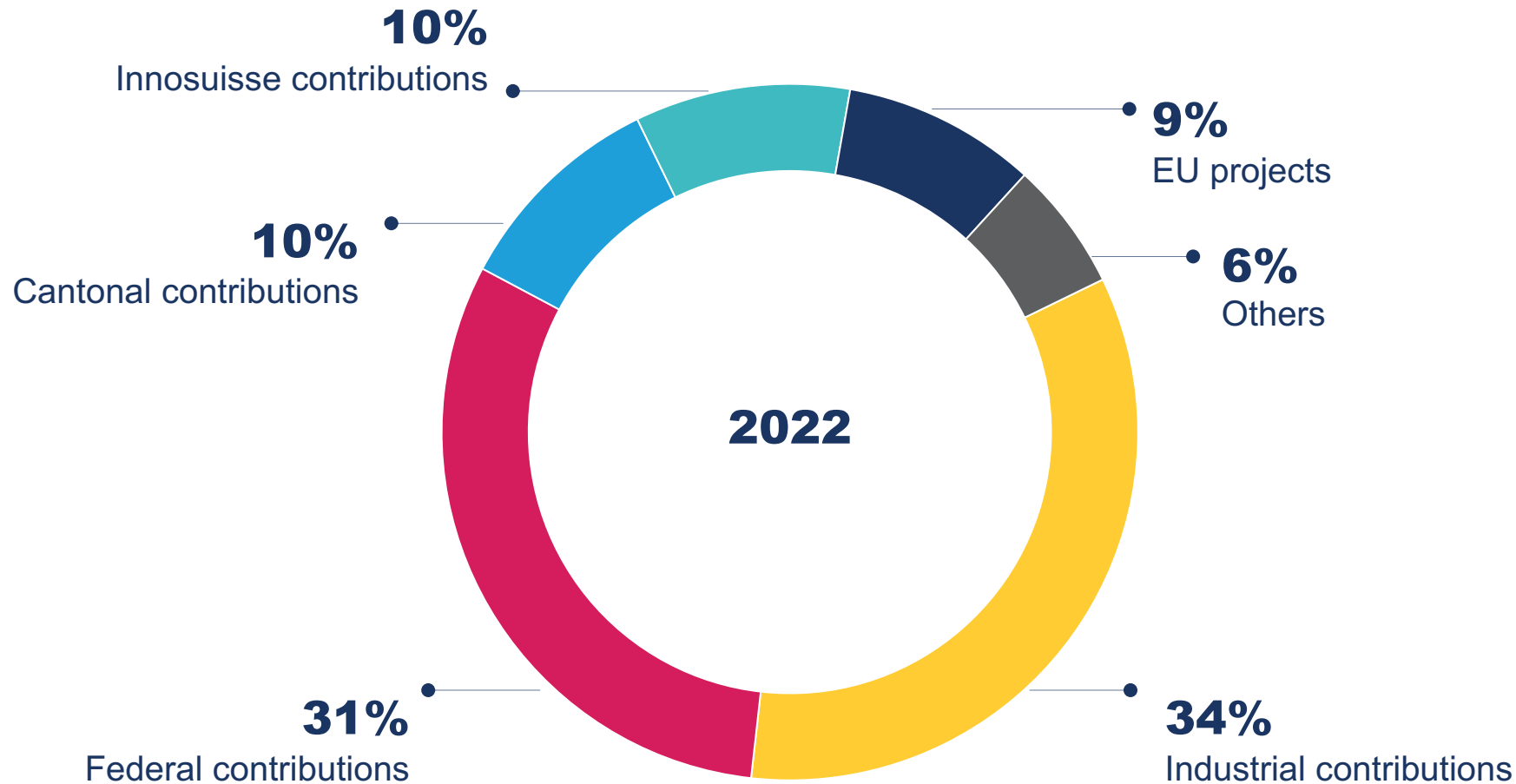
59%
IN SWITZERLAND

26%
IN EUROPE

10%
IN USA

05%
IN ASIA

BALANCED SOURCES OF FUNDING

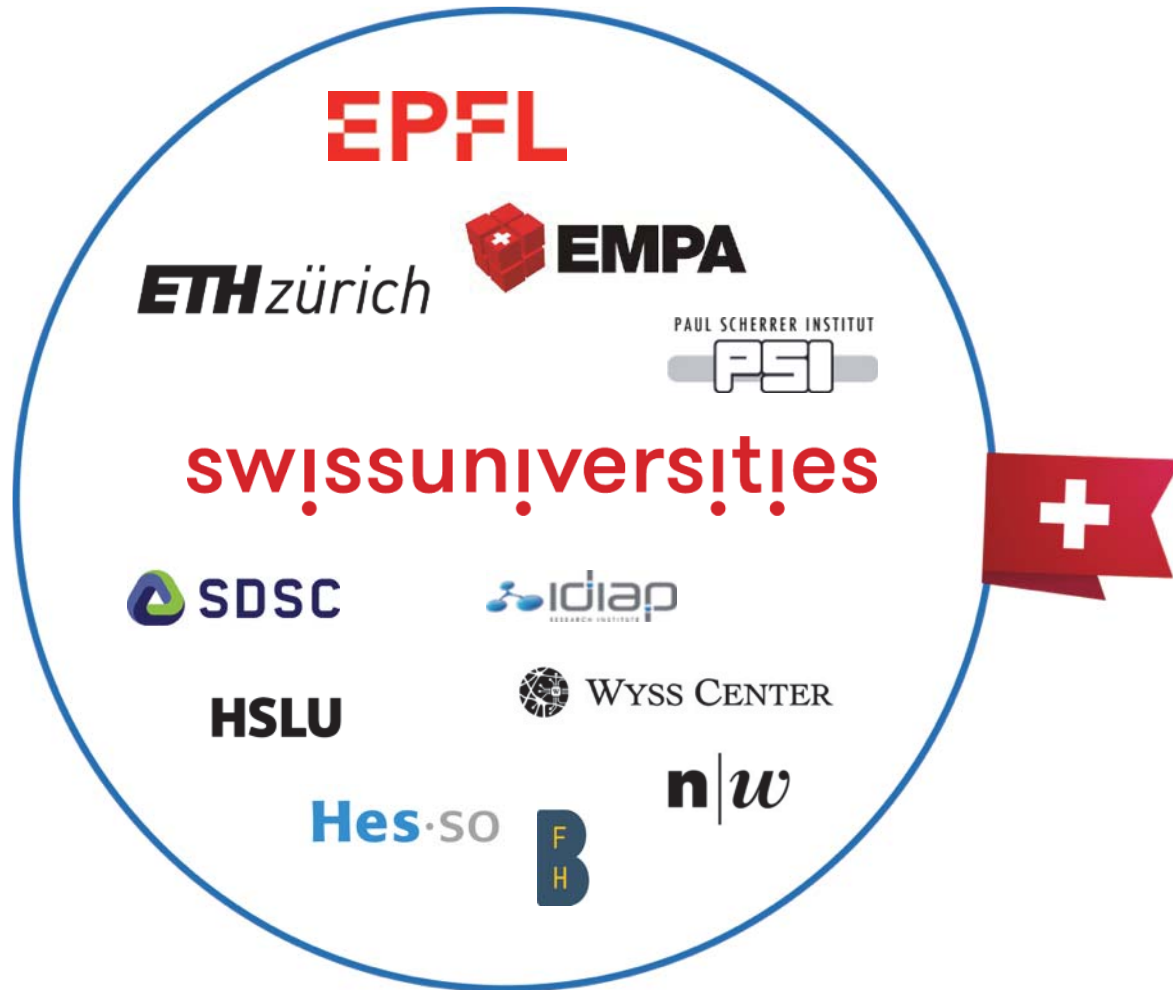


100.4
MCHF
INCOME



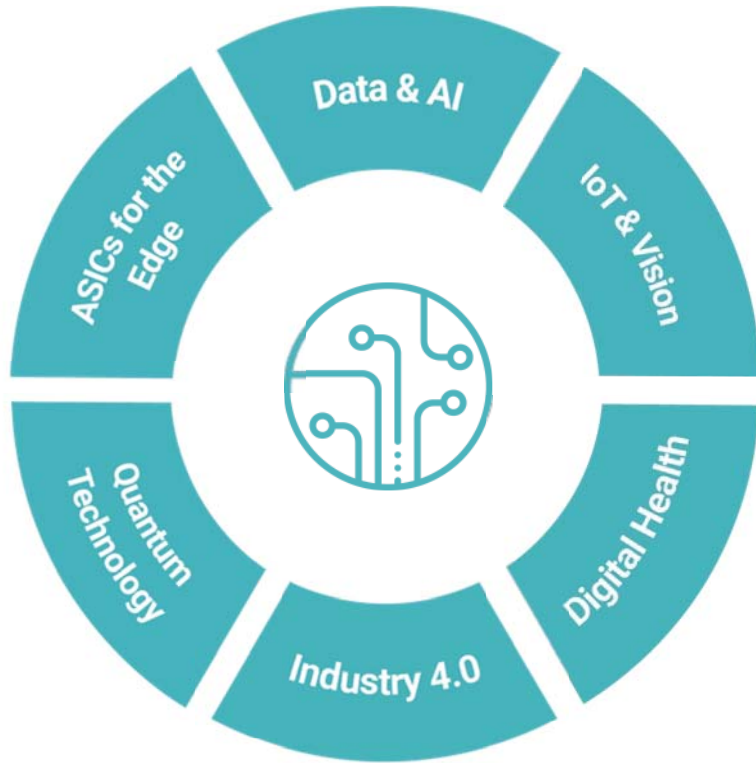
203
PATENT
FAMILIES

FULLY EMBEDDED IN THE RESEARCH ECOSYSTEM

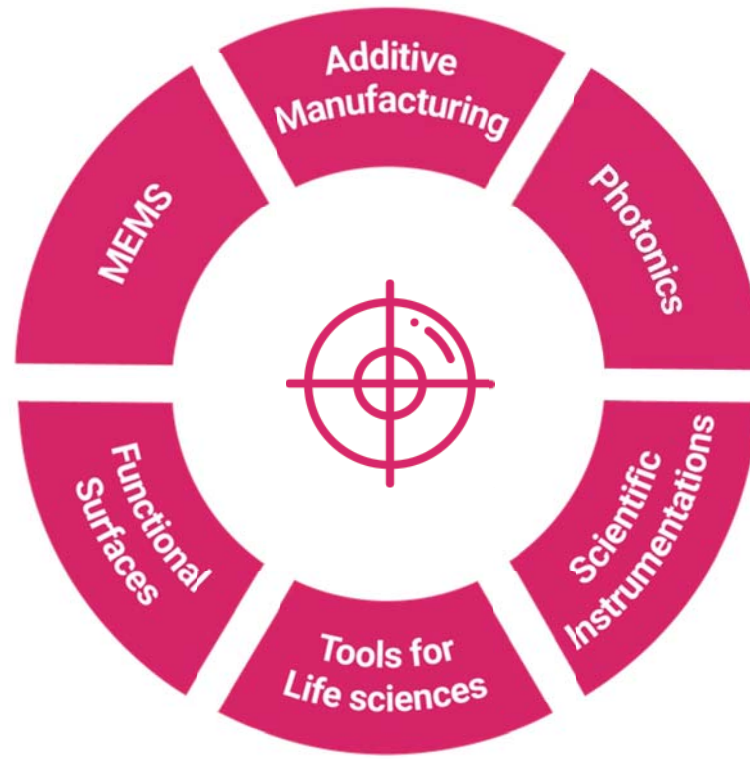


WE FOCUS ON THREE RESEARCH PRIORITIES

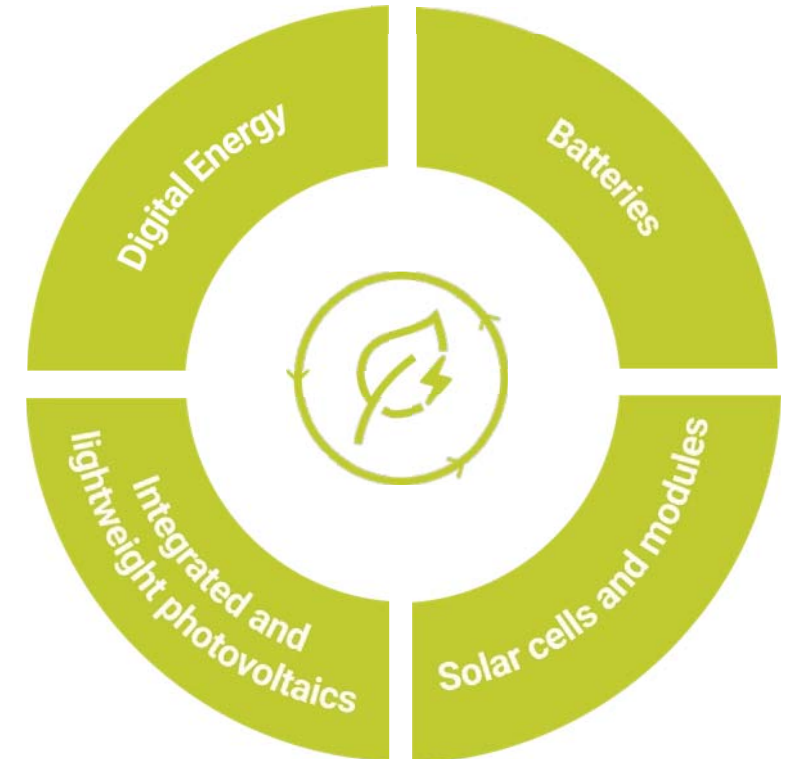
Digital Technologies

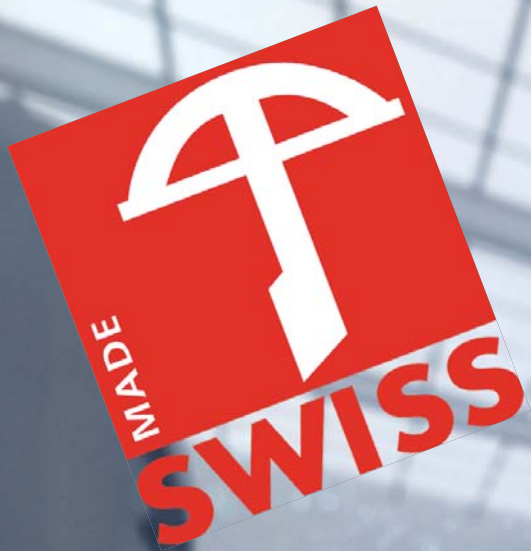


Precision Manufacturing



Sustainable Energies





:: csem

source: www.siemens.com



PERFECT QUALITY HIGH EFFICIENCY CUSTOMIZATION

:: csem

