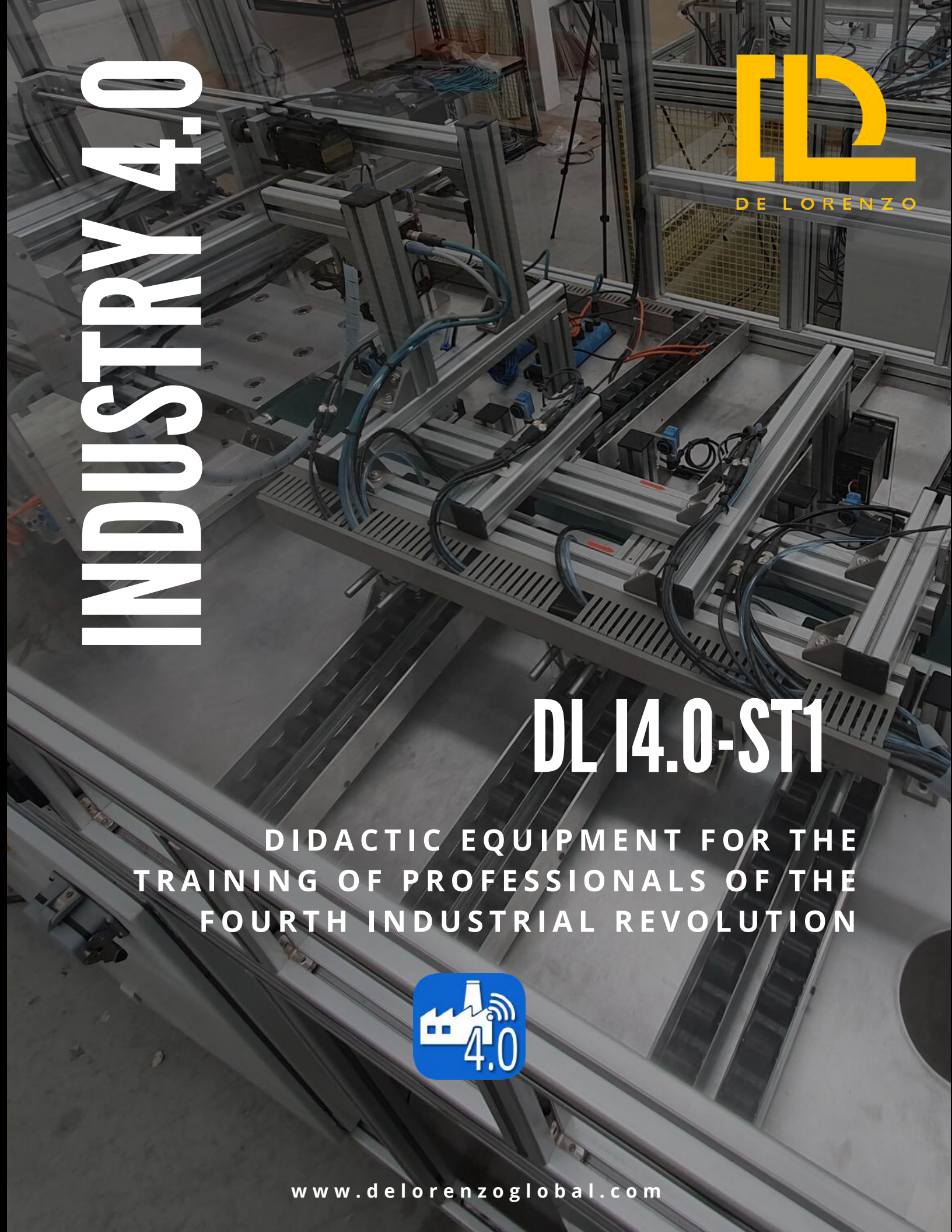

INDUSTRY 4.0

DE LORENZO

DL I4.0-ST1

DIDACTIC EQUIPMENT FOR THE TRAINING OF PROFESSIONALS OF THE FOURTH INDUSTRIAL REVOLUTION

www.delorenzoglobal.com

INTRODUCTION

With the new industrial revolution, software, hardware, and processes are integrated so that a “Push” production (manufactured first and then sold) becomes a “Pull” production (only what the consumer requests is manufactured).

