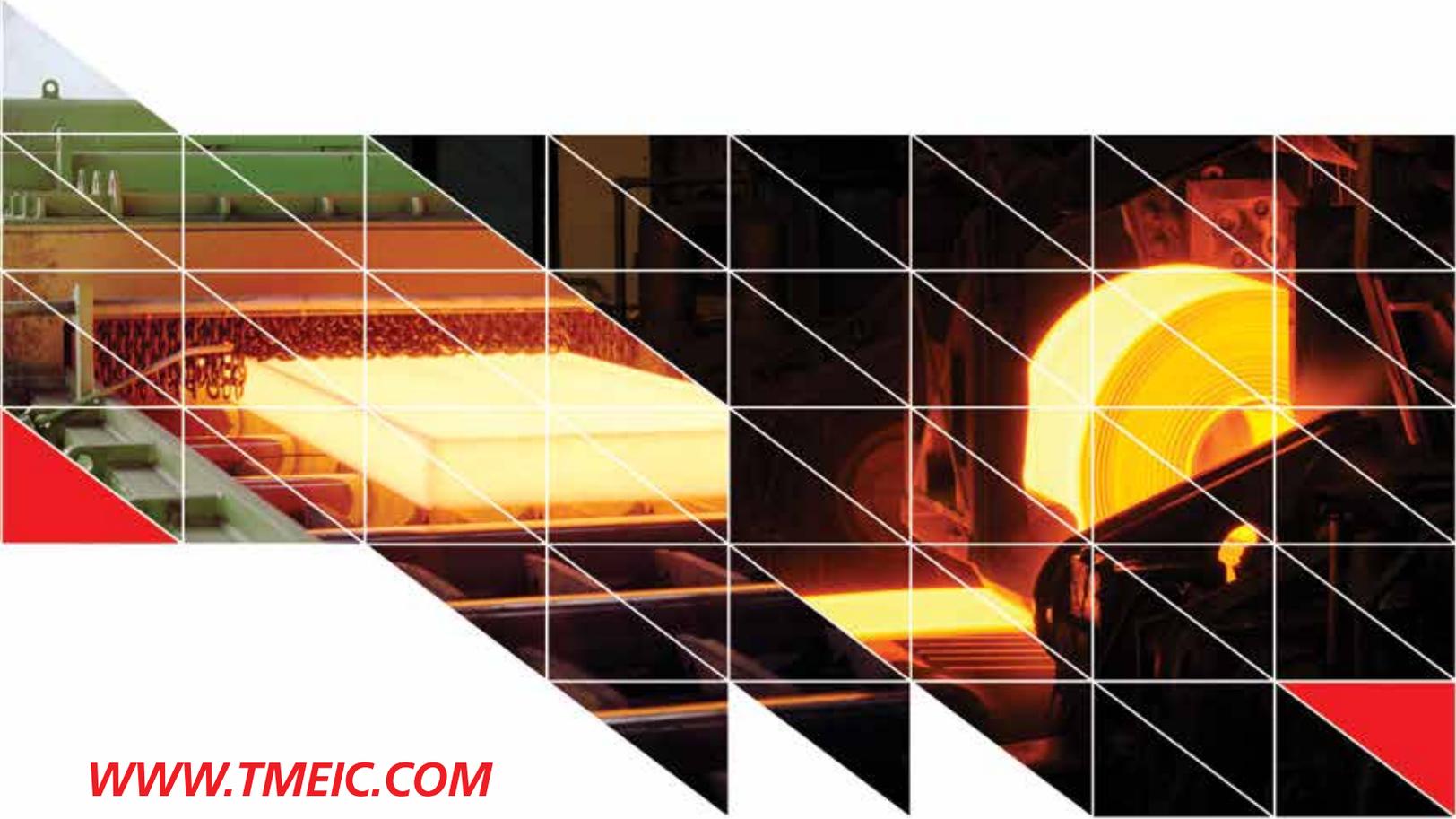


**TMEiC**  
*We drive industry*

# Automation and Drive Systems for the Metals Industry



***WWW.TMEIC.COM***

JAPAN | NORTH AMERICA | SOUTH AMERICA | EUROPE | SOUTHEAST ASIA | INDIA | CHINA | MIDDLE EAST | AUSTRALIA

# A Global Supplier of Automation & Drive Systems to the Metals Industry

## TMEiC

Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEiC) was formed from the merger of the industrial systems departments of Toshiba Corporation and Mitsubishi-Electric. TMEiC manufactures and sells variable frequency drives, high-power electric motors, and advanced automation systems for the metals industry and a range of other industrial markets.



Drive Manufacturing Plant, Japan

## TMEiC Corporation

TMEiC Corporation is the North American subsidiary of TMEiC, headquartered in Roanoke, Virginia. Prior to 2000, this group was the industrial drives division of the General Electric Company. Our engineers have global experience designing and building large control and automation systems for the metals industry.



