



Whitepaper

Introducing the
Digital Cell.

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A bold new vision for die casting.

Jonathan Abbis, Managing Director Bühler Die Casting, argues that bringing technological advances together with Industry 4.0 and IoT capability in a Digital Cell has the power to create a step change in our industry. And that change has already begun.

Is this the next big technological step-change?

When we look back at the modern history of die casting, there are a number of technological advances that proved to be the catalyst for a positive, sustainable step-change in productivity, efficiency and cost-effectiveness.

The first big change was the introduction of the PLC (Programmable Logic Controller) which led to the first real-time controlled shot in 1989. This enabled a more stable and reproducible production quality, driving efficiency and quality in our industry.

The next big change came with the technological breakthrough of the two-platen die-casting machine in 2007. This new approach enabled die-casters to produce lighter-weight structural parts in aluminum, opening up an important new market area, particularly in the automotive business.

2019 sees the vision for the Digital Cell, bringing all of the individual die-casting components together under one smart digital brain. Bühler believes that this will be the next big step-change – and it begins now.

Imagine

Today, when something goes wrong, your operator has to walk around the cell working out where a problem might be, before trying to fix it. They then need to reset every component.

Imagine having a screen on any smart device that tells you where and what the problem is as well as a home button that resets every component simultaneously, once it's fixed.

Introducing the Digital Cell – a new way to monitor, control and manage the die-casting process

“To achieve a step-change in die casting, it's not enough to focus on single components. To significantly boost productivity, we have to tackle the system as a whole.”

- Jonathan Abbis, Managing Director, Bühler Die Casting

Up until now, digital technology has been used to improve processes within the machine and to collect and analyze data. Companies like Bühler have even integrated some proprietary peripherals such as sprayers, ladlers and robot arms.

The vision for the Digital Cell is to monitor, control and manage the complete cell. This approach could transform die casting, delivering key benefits in foundries around the world:

0% Scrap

By analyzing data points of all key processes in real-time, the Digital Cell will ultimately recognize quality issues and immediately optimize itself to correct the problem. Zero scrap would be a game-changer for the economics and sustainability of our industry.

40% reduction in cycle time

At the moment, about a third of average cycle time may be taken up with the thermal management processes. Harmonizing micro-spraying, conformal cooling and infrared cameras within the Digital Cell will significantly reduce cycle time – potentially by as much as 40%.

24/7 uptime

Today, when there is a problem in a process, the cell may detect it, but it cannot proactively do much more than halt the process until it is fixed. The plan for the Digital Cell is for it to use machine learning (ML), artificial intelligence (AI) algorithms and other technologies to make smart decisions, without the need for intervention. Imagine the cost and productivity advantages for 24/7 uninterrupted production.

A solution for the 3D problem

Finding skilled operators prepared to work in a loud and noisy foundry environment is one of the biggest challenges facing our industry today. The 3D phenomenon – Dangerous, Dirty and Demanding – is a barrier to recruitment around the world. Finding skilled people prepared to work through the night in this environment to support 24/7 production is a particularly difficult.

The Digital Cell could help solve this problem.

It will give operators and managers the best possible information when there is a problem that needs an intervention. This will include a clear explanation of what to do and how to do it, minimizing the skill level and training people will need.

In fact, the Digital Cell could be so easy to use it won't even need special training. Intuitive prompts will enable people to operate, reset and repair, quickly and easily.

Not that intervention will be required very often. The Digital Cell will be more robust and stable. ML and AI will potentially correct issues before they become a problem.

Alarms, alerts and data will of course be available on any device (who knows what devices we may have), enabling decision-makers to remain fully informed, 24/7, wherever they may be.

Imagine

It's hard to find, train and keep good people to manage machines on the foundry floor.

Imagine a world where your production experts sit in a quiet, clean, control room, responding to occasional prompts. They will get clear information on what needs doing and can often manage interventions remotely.

Communicating with your Smart Factory

One of the biggest benefits of the Digital Cell and its Industry 4.0 infrastructure, is that is ready to communicate with wider Smart Factory solutions that connect with other parts of the process, from customer orders to storage and shipping.

As part of a Smart Factory, the Digital Cell will be connected to the whole production system, receiving information from other areas and sending instructions to improve efficiency.

The exchange of information with other production areas can optimize die-casting production on a machine, across a site, or at a global scale.

So how far away is the Digital Cell?

Given we are a conservative industry and in some way behind the automation frontline in industries like automotive or food production, the vision for the complete Digital Cell delivering 0% scrap; 40% less cycle time; 24/7 uptime may be some time away.

The good news is that significant enabling technologies and services are available right now, as the launchpad for the Digital Cell.

Digital Cell.

Enabling technologies available now.

Here are three important break-through technologies Bühler is launching at GIFA in June 2019, that represent the start of this important step-change for the industry.

