

3Q AUTOMATION

One step ahead
in Process Control

DANIELI AUTOMATION



Manual

Mode

Electrodes

Electrode 1 Electrode 2 Electrode 3

Lifting

All Electrodes

Fast Shift

Slow Shift

Unlock

Lock

Electrode 1

Fast Shift

Slow Shift

Lock

Electrode 2

Fast Shift

Slow Shift

Lock

Electrode 3

Fast Shift

Slow Shift

Lock

Assistant

Maintenance

Tilting

Slag Door

Sampling

Sample

Close

A close-up photograph of a control panel for a machine, likely a welding or cutting system. The panel is dark grey or black with various buttons and indicators. At the top left, the word "Manual" is printed in a large, white font. Below it, there are several sections of controls. The "Electrodes" section includes buttons for "Manual" (a hand icon), "Spray" (a spray gun icon), "Assistant" (an information icon), and "Maintenance" (a wrench icon). The "Lifting" section is the most prominent, featuring a "Lock" button (a red padlock icon) which is being pressed by a person's finger. Other buttons in this section include "Unlock" (a green padlock icon), "Fast Shift" (a triangle with an upward arrow), and "Slow Shift" (a triangle with a downward arrow). These "Fast Shift" and "Slow Shift" buttons are repeated for "All Electrodes", "Electrode 1", "Electrode 2", and "Electrode 3". At the bottom, there are buttons for "Tilting" (a house icon), "Sampling" (a droplet icon), "Sample" (a droplet icon), and "Close" (a square with an 'X' icon). The overall layout is organized and functional, with clear labels and icons for each control.

3Q AUTOMATION

The Automation System in a modern steel plant is the real key factor upon which invest, due to its increasing importance in the achievement of high standards and low production costs.

In this regard, this consideration seems particularly important because a recent study has revealed that a global industrial process loses about 5% of the annual production caused by unscheduled downtime and low-quality production. Moreover, almost 80% of these losses are predictable and most of the time they are caused by human operator errors.

Only state-of-the-art technical solutions can reach main targets as productivity, quality, safety and operability in a market background whose fluctuations require a fast response with intelligent manufacturing systems, justifying new investments in process control automation.

Today's market requires to reduce transformation cost by increasing the productivity, optimizing the raw material and energy utilization and limiting the human intervention, keeping the so-called "corporate knowledge" inside the Industrial Company.

Following more than 50 years of experience in supplying IT and automation systems to the steel and metals industry worldwide, 3Q concept is the solution created by Danieli Automation to face such requirements and needs, because it has been designed especially to contribute to the aspirations of many steelmakers to turn their performance independent from the "human factor", an innovative automation philosophy applicable both to new projects as well as process implementation in existing production plants.

The 3Q Concept

Danieli Automation puts its know-how into a new system architecture, using the latest technology to bring the best solution to the real world production.

The 3Q system is a complete suite of functionalities covering all the steelmaking processes, from raw materials handling to final products shipping. It comes from a long operational support experience of the plants grown up within the Danieli Group, sustaining the numerous demands of customers and making a synthesis together with an ergonomic and sophisticated analysis and an exploitation of the most modern information technology and electronic equipment. Danieli Automation wants to propose a system

that transfer knowledge from man to computer ensuring a more modern and easier interoperability, allowing independance from user's operate.

One of the most important roles in the evolution of process automation has been the massive introduction of electronics in support of industrial automation systems. As first step, the man was the provider of the three fundamental ingredients of the work: energy, control and information.

With the exclusion of man as an energy supplier, we will come to the process of industrialization through the industrial revolution.

The second step was to exclude the man from the process control using the extraordinary ability of



Our systems are designed based on the 3Q concepts:

QUALITY
Excellence in quality and product quality certification

QUANTITY
High productivity

QUICKNESS
Quick response to market demand



modern computers that integrated a method based on predetermined “rules”. It has been finally left the approach of operation based on skills operator. In the third step a modern automation system is called upon to provide a set of tools that enable the computer to take decisions where the operator is not able to.

