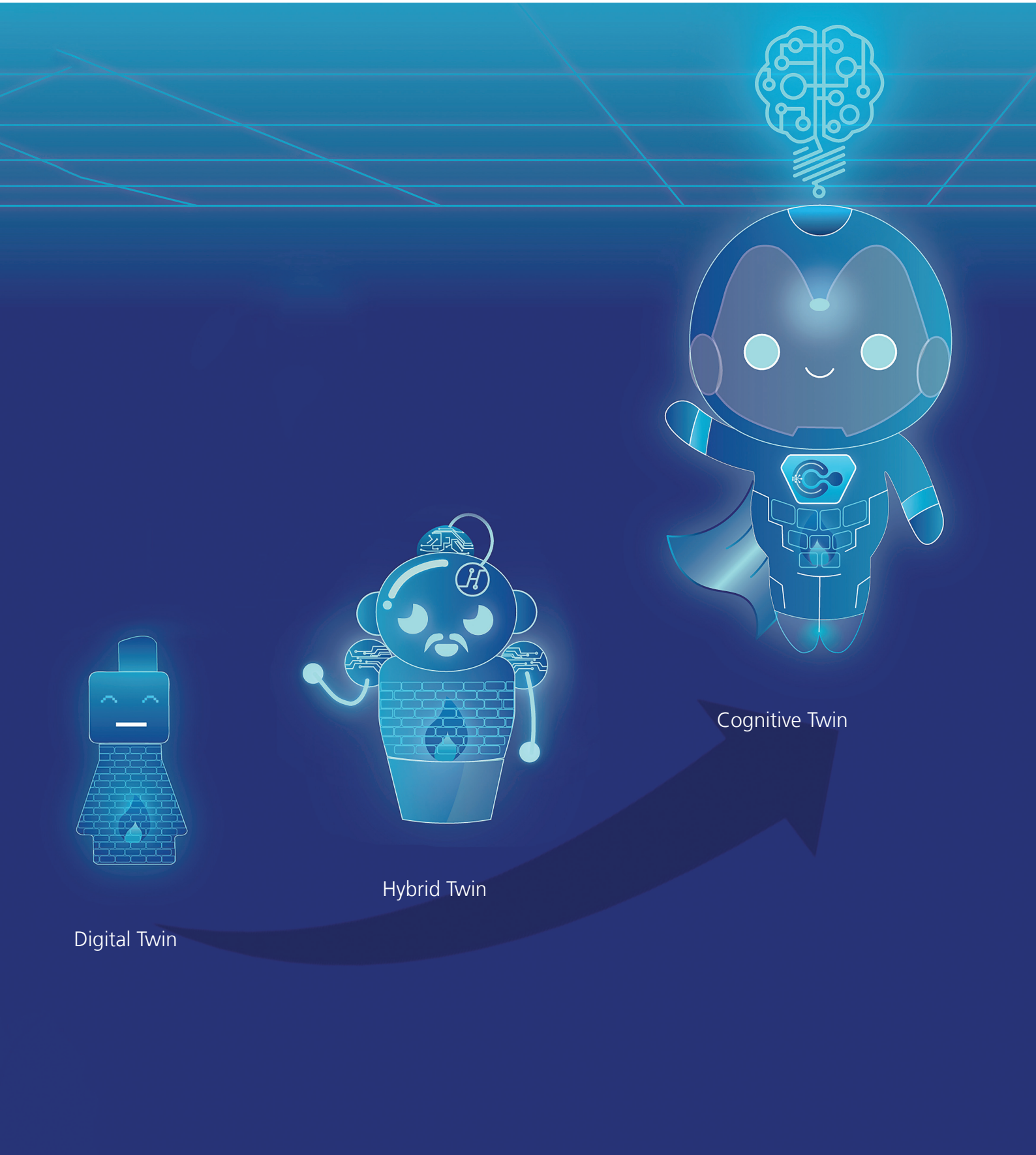
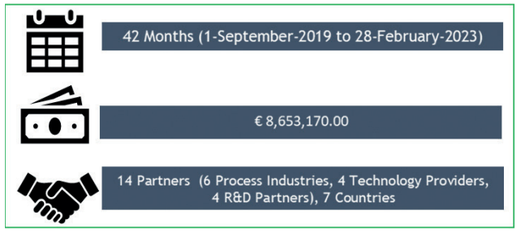
COGNITWIN



CONTENT

COGNITWIN Project Information



The COGNITWIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870130.

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Dear readers,

We are pleased to share with you the 4th COGNITWIN newsletter.

While the first newsletter introduced the COGNITWIN project and the second and third newsletters presented the challenges and results from a research/technical point of view and the achievements of the pilot partners, respectively, in this newsletter we focus on the experiences gained during the 30 months of project execution.

The contributions of partners follow the same structure: for each partner, we introduce the partner and its role in the project, give a short description of its expectations from the project and highlight the main results achieved so far. We also describe the next steps to extend and further improve the project results until the end of the project and explain how the key project results will be exploited. To make the newsletter more attractive and draw the attention of a wider audience, the representative pictures of the key results of each partner are also included.

The results achieved so far are tangible. The public deliverables and publications can be found on the **COGNITWIN web side**, the public videos could be found on the COGNITWIN YouTube channel and the open source results are available at Github (e.g. **https://github.com/FraunhoferIOSB/FAAAST-Service**). For more information about our projects, please join our webinars. Information about the next webinars will be announced on the COGNITWIN LinkedIn.

Enjoy the reading & contact us if you have questions or suggestions!

