

I4

NEXT  
GENERATION

MILLING SYSTEMS

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# The journey through Industry 5.0

1800's

## Industry 1.0

Mechanisation (Water and Steam Power)



1900's

## Industry 2.0

Serial Production (Electric Power)

2000's

## Industry 3.0

Automation (Computerizing)

2011

## Industry 4.0

Digitalisation (Internet Technologies) and  
Artificial Intelligence



2100's

## Industry 5.0

Unmanned Technologies

# I4: The Milling Technology of Next Generations

Alapala presents I4 – Next Generation Milling Systems, which provides the ability for machines to operate self-dependent and error proof without any human interaction.

We developed the world's next generation milling technology which provides:

**Consistent Quality**

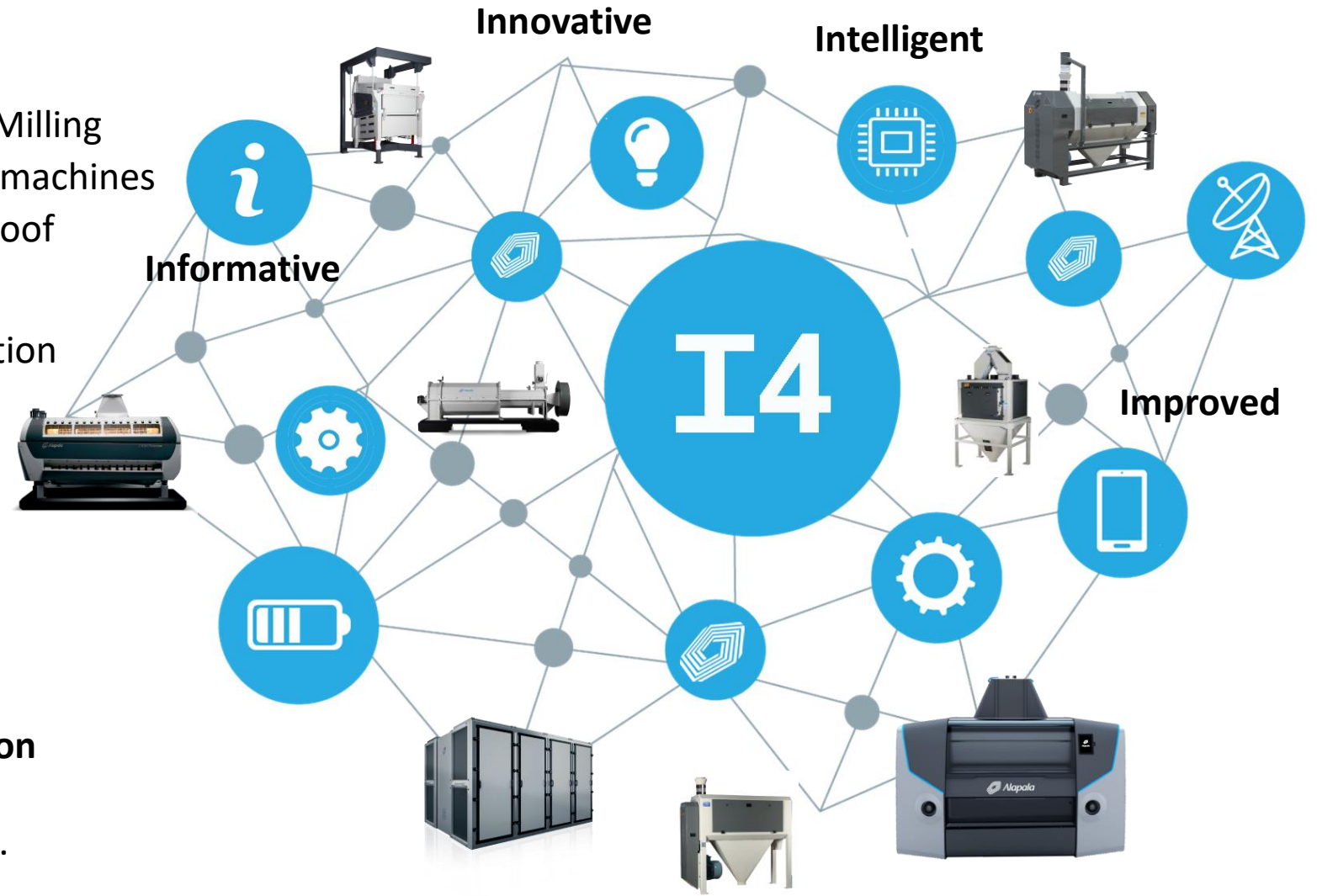
**High Reliability**

**Process Optimization**

**Energy Efficiency**

**Need for Less or No Human Intervention**

all together in the grain milling process.





# Technology

## I4 Next Generation Milling

### 1. IIoT (Industrial Internet of Things)

enables machines, systems, and even plants to connect and communicate with each other

### 2. Sensorization

Higher reliability of machines and closer control on process parameters

### 3. Algorithms

Autonomous Operation with a *'Reactive to Adaptive' Automation System*

# I4

## NEXT GENERATION MILLING SYSTEMS



# Automation System

I4 Next Generation Milling

Implementing the **Jidoka** (intelligent automation) approach into flour milling, we have developed a semi- autonomous system based on function blocks and sequential processes.

The automation system itself is self-decision, which is able to:

**Separate human from machine work**

**Machines detect/prevent abnormalities**

**“Stop the Line” authority in Operation**

**Reactive to Adaptive**

# I4

**NEXT GENERATION  
MILLING SYSTEMS**



# Automation System Reactive to Adaptive

For this approach, the plant automation system is programmed by using defined **Abnormality Cause Effect Classification** according to Severity and Effect degrees (case-reaction) by using many years experience and know-how of Alapala.

