

Q3Intelligence

Business Intelligence
for the Metals Industry



DANIELI AUTOMATION

Know-How in Process Control

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WHY BUSINESS INTELLIGENCE

Business Intelligence (BI) is not about business as usual. Rather it is concerned with making better decisions easier, and making them more quickly.

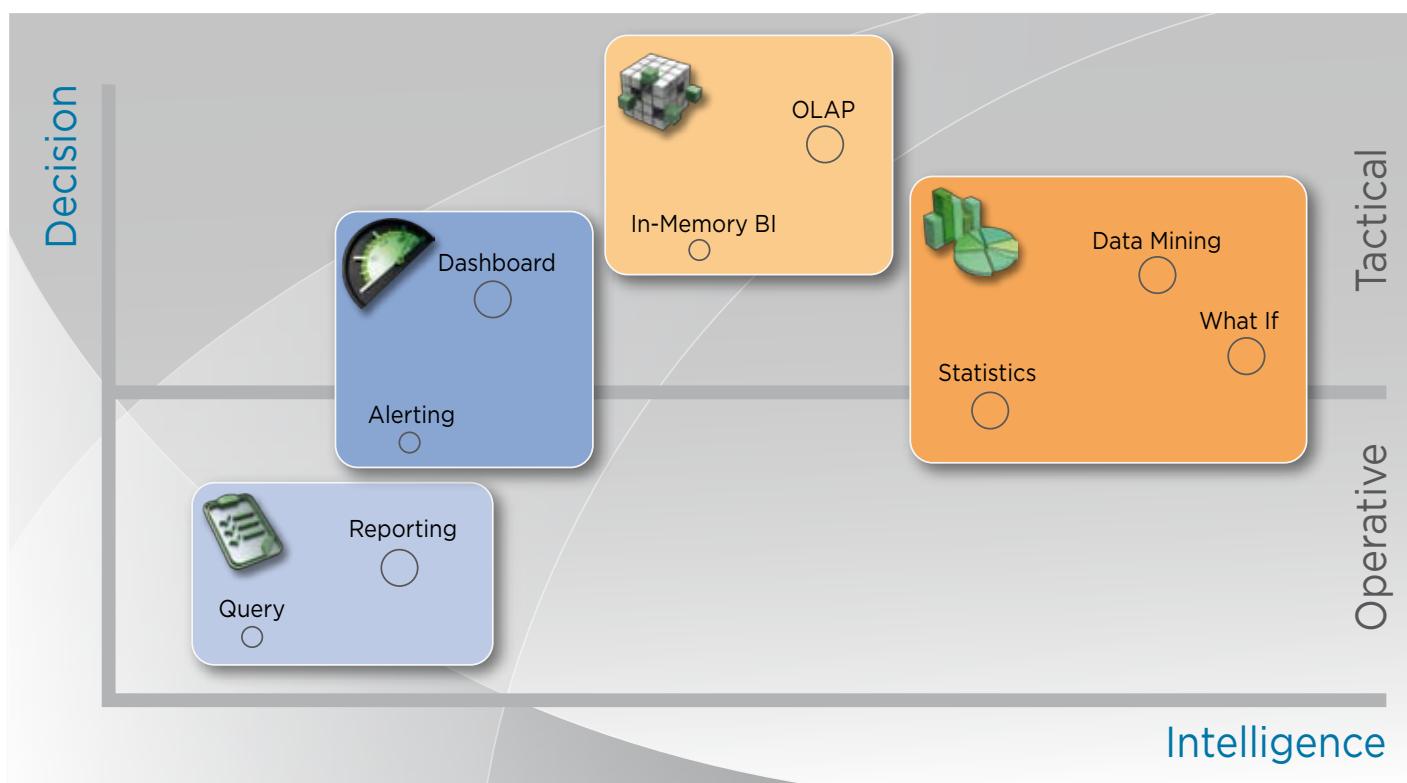
The fact is that the rate of generation of business data is increasing exponentially, even faster than for computer processing power. On the other hand, there is an increasing need for in-depth analysis, as organizations move from standard reporting towards interactive ad hoc BI, predictive

analysis and the need for near real-time results. BI platforms combine operational data with analytical tools to present complex and competitive information to planners and decision makers.

As a key strategic driver, BI must serve as the way to change the manner a company conducts business by improving its processes and transforming decision-making to be more data-driven and user-guided.

By obtaining the right data,

discovering its power and sharing its value, a BI platform transforms this information into knowledge, and delivers the ability to comprehend the interrelationships of the facts presented in such a way as to guide actions towards desired goals.



