Automation

EN

Hollow Glass Technology

we • glass

we • glass

We know glass, we love glass

As a global leader in hollow glass and flat glass processing technology, we have been helping to shape one of the most beautiful and useful materials in the world for over 60 years. Its unique qualities, combined with the passion for technology and innovation, guide us in seeking for newer and more effective solutions to improve and expand its use.

BOTTERO

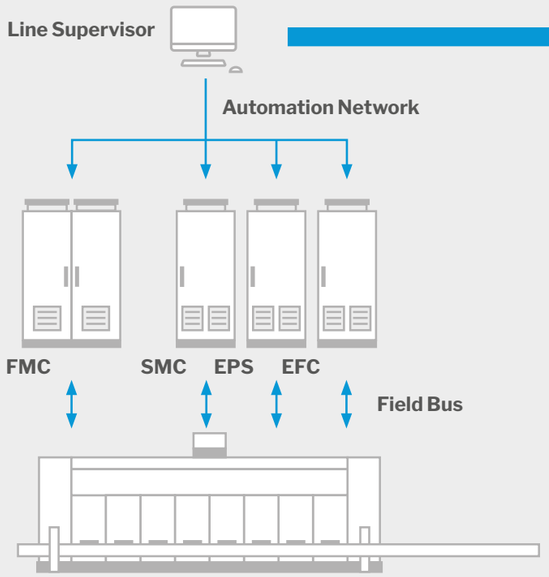
Automation

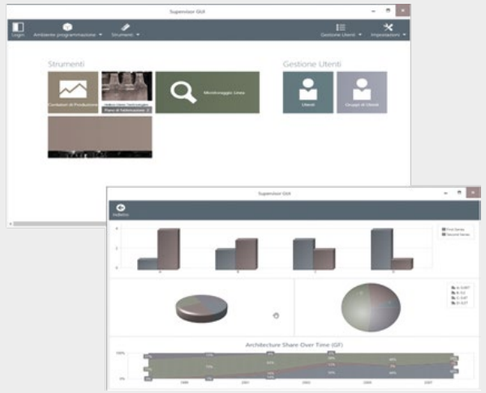
During the last decade, Bottero has made significant investments in Automation, bringing innovative solutions in the Glass Industry and applying Industry 4.0 principles in a continuous product evolution, targeted to the automatic control and optimization of the production process.
Thanks to advanced automation techniques and Machine Learning-based approaches, Bottero developed closed-loop control systems, based on data coming from state-of-the-art sensors, able to automatically control the most critical areas of the forming process, stabilizing the production and optimizing the performance.

Bottero Integrated Automation Platform

- Full standardization of HW components, SW modules and communication interfaces
- Unique, integrated development platform putting together:
  - Supervisory platform with open interface toward external Systems
  - Wide configuration capability of timing special cycles
- **Tier 1 closed-loop** controls (DFS, GWC for BB, Servo Plunger, Prop. Valves 2.0, MWM)
- **Process view closed-loop** controls (BoX)

Open Supervisory Platform

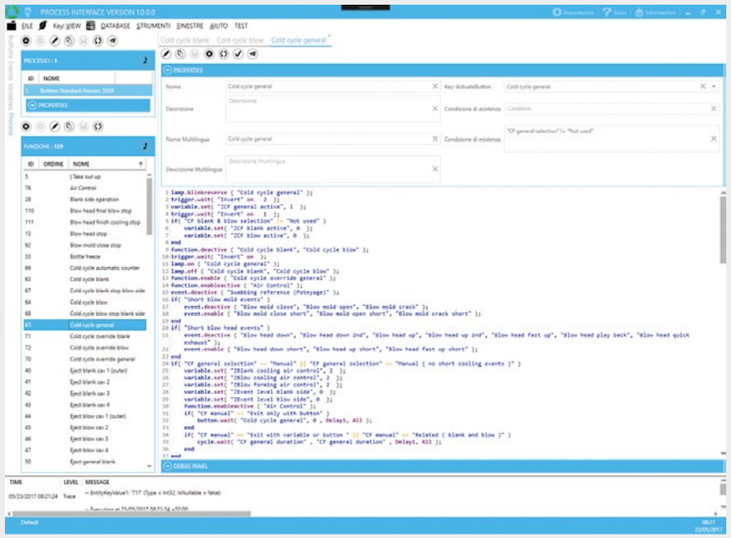




Production counters and data gathered and made available for external applications to measure line performance.