It has special algorithms to detect and react critical operating conditions, such as:

Find/detect the abnormality

Fix the problem and solve the root cause without operator touch

Adapt the system

Send notification for information and intervention if operator touch is necessary



## I4

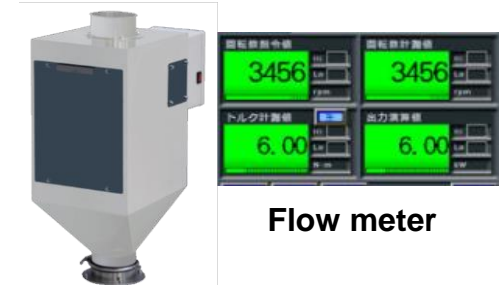
NEXT GENERATION  
MILLING SYSTEMS

# Principles

## I4 Next Generation Milling



Machine Operating Parameters  
by sensors



Flow meter



Processing Parameters  
by sampling and further analysis  
devices



NIR Ingredient analyzer

Product Specifications  
by Online NIR



Real Time

Process Monitoring System  
allowing remote control

We have used IIOT TECHNOLOGY including sensors that are our eyes on process monitoring and reacting for machines /equipments paramaters, process parameters and product parameters; and achieved to have **I4 Milling System** which operates without human touch.



### High Temperature Detection for Rolls

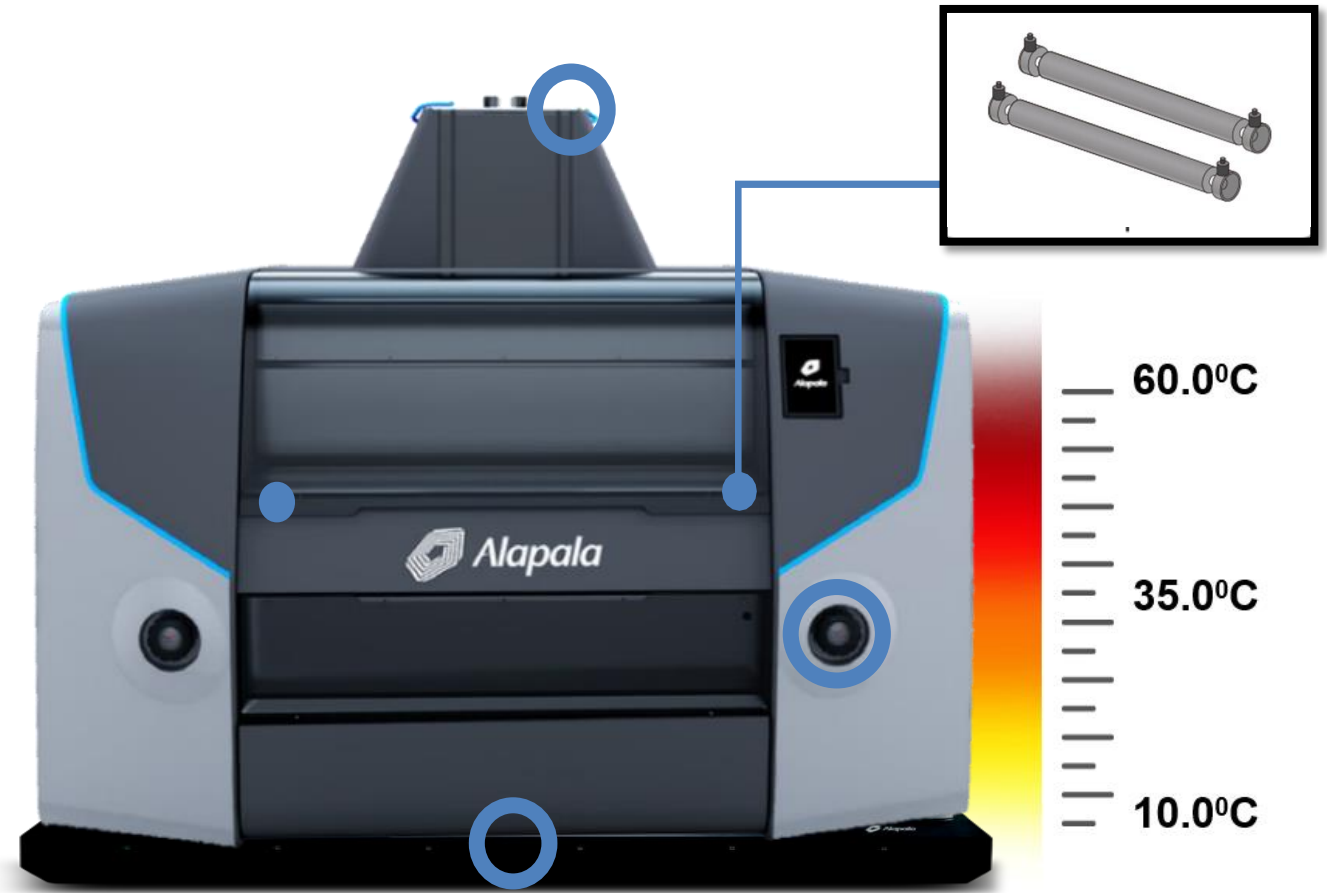
**Effect:** Safety risk, wearing roll surface, unbalanced granulation, extra Energy consumption, ash value

**Actions:** Check the roll gap alignment, product feeding flow rate, scraper position

### High Vibration Detection for Rolls

**Effect:** Safety risk, wearing roll surface , damaging machine parts including electronics

**Actions:** Check the roll gap alignment, product feeding flow rate and distribution, running hours and greasing period (MMS)



Temperature and Vibration Monitoring  
Flow Monitoring (sensors at inlet-outlet)  
Half Automatic Roll Gap Adjustment System



# Process Parameters

In process we used special sensors to ensure the high reliability and consistent performance of the system.