Best regards
The COGNITWIN project

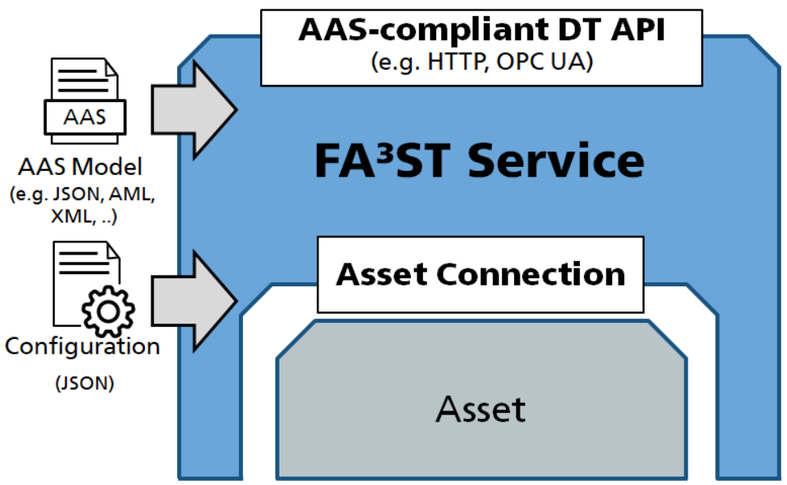
Fraunhofer IOSB – FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

The Fraunhofer-Gesellschaft is a leading organisation of institutes of applied research in Germany, undertaking contract research on behalf of industry, the service sector and the government. The Fraunhofer IOSB institute and in particular its department Information Management and Production Control (ILT) work on developing open and secure architectures, software components and solutions for information, control and test systems in application domains of the Internet of Things (IoT). In the COGNITWIN project, Fraunhofer IOSB leads the work on digital twins and also on communication, networking and standardization.

EXPECTATIONS FROM THE PROJECT

As one of the cornerstones of Industry 4.0, the concept of digital twins (DTs) is recently gaining more and more importance. The Asset Administration Shell (AAS) specification by Plattform Industrie 4.0 is a concrete adaption of the DT concept with focus on the domain of industrial production. We expect to learn from the pilot partners what the specific requirements are for an AAS-compliant DTs in the process industry, how our solution can be improved to meet their needs, and to provide feedback to the Plattform Industrie 4.0 standardization bodies based on the insights gained from the pilots.



FA³ST Service - Non-Technical View

MAIN PROJECT RESULTS

We released our open-source software FA³ST Service as first building block of the Fraunhofer Advanced Asset Administration Shell Tools for Digital Twins (FA³ST).
FA³ST Service enables to create and run DTs based on the AAS specification by Plattform Industrie 4.0 that can be interacted with via standard-conform APIs.
FA³ST Service embraces an open architecture making it easy to customize and extend. It also enables synchronization of the DT with the underlying asset or other data sources. Internally, FA³ST Service operates in a protocol-agnostic manner which enables supporting multiple different communication protocols such as HTTP and OPC UA for its AAS-conform API as well as OPC UA and MQTT for connecting assets. By offering a command-line interface, a ready-to-use docker container, and being embeddable into custom applications it supports most application scenarios. FA³ST Service is part of the FA³ST ecosystem which aims to provide tools targeting the whole life cycle of a DT.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Development of FA³ST Service continues by adding new features such as database-backed persistence as well as implementing missing functionality and improving usability. This is work in progress and will be released in the near future. FA³ST Service is also just the first tool of the FA³ST ecosystem. FA³ST Service will be used to develop the PI4.0 compliant DTs for various COGNITWIN use cases.

PLAN TO EXPLOIT THE PROJECT RESULTS

Fraunhofer in its role as a research institute has as its exploitation goal to develop and extend emerging technologies in order to create innovative solutions for industry and government and to create impact through standardization and technology transfer. Our most important exploitation result from the COGNITWIN project is the FA³ST ecosystem for DTs.
FA³ST Service is a Java-based open source implementation of the reactive AAS and cornerstone of the FA³ST ecosystem. It is released under Apache 2.0 License. For further information visit FA³ST Service at Github (https://github.com/FraunhoferIOSB/FAAAST-Service) where you can find the code, report issues and are welcome to contribute

DFKI - DEUTSCHES FORSCHUNGSZENTRUM FUR KUNSTLICHE INTELLIGENZ GMBH

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

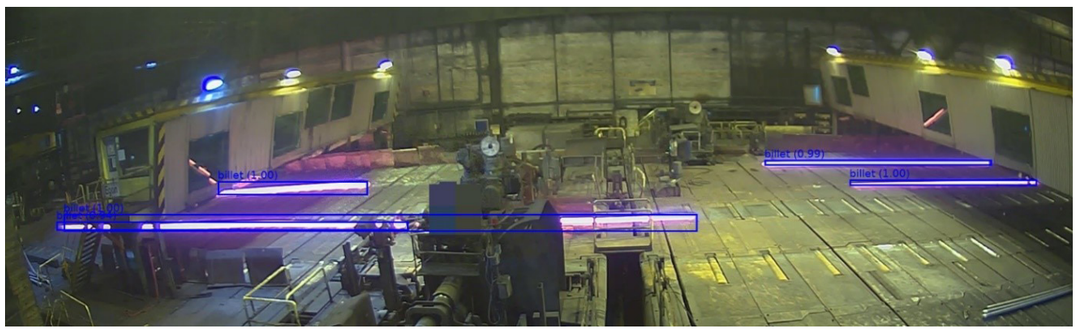
DFKI in its role as a research institute brings its expertise in the field of synthetic data generation and machine learning. In the course of the COGNITWIN project, DFKI and Saarstahl AG develop a real-time computer vision system to track steel bars individually throughout Saarstahl mill train.

EXPECTATIONS FROM THE PROJECT

Simulation is a useful tool in situations where training data for machine learning is hard to acquire or needs heavy human annotations. In the COGNITWIN project, DFKI aims to evaluate potential of simulated training data for real-world applications. DFKI also works towards developing a generic image simulation pipeline that can be applied as a blueprint to other industrial applications.