The digital transformation applied to the industry is characterized by the total interaction between the elements and processes that constitute a production unit.

Our didactic system is designed to integrate the knowledge of different areas or departments within a company. Therefore, students from different careers can interact, learn, and apply concepts from their specialization area “hard skills” and study concepts from other knowledge areas.

The students can carry out practices form different disciplines allowing the development of “soft skills”, that is, the development of skills for the professionals of the fourth industrial revolution such as:

- **Critical thinking**
- **Coordination between work teams**
- **Cognitive flexibility**
- **Emotional intelligence**
- **Teamwork**
- **Leadership**
- **Self-learning**
- **Creativity**
- **Negotiation**

STORAGE AND FEEDING

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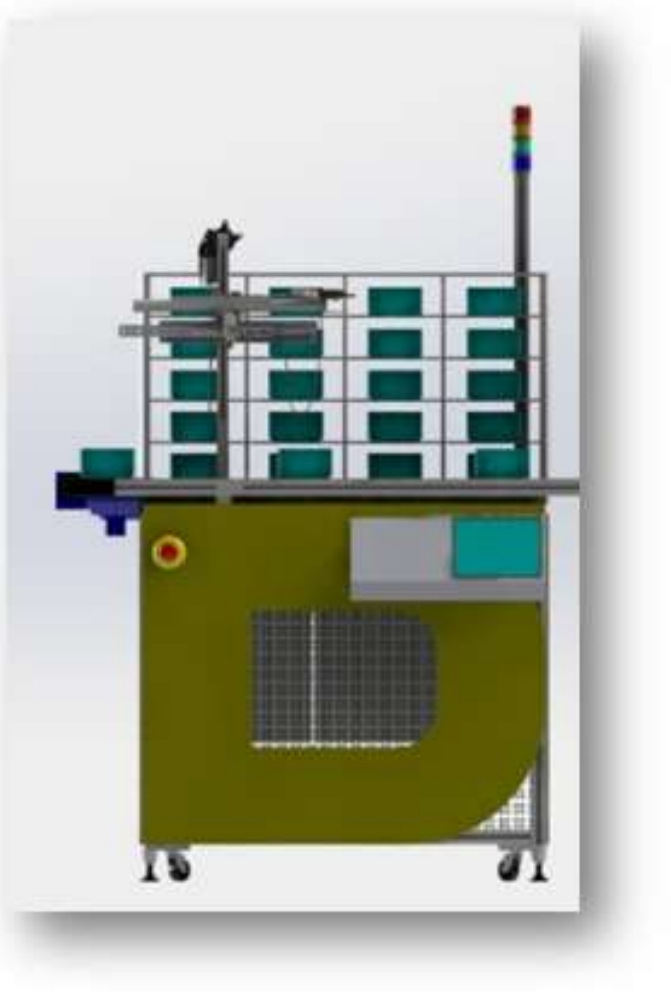
This station functions as an Automated Storage and Retrieval System (AS/RS) warehouse.

The station is composed of a conveyor belt that feeds the material into the system, and a cartesian robot that positions it in one of the four warehouses, in the location determined by the software according to the type of the material identified by the visual inspection sensor.

Two additional stations (Control Station and 3D Print Station) complete the main station.



1

PROCESSES. Key elements of every industry that allow the correct operation of a company. For the student, their understanding and assessment is important for a successful professional life. In the trainer, the processes are based on the study of Lean Six Sigma.

2

HARDWARE. The trainer consists of three stations: storage and feeding, 3D print, and monitoring. In these stations we will find technologies such as: IoLink, PLC, RFID, Cartesian Robot, Smart Sensors, IoT.

3

SOFTWARE. Essential for the industry and the student's life, its use will allow him, in addition to knowing the processes, to obtain specific technical skills in the management of WMS (Warehouse Management System), MES (Manufacturing Execution System), as well as: Software for Data Analysis, Augmented Reality, Virtual Clone.