Q₃INTELLIGENCE

THE ADVANCED DATA ANALYSIS AND VISUALIZATION SYSTEM FOR THE METALS INDUSTRY



Q₃Intelligence allows the users to analyse data in depth and from different perspectives, summarizing it into useful information, without the need of any special skills or the support of any IT expert.

Combining Danieli Automation's extensive experience in designing, manufacturing and commissioning automation systems for the metals industry, with skills in designing and developing BI systems, Q₃Intelligence addresses the needs to transform large amount of data into useful information, in order to optimize the metallurgical production process.

In a modern plant, a vast amount of data is constantly collected by the various acquisition systems, such as the PLCs, and HMIs. Only a small proportion of this data is ever properly analysed to obtain useful information concerning the metallurgical processes. As a matter of fact, most of the plant's data is simply displayed in real-time using the HMI displays

and is then lost forever. Furthermore, process control system (Level 2) databases typically store process data for just a few months; in other words, there is a considerable waste of the opportunities to analyse information, since raw data cannot be considered from an historical perspective.

The system extracts data from a wide range of heterogeneous sources; it automatically transforms and consolidates it into a uniform standard in order to load it into a single source, ready to be consulted.

Q₃Intelligence is user-friendly and easy to work with; thanks to its advanced data model that has been developed over several years, and its simple and logical user interface.

↓ The Q₃Intelligence platform interface



DANIELI AUTOMATION Q₃Intelligence

Danieli Automation Q₃Intelligence is not only an information delivery system, but a complete decision platform embedded in the business process. The platform includes sophisticated components and industry specific analysis that improve decision making and help the users to increase the value of their business.

		MOREIntelligence	
Web-Report	Web-Dashboard	OLAP	Analytics
 <ul style="list-style-type: none"> › Distribution of reports across Internet and Intranet. › Access control security and permissions configurable for each individual user/report. › Integrated reports based on multiple data sources. › Export of reports and data to various standard formats (Microsoft Excel, Adobe PDF, Microsoft Word). 	 <ul style="list-style-type: none"> › Innovative Key Performance Indicators (KPI) library per each plant area. › Single point of access to production data across Internet and Intranet. › Plant performance metrics are compared with their target values. › Intuitive visualization approach. › Readily performed comparisions by period, team and process. 	 <ul style="list-style-type: none"> › Historical Data Warehouse (DW), with years of data available online. › High-level data model and advanced analysis capabilities. › High-performance query engine. › Completely integrated with Microsoft Excel. › Short learning curve times. 	 <ul style="list-style-type: none"> › Advanced statistical analysis and mathematical algorithms. › Discover relationships and correlations within sets of data. › Process large volumes of data to extract useful properties. › Data-intensive simulations and scenario analysis.
The Report module creates formatted and interactive web-based reports, which are available through a web portal that offers a high level of security and scalability. An extensive library of reporting templates is available and the users can use these directly from their own workspace.	The Dashboard module offers a set of web-based consoles that include the most useful KPIs for assessing the current status of each plant area. Each dashboard is directly connected with operational applications updated in real-time, and contains dials, gauges, traffic lights and other graphical components that indicate the state of a particular performance metric, compared to its target value or the preset thresholds.	With the online analytical processing (OLAP) module, the users can analyze huge amounts of data thanks to queries that have extremely fast calculation performances. Without any help from the IT department, users can display numerous and relevant aspects of the data in a simple and flexible manner, using an interactive interface. This module is completely integrated with Microsoft Excel; this allows advanced data analysis to be deployed to a wider range of users, who can use these functionalities within a well-known environment.	The Analytics module allows exploration and investigation of past process performances to gain insight and drive process design and planning, via advanced statistical methods and predictive modeling. Querying, reporting, OLAP and alerting tools in the OLAP module can answer questions such as "what happened?", "how many?", "how often?", "where is the problem?", and "what actions are needed?". Analytics can help answer questions such as "why is this happening?", "what if these trends continue?", "what will happen in the future?" (predictions), "what is the best that can happen?" (optimizations).

Q3INTELLIGENCE

ARCHITECTURE

The Q3Intelligence system is based on a server computer running a standard Microsoft Windows operating system, a database engine, and the application software.

It is important to note that Q3Intelligence does not use any particular dedicated hardware or any special software, relying only on standard market products.

This means a **reduced Total Cost of Ownership (TCO)**, as both its maintenance and its portability to any suitable new platforms that may become available in the future are easier and faster to accomplish. Figure on the right illustrates the Q3Intelligence architecture:

in particular it shows how data is collected from typical sources (Level 1 system, Level 2 and Manufacturing Execution System - MES databases) and how the information extracted from these is presented to the users (on a standard desktop or laptop PC with a Web browser and Microsoft Excel installed).