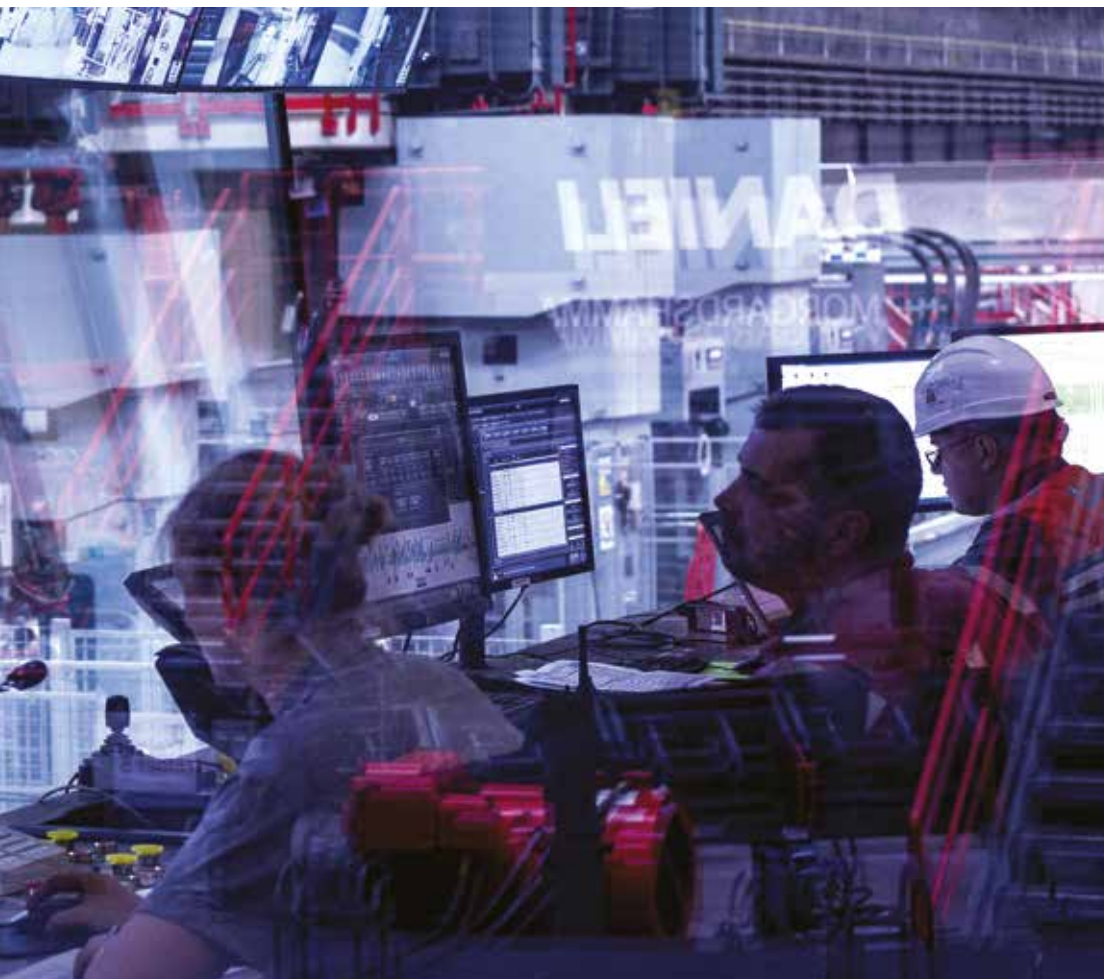
This approach eliminates the concept of operator giving commands to the machine by replacing it with the one in which the system suggests the operator what to do, and in case situations present multiple-choice possibilities, it appeals the operator intelligence to decide which path to choose.

The target is to reduce repetitive actions more and more. This new method, based on “knowledge”,

which resides in the automation system, reshapes the role of the operator. Infact, now he is called to oversight and monitor rather than identify alternative strategies, which lead up to minimize consumption and emissions and maximize productivity ‘as well as’ anticipate potential problems through the diagnostics.

The union of several technological packages that reduces operator intervention and makes the system more efficient was the guideline in the creation of our latest projects.

Results obtained in these plants well represent the 3Q concept of Quality, Quantity and Quickness.





QUALITY

Quality of final production means competitiveness, access to new markets, reputation and improved margins. The combination of high quality control systems and constant innovation of process technologies guarantees top quality production in high-productivity steelmaking plants. One of the tasks of our automation systems is to assist our customers in producing quality, ensuring continuous monitoring and providing quality certification of the final product.

QUANTITY

Our system design guarantee the availability and efficiency required in the steel industry, thanks to advanced solutions for specific process aspects and a complete line of technological packages, including mechanical and integrated automation equipment. Higher plant availability is possible due to the architecture of the automation system, with client-server solutions and redundant operator workstations, fiber optic ring type Local Area Network and dedicated monitoring tools.