1

PROCESS

DL I4.0-ST1

FOR THE DEVELOPMENT OF THE
COMPETENCIES OF THE 21ST CENTURY

PROCESS

Plastic beads of different colors, that act as different part numbers, are poured into containers, and placed onto the input band. The cartesian robot picks up the container and places it in its corresponding position within the automated warehouse. When a production order for a certain recipe (different part numbers) is launched by the software, the cartesian robot retrieves the necessary containers and positions them on the output band to travel to the second station and start the production.

This automated process is controlled by the SCAP (Warehouse and Production Control System) software, which ensures the communication between software and hardware and enables the warehouse automation to operate under the ASRS (Automatic Storage Recovery System) scheme.

Specific warehouse management processes are illustrated.

01 PURCHASE ORDER

02 INVENTORY MANAGEMENT

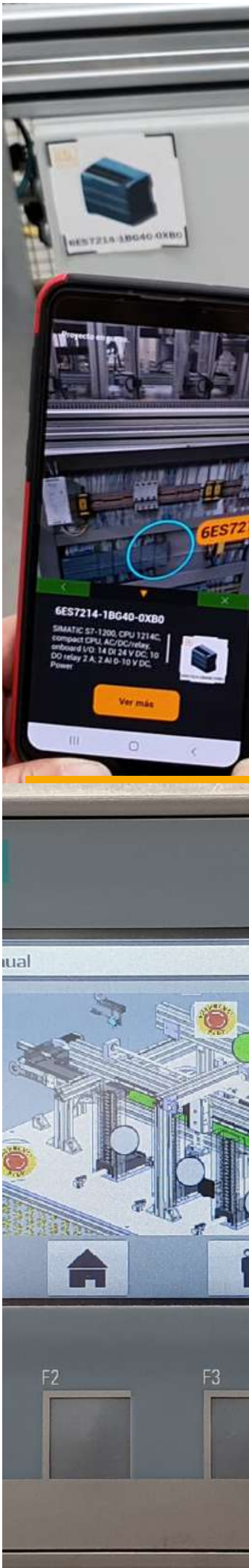
03 PURCHASE SUGGESTION AND RESTOCKING

04 STOCK

05 KARDEX

06 TRANSFER BETWEEN WAREHOUSES

07 PRODUCT LOCATIONS CONTROL IN THE WAREHOUSE



2

HARDWARE

DL I4.0-ST1

FOR THE DEVELOPMENT OF THE
COMPETENCIES OF THE 21ST CENTURY

HARDWARE

Cabinet

- With banana plug connections.

Supply

- Power supply 110/220 V, Frequency 50/60HZ, Single-phase and Biphase.

PLC

- CPU.
- Power Supply: 24VDC.
- Slot for memory expansion.
- Support for DB, FB, FC, OB blocks.
- RJ45 connection.
- UA OPC support.

Master I/O Link

- Connection of conventional sensors and IO Link.
- Monitoring of the sensors integrated in the station.
- Web browser access for monitoring.

Cartesian Arm System (XYZ)

- Places the product in the ASRS warehouse. Dispatches the product to the production station.
- Rejects the product if the reception inspection is
- negative, or if all locations are occupied. Positions are determined by the Warehouse Management
- System.
  Movement through stepper motors controlled by the
- driver from the PLC.

RFID

- Reader and antenna for HF reading of embedded tags.

All station components are industrial grade.

HARDWARE

Sensor to determine the colors of raw material

- The sensor identifies the material that the student feeds to the system and compares it with the warehouse entry request.

Air supply, pistons, and pneumatic gripper

- They perform the entry and exit of the warehouse.
- Fingers to hold the containers.
- The air supply also serves the linked stations.

