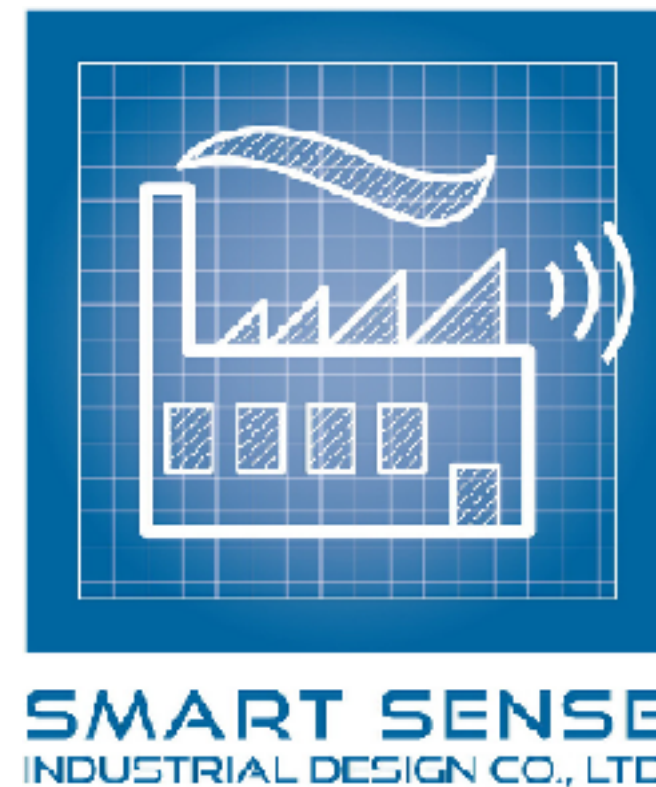


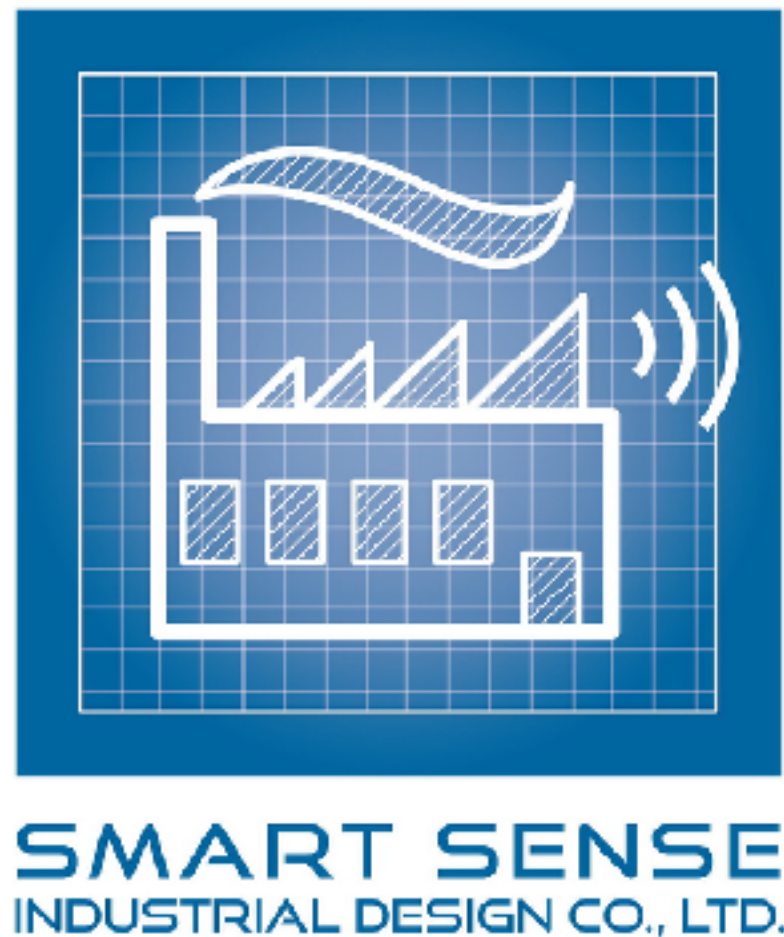
# Industrial IoT & TinyML Opportunities

Apinun Tunpan  
Chief Technology Officer  
April 2024

[apinun@smartsensedesign.com](mailto:apinun@smartsensedesign.com)



# Sustainable Industrial Digital Transformation Made Easy

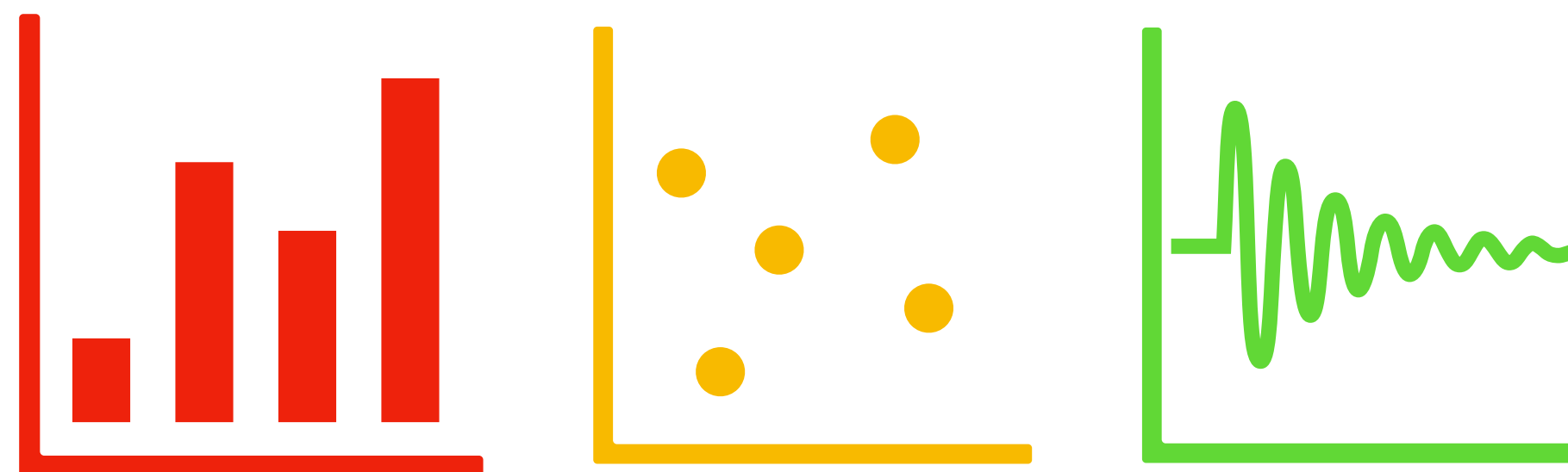
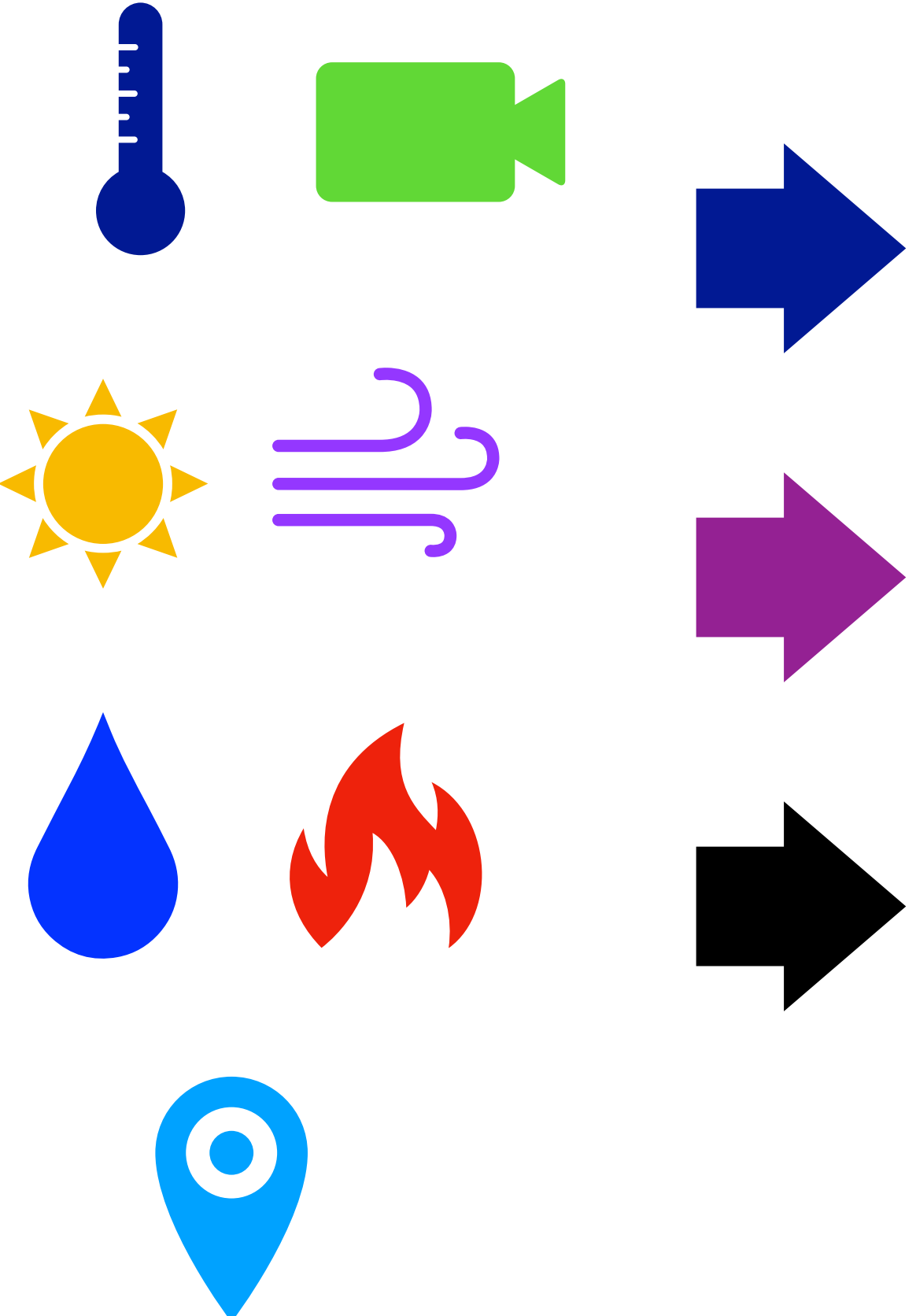


