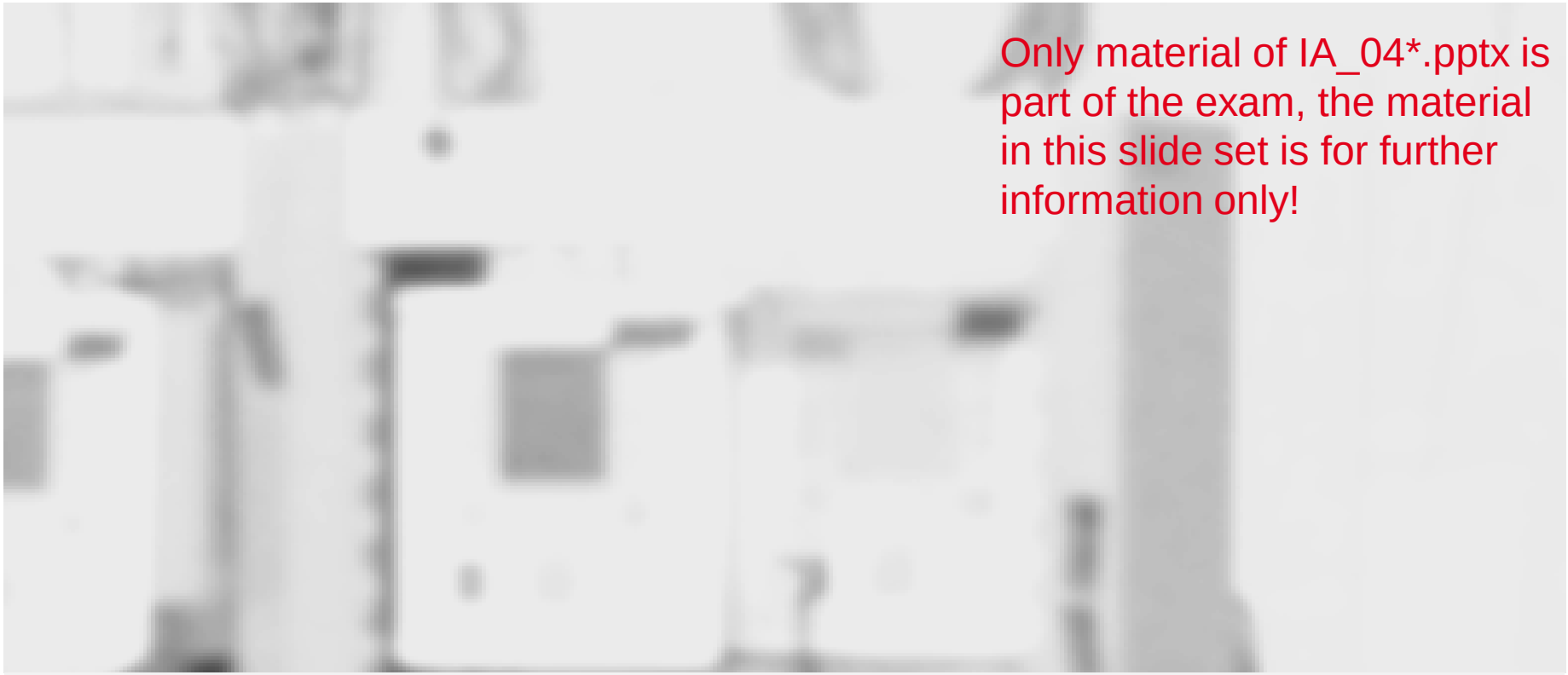

Only material of IA_04*.pptx is part of the exam, the material in this slide set is for further information only!

EPFL, Industrial Automation

Manufacturing Execution System

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FÉDÉRALE DE LAUSANNE

ISA S95: 1. Resource Allocation and Status

Guiding what people, machines, tools, and materials do, and what they are currently doing.

Maintains and displays status of resources including machines, tools, labour, materials, etc. that must be available in order for work to **start**.

Detail

1. manage **resources** (machines, tools, labour skills, materials, other equipment, documents, … that must be available for work to start and to be completed, directly associated with control and manufacturing.
2. do local resource **reservation** to meet production-scheduling objectives.
3. ensure that equipment is properly set up for processing, including any allocation needed for set-up.
4. provide real-time **statuses** of the resources and a detailed history of resource use.

ISA S95: 2. Dispatching production (routing, workflow)

Giving commands to send materials or order to parts of the plant to begin a process or step.

