Digitalisation in Steel Industry,

current situation and future trends

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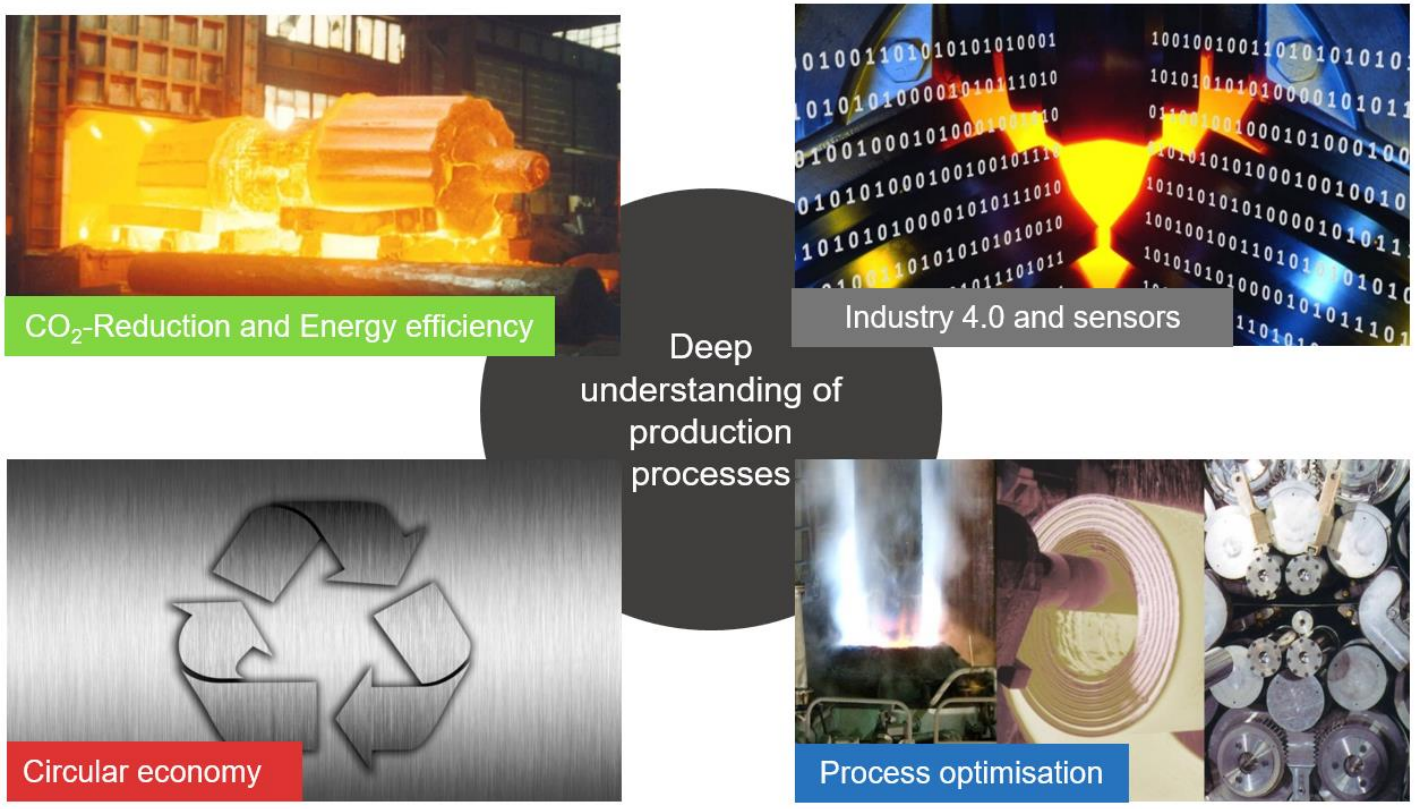
BFI Excellence in Applied Research | VDEh-Betriebsforschungsinstitut GmbH

Stahl

VDEh-Betriebsforschungsinstitut GmbH

- **non-profit** organisation
- **applied research** driven by concrete production topics
- **steel** and other **process industries**
- app. 100 employees
- **research**, **development**, **services** around steel production (like measurements, etc.)
- located in Duesseldorf, Germany

