

DIGITAL SOLUTIONS FOR METAL CASTING INDUSTRIES

THE USAGE OF ARTIFICIAL INTELLIGENCE (A.I.)

IN (DIE-) CASTING OPERATIONS

Christian Kleeberg – Managing Partner – RGU Asia Pte Ltd

Dileep Yadav – Director – Foundry Resource Planning and Consulting Pvt. Ltd.

INTRODUCTION

AI = Artificial Intelligence in Die-Casting or better to say in metal casting operations overall is TOTALLY NEW, there are very few players in the market that even consider this, we must be clear here!

HOWEVER, and to make this also clear to all concerned stakeholders:

A.I. IS NOT THE FUTURE OF TECHNOLOGY!

It's the technology of TODAY that's shaping our future in many ways!

A.I. in BUSINESS and in METAL CASTING MANUFACTURING including all metal casting processes involves:

- Process Automation including in the supply chain where machines learn iteratively
- Robotics and machine vision systems supporting image recognition systems
- Automated Quality Management and product assembly with defect detection algorithms deployed
- Algorithms are overlaid on data tables and smart SQL programming allow for “artificial” decision making → “Smart” data utilization
- Many more...

Above topics will be addressed, but now and below are our basics that must be understood FIRST and this includes – without the claim of being complete – all current challenges as well as opportunities:

What is A.I. anyway and WHY is A.I. so vital for metal (Die-) casting foundries?

Aluminium Die Casting is a pivotal process in manufacturing, revolutionizing the production of intricate metal components.

It involves injecting molten aluminium into precisely machined moulds, facilitating the creation of complex shapes with unparalleled precision and consistency.

This versatile technique finds application across diverse industries, from automotive components to consumer electronics.

The lightweight and corrosion resistant properties of aluminium, coupled with the adaptability of die casting, make it indispensable for manufacturing high-quality components that adhere to stringent industry standards.

Several key factors fuel the global market's growth. Notably, aluminium's exceptional strength-to-weight ratio and cost-effectiveness appeal to industries seeking improved performance, reduced weight, and lower costs. Components produced through die casting not only exhibit structural robustness but also enhance fuel efficiency in sectors like automotive and aerospace.

Furthermore, the global shift towards sustainability and decarbonization is reshaping manufacturing practices, with aluminium die casting playing a vital role.

Aluminium boasts the unique ability to be infinitely recycled without compromising quality, aligning seamlessly with the principles of a circular economy.

Incorporating recycled aluminium into die-casting processes reduces energy consumption and minimizes environmental impact, aligning with the values of "eco-conscious" consumers and regulatory mandates.

In this aspect more and more A.I. related (software) applications become essential in mandating the process and being able to manage it using digital tools throughout.

This paper will provide a quick guide on the following aspects and addresses the challenges, certain A.I. techniques, certain A.I. implementation key points and much more.



THE CHALLENGE ALL FACE

Why should (Die-) Casting foundries investigate the usage of A.I.?

It's after all the manufacturing data that is in the foreground where data harnessing using A.I. allows for the optimisation of entire foundry processes. This will shape the metal casting operation by looking at game-changing technology advancements and utilising them e.g. in quality laboratories for enhanced quality. It's that simple.

Scrap increases production costs. A.I. powered algorithms and applications on data analytics help minimise scrap and cuts those costs to a minimum. Think of A.I. as a "*virtual engineer*" that sits alongside the foundrymen and guides their actions. A.I.'s huge value lies in knowing which parameters are the most influential and when and how they must be adjusted. Recent development in and with simulation tools into this direction have shown promising results, but still much R&D needs to be done. In addition, software systems in PPC for example start deploying A.I. powered solutions to improve on such reject analysis and reductions.

System modelling and deployment of A.I. powered software models for better data analytics are another factor that should be considered when investigating the usage of A.I. as an *in-principle* technology.

What is A.I. and how does it work in foundries?

A.I. is intelligence demonstrated by a machine, which includes functions similar to (but not the same as) human behaviours like learning and problem solving. Combined with cloud computing power, an A.I. software solution can analyse far more complex data sets than any human could possibly manage, with hundreds or even thousands of variables in the mix. Above works of course ONLY if all manufacturing data is collected in an integrated system. Once that is settled the application of an A.I. is certainly possible.

Leading system suppliers like the big 3 (SAP / Oracle / MS-Dynamics) are experimenting already with standardised A.I. powered software solutions. But in metal casting these solutions are not widely used since they are not covering downright to the shop-floor the various levels of the required digitalisation. If for example a metal casting organisation has a "level 4" system BUT deploys classical Excel sheets on the levels 1 to 3 (PLC / SCADA / MES) then neither the collection of mission critical manufacturing data nor the respective integrated system utilisation and requirements are fulfilled.

As well as reducing scrap, what else can A.I. do for metal casting enterprises?

A foundry A.I. is "trained" on historic data to work out the relationship between process parameters like metal temperature, pouring time or injection speed and the output of interest. In most cases, this will be the amount of scrap.

The A.I. “learns” which parameters affects scrap and all the possible links between them, building a unique A.I. model of the entire process.

