AVEVA PI WORLD

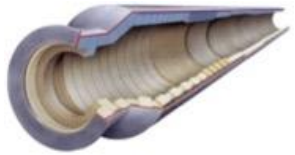
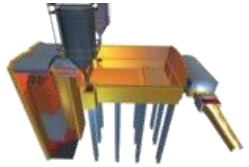
Connected Machines

Using Data from Refractory Application Machines

Presented By: Alexander Platzer

RHIMagnesita: World Leading Refractory Supplier

Taking innovation to 1200 °C and beyond.

		Typcial Applications	Refractory Lifetime	Portfolio Impact
Steel		Basic oxygen-, electric arc furnace casting ladles, tundishes	20 minutes to 2 months	60%
Cement		Rotary Kiln	1 year	8%
Non-Ferrous metals		Copper Converter	1 – 10 years	10%
Glass		Glass Furnace	Up to 10 years	7%
Energy/ Environmental/ Chemicals		Secondary reformer	5 – 10 years	15%

Typical refractory Volume p.a.

2.9 mio tons

Revenue (2020)

€2.3bn

Adjusted EBITA margin (2020)

11.5%

Connected Refractory Application Machines are the link between the refractory business and digitalization.

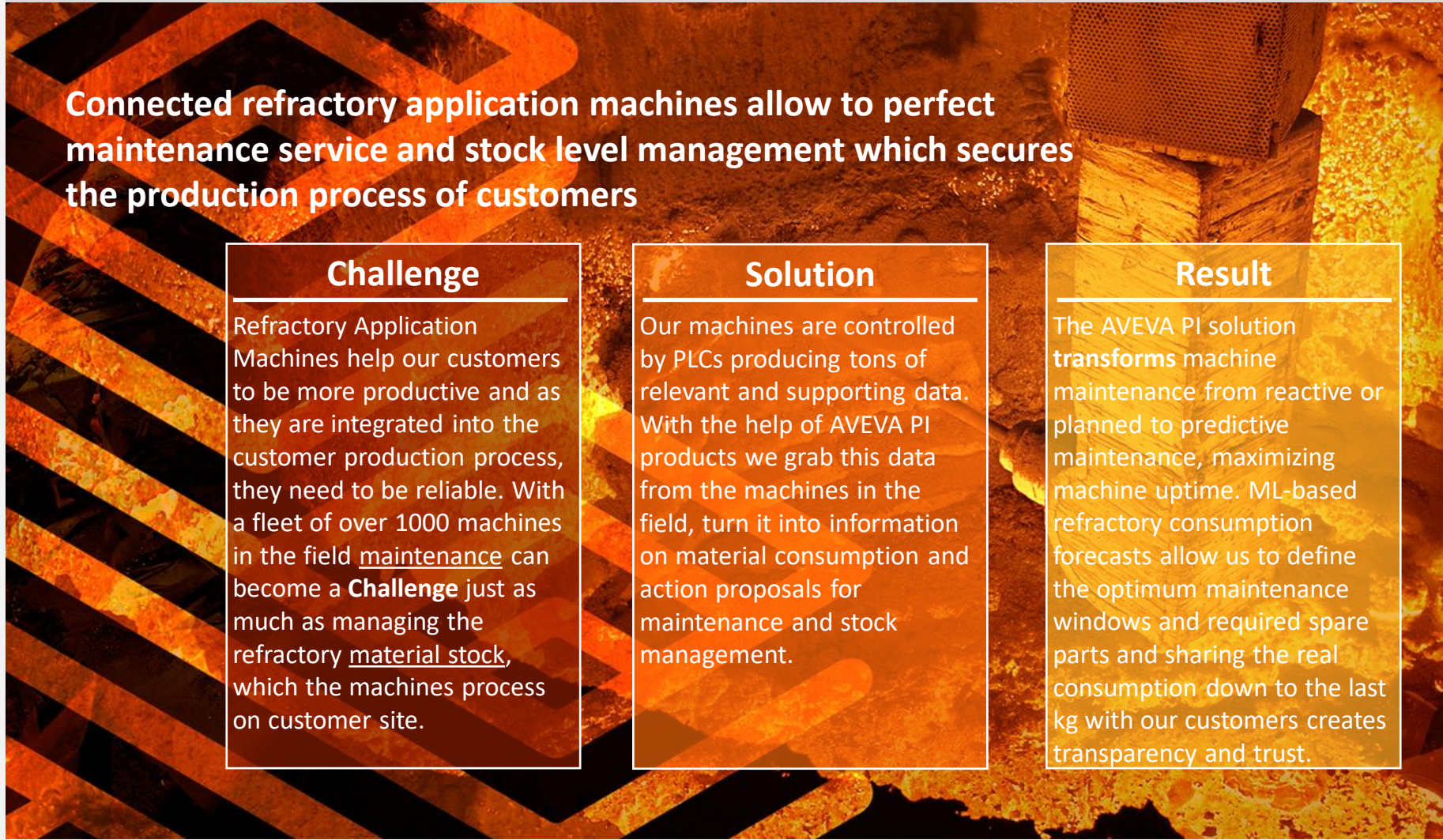
RHI MAGNESITA

Refractory Application Machines

Refractory application machines must withstand harsh environments, typically in a steel mill. They allow steel producers (RHIMagnesita's customers) to extend their production campaigns in order to maximize their output. A standard machine repairs a refractory lining in short maintenance breaks to ensure safe production and extend the refractory lining lifetime.

But refractory application machines also produce data, which is far from being fully used today.

Using this data can help to build a predictive maintenance system for refractory application machines, improve our on-customer-site warehouse management and sharing the consumption data with our customers can deepen the trust into our collaboration.



