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Fachkonferenz: Neue Produkte in der digitalen Welt

Siemens on its way to become a digital company

Dr. Norbert Gaus | Siemens AG | Munich, January 27, 2016

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- 26 high-speed trains at Renfe Spanish Rail Company (Madrid-Barcelona-Malaga)
- Performance contract with availability guarantee
- Passengers are reimbursed for delays >15 mins
- On-time rate of 99.9%
- 60% passengers switched from aircraft to train

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Siemens strategy – ‘Ingenuity for Life’

Global trends

Digital transformation
Networked world of complex and heterogeneous systems

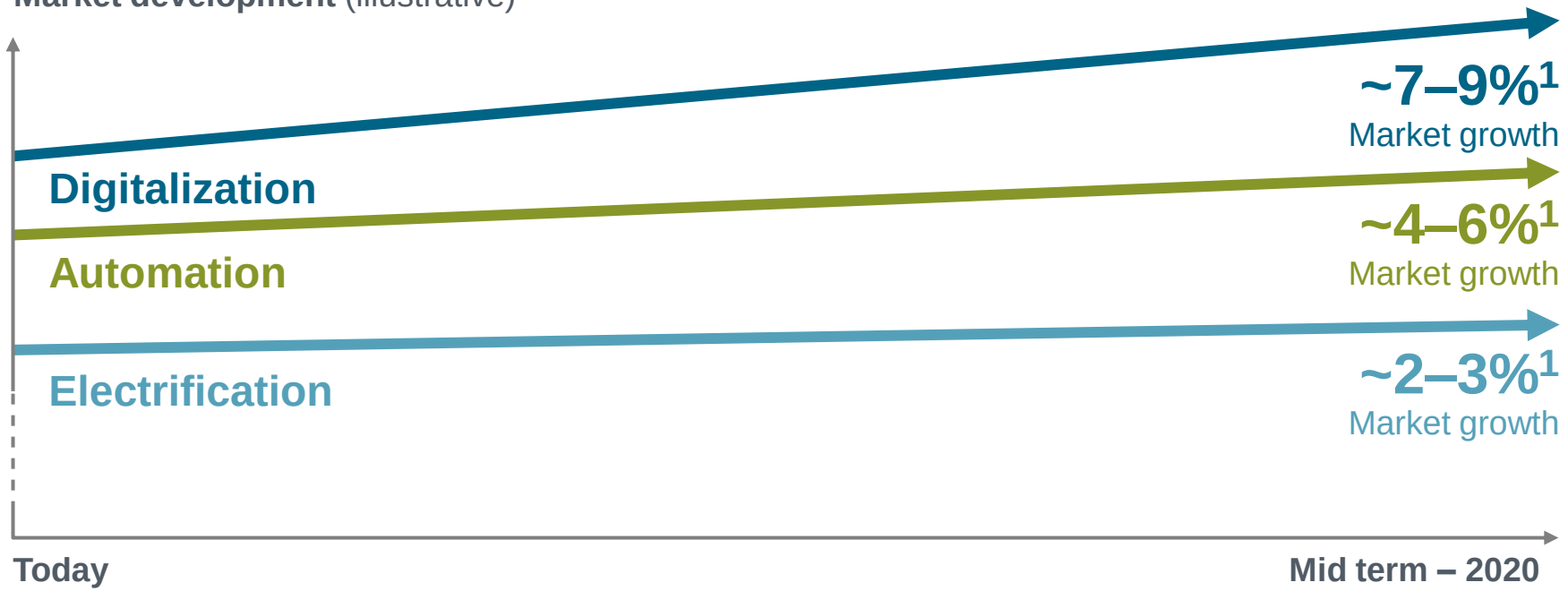
Globalization
Global competition driving productivity and localization

Urbanization
Infrastructure investment needs of urban agglomerations

Demographic change
Decentralized demand of a growing and aging population

Climate change
Higher resource efficiency in an all-electric world

Market development (illustrative)



Innovating along the electrical value chain

Power Generation	Power Transmission, Distribution & Smart Grid	Efficient Energy Application	Imaging & In-Vitro Diagnostics

1 Est. market growth (CAGR) **over cycle**

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Siemens Digitalization – Leveraging digital technology trends for concrete customer benefits

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- Collaboration and mobile
- Smart data and analytics
- Cloud technologies
- Connectivity and Web-of-systems
- Cyber-Security

Siemens Digitalization

Improved productivity & time-to-market	Higher flexibility & resilience	Increased availability & efficiency
Design & engineering	**Runtime & operation**	**Maintenance & services**

Combining the virtual & physical world …
… across entire customer value chains

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Customer benefit translates to substantial revenue growth for Siemens – Siemens Digitalization