It uses that A.I. model to predict which machine settings and other parameters will deliver stable, high-quality production. Working in real time, software systems can predict the next best action to take before any scrap is produced. So, it does not just predict scrap, it prevents it.

Does A.I. support new business models for foundries?

Absolutely!

Just like 30+ years ago when simulation in metal casting operations was kind of “new” it allowed already then so-called “what if” scenarios using virtual tools. In today’s fast moving engineering environment such tools and approaches are state-of-the-art.

Because A.I. powered software solutions can handle very complex processes, foundries can bid for more challenging castings which normally have higher margins. That helps them move into new parts of their existing market and be competitive. Hence A.I. improves process efficiency, letting foundries produce at lower cost – and so compete with competitors in lower- cost countries.

Is A.I. only for green sand foundries or also for Die-Casting foundries?

No, any casting process can be applied, and much more e.g. in steel making, in alu smelting, in hot-forging and so on. Production data is used and A.I. models are deployed to detect and prevent production interrupts and scrap generation.



THE SOLUTION AND BENEFITS ALL GAIN

What are the true benefits combining it with digital software platforms?

Integration and sophisticated machine learnings allow for deployment of A.I. technologies. Digital software platforms that work in integrated environments support this deployment and that is the biggest benefit today. At this juncture and looking at many die-casting companies globally but very much in APAC and certainly in India, they are not (yet) working with integrated platform systems, hence the deployment success of A.I. tools is limited. That's a fact and will prevail for the time to come.

What is the difference between AI and Industry 4.0?

Industry 4.0 technologies provide the smart factory infrastructure necessary for A.I. deployment, for example, the connectivity and networking that support data collection. A.I. is hence a computer application.

As well as reducing scrap, what else can A.I. do for foundries?

A.I. can help reduce energy use which, along with lower scrap, cuts both costs and CO2 emissions significantly. It can also predict which parts have hidden defects that only become apparent once shipped. Identifying these parts and not shipping them reduces the number of customer returns. Because it increases quality, an A.I.-supervised process will become a competitive advantage. Customers will see that parts made in a process supervised by an A.I. service are inherently better made.

How do you get started?

To be accurate and effective, an A.I. application needs data – lots of it. To optimize a complete process, you need to collect data from melting all the way to final quality control.

But to start your digital journey, just collect data from one system or sub-process. Technologies like that make data collection cost-effective and easy to implement are available and you just plug the box into the machine and your network. There are system providers who have already ready-made solutions.

Would I need to buy a lot of new IT hardware or employ data scientists?

There are many companies that deliver A.I. as a service so there's little or no new hardware and no new staff. Infrastructure, system operation, generating the A.I. models and tailoring them to your process are all part of the service. You can start with a small investment and so a very low business risk, connect machines and gather data, then get the first results in a very short time. Most importantly however is : LEARN FROM IT!

A typical A.I. project installation time is around three months. Clients see results as early as one month after installation. Almost all the work can be done remotely, which was extremely useful during the pandemic. Today many (die-) casting operations however prefer an on-site service.



THE STEPS ALL NEED TO TAKE

Now that we have addressed all the above let us look at the big picture!

Digitalisation of metal casting operations:

It's a MUST DO in order to be future ready and deploy A.I. tools!

In a world that is constantly evolving and changing, digitalisation of operations and processes are no longer “a trend” – it’s a must do necessity!

This is especially valid for metal casting operations, which are traditionally technically intensive, very often manually controlled and in 90% or more of companies operating in still very “old school” manner. So WHY is digitalisation of foundries is so important?

1. Efficiency: Through automation and digitalisation, you can simply streamline and optimise manufacturing processes, which in return leads to a clear and tangible reduction of production times. That includes of course product development as well.

2. Quality control: Via the help of sophisticated data analytics and their respective A.I. tools you are enabled to check quality related issues in real-time monitoring. This in addition allows you to countermeasure immediately without delay.

3. Real Cost Savings: While you are able to monitor your production in real time you also control your rejects better as well optimise your processes. This in return provides opportunity for real cost savings. On the side note please also check if you are aware of your ABC = Actual Base Cost, we published a separate paper on that topic with Alucast India last time.

4. Sustainability: Because we can pin-point in our processes we are in a position to reduce material consumption and hence contribute actively to the environment. Think of it this way, one overflow on a typical die-casting part saved means little or nothing but if considered in the millions of parts produced it means a lot. Sustainability is here the driving force.

5. Competitiveness: In a globalised world and market place digital transformation is taking place throughout all industries and remains relevant in order to stay competitive. Your direct competitor maybe already ahead of you so be on the lookout.

Let's look at the near future: Foundries who invest into digital technologies, digitalisation and digital transformation are laying the founding brick of long-term success. Be it the deployment of I-IOT, Big Data or A.I. tools – the possibilities are borderless.

SUMMARY

Yours to explore! Be inspired! Look beyond! Optimise wherever and whenever you can! Do not stay constant, but evolve and develop! A.I. tools are at your fingertip, you just need to grab them and see IF you can make use of them. AND, if you don't know what to do or who to ask, just goggle it. Your A.I. answer is right there.