U.S. Headquarters, Roanoke, Virginia

## TMEiC Core Technologies

### Control Systems

- System Engineering
- Network Technology
- Electromechanical Engineering
- Intelligent Sensor Systems
- Analysis and Synthesis
- Control Theory
- Modeling
- Simulation

### Power Electronics Technologies

- Power Semiconductor Application
- Controls
- High Voltage/High Current Circuit Design
- Advanced Digital Circuits
- Software Development
- Assembly Processes
- 3D Design/Analysis Integration

## Superior Power Electronics

- Over 35 years of Medium Voltage drive experience
- MV drives up to 120 MVA
- Voltages up to 11 kV



## World Leading Motor Technology

- Custom Motor Design for Metals Industry Applications
- Very reliable motors for rough industrial applications
- Leader in high power, high performance motor technology



**TMEiC**  
CORE TECHNOLOGIES

### Rotating Machinery Technology

- Insulation Technology
- Cooling and Ventilation Technology
- Mechanical Structure Analysis
- Material Strength
- Vibration and Noise Reduction
- Electromagnetic Analysis
- Tribology

## Total Solutions for Mill Automation

### Hot Mills



TMEIC's control and automation systems have been applied to many of the world's hot strip mills. TMEIC firsts include the first use of all AC main drives, the first computer-based hot mill setup, and the first semi-continuous hot mill rolling. Our team has installed hundreds of major beam, plate and hot strip mills worldwide

#### Hot Mill Solutions:

- Caster and Furnace Control
- Slab Sizing Press
- Roughing Mill & Steckel Mill
- Finishing Mill
- Coiling Temperature Control
- Coiler Control

### Cold Mills



TMEIC has provided automation solutions for over 100 cold mills worldwide. This vast experience supports our superior control systems, based on accurate process models and tightly integrated Level 1 and Level 2 controls. Outstanding mill product quality has been achieved along with record breaking production.

#### Cold Mill Solutions:

- Tandem cold mills
- Single and Multistand Reversing mills
- Temper Mills
- Sendzimir Mill

### Process Lines



TMEIC has developed strip transport controls based on power analysis of all the elements, allowing high line speeds while eliminating problems such as strip breaks and bridle slippage. These advanced controls have demonstrated benefits including reduced operator intervention, maximized line throughput and uptime, and seamless product transitions.

#### Process Line Solutions:

- Galvanizing Lines
- Pickle Lines
- Tinning Lines
- Coating Lines
- Paint lines

### Long Products



TMEIC's looperless minimum tension control is obtained by measuring torque and controlling stand speed, with upstream stands under cascade control. The automation system tracks billets from the furnace, through the rolling stands, cooling bed, no-twist block and shears to the finished coils. Product data is sent to each stage controls and HMIs.

#### Long Products Solutions:

- Rod Mill Sizing Block control
- Rod Mill Laying Head control
- No Twist Mill control
- Section Mill Saw management
- Tube Mill control

### Control Modernization



Many existing mills are operating with our old legacy DC and AC control systems, or other vendor control systems, and are due for replacement or modernization. TMEIC has the technology and project engineering team to ensure a smooth migration path and execution to our current platform.

#### Upgrading Old Control Systems:

- DC controls from the 1980s
- DC controls from the 1990s
- More recent AC control systems
- Other vendor's control systems

### Mill Audits



The TMEIC Mill Audit investigates present mill operation, control systems, equipment, and upstream/downstream processes. The result is a road map of solutions with emphasis on Return-On-Investment. The solutions identified incorporate emergent digital technologies as well as traditional control philosophies to provide a wholistic approach toward long-term profitability.

#### Experienced engineers look deeply into the mill operations to uncover potential for improvement in:

- Performance -- increase prime product -- higher value
- Yield -- increase output -- less scrap/ rework
- Uptime -- increase available time to produce -- operational efficiency
- Energy use -- reduce production costs -- lower carbon footprint

## Mill Motors and Drives

TMEiC's family of medium voltage high-powered motors and coordinated Variable Frequency Drives are designed for the special demands of rolling mills. Low voltage coordinated drives are designed for process line applications such as galvanizing lines, pickle lines, and strip and bar conveyors.

### High-Power Drives and Motors for Rolling Mills



**Variable Frequency Drives  
TMdrive-70e2**  
Power levels: up to 36,000 kVA  
Voltage: 3,300 - 3,650 Vac  
Frequency: up to 75 Hz



**Main Drive Mill Motors**  
Synchronous & Induction motors supplying high torque and low speed for roughing and finishing mills, and reversing applications with impact.  
Power levels: up to 16,000 kW  
Voltages: up to 3,650 V  
Shaft Speeds: up to 1,540 rpm



**Custom Designed Motors**  
Large motors requiring high power for blowers and compressors.  
Power Levels: up to 107,000 kW  
Voltages: up to 13.8 kV  
Shaft Speeds: up to 3,600 rpm

### Low Voltage Drives and Motors for Process Lines and other Mill Applications



**Variable Frequency Drives  
TMdrive-10e2**  
Power levels: up to 2,749 kVA  
Voltage: 440 - 690 Vac  
Frequency: up to 200 Hz