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Digital services

€0.6 billion revenue in FY15

+15% yoy growth FY15

>300k devices

- Remotely monitored and administered
- Data driven
- Analytics enabled

Vertical software

€3.1 billion revenue in FY15

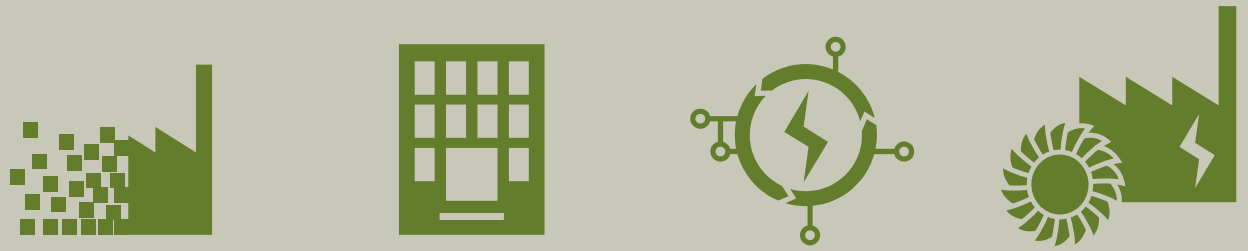
+16% yoy growth FY15

Leading provider across verticals

EnergyIP XHQ Tecnomatix Comos syngo.via NX Teamcenter

Digitally enhanced electrification and automation

#1 automation player in industry, buildings, grids, power plants, and rail



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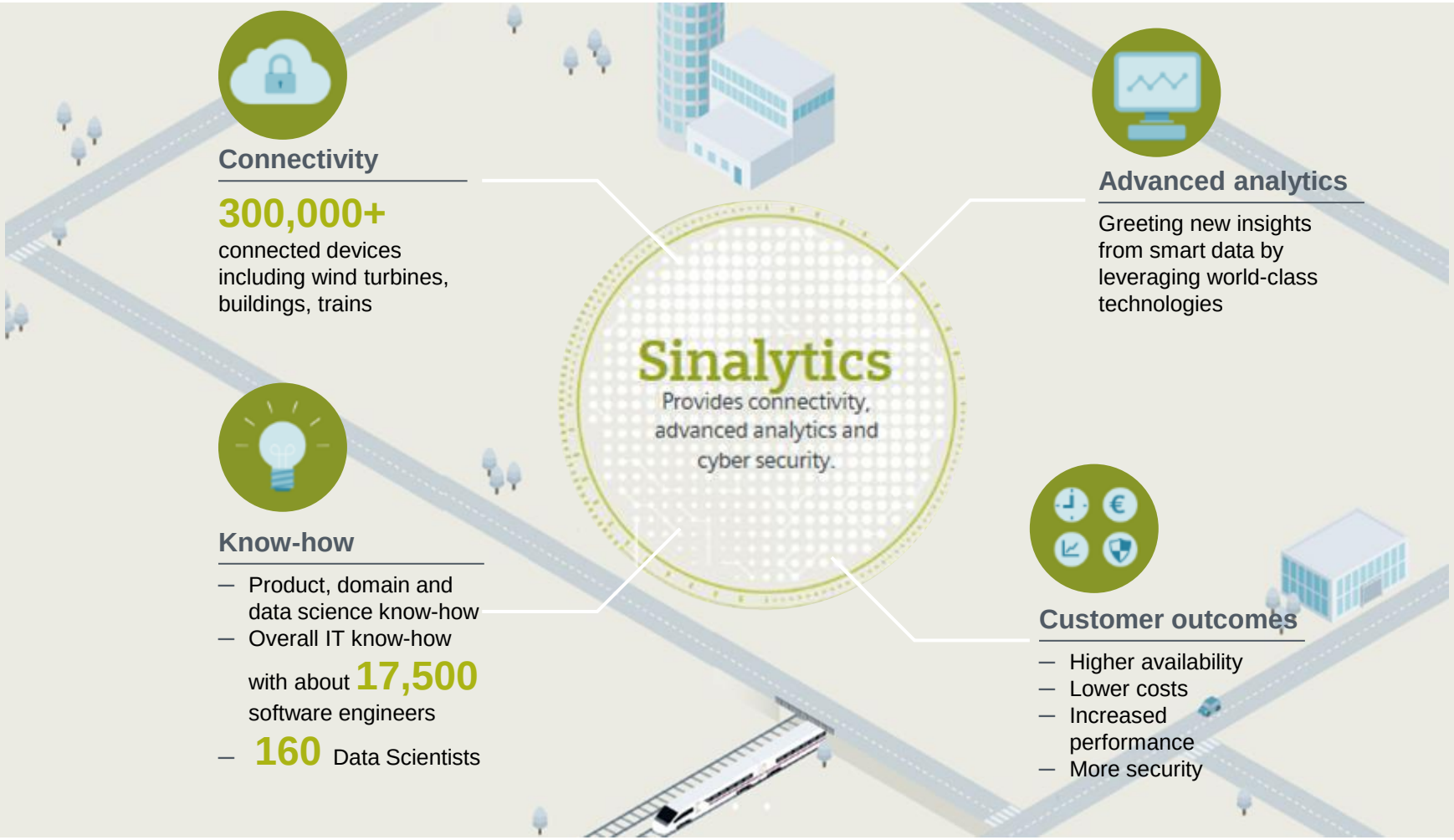
Sinalytics Platform powers Siemens Digital Services



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The Digital Transformation of Services

Powered by Sinalytics

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Classical Time & Material Maintenance → **Performance & Outcome based Contracting** → **Network Platforms**