A man with grey hair, wearing safety glasses and a blue work shirt, is leaning over a large metal surface. He is using a magnifying glass to inspect the surface. The background shows a factory environment with various pieces of equipment and machinery.

EXCELLENCE

Weiterentwickeln statt rekrutieren!



Eine Stimme aus der Praxis zum Thema Fachkräftebedarf

06.02.2023

Der Fachkräftemangel ist nach wie vor ein grosses Thema, wenn es um die Besetzung offenen Stellen geht. Fachkräfte auf dem hart umkämpften Stellenmarkt für das eigen Unternehmen zu finden, gestaltet sich als schwierig. Teilweise dauert es bis zu einem bis ein Unternehmen eine bestimmte Stelle wieder besetzen kann.

Employees Bear Burden of Shortage of Workers

In half of the companies, employees have to do the work of absent colleagues. We need other recipes.

from Hansjörg Schmid · published on May 25, 2023

UBS Outlook Suisse – Les collaboratrices et collaborateurs au centre des préoccupations

SWI swissinfo.ch

[Workplace Switzerland >](#)

Zurich | 16 mai 2023, 10:30 CEST | Media Switzerland

Si, ces dernières années, les entreprises suisses ont retrouve aujourd'hui menacée par une grave pénurie donc garder plus longtemps leurs collaborateurs à augmenter leur taux d'occupation, comme le mon entreprises. Contrairement à ces risques structurels, les menaces conjoncturelles ont reculé.