MAIN PROJECT RESULTS

Deep Learning is a technology of choice for implementing the multi-billet tracker. The main challenge of applying deep supervised learning in the SAARSTAHL pilot is lack of annotated training data. DFKI developed an image simulator that generates training data. The simulator is a complex interplay of different components and technologies: aerial photogrammetric capturing of the blooming train, parametric 3D modelling of steel bars, and simulation of different environmental settings. Porting the entire simulation chain to a high-performance GPU cluster allows rendering of large-scale data and quick data regeneration if changes to the model are required. Validation of the rendered data via segmentation and object detection algorithms demonstrated that simulated and real image domains have close enough matching.



An object detection network trained solely with simulated data detects billets with high precision

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

The next steps include training tracking networks using the simulated training data. In the SAARSTAHL pilot we face very challenging situation for implementing a tracking system because long thin-shaped steel bars have almost identical appearance. Static and dynamic occlusions in the scenery further complicates the situation. To tackle these issues, the temporal coherence component, i.e. linking about several frames in an image sequence, will be added into the tracking training loop as additional data source.

PLAN TO EXPLOIT THE PROJECT RESULTS

The project is strongly related to manufacturing technology and material science topics. DFKI's most important exploitation result from the COGNITWIN project is development of image simulator that allows good cross-domain generalization. We plan to use the simulator in following research projects.

CYBERNETICA - CYBERNETICA AS

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

Cybernetica develops, implements, commissions and maintains solutions for model-based control, supervision and optimization of industrial processes. Within the COGNITWIN project, Cybernetica is involved in two pilot applications. Firstly, we have developed a digital twin for Elkem's FeSi refining process. Secondly, we have developed a digital twin for the GTC at Hydro's pilot plant.

EXPECTATIONS FROM THE PROJECT

Our expectations from the COGNITWIN project are to deliver state-of-the-art software solutions for the control and monitoring of the two pilot installations.

MAIN PROJECT RESULTS

For Elkem's Bremanger pilot we have

- Implemented a Digital Twin and installed it online at the plant
- Developed an extension to Cybernetica OPC UA Server to obtain manual measurements
- Fitted the Digital Twin to plant data and verified the resulting model

We are currently testing an operator support system where we calculate optimal recommendations for the operator which will reduce product variation and utilize excess heat to remelt scrap material. You can read about our work in our paper presented at Silicon for the Chemical and Solar Industry XVI here: https://dx.doi.org/10.2139/ssrn.4121131

	Phase 1 & 2					Phase 3
Cybernetica	Year 1 (2023)	Year 2 (2024)	Year 3 (2025)	Year 4 (2026)	Year 5 (2027)	Years 6 ->
No. of new FeSi applications	2*	2	2	2***	2***	4
No. of running FeSi applications	2	4	6	8	10	14 *(out of 24 possible)*****
No. of new GTC applications	1**	1	2	2	2	4
No. of running GTC applications	1	2	4	6	8	15 *(out of 30 possible)*****
No. of new Phase 3 applications	0	0	0	0	0	*??*
No. of running phase 3 applications	0	0	0	0	0	*??*

* pilot at Elkem
** pilot at Hydro
*** high Si-alloys
**** see market analysis in D6.2

Initial exploitation plan

For Hydro's Gas Treatment Centre at Karmøy Technology Pilot Cybernetica has

- Developed a first-principles model as a Digital Twin running online at the plant
- Connected the Digital Twin to the weather data acquisition tool developed jointly with SINTEF
- Established a custom web viewer for the Hybrid Digital Twin for engineers and operators

The viewer shows a comparison between historical model predictions and the main process measurement (HF concentration laser) as well as predictions of and advisory information about the optimal primary alumina feed needed to stabilize the secondary alumina fluoride content.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

The next step for the Elkem pilot is to combine Cybernetica's Digital Twin, the machine vision algorithms and SINTEF's slag model to a Hybrid Digital Twin.
Next steps for the Hydro pilot involve live testing and validation of the digital twin's recommendations.

PLAN TO EXPLOIT THE PROJECT RESULTS

The results from the project will be exploited in three phases. In the first phase, we will implement the developed results in the Elkem and Hydro pilots. In the second phase, we will further develop and implement the results in other FeSi and GTC plants within Elkem and Hydro, as well as other high Si-alloys plants in Elkem with similar refining processes. Lastly, in phase three of the exploitation plan, we will look into related industry segments within the European market where our developed technology can be applied.

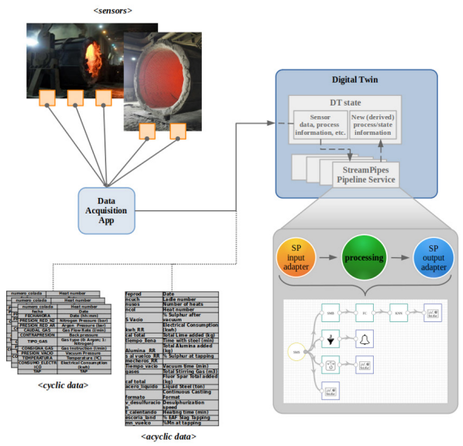
An initial exploitation plan for the exploitation after the end of the COGNTWIN project is shown in the figure.

Nissatech - Company for Provision of Services, Research and Development NISSA Innovation Centre DOO

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

Nissatech is a research performing SME with strong international cooperation and vision to become one of European top innovators in the domain of advanced AI and cognitive industrial solutions. The main objective is to develop own technological building blocks through an efficient implementation of the cutting-edge research and their usage for resolving challenging real-world problems in different industrial domains.

In the COGNITWIN, Nissatech supports the development of the Cognitive Digital Twins, esp. the cognition part and its application in selected pilots.



ToolWearMonitor - Conceptual architecture illustrated on Sidenor pilot

EXPECTATIONS FROM THE PROJECT

Two main expectations are:

1. Development of the technology building blocks for realizing cognition-driven industry systems, focusing on the complex use cases (e.g., dealing with unknown situations)
2. Collecting experience in developing AI-based solutions for Process Industry

MAIN PROJECT RESULTS

The main result is the ToolWearMonitor service, which enables efficient monitoring of the degradation of equipment used in the process industry in harsh conditions. Degradation is usually a slow process, but very unpredictable due to the dynamic environment in which the equipment is used.