### DC drives & upgrades for Legacy Systems



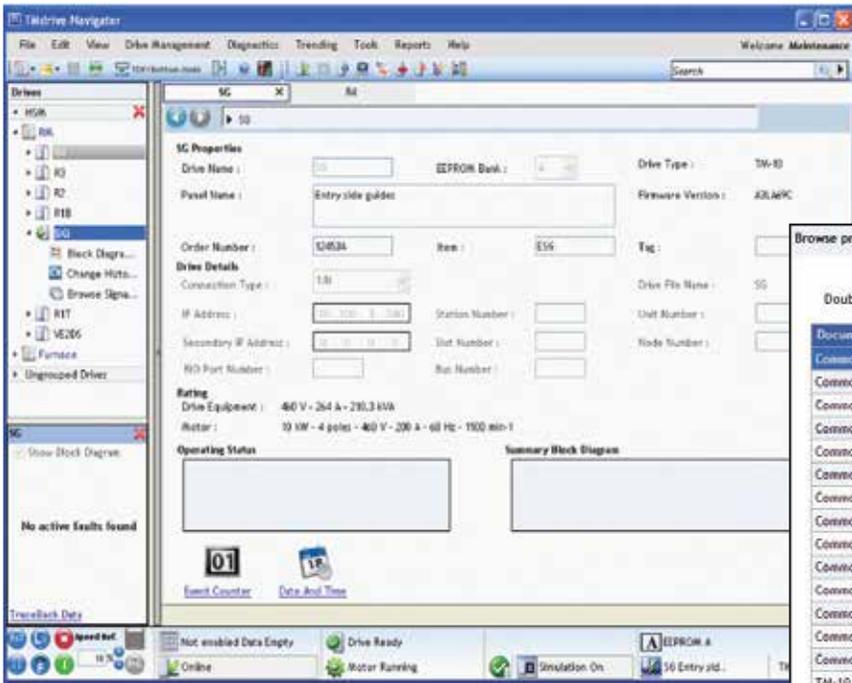
**Thyristor Based AC-DC Converter  
TMDrive-DCe2**  
Current Level: up to 18,000 A  
Voltages: 300 to 1200 Vdc output

### Dual Purpose Drive for Legacy DC system to modern AC system

**TMDrive-10e2 DP**  
The Dual Purpose drive uses standard TMdrive-10e2 drive power and control hardware for both AC and DC motor control.



# TMdrive-Navigator – Simple Drive Configuration and Maintenance

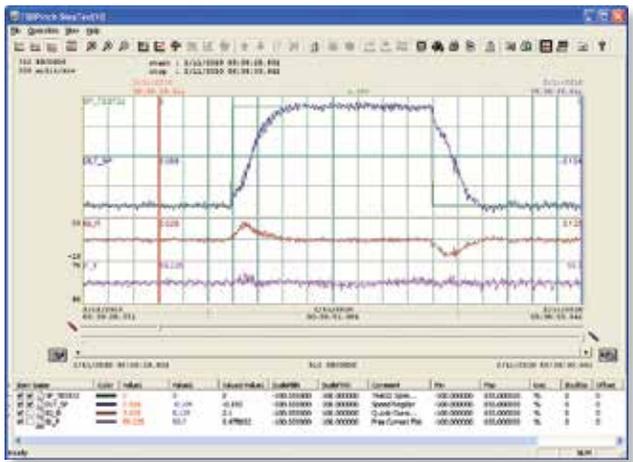


The TMdrive-Navigator tool helps mill engineers and technicians configure and maintain TMEIC drives themselves. Any user can easily access current drive performance data, see below.

This block shows several overlaid windows from the software:

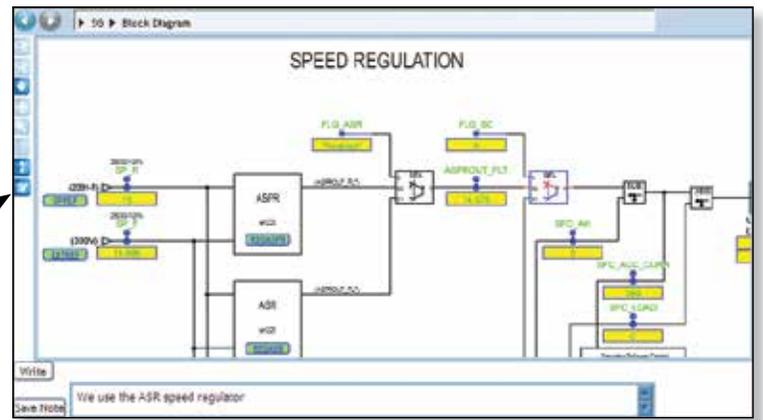
- Browse product help documents:** A table listing documents with columns for Document Info and Description.
- Search Results:** A search window for 'ASR' showing parameters and variables.
- Parameters and Variables:** A table listing parameters like ASR\_ERR\_OUT, ASR\_I, ASR\_I\_T, and ASR\_J\_T with their values and units.
- Change History:** A log of recent changes, such as 'Changed ASR\_I (ASR Integral Gain) from 6 (rad/s) to 5'.
- Block Diagram:** A small diagram showing a component labeled '221.svg:FL6\_ASR'.
- View Object List:** A table listing objects in the current view.
- Fault and Parameter Help:** A window providing detailed information for specific parameters.

Desktop-like search technology links topical signal lists, block diagrams, help files, product documentation, change history, and user notes. The status of all drives is always in view.



High speed data is automatically captured and saved in the event of a drive fault. Users can also capture high speed data based on their own trigger conditions or perform high resolution real-time trending. Fault data can be automatically published to key users.

Live block diagrams provide a real-time graphical view of drive functions. Functions can be configured directly from the graphical view. Product documentation is integrated right into the tool. Users can even capture their own notes to benefit future troubleshooting.