QUICKNESS

Quickness is a must today, because lost time is lost money! Product changes must be quick. This is obtained by means of flexible control systems and process controls including the required setups for the complete production range. Quick production steps are achieved by predefined and fully automatic sequences. Reaction to unexpected situations must also be quick. Dedicated technological packages are applied for prompt system reaction to unusual circumstances.



3Q Architecture

The new architecture of 3Q gives large importance to the disappearance of the concept of levels of automation and focuses the attention on the role of the functions and the technological packages.

Q3MET is the Danieli Automation Manufacturing Execution System (MES) designed to satisfy a common set of metal industry requirements, namely sales and orders management, production planning, raw material and stock yards management.

Q3MET is mainly a wide set of customizable modules realized to support the Business Management to control the process, from acquisition of customer's purchase order to its final closure, through production planning, scheduling, tracking, quality, storage, shipping, invoicing and customer acceptance. Modular approach means that all the business processes are completed avoiding overlapping. Thanks to accurate traceability of orders, every single operation is recorded and made available for future analysis and elaboration.

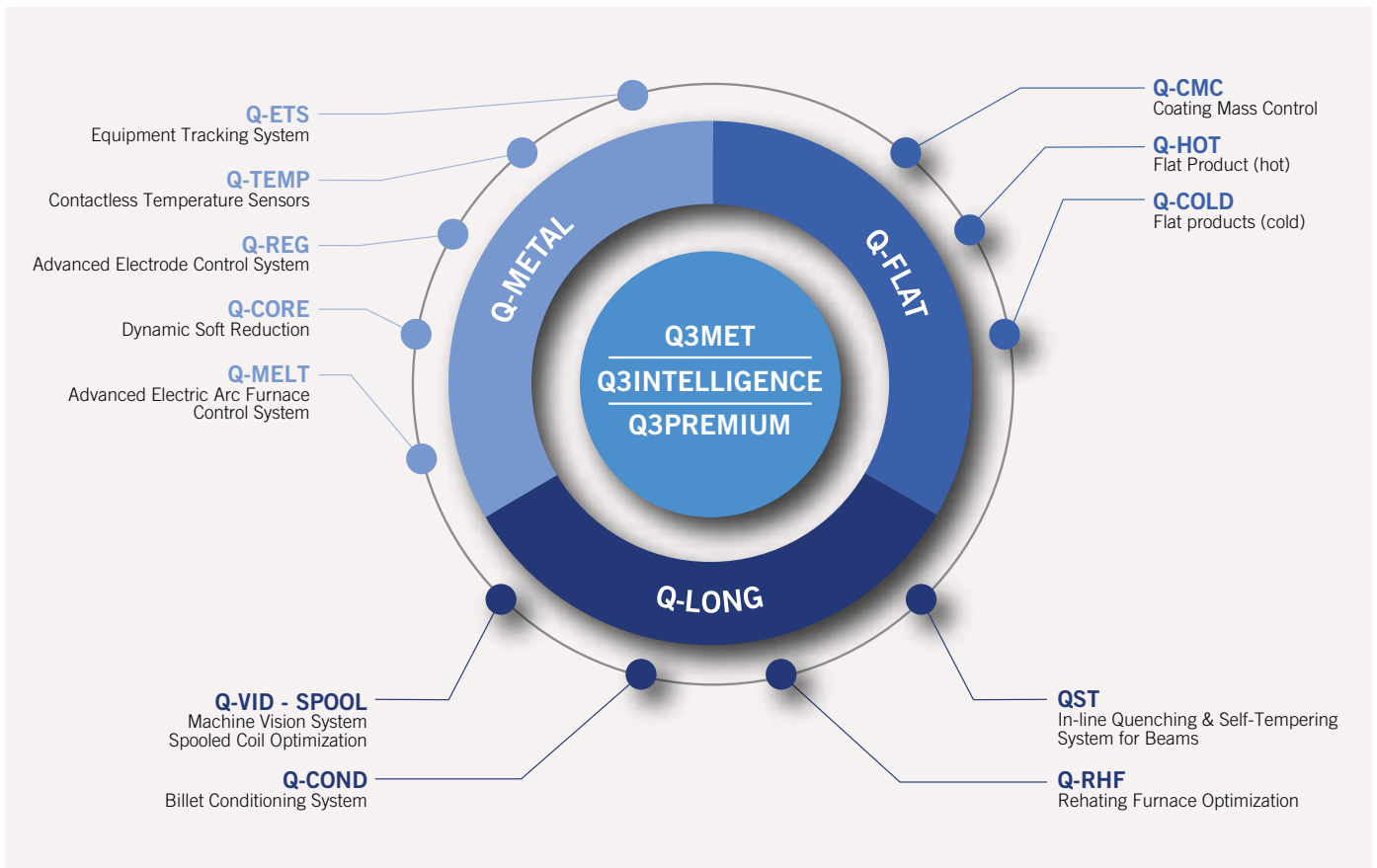
Q3INTELLIGENCE is the Business Intelligence suite that provides deep analysis and batch reporting of the process, interfacing and elaborating the data of the other 3Q pyramid systems. This suite combines operational data with analytic tools to elaborate complex and competitive information to process planners and decision makers. Q3Intelligence allows the users to analyze data from different perspectives, summarizing it into useful