The service processes all available data (real-time process data/time series, product feature data, etc.) and numerical models to develop accurate prediction models for RUL (remaining useful life). These predictions can take the form of the remaining number of uses or the degree of deterioration.

The service is intended to serve as additional information for the technical operator to decide whether to replace/repair the device. Usually, a technical operator makes a low-risk decision and proposes to replace/repair the tool before it becomes non-functional. The right time to replace the tool brings significant cost savings.

The service supports decision-making in challenging situations by using all available data, models and (human) knowledge as defined in the COGNITWIN vision. It bridges the gap between the real world (tools, equipment) and the digital world (data) by deriving the status of real assets from data.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Further work will focus on integrating data-driven and numerical models into so-called hybrid models to model complex tool degradation processes. Hybrid models are more detailed models and represent the degradation process more accurately. This integration/hybridization can be done in different ways and the dynamics of tool degradation can be described (and simulated) more accurately.

PLAN TO EXPLOIT THE PROJECT RESULTS

The development of the selected pilot will be used as a PoC (Proof of the Concept) to provide an efficient solution for tool wear/plant deterioration monitoring in the process industry. USP is the capability for complex modelling of the tool wear process by combining data-driven models, numerical models and human experience/knowledge. It is an end-to-end solution, starting from data acquisition to decision support (interactive visualization).

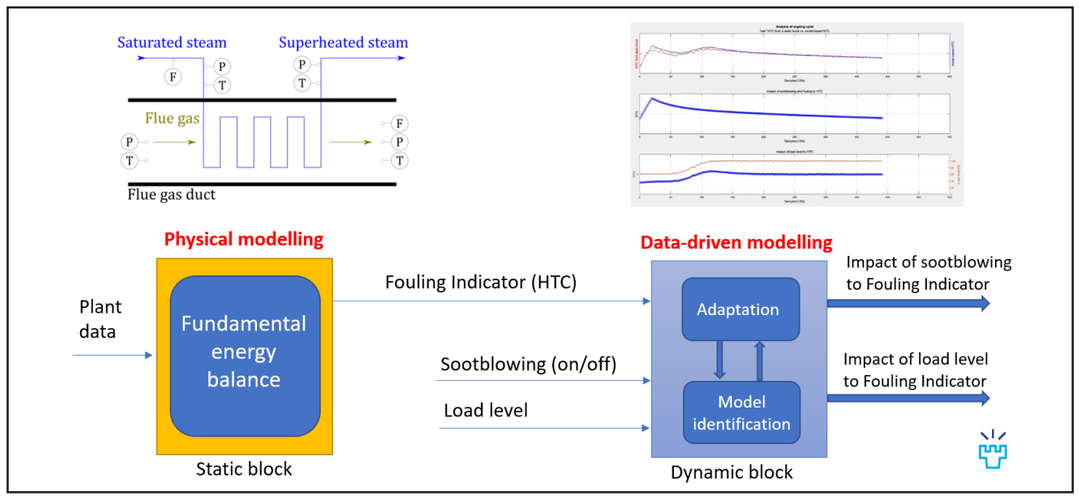
UOULU - OULUN YLIOPISTO

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

The Intelligent Machines and Systems research unit at the University of Oulu (UOULU) conducts research on theory and methods of control and systems engineering, machine diagnostics, and modelling and simulation of industrial processes, machines, and controlled systems. In COGNITWIN we examine model-based approaches to monitoring and control, from the viewpoints of physics-based and data-driven process models, digital twins, and applications in process engineering. We focus on the COGNITWIN boiler pilot problem but cooperate actively also with other pilots and partners.

EXPECTATIONS FROM THE PROJECT

We believe that the COGNITWIN can collect experiences and extract feasible hybrid solutions for pilot-driven problems, to be applied also more generally in the heavy process industry. We expect that the COGNITWIN will provide solutions for process monitoring and control promoting full exploitation of dynamic physical models of plants, up-to-date methods in process identification, state estimation and optimization.



Model-based state estimation applied to boiler sootblowing

MAIN PROJECT RESULTS

We have developed estimation of uncertain properties of plant input feed using physical model-based bayesian state estimation, looking especially at estimating fuel quality in demolition wood combustion boilers. This involved development of a novel approach to adjust the physical model to local site conditions. Approaches for monitoring of fouling in boiler flue gas path heat exchangers were developed, to provide means to solve the COGNITWIN pilot case problem of fouling management. Among others, a new approach using subspace identification and lti-state estimation was developed, with emphasis on implementability and feasibility in real life plant operating environments.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

In the ongoing work, methods for optimization in plant maintenance are developed, making use of the monitoring and prediction tools, and with focus on cognition in plant feedback and operator support. From applied perspective, the optimization of sootblowing for fouling management is considered, exemplified by the COGNITWIN pilot problem. In addition, fresh methods in ensuring data quality are examined, such as detection of outliers.

PLAN TO EXPLOIT THE PROJECT RESULTS

Work is done in close cooperation with the boiler manufacturer, with keen interest in providing services for utilities. As a university research unit, the UOULU can facilitate that the project research outcomes and gained experiences will find their way also to future projects and education.

TEKNOPAR - TEKNOPAR ENDUSTRIYEL OTOMASYON SANAYI VE TICARET ANONIM SIRKETI

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

TEKNOPAR applies multidisciplinary science/techniques in mechanics, hydraulic, electric-electronics and information technologies to develop industry 4.0 compliant end to end systems. In COGNITWIN, TEKNOPAR has roles to: take part in identification and integration of physical resources/devices and the related data, contribute to specification of capabilities of physical resources/devices needed for trustworthy and secure communication, design, develop and deploy IIoT platform for the NOKSEL pilot, asses the existing systems, assets and technologies, conduct gap analysis, conduct feasibility analysis, specify the concept, methodology, architecture framework, and main operating procedure, elicit and specify requirements for multi-modal monitoring platform, multi-variate data analysis, and interfaces of IoT/Edge framework, develop digital twins, ML/DL models and perform dissemination, exploitation and project-management tasks.

