Resources for a Connected World
FEBRUARY 24 – 27, 2019 · DENVER, COLORADO

SME
2019 SME ANNUAL CONFERENCE & EXPO

CMA
COLORADO MINING ASSOCIATION
CMA 121st NATIONAL WESTERN MINING CONFERENCE

SIEMENS
Ingenuity for life

New trends in Material Handling: Autonomous operation of stockyard machines and smart drive applications

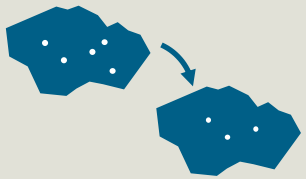
Christian Dirscherl

Restricted © Siemens AG 2019

Five fundamental drivers in Mining

SIEMENS
Ingenuity for life

Lower Grade



- Continuously decreasing average ore grade
- Less large high quality deposits

Go deeper

- From open pit to underground mine
- New underground operation

HSSE

- Health, Safety and Security in harsh environment
- Awareness of environmental care
- Lack of skilled talents

Costs

- CAPEX efficiency
- OPEX reduction
- Organizations and processes optimization
- Standardization

Output

- Increasing ore recovery
- Asset Efficiency & Reliability
- Production and Resources efficiency

- **Increased productivity and output by optimized** processing
- **Long plant lifecycles** with highly **fragmented data landscape**
- **Continuous, safe, secure and reliable** operations

Restricted © Siemens AG 2019

SMART MINING

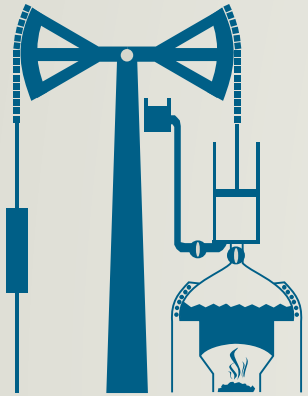
The Digital (r)Evolution

SIEMENS
Ingenuity for life

Siemens has been at the forefront since the beginning of the Industrial Revolution

