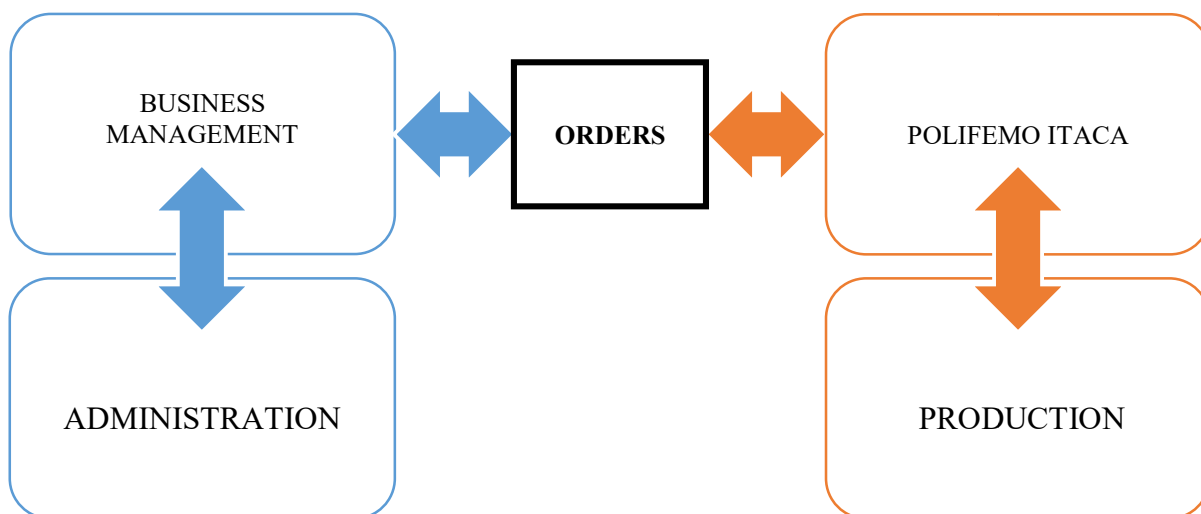




Interconnection to the POLIFEMO Manufacturing Execution System

The data exchange interface between the machine and the company information system takes place through the POLIFEMO application, software for production management produced by ITACA SRL.



System Description

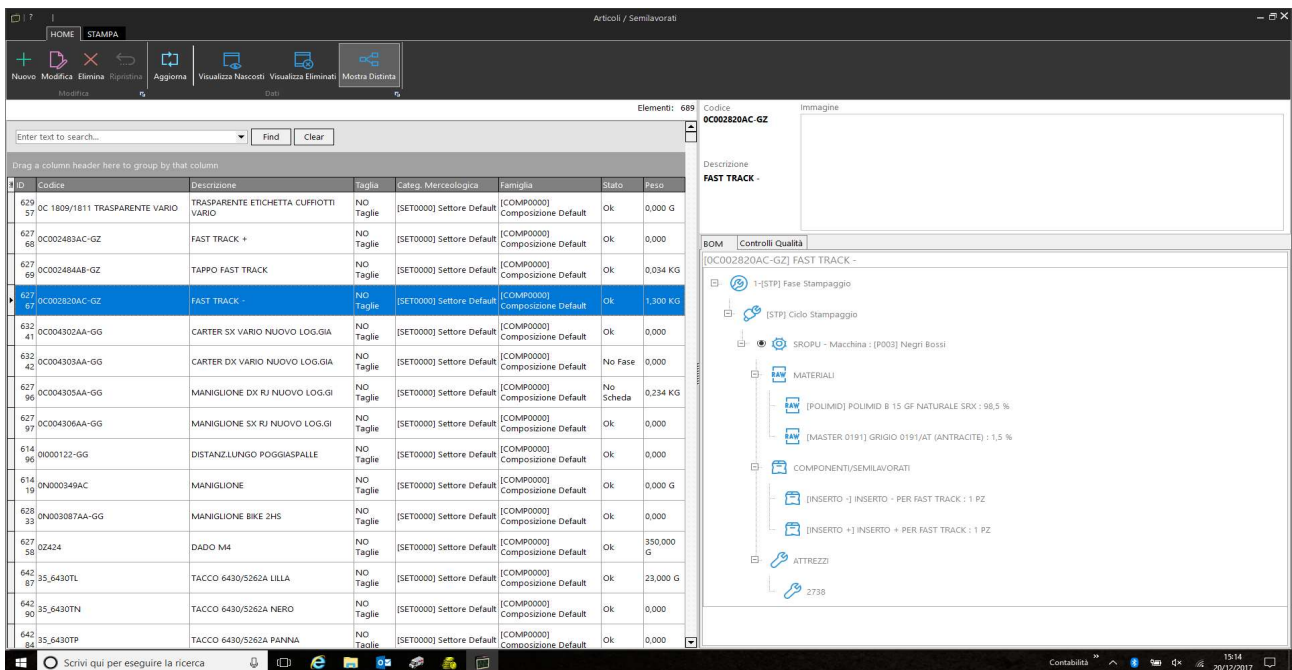
The 'Polifemo' software of Itaca allows the monitoring of machines, as well as the management of the master data and planning/scheduling. Through appropriate connections to the machines it is also possible to acquire data from them for the progress of production and the writing of parameters for programming the machines themselves. The system is based on a production server that acts as a data collector and one or more clients within the network that can totally or partially carry out management activities depending on the access rights provided to each station.