Detail

1. Manage the flow of production in the form of jobs, orders, batches, lots, and work orders, by **dispatching** production to specific equipment and personnel.
2. Dispatch information is typically presented in the **sequence** in which the work needs to be done and may change in real time as events occur on the factory floor.
3. Alter the prescribed schedules, within agreed upon limits, based on local availability and current conditions.
4. Control the amount of work in process at any point through buffer management and management of **rework** and **salvage** processes.

ISA S95: 3. Data Collection

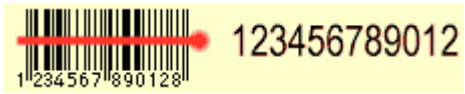
Monitoring, gathering, and organizing data about processes, materials, and operations from people, machines, or controls.
Ability to collect and store data from production systems to use for population of forms and records. Data can be collected manually or automatically in real time increments

Detail

1. obtain the operational production and parametric data associated with the production equipment and processes.
2. provide real-time status of equipment and production processes and a history of production and parametric data.

3. Data Collection Input devices specific for manufacturing

EAN Barcode



universal input device, serial number, error report.
Limited text length

Bar code label printer

Bar code scanner

PDF417: upcoming standard, high density coding
even small ink quantities may impair some products.

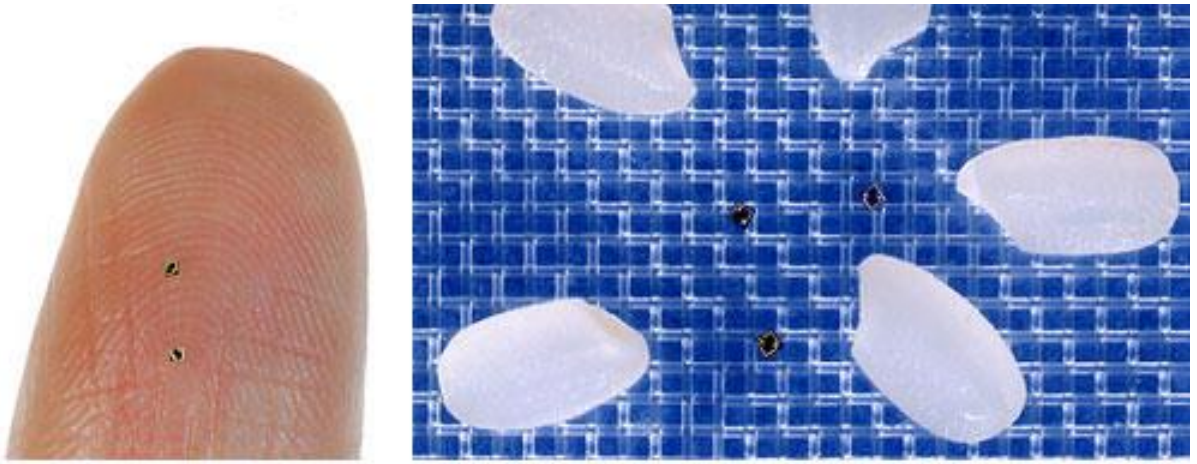
3. Data Collection RFIDs

RFID = Radio Frequency Identifiers

Hundreds or even thousands of tags can be identified at the same time at distance of 3m with a single reader antenna and 6m between two reader antennas.