- . Cleaning Effectiveness (% impurity)
- . Humidity / Water Metering

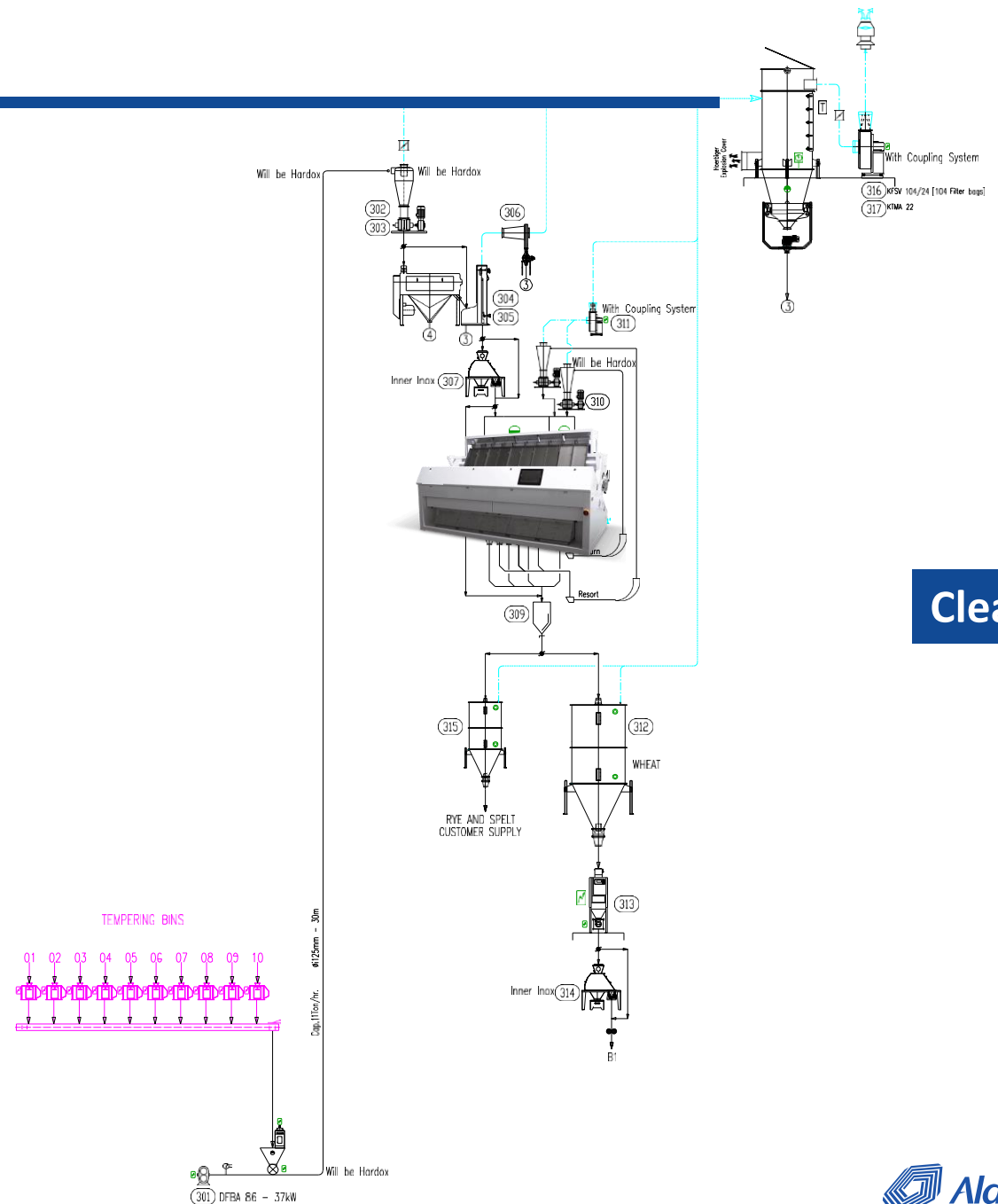
## Insufficient Humidity of Wheat at Dampening

### Effect:

Negative impact of roller mill grinding operation, yield and capacity problem, profit decreasing, extra energy consumption, noise, increasing ash value.

### Actions:

Increase the adding water amount to wheat by using auto dampening system.



Cleaning

# Process

## Parameters

In process we used special sensors to ensure the high reliability and consistent performance of the system.

