67\% decentral power
40% energy cost
+60% sub-urban passengers
~100% quality
32% older than 60
Siemens addressing these challenges using digital technologies – building on Electrification – Automation – Digitalization

Digitalization
- MindSphere
- Siemens Digital Services
- Siemens Software

Automation

Electrification
- Digitally enhanced Electrification and Automation
Enhanced Electrification and Automation

Smart Motors – connected to MindSphere

Challenge
– Lacking transparency on operational machine data of drive applications
– Limits to performance and reliability improvements

Solution
– Smart Box with integrated vibration, magnetic flux and temperature sensors
– Wireless connection to MindSphere for monitoring and analytics applications

Outcome
– Increased availability
– Improved performance
– Optimized serviceability

Enhanced E&A – benefit for Siemens
– Expanding #1 position in automation
– Enhancing the installed base for Digital Services
– Enabling the MindSphere ecosystem
Siemens Software
Digital Enterprise Suite for Maserati

Challenge
– Customer seeking to reduce time-to-market while maintaining highest quality and increasing model variety

Solution
– Siemens software for product development and simulation integrated with production engineering

Outcome
– Development time reduced by 30%
– Time-to-market reduced from 30 to 16 months

Siemens Software – benefit for Siemens
– €3.3 bn cross-divisional business
– Strong growth and high-profit
– Stable, recurring revenue stream
Challenge
– Products, systems of infrastructure & people are becoming increasingly complex – harder to design and to optimally control

Solution
– Simulation for rapid virtual prototyping
– Testing of control actions prior to execution

Outcome
– Optimized design and operation of infrastructures
– Increased productivity, efficiency, resilience and availability

Simulation Software – benefit for Siemens
– Strong differentiator for digital portfolio
– Key for closing the life-cycle data loop
Siemens Digital Services

Predictive maintenance for high-speed trains in Russia

Challenge
– Safe-guarding highest availability of trains at down to -40ºC in exposed environments

Solution
– Analytics on sensor data of critical components for predictive maintenance

Outcome
– 99% availability in harshest conditions

Digital Services – benefit for Siemens
– €1.0 bn cross-divisional business
– Strong growth and high-profit, recurring revenue
– Capitalizing on 800,000 connected devices
Siemens creating benefit along entire customer value chains

Enabling the next level of...

... productivity
and time-to-market ...

Design &
engineering

... flexibility
and resilience ...

Automation &
operation

... availability
and efficiency ...

Maintenance &
services

Ensuring industry grade cyber-security
Electrification – Automation – Digitalization: a strong and complete offering for our customers

Siemens Software

Siemens Digital Services

MindSphere – the IoT operating system

Digitally enhanced Electrification and Automation

Sinalytics Apps
Electrification – Automation – Digitalization: a strong and complete offering for our customers

Siemens Software

Siemens Digital Services

MindSphere – the IoT operating system

Sinalytics Apps

Design & engineering

Automation & operation

Maintenance & services

Digitally enhanced Electrification and Automation

€4.3bn
+12% y-o-y
profit +++
Electrification – Automation – Digitalization: a strong and complete offering for our customers

Siemens Software
- Unique simulation
- ~70mn contracted meters

Siemens Digital Services
- €4.3bn
- +12% y-o-y profit
- 800k connections
- €3bn backlog @Power
- Sinalytics Apps

MindSphere – the IoT operating system

Digitally enhanced Electrification and Automation
- #1 position in automation
- ~30mn automation systems
Electrification – Automation – Digitalization: a strong and complete offering for our customers

Next steps
- Mentor Graphics M&A, $1.2bn revenue
- Bentley Sys. partnership
- Global MindSphere roll-out

Continuous innovation makes the difference!

Design & engineering
Automation & operation
Maintenance & services

Siemens Software
Siemens Digital Services

MindSphere – the IoT operating system

Digitally enhanced Electrification and Automation

Sinalytics Apps
What's next? – Full leverage of the closed-life-cycle data-loop and artificial intelligence

- **Descriptive**
  - Monitoring & transparency
  - Data analytics

- **Predictive**
  - Understanding & predicting
  - Closed life-cycle data-loop

- **Prescriptive**
  - Decision support
  - Artificial Intelligence

- **Deductive**
  - Continuous improvement

- **Business value**

- **Depth of data-use**
Siemens Innovation

Machine learning & distributed analytics – intelligent grid controllers

Challenge
‒ Reliably classifying and locating faults in power grids
‒ Conventional methods at ~80% reliability

Solution
‒ Machine learning applied to ~70,000 fault events
‒ Resulting optimized algorithms embedded in SIPROTEC™ protection relays
‒ Real-time streaming and interpretation of grid data

Outcome
‒ Considerably improved reliability of locating faults
‒ Faster recovery times, reduced maintenance cost
‒ Enabling large-scale integration of solar & wind

Benefit for Siemens
‒ Enhancing the electrification & automation portfolio – expanding leadership
Siemens Innovation

**NO\textsubscript{x} emission reduction of gas turbines based on machine learning**

**Challenge**
- Conventional NO\textsubscript{x} emission reduction approaches reaching limits
- Tightening environmental regulations

**Solution**
- Machine learning algorithms for optimization of control parameters

**Outcome**
- 15–20% additional NO\textsubscript{x} reduction
- Providing more sustainable balancing power

**Benefit for Siemens**
- Enhancing the electrification & automation portfolio – expanding leadership
Siemens Innovation

MindSphere & the Digital Twin – operational data for product optimization

Challenge
– Reaching the next level of design and product quality of cranes by feeding operational product sensor data back into design

Solution
– Collection and management of data using MindSphere and Teamcenter product data management software
– Direct interface to design tool NX
– Co-operation with Aalto University

Outcome
– Effective, efficient and reliable product improvement
– Closing the life-cycle data-loop

Benefit for Siemens
– Enhancing E-A-D via data based learning
– Growing a the MindSphere ecosystem
# Innovation

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**MindSphere – the IoT operating system**

**Digitally enhanced Electrification and Automation**
Innovation – closing the life-cycle data-loop

- Design & engineering
- Automation & operation
- Maintenance & services

Siemens Software

Siemens Digital Services

MindSphere – the IoT operating system

Digitally enhanced Electrification and Automation

Sinalsapps

DIGITAL TWIN