EXPECTATIONS FROM THE PROJECT

TEKNOPAR has achieved creation of a smart IIoT platform based on its expertise for STEEL4.0 Intelligent Data Processing Platform. The company aims to fulfil the requirements of the NOKSEL pilot, and implement the required tools as part of WP4 and WP5.

MAIN PROJECT RESULTS

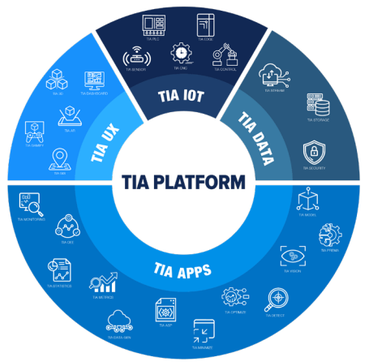
TEKNOPAR's TIA Platform and its related services and products are partially developed in COGNTIWIN, especially TIA AssetHealth used to monitor and control the real-time condition of systems. SWP machine's components statuses are tracked. TIA IoT, TIA Data, TIA Stream, TIA Storage and TIA Dashboard for the NOKSEL pilot are in use at the real facilities for real production.

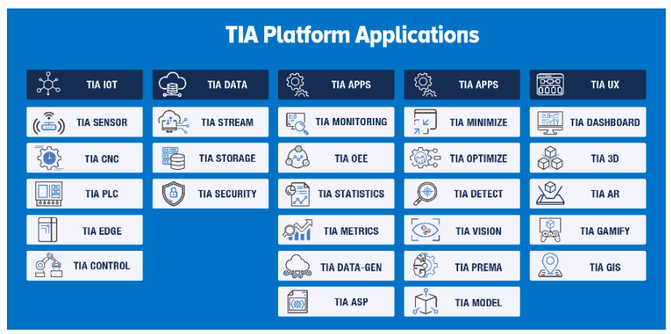
NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

By the end of the project, deep learning models to embed tacit knowledge of the operators will be developed. In order to do this, knowledge graphs will be generated.

PLAN TO EXPLOIT THE PROJECT RESULTS

We attended to Tube and Wire 2022 Düsseldorf fair. We published a dedicated TIA Platform web site (www.tia-platform.com), TIA Platform will be used to exploit the project results. More fair attendances are planned, Digital Agora and Change2Twin existence have been realized. Webinars will be organized; Google Ads will be used, and patent application will be done. Conference papers and book chapters have been published. More academic articles are planned.





TIA platform application

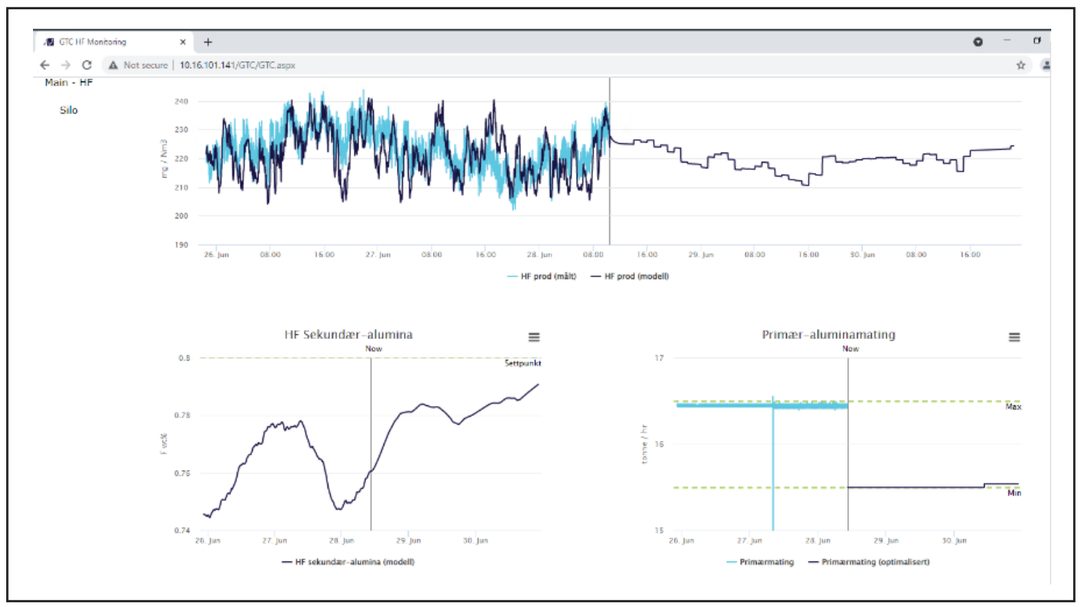
Hydro - HYDRO ALUMINIUM DEUTSCHLAND GMBH

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

Hydro is a fully integrated aluminium company with 35,000 employees in 40 countries on all continents, combining local expertise, worldwide reach and unmatched capabilities in R&D. On the smelter side, Hydro has traditionally and continues to aim towards a low environmental impact electrolysis technology. By continuously improve the efficiency simultaneously maintaining environmental performance well below licence to operate and aiming for further reductions. As aluminium producer, Hydro acts in the COGNITWIN project as pilot plant in WP1 Non-Ferro Alloys.

EXPECTATIONS FROM THE PROJECT

The expectations to the COGNITWIN project, is to further integrate the operation of Gas Treatment Centre (GTC) with the needs from the electrolysis cells. This to achieve stability, and through this; lower emissions, lower energy consumption and less exposure for operators to heat and hazardous gases. The pilot is divided into 3 cases;1. Predict and measure the evolved HF gas to be adsorbed, and feed primary alumina, accordingly, resulting in stable fluoride feed to cells (heat balance). 2. Maintain reactor temperature within an optimal temperature range for adsorption (85-95°C).



Online Digital Twin for Case 1, predicting raw gas HF content, and suggests primary alumina feed.