Connected refractory application machines allow to perfect maintenance service and stock level management which secures the production process of customers

Challenge

Refractory Application Machines help our customers to be more productive and as they are integrated into the customer production process, they need to be reliable. With a fleet of over 1000 machines in the field maintenance can become a **Challenge** just as much as managing the refractory material stock, which the machines process on customer site.

Solution

Our machines are controlled by PLCs producing tons of relevant and supporting data. With the help of AVEVA PI products we grab this data from the machines in the field, turn it into information on material consumption and action proposals for maintenance and stock management.

Result

The AVEVA PI solution **transforms** machine maintenance from reactive or planned to predictive maintenance, maximizing machine uptime. ML-based refractory consumption forecasts allow us to define the optimum maintenance windows and required spare parts and sharing the real consumption down to the last kg with our customers creates transparency and trust.

Refractory Application Machines: Prepare and Repair

All our machines are included into the customer process

Lining (prepare for production)

Tundish

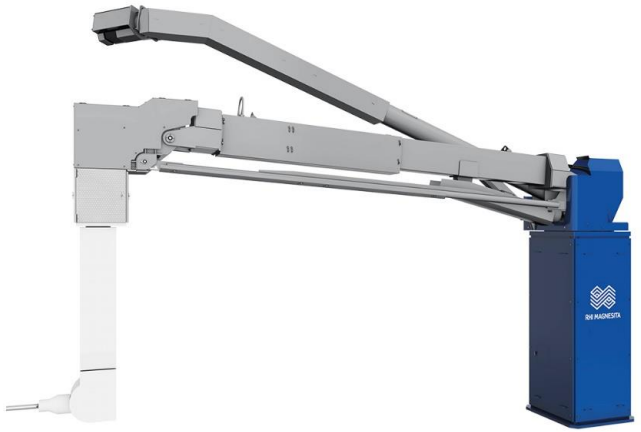
Ankertun CS

Refractory Application Machines

- Must prepare or repair when the customer plant logistics allow for it
- Must withstand quite rough environments
- Must provide the safest and most economical usage of refractory materials