Rotation, outlet sleeves position, and hanging position control sensors

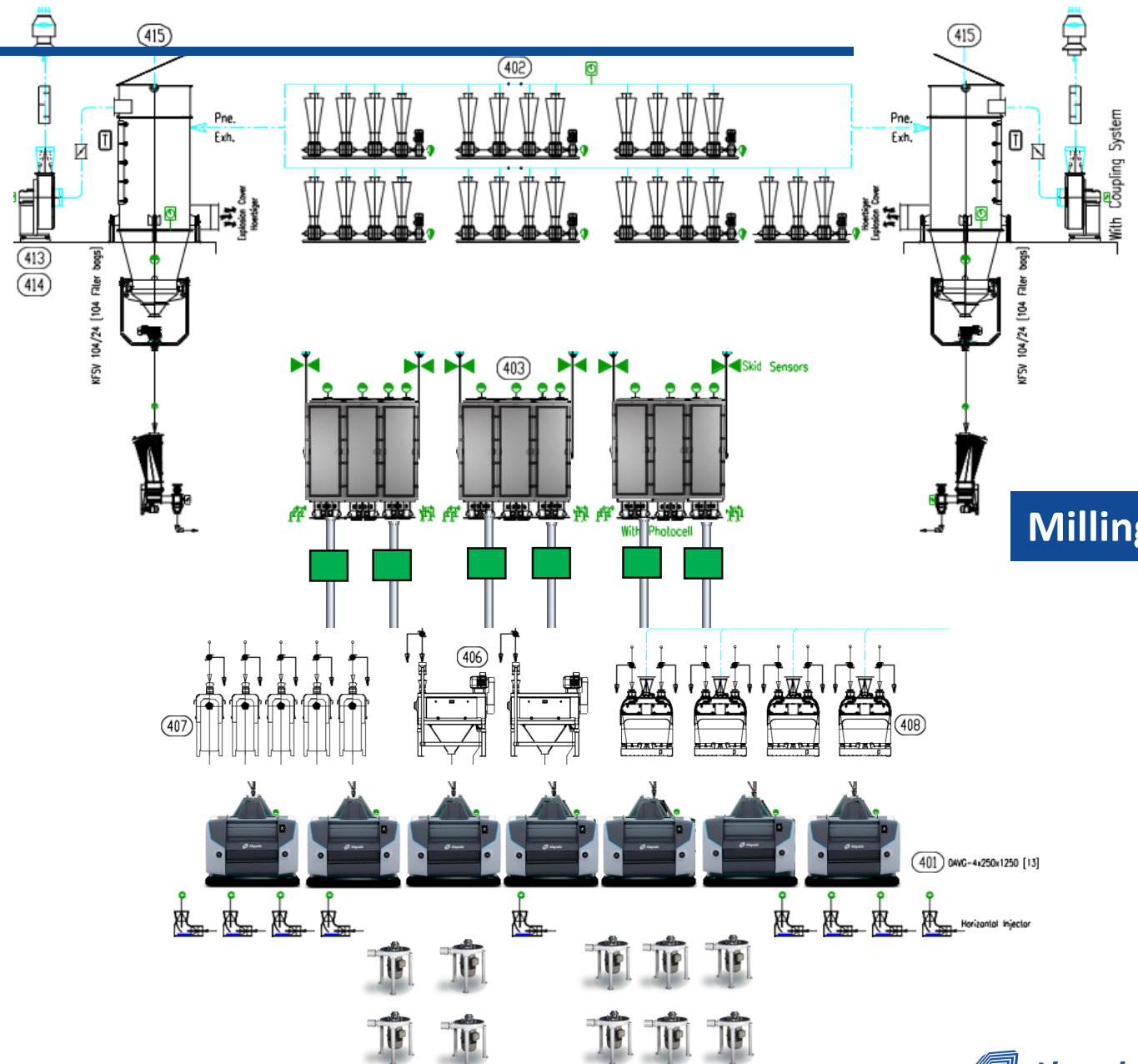
in plansifters

Particle size distribution measurement

with flow meters

Clogging sensors

(Impact detachers, injectors, inlet/outlet of roller mills and plansifters, etc.)