Swiss perspectives in 10 languages

Swiss industry faces record shortage of skilled workers



DIGITALIZING THE KNOW-HOW

Monitoring

Modelling

Prediction

Optimization



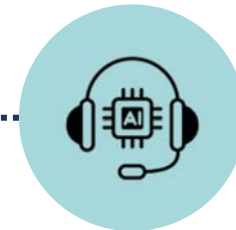
Predictive
Maintenance



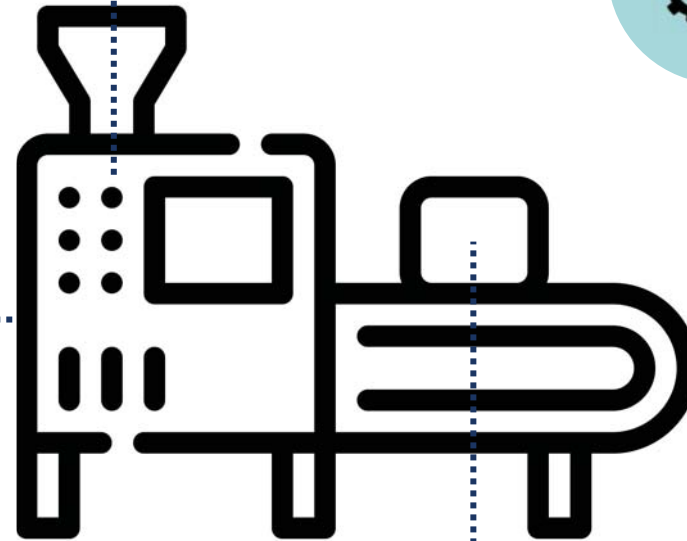
Process Parameters
Optimization



Expert Systems for
Process Discovery



Predictive
Quality





DES SOLUTIONS END-TO-END TAILLÉES POUR L'INDUSTRIE



PREDICTIVE ANALYTICS FOR CEMENT PRODUCTION

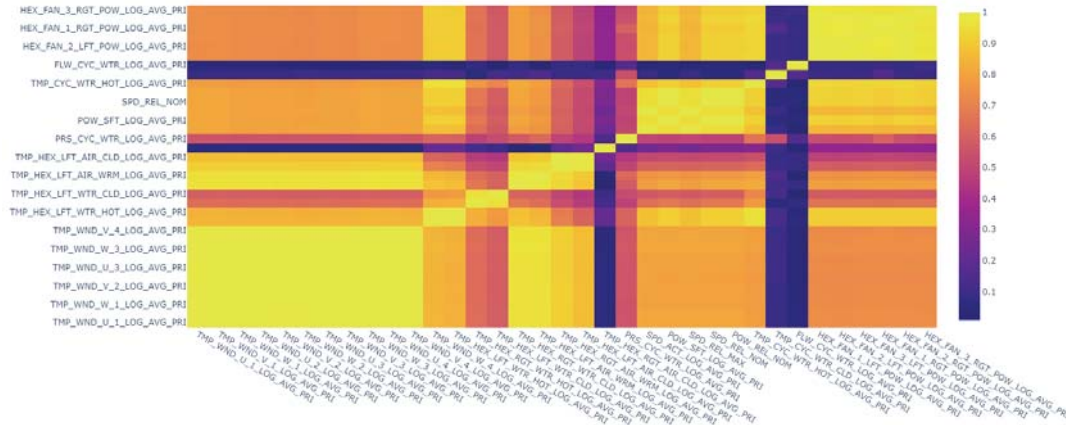
Predictive maintenance for gearless mills drives

Architecture design and implementation on MS Azure

Prediction of cement quality



PREDICTIVE MAINTENANCE OF GEARLESS MILLS DRIVES



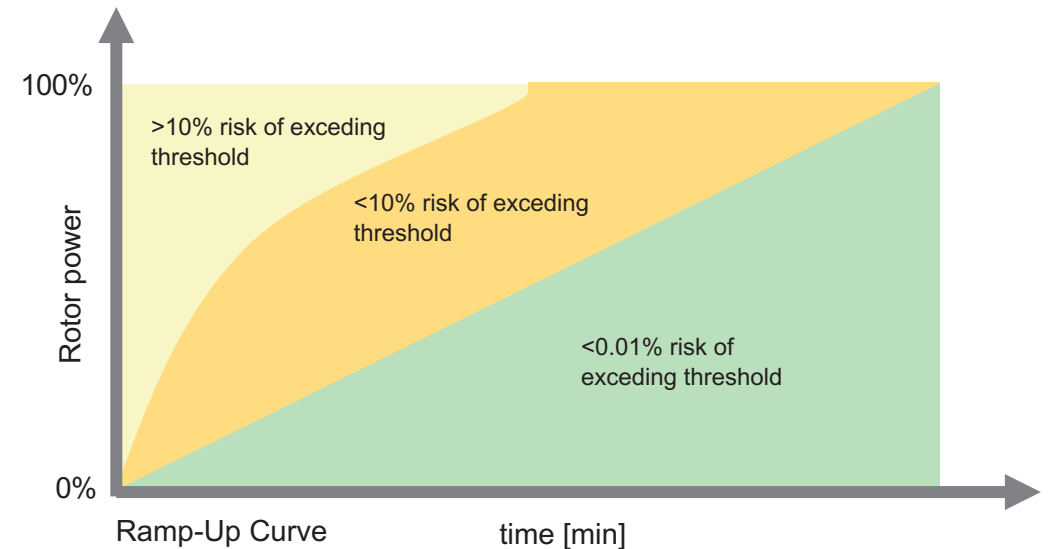
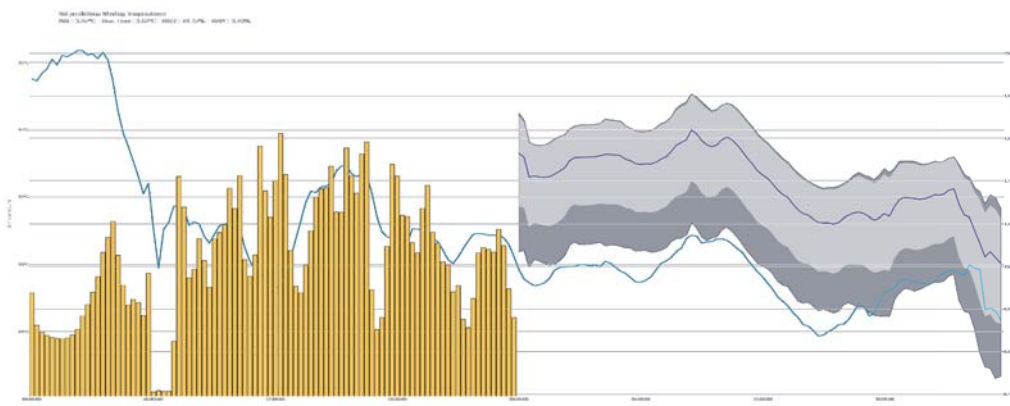
Given the current system state, rumping up power with a gradient over 288 kW/min may lead to a trip within the next 10 min at risk 15%