information, usable without the need of any special skills or IT expert support.

Q3Intelligence has modules which cover the entire range of metal production processes. Informations are available in customizable formats, as interactive web-based reports, web-based consoles with KPI (Key Performances Indicators) updated in real-time, on-line analytical processing module (OLAP) for historical database and advanced statistical analysis.

Q3PREMIUM is a digital solution designed by Digi&Met to support smart quality control and management for high-end steel production. Built on top of an Industrial Internet of Things platform specifically designed for metals business, it is a Decision Intelligence suite which makes use of data-driven technologies to turn information into actionable insights. Collection and online processing of massive flows of process data integrated with material tracking provide a



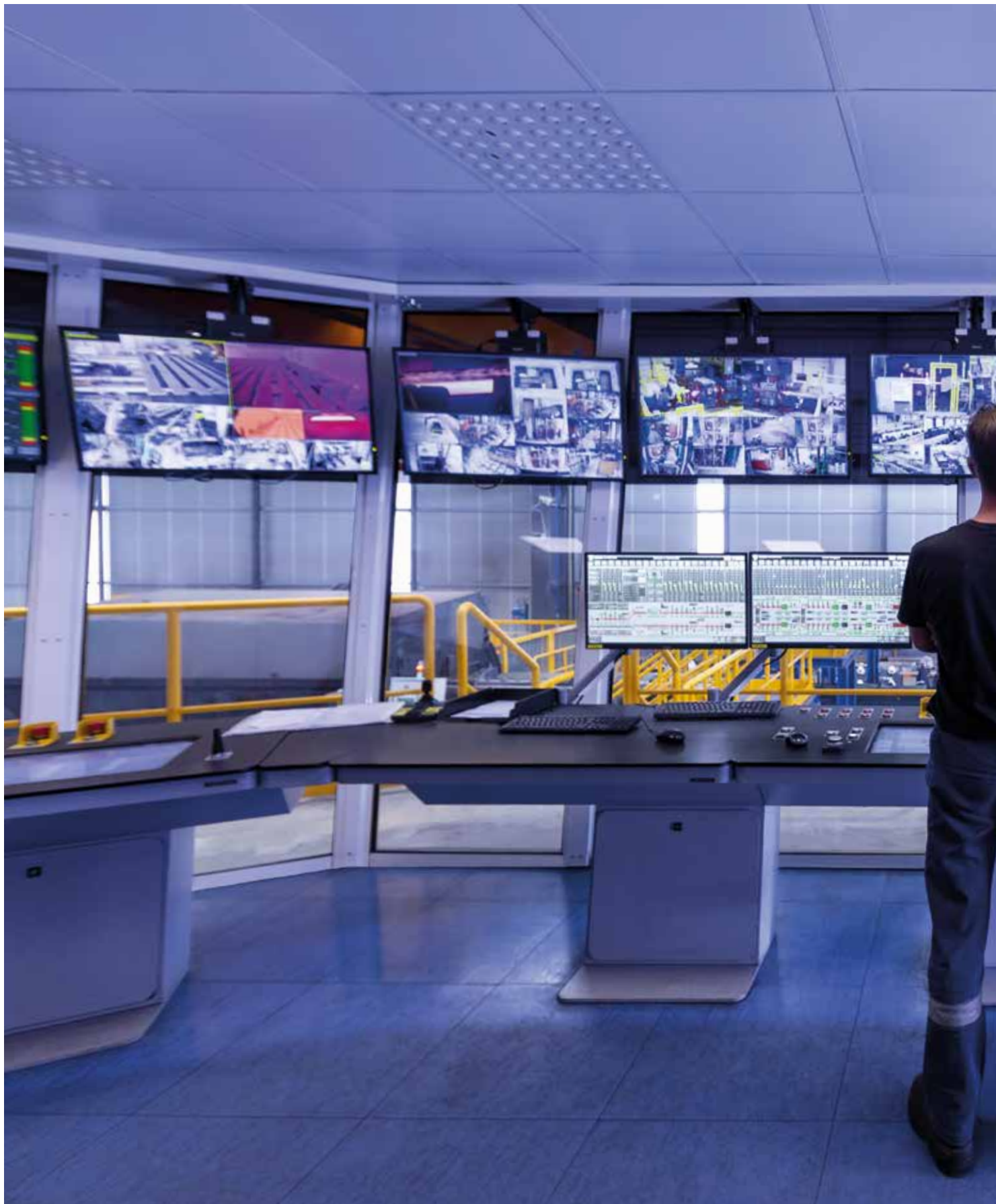
complete view over the entire product lifecycle, as well as digital support for certification and management of customer claims. A plant-wide quality control rules engine supports integration of process expert know-how with machine learning models for real-time quality prediction and automatic product grading. The early detection of potential issues allows the implementation of prompt corrective actions to handle production non-conformities