Configuration of timing Special Cycles

- Bottero proprietary language to program and customize Timing Special cycles.
- Robust and easier safety controls.
- Interface towards external system.

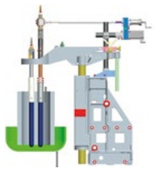


Process editor for configuration of special cycles

Tier 1 closed-loop controls

Dynamic Forming System (DFS)

- For both **BB** and **NNPB** productions.
- Integrated THD (Tube Height Device) and PAC (Plunger Adjustment Control).
- Full stroke plunger motion tracking in **NNPB**.
- Integrated Weighing Station for **BB**.



Vertical & Horizontal Plunger Adjustment.

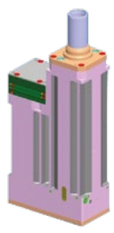
Magnetic Position Sensors.

Weighing Station.

Tube Height Control.

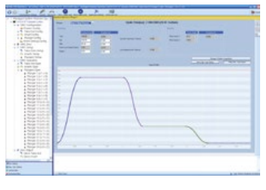
Servo Plunger integrated with DFS

Fully integrated with DFS to implement gob weight control functionalities without the need of position sens.



Vertical & Horizontal Plunger Adjustment.

P&B

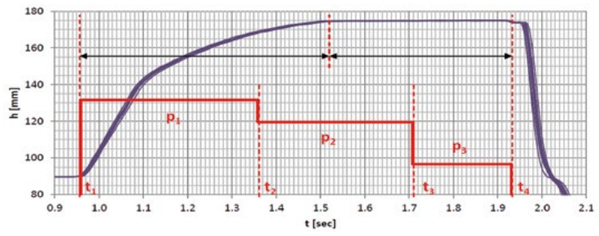


B&B

DFS: Plunger Motion Control

System to automatically regulate the pressure profile (duration and pressure levels) of the proportional valves controlling the plunger up movement for PB productions, with the aim to:

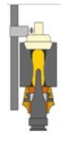
- Equalize and keep stable the motion profile of each plunger mechanism to minimize container defects.
- Keep stable the required pressing time to get homogeneous behaviors in dynamic environments.
- Avoid over-pressures during the plunger up phase.



P1 quickly brings the plunger to a height close to the final value (avoiding over-pressures).

P2 smoothly complete the plunger up phase, minimizing variations of the pressing time.

Proportional valve for plunger up



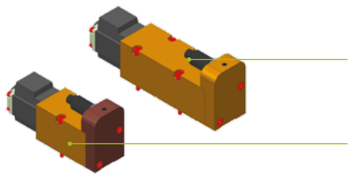
Plunger up motion

Pressing Time

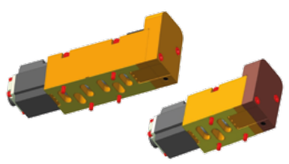
Tier 1 closed-loop controls

Bottero Proportional Valves 2.0

- **Closed loop** on the output pressure based on a dedicated sensor.
  - Response repeatability and precision of the output pressure
  - Response homogeneity among different valves
  - Better precision of the control at low pressure
- **Two valve types**
  - Cost reduction of spare parts management
- **Possibility to electronically configure the valve type (flow or pressure).**

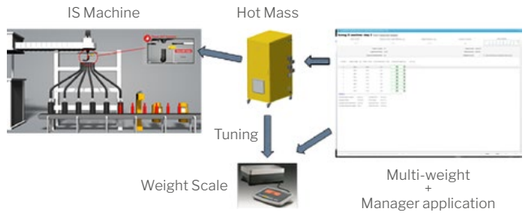


- Complete mechanic retrofit with existing bases.
- Same operator interface with control electronic.