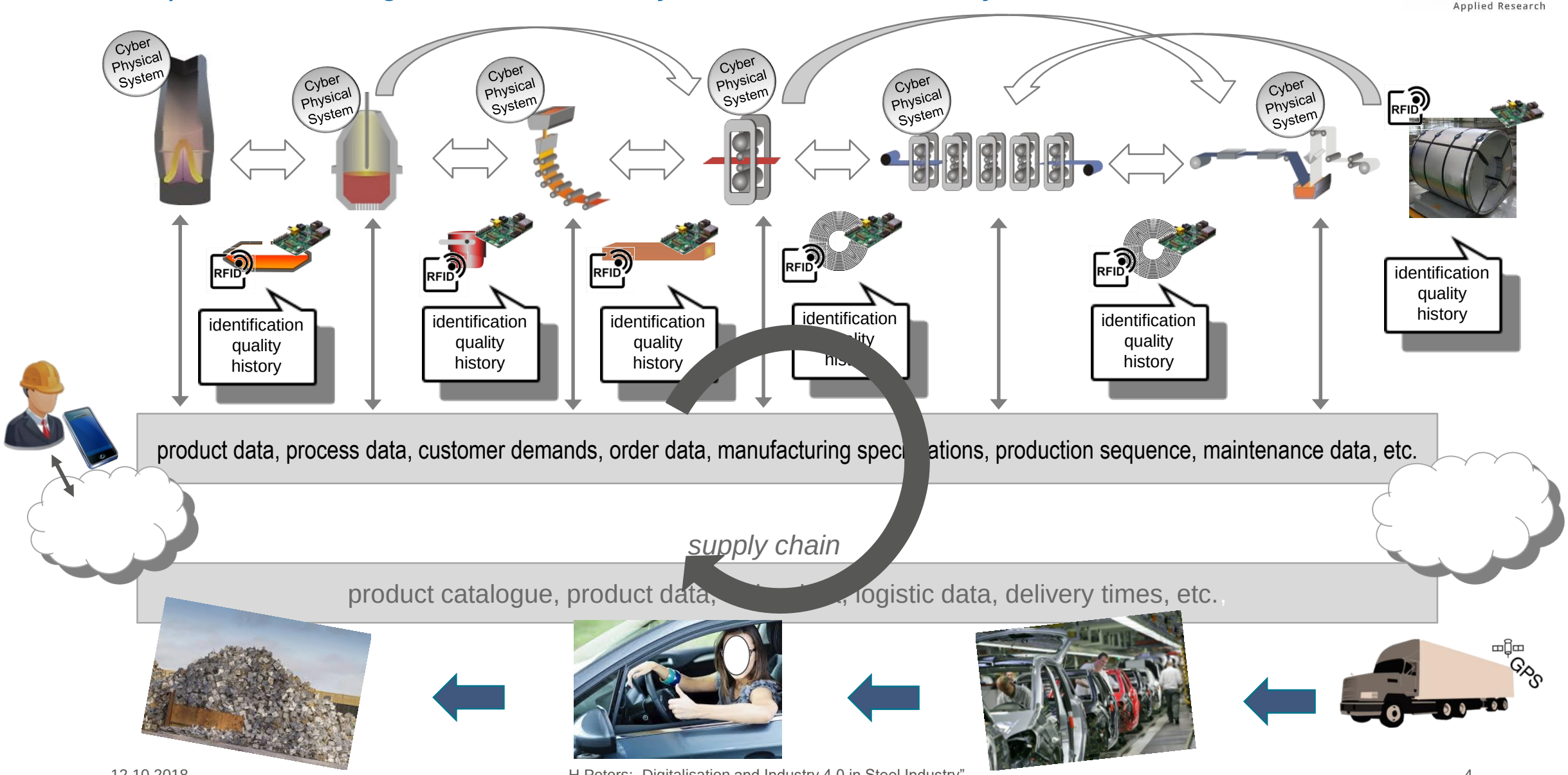


Statement I

"Digitalisation is a pre-condition for Industry 4.0,

but Industry 4.0 is **much more** than digitalisation!"

Interpretation of Digitalisation/Industry 4.0 for Steel Industry



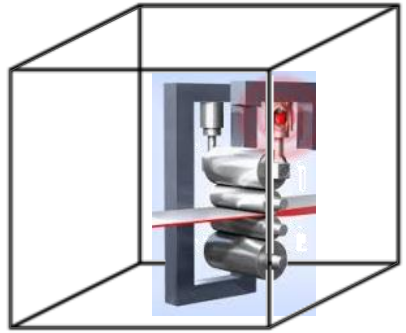
Interpretation of Digitalisation / Industry 4.0 for Steel Industry

- Single plant as Cyber Physical Production System (CPPS, **vertical integration**)
- **100% traceability** of intermediate and final products
- „Intelligent“ product with knowledge of its own quality and production history (one aspect of **end-to-end engineering**)
- Intensive networking and communication of all plants (**horizontal integration inside company**)
- Intensive communication along the complete supply chain (**horizontal integration outside company**)
- Suitable handling and usage of **all data**
- De-central instead of central solutions / **self-organisation**

What is a „Cyber Physical System“?

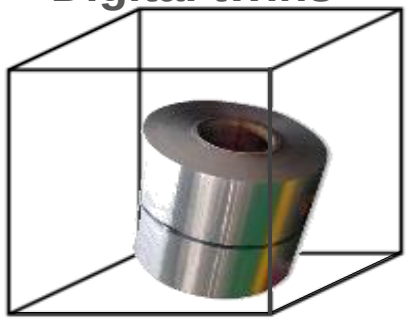
„…merging of information processing with physical processes“

- IT-systems directly **embedded** in the technical process,
- Integration of processes among themselves by **information flows**,
- **Interaction** of the technical process with its environment,
- **Learning functions** to adapt technical processes and IT-systems.



Digital twins

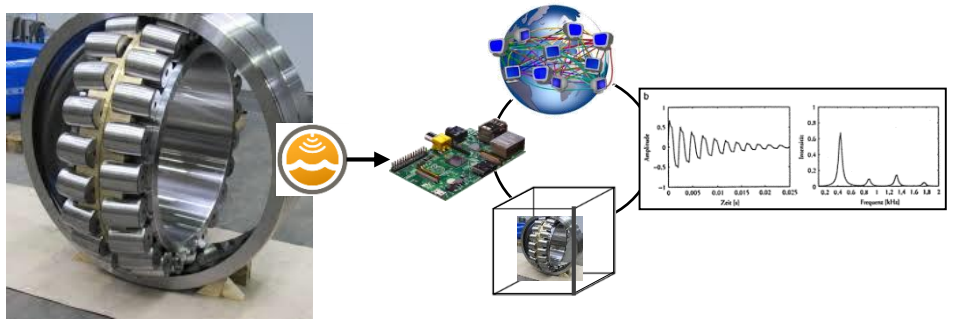
- mechanics
- electrics
- automation
- IT + Software
- maintenance
- HMI
- identification



- identification
- quality / process data
- production history
- customer demands
- models, algorithms
- “intelligence”
- …

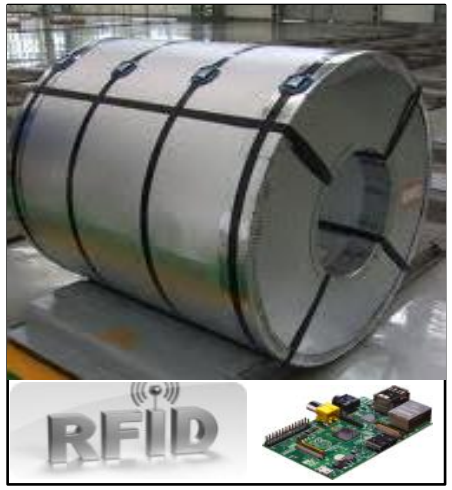
Possible “Cyber Physical Systems” in Steel Industry