Computer Equipment

Computer equipment containing the software required to operate the station:

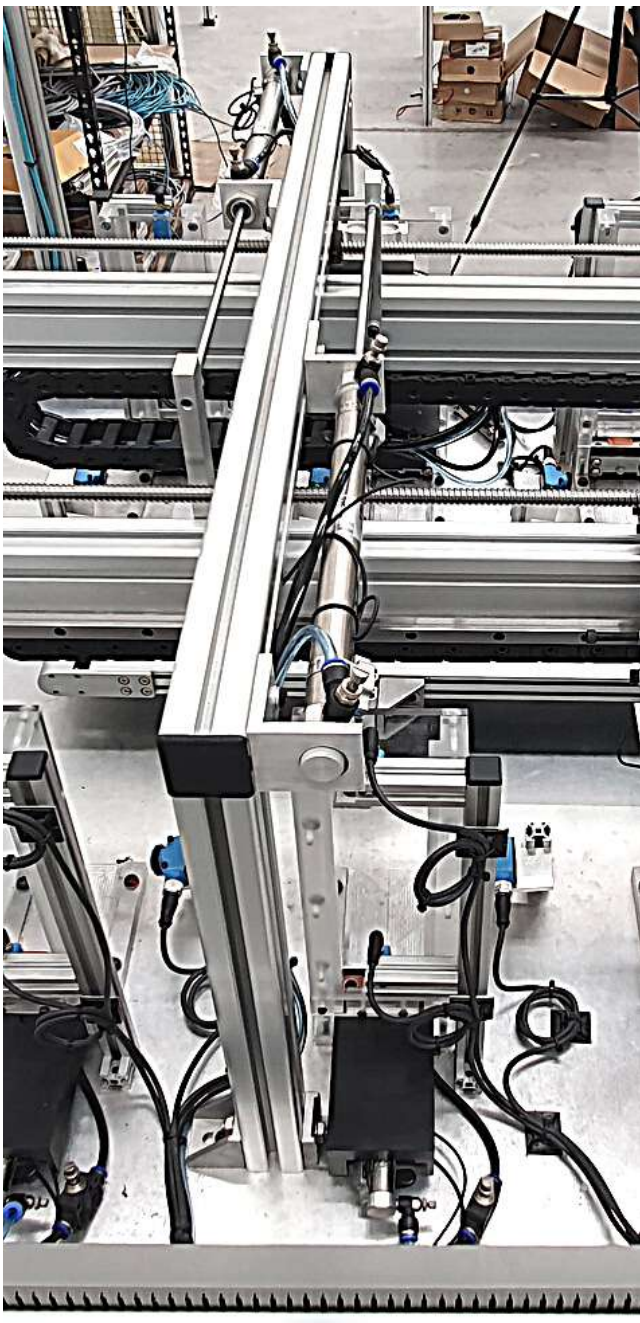
- Warehouse Management System.
- Production Control System.
- Batch processes for hardware monitoring and database power.
- Web server to extract the information.

IoT

- Humidity and temperature measurement sensors.
- Deliver information to the database using HTTP or MQTT protocol.