1. Predictive Maintenance

E.g. Healthcare

Objectives

Prevent unplanned downtime of CT scanners caused by tube failures

2. Performance-based contracts

E.g. Mobility

Objectives

Increase availability and reliability of trains

3. Outcome-oriented contracts

E.g. Power Services

Objectives

Improve customer ROI through flexible service in any market condition

Reactive Maintenance → **Preventive Maintenance** → **Condition-based Maintenance** → **Predictive Maintenance** → **Prescriptive Maintenance**

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Siemens Digital Services Portfolio – Overview

Powered by Sinalytics

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Digital Service

Remote services based on device connectivity

– Data generated by connected devices and transferred for evaluation

Data analytics-enabled services

– Value added by additional insights generated from available data

Network Platforms

– Generation of additional value by bringing experts and data together

Division view (examples)

Power generation, transmission & distribution

PG WP PS EM

– Power Plant optimization, remote support/-operation
– Flex LTP, data-driven upgrades of turbines
– Fleet statistics of power plants and wind farms
– Wind farm optimization
– Performance contracts / consulting
– SCADA, WTC3 and vibration diagnostics
– Remote Monitoring (Switchgear and Transformers)
– Smart Grid Asset performance management / security services
– Smart Grid Asset operation services

Building Technologies

BT

– System performance services
– Building performance / energy optimization services

Mobility

MO

– Smart Guidance
– Smart Monitoring
– Smart Data Analysts
– 3D printing for optimized parts logistics

Digital Factory & Process and Drives

DF PD

– Master Asset Uptime
– Optimize energy performance
– Maximize process efficiency
– Enhance Industrial Cyber security

Healthcare

HC

– Predictive maintenance
– Network platform for diagnostic exchange

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Siemens Digital Services powered by Sinalytics – Combining technology with domain and context know-how for customer value

Powered by Sinalytics

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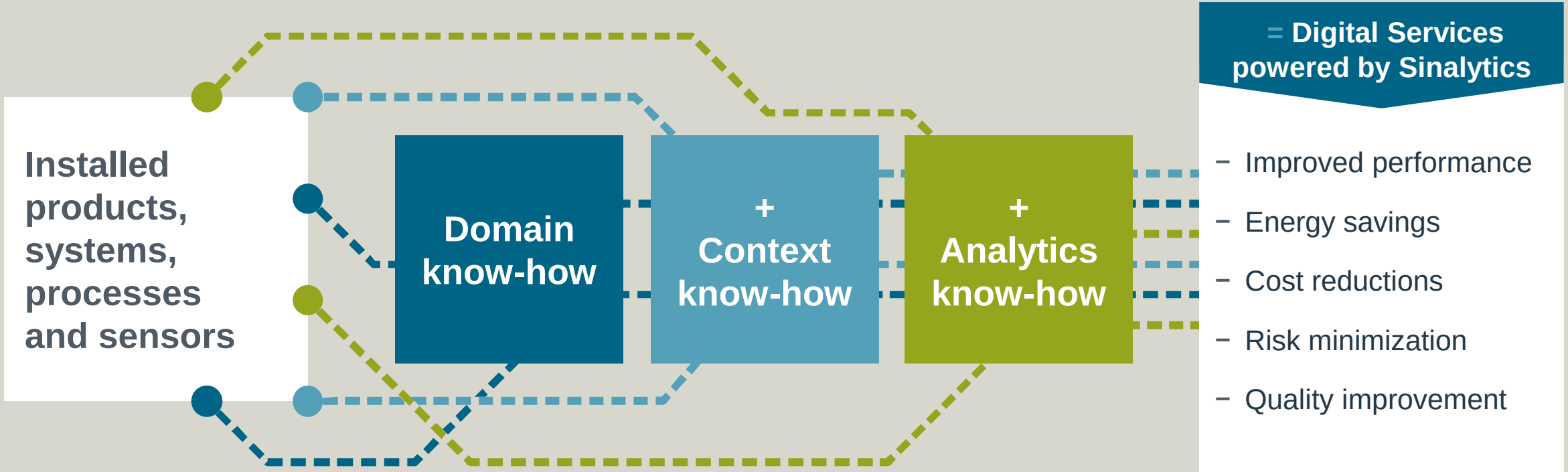
Context of data from installed basis



Data → Data analysis → Information → Options for action → Customer value

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Siemens Digital Services powered by Sinalytics – Example: Predictive maintenance of trains and locomotives

