Mathematics for Data Capture

IMPRESE E MATEMATICA 5/12/2024

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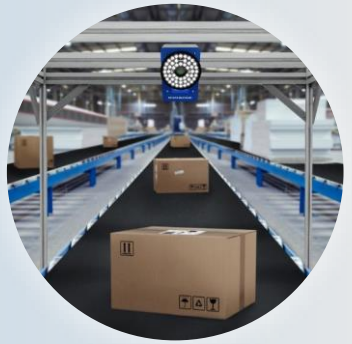
DATALOGIC
EMPOWER YOUR VISION

Datalogic at a Glance

Global technology leader in the **data capture** and **industrial automation**, in the **Retail**, **Manufacturing**, **Transportation & Logistics**, and **Healthcare** industries.
Founded in **1972** by **Romano Volta**, listed on the Italian Stock Exchange since **2001.**

Retail

Manufacturing



Transportation & Logistics

Healthcare

A portfolio of about 1,200 patents and patent applications

450+ Engineers in 8 R&D centers and 3 DL Labs in Italy, USA, Vietnam, and China

10% Revenues invested in R&D

3,000+ Employees in 29 countries:
16,3% Americas, 58,8% EMEAI, 24,9% APAC

11 Manufacturing & Repair sites in:
USA, Hungary, Slovakia, Italy, China, Vietnam, and Australia

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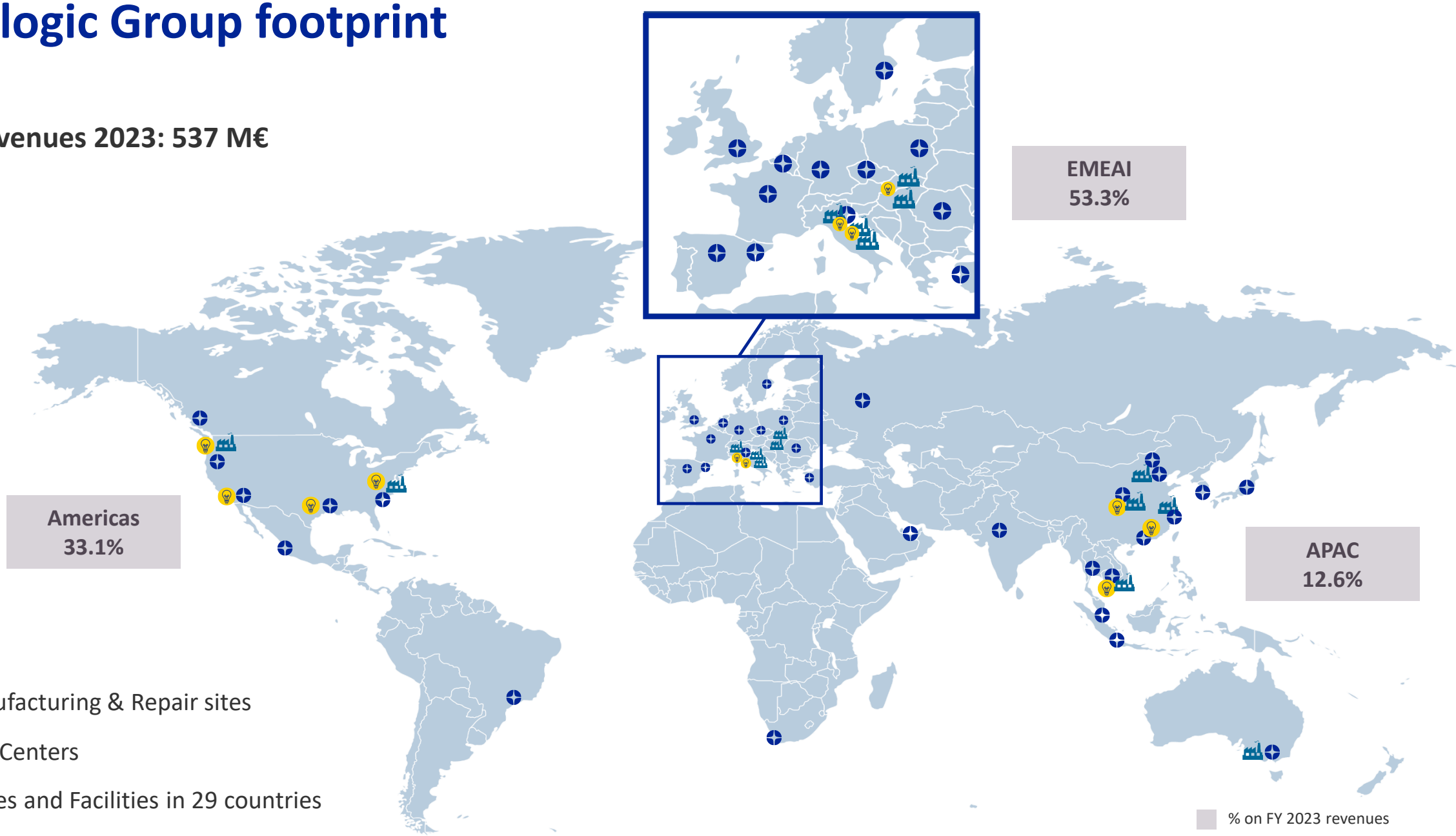
Datalogic Group footprint