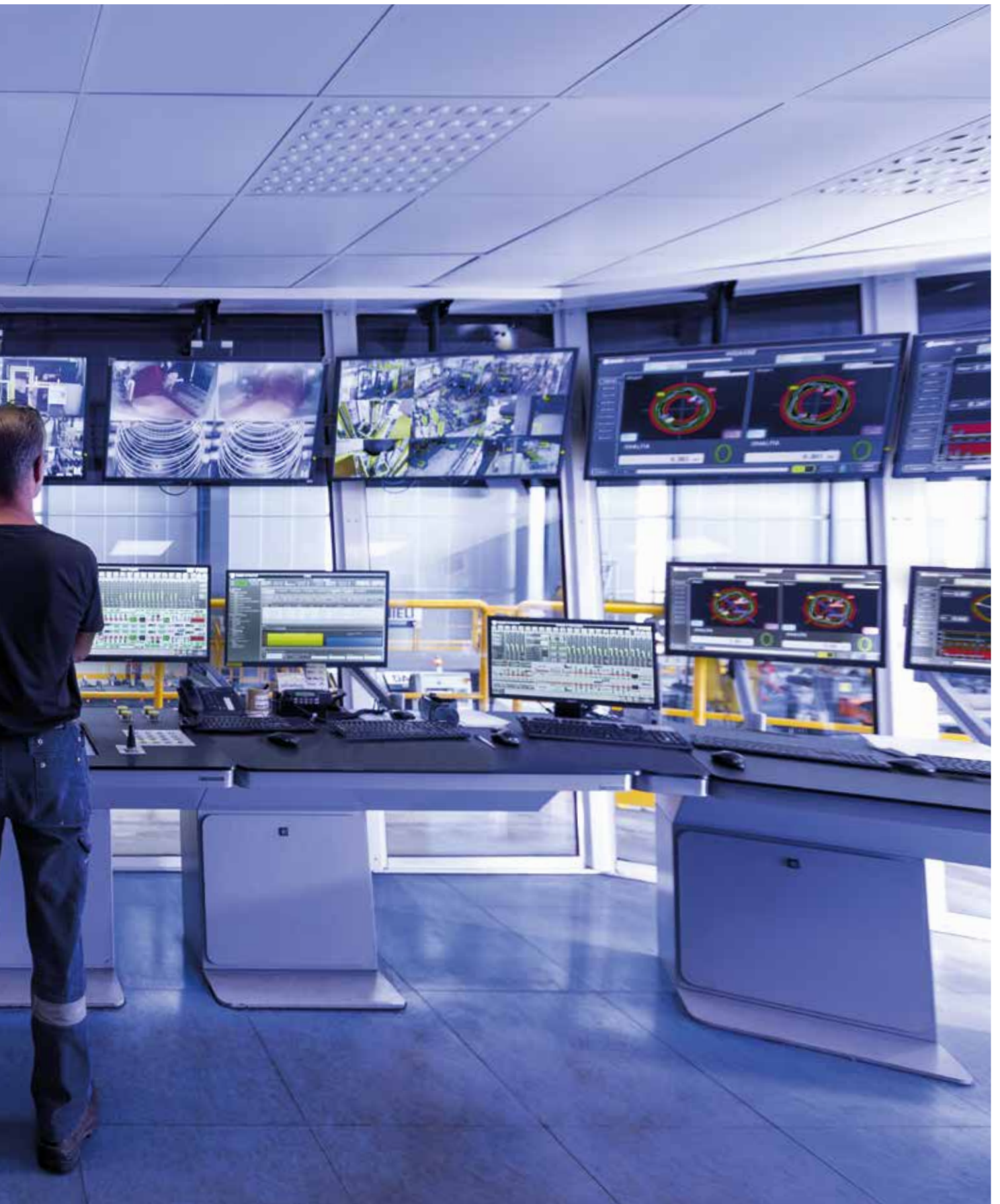
and guarantees the reduction of quality-related risks. The integrated web portal provides a collaborative environment for real-time operation support and for statistical data analytics and optimization for continuous improvement and consolidation of best practices.