All these steps are performed automatically by Q3Intelligence, without the need for any manual intervention in this data processing.

An advanced scheduling application is used to manage the data extractions, and quality control procedures are used to ensure the accuracy and consistency of the data loaded into the data warehouse and then made available to the users through the

multidimensional data model. The application front-end for OLAP and Analytics is completely integrated with and based on Microsoft Excel; this reduces **learning curve times**, as users then remain within a familiar environment.

There is also the possibility of using Microsoft SharePoint to browse the Q3Intelligence data warehouse and to share the results of the analysis with other users.

Two of the most famous and well-known Microsoft products can thus be used together to combine their powerful capabilities with an advanced data model, giving the user the chance to explore, analyze and share information across multiple platforms and devices.

Mobile BI

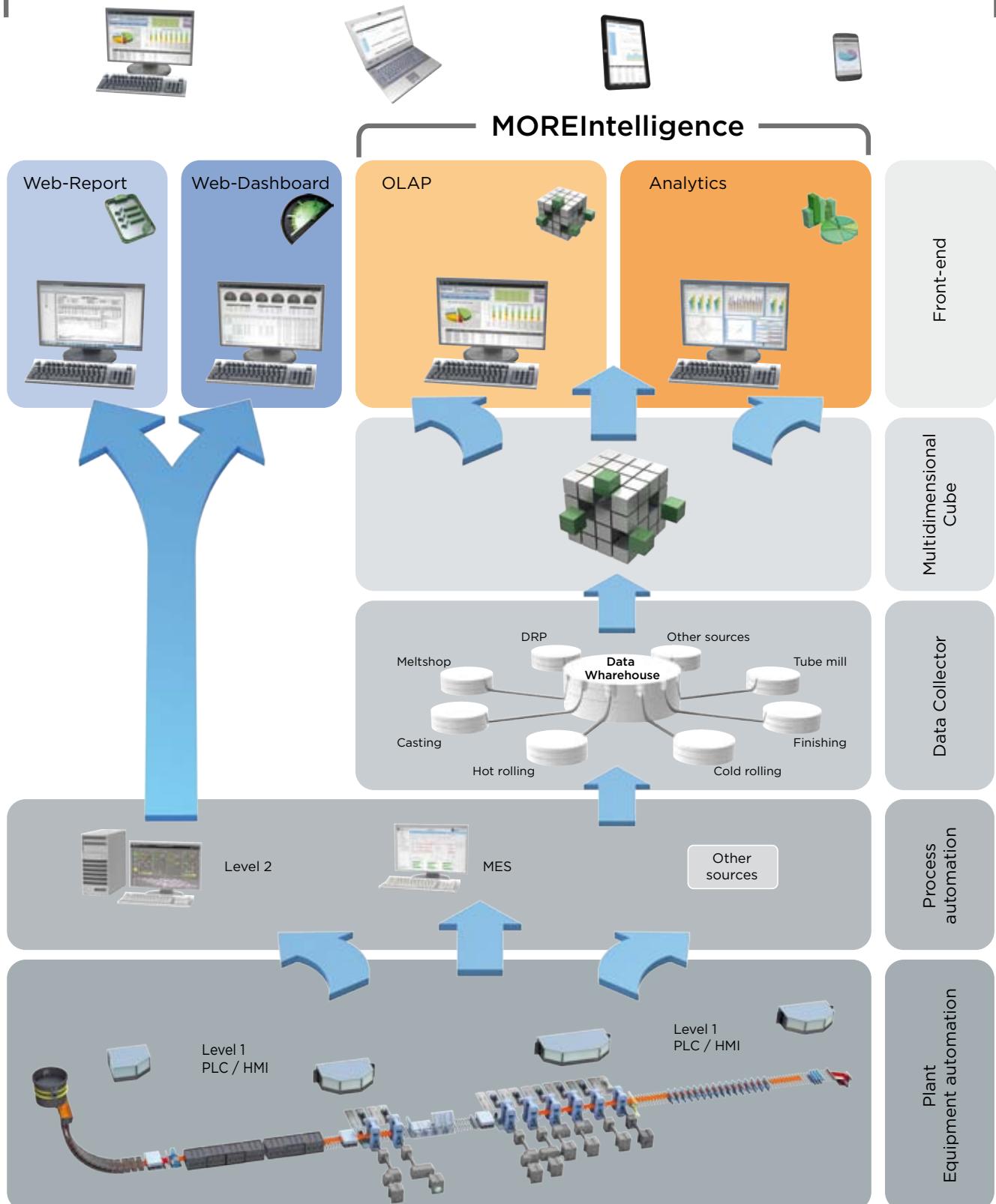


With Q3Intelligence you can also count on a powerful mobile extension with which to obtain instant and highly interactive access to plant data from virtually anywhere.