**Why do we mainly focus on AI+IIoT ?**

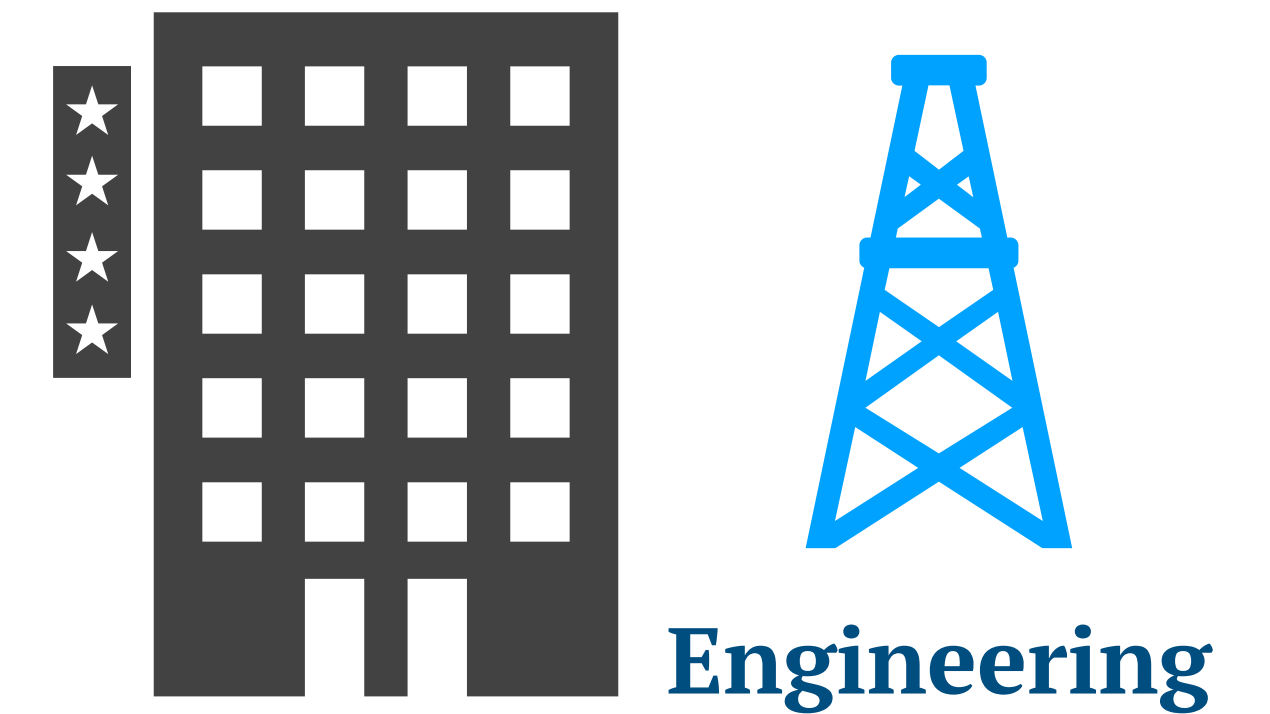
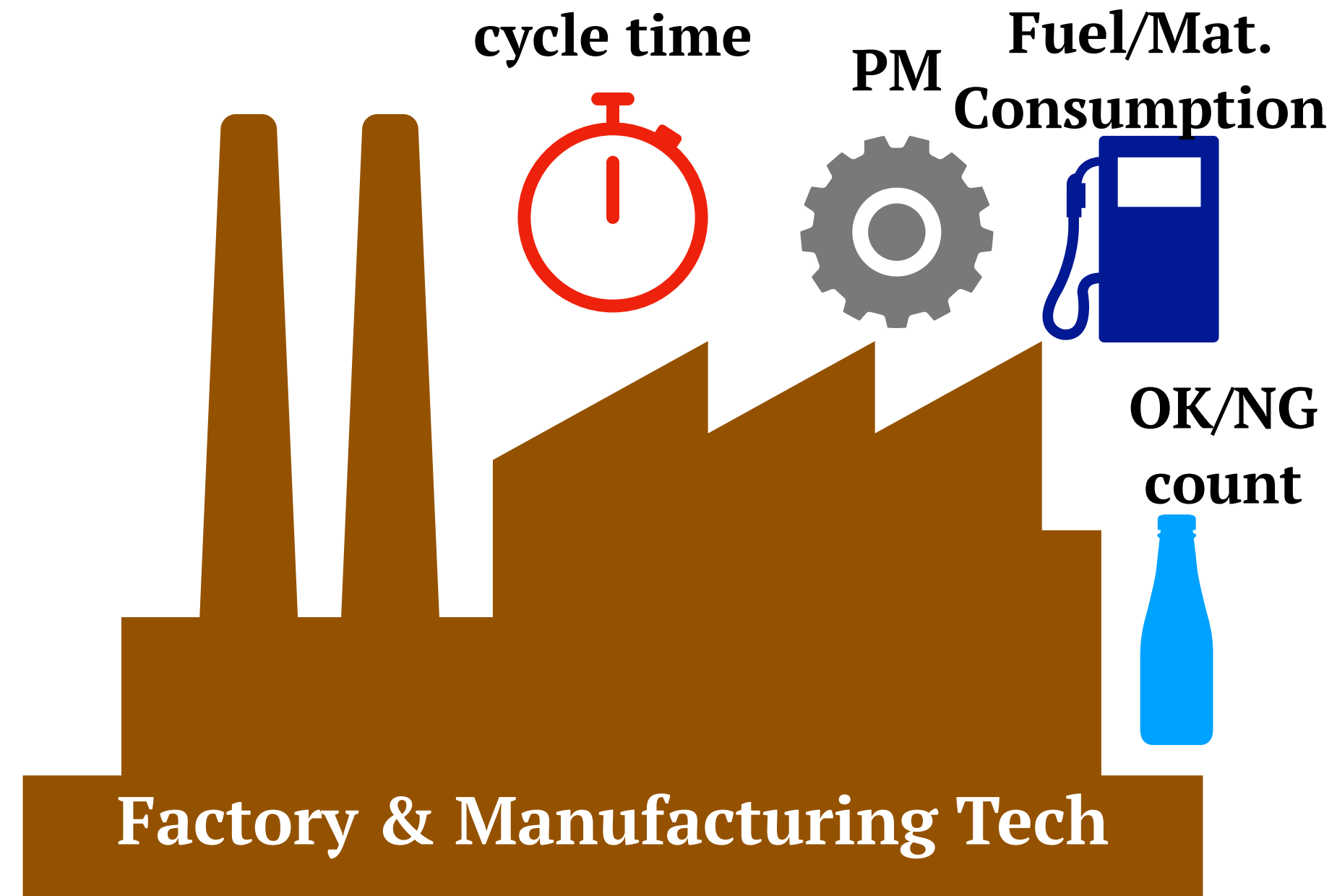
- Market size
- Environment, Social, and Governance Impacts

# Our Core Services : Data Acquisition and Analytics for Process Monitoring & Decision Making

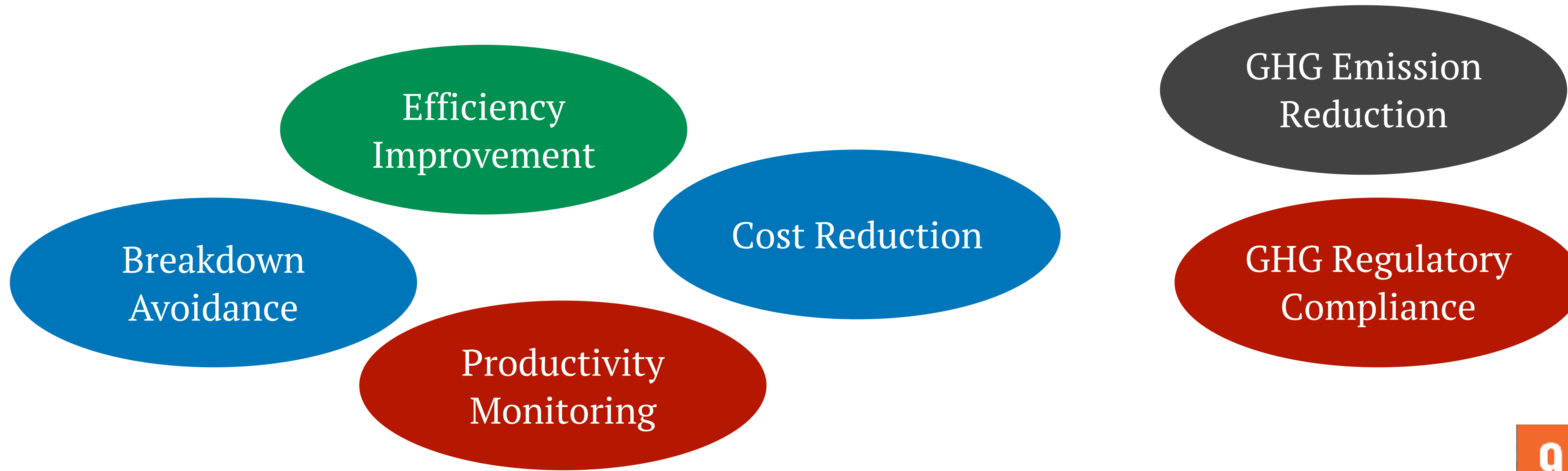
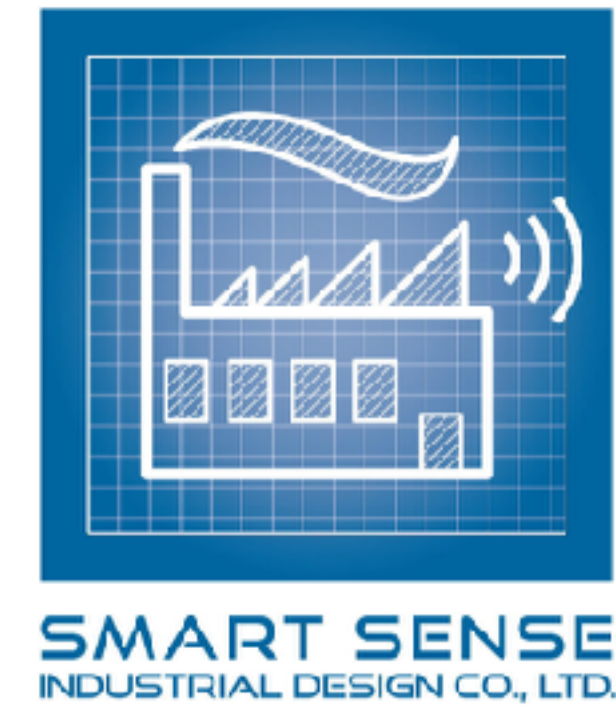
## Sensors



# SMART Sense's Data Acquisition and Analytics Experiences



# The Problems



**Manufacturing**



**Transportation and Logistics**



# Common Pain Points ปัญหาที่พบบ่อย ๆ



อุบัติเหตุ การบาดเจ็บ  
Accidents & Injuries



เครื่องเสีย  
Machine Breakdowns



เวลา / คุณภาพ / ต้นทุน  
Time, Quality and Costs

# Common Gain Points    สิ่งที่จะช่วยเพิ่มผลงานให้เราได้



การวางแผนการผลิต  
Planning & Scheduling



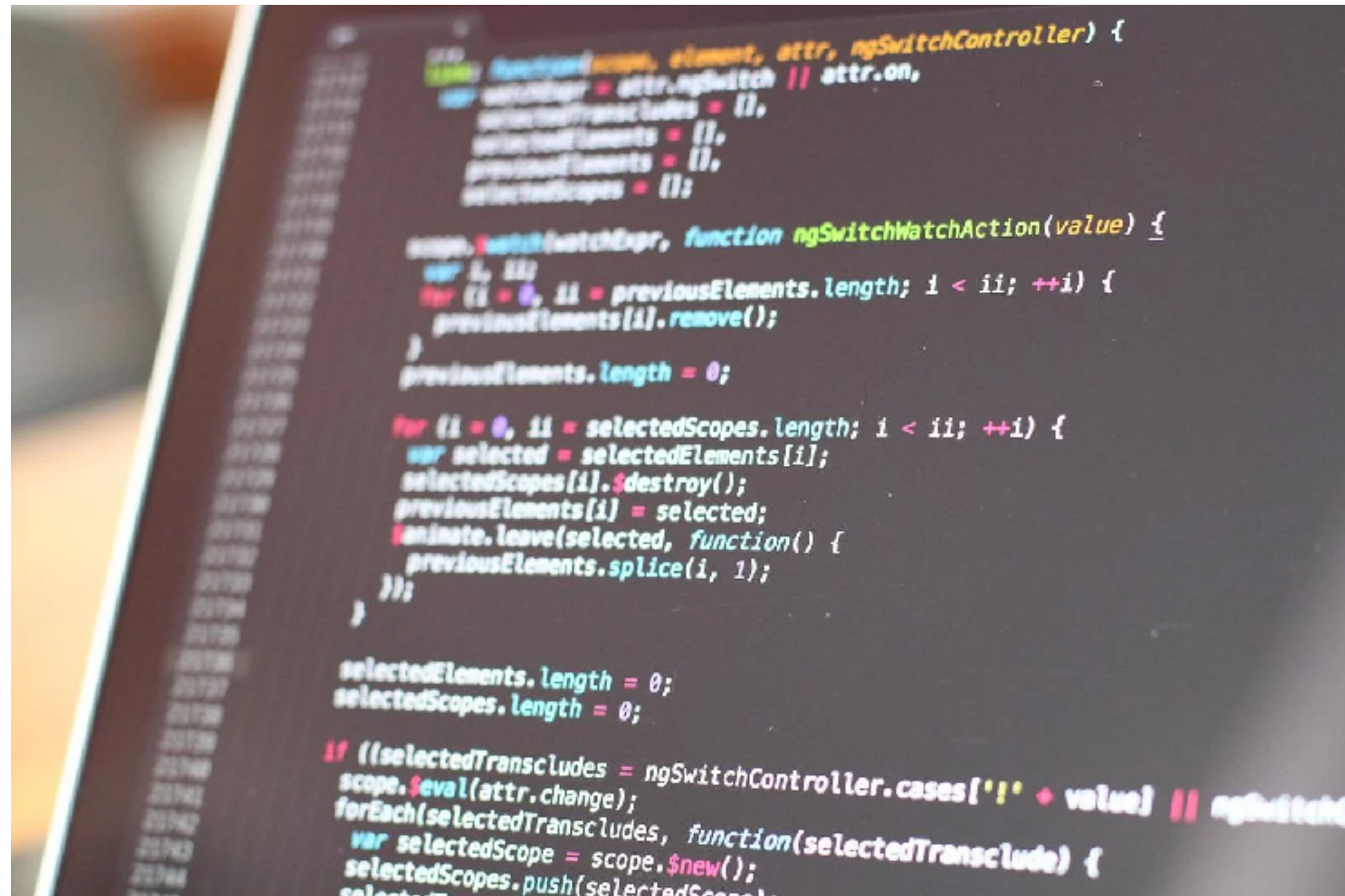
การติดตามเผ้าระวัง  
Monitoring & Tracking