Milling

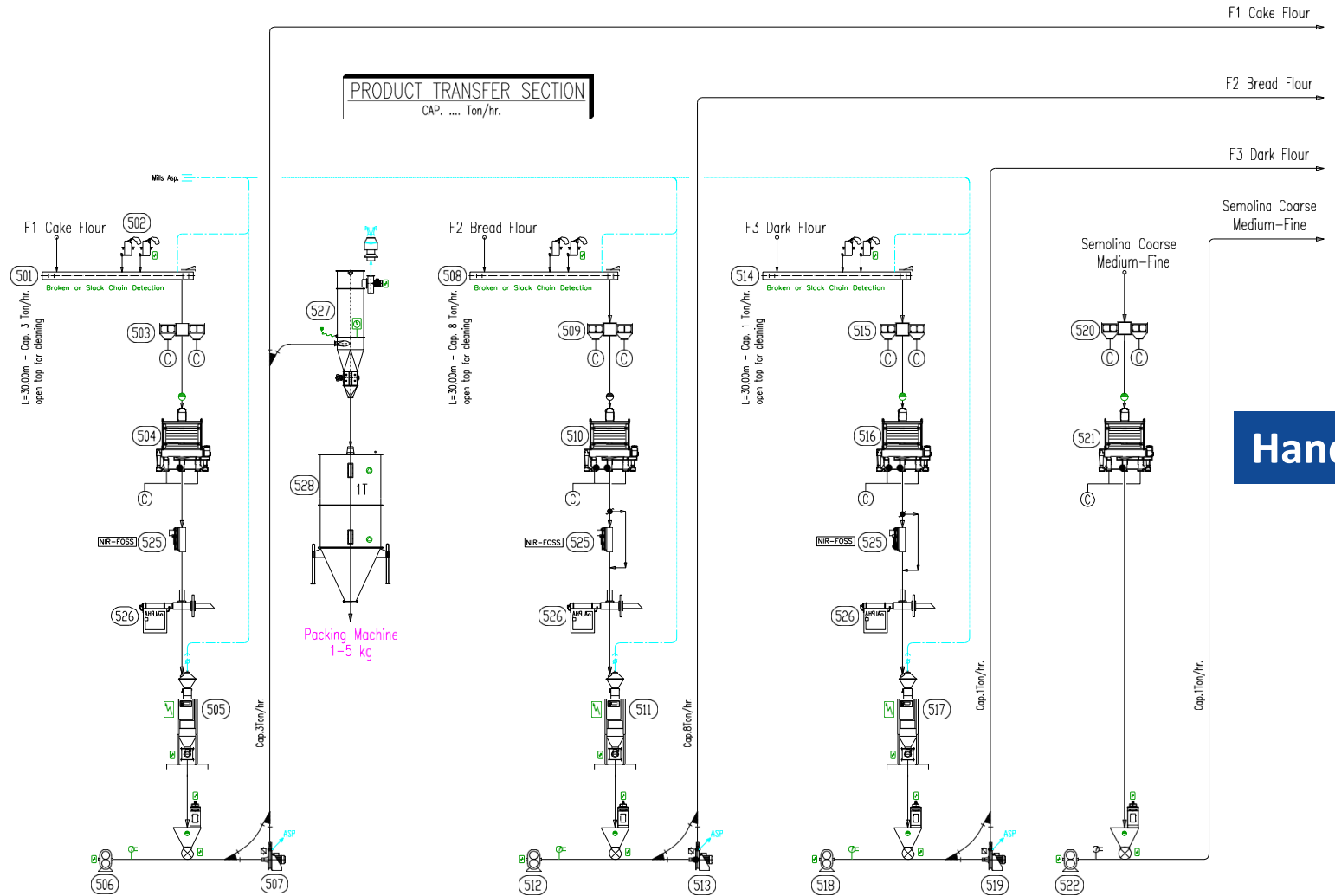
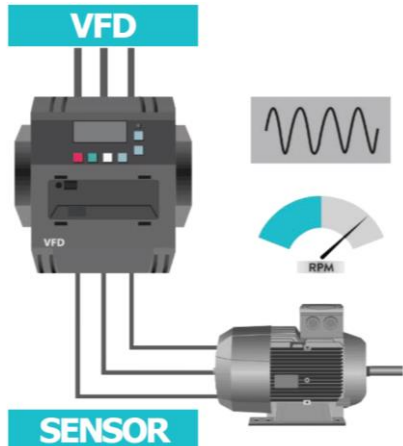
# Process Parameters

## Mechanical Handling

Safety Sensors (choking, skidding of the belt and chain, etc.)

## Pneumatic Handling

Process optimization and energy saving with 'VFD and pressure sensors' in fans, blowers, compressors etc.



Handling



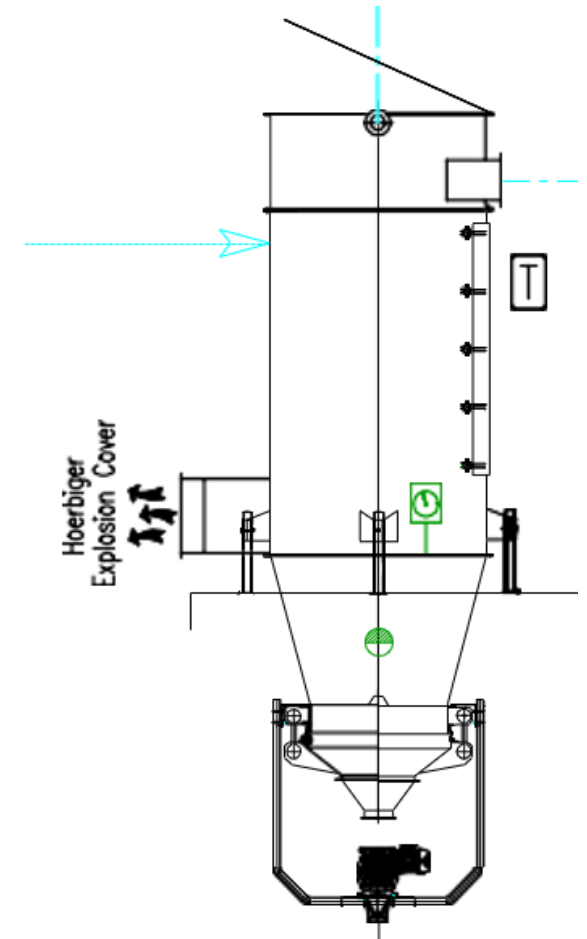
### Controlling the Cleaning of Filter Sleeves and Adjustment of Pneumatic Air Pressure

#### Effect:

Capacity decrease, yield decrease, extra energy

#### Actions:

- Check the pneumatic line pressure and flow rate accordingly adjust the fan speed by using VFD.