Mobile access to your data comes with a gesture-driven application that brings intelligence to the front-line: this means quick touch access to **trends, metrics and plant KPIs**.

In addition, the possibilities for configuring Feeds and Alerts provide high-value content delivery, making sure that the right people get the right information at the right time.

Q3Intelligence



Web-Report



Main features

- › Access control security and permissions configurable for each individual report.
- › Multiple distinct and configurable user profiles.
- › Uploading of an unlimited number of reports.
- › Distribution of reports across Intranet and Internet.
- › Full control of report layouts for each user.
- › Tools for independent report construction.
- › Integrated reports based on multiple data sources.
- › Export of reports and data to various standard formats (Excel, PDF, Word).
- › Direct definition of data views (queries) in Web-Report.
- › Automated scheduling of reports generation for alerts and group e-mailings at defined times.

In modern systems for managing plant production data, **reporting functionalities** that can rapidly and efficiently transfer the information gathered by the underlying automation to the end users are of ever-increasing importance.

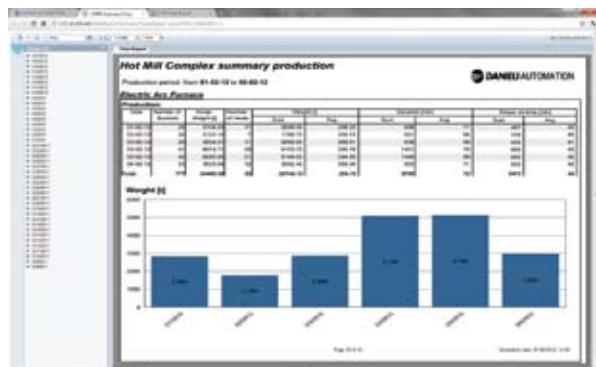
The Web-Report solution integrates the most recent technologies for the creation and distribution of the various types of reports. **Rapid access to information** is provided through queries and reports. Even inexperienced users can obtain this by themselves without involving the IT department, with the data being presented in terms that non-technical business users

can readily understand. Conversely, experienced users will welcome the more sophisticated additional query and **layout functionalities** that are also provided. Training and support costs are minimized, while the IT department remain in control of data acquisition and security.

Automated emailings of pre-defined reports assist operations further, via the visualization and availability of important results without any user intervention. Web-Report is provided with a complete **set of specific reports for each process area** to be covered, to which it is then possible to add an unlimited number of new reports.

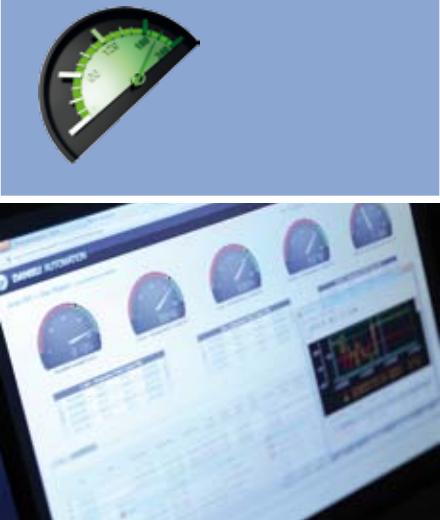


◀
EAF Heat Report: the summary page covers the main timings, consumptions and analyses for the given heat, which is chosen from the list of such for the selected day, to the left. The more detailed report pages for this heat are then accessed via either the tabs above the report, or the active links at the base of it.



◀
Production Summary Report: for the selected period, the upper part of the report shows the cumulative daily totals for each of the days involved, including some heat averages. In the lower section, there is a graph of the total produced weight per day.

Web-Dashboard



Main features

- › Innovative KPI library per each plant area.
- › Plant performance metrics compared with target values.
- › Intuitive visualization approach.
- › Distribution of dashboards across Intranet and Internet.
- › Multi-level grid with drill down capabilities.
- › Access control security and permissions configurable for each individual dashboard.
- › End-user customization capabilities.
- › Single point of access to production data.
- › Integration with operational applications.

The **Web-Dashboard** module enables users to use a set of web-based consoles to monitor **Key Performance Indicators (KPI)** that convey how well each process area is performing; an innovative and complete KPI library is available, consisting of a set of advanced KPIs that are structured and categorized according to the type of process that they apply to.

The user can evaluate the production performances from an historical point of view or in **real time**. Each dashboard, using **intuitive visualization** and including graphical components and links, helps to improve decision making by presenting and communicating in-context information regarding the production process.