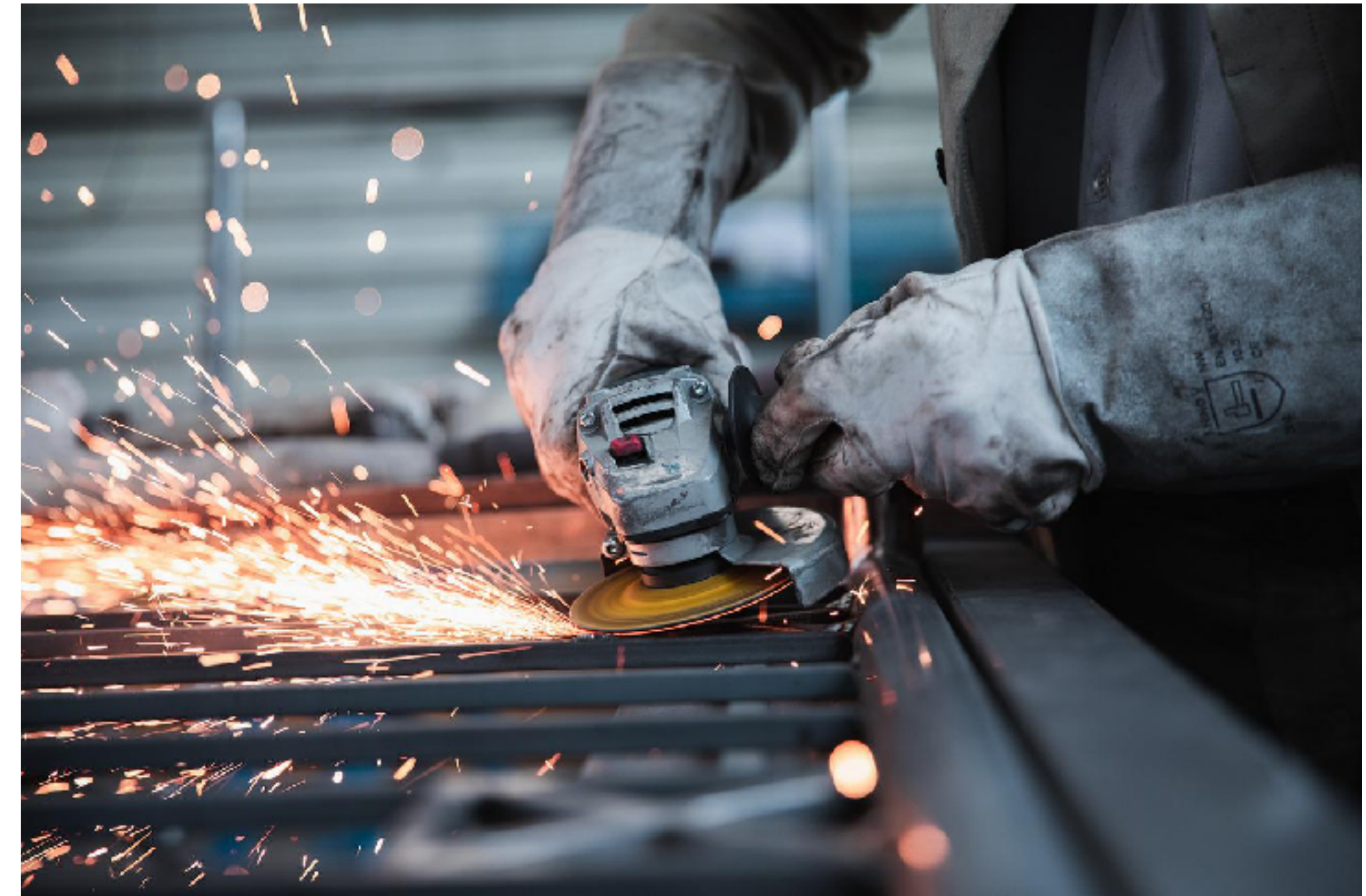
การตรวจสอบควบคุมคุณภาพ  
Quality Inspection

# Digitalization : The use of digital technologies in our processes

## Information Technology (IT)



## Operational Technology (OT)

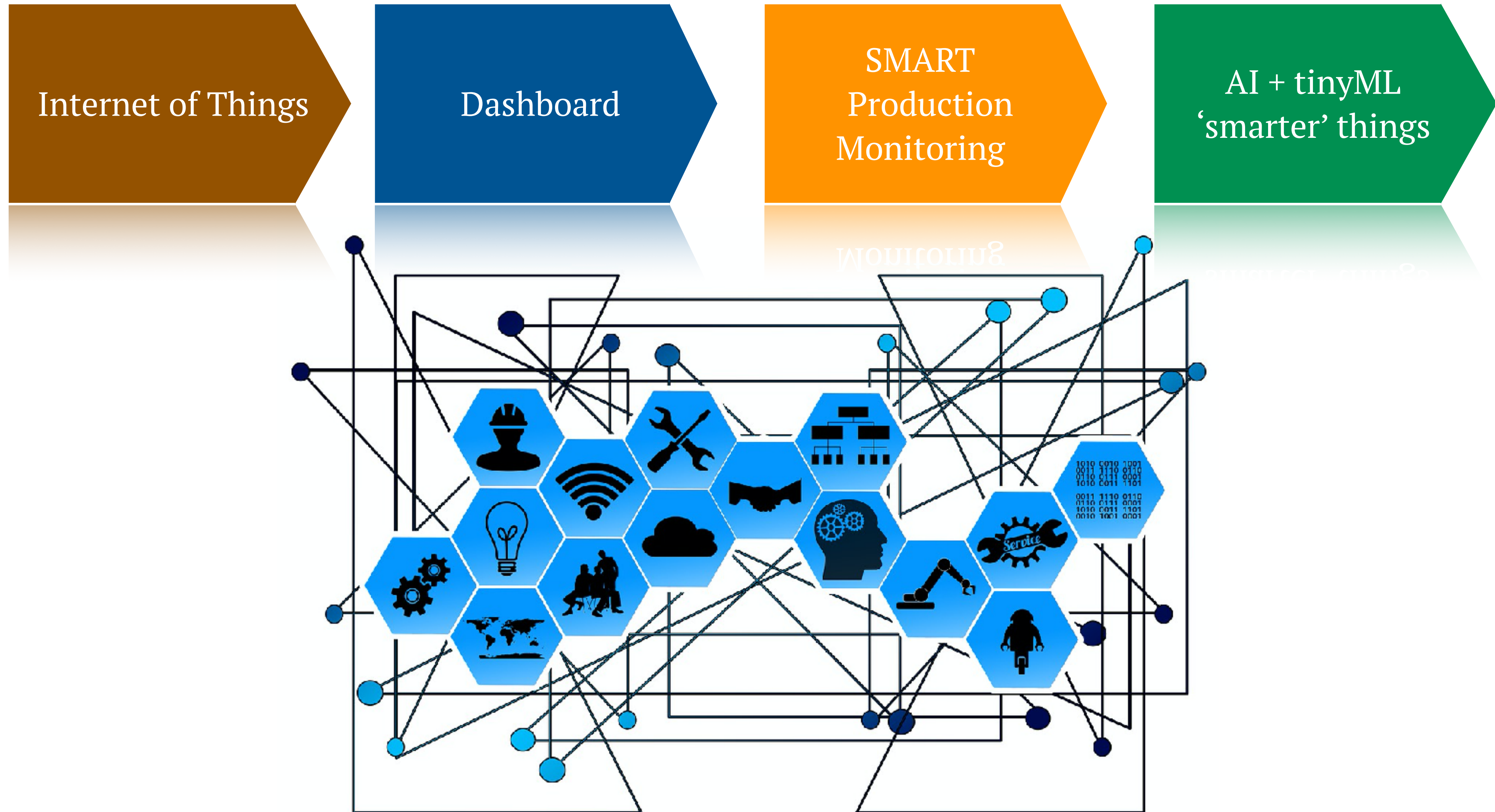


Some of the most important things in Industry 4.0 are **Data Making** and **Acting upon that Data**

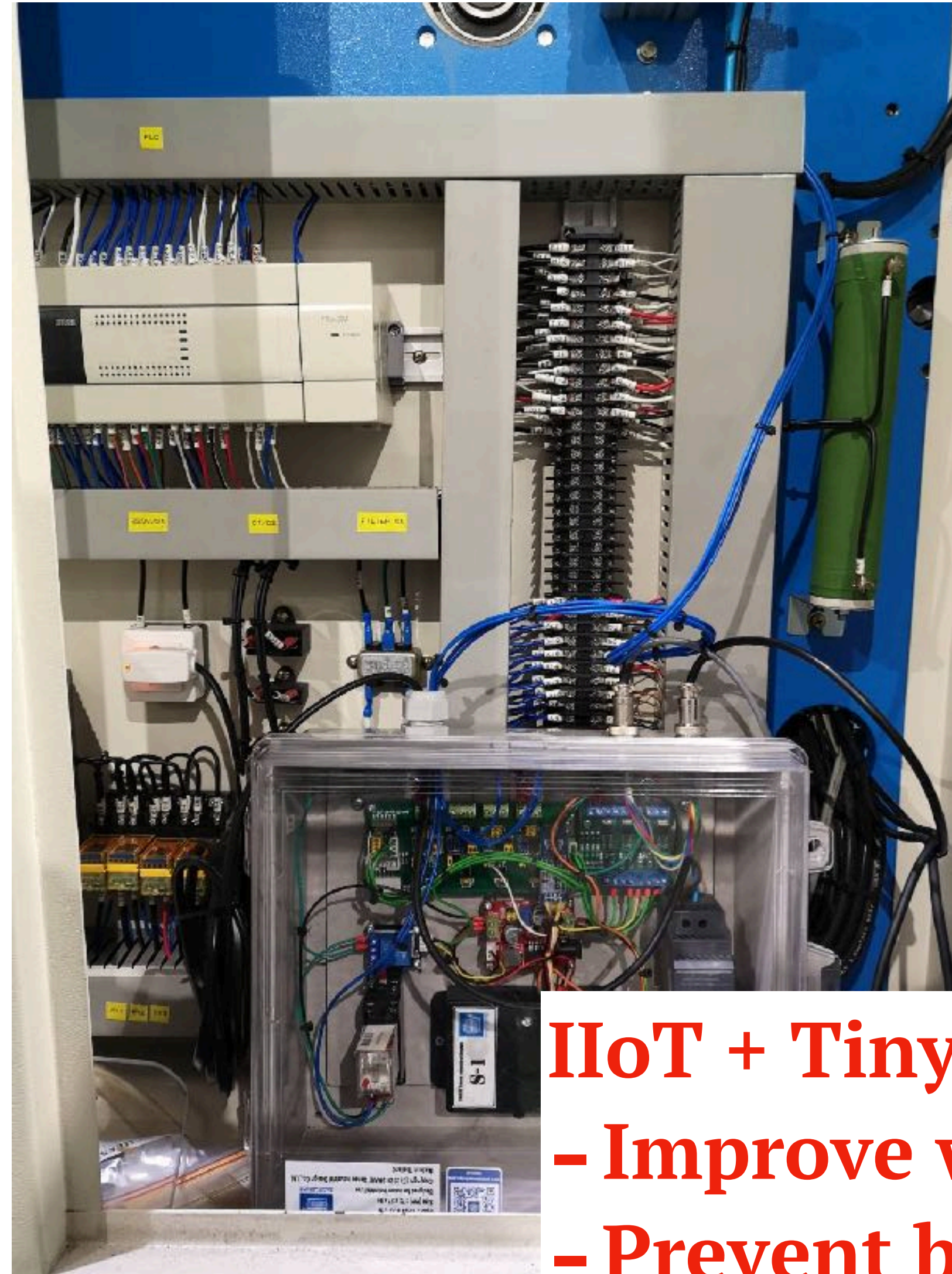
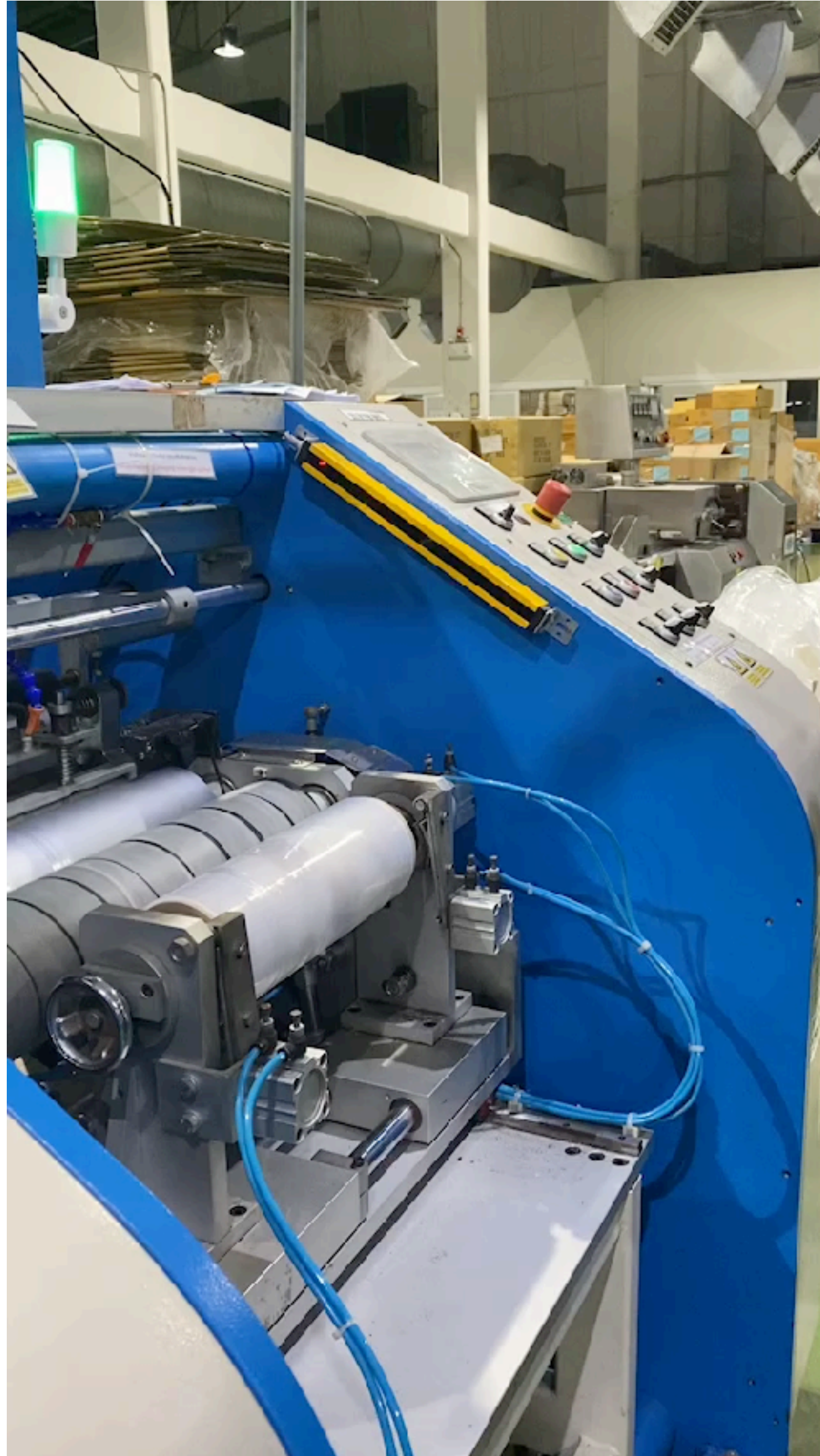
สิ่งที่สำคัญอันดับต้น ๆ ใน Industry 4.0 คือ การสร้างข้อมูล และการนำข้อมูลไปใช้