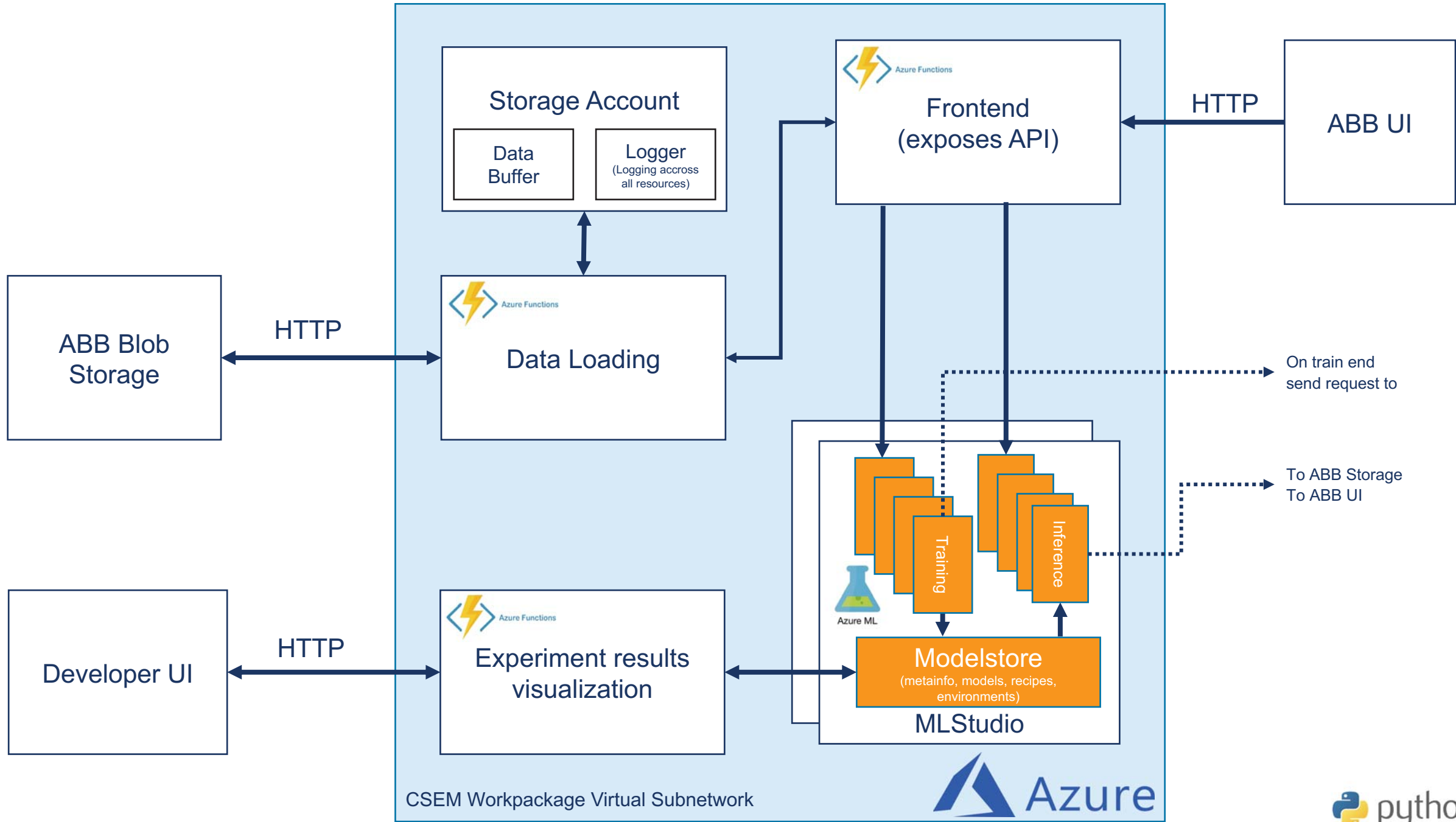


The following scenarios for input temperature and pressure will result in a trip within the next 10 min at >20% probability!