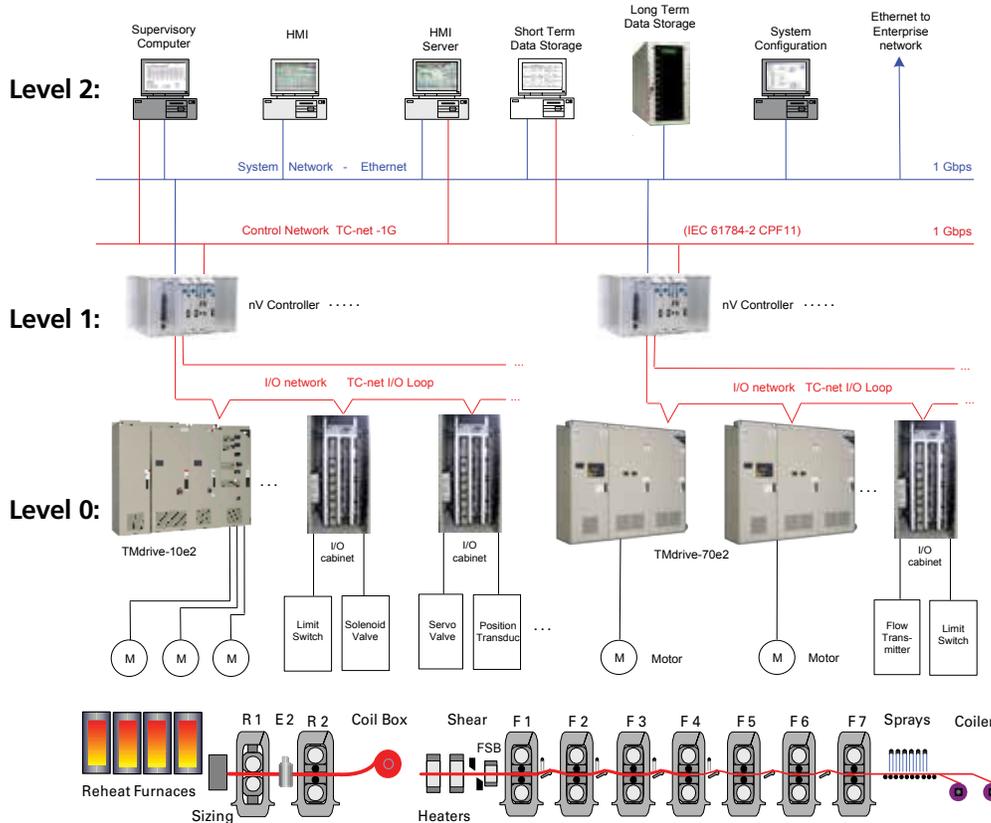
## Programmable Logic Controller (PLC)

TMEIC has developed structured software for a variety of PLC vendors. The selection of the PLC is based upon customer preference and the capability of the PLC.

### Selection of four standard programming languages.

Modern controllers provide four standard IEC 61131-3 languages: Ladder Diagrams, Function Block Diagrams, Sequential Function Charts, and Structured Text.

## TMACS – TMEIC Advanced Control Solutions



The TM Advanced Control Solutions industrial control system is designed to handle the high-speed processing and data transmission required to provide real-time control. Based on advanced multi-core controllers, the hierarchical system employs up to 1 gigabit/sec networks to bring data from the Level 0 input/output devices to the controller, and up to the operator interfaces.

At Level 2, supervisory control computers run software models to provide optimum set point to the controllers to achieve superior product quality and increased mill speed.

## Unified Tool – uTool

**Web-based Access to Everything.** TMEIC's uTool simplifies the gathering and access to manufacturing data needed to monitor and improve mill performance. uTool offers connectivity to key mill information and diagnostic power through easy to use Web-based technology. The integrated view of product, process, and system information delivers the right information at the right time to the right persons – the maintenance, supervisory, and executive staff.

### uTool System Features:

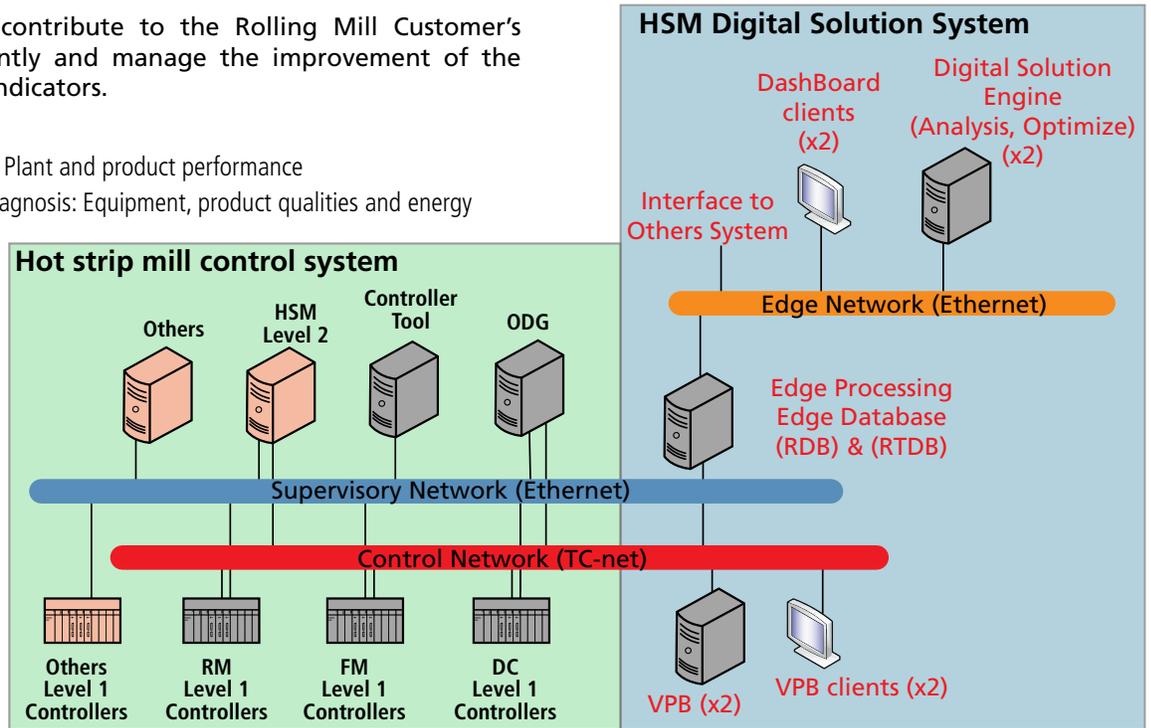
Reports	Quality and production reports, engineering logs, equipment status, production dashboards	Document Linkage	Fast access to documents such as manuals, company standards, FAQs
Web-based	Internet Explorer browser over the plant network	Configurable	Common Web programming language (PHP) used to meet new demand
Deep access	Drill down to low level, detailed information throughout the automation system		