Total Revenues 2023: 537 M€



13 Manufacturing & Repair sites

11 R&D Centers

48 Offices and Facilities in 29 countries

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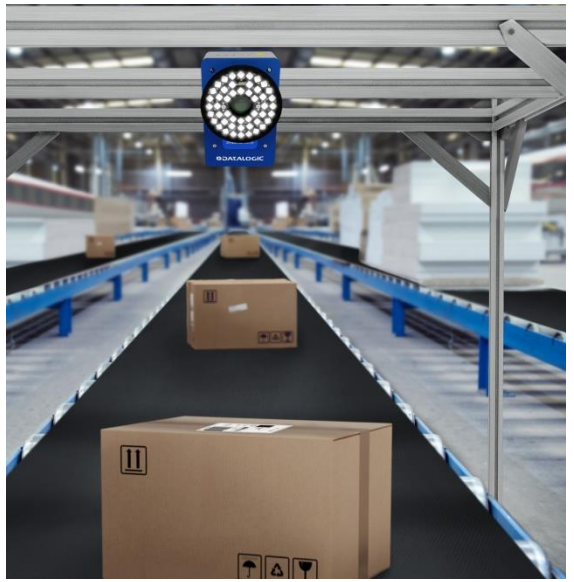
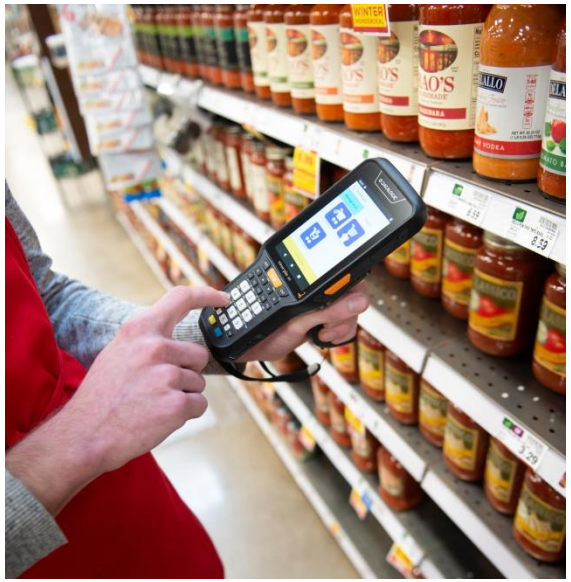
Barcodes …

- Barcodes are ubiquitous
- Historically a big Datalogic asset
- Hardware and software
- Key areas of application:
  - Manufacturing
  - Transportation and Logistics
  - Retail
  - Healthcare



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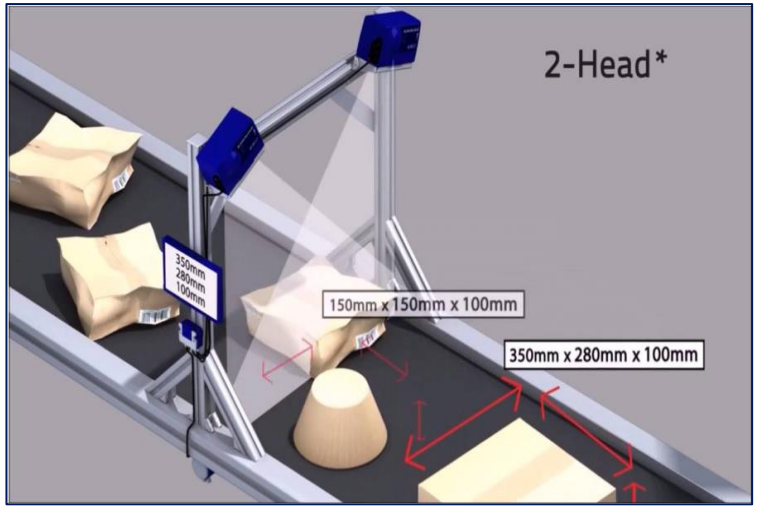
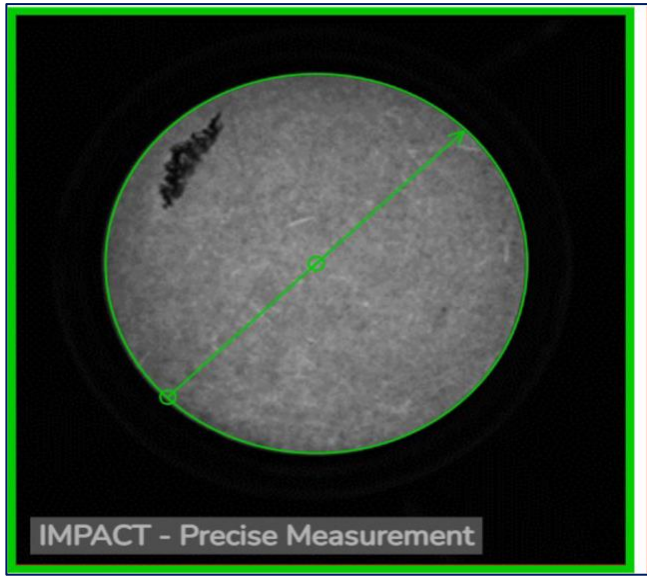
… and beyond