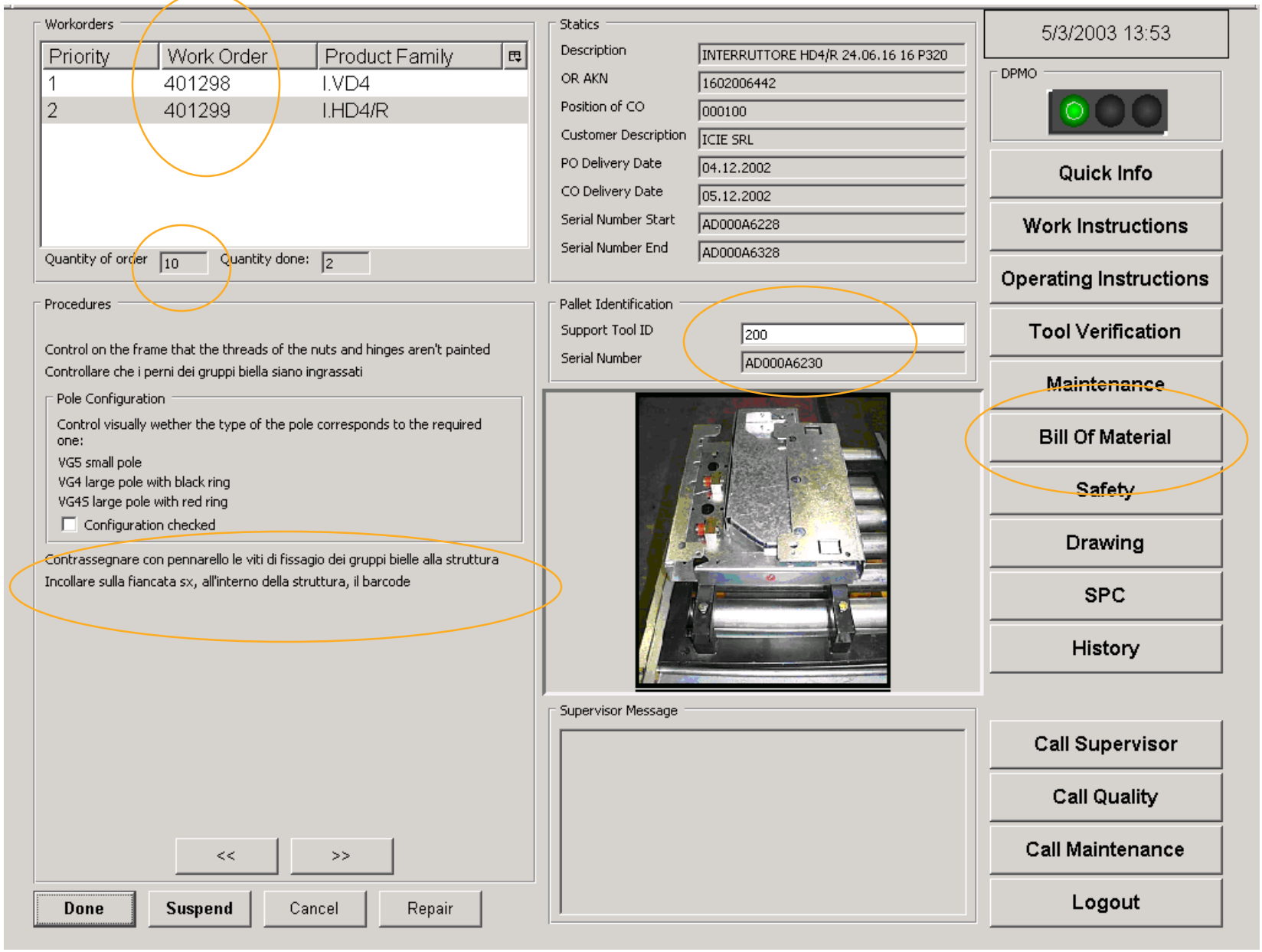
At 13.56 MHz can store 512 bits, new versions working in the 915 MHz range
Price: 0.1 € / piece

Unsuitable on metal, high temperatures, - for the better and the worse.



A New RFID with Embedded Antenna μ-Chip

3. Data Collection Local HMI



ISA S95: 4. Quality Management

Recording, tracking and analyzing product/process characteristics against engineering needs.

Detail

1. provide real-time measurements collected from manufacturing and analysis in order to assure proper product quality control and to identify problems requiring attention.
2. Recommend corrections, including correlating the symptoms, actions and results to determine the cause.
3. **SPC/SQC** (statistical process control/statistical quality control) tracking and management of offline inspection operations and analysis in laboratory information management systems (LIMS).

4: Quality Test

STEPS in assembly:

1. Scan serial # from cabinet to id unit
2. Examine Work Order
3. Package both cabinets for shipping
4. Fill out checklist & test reports
5. Update Syteline & ship

Pack next cabinet

ABB DISTIBUTION AUTOMATION EQUIPMENT DIVISION
LAKE MARY, FLORIDA
CERTIFIED TEST REPORT - RETROFIT CABINETS

GENERALORDER #_____ SHOP ORDER_____

UNIT SERIAL #_____CUSTOMER #_____

PCD STYLE #_____ PCD SERIAL # _____

SOFTWARE VERSION NUMBER _____

FRONT PANEL CONTROLS

A. REMOTE ENABLE_____ OK
B. GROUND BLOCK_____ OK
C. ALTERNATE PU _____OK
D. SEF ENABLE _____OK **(WHEN APPLICABLE)**
E. RECLOSE BLOCK_____OK
F. PROG. 1_____OK **(BATTERY TEST)**
G. FAULT TEST _____OK **(SELF TEST)**