## TMEIC Digitalization

TMEIC Digital Solutions contribute to the Rolling Mill Customer's ability to operate efficiently and manage the improvement of the plant's key performance indicators.

Provided Solutions;

- Visualization and reporting: Plant and product performance
- Condition monitoring and diagnosis: Equipment, product qualities and energy consumption.
- Optimization of operational conditions: Mechanical property and energy consumption.



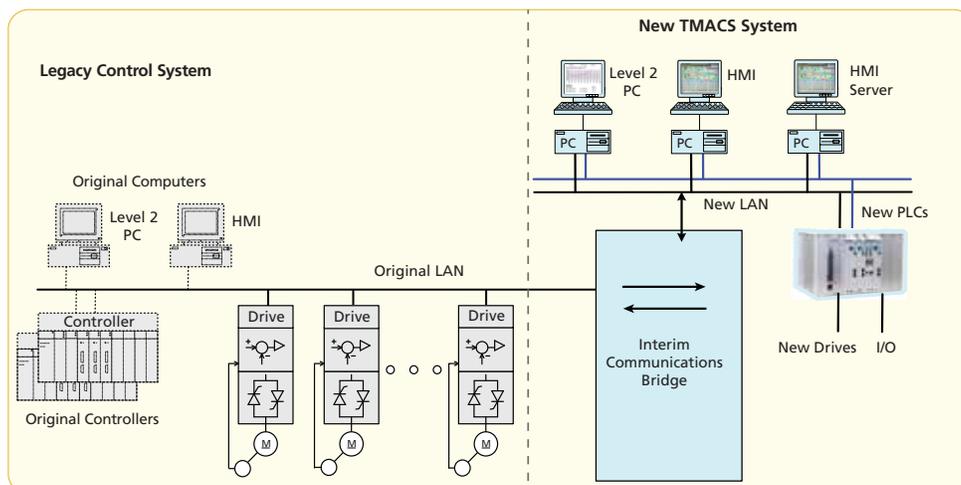
## Upgrading Legacy Control Systems to TMEIC's latest System

### AC Control Systems

TMEIC legacy control systems dating back to the 1980s can be easily upgraded to TMACS, the latest control system. Simple revamps consisting of installing new HMIs and PCs are often first steps in complete mill modernizations that may include replacement of existing controllers, I/O, and full repowering of the mill. Other manufacturer's systems can also be upgraded. Most projects can be phased in during regular outages without shutting down production, as described below.

The diagram below illustrates a typical legacy control system modernization. The gray shaded equipment is the original control system shown part way through the upgrade. The blue shaded equipment is the new TMACS control system, which is being added. The blue block containing network interface cards is the bridge to the new system network.

The original drives can be kept or replaced with new ones connected to the new controller. I/O can be moved over to the new controller when convenient. The gray dotted items are the computers and controllers which will eventually be removed when all control has been moved to the TMACS system.