3. Minimise and keep constant the gas evacuation rate through main fan control, save main fan energy, and constant extraction of energy from cells

MAIN PROJECT RESULTS

Case 1, now finished and deployed on site as a digital hybrid twin, for predicting HF evolvement and suggesting primary alumina feed to achieve desired adsorption level in secondary alumina. Case 2, able to keep 85% of the temperature within desired range, hence securing adsorption conditions. Case 3, Fans sat to constant mass of gas extraction, saving 7% of the main fan energy consumption during the coldest month of the year.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Further now will be to introduce the operators to the online twins and let them adjust to the suggested parameter setting. After that the digital twins will be set to regulate automatically, and later corrective actions by operators will be recorded, and assimilated into the Cognitive Digital Twin when validated.

PLAN TO EXPLOIT THE PROJECT RESULTS

Results and competence from the COGNITWIN have and will continuously be included in the development of operational procedures and modifications. Specifics such as the digital twins and their predictions and regulations, will be introduced piece by piece as the GTC's are equipped and ready.

SFW - SUMITOMO SHI FW ENERGIA OY

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

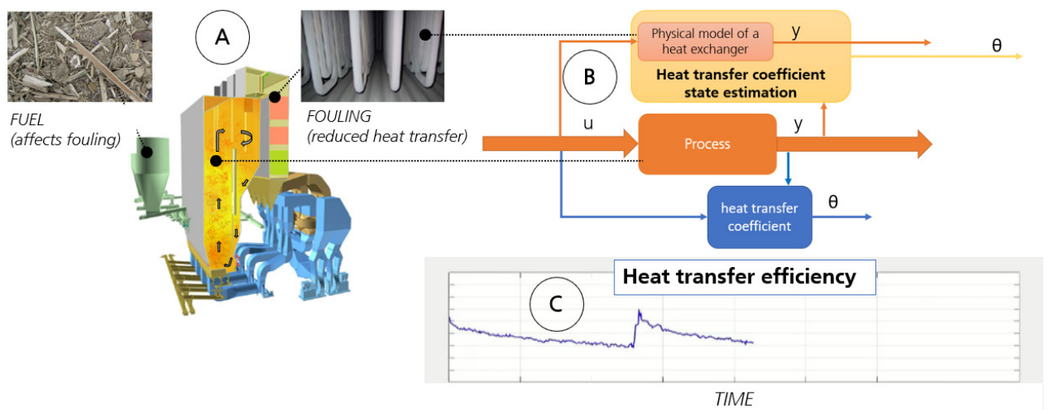
Sumitomo SHI FW (SFW) is a global, innovative provider of energy and environmental technologies and services focusing on high efficiency and flexible generation of energy. Our solutions expand from our world leading circulating fluidized bed (CFB) technology, to long duration cryogenic energy storage solutions, flue gas cleaning, gasification, waste heat boilers and a full spectrum of services for the global power and industrial markets.

SFW's main role in COGNITWIN has been coordinating the work related to WP3 (Engineering pilot) and setting up the energy boiler pilot environment for testing and demonstrating the technology being developed in the project. SFW has designed and constructed the Hybrid Twin environment for the pilot case in WP3, including the IoT and cloud platforms and visualization tools.

EXPECTATIONS FROM THE PROJECT

Although there are many challenges that power industry must face nowadays, such as continuously changing fuel quality, novel measurements and advanced digital technologies will potentially provide new, efficient approaches to optimize the operations and processes in the power industry. This will hopefully lead to reduction of operating costs in the pilot plant. On the other hand, the results may provide new useful digital tools that can be offered as digital services within the power industry sector.

The problem to be tackled in WP3 by the Cognitive Twin is the fouling of heat exchange (HX) surfaces (i.e., the deposition of material on the convective HX surfaces) in the pilot CFB. It is expected that advanced digital tools for better control of fouling would be beneficial to cut and optimize the operating costs.



A) The CFB process and the fouling problem, B) Model-based estimator for fouling, C) The output of the model-based estimator

MAIN PROJECT RESULTS

To reach the project goals and to achieve the desired to-be situation in WP3, more exact real-time information on the fouling of heat exchangers was needed than was available in the starting phase of the project. The natural step to satisfy this need was to apply the Hybrid Twin technology that has been under development in COGNITWIN. Now, the Hybrid Twin environment for the Engineering pilot has been successfully set up, physical model for the boiler is ready and tuned by the measurement data, HX state estimation method for fouling modelling is ready, and the first efforts toward cognitive fouling control have been started. Novel tools for model-based fouling monitoring have been mainly developed by the University of Oulu (UOULU). In addition, the development and testing of a novel fouling sensor based on acoustic sensing has been under development by SINTEF.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Development of analytics continues in close co-operation with project partners by testing and finetuning the fouling models with real pilot data, as well as by analyzing the data gathered by the acoustic sensing method during the onsite measurement campaign. The work is now progressing to the final cognitive phase, which involves the development of advanced optimization routines for sootblowing operations, based on the Hybrid Twin technology and online pilot data.

PLAN TO EXPLOIT THE PROJECT RESULTS

Sumitomo SHI FW has its own product family of digital services available for power industry, and we are continuously looking for new fruitful approaches to complement and improve our existing service offering. The achievements of COGNITWIN may provide one possible route to more advanced, additional digital services aimed at improving the boiler operations.

ELKEM - ELKEM AS

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

In the EU-funded COGNITWIN project, Elkem is partnering with Cybernetica and SINTEF to improve the production process of ferroalloys. Infrared cameras have been installed at different locations in the post taphole process, where molten ferrosilicon is being treated to achieve the correct chemistry and temperature. The application of infrared camera technology and image analysis enables us to estimate the amount of slag tapped from the electric arc furnace during production of ferrosilicon alloys. This information is vital to an on-line mass/energy balance (developed by Cybernetica) that provides recommendations through a decision support system to the operator for each batch of ferro-silicon. The upgrade of the decision support is expected to improve key
process indicators such as yield of metal and quality. In the greater picture, these improvements will allow Elkem to reduce the carbon footprint as well as the production cost associated with the production of ferroalloys.