These consoles have been conceived and designed in order to enable the users to explore production data with a **top-down analysis approach**; from a summary overview to a detailed analysis, drilling down to successive levels of detail, to explore why a particular KPI is off target.

It is possible to access other applications used to monitor and analyze production such as reports, production images, external files (e.g.: Fast Data Analyzer -FDA- files) directly from the dashboards, thus ensuring a **single point of access** to production data. All the contents of the dashboards are displayed in a role-based, secure, customizable and extensible environment.



Electric Arc Furnace Day Report: general overview of the analyzed period with gauges and KPIs displaying the most significant information regarding the furnace (e.g. number of heats, productivity, yield, energy consumptions,...) as well as a detailed summary grid where the user can explore data aggregated per day or for individual heats.



Rolling Mill Day Report: general overview of the analyzed period with gauges and KPIs displaying the most useful information regarding the rolling mill area (e.g. bundle weight, plant utilization, ...) as well as a detailed summary grid where the user can explore data per job and shift and browse level 2 applications such as production reports, or view FDA files.

MOREIntelligence OLAP



Main features

- › Historical Data Warehouse with years of data available online.
- › High-level data model and advanced analysis capabilities.
- › High-performance query engine.
- › Completely integrated with Microsoft Excel.
- › Short learning curve times.
- › Provided with a set of specific advanced analyses for each process area.
- › Advanced customization capabilities.
- › Access control security and permissions configurable for each individual element in the data model.

MOREIntelligence is the advanced data analysis and visualization system for the metals industry; this is the most powerful data-investigation tool of Q3Intelligence, comprising two modules, OLAP and Analytics.

The MOREIntelligence system is fully integrated with the Level 2 and MES systems and applications, but it also provides the opportunity to collect data from other external sources.

Thanks to its advanced data models and the interactive interface developed over several years, MOREIntelligence is a powerful tool with which to make in-depth and flexible analyses across the various plant areas and processes.

OLAP

On-line analytical processing (OLAP), is an **advanced database technology tool** used by decision-support systems to analyze aggregated information. The core of OLAP technology is the data-cube, a database structure configured as a **multidimensional data model**. Developed over years of

experience, the MOREIntelligence data models contain a **large set of key variables** for the analysis of the metals-making process. Multi-dimensional analysis provides the capability to monitor process factors such as production, consumptions, process times, variables, temperatures, etc. that can be analyzed from different perspectives: per date, per crew, per heat, per grade and so on.

Users wanting to access the information system will have different needs relating to the specific roles that they have in the company, for example:

- › **Strategic planners** need to monitor progress and plan ahead in order to improve corporate global aims;
- › **Financial managers** need to define economic targets and verify the performances towards reaching such;
- › **Plant managers** need to define executive activities, monitor production, and improve yields, productivity and utilizations;
- › **Quality managers** need to identify the relationships and events that influence



Advanced coating process performance analysis, where a scatter plot permits the user to define its regions, focusing on the specific products for a reliable analysis and study the correlation between the skinpass input speed and the lower and upper coating weight on both sides, highlighting the coils that did not comply with the defined target parameters.

the quality of the products. For all of these users, MOREIntelligence dynamic reports can provide those **trends and relationships which are not evident from standard reporting**.

These analyses can be easily created, modified and browsed by the users, without the need of special tools or programming skills. Indeed, these MOREIntelligence dynamic reports have been developed within Microsoft Office Excel, a working environment familiar to nearly all users. Connected to the OLAP cube, Excel then uses basic tools such as pivot tables, charts and slicers, which allow users to:

- › **Analyze** plant production data thanks to queries that have extremely fast calculation performances;
- › **Explore** a large amount of historical data from multiple perspectives, with a style of analysis known as “slicing and dicing”, with which it is possible to select period, heats, crews, practices, etc.;
- › **Drill-down through data**, moving easily from an aggregated level of analysis down to the detailed values (e.g. from the yearly summary down to single product data);
- › Perform the groundwork for advanced statistical analysis (Data Mining) and scenario analysis (What-If analysis), via operations such as **data cleaning, transformation and pre-processing**.

MoreIntelligence OLAP provides a complete set of specific advanced analyses for each process area. Each such analysis can readily be extended by the user due to their high potential for customizations.

In-memory BI

Together with OLAP technology, MOREIntelligence dynamic reports use an in-memory data processing tool to carry out interactive analyses of large amounts of data and to perform simulations directly from Excel.