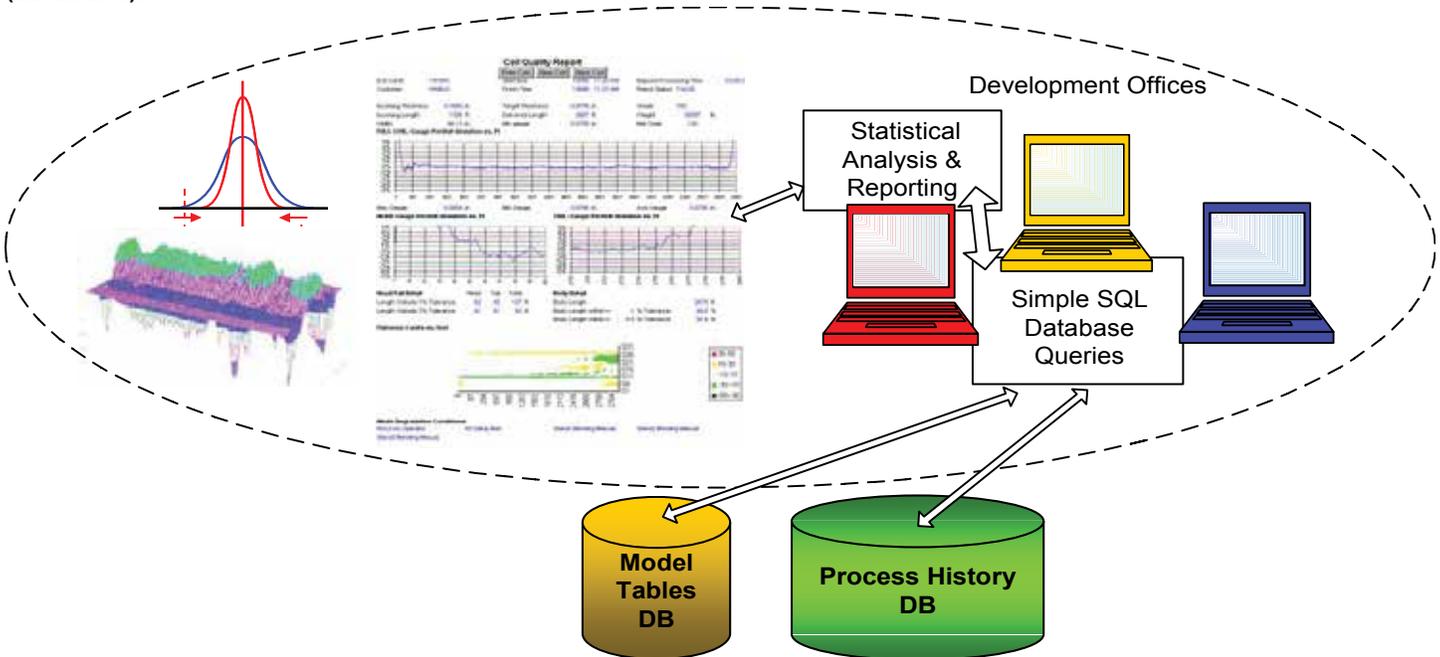


## Mill Level 2 Software and Models

Level 2 provides mathematical process models and the required software infrastructure for them to function. Level 2 distributes references to the level 1 controllers in a timely manner, and receives process feedbacks for model updates and data collection. Typical level 2 functions include:

- Material tracking through process zones
- Distribution of references
- Process feedback scans and process setups
- Production logging
- Engineering logging
- Performance classification and reports

Software and hardware (if necessary) is split into two basic parts: process control (executables) and data storage (databases).



### Features

#### Open Architecture

The hardware platform is based on industrial standards (PC servers), software platform C++, open communication links via Ethernet, and database (MS SQL or Oracle) accessed via ODBC.

#### Structured Software Products

Based on OOD and OOP concepts, the suite of software products is fully configurable. The functions are configured for various applications, NO CODE CHANGES are required.

#### Platform Independence and Distributed Computing

The same source of software products is used for various OS platforms: Windows, OVMS, or Linux. The same applications can run on the centralized computer or can be distributed onto various units as required.

#### Customer Benefits of Level 2 Software and Models

- High product quality
- Low cost of system ownership
- Simple maintenance and troubleshooting

### Benefits

#### Scalability

The software products can be simply “instanced” and added to the application software for easy expansion.

#### Cohesion of all Control Layers

The concept of global signals (Signal Data Base) and central data structure definition (data Dictionary DB) simplifies the system design and maintenance.

#### Comprehensive Analysis Tools and Reporting

System diagnosis utilities allow monitoring of process execution and detailed communication diagnostics. Process data can be accessed via ODBC, analyzed, and reported using standard applications such as: Excel, Access, MathCAD, and Statistica.

- Minimum downtime
- Short system startup and tune-up
- Comprehensive reporting & record keeping system

## Process Models Ensure Production of Quality Product

TMEIC's automation system provides superior mill control based on accurate Level 2 process models and integrated Level 1 controls for hot mills. Some cold mill process models are listed below along with the shape control block diagram.

### Force and Power Models

Force, torque, and power models with the effects of tension and friction.

### Flow Stress Models

Flow stress models with the material chemistry and work hardening effects on elongation.

### Friction Models

Compensation for coefficient of friction variations.

### Strain Model

In-coil strain distribution.

### Roll Wear Model

Thermal and wear effects on roll diameter profile.

### Interactions

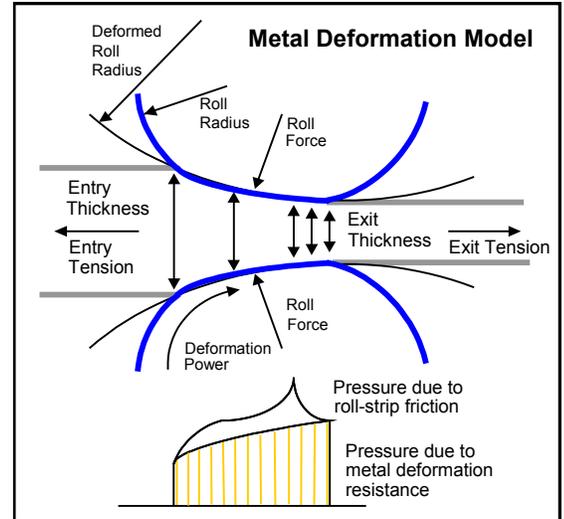
Interactions between tension, forward slip, friction, and speed.

