Digital IIoT Solutions at ANDRITZ
Digital IoT solutions for industrial applications with Metris

www.andritz.com
1. ANDRITZ Digital Solutions
   METRIS

2. METRIS – ANDRITZ GROUP Products and Services
   HYDRO, PULP & PAPER, METALS, SEPARATION

3. SMART Services
   eShop

4. Optimisation of Process Performance
   OPP
METRIS
ANDRITZ Digital Solutions

- **Industrial IoT**: Provide IoT solutions to improve customer’s machine and process performance
  - Smart Sensors
  - Big Data
  - Augmented Reality

- **B2B Smart Services**: Provides the unified entry point for customers to SMART service offerings
  - Customer service portal
  - Field service support
  - Spare part catalog (eShop)

- **Ventures**: Coordinate venture capital and start-up activities within the ANDRITZ GROUP
  - Cyber Security
METRIS
Mission Statement

CUSTOMER NEED IS OUR FOCUS

DIGITALIZATION IS THE ENABLER

Smart solutions are the driver

Value
METRIS
ANDRITZ GROUP Products and Services

**HYDRO**
- Key Product offerings:
  - DiOMera

**PULP & PAPER**
- Key Product offerings:
  - OPP
  - ChipperEKG
  - DD Washer Portal
  - WLF – Monitoring

**METALS**
- Key Product offerings:
  - AFC
  - 3D-ViSE
  - Smart Assist

**SEPARATION**
- Key Product offerings:
  - addlQ

**B2B - Smart Services**
  - eShop
HYDRO
HYDRO – typical project solution
For hydropower plant automation

Power plant automation solutions for
- SCADA system
- Unit control
- Turbine governor control
- Electrical protection
- Generator excitation control
- Switchyard control

Typical use case
- Run of River Power Plant
- 8x Francis Turbines, each 266MVA
- Total Power Output 2.128 MVA

Standard Automation solution for hydropower
One Automation solution for one customer

HPP Hoa Binh - Vietnam

The customer receives the complete system for the power plant; the equipment will be installed and commissioned at customers site.
HYDRO – typical project solution
For a SCADA implementation

SCADA solutions for
- Operation of up to 160 HPPs from a central dispatch center
- Remote or local operation
- 6 Operator Stations, 2 Engineering Stations
- Large Screen Display 6x2 70”

Typical use case
- Dispatch Center
- Centralized control of decentralized hydro power plants
- Seamless control of HPPs at >7 rivers

The customer receives the complete system for the power plant; the equipment will be installed and commissioned at customers site.
HYDRO - new challenges from today’s energy markets
Volatility and cost pressure

- Price volatility
  - Rapidly changing prices and regulatory conditions complexity

- New financing models
  - Secure reliable long-term operation

- Increasing competition
  - On energy sources

- Asset management
  - From self-operated resources to pure asset management

- Owners skill change
  - From technically based to financially oriented

- Grid volatility and climate change
  - Increasing number of volatile energy sources and hydrological changes
HYDRO - success criteria
for today’s power generation

- Reduce total costs, OPEX (total costs = maintenance + unavailability)
- Maximize annual energy production
- Ensure plant availability and safety
- Protect the assets’ value
- Manage complex and instable boundary conditions

ANDRITZ can help and support to reduce maintenance costs and optimize power plant operation
HYDRO – Operation and maintenance
We offer a scalable service concept for maintenance

Enhanced spare part management
Remote assistance
Preventive / predictive maintenance
O&M intelligent modules
Break down maintenance
System assessment
Extended warranty
Analysis and optimization
24 / 7 assistance
Daily maintenance

Customizable maintenance services
We offer you a scalable service concept for operation.

**HYDRO - Operation and maintenance**

- Supervision of units
- Unit inspections
- Assistance for malfunctions
- Safety / environmental management
- Provision of operation staff
- Local / Remote HPP operation
- Power plant staff management
- Spare part management
- O&M intelligent modules

**Levels**
- **BASIC**
- **ADVANCED**
- **PREMIUM**

**Customizable operation services**

![Image of a service concept diagram for operation and maintenance services, including supervision, inspections, assistance for malfunctions, safety, environmental management, and power plant staff management, with levels from basic to premium.]
HYDRO - Operation and maintenance: locally taking care of your HPP with our global know-how

Customer

O&M Support
(ANDRITZ HYDRO - Locations)

Customer contact and support
Maintenance and its optimization
On-site O&M, local HPP operation
Optimization of production
Condition monitoring

Control Center

Remote HPP operation
24 / 7 assistance
Operational data analytics
Global O&M experts
Metris DiOMera – a new approach
For operation and maintenance of hydropower plants