Hardware connection

In the specific case of the interface towards the molding presses, the connection is made through ethernet network between the management PLC of the presses and the data acquisition PC located inside the same company network. The data acquisition PC reads the production data and writes the programming data.

Data Exchange

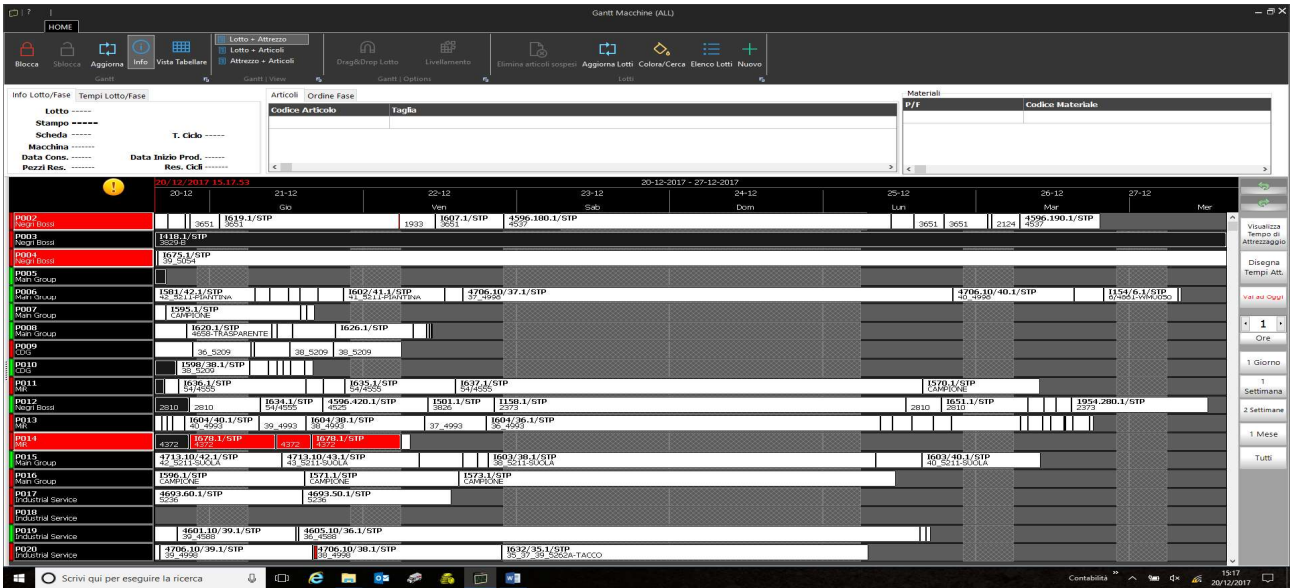
In the 'Polifemo' MES, the user, after having defined the necessary master data from the system (or having acquired them from a remote management system) can program the activity of each of the presses connected to the system. For each press, it will program a series of production batches per PN / quantity. At the time of the mold change the remote user, from one of the Polifemo system clients, will confirm the mold change and this will write on the machine the PN in progress, the pieces to be made, and possibly, if previously stored, all the parameters of recipe already used for this PN / machine size; this activity will reset the number of pieces made on the press. At this point, the machine operator will check any written parameters and give the ok at the start of production by accepting the change on the operator keyboard in the machine.