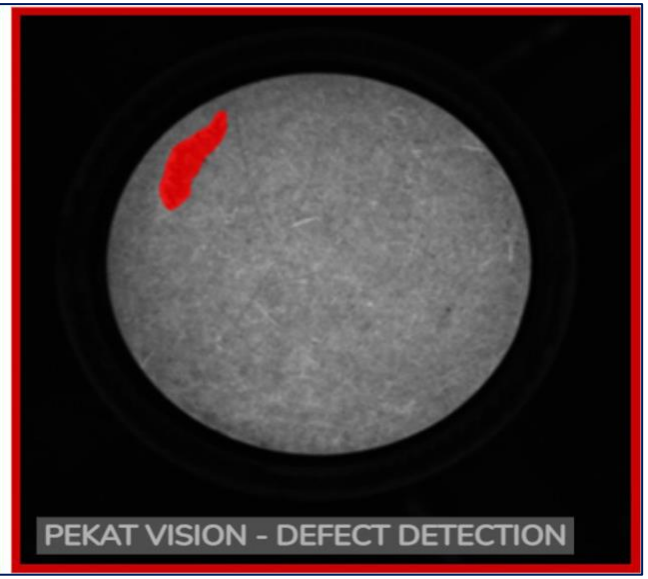
- **Produce recognition**
  - Grocery classification
  - Smart checkout
- **Dimensioning**
  - Camera based parcel size estimation
  - Automatic item sorting
- **Measuring**
  - Dimension conformity in manufacturing
- **Anomaly detection**
  - Discard “abnormal” items

Magellan 9800i

DM3601







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Computer Vision and Machine Learning Unit

- **Transversal to Datalogic Units/Products**
  - 10 team members
  - 2 PhD's
  - 2 from non engineering background

- **Provide algorithmic/software solutions** to be integrated in Datalogic products

- **Top down** and bottom up

- **All phases** from bibliography, design, prototyping to low level optimized implementation

- **Main areas of expertise**
  - Image analysis/processing
  - Computer vision
  - Machine learning
  - Embedded programming (limited computing power)

- All these areas benefit from **mathematical background**

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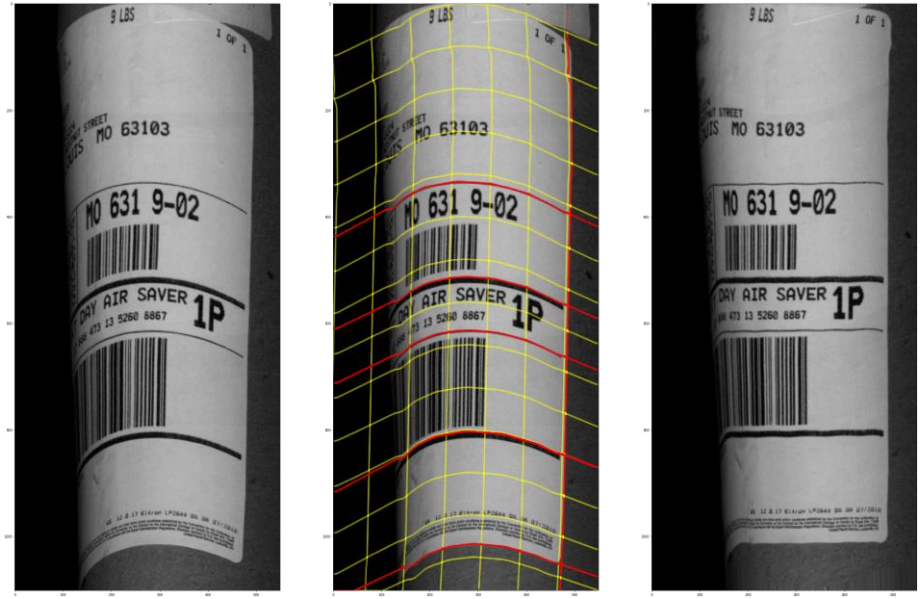
Sample applications