Operation and Maintenance solution for
- Each power plant, every size, type, location
- Local / remote operation
- Optimization of production
- Customized acc. customer needs

Typical use case
- ANDRITZ HYDRO control center remote operation
- Automation and Monitoring systems installed locally
- Data hosting and big data analyses in the cloud

ANDRITZ HYDRO Control Center Italy

Standard Operation and Maintenance solution

Operation and Maintenance

ANDRITZ HYDRO is offering a service for Operation and Maintenance. The delivered solution comprises local installation, cloud implementation and remote control from an ANDRITZ HYDRO location.
PULP & PAPER: OPP (Optimization of Process)
Performance – autonomous operation

Optimizing equipment and plants in the pulp & paper and other process industries

Anomalies and deviations detected in an early stage, advising operator or taking autonomous action to correct

Proven technology deployed at various key customers in the pulp and paper industries
On-line diagnostics

Smart Sensors + Condition Monitoring

ChipperEKG

On-line knowledge of chipper and chipping.
ChipperEKG
On-line diagnostics

Chipper Electrical Knife Graphs indicates the knife hit into log and shows the condition of knives, which is the heart of chip quality.
Smart Sensors + Condition Monitoring

DD-Washer
Customer portal

Customer portal with traffic light indicator shows how the end seal, critical consumable part in Drum Displacer washer, is performing
Customer benefits

- Reliability and predictability of the Drum Displacer washer
- Ability to see the status of operations at any time
- Possibility to seize early warnings and take immediate actions

Your steps to the solution

- New measurements installed to the DD-Washer’s steering logic
- Set-up customer portal with traffic light indicator
- Installation of mobile user interface as a daily tool for the maintenance workers

Smart Sensors + Condition Monitoring

**DD-Washer**

**Customer portal**

Customer portal with traffic light indicator shows how the end seal, critical consumable part in DD-Washer, is performing
Smart Sensors + Condition Monitoring

White liquor filter
Condition Monitoring

Prediction white liquor filter operation for improved reliability

Example
Customer benefits

- Improved reliability and predictability
- Increased safety
- Better preparation for the next shut-down
- Optimization of the service interval

Your steps to the solution

- Install sensors to filtrate end sealings and lime mud dilution Online portal
- to monitor the sensors and meters.
- User interface with condition-related alerts.

Smart Sensors + Condition Monitoring

White liquor filter Condition Monitoring

Prediction white liquor filter operation for improved reliability
Example

Big Data + Augmented reality

Datalytic team and process data analyses

Making it possible to have the mill in your hands all the time with optimized availability and efficiency.
Insight on the first practical steps to start improving the mill operations together through digitalization

- Getting your fleet information updated and machines connected
- Continuous forecasts on how the function of the equipment and state of the processes is going to change

Our team to the solution

- ANDRITZ Data Analytics Team
- Customer Case: Data analyzes about impregnation vessel level control

Big Data + Augmented reality

**Datalytic team and process data analyses**

Making it possible to have the mill in your hands all the time with optimized availability and efficiency.
From traditional pulp mills to advanced plants and machinery with self diagnostics, internal and external wireless technology, utilizing modern communication medias, diagnostics and big data tools.
Customer benefits

- On-line condition monitoring with advanced diagnostics
- Advanced wireless video/audio communications, augmented reality tools
- Maintenance planning based on actual needs and fact-based information (e.g. wearing, running times)

Your steps to the solution

- Install videowall and control system
- CCTV systems connected to video wall system

Big Data + Augmented reality

Decision Support for Operators and Maintenance

From traditional pulp mills to advanced plants and machinery with self-diagnostics, internal and external wireless technology, utilizing modern communication medias, diagnostics and big data tools
R&D
Smart Sensors

“Development of smart, wireless, micro-sensors for industrial applications!”

SENSOR TYPES

- Pressure
- Magnetic field
- Temperature
- Ultrasonic
- Hall effect
- ...