Pressure Sensor  
Choking Sensor

### 1. Recipe Management (Flow balancers)

### 2. Raw/Finished Product Quality

(Protein, Moisture, Ash, Gluten, etc)  
measured by online NIR devices at:

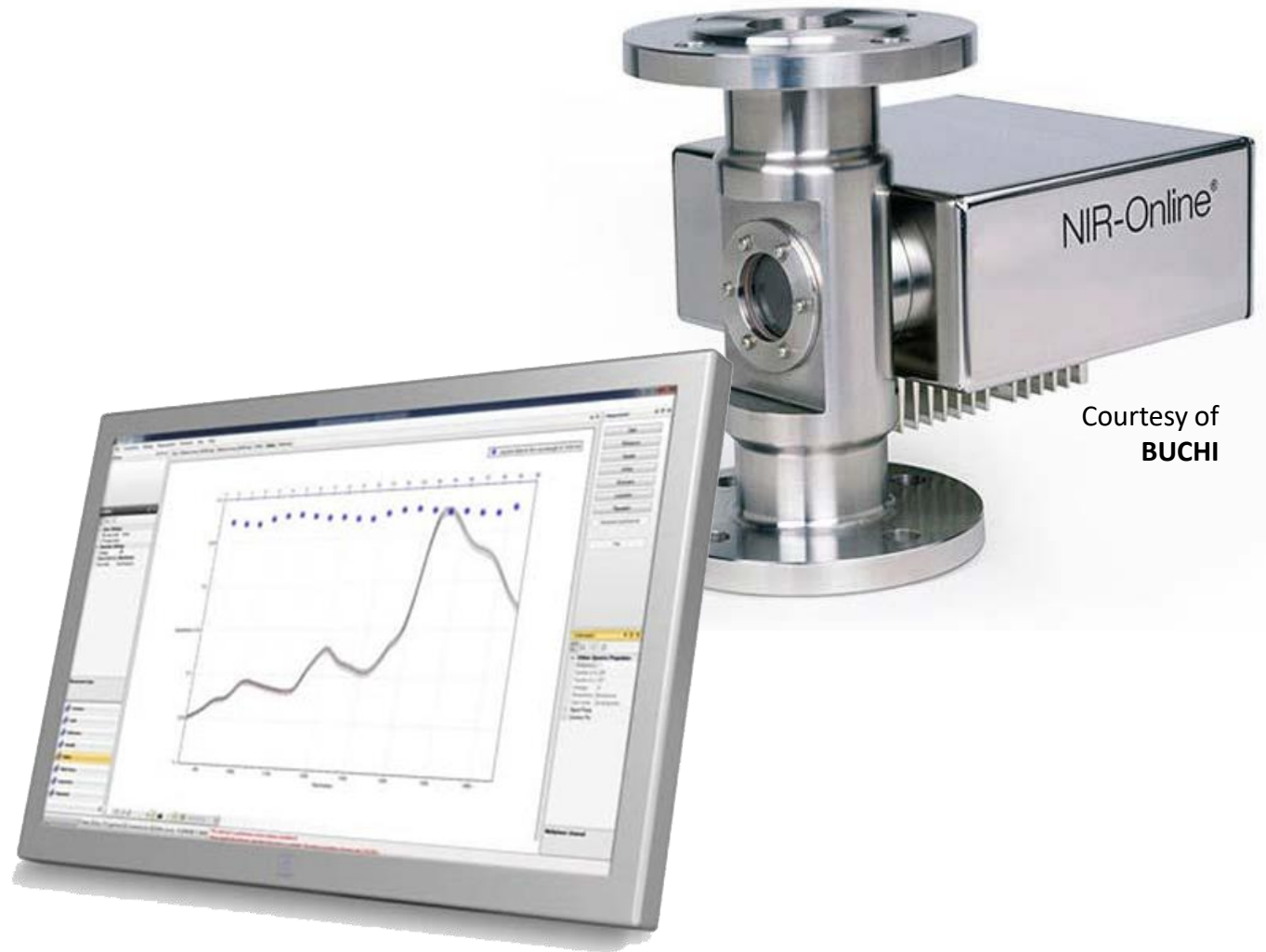
- . Reception
- . In Process
- . Finished Product