The key benefit of this MOREIntelligence feature is fast response times for interactive visualizations of large

multidimensional datasets. In fact, storing data in-memory **speeds up access** dramatically, thus permitting real-time analysis to be performed on vast amounts of process data, thus providing the results to the users much more rapidly.

Most importantly of all, the in-memory BI tool empowers business users to create and share rich, powerful analyses via familiar applications from Microsoft Office. The possibility to easily create author-customized and flexible reports enables teams to collaborate and **share self-service analyses**, thus accelerating decision-making cycles.



←
In-depth semi-product analysis, where the user is able to compare the inspection results, month by month, the user has also the ability to easily track down the inspection results, considering all the production variables collected during the production process.



←
The scatter plot chart suggests the possible correlations between all the variables selected from the advanced data model available, even with a huge amount of production parameters. Here, the relationship between the electrical energy and the carbon consumption is displayed for each steel grade produced.

MOREIntelligence Analytics



Main features

- › Advanced statistical analysis and mathematical algorithms.
- › Discover relationships and correlations within sets of data.
- › Process large volumes of data to extract useful properties.
- › Data-intensive simulations and scenario analysis.
- › Completely integrated with Microsoft Excel.
- › Analytics methods based on the advanced MOREIntelligence data model.

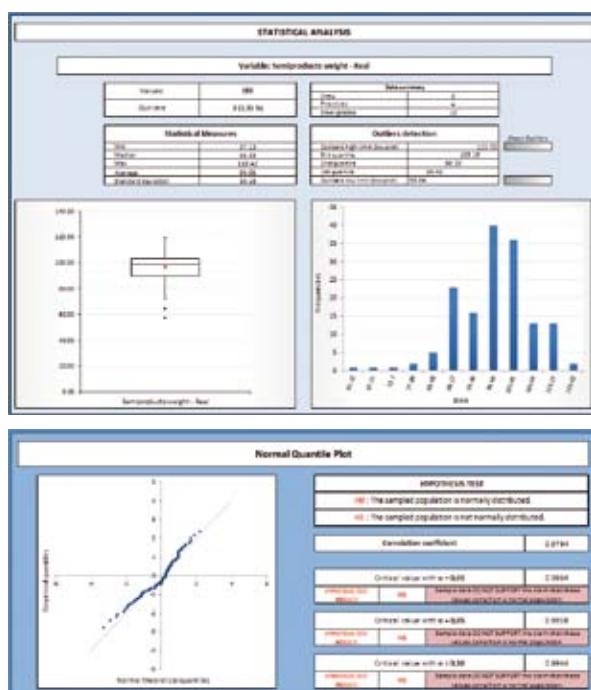
One of the most important innovations of MOREIntelligence is the introduction of the Analytics module, with which users can increase the information content generated from the data, extracting some knowledge from it that was not previously available.

The analytics module allows to:

- › Perform advanced **statistical analysis** on plant data;
- › Evaluate the **quality** of the production processes;
- › Apply the advanced Data Mining algorithms in order to **discover the relationships** within sets of data, or to **predict trends and behaviors** of the analyzed variables;
- › Perform analyses on **different scenarios**, also known as What-If Analysis.

All these analytics methods are based on the advanced MOREIntelligence data model, together with OLAP technology and in-memory data analysis engines.

They also can be used from within the well-known working environment of Microsoft Office Excel.



Within the statistical analysis module users can rerun the validation of the KPI through statistical measures (best/worst values, average, quartiles, trends, etc.), outlier detection and data distribution model analysis. The advanced statistical tools included in this module permit analyzing the data distribution with or without considering the outliers, in order to simulate the process performance excluding any previously identified out-of-control situations.

Statistical Analysis

These MOREIntelligence modules has been developed with the aim of providing users with the **statistical validation of production data**.

For each KPI, users can evaluate the mean, standard deviation and distribution of values in the selected period, detecting any anomalies (also known as "outliers").

Using the techniques of descriptive and inferential statistics, it is possible to increase the information content generated from the data, making the behavior of the analyzed variables more comprehensible.

Regarding statistical quality

control, MOREIntelligence offers a set of advanced control charts, one of the best tools with which to monitor the performances of a production process and to predict and plan its improvement. With MOREIntelligence control charts users can evaluate whether the process is currently under control, or whether it is instead subject to one or more sources of variability, such as malfunctioning equipment, poor raw materials, operator errors, etc. For each variable analyzed it is possible to define the control limits, either directly or via formulas.



Each type of statistical analysis available can be conducted at different levels of detail, putting the focus for example on the grade, on the practice or on the crew, and considering all the production variables available in the underlying data model.



Another key feature in the statistical analysis module is the availability of statistical process control through quality control charts, in order to intercept out-of-control points in the process and manage them under a continuous improvements approach.



