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Digitalisation of foundries – the path towards the future

From Zorc Technology *to* Tvarit*: digitalisation has arrived in the foundry industry. While still standing in the shadow of their sibling sector, the steel industry, foundries have now also realised the potential of digital transformation – driven by the wish to improve the margins of existing business and increasingly by the challenges of decarbonisation. It is first and foremost improved earnings and extension of the service portfolio rather than disruptive new business models that feature on the agenda of foundries. New digitalisation solutions – from the transformation of the blast furnace to the vision of an autonomous steel mill, from digital melting operations to foundry 4.0 – will be a focal theme at the coming metallurgy trade fairs GIFA, METEC, THERMPROCESS and NEWCAST held in Düsseldorf from 12 to 16 June 2023.*

The foundry industry here faces the same challenges that steel production is also confronted with. “Connected digitalisation is a very important topic for foundries. The entry barriers, however, are comparatively high so that penetration levels vary widely,” says Prof. Dr.-Ing. Wolfram Volk, Executive Director of Fraunhofer IGCV. There are more than enough applications for digitalisation in the foundry industry. “Alongside the topics of energy, raw materials and traceability of components as a result of the transformation processes now affecting essential markets (e.g. automotive industry) connected digitalisation is tomorrow’s central challenge for our industry.” There is huge potential to tap into. As one example Volk mentions digital quality assurance. “Digitalisation allows us to systematically infer quality-critical cause-effect relations and, hence, to quickly eradicate and/or prevent quality issues,” explains the professor. In this context he also mentions data-assisted preventive maintenance with suitable methods. Furthermore, process-integrated (soft) sensors could also systematically track the condition of the manufacturing lines. Additionally, digital boundary patterns could significantly reduce customer-specific complaints. According to Volk, connected digitalisation also holds great potential for increasing output volumes by data-assisted optimisation methods or by load management in the energy field.

Zorc Technology: digitalising the melting process

Meticulously timed Industry 4.0 solutions are rather rare in this heterogeneous industry that predominantly comprises SMEs. But there are solutions available for foundries, like the FoundryCloud App by the start-up Zorc Technology, for instance. These software developers specialising in foundries have created a software for controlling metallurgical processes. The software saves the operating parameters of the foundry and directly submits experience and AI-based proposals for optimising production to the staff. By continuously documenting the operating parameters a constantly growing dataset is accumulated that benefits the quality of all following casting processes in this metallurgically highly complex workflow.

Zorc has already succeeded in winning over a major industry player - Dortmund-based induction furnace manufacturer ABP Induction Systems - as a cooperation partner. ABP has set itself the task of digitalising the melting process and uses the FoundryApp on its software platform myABP via a gateway. The Siempelkamp foundry in Krefeld uses it to digitalise its entire furnace operation – the first completely digitalised melting operation in Germany.

Tvarit: Artificial Intelligence for foundries

Casting is a highly complex process and cast quality depends on a high number of parameters. But even the most experienced and best-skilled operators cannot simultaneous change more than 1 or 2 parameters using conventional methods to improve the quality of a casting when pouring defects occur. If more parameters are changed the relation between the influence parameters and the result is lost. In actual fact, during a casting process not only one or two measuring points but often 50 – 60 influence parameters not only have to be monitored but also controlled in dynamically changing configurations. The sheer complexity of the casting process makes it impossible to handle using the conventional process optimisation methods or tools such as CPI or technology optimisation. Here artificial intelligence (AI) comes into play. The strength of AI is that across a cycle of thousands of castings the sensors with millisecond sampling rates (and

hence in real time) can be read and their data can be assessed holistically in view of relevant correlations between influence parameters during the manufacturing process. However, there is one drawback to an AI-only model. Many events cannot be measured with sensors like the solidification behaviour of a melt, for example. And if an event cannot be measured, the AI lacks the data for assessment. Frankfurt-based start-up Tvarit claims to have the solution to this problem: “We close the gap that AI models experience due to missing measuring points using a combination of physical simulations and calculations based on the Finite Element Method (FEM),” says Jürgen Schmiezek, Chief Growth Officer at the AI expert firm specialised in the metal industries.

By its own accounts the Frankfurt start-up markets with ‘Tvarit Industrial AI (TiA) for Casting’ a unique, patented AI platform enhanced with FEM calculations that addresses all essential challenges of foundries. “A both holistic and industry-specific AI platform that is exclusively focused on creating sustainable, waste-free production at foundries and metal companies,” as Schmiezek underlines. The Tvarit AI does not deliver actual forecasts but rather concrete recommendations to every machine for operation and the setting of relevant parameters. With this approach rejects (and, hence, indirectly also the waste of energy and resources) can be reduced by on average 30% in just 2 – 3 months and the energy consumption per casting produced can be cut by at least 15%. This, he adds, increases overall system effectiveness by an average of 2% and, in addition, production can be planned with a view to energy efficiency (Green Planning). The AI platform has already been successfully used at several aluminium and iron foundries from Maxion Wheels to Procast Guss and is said to have led to substantial savings by cutting the number of rejects and energy consumption.

Digitalisation is a managerial task

Step by step towards digital foundries.

In the opinion of Prof. Dr.-Ing. Wolfram Volk, Executive Director of Fraunhofer IGCV, consistency and a central innovation project "connected digitalisation" initiated by the board of management are what it takes. The basis for this is a serious intention on the part of management while providing a corresponding budget and staff and/or partners. Then adapted measures and so-called SMART targets (specific, measurable, attractive, realistic, timed) could bring about successes in a timely manner.

Typical approach

1. Take stock of what already exists (sensors, processes, quality)?
2. Close the digital gaps (record missing parameters)
3. Create a central data-server structure
4. Generate matching, data-driven (process) models
5. Gauge portfolio cost and benefit ratio
6. Infer step-by-step plans involving the complete headcount
7. Control and communicate success continuously
8. Develop a sustainable training and continuous education concept

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