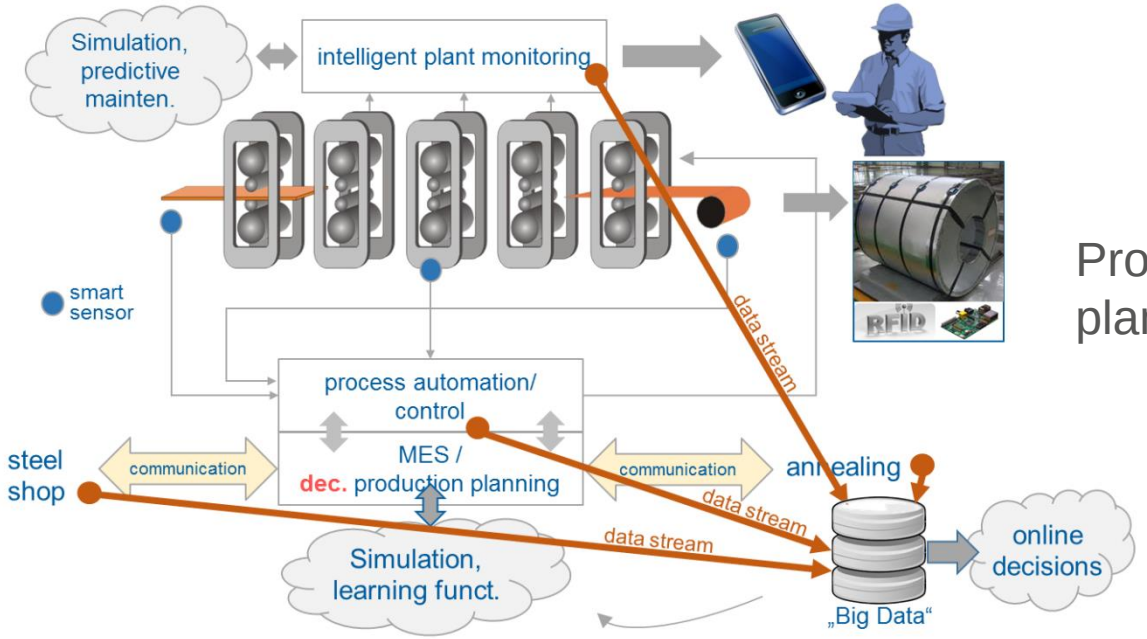
Assistance systems



Plant component

Product





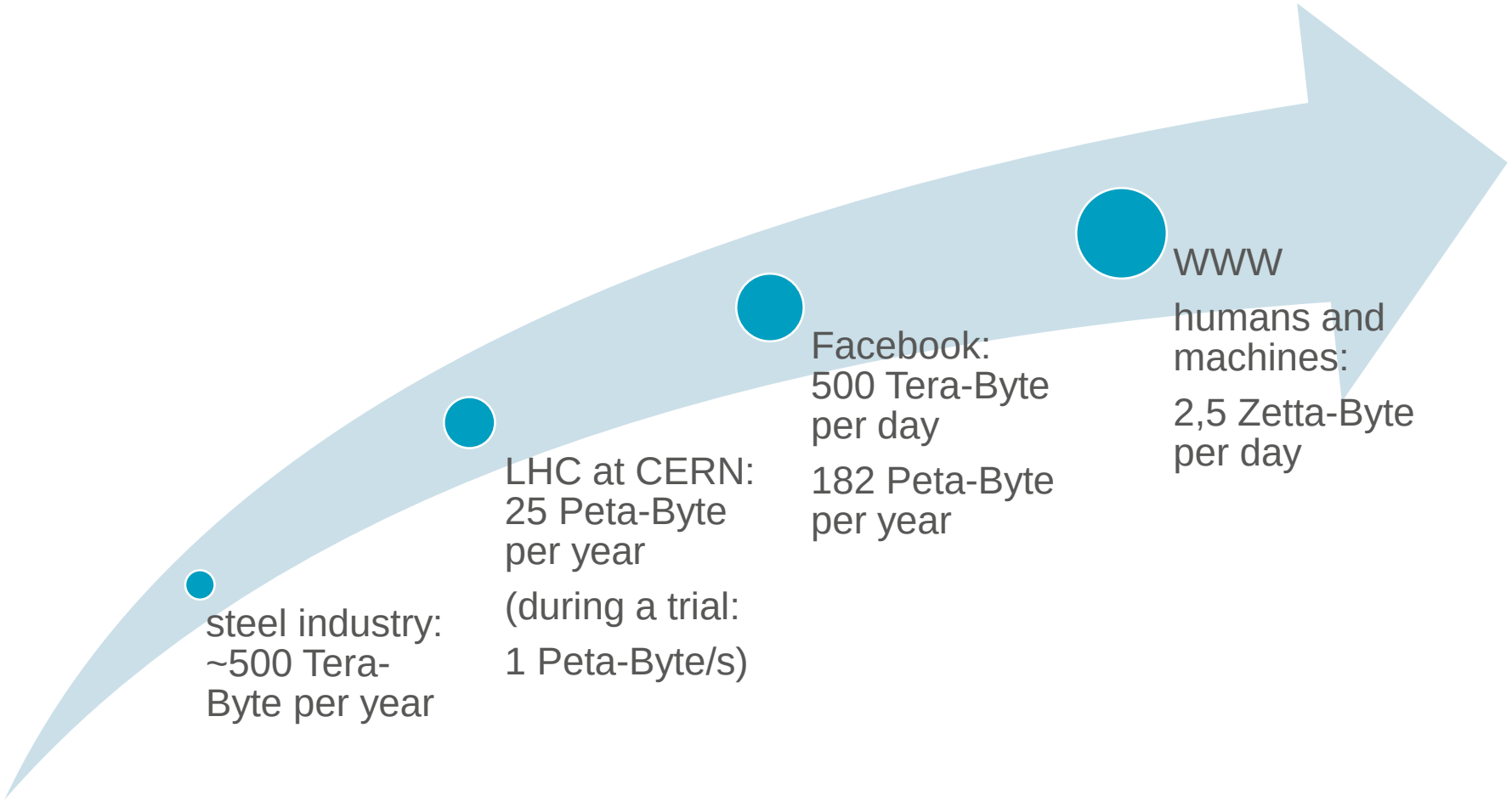
Production plant

Statement II

From the aspect of volume we **don’t** have Big Data in Steel Industry……

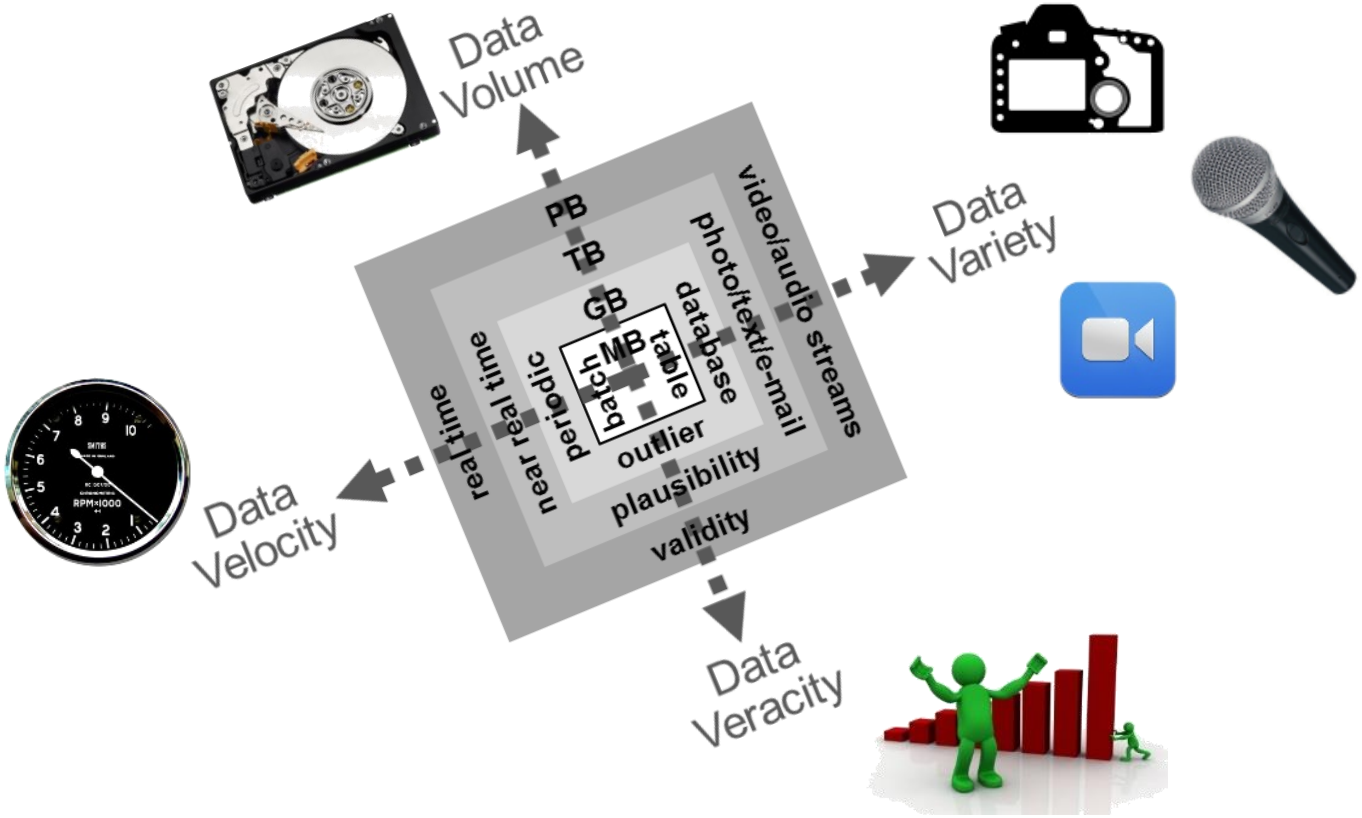
nevertheless, the application of **Big Data technologies** makes very much sense in many applications in Steel Industry!

“Big Data”, here: amount of data



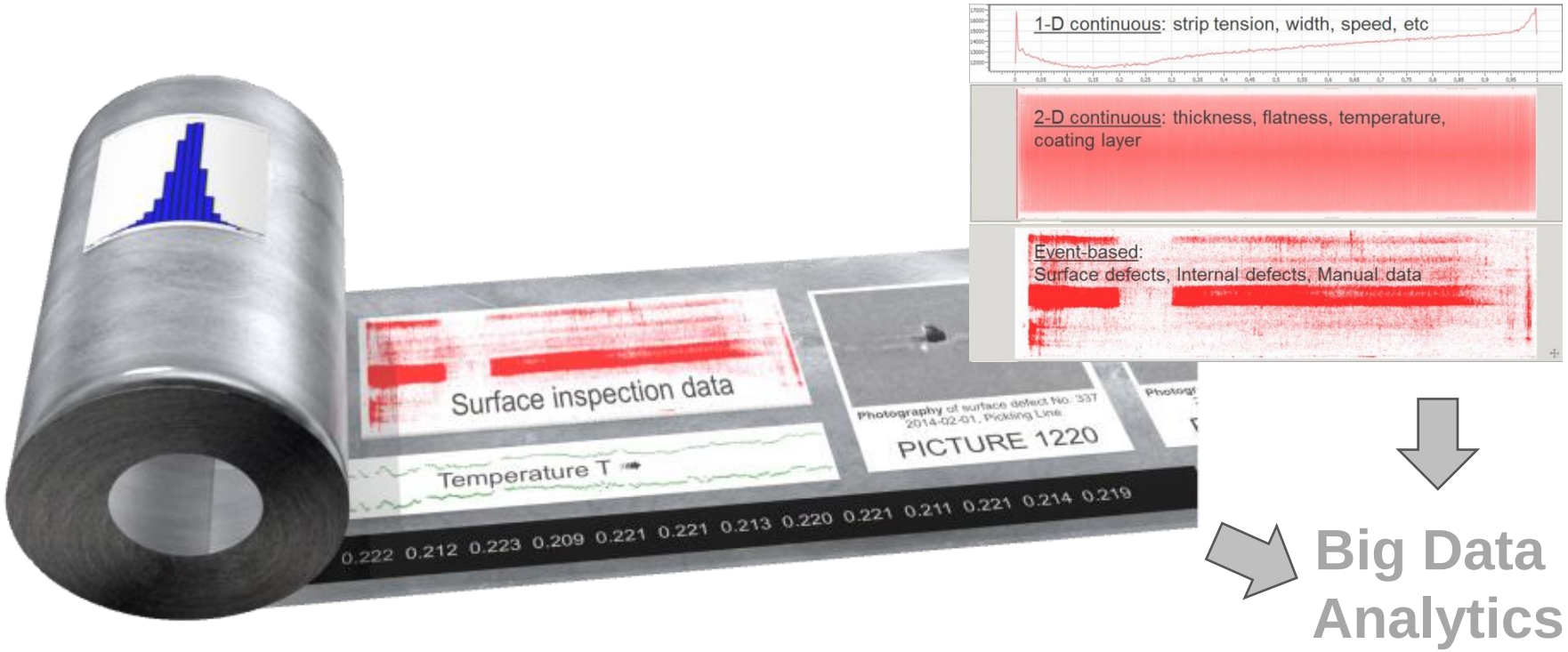
Tera: 10^{12} Peta: 10^{15} Exa: 10^{18} Zetta: 10^{21} Yota: 10^{24}

Big Data /Smart Data



„Big Data means the analysis of large amounts of data coming from different sources with high speed and with the aim to create economic benefit“ (BITKOM)

Big / Smart Data in Steel Industry



- **High resolution** and synchronised data
- Transition to more-dimensional data („spatial“) instead only 1D
- Integration of text data, video-/audio-streams, data with gaps (**unstructured**)
- Fast processing and **„online“-usage** of result

Statement III

Cyber Physical Systems, horizontal / vertical integration, end-to-end engineering are only techniques to realise digitalisation.