EXPECTATIONS FROM THE PROJECT

To demonstrate that a more dynamic process support system will enhance quality of the product and increase yield. We can attain this by adding additional process measurements as well as better utilizing the data that are already captured and stored. If successful, the meth-ods and principles may be applied to other parts of the ferrosilicon production process as well for an additional benefit.

MAIN PROJECT RESULTS

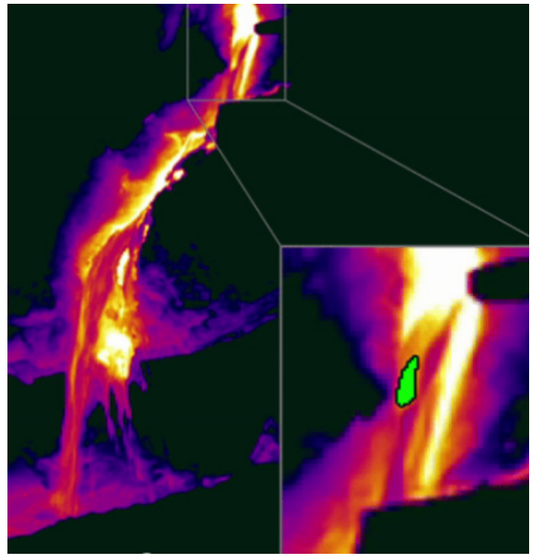
- Successfully installed infrared cameras at different locations along the process route.
- An online simulation model has been installed that follows the process in real-time, i.e. the temperature and composition of the liquid metal is predicted based on “live” process data.
- Algorithms developed for infrared image analysis (slag detection and temperature measurements).

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Collect data from infrared cameras over a longer time span and verify/optimize image analysis algorithms. Continue to improve the on-line model for process simulation.

PLAN TO EXPLOIT THE PROJECT RESULTS

The results from the pilot will serve as a prototype of how a digital/cognitive twin can be used to improve the post taphole processing of liquid ferrosilicon. Upon suc-cessful demonstration of the benefits, the results can be rolled out to other plants within Elkem for a significant improvement of cost position.

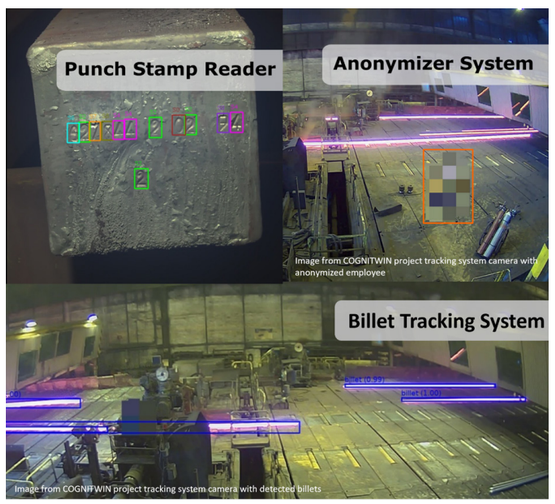


Snapshot of molten FeSi at 1700 °C flowing from the taphole onto the runner and into a ladle, with a small slag particle indicated in green. An algorithm for quantifying the amount of total slag tapped is currently being tested.

Saarstahl - SAARSTAHL AG

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

The Saarstahl AG - with its locations in Völklingen, Burbach and Neunkirchen along with Roheisengesellschaft Saar in Dillingen (Saarstahl and Dillinger Hütte each with 50%) - is a German steel manufacturing company with a global presence on the steel production market. Saarstahl AG specializes in the production of wire rod, hot rolled bars and semi-finished products of various sophisticated grades. These products are important preliminary products for the automotive industry and its suppliers, general mechanical engineering, oil and gas industry, the mining industry and other steel processing branches.
One of the Use Cases in the COGNITWIN project is situated in Saarstahl's Nauweiler rolling mill.



Outputs of Deep Learning models in Saarstahl's COGTNITWIN Use Case

EXPECTATIONS FROM THE PROJECT

The primary objective of the SAG use case is to extend the digital twin of the billet to span the entire production process and enable the twin to acquire cognitive elements.

MAIN PROJECT RESULTS

Billet ID identification: An in-house developed Deep Learning based system recognizes the digits of the billet ID. Combining this output with some 1st principles logic, it provides the corresponding billet ID to other systems.

Anonymizer: An in-house developed Deep Learning based system automatically detects people in the video stream of the blooming train surveillance cameras and pixelates them to prevent unnecessary surveillance of employees.
Blooming train billet tracking: A data driven instance segmentation deep learning network will provide real time information on the location of each individual billet in the blooming train, and thereby a digital twin representation.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Continued work on the blooming train billet tracking system will be the main topic for the remaining part of the project. Aside from that, introducing cognitive elements to the other systems will be continued.

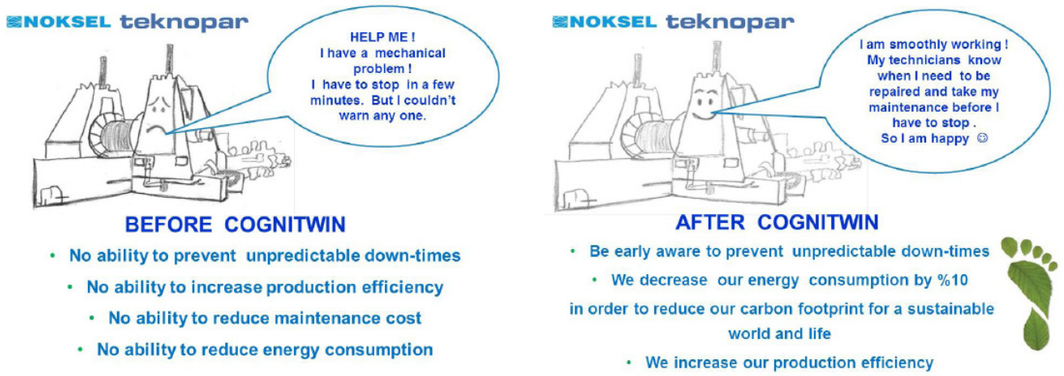
PLAN TO EXPLOIT THE PROJECT RESULTS

Plans for exploitation include running the developed system in the Nauweiler rolling mill and introducing various results to other parts of the production process and other production sites.