### 3. Yield Control

#### **Flour Ash Value out of specifications (NIR)**

Effect: Poor quality of flour and customer claim

Actions: Check humidity ,roll gap, roll temperature, sieves



Courtesy of  
**BUCHI**

**Alapala Plant Management System (APS) includes:**

**MIS (Management Information System) with SCADA**

Receipt and Storage Management

Recipe Management

Yield Monitoring

Temperature and Vibration Monitoring

Energy Monitoring

OEE

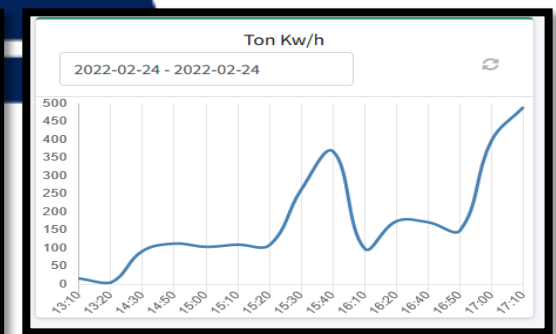
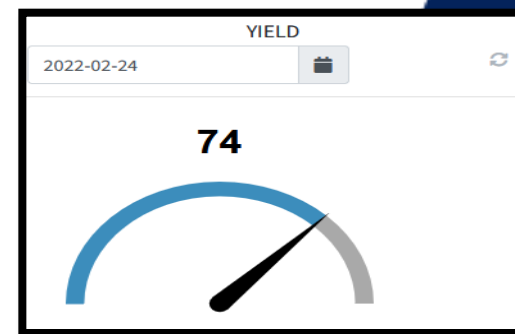
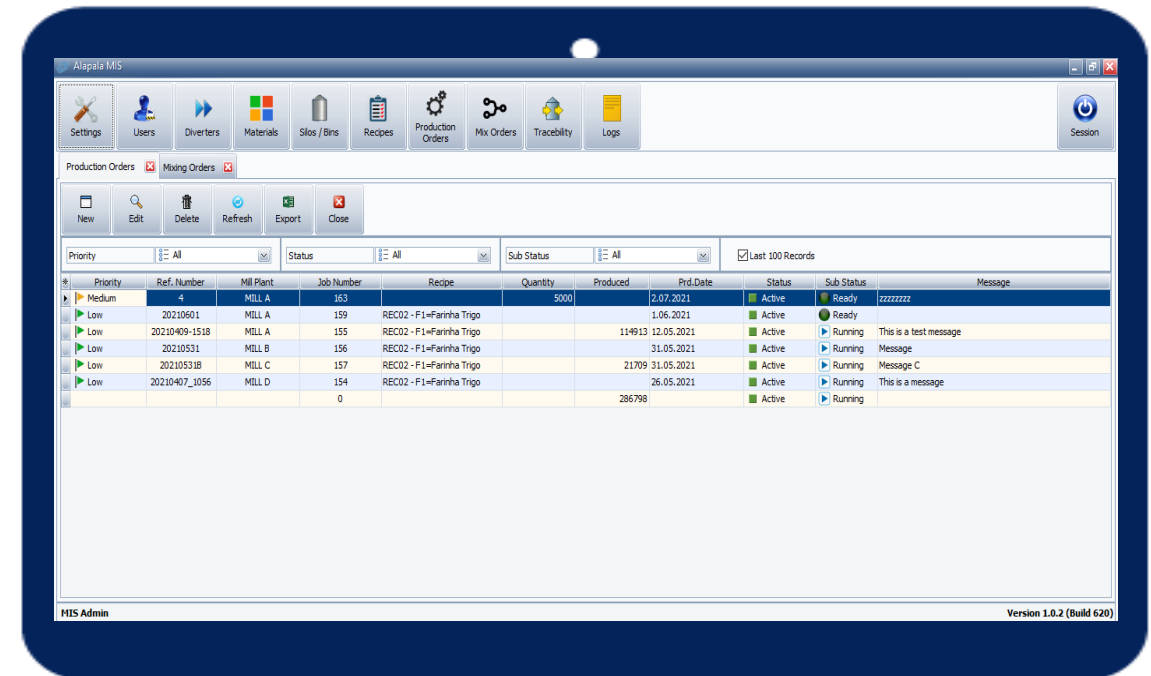
Traceability