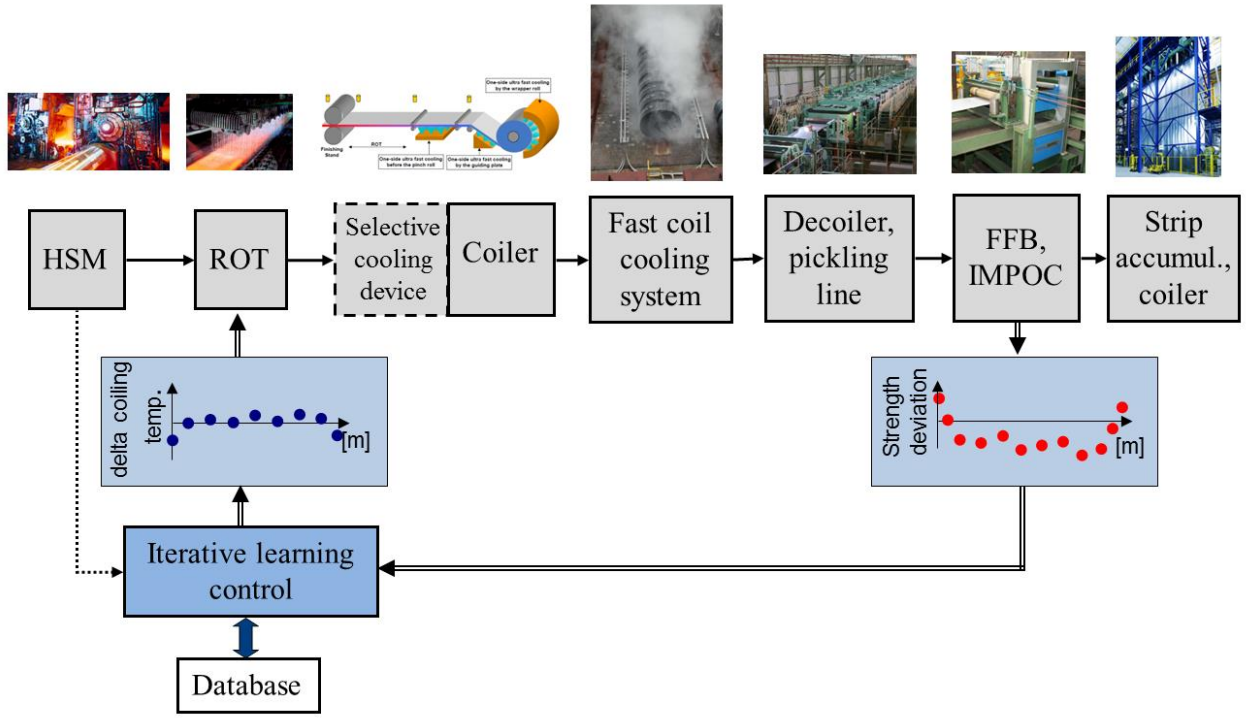
Now we need suitable applications running in such digitalised factories only then we can realise “Industry 4.0 / Smart Factory”!

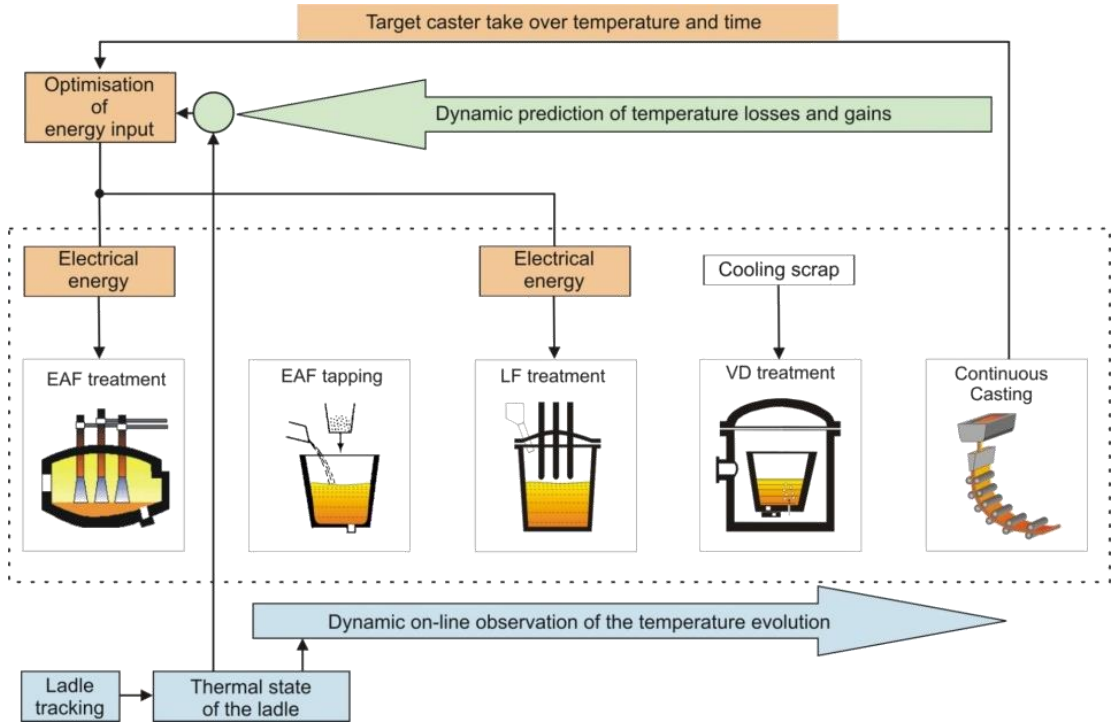
Possible application areas for Industry 4.0

- Smart control of process chain (through-process automation)
- Fast detection of cause&effect relationships
- Through-process quality control
- Self-organised production
- Smart assistance systems
- ...