Metris Smart Sensors
METALS
ANDRITZ 3D-ViSE (3D-Virtuell Simulation Environment)
Digital Twin of Metal Production Lines (1)

3D Simulation with “Digital Twin”

- Independent verification of software functionality (SW FAT)
- Improve software quality during engineering phase and before commissioning
- Higher quality of documentation (e.g. functional descriptions, knowledge database)
- One workflow from concept to Mechanical Design and Electrical & Automation
- Full 3D visualization of the production line and calculation of signal feedbacks
Knowledge transfer between Mechanical Design Department and Electrical & Automation Department

Offline simulation of sequences before software engineering

Internal software test and debugging with virtual panels during engineering phase

Verification and optimization of sequences

Internal trainings

Sales presentation for customers

Operator training before / during commissioning on Digital Twin

Verify locations of further equipment (LOBs, safety fences, safety doors)

Typical use case

ANDRITZ 3D-ViSE (3D-Virtuell Simulation Environment)

Digital Twin of Metal Production Lines (2)
Schuler Smart Assist
Digitally assisted “teach in” of presses (1)

Current Situation
- Setup of presses is highly depending on dedicated and more and more rare experts
- Setup is time consuming due to complex steps
- Manual optimization with step by step approach
- Setup time is directly influencing production

Target
- Instruction based accelerated setup
- Collision free kinetics calculated automatically
- Fine tuning of forming parameters possible
- Guided “teach in” for key position points

Typical Schuler Press

Typical Schuler Smart Assist improvement curve
Schuler Smart Assist
Digitally assisted “teach in” of presses (2)

Implementation
- Structured “teach in” process by using video and text instructions given at press shop
- Setup guidance is including press movement, feeder and transfer as coupled kinematics

Road Map
- Implemented for MSP400 press incl. roller feeder
- Available for all presses with latest automation platform delivered
- Retrofit concept in preparation

Schuler Smart Assist
Combining 176 years of metals forming know how with digital technology and expertise
SEPARATION
Metris addIQ control systems
Intelligence for machine and process control

Focus
- New Installation
- Upgrades
- Optimization through Automation

Typical use case
- A family of addIQ packages
- For separation business to optimize operation
- From breweries to sludge treatment plants

Scalability
addIQ control systems for solid/liquid separation
Metris addIQ simulation
Operator Training

**Focus**
- Authentic operator interface
- Machine digitally modelled
- Realistic operating scenarios and parameters

**Typical use case**
- Flexible classroom training worldwide
- Multiple participants in one training session
- Training to deal with unlikely machine/process incidents
- Certified operators

**AddIQ Simulation for solid/liquid separation**
Metris addIQ simulation the ultimate tool to qualify and certify staff
SMART SERVICE
Either using an identification code at the ANDRITZ equipment or directly guided through the user-friendly application you will find the right parts easily.
Customer benefits

- Streamlining of the part inquiry and order process
- Improved efficiency of a routine work flow
- Up-to-date documentation of what the machine is made of as prerequisite for the solution

Your steps to the solution

- Implement eShop solution
- Equipment should have identification codes

Either using an identification code at the ANDRITZ equipment or directly guided through the user-friendly application you will find the right parts easily.
- Increase the process stability
- Reduce the energy or chemical cost
- Debottleneck production, increasing total production
- Increase the mill availability
- Fast response to move from area to area, or production to cost.
- Keep existing savings in the long term
- Support to Operation: in diagnostics, start-up, mill-balance
OPP – Optimization of Process Performance
OPP is a Metris Service Solution

- Remote Support
- Local Support
- Collaborative Network
  - Control Experience
  - Automation Experience
  - Maintenance Experience
  - Best practices Database
  - Continuous R&D
- Andritz Platform & Methodology
- OPP Server
- OPC
- MILL
- EXISTING DCS
- PROCESS AREA
OPP – Optimization of Process Performance

References – Range of applications
How OPP reaches process performance

- Chemical or Energy savings
- Production target due to instability
- Production Capacity
- Specification
- SP due to variability
- New set point
- New production level
- Variability reduction
- Production Increase
How OPP reaches process performance

- Reduce process variability
- Debottlenecking
- Fast start-up
- Mill balance

- Avoid shutdown using automatic slow down system
- Mill balance
- Production stability
- Equipment failure prediction

<90% (opportunity to improved)  90-91% (acceptable)  91-92% (target)  >92% (excellent)
OPP ultimate unique business model

**3 business models**
- Fixed + performance (based on savings)
- Fixed + performance (based on KPIs)
- Fully based on performance (based on savings)

**OPP Contract**

**SOFTWARE & HARDWARE**
- Software included
  - no licenses needed
- Server included
  - installation included

**RESOURCES**
- 1 local specialist on site
- 1 regional specialist
  - 40 h/month support
  - 20 days/y at mill
  - remote support

**PRICE**

**TERMS & CONDITIONS**
- 1 to 3 years contract
- Target: 2 x investment
- Cancelation:
  - on 3 month (1 x investment)
  - every year (2 x investment)
OPP ultimate unique optimization execution
### Strategy & Organization