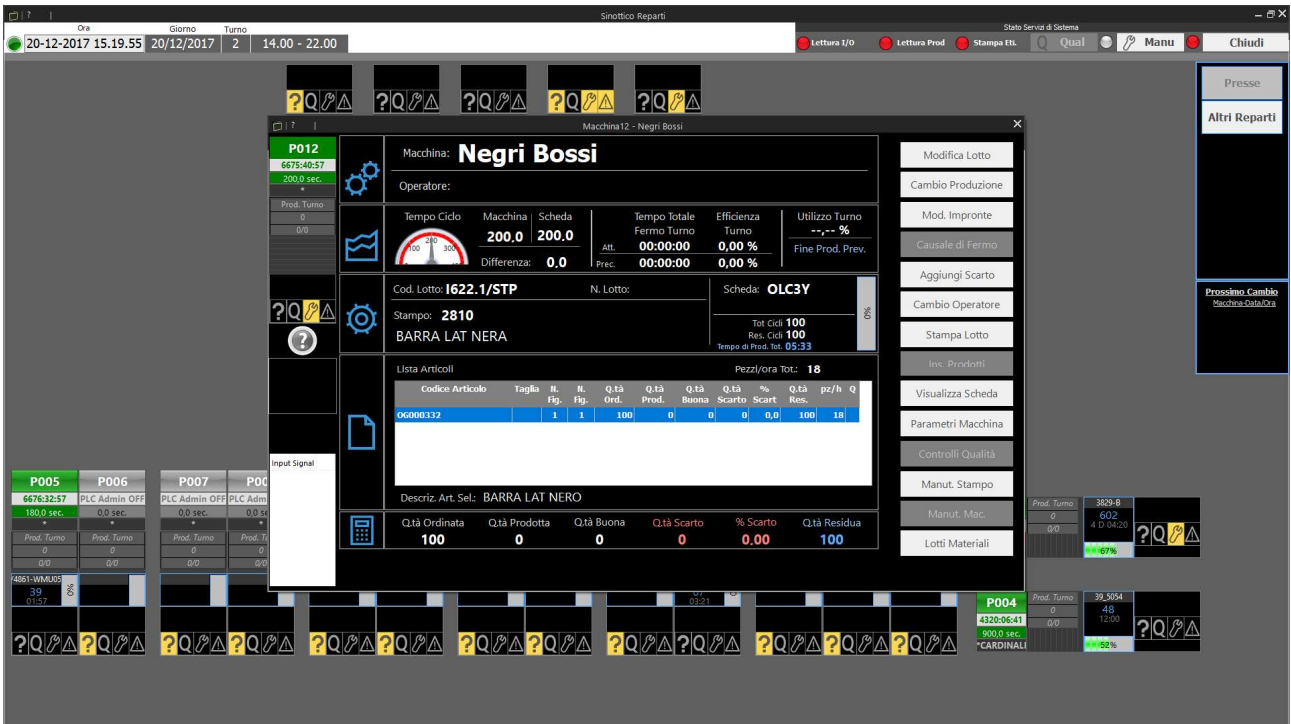
The screenshot displays the ITACA software interface. The main window shows a list of articles with columns for ID, Codice, Descrizione, Taglia, Categ. Mercatologica, Famiglia, Stato, and Peso. The article with ID 627 and Codice OC002820AC-GZ is selected and highlighted in blue. To the right, a detailed view of this article is shown, including its description 'FAST TRACK -', a BOM (Bill of Materials) tree, and a 'Controlli Qualità' (Quality Controls) section. The BOM tree lists various materials and components, such as 'SROPU - Macchina : (P003) Negri Bossi', 'MATERIALI', '[POLIMD] POLIMID 6 15 GF NATURALE SRX : 98,5 %', and '[MASTER 0191] GRIGIO 0191(AT (ANTRACITE) : 1,5 %'. The 'Controlli Qualità' section shows a list of quality control points, including '1-ISTP] Fase Stampaggio', '[STP] Ciclo Stampaggio', and 'SROPU - Macchina : (P003) Negri Bossi'.