Powered by Sinalytics

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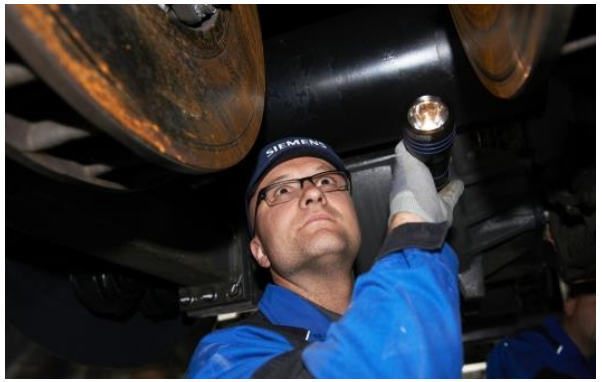
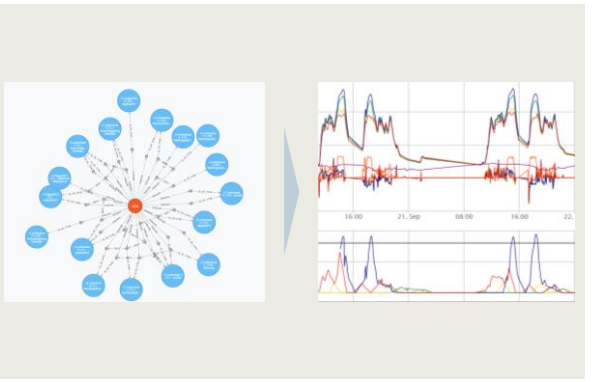
Rail Transport

- Market drivers
- Rail operator challenges
- Rail user demands



Trains/Locomotives

- Rail vehicle engineering
- Mechanical vibrations
- Sensor properties
- Maintenance operations



Data Science

- Pattern identification
- Machine learning
- Automated alert generation

Results

Improved asset availability

Avoidance of unnecessary maintenance

Reduction of maintenance costs

Domain know-how + **Context know-how** + **Analytics know-how** = **Customer value**

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Siemens Digital Services powered by Sinalytics – Example: Optimization of gas turbine operations

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Energy System

- Market drivers
- Customer needs
- Product cycles

Gas Turbines

- Mechanical Engineering
- Thermodynamics
- Combustion chemistry
- Sensor properties

Autonomous Learning

- Neural Networks
- Smart Data Architecture processes data from 5,000 sensors per second

Results

Reduced NOx Emissions

Extension of service intervals

Domain know-how + **Context know-how** + **Analytics know-how** = **Customer value**

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Sinalytics: Our new platform for data-based services

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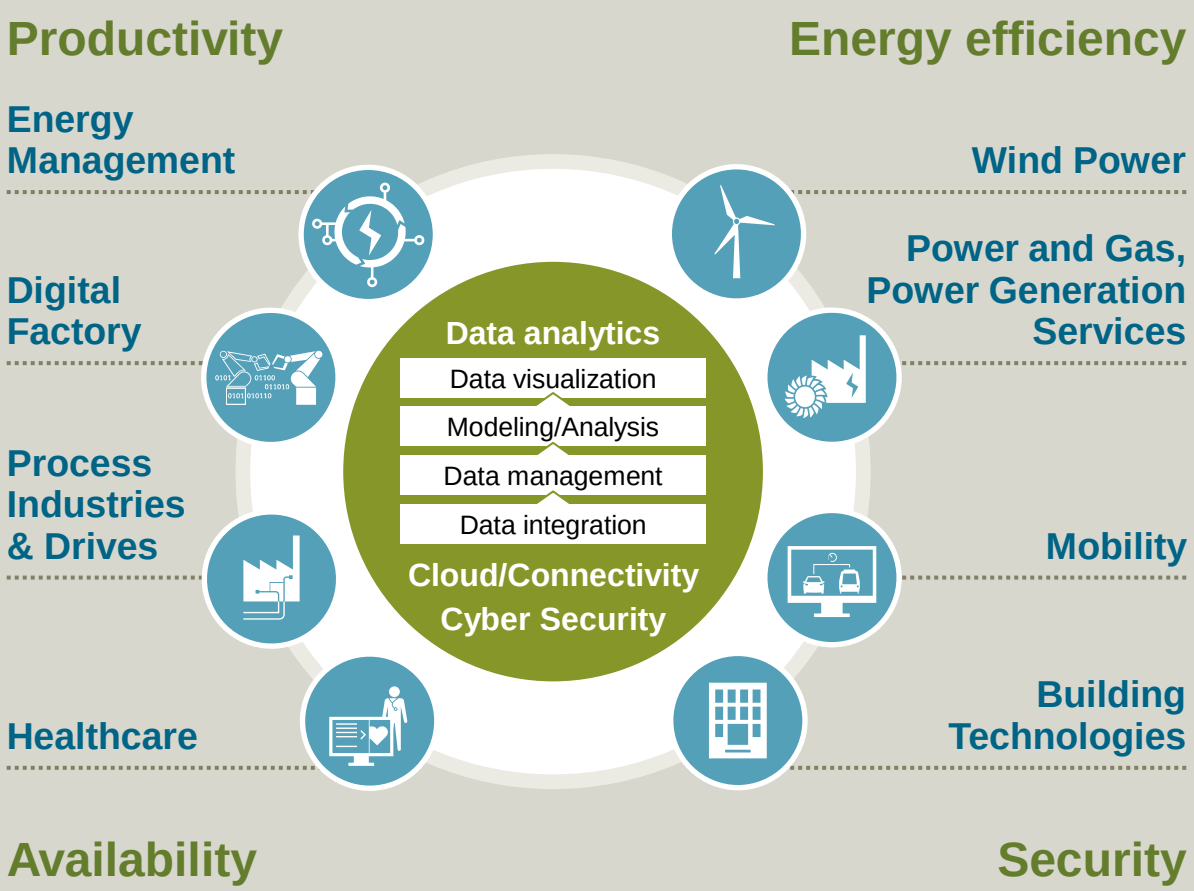