Q-METAL, Q-FLAT & Q-LONG are a set of three innovative and intelligent application of process interface for operators and production managers.

The Q3 Technologies represent the process control systems for each of the main product lines covered by Danieli. Process control systems provide also material tracking, production schedule, consumption accounting, tools management and data logging. Furthermore, each of these systems integrates the various different technological packages i.e. the automation control sequences and loops, supervised by means of mathematical

models and setup functions. The Process Know-how at present is mostly cast inside these packages and into the special sensors connected.





3Q Control Desk

As previously explained, 3Q means Quality, Quantity and Quickness.

These are the tasks of our customers and the principles driving Danieli Automation's solutions. This concept has led us to develop a new generation of operator interface and pulpit design, to make operators work more safely, efficiently and easily. Danieli Automation's 3Q Control Desk is a system allowing a virtual reality control applied to the plant. The pulpit is designed with a new concept of control panels and uses supervision with three-dimensional interactive vision of the production process.

3Q Control Desk is a unique and revolutionary workspace where the operators don't see the plant through windows, but rather watch huge screens applying a new system approach, on

which a real vision of the plant is guaranteed by CCTV monitors.

The knowledge-based approach consists in showing the operator only the useful information required for that precise process step.

The operators have the ability to work on different plant areas from one single pulpit, safely and quickly.

They manage every machine as required by the process and with the control system driving them to the right action at the right time, whereas traditional plants depend mostly on the operator's skill to choose the sequences and process steps.

One of the key points of 3Q Control Desk is the provision of a full "soft-desk" pulpit, totally based on computer screens, through which the operator can both monitor

the plant and operate it at the same time.

In most cases, there is no hard-wired indication facility, with the exception sometimes of an Emergency Shutdown system. This is what Danieli Automation intends for HCI (Human Computer Interface).

Simply by substituting the software of its automation system, this revolutionary pulpit is able to drive processes like Electric Arc Furnace, Continuous Caster or Rolling Mill. Furthermore, the new desk is modular and can be easily adapted to the customer requirements.

The most important components of this desk are: the Operator Assistant (OA), the Plant Performance Indicator (PPI) and the Area Performance Indicator (API).





OA - OPERATOR ASSISTANT

Easy and safe to use, with its multi-touch display that needs more than a simple brush-by to activate, the OA has become the fulcrum of the main pulpit. Instead of working on a panel with many pushbuttons, it's an interface with a knowledge-based approach, that advises about the situation of the plant, any problem or difficulty and, most important, suggests the right sequence of actions to obtain the expected result. The OA concentrates much of the intelligence needed within the automation system and reduces the number of commands that operators have to consider.



PPI - PLANT PERFORMANCE INDICATOR

The PPI function provides overall information on the status of the processes in the controlled areas. The PPI receives information from the various technological area and translates that information into a clear and exhaustive graphical overview, to allow the production manager to obtain an overall vision of the given process area and of all the other ones operating upstream or downstream of it. The PPI is a common interface showing all the significant variables coming from process control and equipment control in a single page, for a quick recognition of critical process status for the entire meltshop.