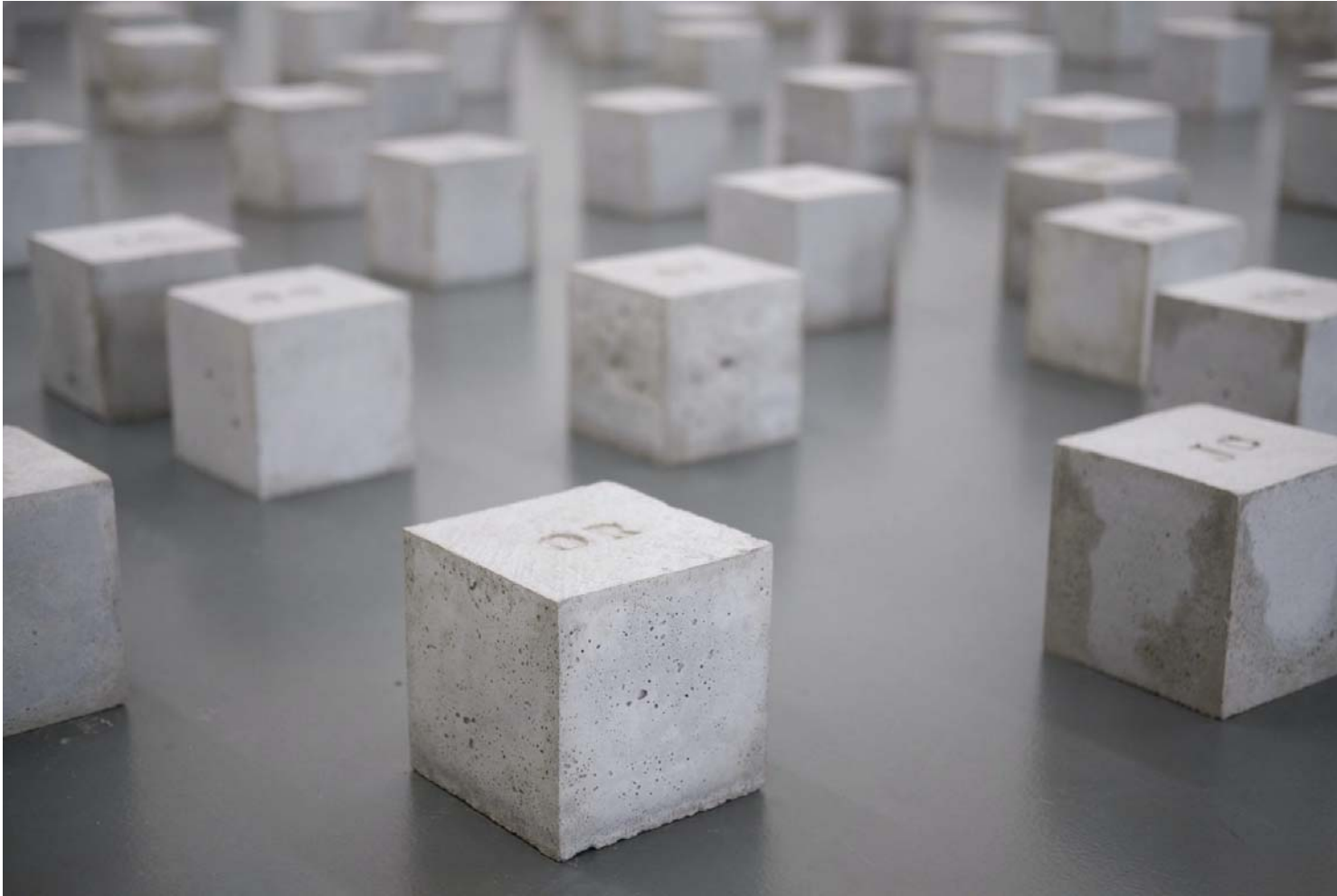


10% risk of exceeding critical value within 5h





PREDICTION OF CEMENT QUALITY



Images: www.giatecscientific.com



PREDICTION OF CEMENT QUALITY

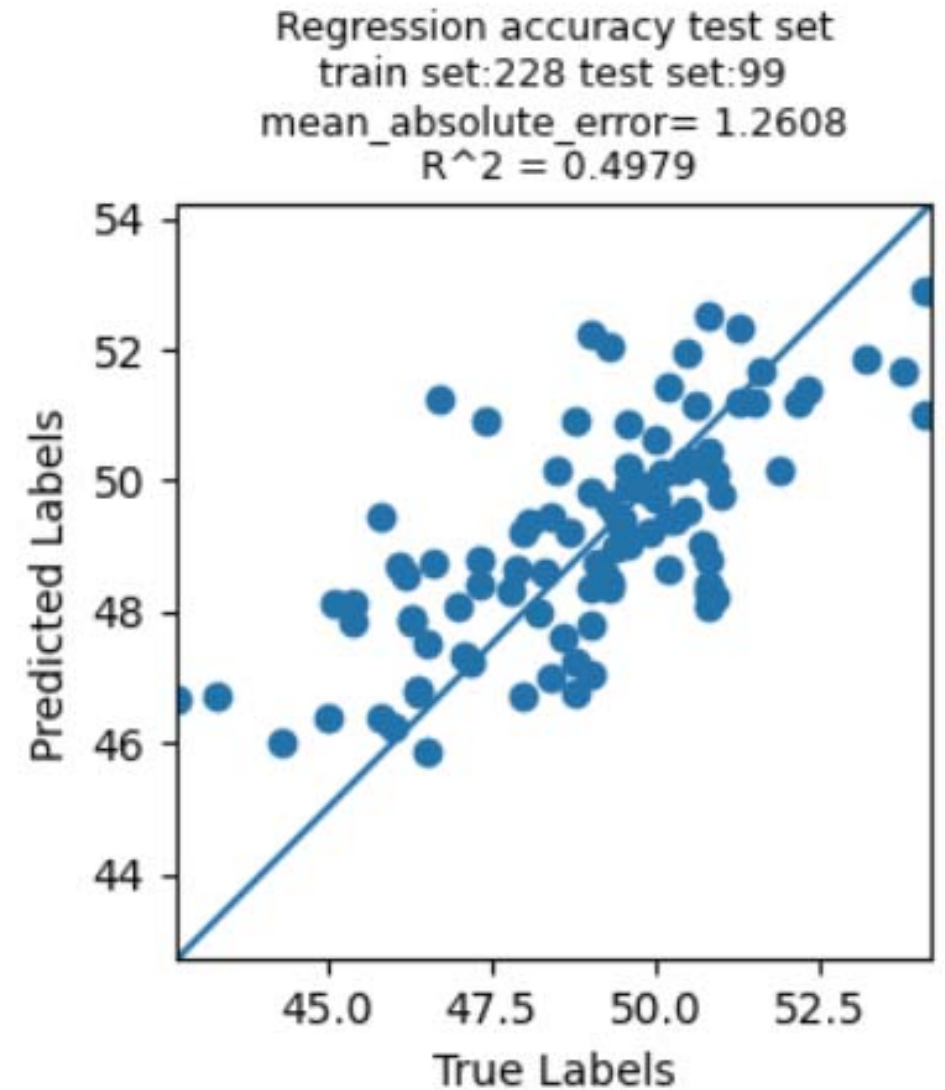
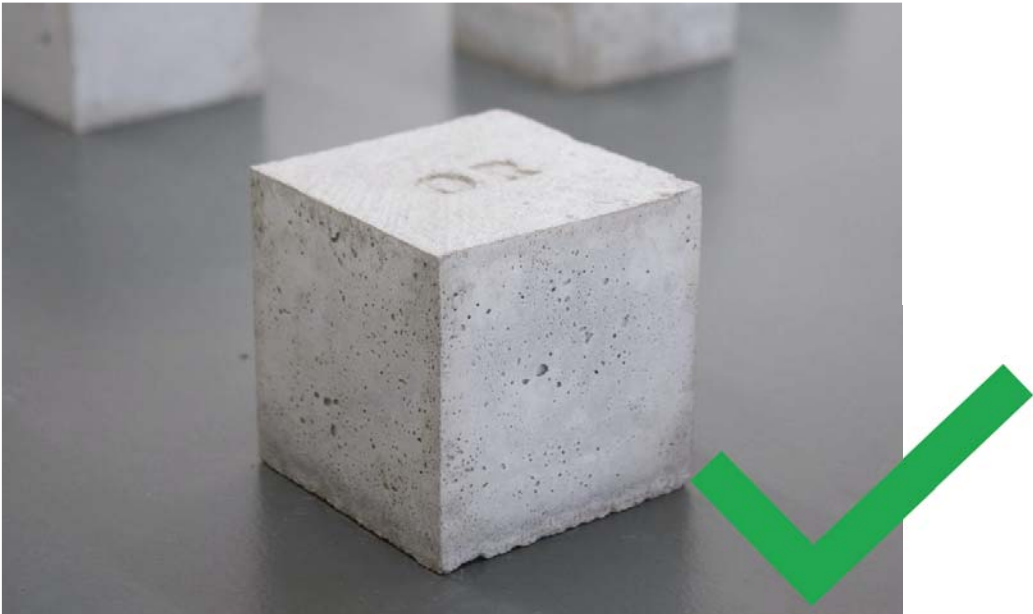