1. SmartCMS – the brain for the Digital Cell

If we think of a die-casting cell like a human body, with lots of different tasks carried out by different parts, then SmartCMS is the brain, ready to coordinate all of that activity in the most effective way.

SmartCMS lays the foundation for the smart management of entire die-casting cells, with the capability to collect information from every component and peripheral in a single control system.

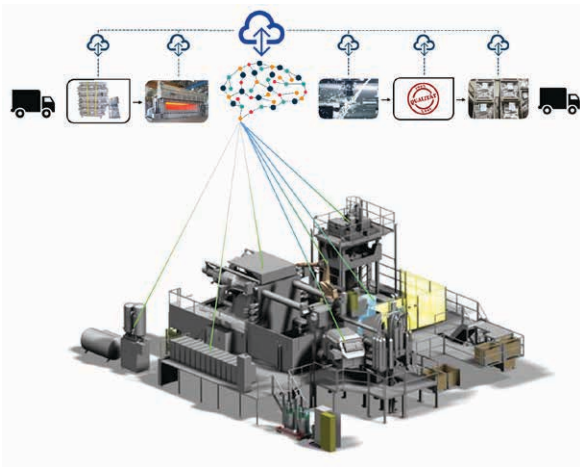


Figure 1: SmartCMS – the brain of the digital cell

Initially available at the cell level, SmartCMS delivers improvements through equipment connectivity, cell automation and operation, centralized alarms, data collection, flexible part flow and recipe management. This can save time and improve up-time in numerous ways:

1.1 Centralized user interface puts the operator in total control

By linking all of the cell components through a single user interface, SmartCMS provides a single screen to view all of the cell components. Real-time alarms and diagnostics can immediately identify a problem, saving diagnostic time and effort.

1.2 Recipe management speeds up set-up and production changes

Recipe management allows operators to set all components from the SmartCMS user interface, making start-up and production changes smoother, faster and more consistent. Operators no longer need to walk around a cell separately setting up robots, sprayers or tempering settings – it will all be done automatically, as soon as a recipe is chosen. Misaligned equipment with the wrong setup within a die-casting cell belongs to the past.

1.3 Home button transforms restarts

After a shutdown, a 'Home button' can reset all components back to their default position, without operators having to walk around the machine or deal with individual components and peripherals.

1.4 Flexible part flow eases production bottlenecks

Changing part of the process, for example, adding or removing a traceability code or stamp applied through a marking device, traditionally takes a good deal of time. SmartCMS enables the user to program different flows and switch between them, saving time and making production planning simpler. Quality sampling, taking one part in every 1,000 for inspection for example, can also be automatically managed in this way.

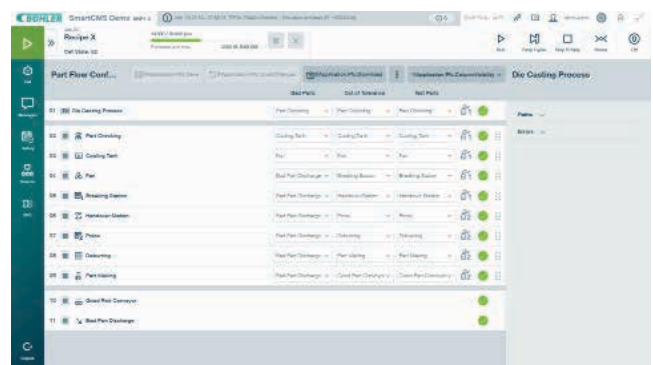


Figure 2: SmartCMS – easy and intuitive user interface

1.5 Automated part rejection simplifies scrap management

SmartCMS also enables the automation of part rejection. If the system detects that a part has not been produced within the set parameters, it can automatically be removed from the process, saving energy and making scrap management simpler.

Using interfaces with a standardized protocol - called BühlerFlex – based on latest technology and enhanced with specially designed connectors for older equipment where required, SmartCMS is designed to accept inputs from virtually any intelligent device, sensor or component.

SmartCMS will be tailored to each customer's specific cell.

SmartCMS as a foundation for the future

Once a foundry installs SmartCMS, it has the foundation for a raft of sophisticated functionality, which is in Bühler's development pipeline over the next few years. Planned developments include:

- Using Machine Learning and Artificial Intelligence, SmartCMS will aim to improve process performance in real-time. At the moment, development is particularly focused on thermal management, cooling, quenching, spraying, furnace control, robots and press trimming.
- SmartCMS will also be able to improve product tracking and traceability, performance analysis and quality control. Using intelligent algorithms and IoT technology with root cause analysis, SmartCMS can identify trends and enhance the management of maintenance, recipes, energy consumption, safety and process flow.
- In addition, its Industry 4.0 infrastructure gives foundries the opportunity to communicate with wider Smart Factory solutions that connect with other parts of the process.