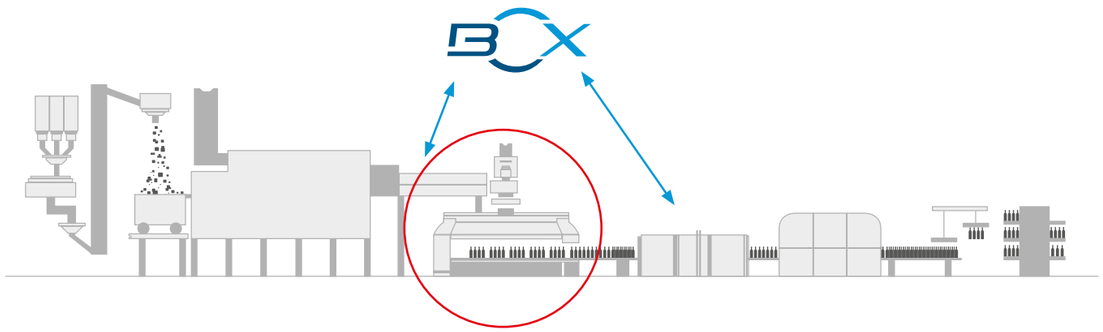
Multi Weight Manager Application

- Tool to support setup and control of productions with multiple weight articles.
- Optional plug-in of Bottero servo feeder.
- The variable gob weight is achieved regulating the plunger parameters of the servo feeder.
- Capability to compensate glass accumulation phenomenon due to the return trajectory of the needles.
- Commercial weight scales can be optionally integrated for a weight acquisition.
- The tool can interwork with Tiama HOT mass, a camera system measuring speed and volume of the gob while falling, with the main objectives to automatically regulate the weight of the gob and to control its shape. This integration offers significant advantages compared to the other solutions:
  - No need to manually weight the produced bottles
  - No production losses due to manual weighting
  - Possibility to setup multi-weight productions (at feeder level) while other operators change equipment at shop floor for the new jobs to be put in production. In this way, as soon as the IS machine is ready for production, the multi-weight gob setup is already up-and-running.

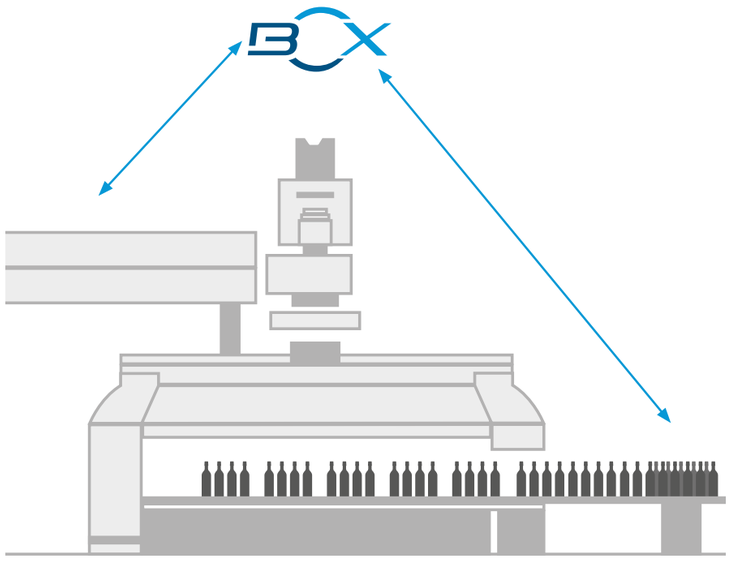


Process View closed-loop controls

The ‘’process-view closed loop control’’ represents a key evolutionary step: from tier1 loops (in charge to control sub-processes) to systems looking at the forming process from a higher level perspective, of which BoX is a unique example, putting the produced containers at the center of the measuring processes at the Hot-End.