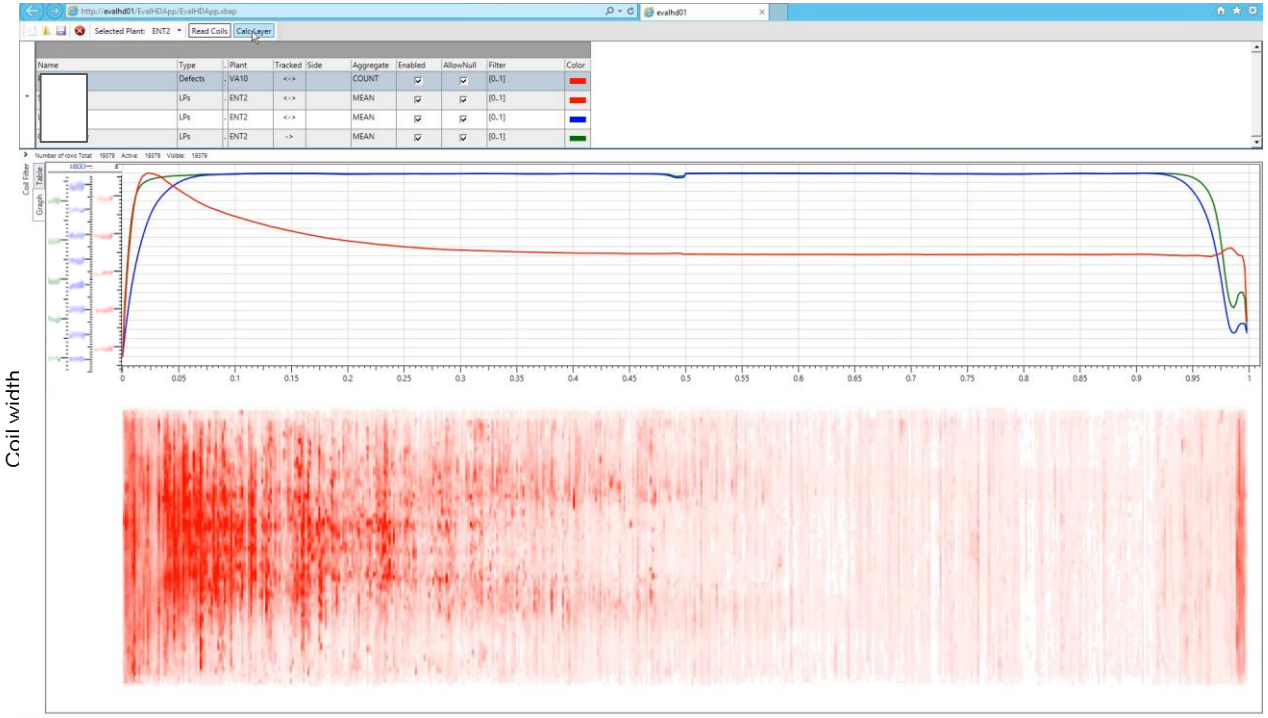
Now: examples of BFI projects!

Smart control of process chain





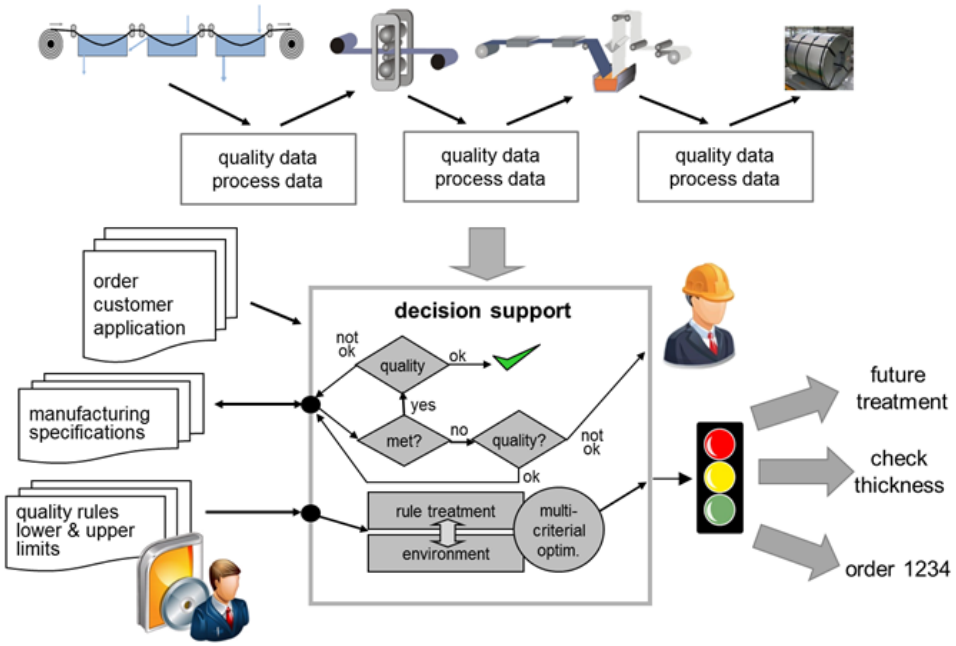
Fast detection of cause&effect relationships