1st Industrial Revolution

Water & Steam

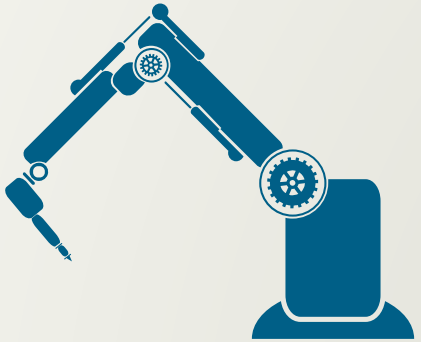


2nd Industrial Revolution

Electrification

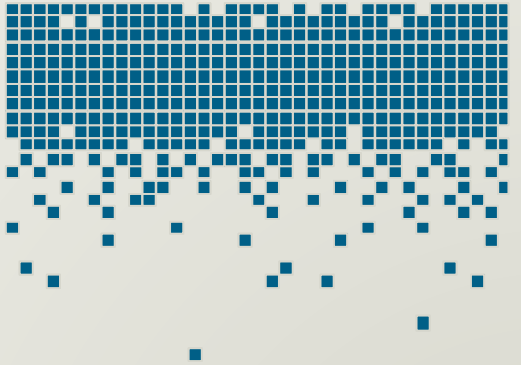
3rd Industrial Revolution

Automation



4th Industrial (r)Evolution

Digitalization



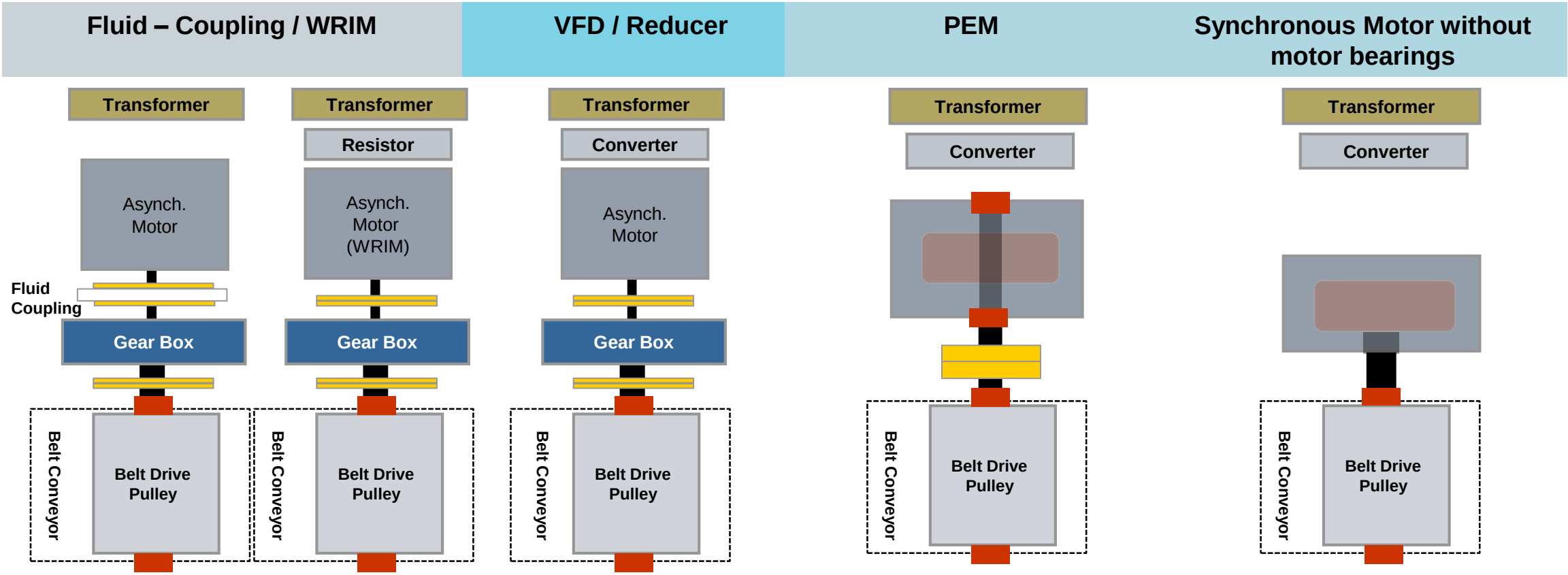
Digitalization is still being defined…

Restricted © Siemens AG 2019

SMART MINING

Smart Drive Applications

SIEMENS
Ingenuity for life



Sensors: e.g. temperature sensors, vibration sensors, air gap sensors
for gearboxes, motors, bearings, foundations, electrical equipment, cooling systems

Restricted © Siemens AG 2019

SMART MINING

Asset Health Analytics for Conveyors
Introduction

SIEMENS
Ingenuity for life

Asset Health Analytics is:

- a software platform for Condition monitoring extended with Forecast abilities

- focused on (a) securing and (b) improving the machine/ process operations

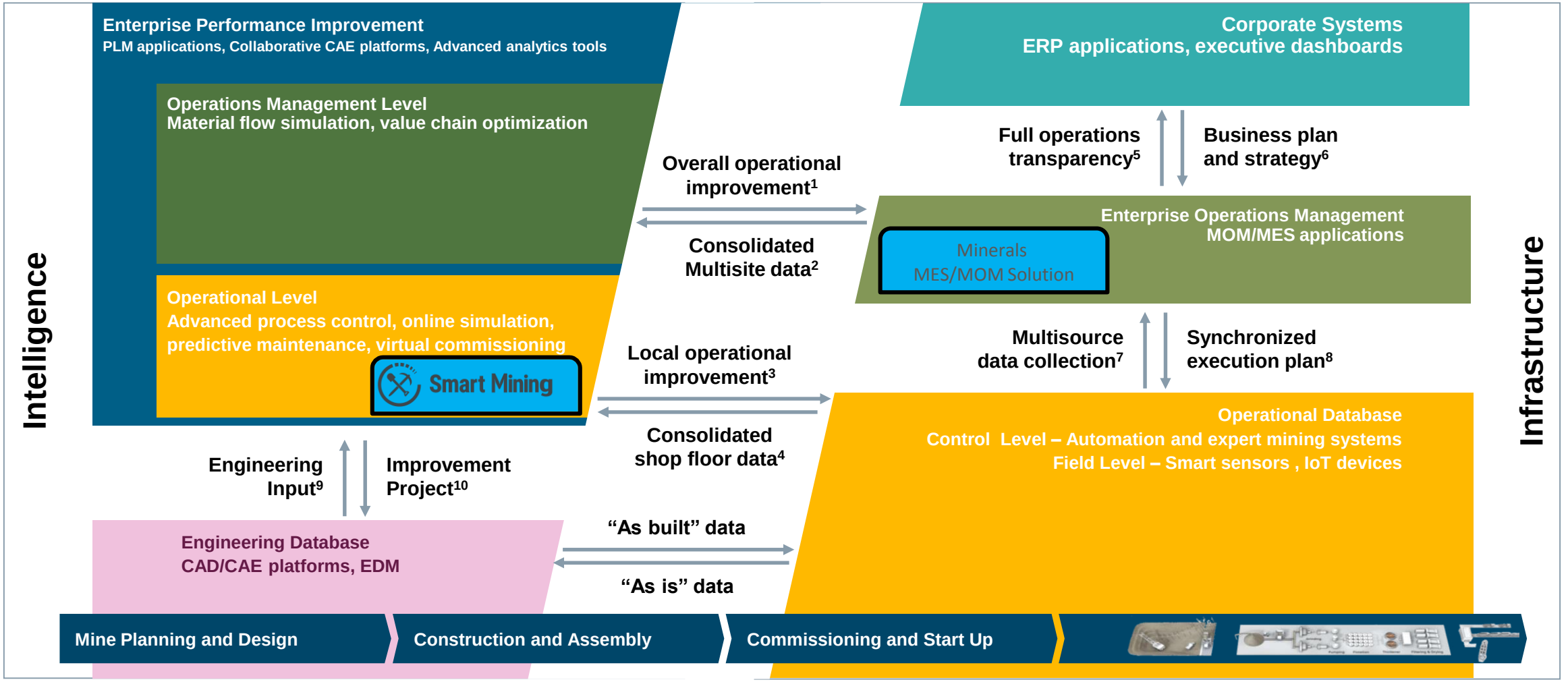
- consisting of four modules:

I.	Monitor equipment condition incl. data pre-processing	Field
II.	Data storage („historian“, „data-base“)	Cloud
III.	Analytics (compare/ solve/ AI etc.) of machine/ process real data	Cloud
IV.	Information (graphic & message) to the user (machine/ process operator as well as expert)	Cloud