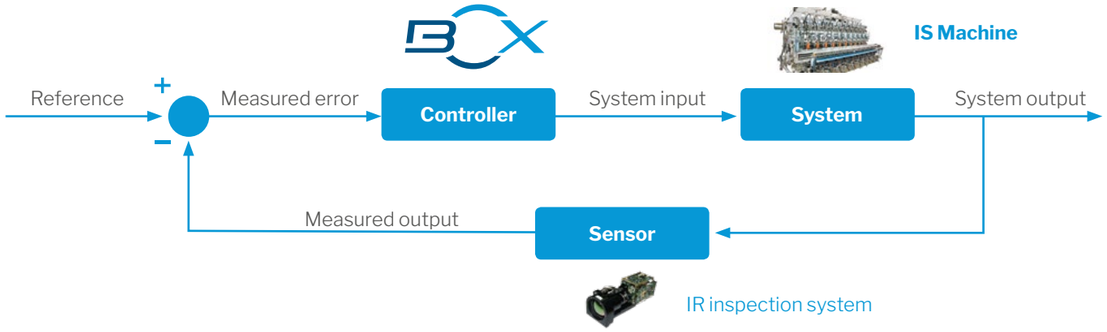


Looking at a complete hollow glass production line, from batch to palletizers, the essential element to control is the HE forming process: mastering the forming process is key to be able to control the overall production line.



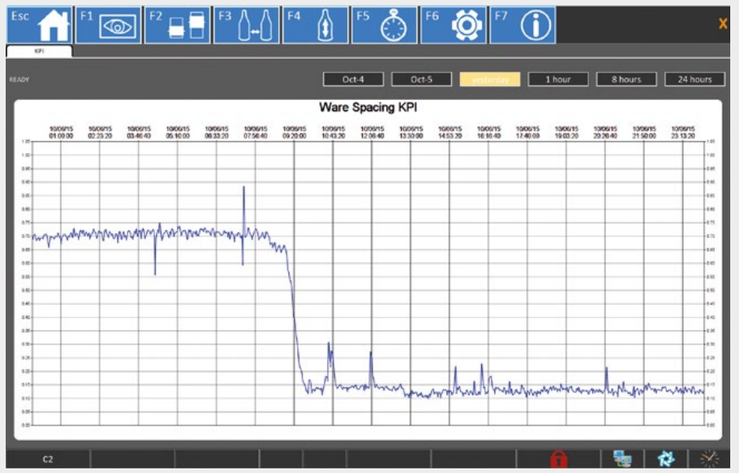
The Box Platform

The ‘’process-view closed loop control’’ represents a key evolutionary step: from tier1 loops (in charge to control sub-processes) to systems looking at the forming process from a higher level perspective, of which BoX is a unique example, putting the produced containers at the center of the measuring processes at the Hot-End.



Ware Spacing Control and Optimization

- Implement the automatic control and optimization of ware spacing
- Achieve a stable ware spacing between all bottles



Benefits

- Less stuck and fallen ware
- Less coating hood jams
- Faster job changes

Reduction of position error thanks to the ware spacing control

The Box Platform

Goals of Vertical Glass Distribution Control

The BoX controls and maintains the vertical glass distribution under continuously changing operational conditions (due to the environment and to the production process):