Maintenance is most critical to guarantee **uptime**

Repair



EAF

TERMINATOR

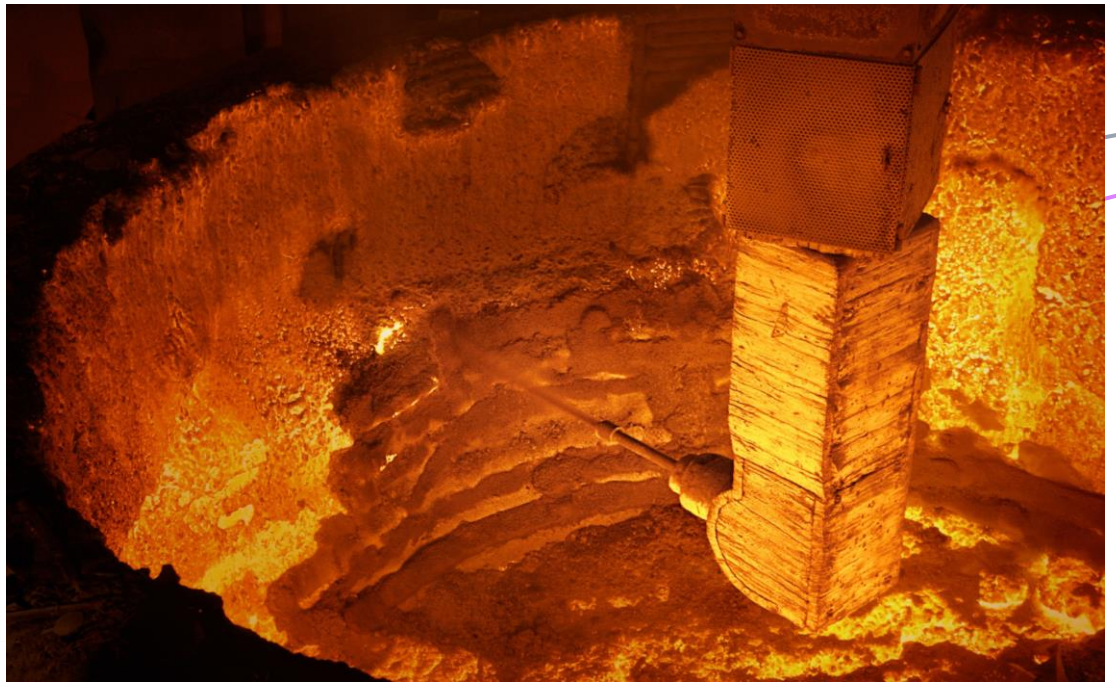
Converter Ladle

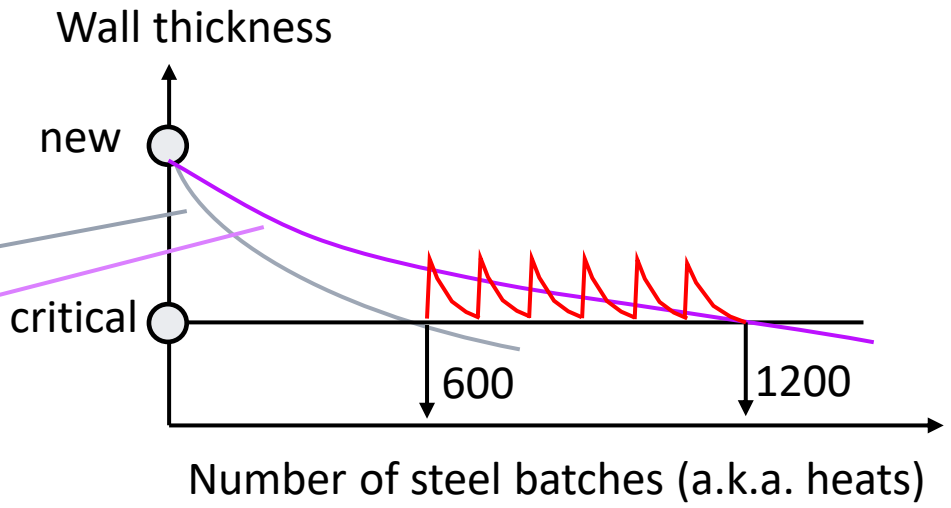
GEKKO

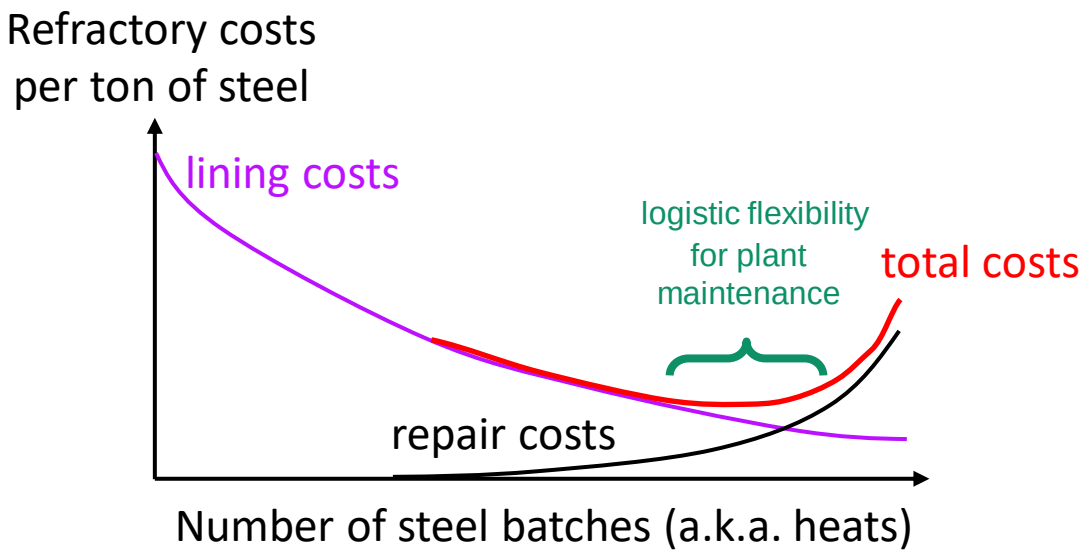
AVEVA

Refractory Application Machinery

Why Refractory Application Machines are needed: one example.







Refractory Application Machines:

→ repair critical areas of the refractory lining during short production stops

→ Increase significantly productivity until shut down for relining

Available Machine Data

Data for collection and monitoring

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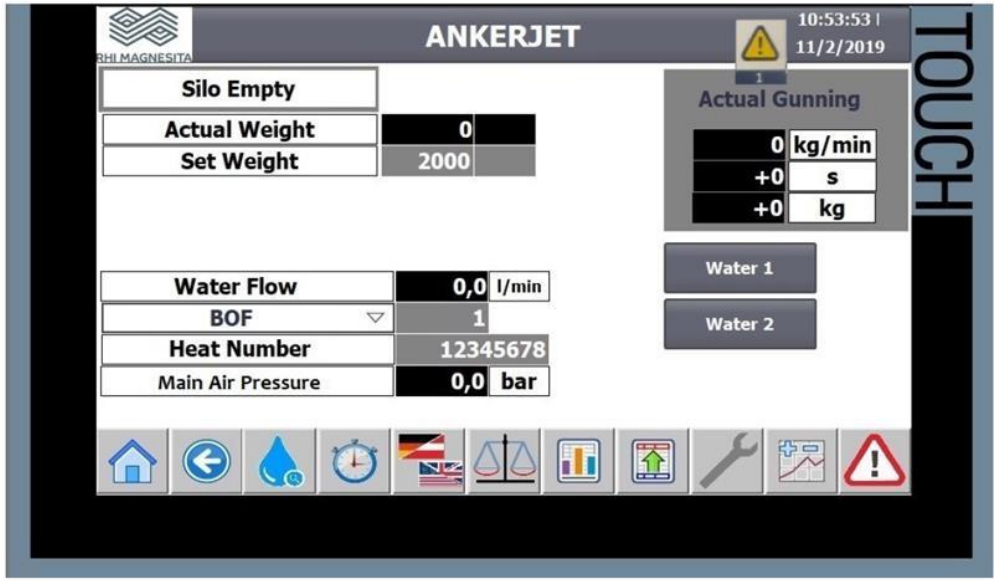
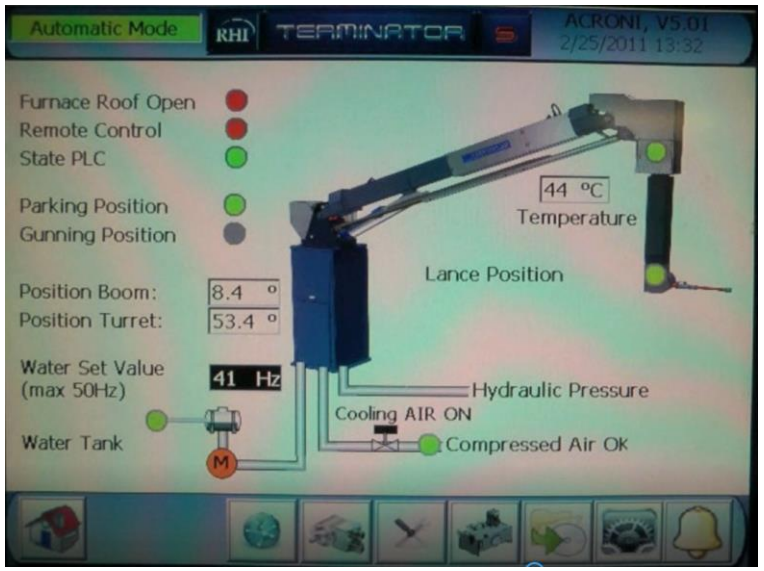
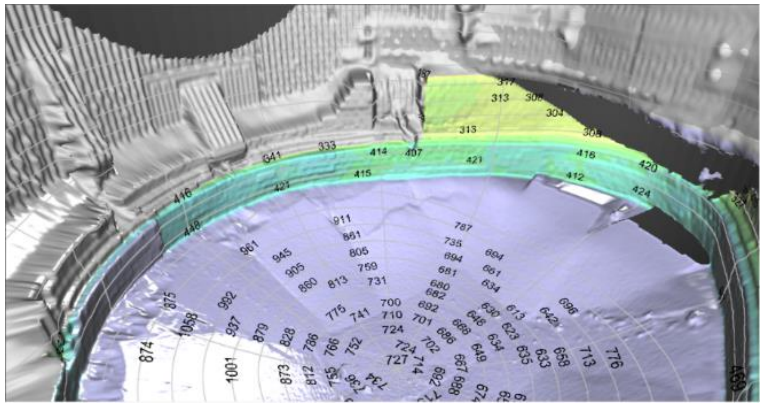