- **Image ironing**
  - Compensate geometrical distortion to improve decoding
  - Model distortion (e.g., thin plate splines)
  - Compensate distortion (elastic registration)



- **De-blurring/Super resolution**
  - Inverse problems

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Sample applications (cont'd)

- **Dense reconstruction from sparse measurements**
  - Inverse problems
  - Optimization
  - Inpainting (PDE)

- **Feature design for barcode localization**
  - Barcodes have distinctive pattern
  - Mathematical modelling of pattern and image formation to design barcode specific image features

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Sample applications (cont'd)

- **Deep learning**
  - Anomaly detection
    - Unsupervised learning
  - Produce recognition
    - Segmentation
    - Classification
  - Theft prevention
    - Tracking
    - Segmentation
    - Action classification
- **Black-box** risk
  - Solid understanding of problem at hand
    - Mathematical modelling
    - Better feature design
    - Appropriate loss functions
    - …

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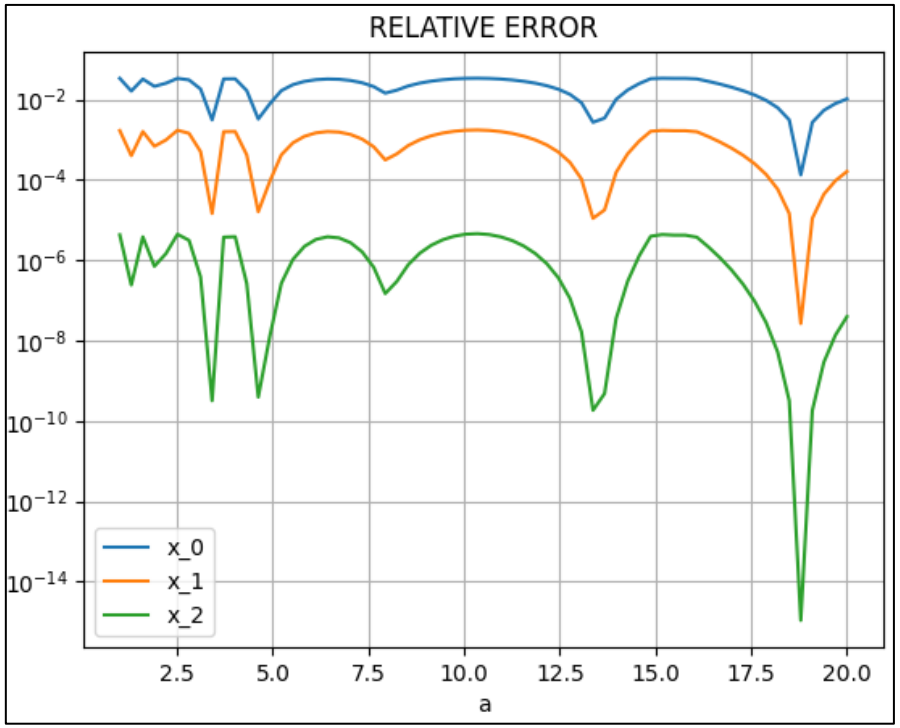
Sample applications (cont'd)

- **Embedded programming**
  - Adapt code to restricted instruction set
  - Distribute operations between registers
- **Example**
  - Computation of $\frac{1}{\sqrt{a}}$ slow on embedded processor.
  - Find zeros of $f(x) = x^2 - \frac{1}{a^2}$
  - Approximate with few iterations of Newton-Raphson $x_{n+1} = \frac{x_n}{2}(3 - ax_n^2)$



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Conclusion

- **Mathematical background is well valued in Datalogic**

- **It is fundamental in several key assets**
  - Image analysis and machine learning
  - Code optimization
  - …

- **Coding skills**
  - C/C++ coding will become necessary
  - High level prototyping in Python/MATLAB

- **Open channel between Datalogic and Department of Mathematics**
  - Master thesis/internship projects
  - hiring

- **Openings advertised in our LinkedIn**

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THANK YOU

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