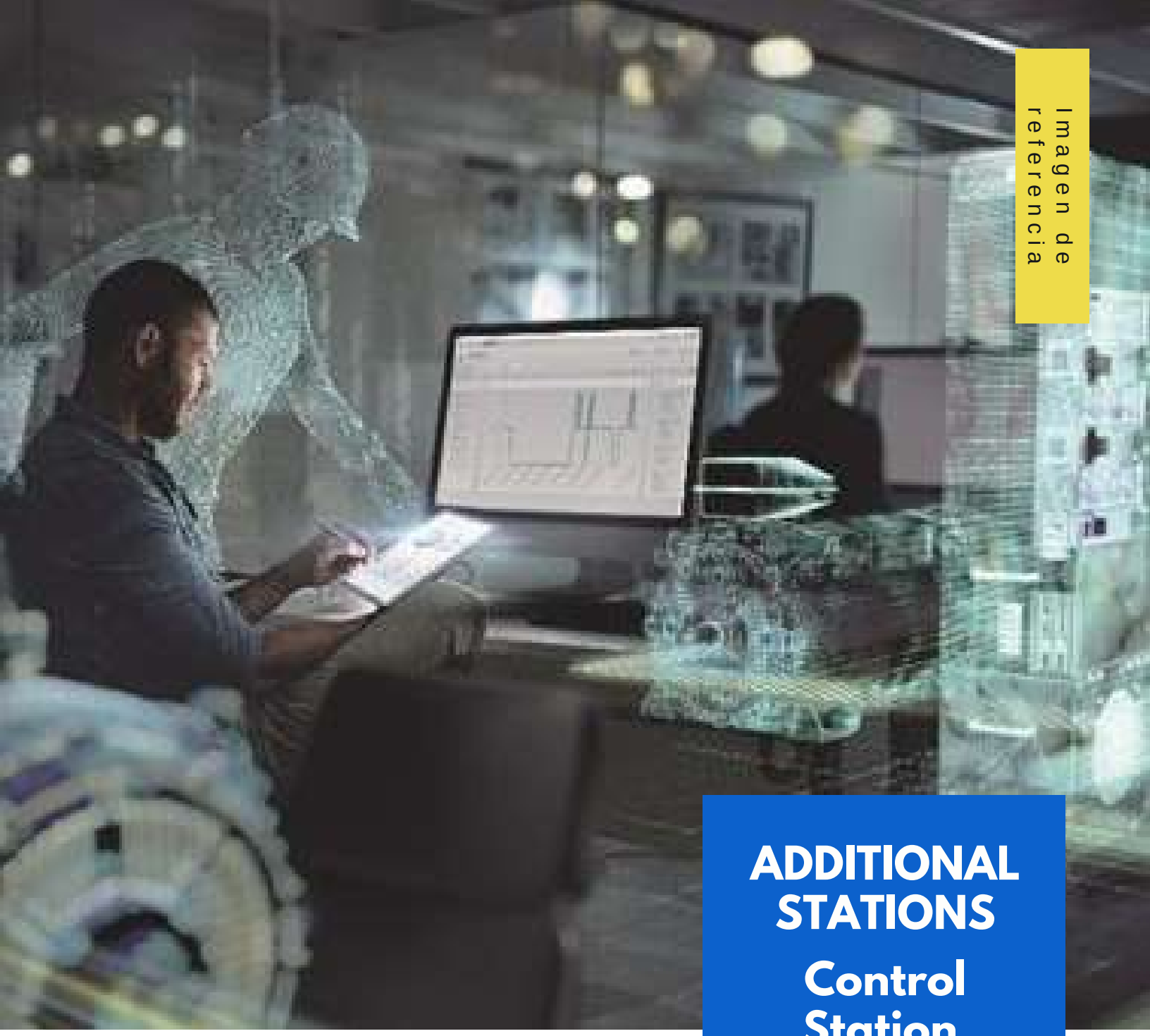
Power Measurement

- A measurement of power that supplies the database so that it can generate consumption graphs.



Additional features:

- **D**imensions: 1.40 m x 1.20 m x 1.90 m.
- Built with aluminum profile.
- Wheels for easy movement.
- Safety grids with clear acrylic walls for student safety and visibility of processes carried out inside the station.
- Emergency stop button.



ADDITIONAL STATIONS

Control Station

- This station has multiple functionalities.
- It has an interface that allows the connection of computer equipment to control and monitor the production line.
- In the practices that illustrate Industrial Engineering and Logistics processes, it is used for the reworking of materials.
- In practices that do not analyze industrial processes, the teacher's or student's computer equipment can be connected to interact with the database or satellite systems.
- When the DL I4.0-ST2 station is installed, the bead separation equipment is mounted on its surface.

- It features:

1. Aluminum profile structure.
2. Base for material resting.
3. Levelling feet.
4. Slots for the attachment of the splitter machine (included in the station DL I4.0-ST2).
5. Electrical interface 110/220V.
6. Led lamp.