Restricted © Siemens AG 2019

Minerals Digital Architecture Concept

SIEMENS
Ingenuity for life



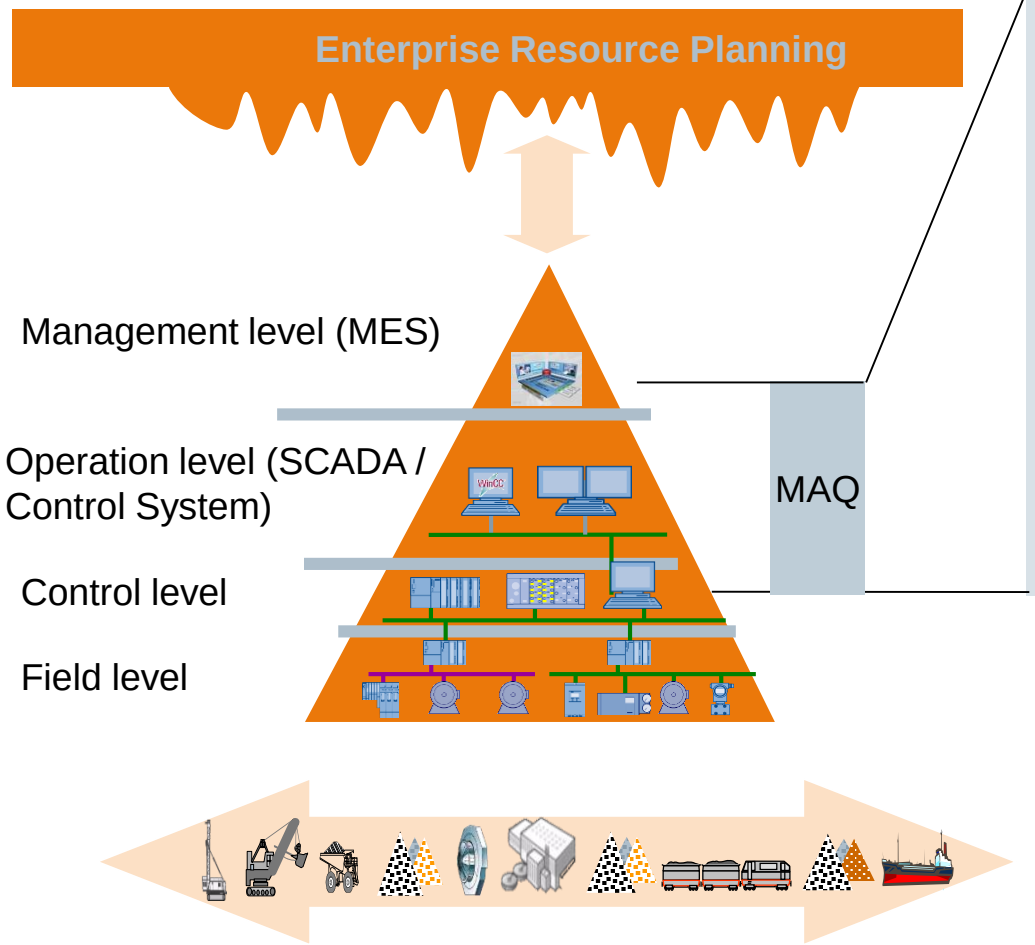
1 E.g. planning, advisement; **2** E.g. production points, logistics infrastructure, stock availability; **3** E.g. set-point, configuration, training, inspection plan); **4** E.g. process data, equipment health; **5** E.g. Real-time production KPIs, stock availability per site;
6 E.g. sales orders/forecast, operational targets; **7** E.g. Pit-to-port, multisite, multisystem; **8** E.g. Control command, schedule, work instruction, training plan; **9** E.g. process and equipment design and datasheet; **10** E.g. conceptual model, innovation program, R&D output

Restricted © Siemens AG 2019

SMART MINING

Advanced Stockyard Management System
SIMINE MAQ

SIEMENS
Ingenuity for life



What is MAQ?

- Located between CONTROL & MES level
- **Advanced bulk material handling system** for ports, power plants, steel plants, open pit mines and other bulk material sites:
  - **Material and quality tracking and monitoring**, including material blending & separation and adjustment of delivery rates to upstream processing
  - **Real time material inventory**,
  - **Driver- (man-) less** machine operation including stacking & reclaiming methods (coneshell, chevron, bench reclaiming, other) , so called **"MOM"**
  - **With a precise 3D – stockyard image,**

MAQ :

- Is **highly modular** designed and **easily adaptable** to **different** transport **technologies**
- prepared for **heterogeneous automation systems** (various brands installed at different points of time)
- Qualified for **green field projects** as well as for **modernizations** venture
- Combining many years of **experiences in bulk material** management with **state-of-the-art IT- technology**

Restricted © Siemens AG 2019

SMART MINING

SIMINE MAQ
Autonomous Operation of Stockyard Machines

SIEMENS
Ingenuity for life

Autonomous operation

- Stockyard machines (e.g. Stacker/Reclaimer/…) for fully autonomous operation
- Material Tracking
- 3D Imaging through mathematical model in combination with 2D/3D sensors
- Collision protection

Benefits of Autonomous Operation

- Simulation and forecasting of material flow
- Material and Quality Management
- Blending of different qualities
- Increased Safety
- Machine wear & abrasion will be decreased by e.g. avoiding of overloading → reduced maintenance costs