# Typical IIoT Value Creation for our Industrial Customers

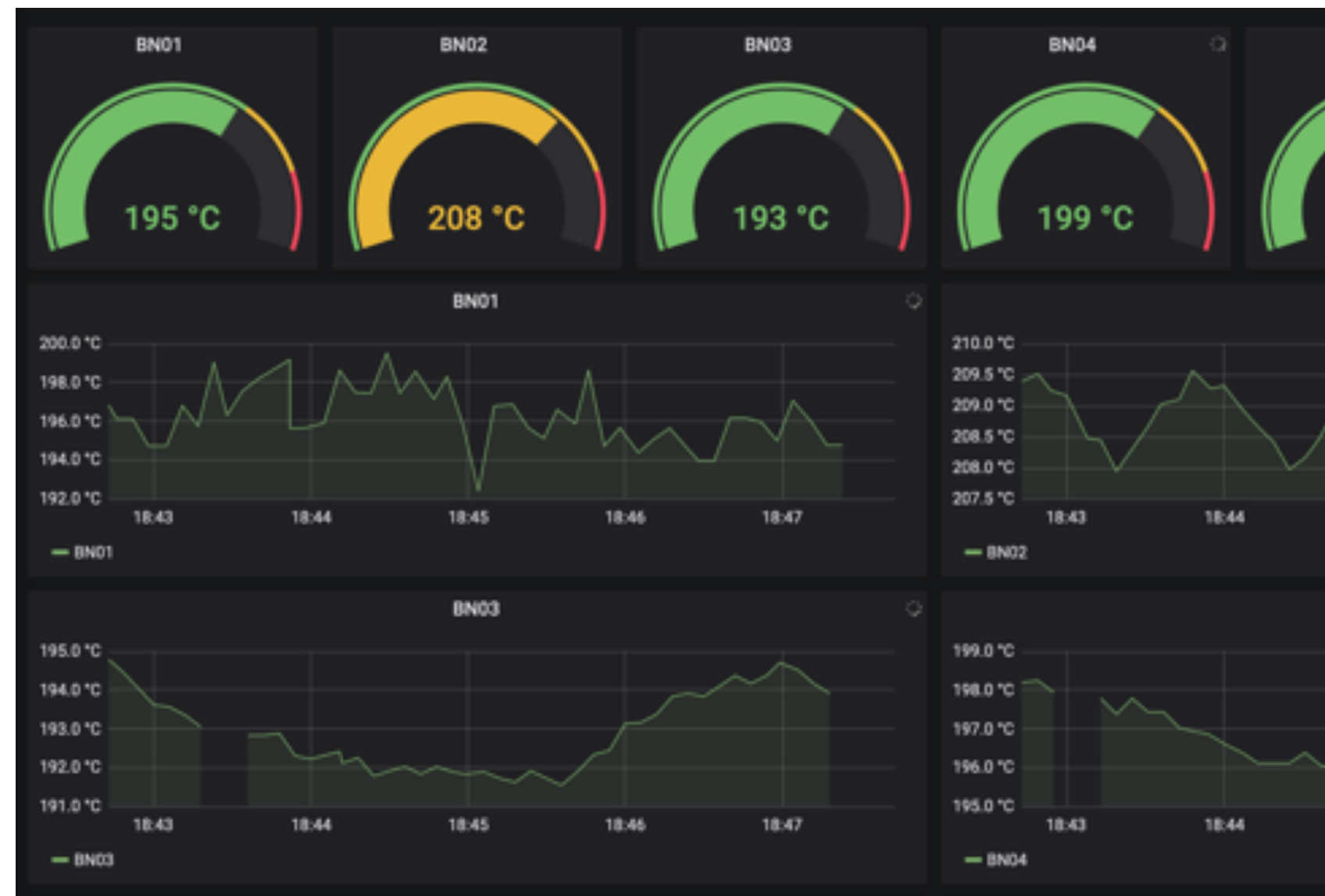
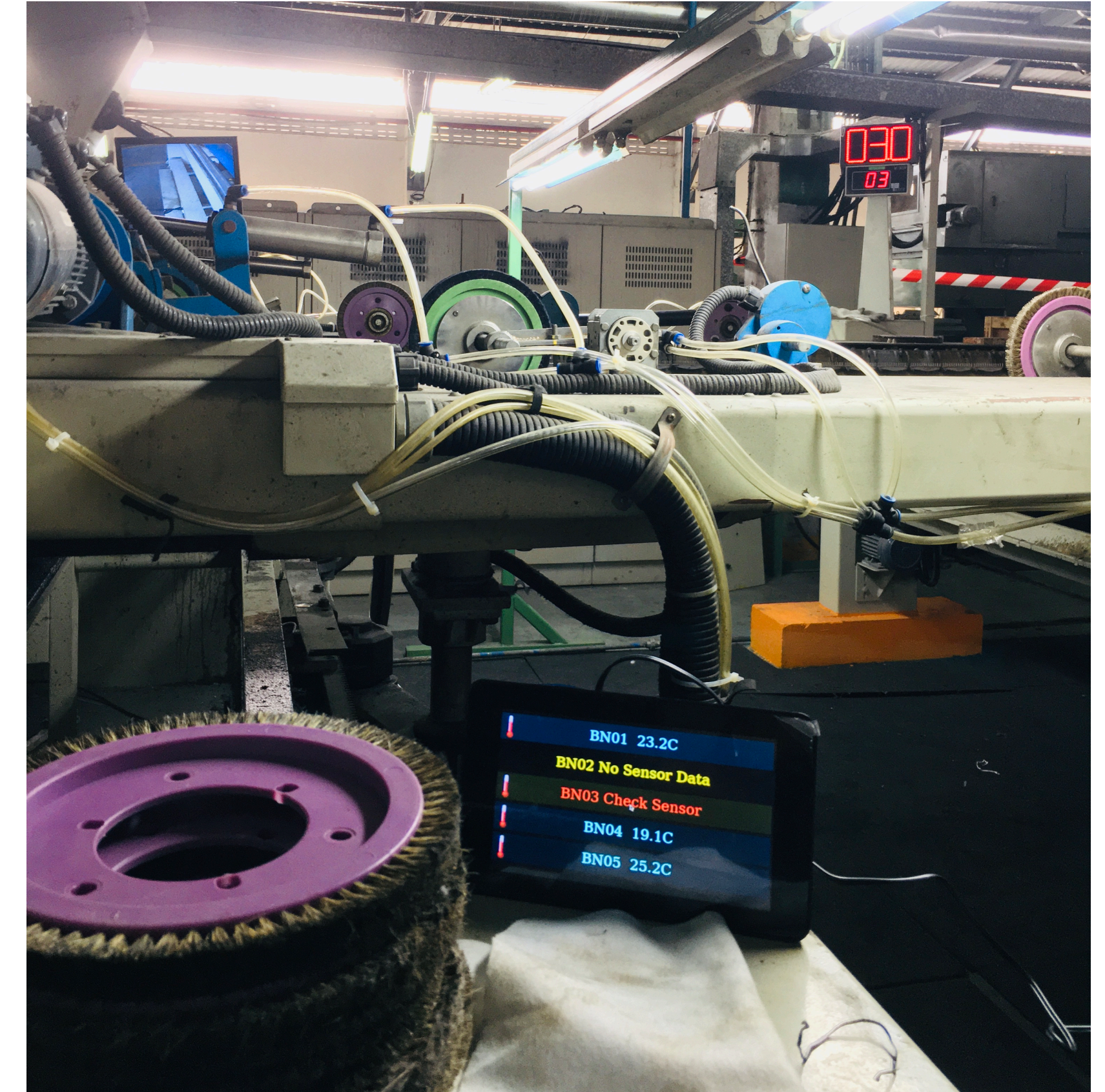