Reference image

3D STATION*

**Supplied with PLA raw material and plans of the containers required by the line.*

- Station for manufacturing pieces through 3D printing process.
- In careers that analyze processes, it covers the need for additive manufacturing, being a slow manufacturing process, it leads students to consider bottlenecks and the need for implementation of batch mechanisms.
- Additionally, the equipment allows the manufacturing of containers that will feed the ASRS station.
- It contains a 3D printer with the following features:

1. Power supply 110/220V
2. Stepper motor drive.
3. Extruder with 0.7mm nozzle.
4. Preheated print bed for material fixing.
5. 3.5in. Display
6. Power supply.
7. Operation with PLT, PETG and ABS.

3 SOFTWARE

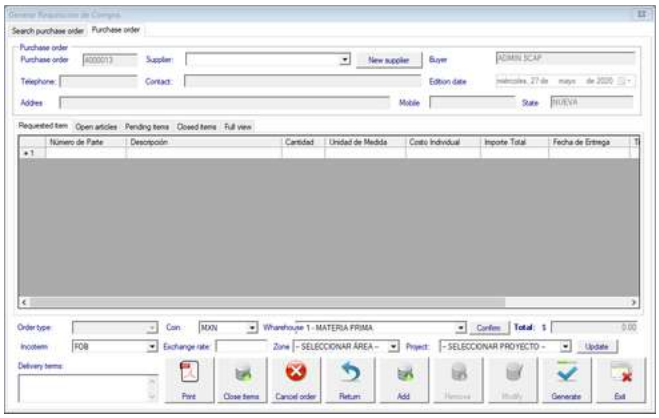
DL I4.0-ST1

SCAP

WAREHOUSE AND PRODUCTION CONTROL SYSTEM

- Unlimited number of devices or users.
- Intuitive and natural use.
- No subsequent licensing costs.
- Multiple languages.
- Information backups.
- Monitoring of system inputs.
- Safety is controlled by the teacher.
- Monitoring of what happens in the station.
- Practice resume function*

**The teacher can restore the information of the practice that was carried out in a previous session.*



SCAP MODULES

1. Warehouse Control System (multi-warehouse).

- Purchase Request.
- Sales request.
- View stock.
- Inventory management.
- Kardex.
- Purchase suggestion.
- Product reception.
- Product return to inventory.
- Warehouse transfer.
- Dispatch warehouse.
- Production order dispatch.

2. Traceability Control.

3. Production Control System.

- Production order generation.

4. Environmental Variables Monitoring System.

- Environmental variables monitoring (Humidity, Temperature).

5. Quality Capture.

- Customizable screens to take different captures.
- Interface with the trainer to integrate quality metrics into product traceability and process performance calculations.

6. SCADA

- Supervision, Control and Data Acquisition of each of the modules that make up the line.

- Interaction with the PLC and the implemented sensors.
- Reading/Writing information in the Database, which is the principal element within the architecture.

BACKGROUND PROCESSES

Processes running in the background for station monitoring:

- Execution of web services that interact with the peripheral applications of the cell and where the applications can be developed on different platforms such as: LABVIEW, CVI, VS.NET and JAVA among others.
- They provide the infrastructure needed by careers that require information exploitation.
- They allow augmented reality to exploit information on the elements contained in the cell.

Includes APP's for Android Mobile Devices

It allows analyzing the processes that are carried out when moving through the warehouse and the “time and motion” involved in its handling.

Warehouse:

Implements the basic functions of Cycle Inventory, Warehouse Input, Warehouse Output, Environmental Monitoring and Alerts.

Virtual Clone

It is an augmented reality environment that displays information through an app developed for Android operating system.
Pointing to markers positioned on the equipment, the application will allow the user to access information from the following two levels:

- Display of administrative and process information.
- Display of technical information.

With this interaction the student will learn how industrial processes work and their impact on hardware performance, allowing information to be generated in the virtual environment without affecting real indicators. This way, the student will be able to generate a virtual manufacturing, to make decisions on the viability of the production. He will also understand the use of technology implemented in the cells and the functionality of each technological aspect.