Restricted © Siemens AG 2019

SIEMENS
Ingenuity for life

Reference LEAG, Germany

Fully Autonomous Stockyard for Stockyard Power Plant Boxberg

- Stockyard equipped with 4 autonomously operating stackers/reclaimers including belt conveyor system and fully automated train loading
- Material and Quality management including blending
- In operation since 2009

SMART MINING

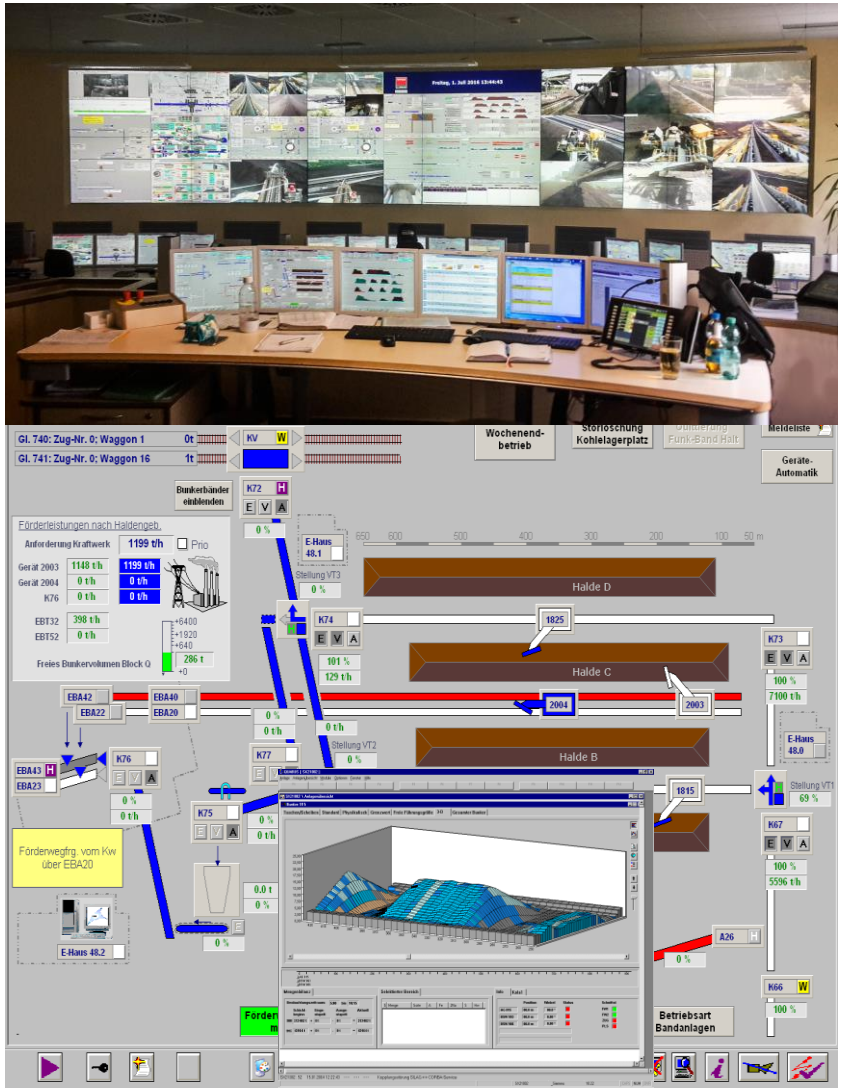
Reference Boxberg
Fully automated stockyard

SIEMENS
Ingenuity for life

Description

- Manual and automatic operation of transport equipment, like conveyor belts, including selection of transport routes
- Adjustment of delivery rate to stockyard and train loading
- **Material tracking** (quantity and quality)
- **High resolution 3D image**
- Separation & **Blending** calculation
- **Reconciliation by 2D or 3D scanning**
- **Full automation – driverless operation - of Stacker and Reclaimer equipment including job management**
- Stacking & reclaiming methods like Coneshell, Chevron, advanced block stacking or bench & long travel reclaiming
- Full collision avoidance system
- Simulation system of coal handling