ID	Codice	Descrizione	Taglia	Categ. Mercatologica	Famiglia	Stato	Peso
629	OC 1809/1811	TRASPARENTE ETICHETTA CUFFIOTTI VARIO	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000 G
627	OC002483AC-GZ	FAST TRACK +	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
627	OC002484AB-GZ	TAPPO FAST TRACK	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,034 KG
627	OC002820AC-GZ	FAST TRACK -	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	1,300 KG
632	OC004302AA-GG	CARTER SX VARIO NUOVO LOG.GIA	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
632	OC004303AA-GG	CARTER DX VARIO NUOVO LOG.GIA	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	No Fase	0,000
627	OC004305AA-GG	MANIGLIONE DX RJ NUOVO LOG.GI	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	No Scheda	0,234 KG
627	OC004306AA-GG	MANIGLIONE SX RJ NUOVO LOG.GI	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
614	90001122-GG	DISTANZ.LUNGO POGGIASPALLE	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
614	90000349AC	MANIGLIONE	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000 G
628	90003087AA-GG	MANIGLIONE BIKE 2HS	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
627	02424	DADO M4	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	350,000 G
642	35_6430TL	TACCO 6430/5262A LILLA	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	23,000 G
642	35_6430TN	TACCO 6430/5262A NERO	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000
642	35_6430TP	TACCO 6430/5262A PANNA	NO Taglie	[SET0000] Settore Default	[COMPO0000] Composizione Default	Ok	0,000

After the production has started, the remote system remains in constant connection with the press by reading the pieces made and the alarms in progress, furthermore the machine operator can change the working parameters for the current PN and, once these parameters are considered valid, at any time the operator can press the 'Save data' button on the press keypad which will command the 'Polifemo' remote system to archive the production data per PN/press.