# Worker Safety Monitoring



**IIoT + TinyML's opportunities**  
**- Improve worker's safety.**  
**- Prevent bodily injuries.**

# Burner Monitoring



**IIoT + TinyML's opportunities**

- Better temperature anomaly monitoring
- Fewer production defects and wastes

# Block Heating Element Monitoring

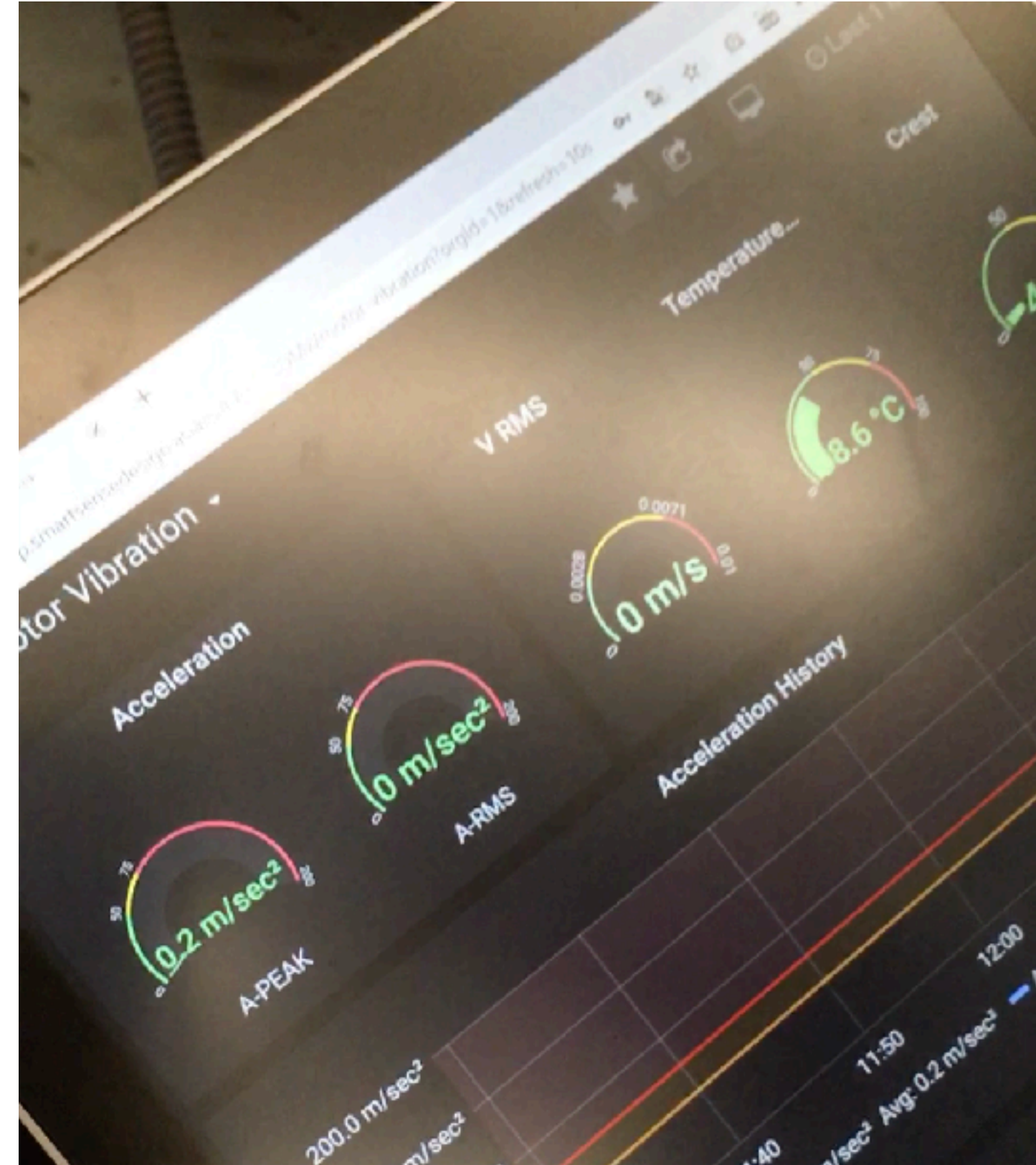


**IIoT + TinyML's opportunities**

**- Better temperature control**

**- Better quality & lower productivity losses**

# Motor Vibration Monitoring



## IIoT and TinyML's opportunities

- Motor's health
- Alarms on abnormal vibration or temperature

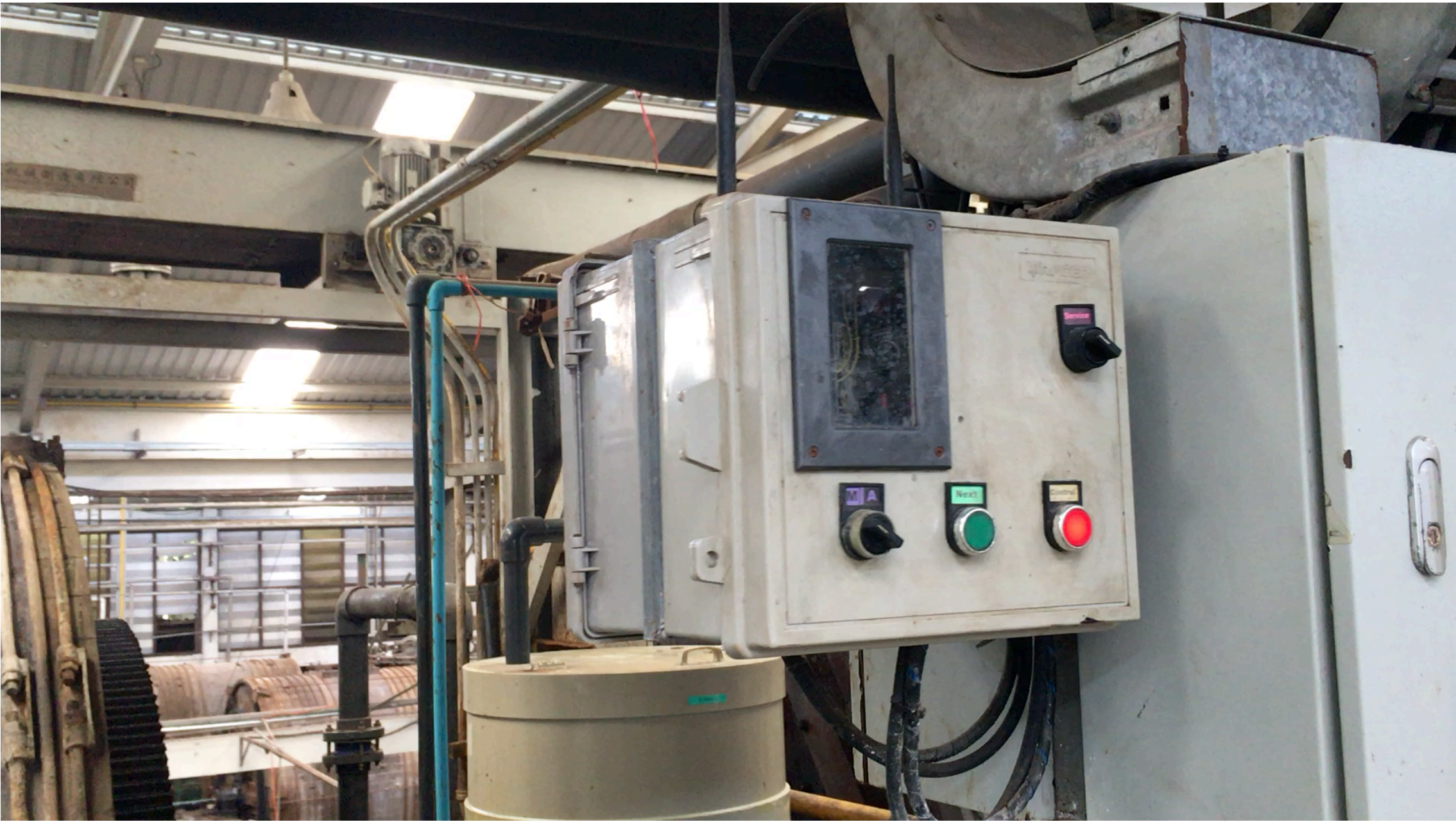
# Cycle Time & Productivity Monitoring



## **IIoT and TinyML's opportunities:**

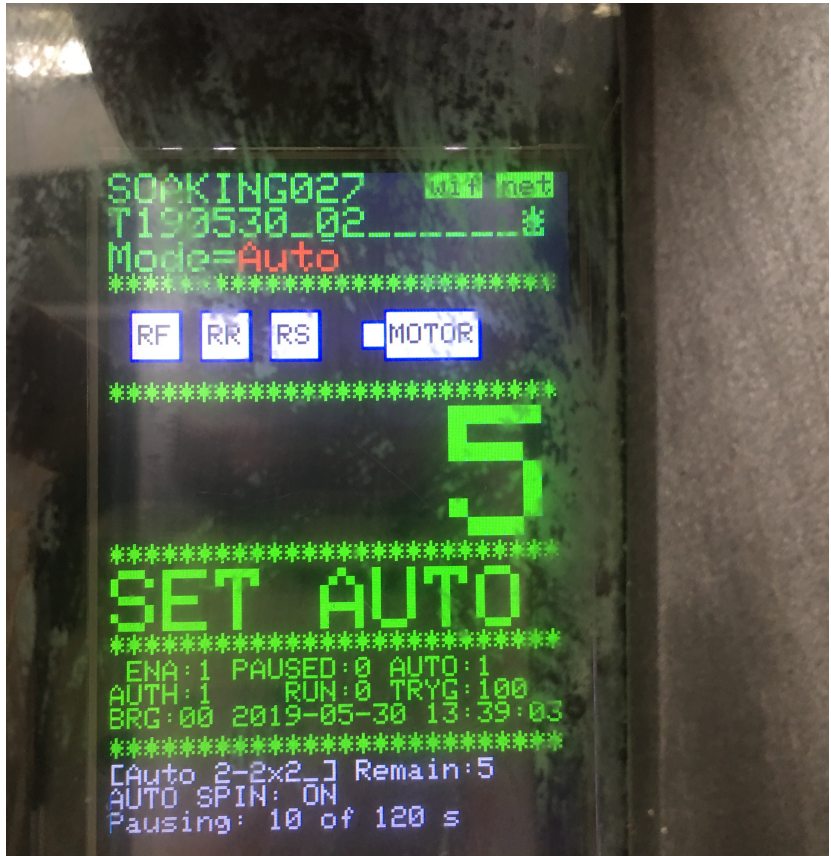
- Item counting & cycle time monitoring**
- Machine breakdown status**

# Leather Soaking & Tanning Process (Industrial Agri Tech)

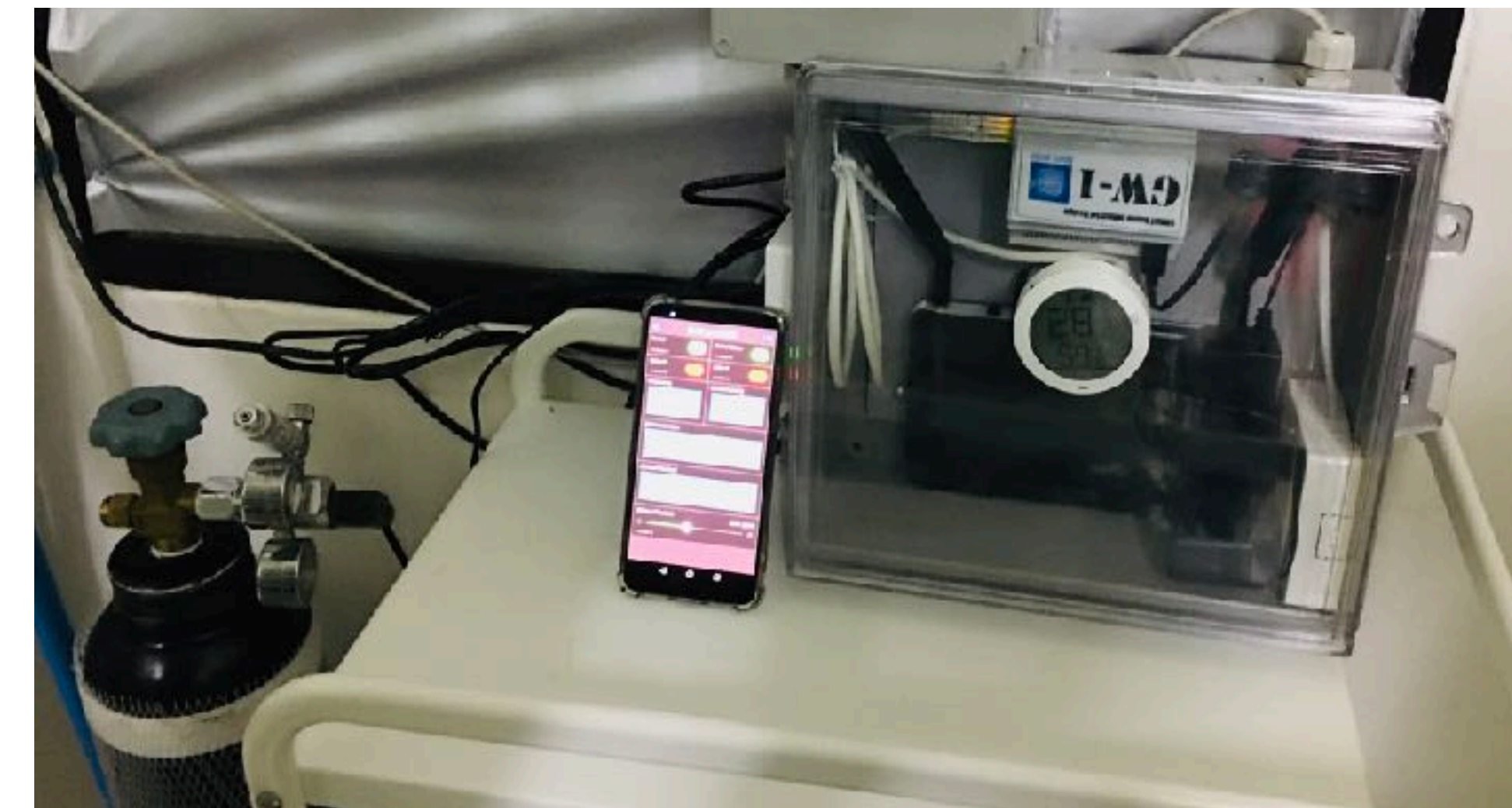
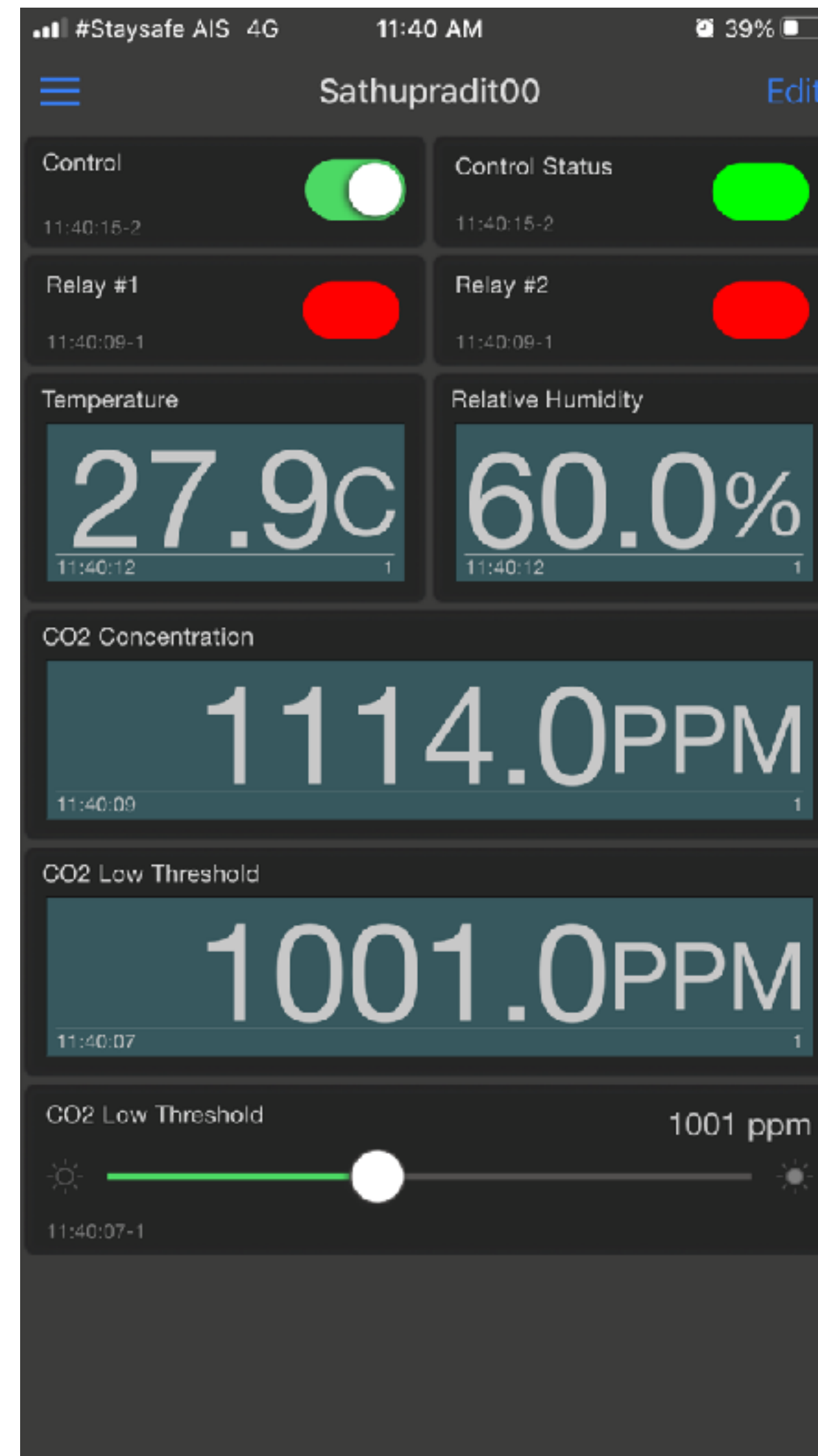