API - AREA PERFORMANCE INDICATOR

The API function provides, for each technological area, overall information on the status of the process in the controlled area. As for the PPI, the API receives and translates information into a graphical overview that is presented to the operators, in this way simplifying the view of process parameters and process sequences, but limited to each technological area (i.e. EAF, LF, CCM, RM).

iSTAND Visual control desk for commissioning

iSTAND is Danieli Automation simulation platform provided with 3D model, for virtual commissioning of a plant unit. It can be well utilized for Interactive Training, as well as for virtual commissioning: the virtual control desk can be used as a test unit to verify HW and SW applications before commissioning stage. As training complement, this special tool provides a realistic system with which the operators can be trained without needing a real equipment. Using 3D CAD models to simulate the plant and connecting virtual sensors and actuators to a real PLC, control system engineers can use the model to look into the different plant operation conditions, checking in advance

the interference between mechanical parts, reactions in specific situations, the effectiveness in emergency and the effects of wrong commands.

Using virtual reality it is possible to validate and perform debugging tasks of PLC codes and to integrate all mechanical and electrical systems, improving quickness and quality of execution.

This is a simulated commissioning phase, done before the assembly and installation.

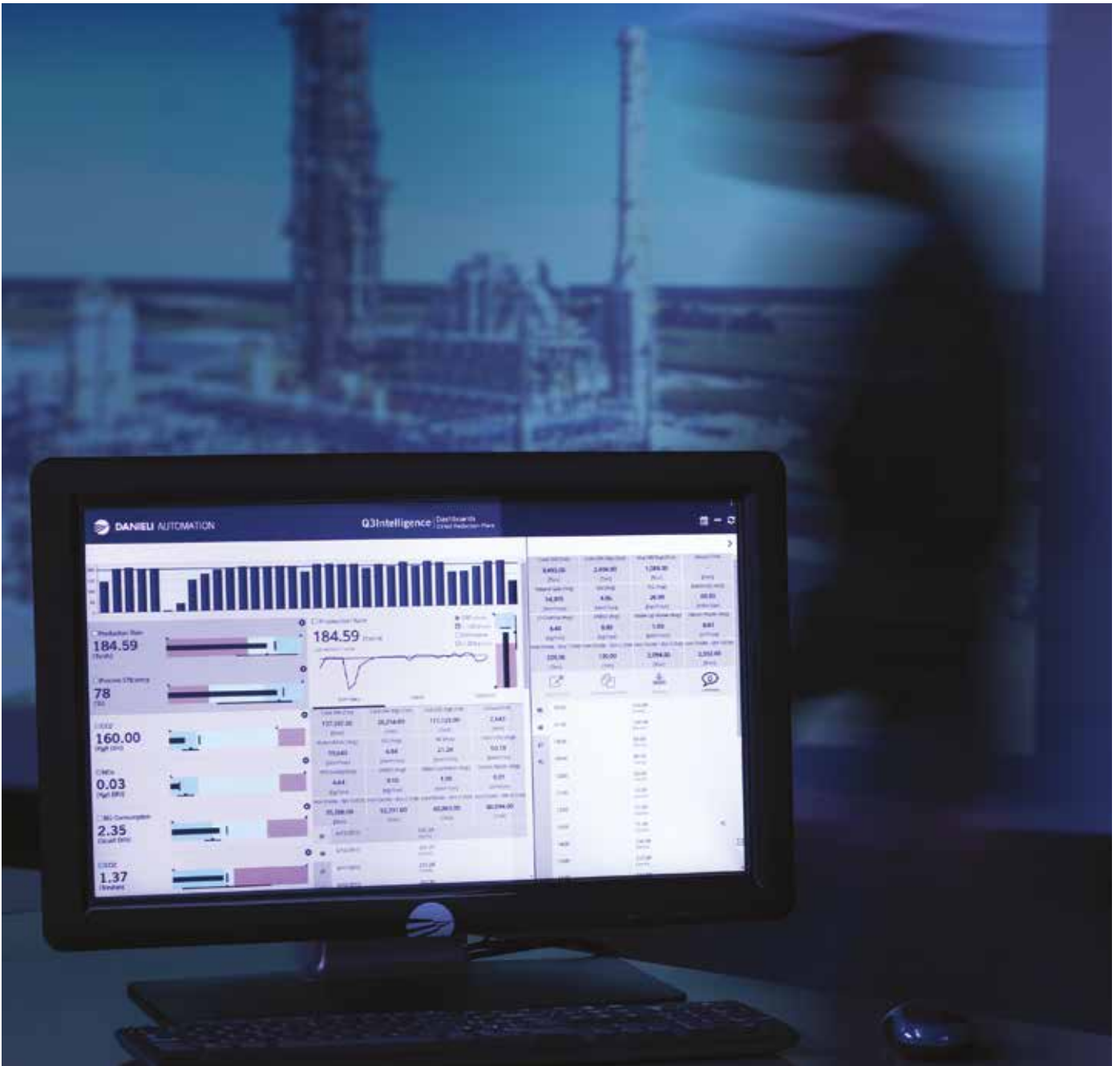
The virtual simulation through iSTAND reduces time and personnel costs during plant installation and represents a more effective support for the Commissioning activities.

