The value of in vitro diagnostics
Transforming data into actionable information
In Vitro Diagnostic (IVD) Analyzer
Example of cobas®6800 - Molecular Diagnostics

- Scanning of each rack and single sample barcode.
- Order test request from Lab IT
- Input/output of patient blood sample tubes/racks
- DNA/RNA extraction and test preparation
- Polymerase Chain Reaction (PCR) and detection of viral load by multiplying DNA/RNA and recalculation of original concentration

384 Samples
in 8 hours
Digital Transformation Program
Predictive Maintenance

Industry 4.0

- Increase Availability
- Reduce Emergency Visits (Travel Costs)
- Protect Car&Driver (Secondary Damage)
- Avoid Production Stop (Batch waste)

Improve Customer Satisfaction

Roche
Digital Twin
Definition of Components and Purpose

**Physical Product**
Is represented by:
- Specific **Configuration** as build and as maintained
- **Specific Condition** depending on aging and issues on internal components

**Digital Twin**
Is represented by:
- **Generic virtual Model** based on CAD data and simulation
- **PLM based configuration**; Physical, electronical and SW information
- **Specific condition** based on internal sensor and counter data, event protocols, enriched with new information from additional sensors and unstructured data

**Digital Twin Solutions**
Are performed based on the appropriate **Digital Twin** and used to:
- Visualize as user interface the real product for **remote service**
- Monitor condition for **predictive maintenance**
- **Operator Feedback** on usability and functionality
Digital Transformation Program
Pathway to predictive maintenance

- Machine Data Capturing
- Gateway
- Data Transfer to Cloud Services
- Cloud App based Data Processing
- Existing Service History Data Base
- Combine Machine Learning and Technical Expertise
- Condition Monitoring
- Predictive Maintenance
Digital Transformation Program
Pathway to predictive maintenance

Combine Machine Learning and Technical Expertise

Existing Service History Data Base

Cloud App based Data Processing

Retrofit Sensor Package

Machine Data Capturing

Gateway

Data Transfer to Cloud Services

Condition Monitoring

Predictive Maintenance
Digital Transformation Program
Predictive Maintenance
Digital Transformation Program
Machine Learning in Predictive Maintenance

Outcome Prediction

<table>
<thead>
<tr>
<th>Block Temp</th>
<th>Reference Temp</th>
<th>Deviation</th>
<th>Cycler Temperature out of Range - Instrument runs out in 2 hours</th>
</tr>
</thead>
<tbody>
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<td>91,124</td>
<td>90,000</td>
<td>0.876</td>
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Anomaly Monitoring

- BlockTemp
- Ref Temp
- Deviation

Identify Key Parameters for condition monitoring & their Contribution to Failure Prediction

Failure Prediction for Equipment (Requires Historic Data)
Increase Uptime – Best Parts / Smart Parts
Component Reliability Improvement

- BETTER component
  - Best of existing multiples
  - New component
  - Based on existing machine data extraction
    - Sensor Retrofit
  - Smart component

Historical performance and reliability Data

CONDITION Monitoring

PREDICTIVE Maintenance
Digital Twin
Smart Lab Assistant
Digital Transformation for Roche Diagnostics

Digital Production Twin

Digital Product Twin

Digital Performance Twin

Digital Twin
Doing now what patients need next