## IIoT and TinyML's opportunities:

- Machine status monitoring
- Better scheduling & automatic control



# SMART Vertical Farming

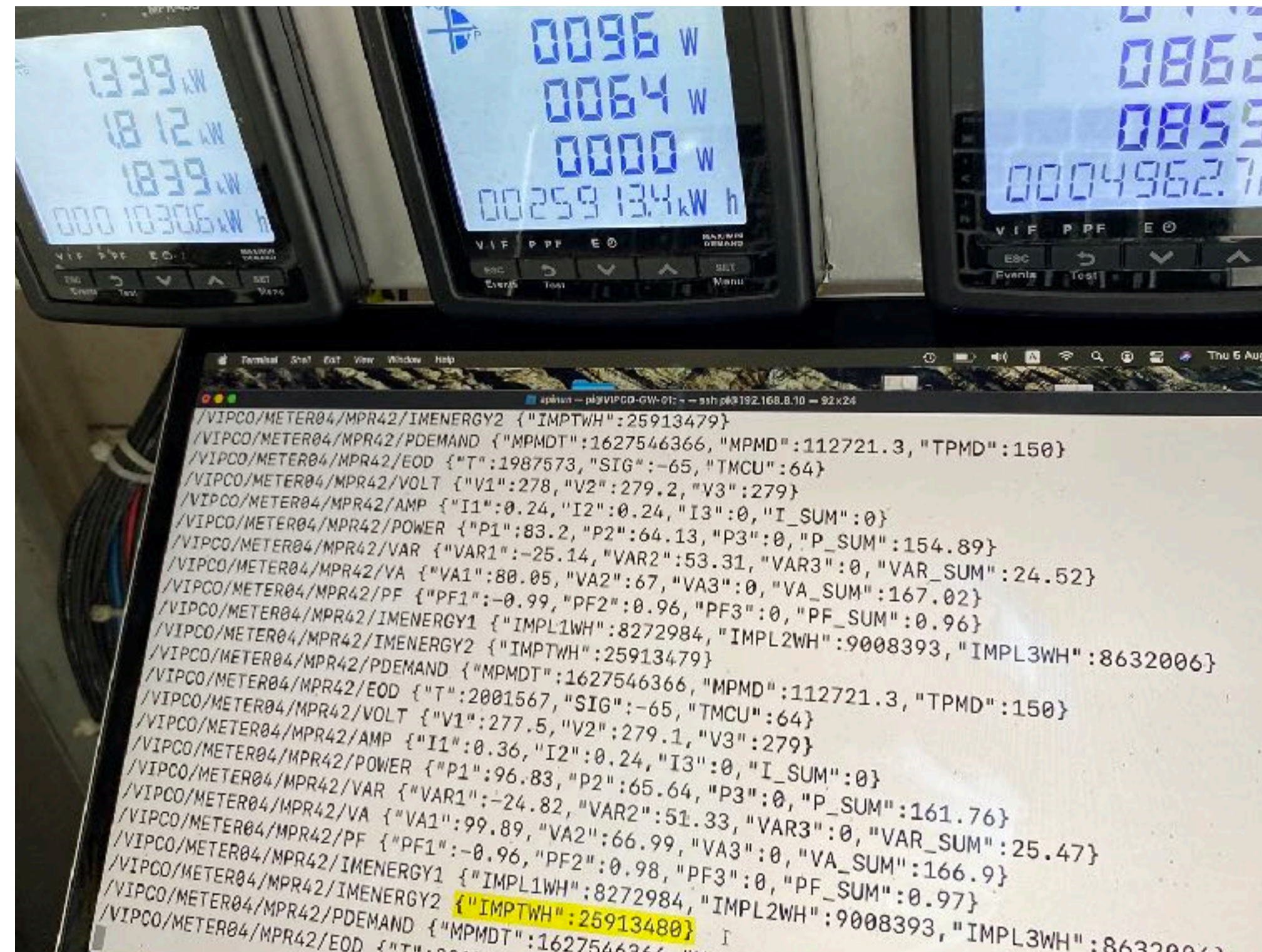


## IoT + TinyML's opportunities:

- Better monitoring and control of indoor environment
- Better monitoring monitoring and control of water pH, EC
- Better monitoring and control of CO2 gas concentration.



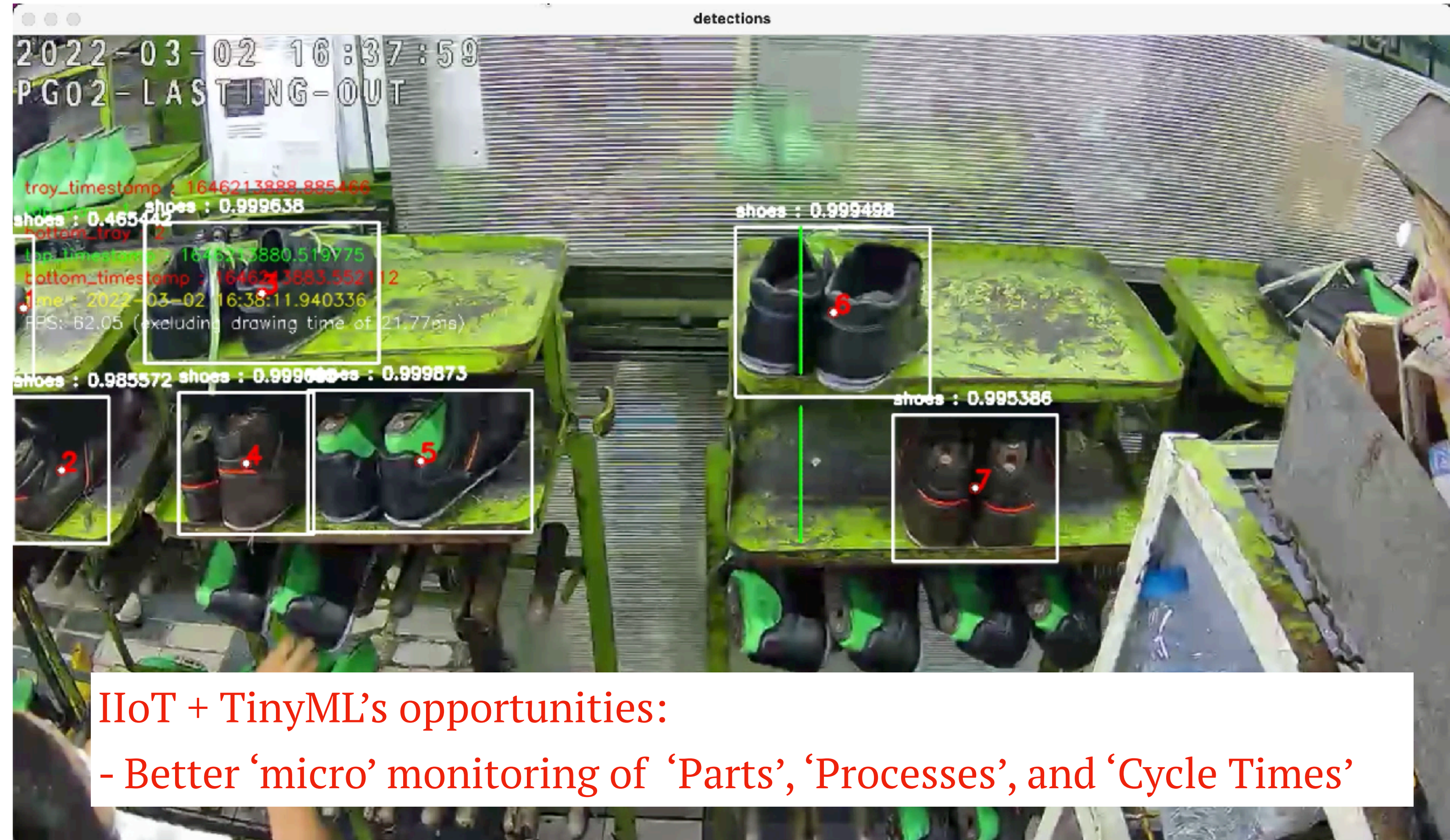
# Energy Consumption Monitoring



## IIoT and TinyML's opportunities

- Better monitoring & classification of Power & Energy Consumption characteristics ( KW, KVAR, KVA, PF, KWH )
- Detection of abnormal or irregular power/energy behaviors

# Camera as a Sensor Testbed

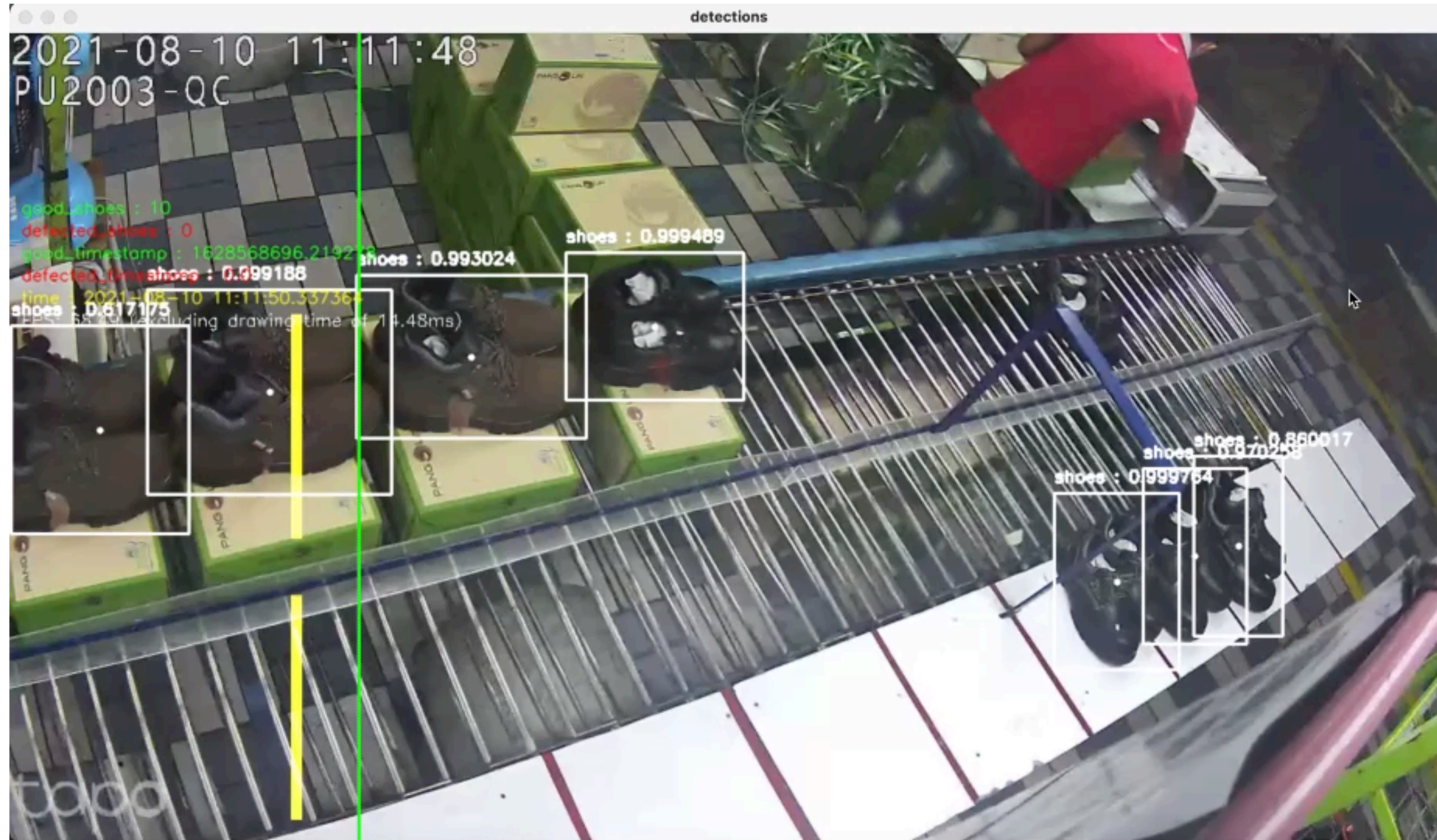


**Industrial Video Analytics Research Credits:**

- Mr. Nisit Sirimarnkit, SMART Sense Industrial Design

- Dr. Chawalit Jeenanunta, Sirindhorn International Institute of Technology (SIIT)