We build on common technology platforms …

+ Latest technology for all Siemens businesses
+ Reduction of technical complexity in the company
+ Leveraging synergies through scaling
+ Faster development

… and use the customer proximity of our operating units to develop applications

+ Know-how regarding large installed bases of products and systems
+ Deep know-how of customer processes and challenges
+ Many existing applications that already generate value for our customers

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Sinalytics builds on a strong technology stack for connectivity, data analytics supported by state-of-the-art cyber security

Powered by Sinalytics

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DF | PD | PG | PS | WP | EM | MO | BT | HC

Mindsphere | EnergyIP | …

Use case 1 | Use case 2 | … | … | … | Use case n

Customizable analytics solution packages

Data presentation

Data analysis

Data management

Data integration

On premise | *Cloud*

Variety of data sources and types

~300,000 devices | cRSP, ISB | ...

Siemens Digital Services

Industry specific Applications/Platforms

Business Unit specific use case implementation

Powered by Sinalytics

Sinalytics

Common data analytics set-up
- Modular analytics solution packages

Common industrial data analytics platform
- Several off-the-shelf tools are available in each layer
- Tools are integrated with each other through “glue code”
- On-premise and cloud deployment possible

Connectivity
- Build on reliable and secure solutions e.g. common Remote Service Platform

Cyber security solutions

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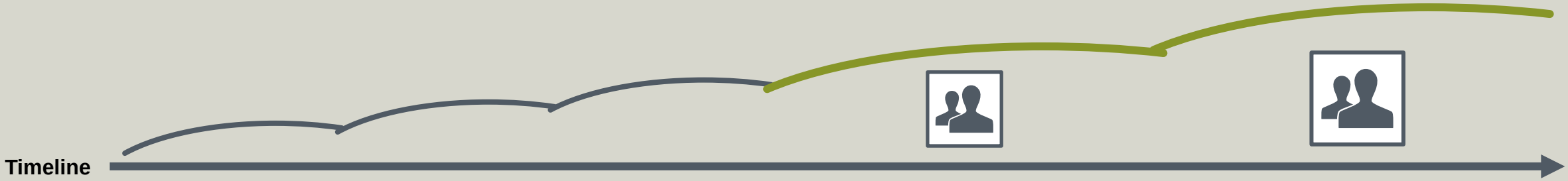
The “Digital Twin” vision promises an ultimate boost in productivity



	Computer aided design	Computer aided engineering	Digitalized PLM processes	“Smart Digital Twin”	“Digital Twin Singularity”
Details	▪ Mechanical 2D drawings ▪ Electronic circuit layout	▪ Mechanical 3D drawings ▪ Electronic design automation	▪ PLM, MES and ERP ▪ Production process and traceability ▪ Plant optimization simulation	▪ **Unification of data structures and tools for combined data models** ▪ **Utilization of field and smart data with regards to methodology, data amount and consistency**	▪ **Complexity of simulation and related IT systems** ▪ **Integration of lifecycle (PLM) data** ▪ **“Closed-Loop” to bring field and smart data back to design**
Main innovation	CAX in design and manufacturing	Simulation software for PCs	PLM/ PDM/ Collaboration software	**Combination of data models**, covering e.g. system description, behavioral description, but also measured field data and **smart data**	**Seamless fusion of data models** with regards to usage and content e.g. mechanical, electrical, software description, but also lifecycle data / **Automatic creation and optimization**