TERMINATOR

Depending on machine type we have:

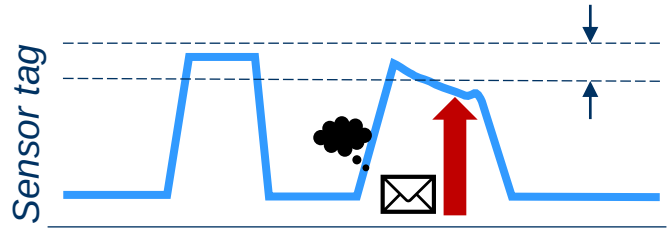
- → Gunning weight
- → Water flow rate
- → Air pressure(s)
- → Oil pressure(s)
- → Temperature(s)
- → 3d-positions
- → 3d – scans of lining wall thickness
- → Engine power consumption



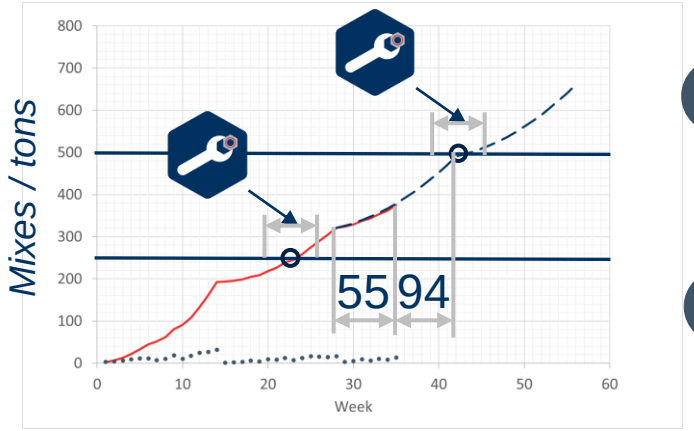
Defining Data Usage for Connected Machines