CONTROL FUNCTIONS

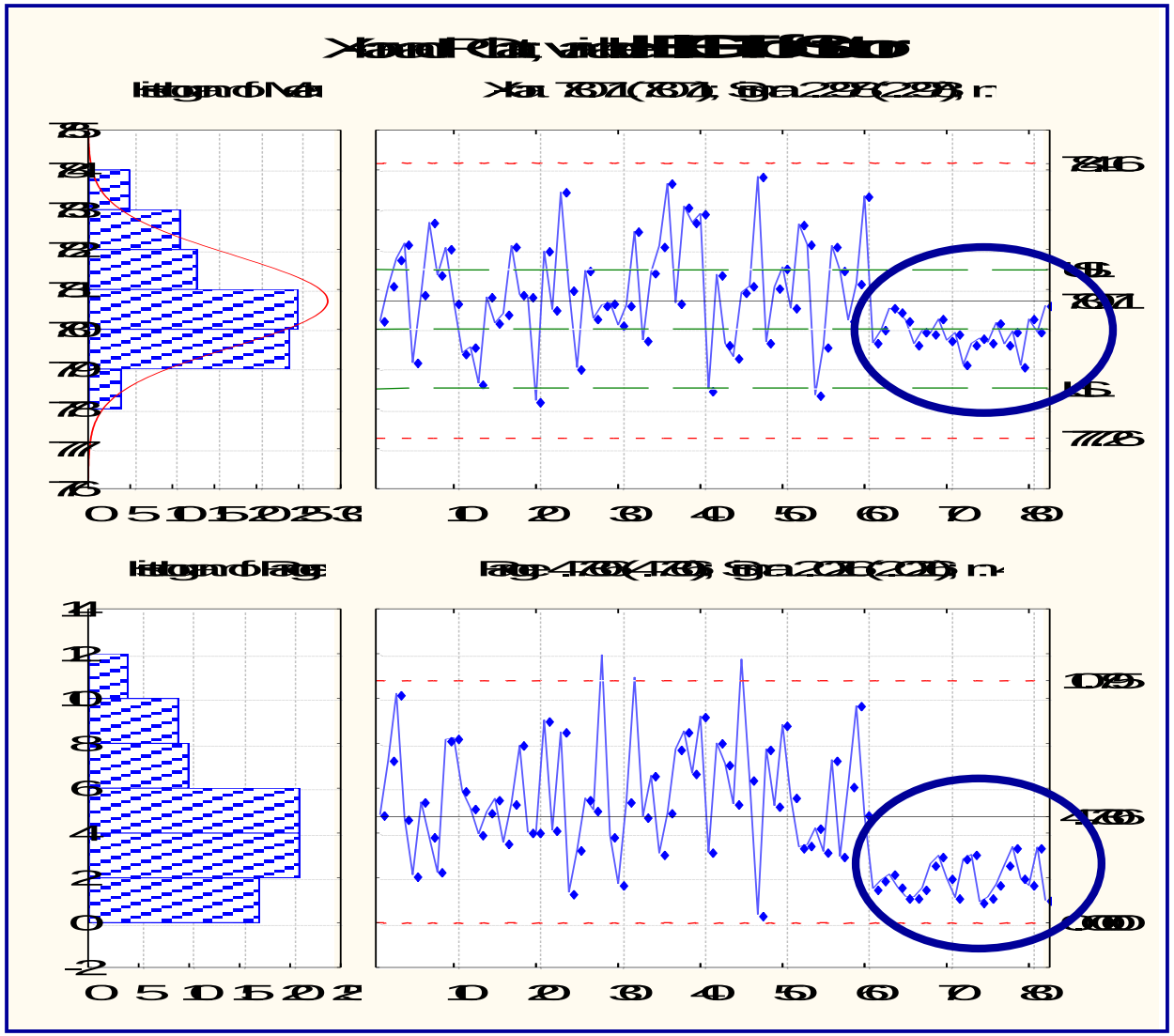
A. MINIMUM PICKUP, PHASE 1____OK PHASE 2 ____OK PHASE 3 ____OK GROUND ____OK
B. INSTANTANEOUS TRIPPING_____OK
C. TIME DELAY TRIPPING_____OK
D. RECLOSE TIMES_____OK
E. RESET TIME_____OK