MOREIntelligence Analytics



Data Mining

Data mining consists of a set of **analytical functions** and **statistical techniques** to transform data into useful information such as patterns, trends, correlations, clusters.

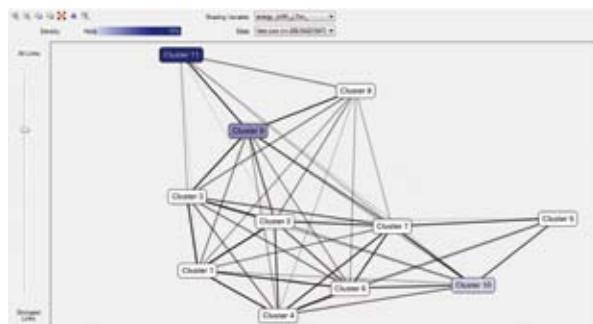
These algorithms, together with the MOREIntelligence data model, permit the processing of large volumes of cleansed and transformed data, using different methods such as:

- › **Classification:** placing individual items into target groups based on quantitative information on one or more of the characteristics inherent in these items;
- › **Regression:** estimating one

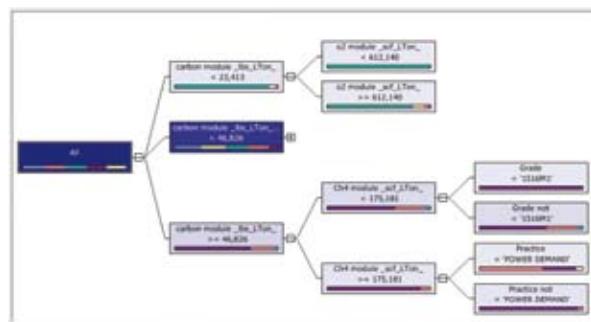
or more correlation functions, based on the attributes of the considered set of data;

- › **Segmentation:** finding groups, called “clusters”, made up of elements with similar properties;
- › **Association:** finding any correlations between different attributes of a given set of data;
- › **Sequence analysis:** identifying events or sequences that occur frequently in the data;
- › **Forecasting:** predicting future values of a time series variable.

The results obtained from this data processing are shown in graphical views. The images below show examples of “Cluster analysis” and



◀
Cluster network, highlighting the connections among the clusters. The clusters are colored according to their specific energy consumption levels.



◀
The goal of Classification Trees is to predict and explain responses on a categorical dependent variable. In the case shown the discriminant variable considered is the energy consumption.

“Classification trees” available with the Data Mining application, as applied to EAF production. With these techniques, users can evaluate the impact of variables such as carbon, coal, and slag-builders on energy consumption, analysing clusters of heats with same characteristics (e.g. the ones with clearly high/low energy consumptions) or the branches of the tree (e.g. the first branching highlights the correlation between carbon module usage and the energy consumed).



What-if

What-if Analysis consists of a **data-intensive simulation** whose objective is to analyze the behavior of a complex system, known as a **scenario**, by monitoring the impact of changes to a set of independent variables on a set of dependent variables.

With this MOREIntelligence feature, the user can, for example, run simulations or advanced statistical analysis by modifying, removing, or adding data (e.g. leaving out any heats with anomalies) or evaluate how variations of ranges and tolerance thresholds would impact on production performances.