What we intended to do with the machine data

1. Detect abnormalities on machines

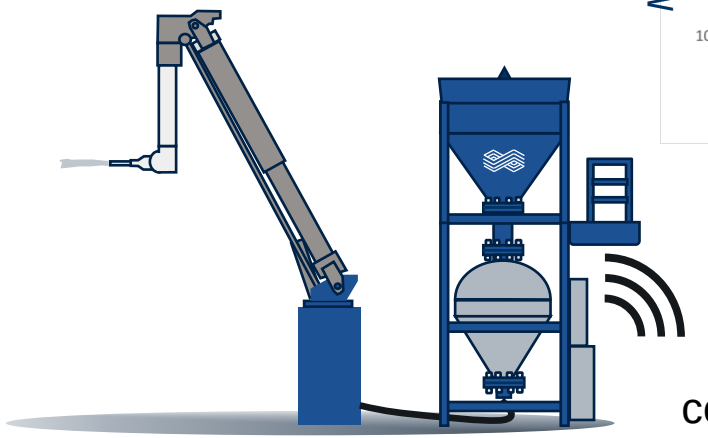


2. Record and forecast refractory consumption



3. Develop based on forecasts optimized maintenance windows

4. Precise consumption accounting and usage of consumption forecasts for future material shipments



Continuous, central recording of machine data

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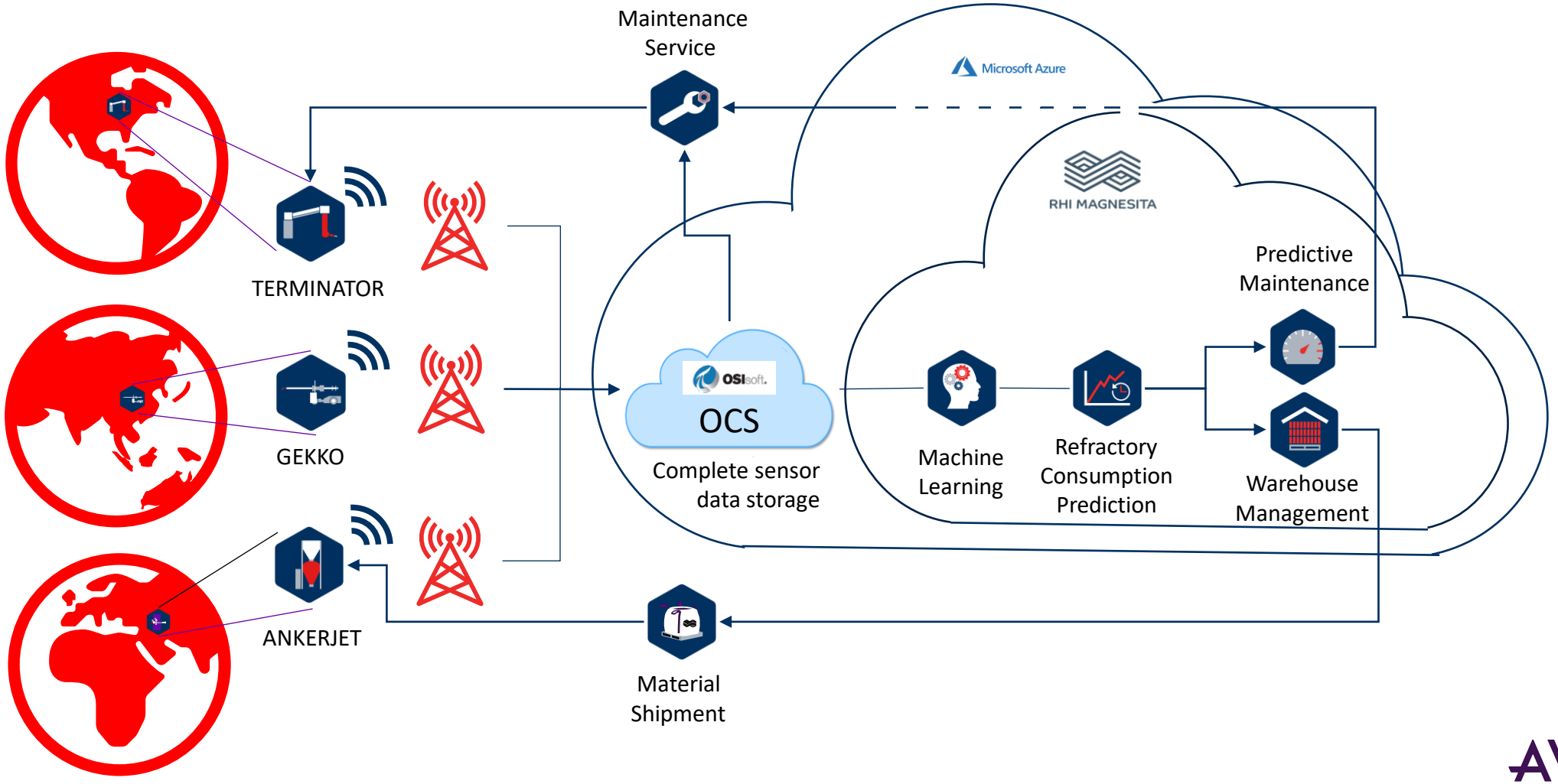
Connected Machines Architecture