**MMS (Maintenance Management System )**

Planned/Unplanned maintenance, instructions, spare parts

Downtime Monitoring

**Remote Monitoring**

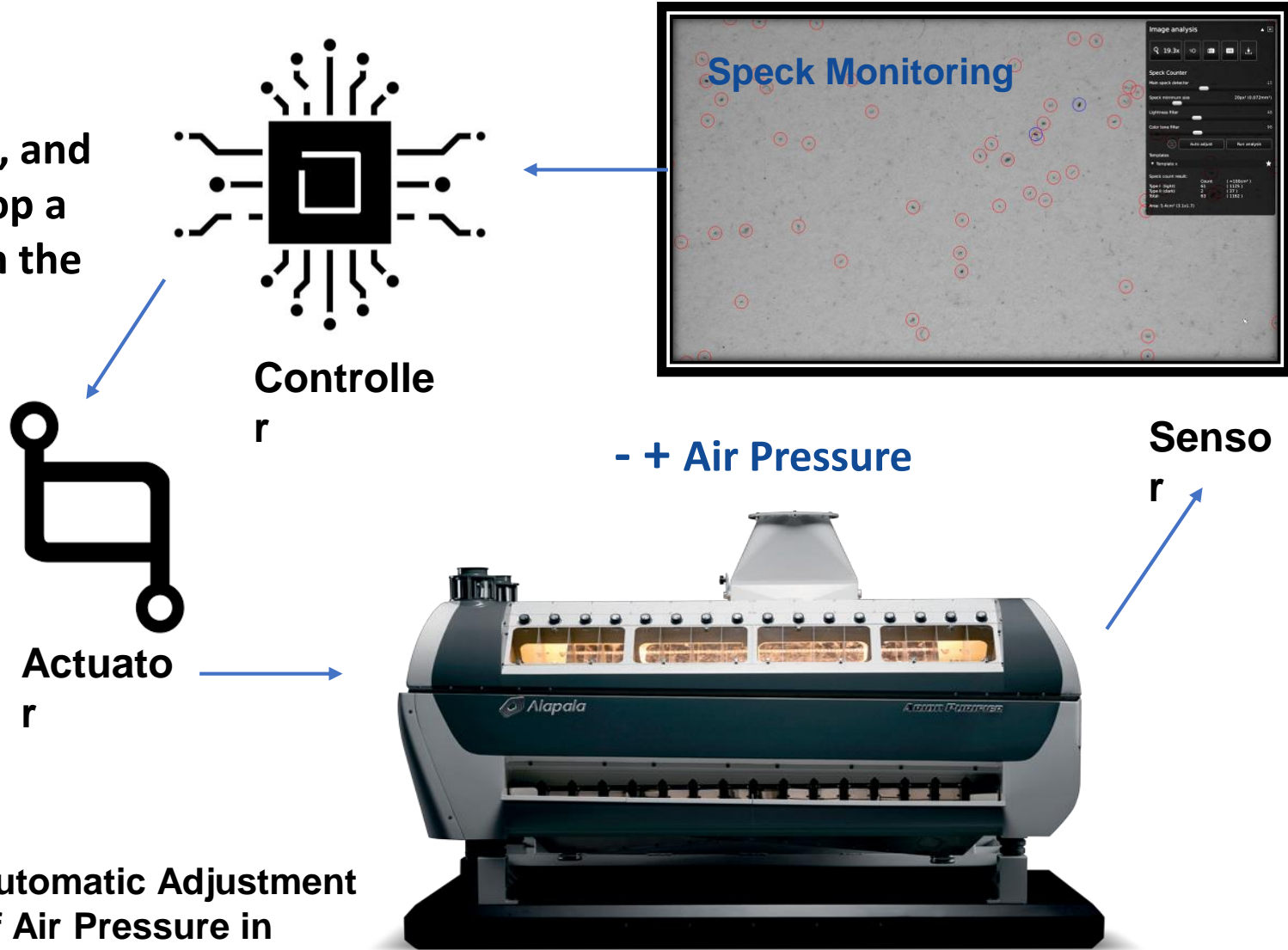




# What is waiting for us in the near future?

In the next step, we will use the combination of sensors, controllers, and actuators in our machines to develop a 'fully automated milling plant', with the abilities of:

- . Self Management
- . Process Optimization
- . Standardization



# What is waiting for us in near future?

Regarding automation technologies, we will develop a 'thinking milling system' using:

Data Collection

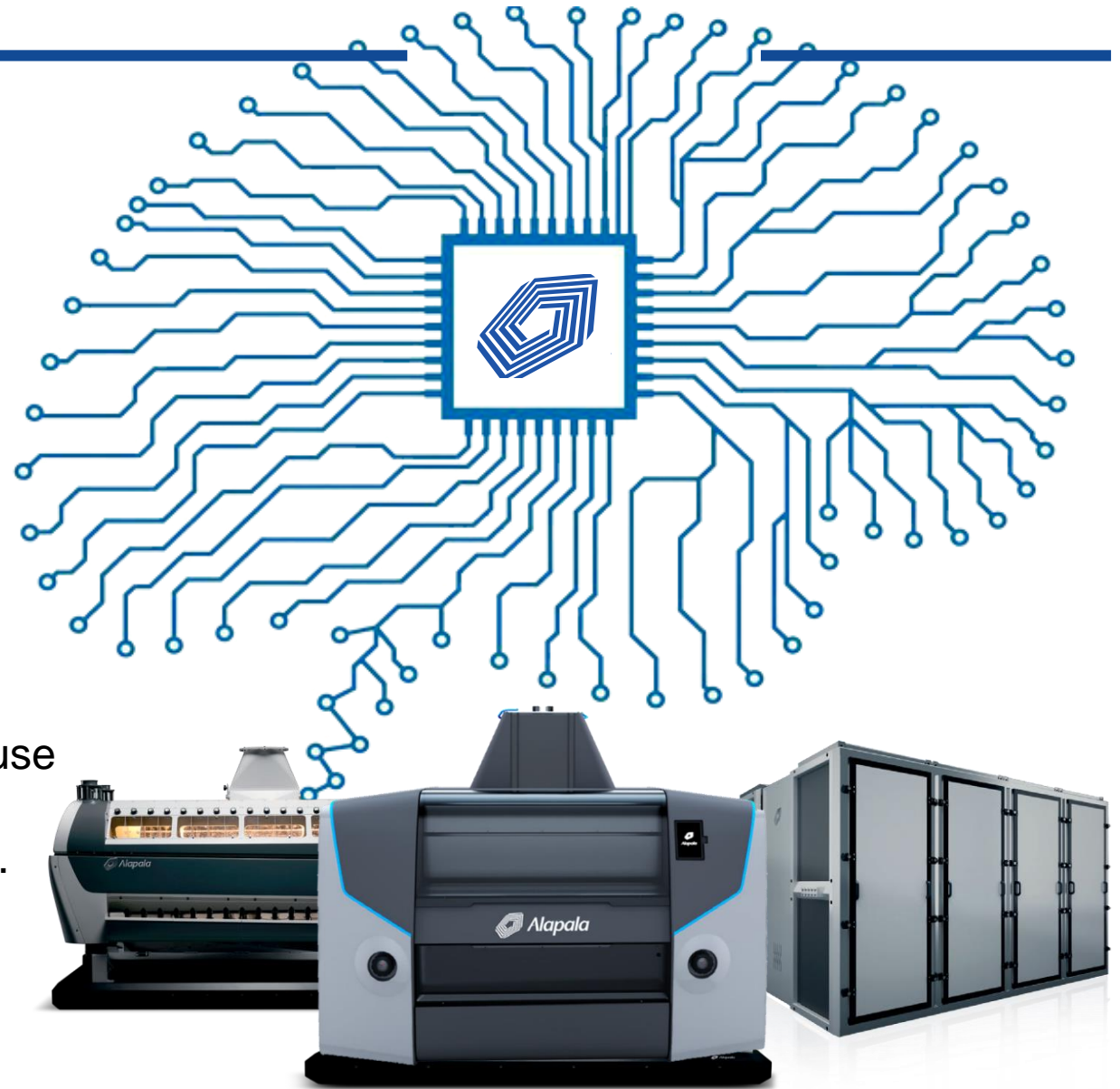
Data Analysis / Engineering

Modelling

Machine Learning

**Decision Making Systems with AI**

Build algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data becomes available.



# CONCLUSION

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## **A Miller Can Not Be Replaced!**

To conclude, it is always important for us to know what millers require to automate your milling facilities. For this reason, we humbly request you to advice us of your requirements. This will enable us to design, engineer and provide a system tailor-made to your specific needs.



Thank You \_\_\_\_\_



*Alapala*

Further Questions:  
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[alapala.com](http://alapala.com)