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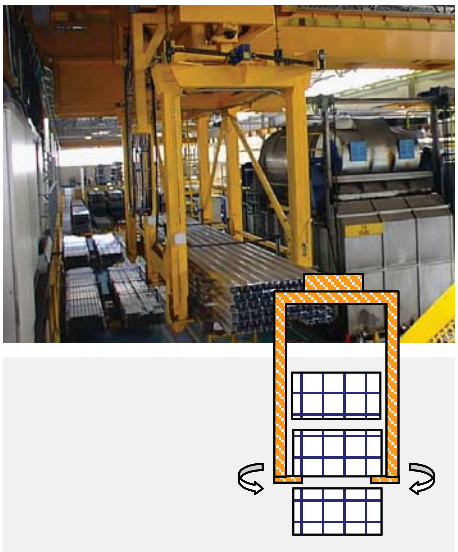
FMC Supervision

Plant description

Issues related to the complexity of the system in terms of machines to manage. System based on Siemens PLC S7 / S5.

Physical Characteristics

Material moved:	containers of aluminum bars
Number of ovens:	4
Number of packaging lines:	6
Number of buffers at 3 levels:	60th
Number of workstations managed:	349
Number of rollers:	24th
Sorting system:	Automatic gantry crane

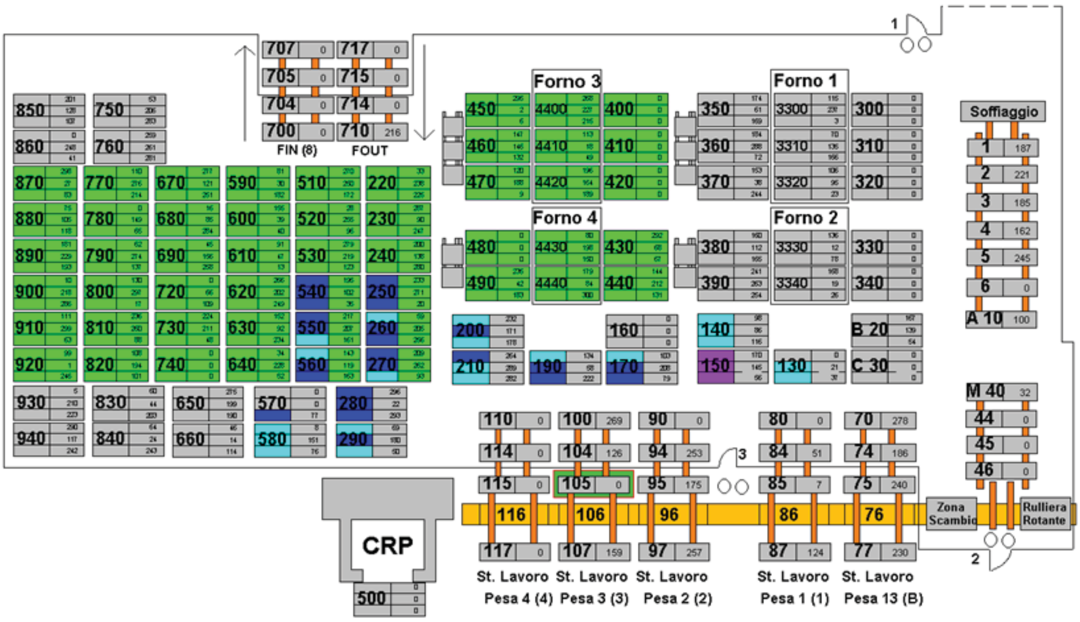


Technological Characteristics

Number Plc in the plant:	5 PLC Siemens
PLC network architecture:	L1 / Ethernet / Profibus
PLC network infrastructure:	Optical transducers SICK
Communication protocol PC / PLC:	Ethernet (TCP / IP) with OPC Server
Development of environment control system:	Microsoft Visual Studio C / C + +
Software architecture of control:	Management processes (tracking / monitoring)
Data management system:	Microsoft SQL Server 2000
Interfacing with ERP system:	AS400
System redundancy:	Management control system with automatic backup on AS400

Plant map

(Map the actual plant was modified according to the privacy of the customer)



Activity list made by Taiprora

Electronic Interventions

- Revamping management framework for transport
- Revamping management framework interconnection systems