Vision & Challenges

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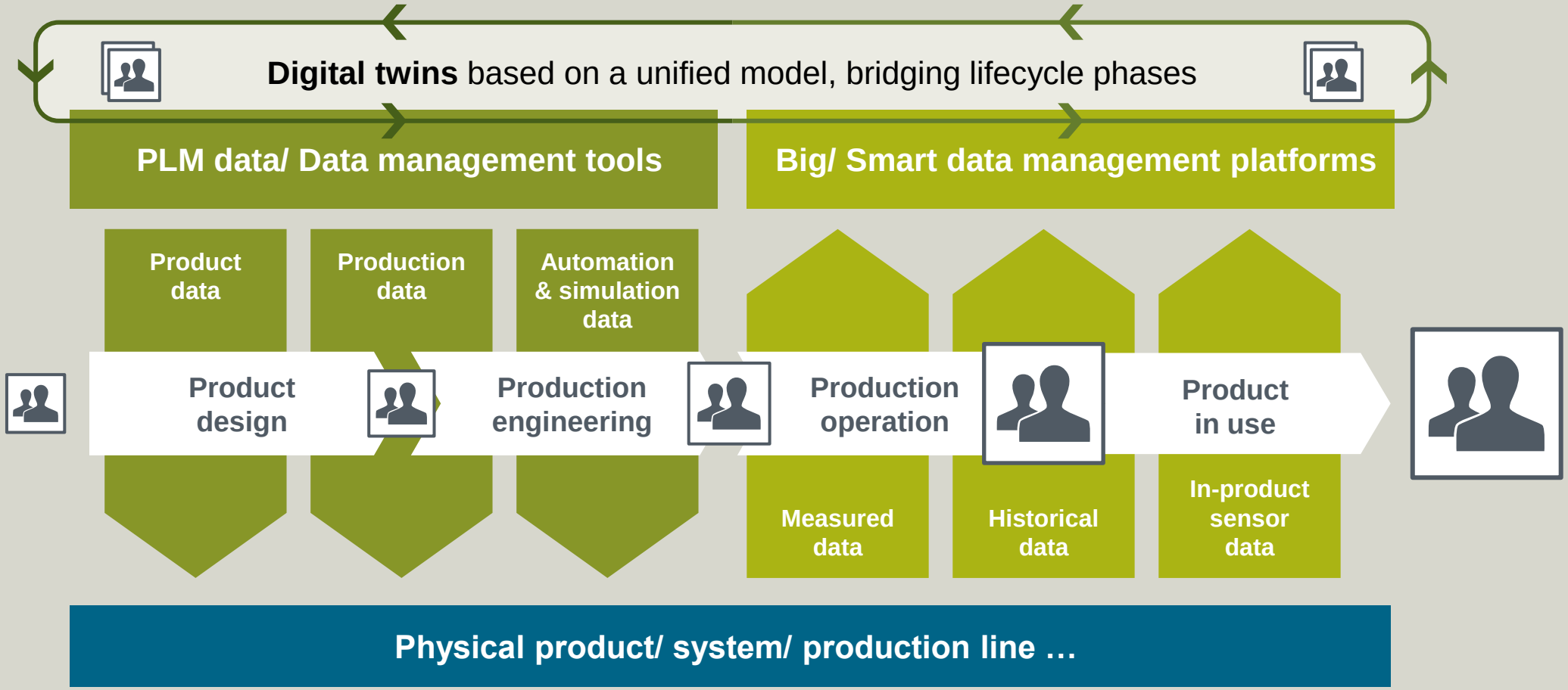
Digital Twin – Close the loop to improve or even “automate” model creation, and to constantly optimize and enrich data models, using field and smart data



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The Digital Twin address products, productions systems, automation systems, but also internal and external “value chain networks”

Digital Twin of Cyber-Physical Production System (CPPS)

Example 1

Digital twin of a production line integrated in a MES to enable decision support (prescriptive) due to upfront simulation of alternative decisions

Example 2

Digital twin of a production line integrated in a machine, automation system or a robot to enable environment simulation for self-coordinating, self-optimizing, autonomous systems

Digital world

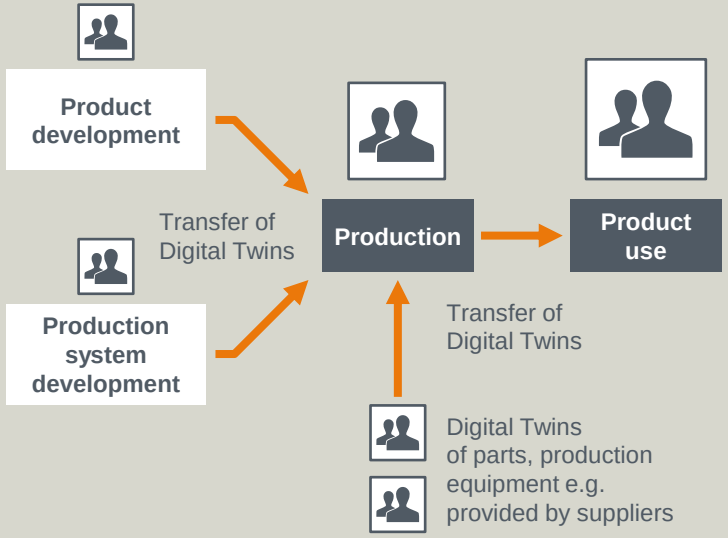
Sync digital and real world

Revolving synchronization of digital and real world in order to mutually optimize, enrich digital twins based on historical data, individual and fleet data as well as engineering and simulation models

Physical world

Digital Twin bridges value chain networks

Digital twins follow the value chain and cross company borders, targeting at a comprehensive integration of data and models from the entire value chain including suppliers



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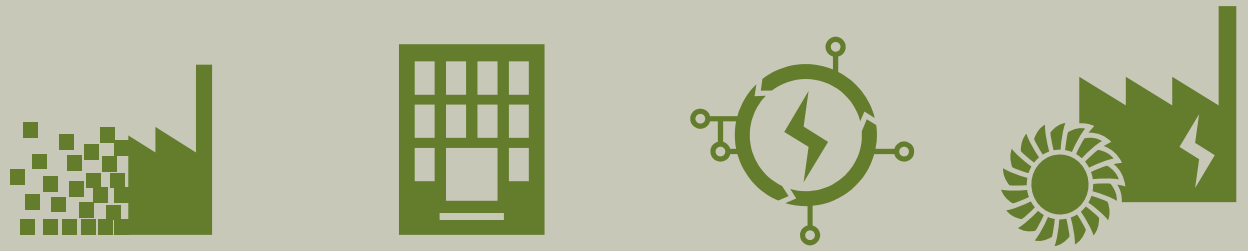