2. Digital Services

The Digital Cell, with its Industry 4.0 and IoT technologies can create opportunities for a wide range of digital services, aimed at improving die-casting performance.

But capturing the data is not enough. Crucially, algorithms need to be based on deep process knowledge in order to create intelligent services that can deliver real improvements.

Bühler invests nearly 5% of its annual revenue in research and development and has many digital services fully operational in other industries.

Developed with Microsoft Cloud and based on their platform, these services provide a secure, globally available, fully supported data hub for an incredible range of services.

Three of these services will soon be launched for die-casting customers:

2.1 Die Casting Dashboard

The Die Casting Dashboard offers a visual platform for machine monitoring, alarms, remote support and historic performance data. Available 24/7, anywhere, this is a first important step to giving foundry managers and owners timely information and strategic insights.

From performance of individual cells during specific shifts, to comparison of scrap or overall output between cells, the Die Casting Dashboard can inform decision-making at any level.

2.2 Predictive Analytics

Using ML from data gathered from sensors on each cell, Predictive Analytics calculates "engineering parameters" of key machine parts and suggests scheduled interventions to avoid expensive and time-consuming failures. Moreover, it also archives historical machinery conditions and facilitates auditing afterwards.

In the near future, data will be collected from the shot unit and the closing unit. This will soon be extended to include even more critical processes to cover the components typically responsible for around 80% of unexpected downtime in the die-casting machine.

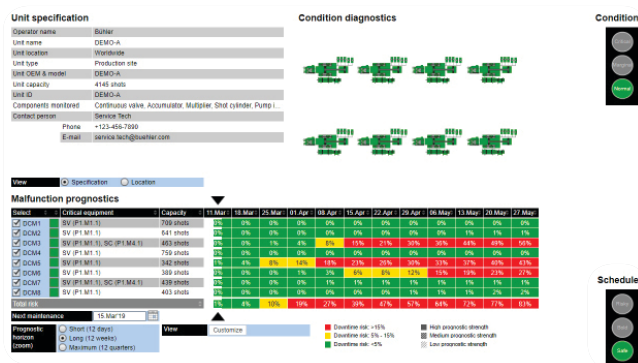


Figure 3: User interface Predictive analytics

2.3 Downtime Analysis

Each hour of cell downtime can cost the foundry a lot. Understanding more about what is causing downtimes and applying proactive fixes can save significant sums.

Downtime Analysis is a comprehensive cloud-based failure analysis tool, providing root cause reporting from the die-casting machine. Analysis can help to reduce downtime on a single machine. It can then inform changes on other machines within the foundry, helping to drive best practice. Whilst data is provided on several the die-casting machine parameters, an extension to cover the entire cell is planned in the near future.

3. Thermal management enhancements

Efficiency is at the heart of the Digital Cell. As part of SmartCMS, Bühler is working on the development of enhanced algorithm that use the consolidated cell data to continually optimize itself for best cell performance, whilst reducing cycle times.

3.1 Die tempering and cooling

At the moment, die tempering and water cooling are often standalone functions. New Bühler machines with SmartCMS provide the opportunity to include die tempering into a control loop at a much higher level than today and supplier independent. This can help to drive improved efficiency, ensure repeatable quality, avoid unscheduled downtime and preserve the life of the die.

3.2 Infrared monitoring

Using an infrared camera mounted on the machine and connected to the SmartCMS creates the potential to provide real-time temperature data across the die.

This infrared camera data displayed on the SmartCMS user interface as a live stream can inform the operator of necessary changes. The next step will be to provide customers with a one-time stamped thermal record for each individual part for analytics, quality control and traceability, at the touch of a button.

3.3. Microspraying

The industry is already seeing that micro-spraying can cut cycle time, improve sustainability and costs. By connecting micro-spraying back through the SmartCMS, producers can benefit from better visibility and control.

Technology supported by applications experts

The vision is for digital self-optimization to constantly refine processes. In 2019, we are not there yet. That's why Bühler backs up these services with a global Applications Technology team and Technology Centers around the world.

They support customers by analyzing performance on-site, simulating die design and cooling models, refining spraying processes, running live tests on products and training foundry staff. One example was reduced scrap for a customer by 25%, by altering machine parameters and adjusting the cooling concept.

2019 – the step-change is here

Compared with other industries, die casting has been slow to adopt the power of digital. Now, in 2019, with digital technologies applied by experts who understand the processes, the time is right.

Whilst the vision for the Digital Cell is driving development for the future, the first steps to this breakthrough are here right now. Some of them will be launched at GIFA in June 2019.

This is undoubtedly the dawn of an exciting new era for the die-casting industry.

Bühler AG

CH-9240 Uzwil,
Switzerland

T +41 71 955 11 11

die-casting@buhlergroup.com

www.buhlergroup.com/die-casting