Design and PLC Software Development

- Plant management software
- Software for interfacing with PLC Header PC monitoring and control
- PC interface between supervisor and ERP on AS400
- Development and commissioning of software monitoring and control
- Optimization algorithm based on mathematical models of changes in Operations Research

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TAIPRORA
Software & Automation Engineering

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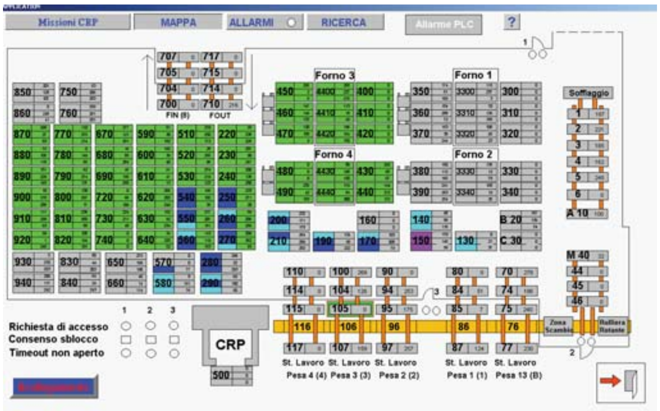
FMC Supervision

User interface



Plant Supervisor

Warehouse Configurator

Movement supervision and control of aluminum extrusions CRP is a project in optimization, supervision and industrial control commissioned by HYDRO, part of the NORSK ESD group, for the Atessa system, in Chieti (Italy), dedicated to the production of extruded aluminum pipes.

The CRP system rationalizes the use of a electrical crane used for moving of pipes and operates in an area of the system called the 'Oven Zone'.

The functional strategy of the crane is decided through optimization algorithms and interfacing with a management system on an AS400 mainframe.

In particular, scheduling of crane tasks, assigning of pallets to ovens and sequencing of oven operations, are controlled through a request service and movements are calculated with efficient optimization algorithms which utilize decision trees explored with techniques of Branch & Bound.

The hardware architecture consists of a PC console which communicates with a network of approximately 400 sensors. The optimization modules developed in C/C++ communicate with the system through the SCADA Factory Link framework. The adoption of new supervision and control software has lead to a 28% increase in system throughput, the elimination of blocks in extraction, and a 40% reduction of crane usage.

System supervisor functionalities

- Block diagram of a system that allows you to supervise the status of the whole plant
- Field alarms management (possibility to configure the types of alerts with an advanced alarm configuration manager)
- Missions priorities manager; possibility to swtch to manual operations
- Activity monitoring system
- System configuration (enable/disable parts of the system - ability to configure the shares of the locations to be sent to Crane with interpolation feature)
- Saving map and recovery in case of system failure
- Optimization algorithm based on mathematical models of changes in Operative Research

Optimization Algorythm

1. Dynamic System
2. Partial Data
   Online Optimization
3. Capacity 3 Crane
   Point to pointi missions
4. Strategy
   Explores all the possible missions and selects the most priority, namely the one with the highest fitness value

$$F = \alpha P_1 + \beta P_2 + \chi P_3$$

$P_1 \in [-100, 100]$: priority of the pickup station
$P_2 \in [-100, 100]$: priority of the deposit station
$P_3 \in [-100, 100]$: priority of the basket

Some strategies

push (priority of the picking) $\alpha = 1.0;\ \beta = 0.0;\ \chi = 0.0$
pull (priority of the deposit) $\alpha = 0.0;\ \beta = 1.0;\ \chi = 0.0$

$$P_1 = \begin{cases} -P_{max} / WS_v & \text{if x free (1)} \\ WS_v \cdot P_{max}/2 & \text{if x occupied (2)} \\ WS_v \cdot P_{max} & \text{else (3)} \end{cases}$$

Buffer:

N = Number of baskets in the buffer
PR_{max} = Max priority among the baskets in the buffer
L = Number of buffer levels

$$P_2 = \begin{cases} P_{max} \cdot N / (L + PR_{max} + 1) - P_{max} & \text{If I am depositing an empty basket} \\ P_{max} / (N + PR_{max} + 1) - P_{max} & \text{If I am depositing a basket on a buffer that does not contain any basket that carries the consecutiveness on basket cleaner} \\ 2 \cdot (P_{max} / (N + PR_{max} + 1) - P_{max}) & \text{If I am depositing a basket on a buffer that contains at least a basket that realizes the consecutivity on basket cleaner (2)} \end{cases}$$