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Siemens leverages the Internet of Things to the needs of our customers in industry and infrastructure

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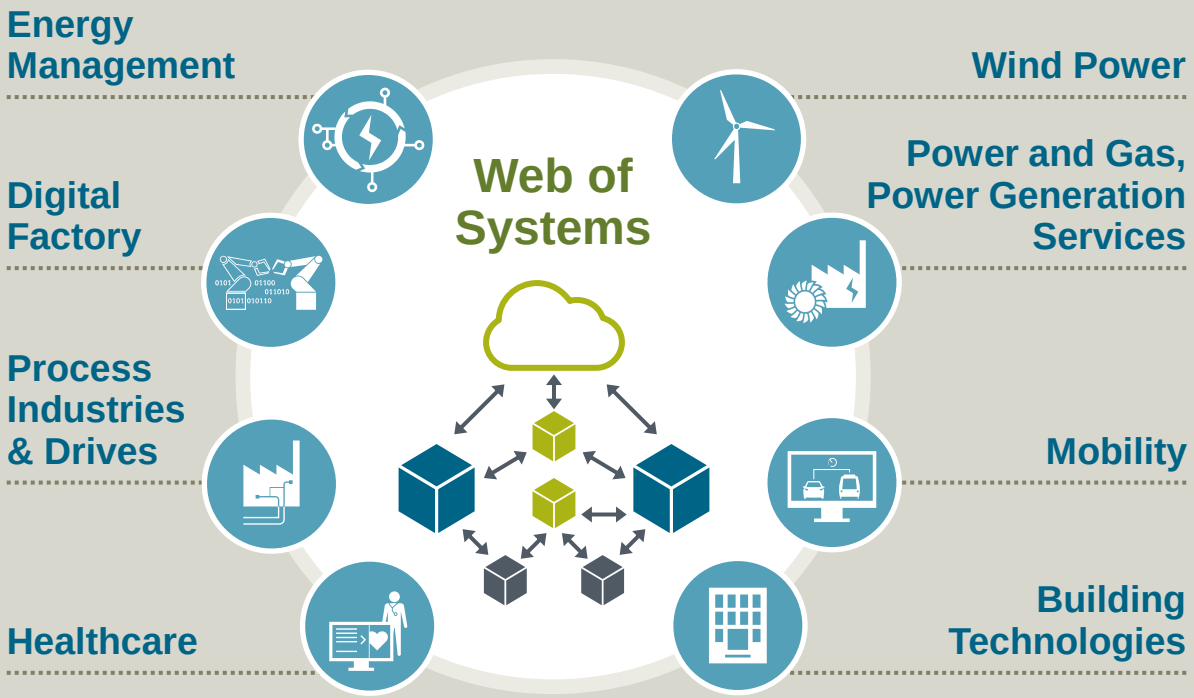

+ The Web of Systems puts devices, machines and their interactions in the center of digitally-networked industries
+ Devices process data locally and make decisions
+ Owners decide what happens with their data
+ Devices organize themselves and communicate with each other
+ New functionalities can be installed as with apps on smartphones
+ The installed base can be digitalized with the Web of Systems
+ Siemens delivers infrastructure and industry solutions characterized by:
  - **Reliability**
  - **Durability**
  - **Data security**

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Web of Systems for distributed autonomous control – Example The Intelligent Secondary Substation in a Smart Grid

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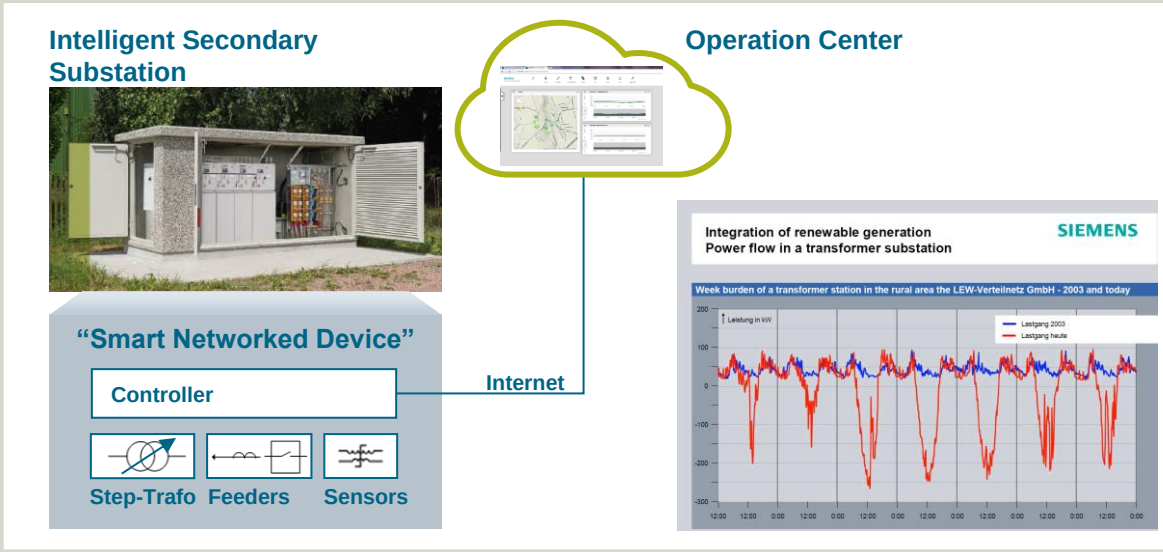