DATAMINING TOOL

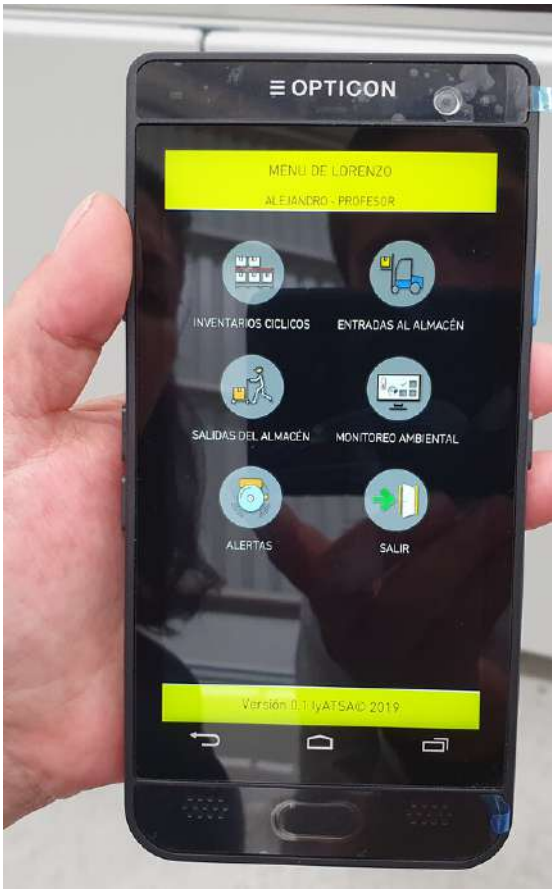
Data analysis

The SCAP (Warehouse and Production Control System) software provides mechanisms for extracting information that allow it to be integrated into the "Orange" software in a very simple way, developing the following knowledge:

- **Machine Learning**
- **Data Display**
- **Interactive Data Analysis**

"Systems for the training of professionals in the 4th Industrial Revolution".

PRACTICES



INFORMATION TECHNOLOGIES ENGINEERING

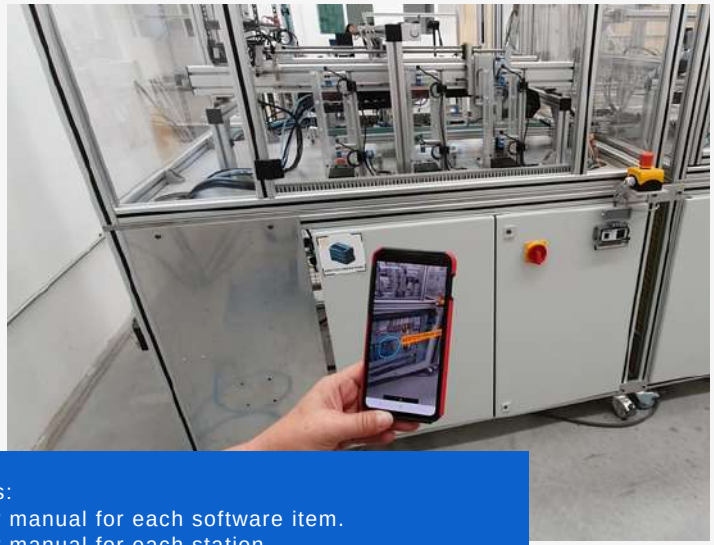
- Database design and modeling.
- Development of desktop, web and mobile applications that interact with the system in real time, taking information from sensors and processes.
- Development of model indicators.
- Database Cloning.
- Basic-Advanced SQL handling.
- Stored procedure development.
- Triggers development.
- Web service development.

AUTOMATION AND CONTROL

- Development of PLC programming and its conditions against the process.
- RFID technology operation and its use in processes.
- IO Link operation with strengths and weaknesses analysis.
- Power consumption measurements.