**METRIS Platform used by OPP**

<table>
<thead>
<tr>
<th>BUSINESS INTELLIGENCE</th>
<th>Management and technical KPIs, dashboards, balanced scorecard, project management tool, etc</th>
<th>LEVEL 4: MANAGERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA ANALYTICS</td>
<td>Data mining, statistics, power spectral density, KPIs</td>
<td>LEVEL 3: ENGINEERS (OPERATIONS AND MAINTENANCE)</td>
</tr>
<tr>
<td>NOTIFIER</td>
<td>OPP, SMS, e-mail, follow-up</td>
<td></td>
</tr>
<tr>
<td>PIMS</td>
<td>Data historian, process displays</td>
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<td>DAILY MANAGEMENT</td>
<td>Tools for Log book, meetings, risk assessment, work permit</td>
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</tr>
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<td>OPERATOR ASSISTANCE</td>
<td>Start-up sequences, diagnostic systems, root cause analysis, process specification check</td>
<td>LEVEL 2: OPERATORS AND SHIFT SUPERVISOR / CORDINATOR</td>
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<td>SMART CONTROLS</td>
<td>Advanced Process Controls, Decision support, adaptative setpoints, mill balance</td>
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<td>Measurement validation, process diagnostics</td>
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<td>REGULATORY CONTROL</td>
<td>Control loop tuning and assessment, dead time compensators, feedforward, etc.</td>
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<td>Real time data, diagnostic, procedures, remote support</td>
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<td>ASSET MANAGEMENT</td>
<td>Risk Based Maintenance, predictive maintenance, condition Monitoring, Valves, motors, analyzers, interlock bypass, etc.</td>
<td>LEVEL 1: FIELD OPERATORS AND MAINTENANCE TECHNICIAN</td>
</tr>
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<td>Strategy &amp; Organization</td>
<td>METRIS Platform</td>
<td></td>
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## Autonomous Operations

### Decision levels

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<tr>
<th>MARKET STRATEGY</th>
<th>Maximize company results</th>
<th>MONTHLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTION STRATEGY</td>
<td>Budget control</td>
<td>DAILY</td>
</tr>
<tr>
<td>PRODUCTION &amp; COST MANAGEMENT</td>
<td>Mill Balance control</td>
<td>MINUTES TO HOURS</td>
</tr>
<tr>
<td>SMART CONTROLS</td>
<td>Control of complex variables</td>
<td>3 - 300 SECONDS</td>
</tr>
<tr>
<td>REGULATORY CONTROLS &amp; SAFETY</td>
<td>Control of simple variables and avoid interlocks</td>
<td>0.1 - 1 SECONDS</td>
</tr>
<tr>
<td>RELIABILITY</td>
<td>Equipment (some assets have their own controls)</td>
<td>MILISECONDS</td>
</tr>
</tbody>
</table>

- **Maximize company results**: Market x Budget analysis and definition of production strategy
- **Budget control**: Speed, Economy, Balanced (It defines how mill balance should work)
- **Mill Balance control**: Start-up/Stop, Speed-up/Slow-down, Recipes (35 controls)
- **Control of complex variables**: Kappa, Brightness, Moisture, Dry-solids, etc. (75-100 controls)
- **Control of simple variables and avoid interlocks**: Flow, Temperature, etc. (1000 controls + 2000+ interlocks)
- **Equipment**: Big assets, instruments, valves, motors, etc. (15000+ devices)
## Autonomous Operations
### How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment must be reliable</td>
<td>Prediction of failure and automatic notification based on on-line data</td>
</tr>
<tr>
<td></td>
<td>Prediction of failure and automatic notification based on inspections. AR (Augmented Reality) can help.</td>
</tr>
</tbody>
</table>

### Equipment for Autonomous Operations

- **Instruments**
- **Control Valves**
- **On-off Valves**
- **Motors**
- **Variable Frequency Drives**
- **Pumps**
- **Smart Sensors**
- **Soft Sensors**
## Autonomous Operations

### How to achieve it

<table>
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<th>How to improve it?</th>
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<tr>
<td>Basic loops must work at least 95% in auto mode, with minimum IAE (Integral of Absolute Error)</td>
<td>Automatic diagnostics of instruments and valves</td>
</tr>
<tr>
<td></td>
<td>Automatic diagnostics of control loop performance</td>
</tr>
<tr>
<td></td>
<td>Control loop monitoring and tuning</td>
</tr>
</tbody>
</table>

![Image showing control loop monitoring and tuning](image-url)
# Autonomous Operations