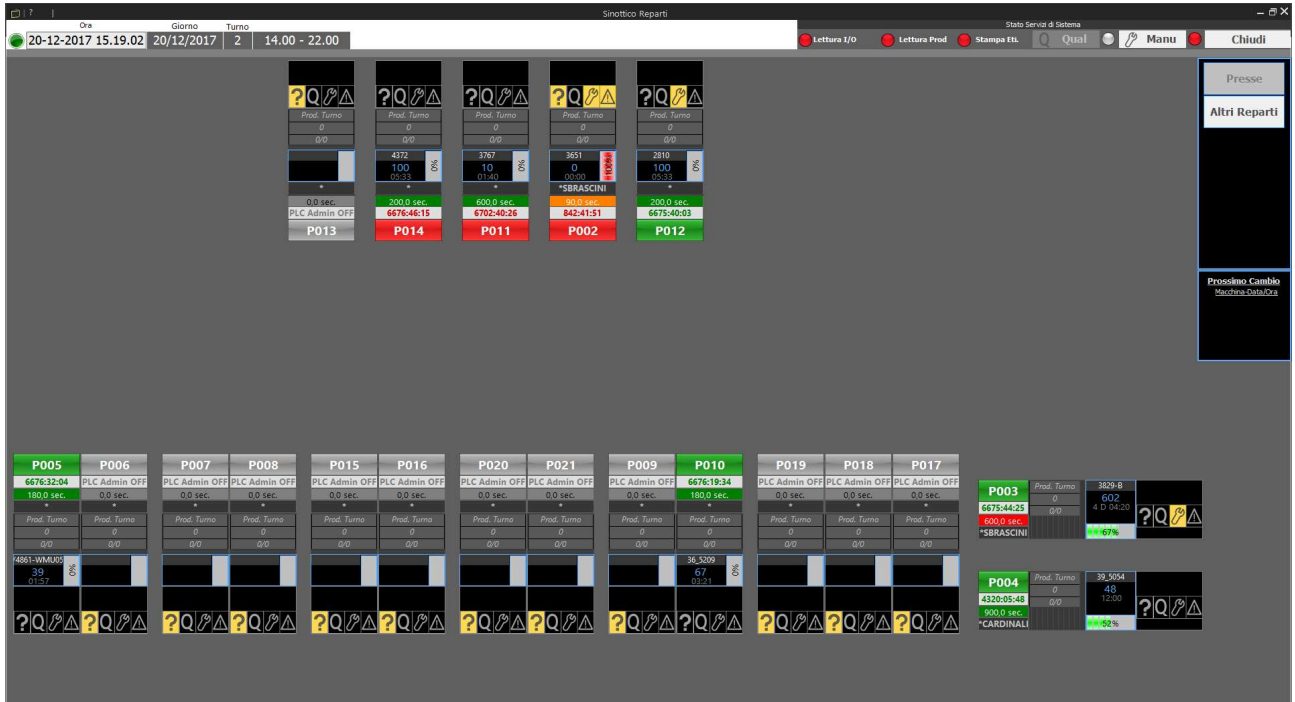


The communication between the machine and the information system takes place using the international standard OPC UA. An OPC UA client is inserted in the information system which communicates with an OPC UA server which resides on a data acquisition PC from which it is possible to access the press PLC, uniquely identified by an IP address, through the customer's company network. The data is inside the PLC, but is returned



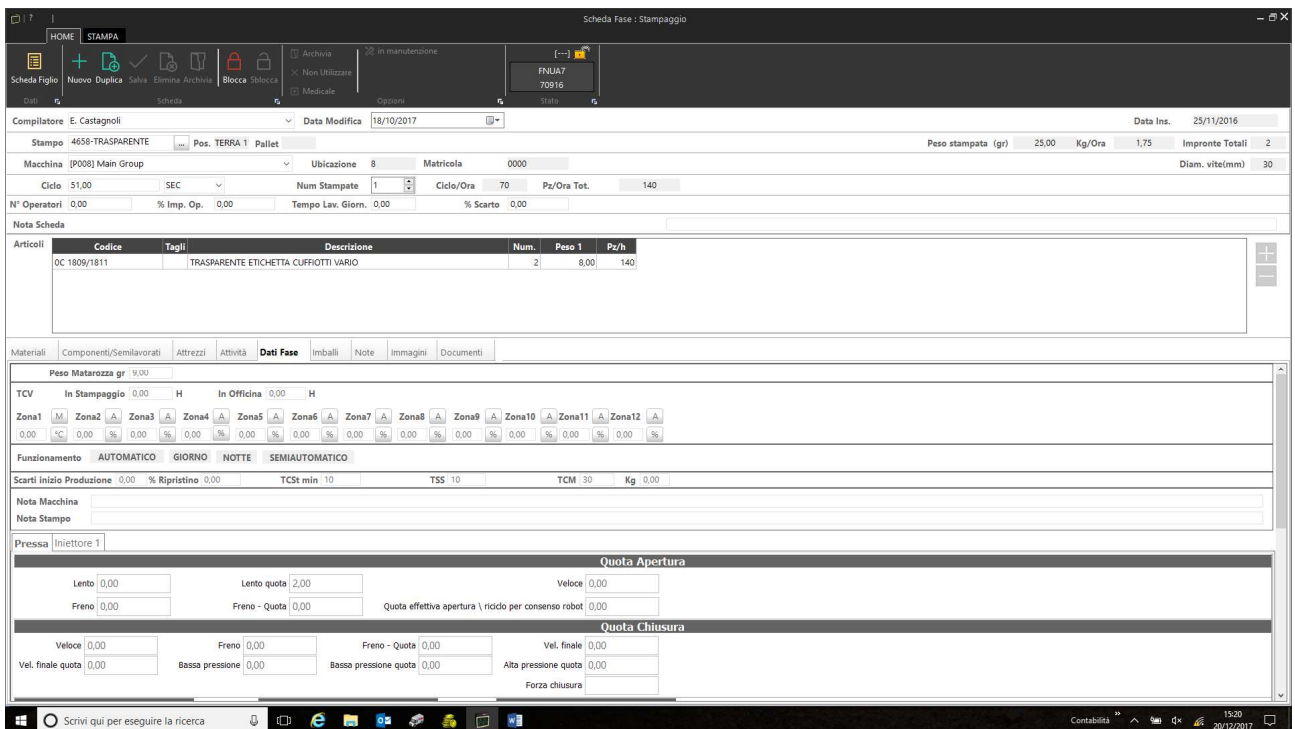
available to the production information system from the OPC server, which reads the production data and writes the programming data. The data format depends on the type of variable to be accessed, that is: binary, integer, real, etc. depending on how it was created within the program in the PLC.