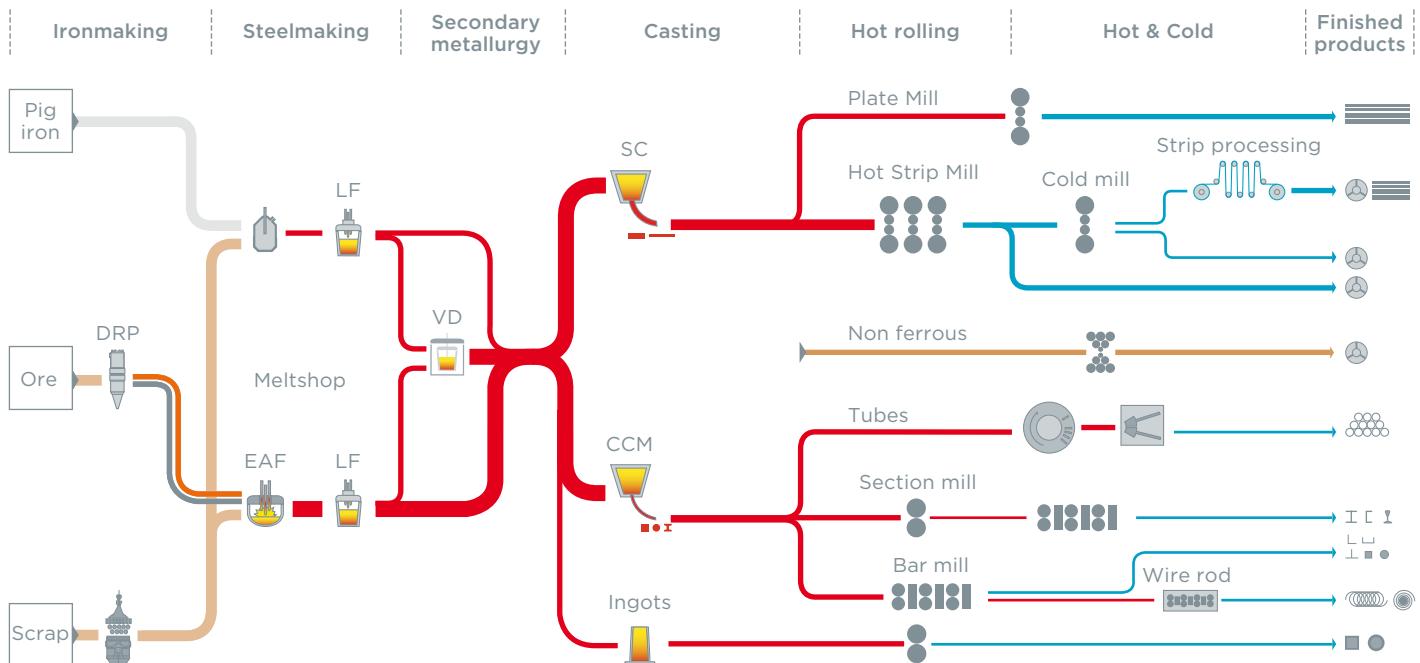
One of the different outputs obtained via Clustering Algorithm. Clustering allows powerful insights into the variability of the processes.

Q3INTELLIGENCE

A Q3Intelligence system, applied either to a single area of your metal-making facility, or otherwise to your complete process stream from the initial charging of the raw materials through to the dispatching of the finished products, can really be the ultimate tool for your decision support processes and the improvement of your plant's performance.

Q3Intelligence has modules which cover the entire range of metals production processes

- › DRP Direct Reduction Plants
- › EAF Electric Arc Furnaces
- › LF Ladle Furnaces
- › VD Vacuum Degassing Stations
- › VOD Vacuum Oxygen Decarburization Stations
- › CCM Continuous Casters for billets, blooms, thick and thin slabs
- › IC Ingot Casters
- › RHF Reheating Furnaces
- › RM Rolling Mills for Longs and Flats
- › Micromills





Q₃INTELLIGENCE

BENEFITS

- › Extensive knowledge of the production processes for metals is embedded in the product.
- › Ready-to-go modules for key processes. Quick to deploy, and easy to maintain and extend.
- › Quick access to key information to make accurate decisions faster.
- › Data quality, in terms of data Accuracy, Completeness, Consistency, Timeliness and Auditability.
- › Advanced analysis capabilities and an innovative KPI library are available.
- › Avoids the usage of intermediate reports and off-line processing steps, via the embedded end-user customization capabilities.
- › Breadth and depth of data (years of plant history on-line) and data models.
- › Minimization of manual operations and the consequent risks of human errors.
- › Innovative web interface and full integration with Microsoft Excel, which results in user-friendliness and short learning curve times.
- › Possibility of adding further data sources and new reports.
- › Technical support services and product release program.

Simply decide what you want to see and how: Q₃Intelligence will take care of it!



PDF download about the Danieli Automation BI at:
<http://www.dca.it/home/Products/Q-Intelligence.aspx>



**QUALITY
QUANTITY
QUICKNESS**

Danieli Automation 3Q

**Our systems are designed based on the 3Q concept:
Quality, Quantity and Quickness.
These are our main targets which are focused on satisfying our customers needs and requirements.**

Quality - Excellence in Quality and Product Quality certification

Quality is of vital importance and automation is essential to achieve and keep it always at high levels.

One of the tasks of our automation systems is to help our customers in producing quality products, ensuring continuous monitoring and providing quality certification of the final product.

Quantity - High productivity

Danieli Automation system design guarantees the availability and efficiency required in the steel industry, thanks to advanced solutions to specific process aspects and a complete line of technological packages, mechanical and equipment integrated automation.

Quickness - Money Saving

Quickness is a must today. Time lost is money lost.

Product changes and reactions to unexpected situations must be quick. This is obtained thanks to flexible control systems and process controls including the required setups for the range of production.

Danieli Automation operates according to the quality certifications:



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