28 Days

Images: www.giatecscientific.com

PREDICTION OF CEMENT QUALITY

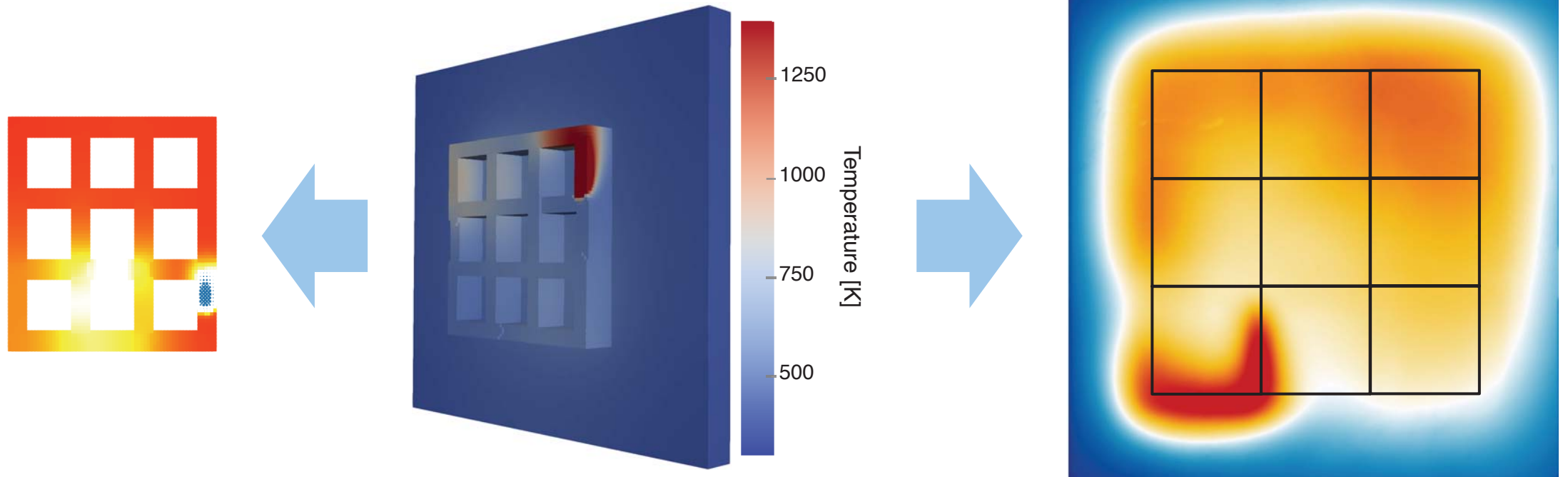
- 59 signals → 9 signals (during production)
- Interpretable model
 - Impact of chemical composition and physical characteristics on quality
- Mean prediction error: +/- 1.26 MPa