### Textured Rolls

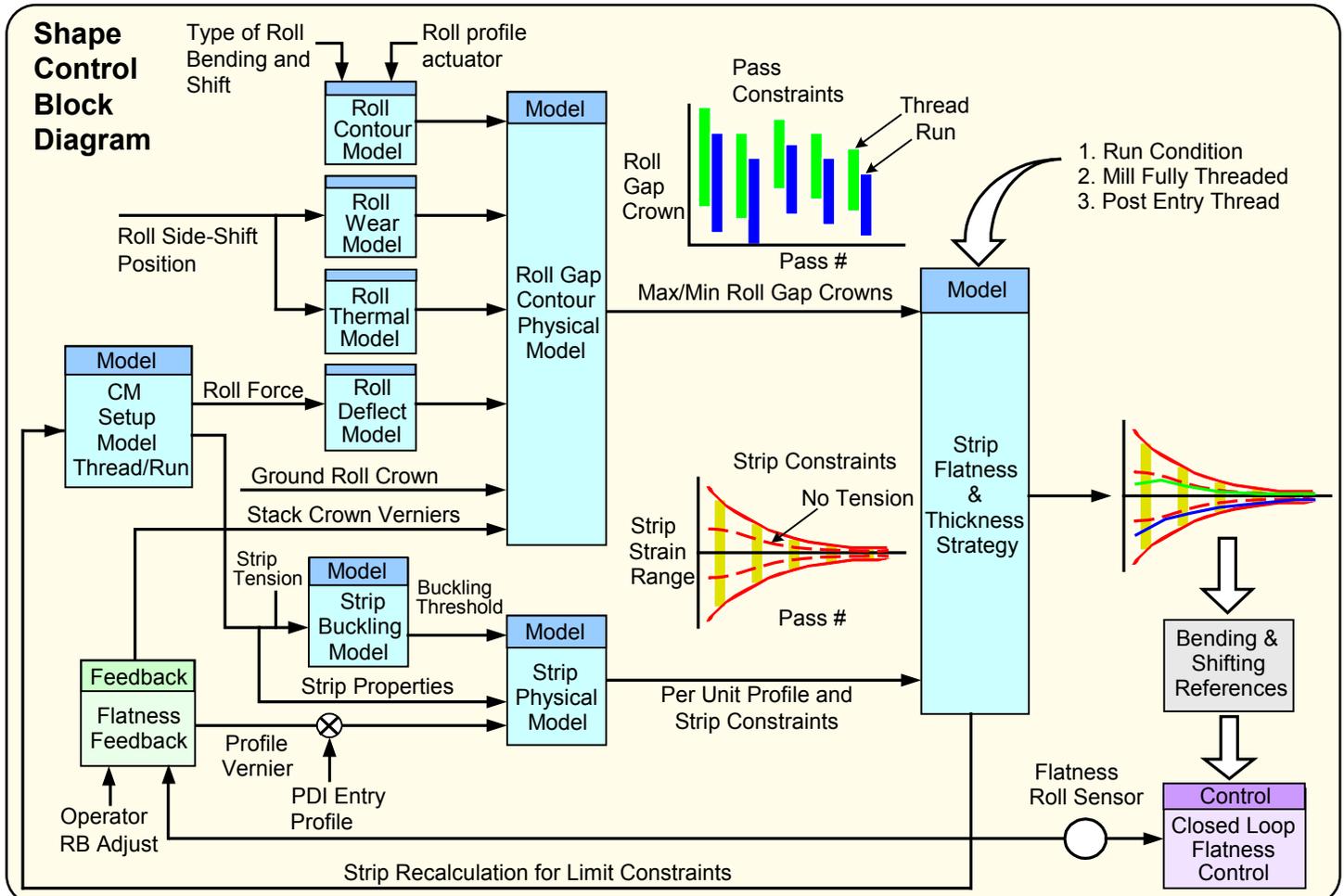
The coefficient of friction effect of textured rolls.

### Product Variations

Product dependent transfer functions for level 1 control.



References from the model provide the setup for level 1 controls, as shown in the diagram below.



## System Commissioning

Commissioning is a team effort. Prior to shipping, the control system is staged in our test lab and thoroughly tested by experienced metals industry engineers. At the mill site, the commissioning team supervises the system installation and wiring, and carries out the initial testing of the drives, motors, and control. After the first coils/slabs are run, the mill is tested to see if the customer's contractual requirements are met, including the desired production rates, material properties, product dimensions, and flatness goals.



*Rolling Mill Commissioning*

## Customer Training



*TMEiC HQ, Roanoke, Virginia*

### Training at our Virginia Facility

Our first-class customer training facility in Roanoke, Virginia features large classrooms and fully-equipped training labs. Training is usually 50% class time and 50% hands-on lab time. TMEiC's drive products, control systems, and programming tools are covered.

### Customized Training at your Plant

TMEiC can offer a course tailored to your project or specific needs and held at your location. In this case, a project engineer and local service engineer train your operators, maintenance technicians, and engineers in your facility.



## Global Customer Support Network

TMEIC Corporation Americas supports customers globally with trained and experienced service engineers. We have service engineers located in North America, South America, Europe, Japan, China, India, and the Pacific.