2 different pits with different coal qualities



Coal Power Plant

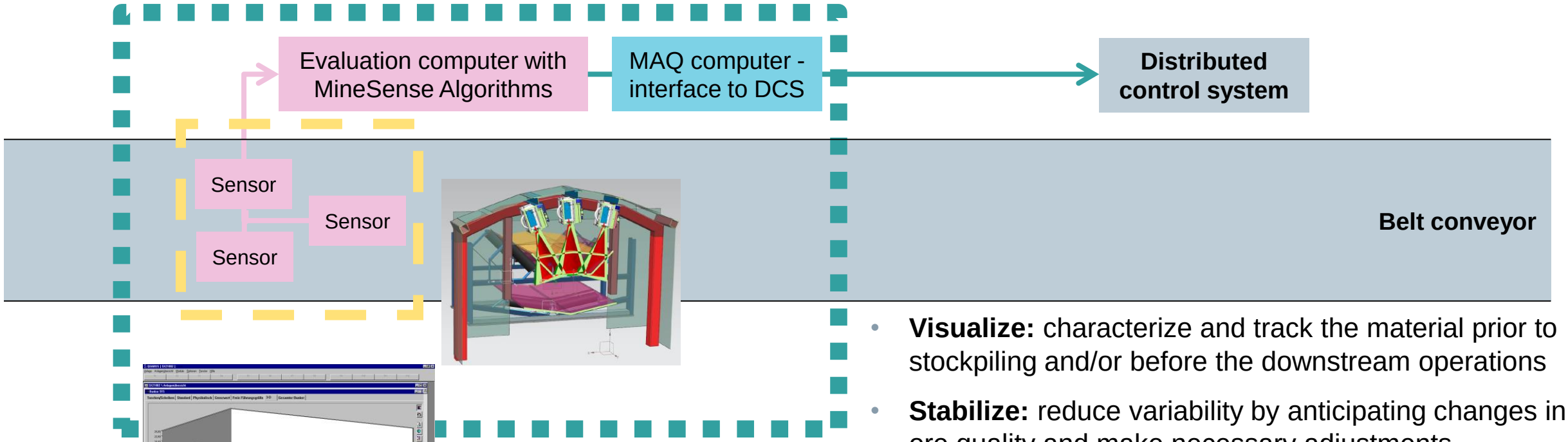
Train Loading Station

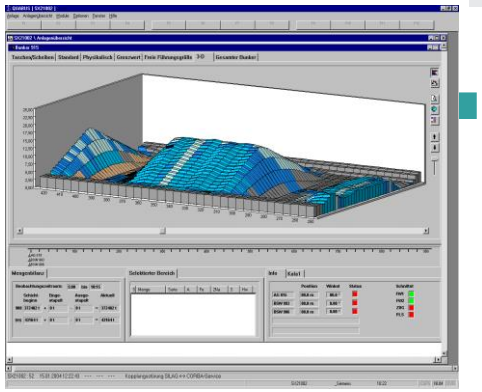
SMART MINING

Restricted © Siemens AG 2019

SIMINE MAQ powered by MineSense - Real-time measurement of ore grade & characteristics for conveyors

SIEMENS
Ingenuity for life





- **Visualize:** characterize and track the material prior to stockpiling and/or before the downstream operations
- **Stabilize:** reduce variability by anticipating changes in ore quality and make necessary adjustments – improves recoveries and better for equipment (e.g. variable ore hardness)
- **Optimize:** deploy advanced blending / stockpile recovery algorithms and strategies to optimize recoveries and overall economics

Restricted © Siemens AG 2019

SMART MINING

Benefits
Higher availability, increased safety, lower OPEX, increased production

Summary Smart Mining

- More intelligence (Fingerprint Analysis, Mathematical Models, Artificial Intelligence)
- Autonomous Operation
- More real time data available, higher transparency

→**Potentials to improve processes/applications**

Thank you for your participation!

SIEMENS
Ingenuity for life

Christian Dirscherl
Vice President for Mining,
Excavation & Transport
Siemens AG
Schuhstr. 60
91052 Erlangen
Germany
christian.dirscherl@siemens.com
Cell: +49 173 3866126

www.siemens.com/mining

Restricted © Siemens AG 2019

SMART MINING