# Example: Counting of OK vs. NG



**Industrial Video Analytics Research Credits:**

- Mr. Nisit Sirimarnkit, SMART Sense Industrial Design

- Dr. Chawalit Jeenanunta, Sirindhorn International Institute of Technology (SIIT)

# Heavy Material Transfer



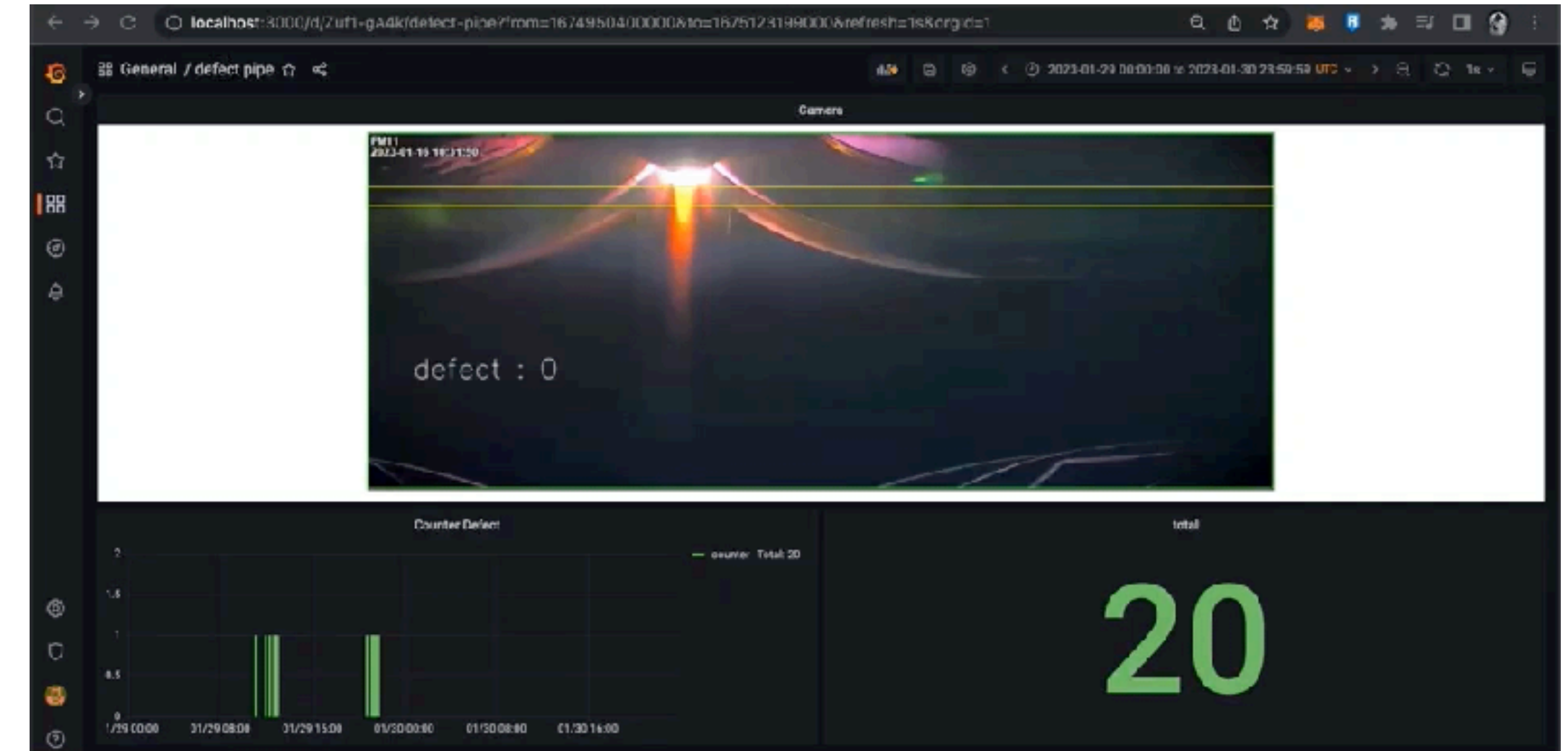
IIoT + TinyML's opportunities:

- Anomaly detection
- Better daily plan scheduling
- Reduce truck's idling time and CO2 emissions

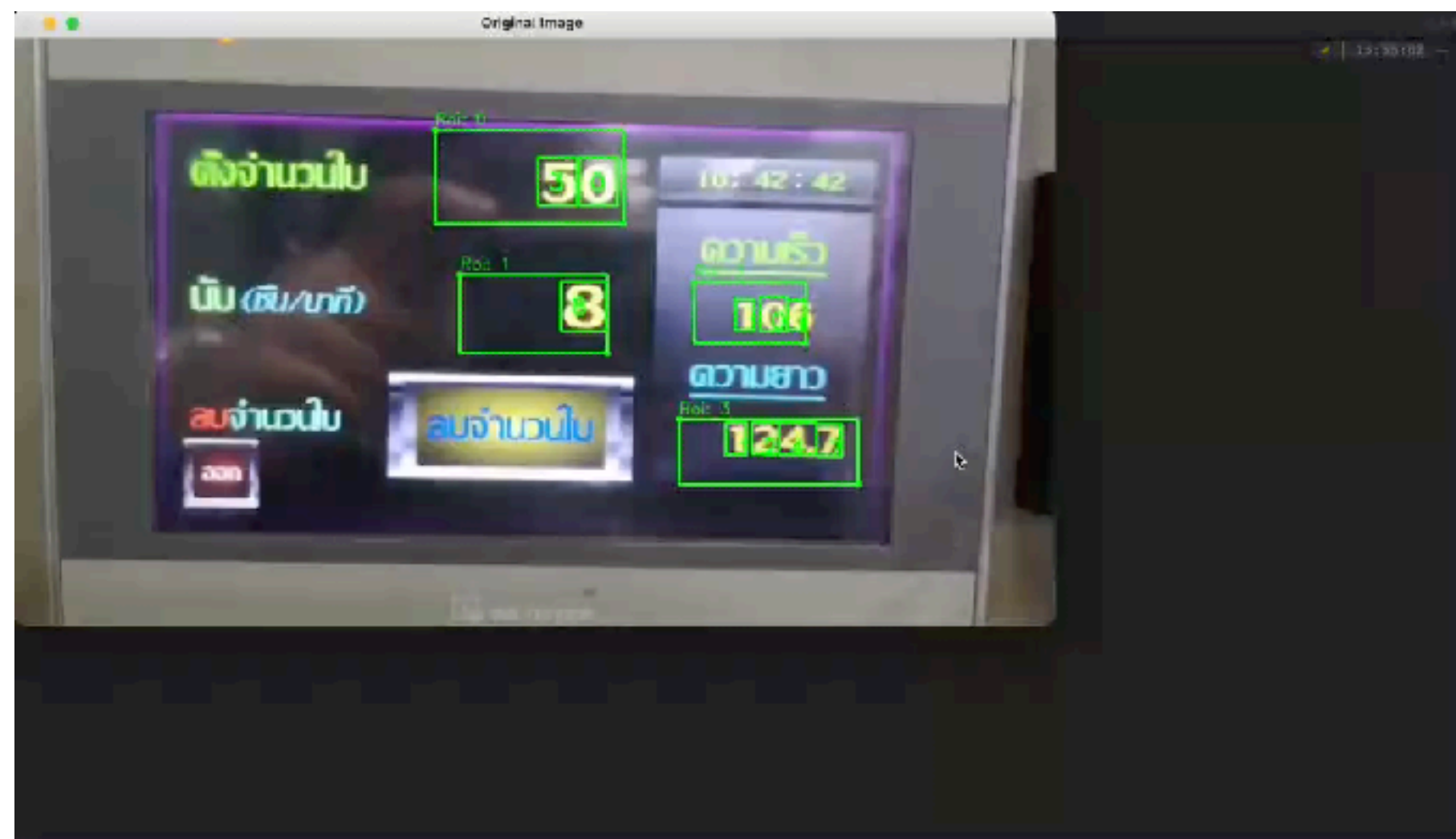
# Examples of our modular AI-IIoT components



**Exhibit #1: Vehicle space occupancy and parking wait time sensing: this can be used to schedule delivery or vehicle admission that aims to reduce fuel consumption.**



**Exhibit #2: welding defect detection -- this can be used to improve production quality, cycle time, and reduce energy consumption.**

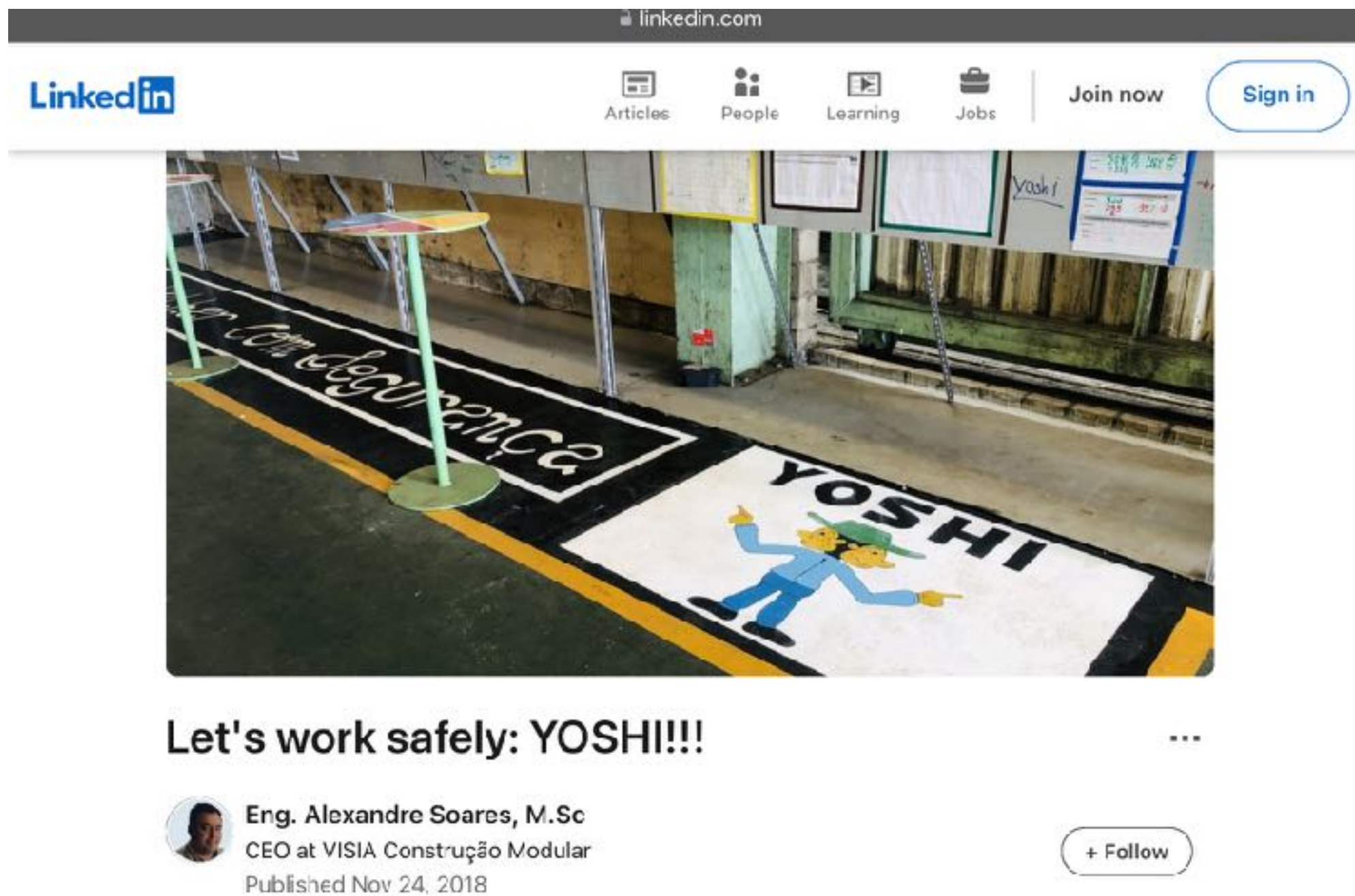


**Exhibit #3: Screen information scraping : this can be used to monitor production output, reduce wait time, and energy consumption per run.**