NOKSEL - NOKSEL CELIK BORU SANAYI AS

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

NOKSEL serves domestic and international markets by manufacturing spiral welded steel pipes for petroleum, gas, water and piling industries, since 1987 in two plants in Turkey. NOKSEL's İskenderun factory is a pilot owner in the COGNITWIN project. As stated in the Grand Agreement, NOKSEL's role in the project are to: set pilot objectives and related KPIs, assess the existing systems and technologies, conduct gap analysis in between the existing and to-be systems, identify required networking, gateways and sensors equipment needed to physically connect all relevant system components with network infrastructure for monitoring, diagnostic and data collection/analysis and main operating procedures, elicit requirements for multi-modal monitoring platform, multi-variation data analysis and interfaces of IoT/Edge framework use multi-modal sensors as data sources to monitor components of the SWP machine take part in evaluation, verification and validation of the concepts, requirements and results for cognitive twin functionality and influence, define and plan experimental systems & demonstrations install and test TWIN prototype, evaluate the fully machine learned cognitive digital twin, involve in the Business SPIRE Industry Impact/Exploitation studies, and demonstrate and promote results of the project in the Process Industry sector, take part in project management and educational impact related studies.



Visual representation of our most important results

EXPECTATIONS FROM THE PROJECT

NOKSEL aims to have an AI enabled Digital Twin Powered Condition Monitoring and Control System in Steel Pipe Manufacturing Industry, which enables to predict anomalies, increase OEE, provide predictive maintenance and reduce energy consumptions due to unplanned machine stops. Maintenance predictions will be visualized real time on Digital twin to notify personnel with up-to-date condition of the machinery as well as anomalies and alarms.

MAIN PROJECT RESULTS

The main results of the project obtained so far includes up and running digital twin using the sensor platform, ERP/MES integration, and AI models that are trained by real data. We can now predict time to failure of our machines.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

Verification and validation studies of the digital twin will continue, together with our efforts to provide human experts knowledge. NOKSEL will continue to collect data in order to be able to achieve targeted KPI's and the project's impact.

PLAN TO EXPLOIT THE PROJECT RESULTS

The project results will be exploited in the international and national fairs like the one that we participate in Dusseldorf International Tube Fair between 20th and 24th June 2022, in online platforms and by means of our technical partner TEKNOPAR's efforts and initiatives.

SIDENOR - SIDENOR ACEROS ESPECIALES SL

BRIEF DESCRIPTION OF THE PARTNER AND ITS ROLE IN THE PROJECT

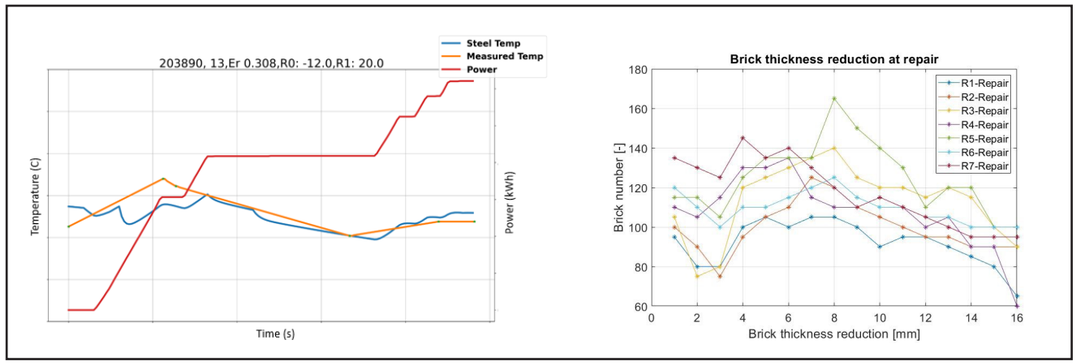
Sidenor is a steelmaker company whose main interests in the last years are oriented to the reduction of emissions and reduction of wastes. These are the reasons why Sidenor is involved in several projects which objectives are the improvement of productivity, energy efficiency and circular economy.

EXPECTATIONS FROM THE PROJECT

The main goal of Sidenor is to increase the working life of the refractory in order to reduce wastes, cost, and improve the security of the people working in the melting shop. This objective will be reach with teamwork with other partners as SINTEF and Nissatech among others.

The analysis done to the production parameters and maintenance data was used for developing two models from the refractory, physical and thermal, which will give information to the operator about the behavior of the refractory bricks and their wear. The final goal is to obtain an objective evaluation of the refractory bricks in order to decide when they must be change in the most reliable way.

The partners are working one step ahead and will introduce the knowledge of the operators, who decide when to change the refractory bricks, into the predictive models. This will enrich the models and give the most accurate measure of the refractory working life.



Results of the (a) thermal model and (b) physical model

MAIN PROJECT RESULTS

The thermal model fits perfectly (Figure a) with the measurements done during the secondary metallurgy, so the prediction of the future heats is expected to be correct. Moreover, the refractory wear is defined with the physical model (Figure b) and we are still studying its reliability, but the values obtained up to now are promising.

NEXT STEPS TO FURTHER IMPROVE PROJECT RESULTS

The on-going work is centered in the possibility of running the models online so that the evaluation of the refractory state could be done after every heat. Once the results are obtained the operator will know if the refractory is in good conditions for producing one more heat or not.

PLAN TO EXPLOIT THE PROJECT RESULTS

The lessons learned from the study of the refractory wear and the development of the thermal and physical models will be implemented in the melting shop. The knowledge will be shared with the rest of the partners and published in several journals.

CONSORTIUM

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