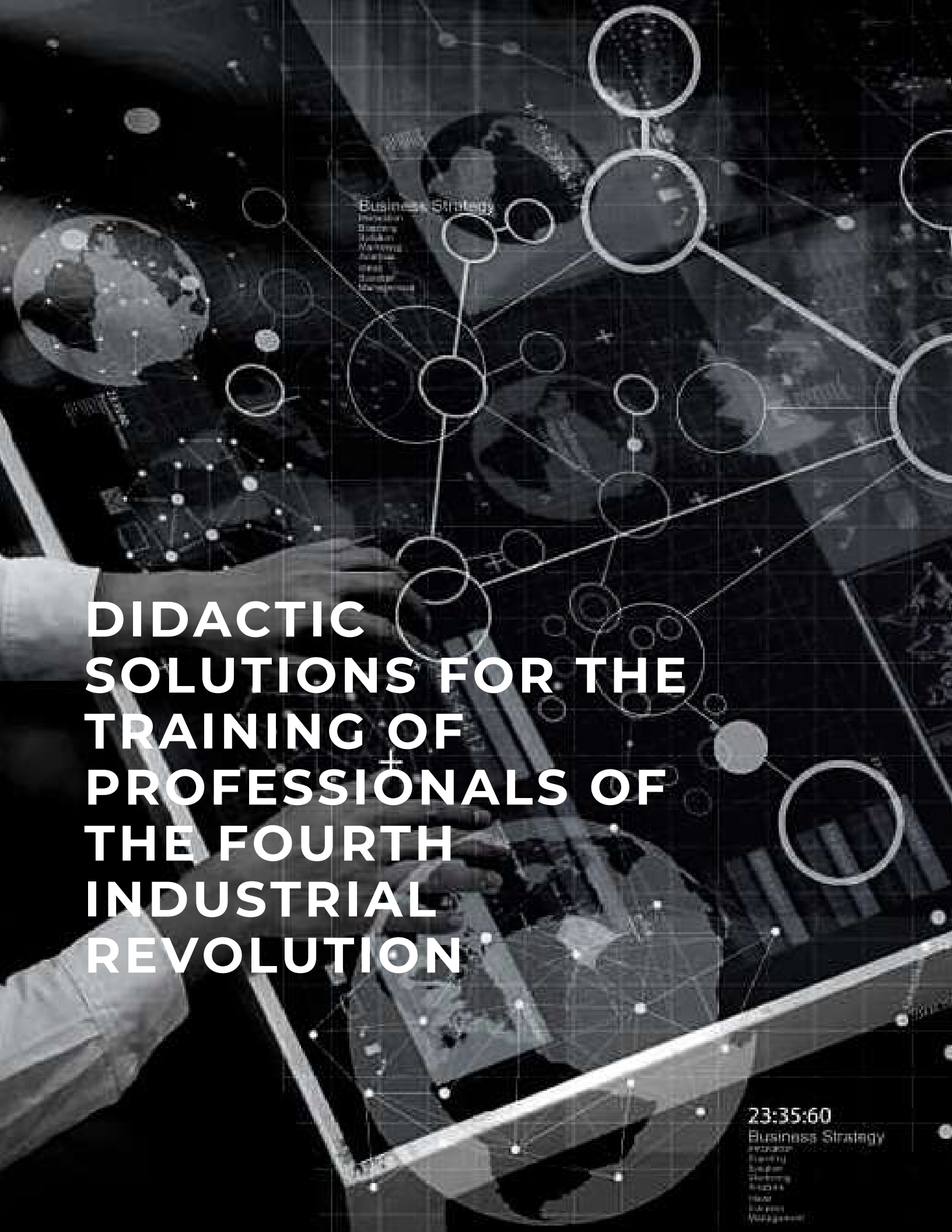
INDUSTRIAL ENGINEERING, LOGISTICS AND BUSINESS MANAGEMENT

- Warehouse and product management.
- Indicators analysis.
- Supply and demand law.
- Warehouse locations generation.
- Purchase orders to credit suppliers.
- Purchase orders to credit clients.
- Production orders.
- Management of suggested purchases.



Includes:

- User manual for each software item.
- User manual for each station.
- Technical and maintenance manual for the elements in the cell.
- Predefined practices (do not limit the ability to perform additional practices suggested to teachers).



DIDACTIC SOLUTIONS FOR THE TRAINING OF PROFESSIONALS OF THE FOURTH INDUSTRIAL REVOLUTION