MODELING IN ADDITIVE MANUFACTURING

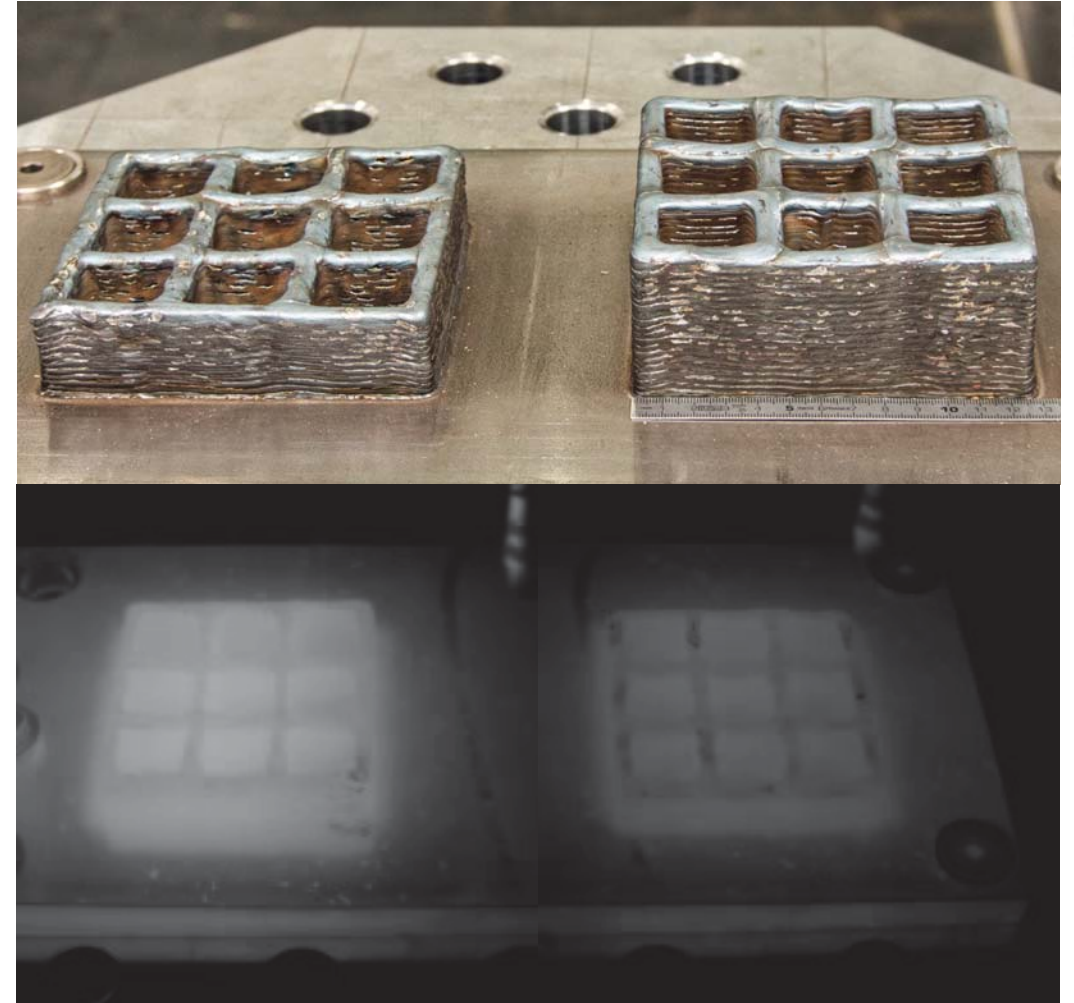
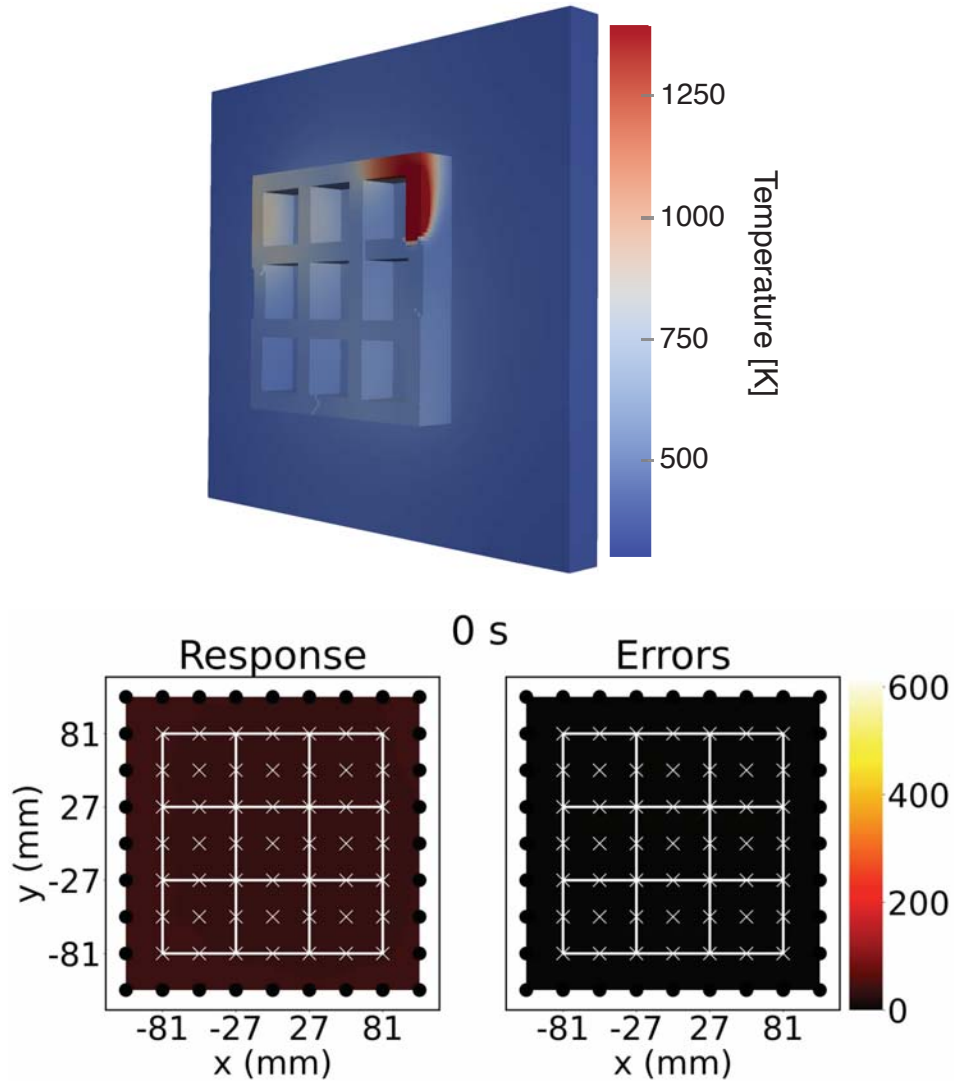
Interplay between **physics** and **data**

- Learning subspace surrogate models to accelerate simulations⁽¹⁾
- Combining physics and deep learning to create observers⁽²⁾



(1) Sideris, I., Crivelli, F. & Bambach, M. GPYRO: uncertainty-aware temperature predictions for additive manufacturing. *J Intell Manuf* **34**, 243–259 (2023). <https://doi.org/10.1007/s10845-022-02019-7>
(2) Bambach M., Sideris I., Fabbri M., Wegener K., Faster than real-time path-sensitive temperature modeling of wire-arc additive manufacturing by a data-driven finite volume method, *CIRP Ann.* (2022)

PATH OPTIMIZATION IN ADDITIVE MANUFACTURING



FROM CHATGPT TO LARGE TIME-SERIES MODELS



LANGUAGE

TIME-SERIES





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