Creating loops of Improvement



Key Features of Connected Machines MVP

What the MVP has delivered

- Tracking of refractory consumption
- Monitoring all other machine sensors
- Predicting refractory consumption for 6 months with an accuracy of + 80%
- Giving proposals on when to check or change individual machine components
- Giving proposals on reordering refractory quantities

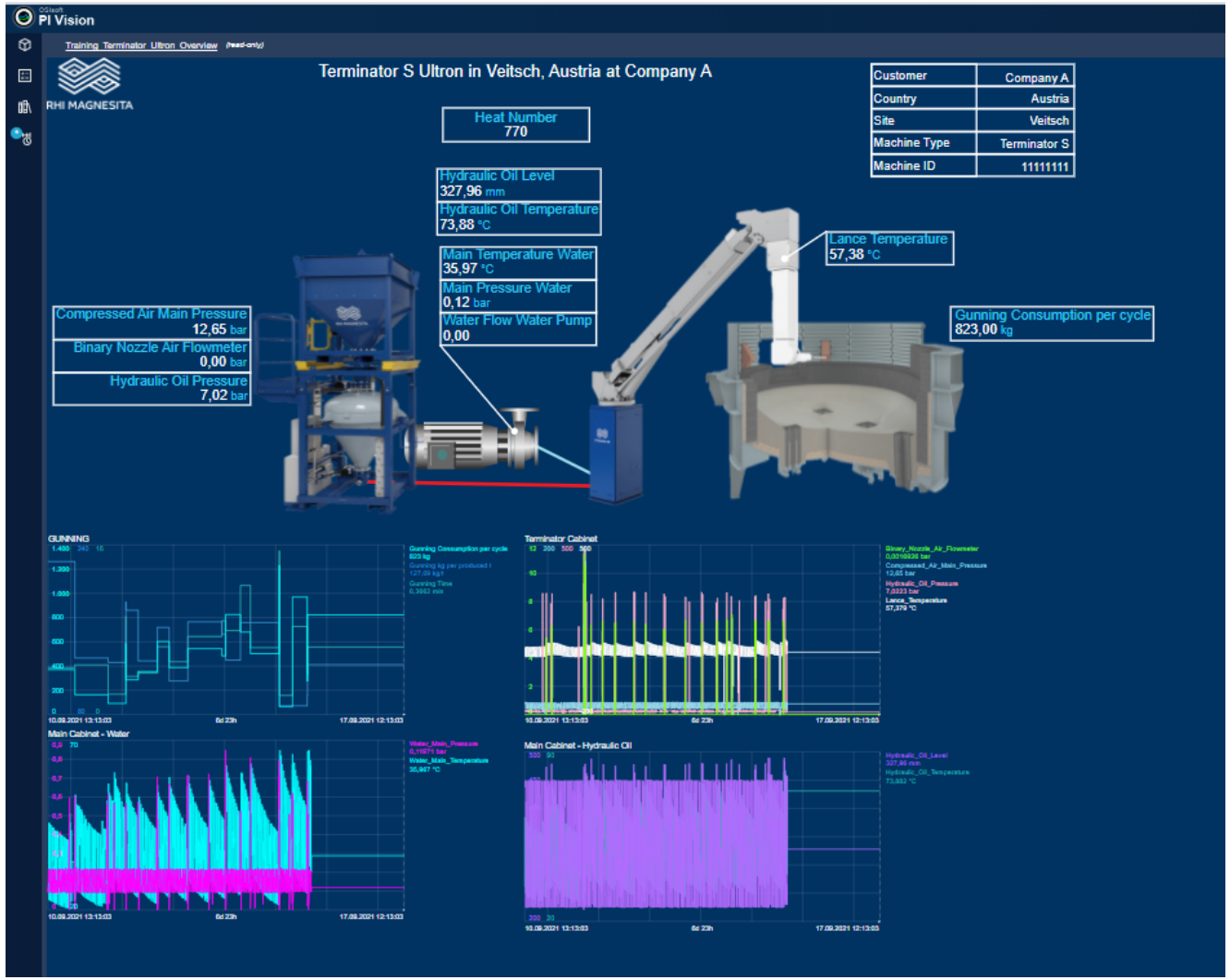
→ All the above was achieved in 10 months