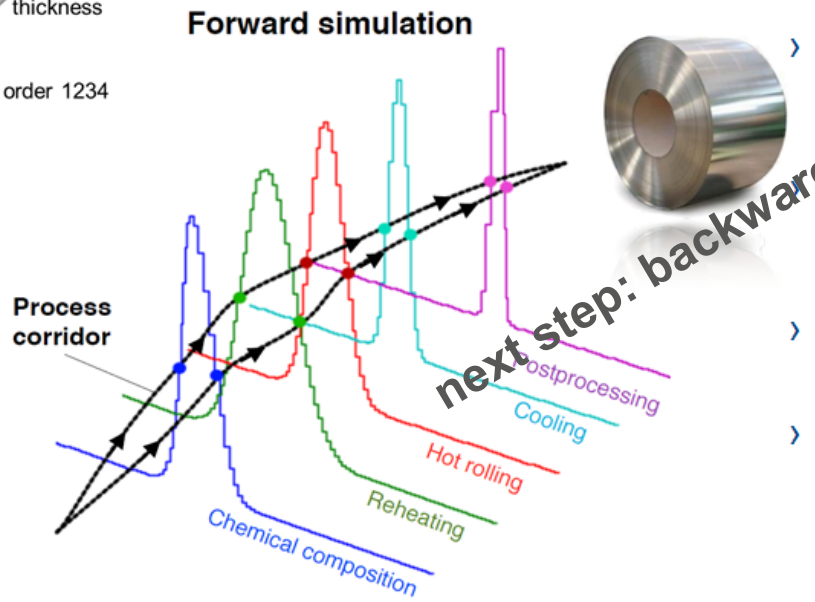


New approach:

- **High resolution time series analysis** plus **enriched data** as basis for Data Mining
- Product-oriented data via **NoSQL**
- **Machine Learning** approach („deep learning“)+ **expert knowledge** for labeling