INPUT/OUTPUT TEST
INTERLOCKED WITH REOTE ENABLED FUNCTION
REMOST CLOSE_____OK
REMOTE TRIP_____OK
REMOTE RECLOSE BLOCK_____OK
REMOTE ALT. 1_____OK
INDEPENDENT OF REMOTE ENABLE FUNCTION
SUPERVISOR CLOSE_____OK
SUPERVISORY TRIP_____OK
VOLTAGE WITHSTAND

CHECK THE CONTROL CABINET WIRING, TO GROUND, AT 1500 VAC FOR

Typical Final Inspection Checklist

4: Example of quality statistics



ISA S95: 5. Process Management

Directing the flow of work in the plant based on planned and actual production activities.

Detail

1. monitor production and either automatically corrects or provides decision support to operators for correcting and improving in-process functions.
   These functions may be intra-operational and focus specifically on machines or equipment being monitored and controlled, as well as inter-operational, tracking the process from one operation to the next.
2. manage **alarms** to ensure factory persons are aware of process changes that are outside acceptable tolerances.

ISA S95: 6. Product Tracking & Genealogy

Monitoring the progress of units, batches, or lots of output to create a full product history.

Detail

1. Monitors and tracks material used in a manufactured part including revisions, sources, serial numbers, supplier identification, or lot.
   This information is retrievable in the event of quality problems or process changes to identify comparable products.
2. record information to allow forward and backward traceability of components and their use within each end product.

ISA S95: 7. Performance Analysis

Comparing measured results in the plant to goals and metrics.

Ability to consolidate collected data and calculate results including real production cost, uptime, SPC/SQC of production parts, etc. Includes comparison of current vs. historical performance.

Detail

1. Provide up-to-the-minute reporting of actual manufacturing operations results along with comparisons to past history and expected results.
2. Performance results include such measurements as resource utilization, resource availability, product unit cycle time, conformance to schedule, and performance to standards.
3. Include SPC/SQC analysis and may draw from information gathered by different control functions that measure operating parameters.

7. Performance Analysis: questions the factory owner asks

What is the number of good / bad pieces produced: by shift X, in week 20 ?
(with / without induced downtime)
What is the relation to the maximum ?

What was the average production speed of a unit compared to the maximum ?
What is the production speed in function of time, deducing stops ?

How much afar from the theoretical production capacity is my plant producing ?

What are the N major reasons why the unit is not producing at full capacity ?
How many stops did the unit suffered ?

What is the availability of my production unit

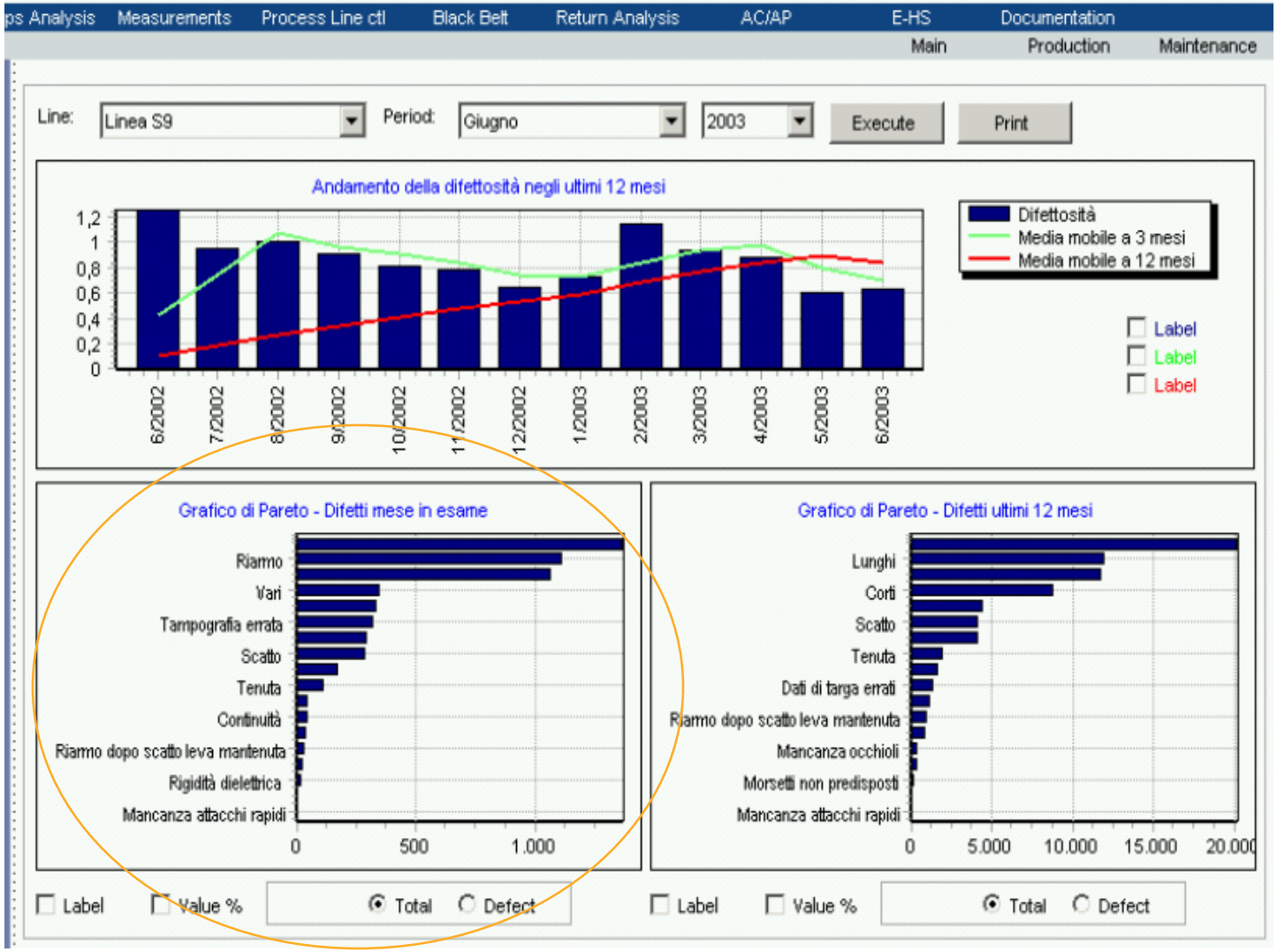
What is the efficiency of operator M ?, of shift S ?