Why could we do that in this time period?

- Existing RHIMagensita team, with extensive knowledge on PI-applications (PI-Core has been used in our production sites for +10 years)
- We had a company transversal (IT, Service Technicians, Engineers) and 3rd party team, working closely together on a daily basis (agile IT-approach)
- Fast support from OSIsoft in case of issues

Established Connectivity

What we achieved in 10 months.



Established Connections by region:

- South America
- North America
- Europe
- Near-Middle East

Established Connections per type:

- Terminator
- Virtual Terminator (“Ultron” our “lab rat”)
- Ankerjet
- Gekko
- MA-Gun

Fundamental Achievements and Learnings

Technological baseline of Connected Machines

Achievement	4	2	1	3	1	4	5
	Different machine types connected so far	Different hardware connector types successfully installed	Centrally controllable data collector system installed	Different data collection templates corresponding to the different machines	Virtual machine for development trials and customer presentation	Machine Learning models established to predict future refractory consumption with 80%+ accuracy	Different maintenance protocols for individual machine types
Learning	**Every RHIMagensita machine can be connected**	**Several solutions work; we have to select the one easiest maintainable**	**PI-Adaptor can be installed on the connector or on a central device → better for maintenance**	**With PI-Vision Templates data storage can be accomplished within less than one day**	**Terminator "Ultron" can be used to develop new applications, like internal interfaces to other systems.**	**A good refractory consumption model requires a minimum of one year of pre-collected data; known down times significantly improve the model prediction accuracy**	**An improvement in machine maintenance already would be possible with a strict logging of maintenance and consumption**

Supported by PI-products

Value

We're currently in the value verification phase

Uptime = Production Time

Example Electric Arc Furnace:

- 1 day = app. 30 heats
- app. 100 tons of steel/heat
- app. 150€/ton steel

→ 90.000 € of turnover

Maintenance Issues

Internal Survey in Q2/2021 on Machinery on service delay reasons:

1. availability of spare parts
2. availability of trained personnel

→ Prediction on parts and replacement time will improve service efficiency

Transparent Accounting

- Charging only really consumed material (single kg)
- Better material performance transparency
- Accounting on time; no delay through inventory count

→ Customer trust

Stock Monitoring

- Assuming to reduce material stock on 50% of the machines
- Assuming 1 big bag/ton per month
- Assuming that app. 70% are MgO based
- Assuming that 1ton of MgO = +1 ton of CO_2

→ >4.200 tons of less CO_2 in one year

AVEVA

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ABOUT AVEVA

AVEVA, a global leader in industrial software, drives digital transformation for industrial organizations managing complex operational processes. Through Performance Intelligence, AVEVA connects the power of information and artificial intelligence (AI) with human insight, to enable faster and more precise decision making, helping industries to boost operational delivery and sustainability. Our cloud-enabled data platform, combined with software that spans design, engineering and operations, asset performance, monitoring and control solutions delivers proven business value and outcomes to over 20,000 customers worldwide, supported by the largest industrial software ecosystem, including 5,500 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 6,000 employees at 90 locations in more than 40 countries. For more details visit: www.aveva.com

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