Thanks to iSTAND, the number of prototypes for new machines is reduced, and their validation can be performed on the 3D model. Indeed, iSTAND system has played a master role in the validation of all the technologies included in the 3Q automation project.

Furthermore, iSTAND is a very important step for know-how transfer, as it makes it possible to train operators before plant installation.

With this process simulation platform, mistakes are avoided during plant production and hands-on training can be performed on the 3D model in Danieli Automation.





3Q Soft Desk

iSTAND simulation platform contributes to the basic design of Soft-Desk, a revolutionary pulpit entirely designed and realized keeping in mind the 3Q automation philosophy, combining and harmonizing both ergonomic and cognitive design, for a full working experience. The result is the most human-friendly automation interface, ever, a real innovative and multi-purpose working desk. This represents the results of thousands of man-hours in research carried out by a team

of automation experts, architects and cognitive gurus. With the benefits of an huge amount of multi-touch screen applications, it is not only possible to substitute every kind of pulpit commands but, more than this, it integrates the expertise in plant operation, assisting the operator in every situation that occurs thanks to an extreme flexibility in terms of visual and interaction design. The main results of this new approach to the control of the process, is the reduction

of the number of commands and useless signals sent to the operators, allowing them to make fast and correct decisions. Infact, the primary ingredient for making right decisions is having the right informations just on time. All the elements (particularly TVCC integrated into 3Q automation system) interact with one another to guarantee this achievement. iSTAND simulation system can be easily configured into different production units, from primary metallurgy to finishing product areas.



CCTV Closed Circuit Video Server



API Area Performance Indicator



PPI Plant Performance Indicator



API Area Performance Indicator



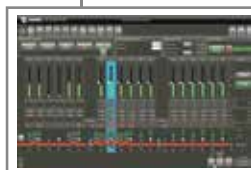
CCTV Closed Circuit Video Server



HMI Human Machine Interface



OA Operator Assistant



HMI Human Machine Interface

3Q Benefits

3Q automation system: practical solutions to bring real benefits to the conduction of both single processes and full plants

SAVE ACTIONS

The actions of the operators are minimized. As a consequence, the operators can concentrate their efforts to analyze the potential problems of the process or to improve the performance of the process itself.

SAFETY

No more dangerous activity for the operators means a new feeling for the professional figure of the operator.

ERGONOMICS

Everything is under the eyes of the operator and quickly available

EASY LEARNING

Operators can be easily switched from one process to another because the operating philosophy is the same. Operators learn from the system and are assisted by it during all the steps of the processes.

COST SAVINGS

Minimization of the operators' numbers. Using 3Q applications, only one operator is needed to drive a process like electric steelmaking.

FLEXIBILITY

3Q System can be implemented also in plant without Danieli technology and could be an effective add-on key factor in any revamping project.



Manuale



Strands Roller Table

Modalità



Intermediate RT Section Mode



Discharge at

Intermediate RT Selection



Cut RT Selection



Discharge RT

Linea#6

Sollevamento

Abbassamento

Linea#5

Sollevamento

Abbassamento

Linea#4

Sollevamento

Abbassamento

Linea#3

Sollevamento

Abbassamento

Linea#2

Sollevamento

Abbassamento

Linea#1

Sollevamento

Abbassamento

Pinch Roll (before CTO)

Linea#6

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Linea#5

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Linea#4

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Linea#3

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Linea#2

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Linea#1

Movimento

Indietro

Avanti

Richiesta

Aperto

Chiuso

Billet 1

Linea#6

Automatico

Manuale

Linea#5

Automatico

Manuale

Linea#4

Automatico

Manuale

Linea#3

Automatico

Manuale

Linea#2

Automatico

Manuale

Linea#1

Automatico

Manuale



EKG Casting Floor



Manuale



Manutenzione



Pilota Auton.



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