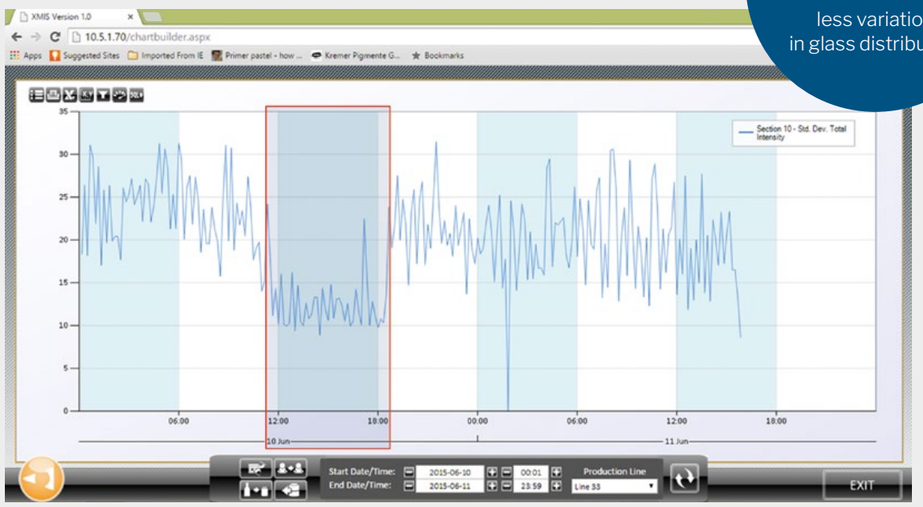
- Feeder temperature & pull changes
- Glass conditions changes
- Temperature changes
- Blank heat transfer changes (new Blank)
- Blank swabbing
- Section stop/start

BoX effects on VGD

- Less VGD variations on single containers
- Less VGD variations over time (process variations)

48%

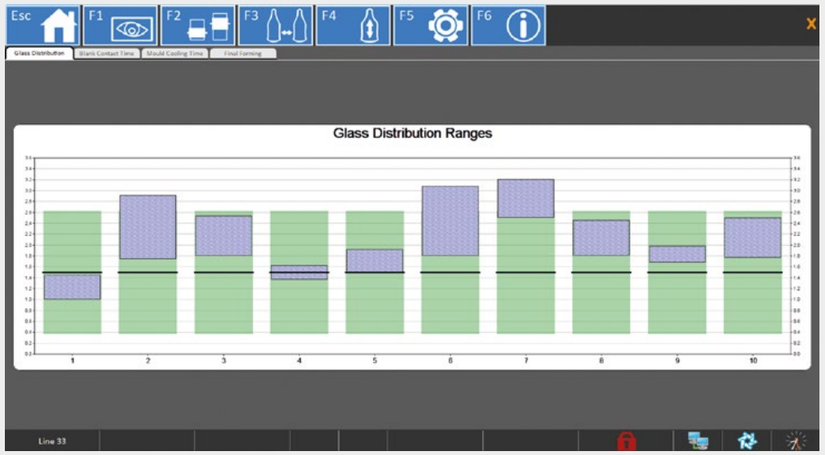
less variation
in glass distribution



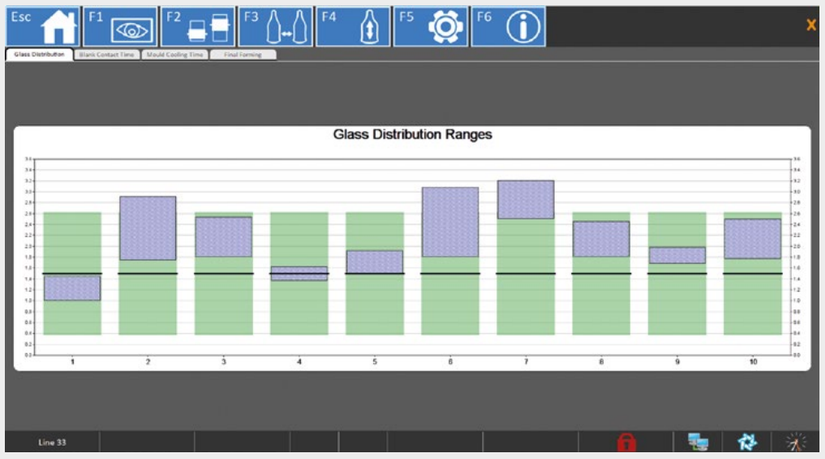
On line infra-red images of containers at the hot end

The Box Platform

- Less VGD variations between different sections
- All bottles with the same glass distribution profile



VDG variation per section with Box not active



VDG with Box active

BoX vs. Blank Temperature control

The blank temperature control implemented by the BoX is based on the effects observed on the produced containers, thus to enforce the overall control of the Vertical Glass Distribution.