Through-process quality control

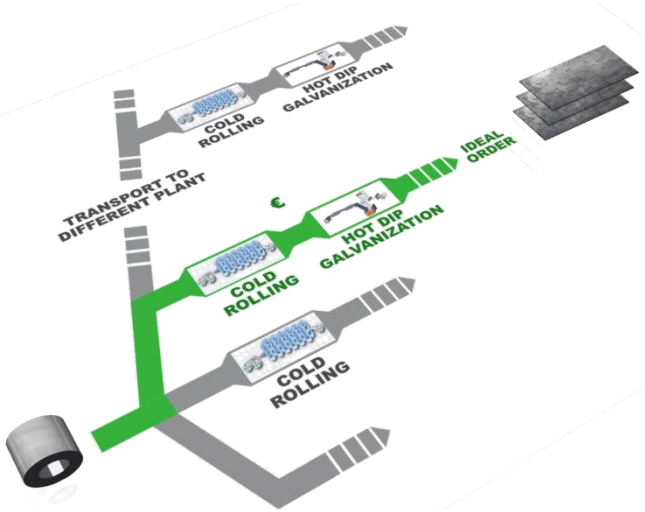


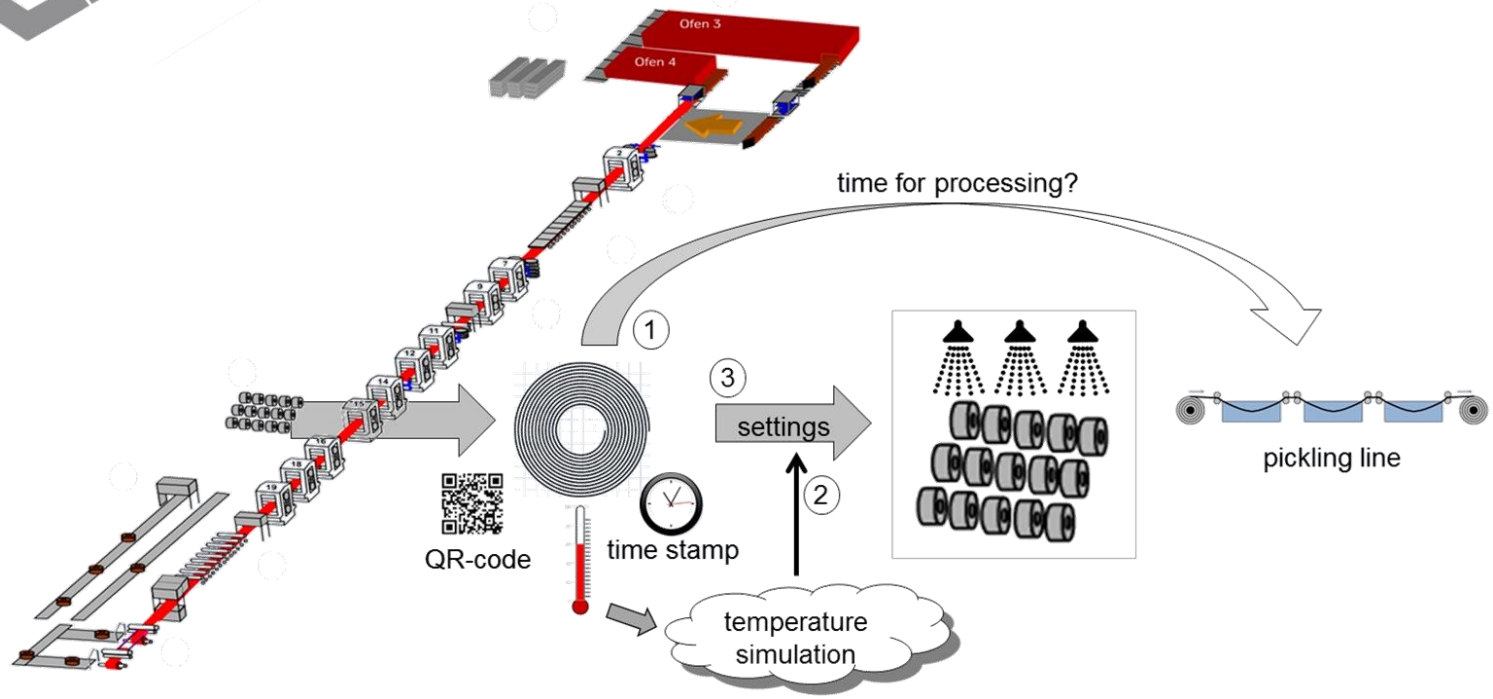


next step: backward simulation

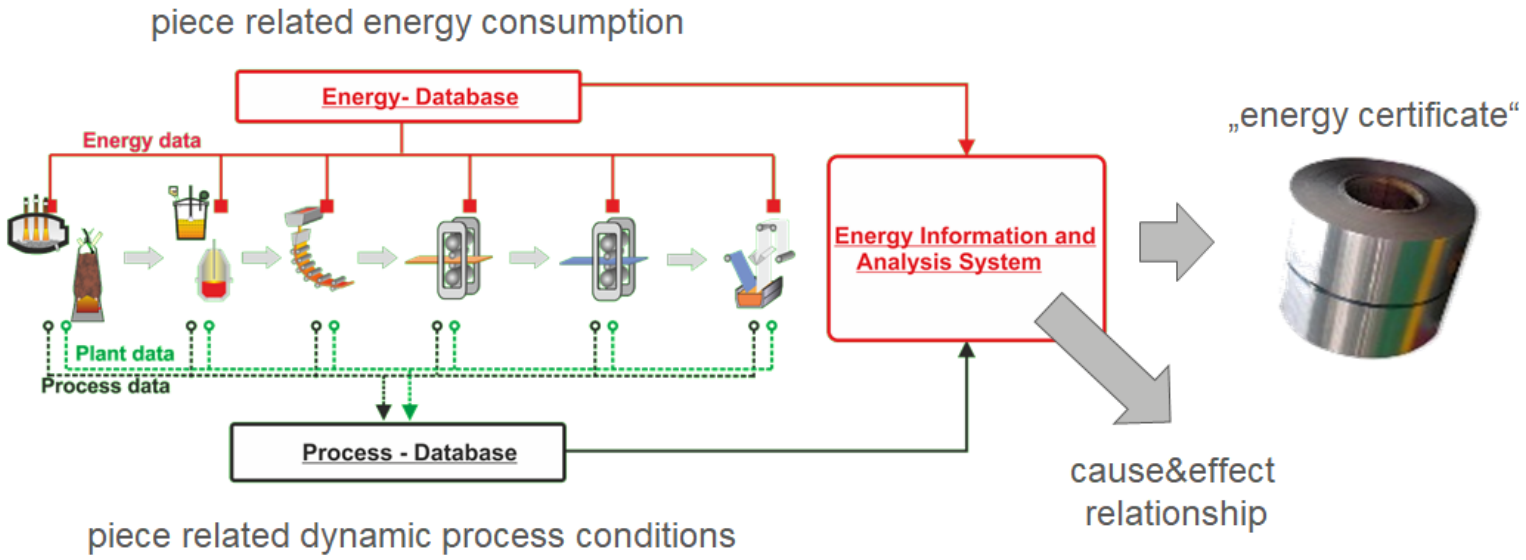
- Detection, that a product has left the foreseen quality corridor
- Dynamic re-scheduling to an alternative process route / alternative process setups
- Forward modelling of process chain
- Selection of best suitable models to predict product properties
  - 1st Principle Models
  - stochastic models
  - data driven / statistical models

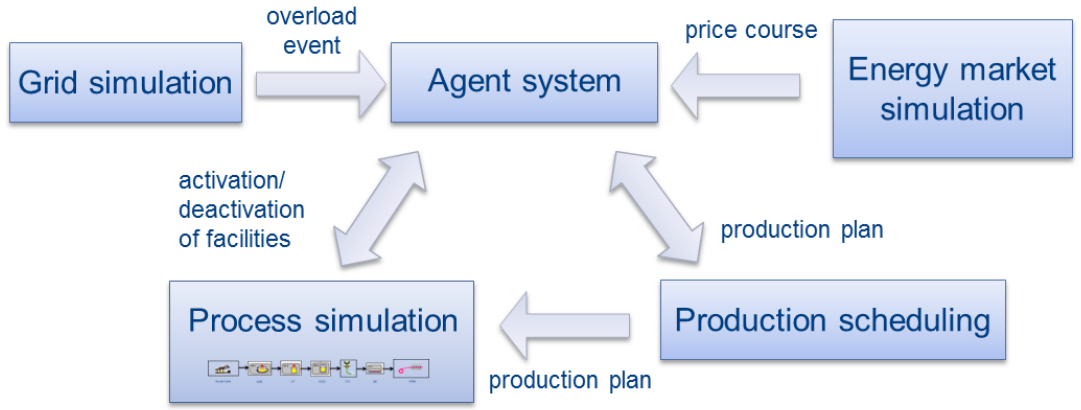
Self-organised production





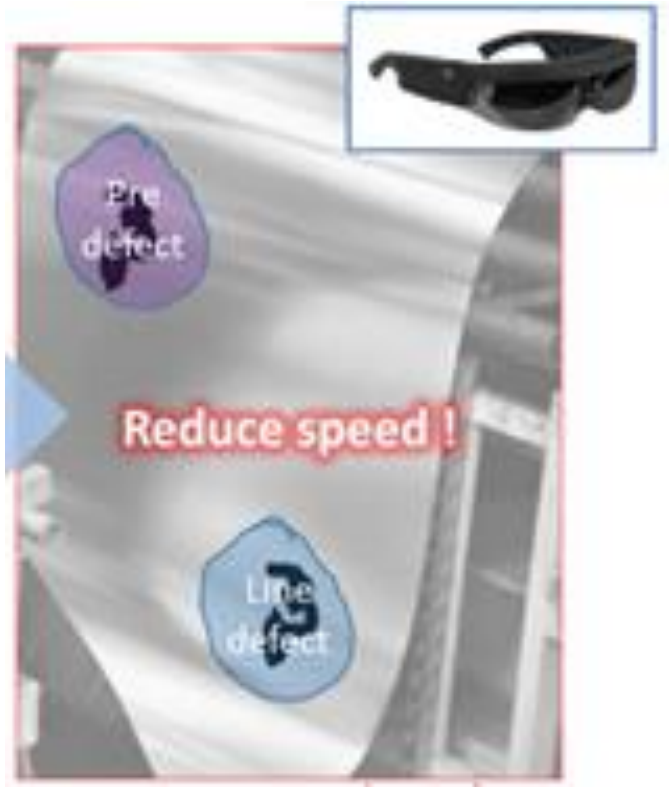
Applications for reduction of energy consumption





Smart assistance systems

- **Autonomous** flying Multicopter monitors gas pipelines by **CO-leckage sensor**
- 3D-camera allows the **automatice** navigation of the multicopter **very near** to the pipes and avoids collisions
- Support of maintenance people by application of **high resolution pictures** from all perspectives
- Improvement of **human safety** by CO-monitoring



Conclusions

- Digitalisation is a necessary **pre-condition** for Industry 4.0 ….
- … but **Industry 4.0** is much more than **Digitalisation**
- Industry 4.0 is more a **paradigm / philosophy** than a technology
- The main job is now to find the best applications for Industry 4.0 with the **largest possible effort** for the process industries

Many thanks for your attention!