"Intelligent Secondary Substation for reliable, stable and cost efficient Smart Grids"

- **Smart Devices:** Local control (e.g. voltage control) using attached sensors & actuators, plug-and-play device2cloud connectivity (e.g. for grid management, monitoring, data analytics)
- **App-powered devices:** Dynamically add features (e.g. control, metering, monitoring, add-on services) and keep ISS "fresh"
- **Interacting Devices:** Mesh network of ISSs for fast fault localization and self healing, decentralized operation coordination
- **Cross domain integration:** interlinked infrastructures of smart grid, power network and buildings

+ **Minimized Engineering Effort:** Plug-and-Play capabilities, remote software update and feature enhancements, asset monitoring

+ **Reliable system operation at lower cost:** Supervised autonomous local control enables reliable and stable Smart Grid operation although making use of highly cost efficient but unreliable Internet connections to the operation center

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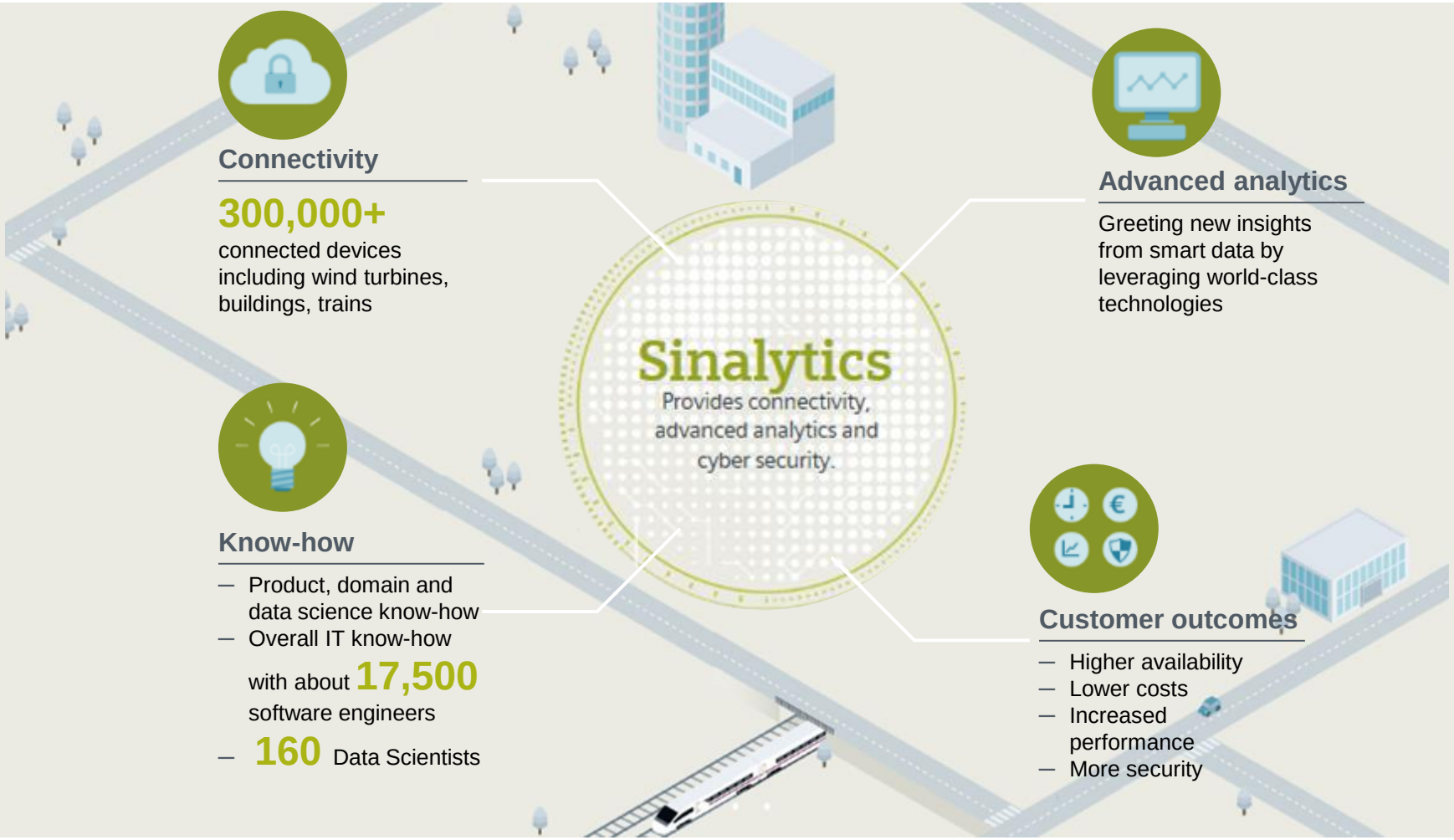
Questions and Answers



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