What is the progression of the OEE (overall equipment efficiency) on a daily basis ?

How much time is spent loading / unloading the machine ?

How does my OEE compares with others ?

7. Performance analysis and Pareto



ISA S95: 8. Operations and detailed scheduling

Sequencing and timing activities for optimised plant performance based on finite capacities of the resources

Detail

1. Provide **sequencing** based on priorities, attributes, characteristics, and production rules associated with specific production equipment and specific product characteristics, such as shape, colour sequencing or other characteristics that, when scheduled in sequence properly, minimize set-up.

2. Operations and detailed scheduling is finite and it recognizes alternative and overlapping/parallel operations in order to calculate in detail the exact time of equipment loading and adjustment to shift patterns.

ISA S95: 9 Document Control

Managing and distributing information on products, processes, designs, or orders.

Controls records and forms that must be maintained to serve regulatory and quality needs and populates those forms with actual production data.

Also maintains current documents provided to operators to assist in production methods.

Detail:

1. control records and forms that must be maintained with the production unit. (records and forms include work instructions, recipes, drawings, standard operation procedures, part programs, batch records, engineering change notices, shift-to-shift communication, as well as the ability to edit "as planned" and "as built" information).
2. send instructions down to the operations, including providing data to operators or recipes to device controls.
3. control and integrity of regulatory, documentation, environmental, health and safety regulations, and operative information such as corrective action procedures.

SA S95: 10 Labour Management

Tracking and directing the use of operations personnel based on qualifications, work patterns and business needs

detail

1. provide status of personnel in an up-to-the minute time frame.
2. provide time and attendance reporting, certification tracking,
3. track indirect functions such as material preparation or tool room work as a basis for activity-based costing.
4. interact with resource allocation to determine optimal assignments.

ISA S95: 11. Maintenance Management

Planning and executing activities to keep capital assets in the plant performing to goal.

Detail

1. Maintain equipment and tools.
2. Ensure the equipment and tools availability for manufacturing.
3. Schedule periodic or preventive maintenance as well as responding to immediate problems.
4. Maintain a history of past events or problems to aid in diagnosing problems.

Additional definitions

12. Work order tracking (not S95)

Directing the flow of work in the plant based on planned and actual production activities

Monitors work orders as they pass through the operations. Real time status provides management with view of actual production output and permits workflow changes based on business rules.

13. Recipe Manager: (not S95)

Mapping production order operations to detailed list of tasks/jobs, providing detailed recipe for manufacturing