## How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interlocks must be avoided</td>
<td>Automatic slow-down system</td>
</tr>
<tr>
<td></td>
<td>“Hacking” operator actions and make it automatically</td>
</tr>
<tr>
<td></td>
<td>Eliminate not needed interlocks</td>
</tr>
<tr>
<td></td>
<td>Review interlock limits</td>
</tr>
<tr>
<td></td>
<td>Delay interlocks when possible</td>
</tr>
</tbody>
</table>

**Diagram:**

[Diagram of process flow with various valves and sensors, labeled with alphanumeric codes.]
## Autonomous Operations

### How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key process variables must be controlled inside specifications</td>
<td>Sophisticated control algorithms must be developed and updated continuously</td>
</tr>
<tr>
<td>Specifications limits must be reviewed based on best operations days</td>
<td>Prediction of process problems and automatic notification</td>
</tr>
</tbody>
</table>

### Advanced Process Control

- **OEE**
- **KPIs**
- **Predictions of variables**
- **Notifications**
Autonomous Operations
How to achieve it

**Customer need**
Production rate and chemical/energy consumption must work must be always optimized

**How to improve it?**
Sophisticated control algorithms must be developed and updated continuously
Create a footprint of key equipment
Benchmark with best productions days and suggest possible changes in the model automatically

Diagram:
- **Customer need**
  - Production rate and chemical/energy consumption must work must be always optimized

- **How to improve it?**
  - Sophisticated control algorithms must be developed and updated continuously
  - Create a footprint of key equipment
  - Benchmark with best productions days and suggest possible changes in the model automatically

- **Diagram**
  - Define Zones
  - Define ranges
  - Define intermediate action
  - Define factors
  - On-line operation
  - Monitor and tune
## Autonomous Operations
### How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to deal with changes in raw material</td>
<td>Process model and recipes must be created for every scenario to make the process at its optimal level</td>
</tr>
</tbody>
</table>
# Autonomous Operations

## How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to deal when something goes wrong, like an instrument failure</td>
<td>Switch off part of the algorithm and give instructions in how to proceed</td>
</tr>
<tr>
<td>Start-up sequence to start the process quickly and in a standardized way</td>
<td></td>
</tr>
</tbody>
</table>

**Prediction of variables**
## Autonomous Operations

### How to achieve it

<table>
<thead>
<tr>
<th>Customer need</th>
<th>How to improve it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to reduce the time to repair</td>
<td>Show contextual information</td>
</tr>
<tr>
<td></td>
<td>Have a knowledge database</td>
</tr>
<tr>
<td></td>
<td>Team of experts to support the mill</td>
</tr>
</tbody>
</table>

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**Image Description:**
- **Customer need**: How to reduce the time to repair.
- **How to improve it?**
  - Show contextual information
  - Have a knowledge database
  - Team of experts to support the mill
## Autonomous Operations

### Results

#### Installation and tuning: Sep-Dec/16

<table>
<thead>
<tr>
<th>KPI</th>
<th>Baseline</th>
<th>Goal</th>
<th>Jan/17</th>
<th>Feb/17</th>
<th>Mar/17</th>
<th>Apr/17</th>
<th>May/17</th>
<th>Jun/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Stability</td>
<td>91%</td>
<td>94%</td>
<td>90.3%</td>
<td>94.1%</td>
<td>93.7%</td>
<td>90.5%</td>
<td>93.3%</td>
<td>95.5%</td>
</tr>
<tr>
<td>(average/ MSR) hour base</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable Costs</td>
<td>0%</td>
<td>-10%</td>
<td>-6.2%</td>
<td>-10.9%</td>
<td>-10.5%</td>
<td>-6.5%</td>
<td>-9.7%</td>
<td>-11%</td>
</tr>
<tr>
<td>(Consumption + Energy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPP controls ON</td>
<td>0%</td>
<td>90%</td>
<td>65.1%</td>
<td>90%</td>
<td>95%</td>
<td>85%</td>
<td>96%</td>
<td>97%</td>
</tr>
<tr>
<td>(% of Time of)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Production Records

<table>
<thead>
<tr>
<th>Records</th>
<th>Before</th>
<th>Q1/2017</th>
<th>Q2/2017</th>
<th>Q3/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>5420</td>
<td>-</td>
<td>5508 (+1.6 %)</td>
<td></td>
</tr>
<tr>
<td>Monthly average</td>
<td>4988</td>
<td>-</td>
<td>5045 (+1.1 %)</td>
<td>5105 (+2.3 %)</td>
</tr>
<tr>
<td>Quarter average</td>
<td>4694</td>
<td>4814 (+2.5%)</td>
<td>4872 (+3.8%)</td>
<td></td>
</tr>
</tbody>
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