For technical service and parts, our phone number is available 24/7:

- U.S. Toll Free 1-877-280-1835
- International +1-540-283-2010

**Remote Connectivity Module (RCM)** is a remote diagnostic service link with TMEIC design and service engineers in Roanoke, enabling seamless integration between your drives and our engineers. This remote access allows TMEIC engineers in Roanoke to quickly analyze data and provide a drive problem resolution.

### System Diagnostics

TMEIC's diagnostic tool is included in the controller programming package, and allows the operator to quickly diagnose system problems which can stop the mill. This tool is available to on-site engineers, and also to service engineers in Roanoke through the RCM.





***Delivering customer success  
every project, every time.***

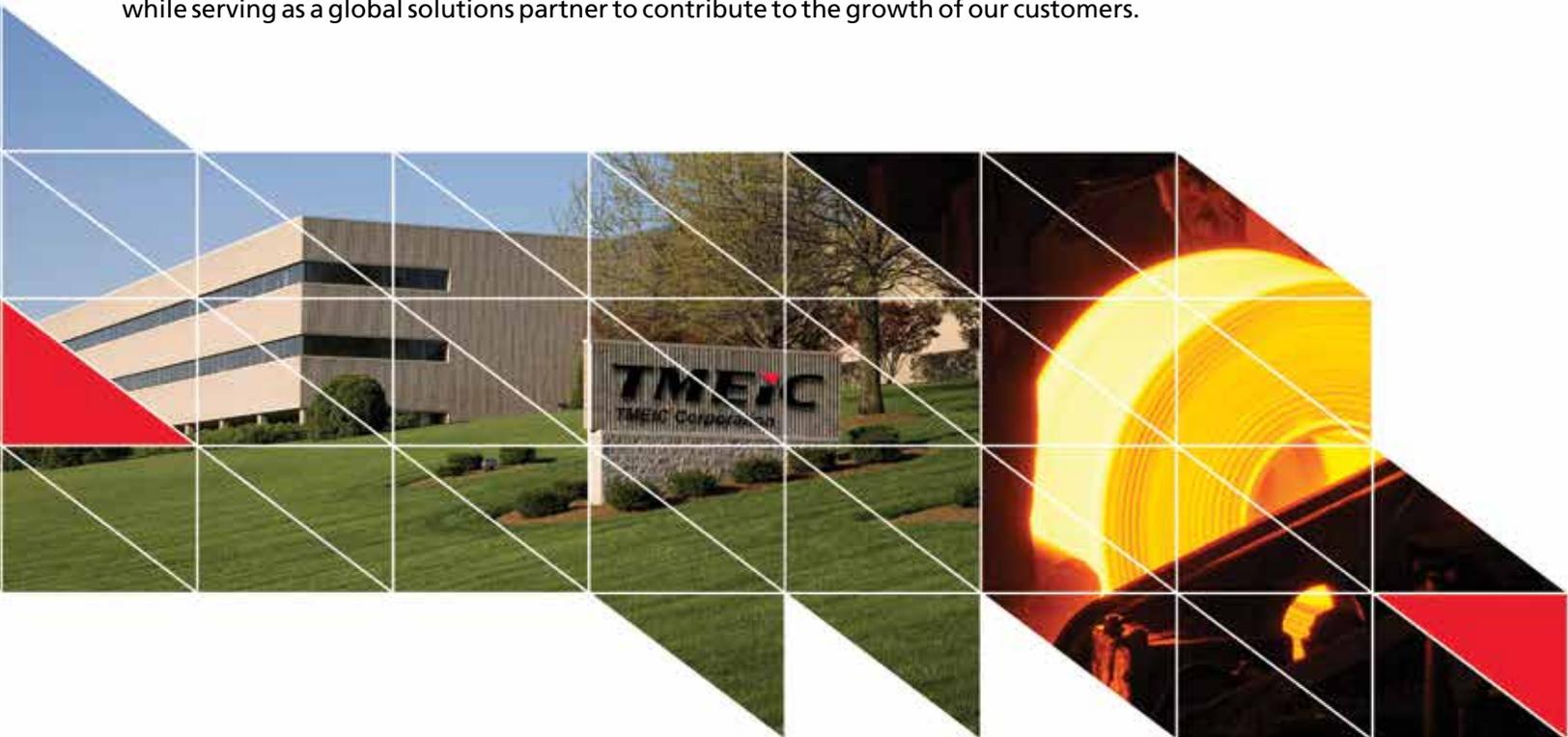
## ***About TMEIC***

### **A Global Network**

TMEIC is built on the combined and proud heritage of Toshiba and Mitsubishi-Electric in the industrial automation, control and drive systems business. TMEIC's global business employs more than 2,200 employees, with sales exceeding U.S. \$2.4 billion, and specializes in Metals, Oil & Gas, Material Handling, Utilities, Cement, Mining, Paper and other industrial markets.

TMEIC Corporation, headquartered in Roanoke, Virginia, designs, develops and engineers advanced automation and variable frequency drive systems.

TMEIC delivers high quality advanced systems and products to factories worldwide, while serving as a global solutions partner to contribute to the growth of our customers.



***TMEIC Corporation Americas | Roanoke, Virginia | Houston, Texas | [WWW.TMEIC.COM](http://WWW.TMEIC.COM)***

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