**Exhibit #4: Parts and assembly line tracking : this can be used to monitor production output rate, reduce wait time, and energy consumption.**

# TinyML Demo : YOSHI Safety Practice



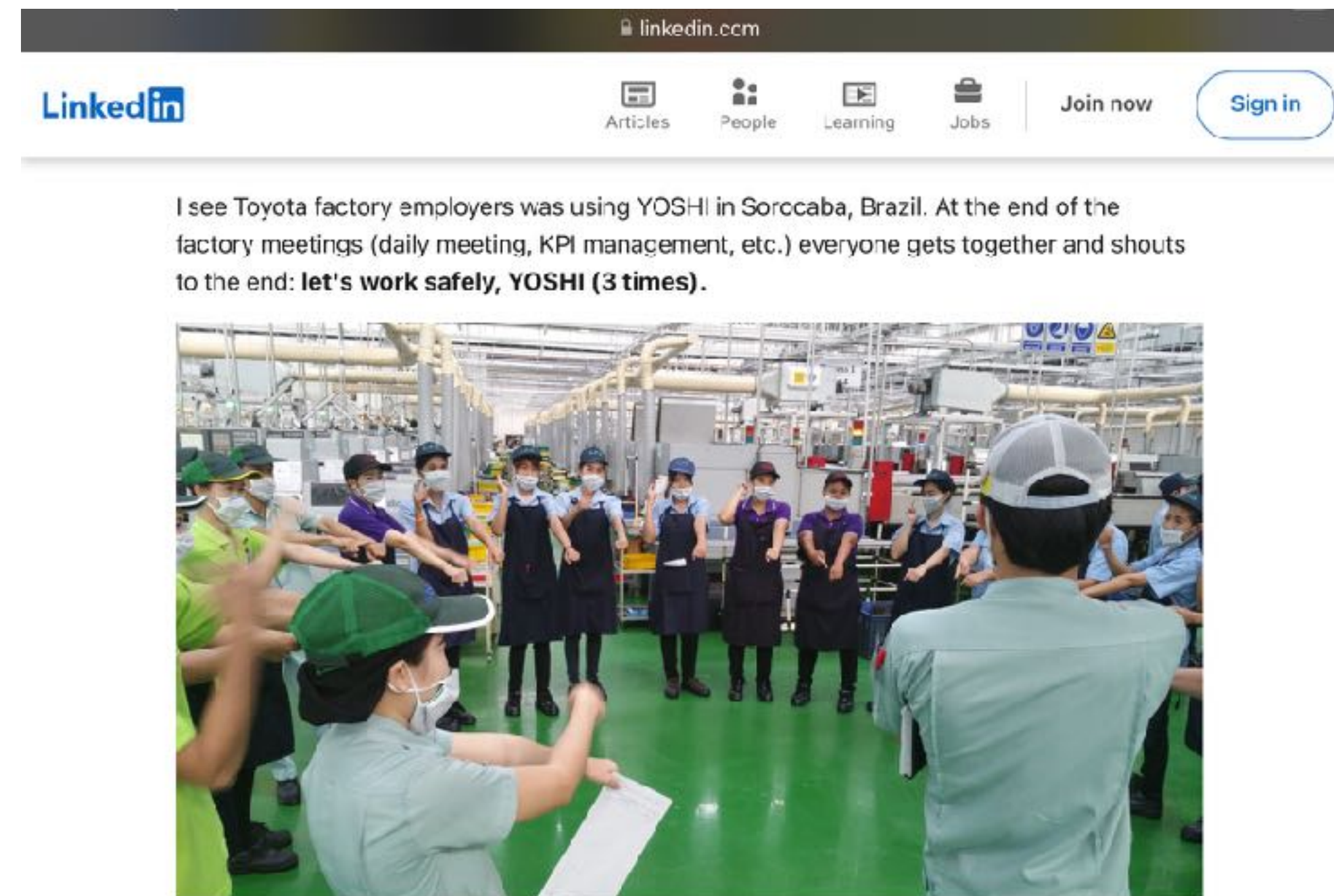
Let's work safely: YOSHI!!!

Eng. Alexandre Soares, M.Sc  
CEO at VISIA Construção Modular  
Published Nov 24, 2018

+ Follow

Toyota is very concerned with safety. A well-known example of this concern with safety is the method of 'pointing and calling'. This method is used by public transport operators in Japan. Japanese train drivers will point at every sign they pass, calling out their status. When the train stops, the speed is verified by pointing at the speedometer. Platform attendants and drivers also point to the platform to check if the train is clear, often also pointing to additional surveillance monitors for this purpose.

**This technique reduced accidents at Japanese railway companies by 30%**, helping them make train travel in Japan the most reliable and safest train travel in the world. The Toyota headquarters in Japan are so large that they include roads with motorized traffic on them. During their initial orientation, the expat employees are instructed on how to cross the road when they are at headquarters: **they have to point to the left, say YOSHI (which means something like, all right, OK), point to the right, say YOSHI again, and only then may they cross.** The Japanese employees follow the safety regulations.



I see Toyota factory employers was using YOSHI in Sorocaba, Brazil. At the end of the factory meetings (daily meeting, KPI management, etc.) everyone gets together and shouts to the end: **let's work safely, YOSHI (3 times).**

**Pointing and Calling gives co-action and co-reaction among the operator's brain, eyes, hands, mouth, and ears.** Not only looking but also pointing and stating the observation avoids sloppiness and helps keep focus and attention. **For simple tasks (and most of these tasks are reasonably simple), this technique reduces errors by almost 85%.** Some companies use only pointing, or only calling, but the technique is most effective when combined.

Additionally, pointing and calling allows easy process confirmation. A supervisor observing the employee can easily verify that the signal has been seen and that the timetable has been checked. Hence, it is much easier to train operators and correct mistakes.

This standard is also often used in industry for visual confirmation. I have also seen this during the quality check of printed products. The operator points with his finger at every spot he is supposed to check. This standard is also used for inspection of the workplace before maintenance, pointing and calling, "Motor stop. Okay! " **Some construction companies have also adapted this approach.**

Quoted from <https://www.linkedin.com/pulse/lets-work-safely-yoshi-alexandre-soares>

# EI & TinyML (The Picture approach)

EDGE IMPULSE

Apinun Tunpan / YOSHI PROJECT

Dataset | Data explorer | Data sources | CSV Wizard

DATA COLLECTED: 75 items | TRAIN / TEST SPLIT: 64% / 36%

Collect data

Connect a device to start building your dataset.

Dataset

Training (48)	Test (27)	Labels	Added
right.4sgt0s7x	right	Yesterday, 14...	
left.4sgtrk06	left	Yesterday, 14...	
left.4sgtrk0e	left	Yesterday, 14...	
left.4sgtrj0n	left	Yesterday, 14...	
left.4sgtrj0r	left	Yesterday, 14...	
left.4sgtrj1n	left	Yesterday, 14...	
left.4sgtrj0s	left	Yesterday, 14...	
left.4sgtrf0b	left	Yesterday, 14...	

RAW DATA: left.4sgtnccp

Model | Model version: Quantized (int8)

Last training performance (validation set)

ACCURACY: 100.0% | LOSS: 0.26

Confusion matrix (validation set)

	LEFT	RIGHT
LEFT	100%	0%
RIGHT	0%	100%
F1 SCORE	1.00	1.00

Data explorer (full training set)

- left - correct
- right - correct
- left - incorrect

Model testing results

ACCURACY: 76.92%

	LEFT	RIGHT	UNCERTAIN
LEFT	57.1%	28.6%	14.3%
RIGHT	0%	100%	0%
F1 SCORE	0.73	0.86	

Feature explorer

- left - correct
- right - correct
- left - incorrect
- unknown

EDGE IMPULSE

Apinun Tunpan / YOSHI PROJECT

Dataset | Data explorer | Data sources | CSV Wizard

DATA COLLECTED: 75 items | TRAIN / TEST SPLIT: 64% / 36%

Collect data

Connect a device to start building your dataset.

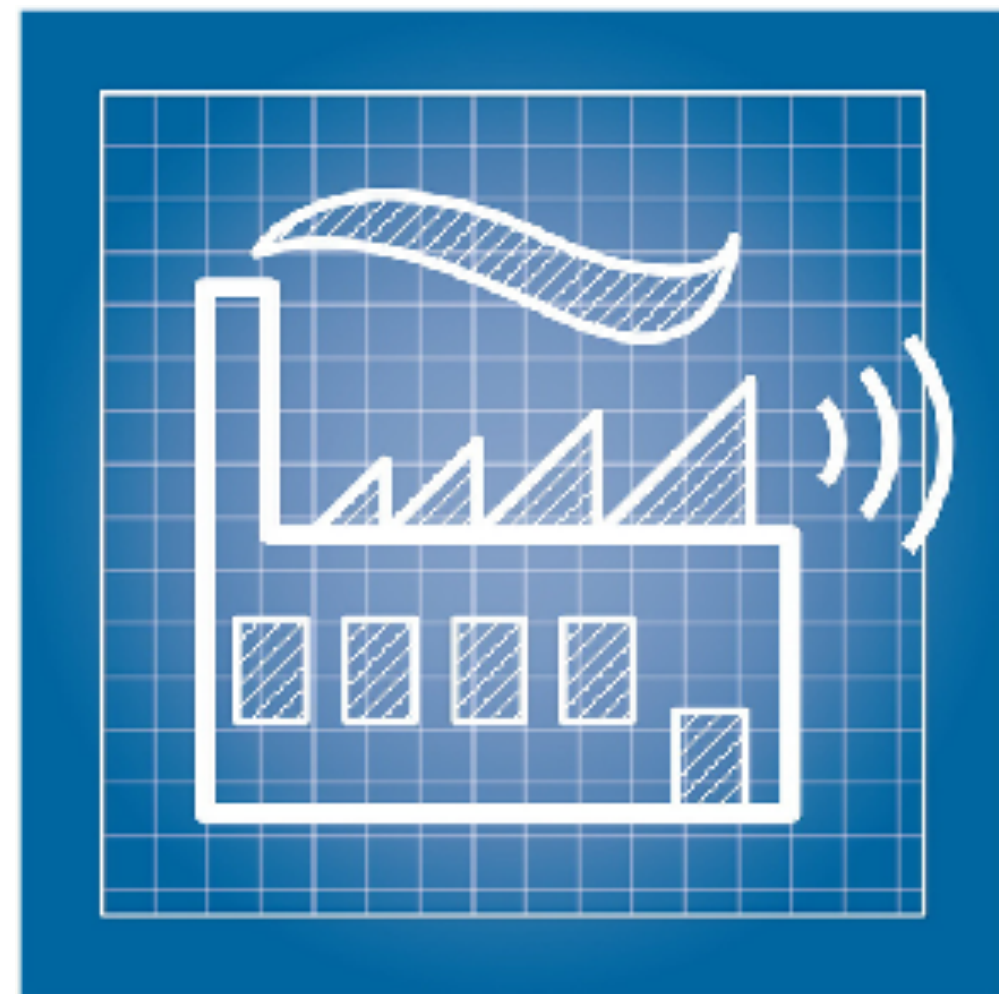
Dataset

Training (48)	Test (27)	Labels	Added
unknown.4s81f4e	unknown	Yesterday, 15...	
right.4sgtrcnv	right	Yesterday, 14...	
right.4sgtrcnf	right	Yesterday, 14...	
right.4sgtrcm6	right	Yesterday, 14...	
right.4sgtrcl7s	right	Yesterday, 14...	
right.4sgtrcjk	right	Yesterday, 14...	
right.4sgtrj0l	right	Yesterday, 14...	
right.4sgtrj0r	right	Yesterday, 14...	

RAW DATA: right.4sgtonlf

# Thank you !

## Q&A



**SMART SENSE**  
INDUSTRIAL DESIGN CO., LTD.



ICTP-UNU Workshop on  
TinyML for  
Sustainable Development

*AN ICTP 60<sup>TH</sup> ANNIVERSARY SATELLITE EVENT*