BoX keeps constant the vertical glass distribution, not just the blanks temperature

GD variations due to pure blank temperature control.

GD variations due to pure blank temperature control.

Evolution of the BoX concept

The BoX platform is evolving to embrace a wider set of automatic controls and applications, putting together Process knowledge, sensors and measures on the most critical process areas, taking advantage from modelling and simulation techniques to create new models for automatic controls, using industrial automation to implement them as part of the Bottero automation platform and create a global system to control and optimize the production process.

The roadmap towards a predictive model of the production process

Sensors:

Integrate sensors to measure critical sub-processes.

Closed-loops:

Control each critical sub-process to minimize drift and variations (furnace, feeder, gob forming, gob loading, parison forming, final blow, transport, ...).

Big data storage:

Connect all systems on a network and store data in a common information base (Furnace, Feeder, IS-machine, Hot End sensors, Cold End inspection equipment,...)

Big Data Analysis:

Connect all systems on a network and store data in a common information base (Furnace, Feeder, IS-machine, Hot End sensors, Cold End inspection equipment,...)

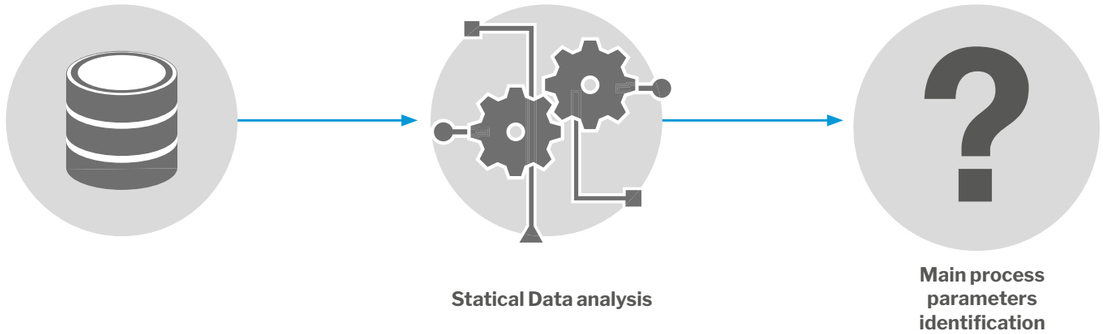
Machine Learning:

Connect all systems on a network and store data in a common information base (Furnace, Feeder, IS-machine, Hot End sensors, Cold End inspection equipment,...)