The instructions that are exchanged between the press and the factory information system are related to the planning, scheduling and control of the process.



The dashboard displays production data for multiple machines. Key information includes:

- Machine P014:** 4372 units produced, 100% completion, 300.0 sec cycle time.
- Machine P011:** 3767 units produced, 100% completion, 600.0 sec cycle time.
- Machine P002:** 3651 units produced, 100% completion, 180.0 sec cycle time.
- Machine P012:** 2810 units produced, 100% completion, 200.0 sec cycle time.
- Machine P010:** 6676:19:34 units produced, 180.0 sec cycle time.
- Machine P003:** 675:44:23 units produced, 600.0 sec cycle time, 67% completion.
- Machine P004:** 4320:05:48 units produced, 900.0 sec cycle time, 62% completion.



The 'Scheda Fase: Stampaggio' screen provides detailed configuration for the stamping process:

- Machine:** FNUA7 70916
- Stampo (Mold):** 4650-TRASPARENTE
- Macchina (Machine):** [P008] Main Group
- Ciclo (Cycle):** 51.00 SEC
- Num Stampate (Number of Prints):** 1
- Cicla/Ora (Cycle/Hours):** 70
- Pz/Ora Tot. (Total Pieces/Hours):** 140
- Articoli (Items):** OC 1809/1811 - TRASPARENTE ETICHETTA CUFFIOTTI VARIO (2 units, 8.00 Kg)
- Funzionamento (Operation):** AUTOMATICO
- Scarti (Waste):** TCM 30 Kg
- Quota Apertura (Opening Quota):** Lento 0.00, Veloce 0.00, Freno - Quota 0.00
- Quota Chiusura (Closing Quota):** Veloce 0.00, Freno 0.00, Freno - Quota 0.00, Vel. finale 0.00



Regarding the information transferred from the factory information system to the press, these can be summarized as follows:

- Table of production orders (production orders);
- Table of production batches;
- Machine tooling table associated with the item (order feature).

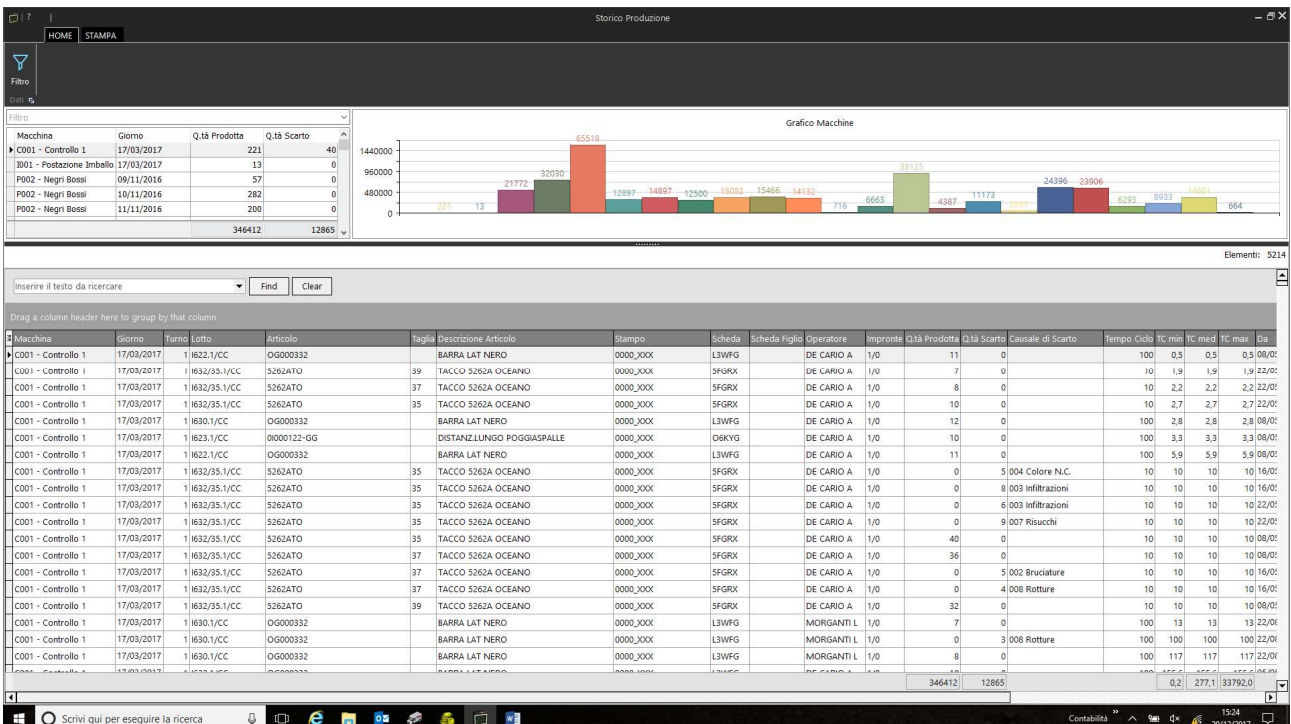
In fact, in the "Polifemo" system, the user can define the necessary master data from the system or acquire them from a remote management system through the "Import / Export" function which connects the software directly to the SQL database of the company ERP/management system. After that, the user can program the activity for each of the presses connected to the system. Specifically, for each press, it will program a series of production batches per PN / quantity.

At the time of the mold change the remote user, from one of the clients of the "Polifemo" system, will confirm the mold change and this will write on the machine the PN in progress, the pieces to be made and, if previously stored, all the parameters recipe already used for this article on the press in question. The activity will reset the number of pieces made on the press.

If the machine tooling fields have not already been defined for that item, the user can enter them on the "Polifemo" system and send them to the machine. In this way they are saved in order to be reused if the condition of the molding of the same article reappears.

At this point the operator on the machine will check any parameters written on the platform, check their accuracy and give the ok at the start of production by accepting the change on the operator keyboard in the machine.

Through the OPC protocol described in the section, once production has begun, by accepting the part-program and starting the machine, the system remains in constant connection with the press, reading the pieces made and the alarms in progress.





Any changes made on the machine on the process parameters can be logged and used to change the molding cycle / recipe using the "save data" command. These data may be associated with the PN. The saved production data can then always be consulted by viewing the item list.

The system will proceed until the next changeover, where, a new PN / size will be written in the machine with its pieces to be made and with the machine data, saved in previous production.

All the batches produced are archived and historicized to have productivity analysis, efficiency statistics, WPI, etc.

In particular, the machine can communicate the following data to the production software:

- Start of processing, with the identification data of the piece, batch and production order and process settings;
- End of processing, with the identification data of the piece, batch and production order, process report;
- Machine operating status (start of machine stop with time and date; end of machine stop with time, date, stop code and operator);
- Alarms status;
- Real values and status of the main functions of the machine (Times, Speeds, Pressures, Temperatures, Positions, total hours counter of the press and number of cycles performed during processing and status of the press, instantaneous powers);
- Configuration variables (Times-cycles, Speeds, Pressures, Temperatures, Positions, machine cycles);
- Production variables (pieces produced, batch, type of material, theoretical production time, etc.).

Furthermore, for each press it is possible to view a dashboard with all the historical parameters relating to the press and the efficiency indices.