Big Data Analysis

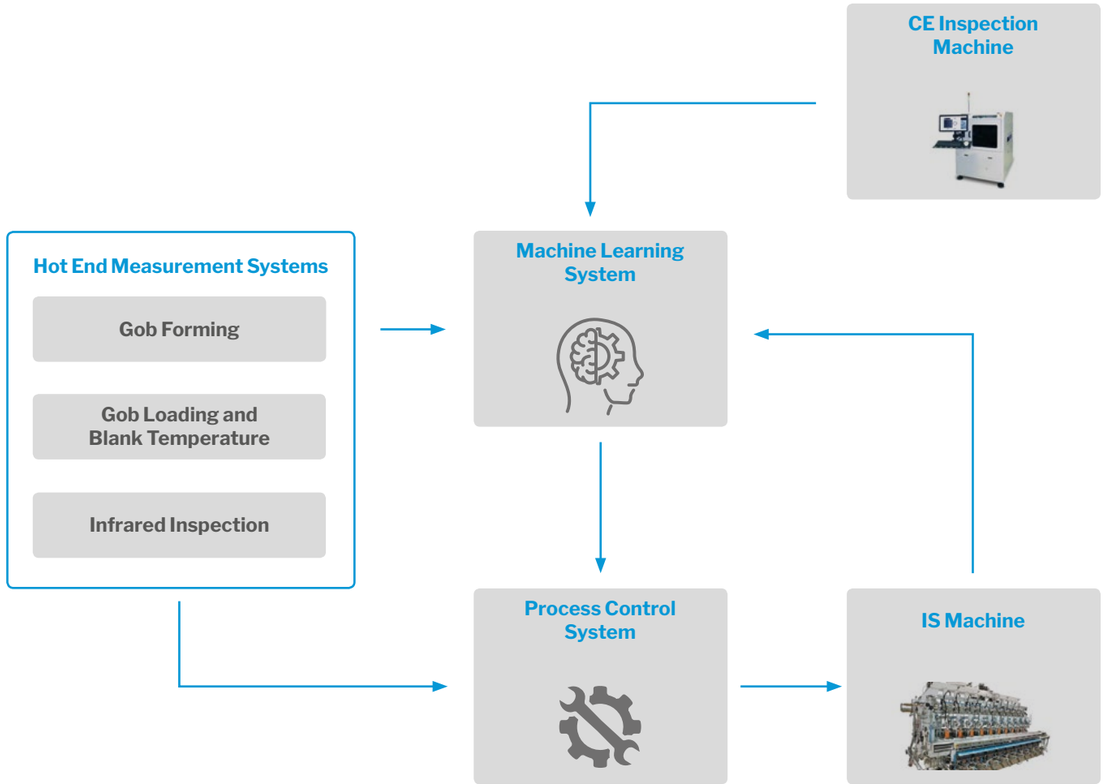
The Big Data approach has the purpose to analyze measurements and data to learn the optimal process behavior, in particular:

1. **Identify the key process parameters that most affect the final results in terms of:**
   - Correlation between HE data measurements (gob and parison data, IR measures, ...)
   - Geometrical characteristics of containers (weight, shape, verticality, etc.)
   - Glass thickness distribution
   - Major defects
   - ...
2. **Find out the optimal correlation between HE and CE data and measurements**



Machine Learning: definition of the process model

The **Process Control** system receives as input HE data and implements automatic corrections to the settings of the IS machine, according to the parameters of the correlation model coming from the Big Data Analysis.
As soon as CE measurements are available, the **Machine Learning** box adjusts and optimizes such model parameters according to the dynamic characteristics of the operational environment.



We support customers' development

Bottero, a global technological partner for customers growth

Thanks to the experience earned in the field through thousands of installations and thanks to the continuous and significant investments in research and development, Bottero has deserved the trust of many among the most important manufacturers of glass containers in the world. The **international** dimension of the company, the ability to be highly **innovative** and the **independent** market positionput Bottero in the ideal condition to supply every customer with solutions for the optimization of production processes and indications on new opportunities for technological investments.

Thanks to the presence in the hollow glass and flat glass sectors, Bottero can boast a widespread presence and top-class technical and commercial assistance.

Bottero S.p.A. - Headquarters
via Genova 82 - 12100 Cuneo - Italy

Bottero S.p.A. - Trana
Trana - Italy

Bottero S.p.A. - Pesaro
Pesaro - Italy

Revimac S.r.l.
Vicenza - Italy

Bottero GmbH
Grevenbroich - Germany

Bottero UK Limited
Rochdale - Great Britain

Bottero France SA
Nice – France

Bottero do Brasil
S.Paolo – Brasil

Bottero Flat Glass Inc.
Kernersville - North Carolina - USA

Bottero Glass Industry Co. Ltd
Shangai – China

Bottero has a unique know-how in glass processing available to customers who need technological development.

The images and data in this Catalog are only indicative and never override the contract engagement of Bottero S.p.A.
For photographic reasons the products are often shown complete with accessories that are not part of the standard equipment of the machine.

Discover the Bottero technology for Hollow Glass

Technology
Forming Machine
E-MOC Technology
Gob Forming
Servo Technology
Ware Handling
Pneumatic Mechanism

Automation
Architecture
Control System

Service
Forming Engineering
Customer Service

BOTTERO S.p.A.
via Genova 82
12100 Cuneo Italy
Tel. : +39 0171 310611
Fax : +39 0171 401611

www.bottero.com