

The **simulation** phase is a **key moment** in the die manufacturing process.

The results need to be clear, providing fast response times. Simulation software should be easy to use, making it simple to share results with key project personnel. It should simulate the process on a detailed level, keeping all variables in check, assisting the designer in each phase of the development of the die. Castle meets these needs via **4 independent modules**, which come into **play** in the various design phases.

### WHY CHOOSE CASTLE?



#### PARTNER IN DESIGN

Castle Mind supports the designer in making key choices and throughout the casting/die configuration phases.



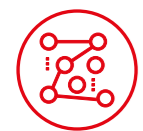
#### COMPATIBLE

Import, modify and export all leading 3D formats (Step, Parasolid, IGES, SolidWorks™, Catia™ SolidEdge™, and many others).



#### USER-FRIENDLY

An intuitive interface enables ease of use by both technical departments and foundry staff.



#### DUAL PHASE

Through the use of dedicated algorithms, Castle software can accurately simulate air behaviour, showing both the flow and any air entrapment.



#### INVESTMENT

Offering a modular and easy-to-use format and reduced operating costs, Castle provides immediate results - guaranteeing a rapid return on investment.

**[castle]**  
MIND

Simulates the production scenario which the die will operate in, providing crucial information to ensure it is developed correctly.

**[castle]**  
RUN

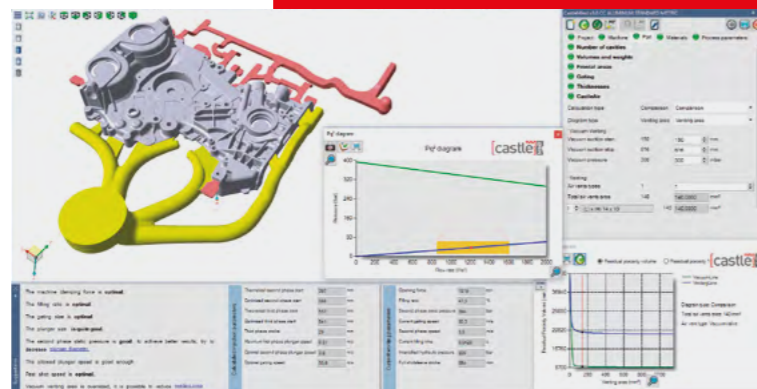
This module allows the user to carry out a simulation of a single runner, in order to optimise a section or quickly assess alternative solutions.

**[castle]**  
BODY

Simulates filling and solidification phases whilst taking air flow into consideration.

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THERMO

This module simulates the thermal cycle of the die.



Castle Mind simulation

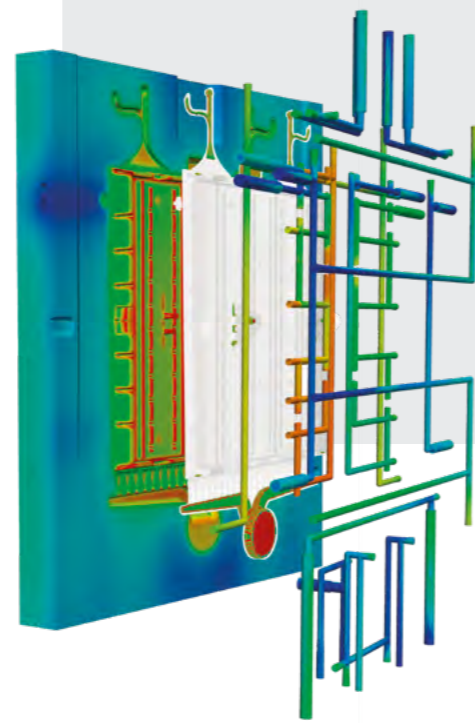
**[castle]**  
THERMO

An innovative approach for the **realistic simulation of the thermal behaviour** of the entire die.



#### FLUID FLOW SIMULATION

Thanks to the **simulation of the flow in the cooling channels**, the thermal exchange within the die can be realistically and automatically calculated at any position or moment in time.



### + MAIN FEATURES

- The full die thermal simulation is now **available to everyone**.
- Setting up the simulation is **fast and easy**, even for the most intricate of dies.
- The simulation is **extremely accurate**, and considers every possible configuration from the simplest to the most complex.



#### ADVANCED MODELLING OF LUBRICATION CYCLE

Complex **lubrication operations** (such as the movement of the lubricator head) **can be modelled in detail** in order to preview the thermal effect of the release agent spraying on the die. In the same way, the effects of air blowing and natural convection in the intermediate phases can be taken into account.



**[PiQ<sup>2</sup>]**  
Developing Expertise

**PiQ<sup>2</sup> S.r.l.**  
Founded in 2011, PiQ<sup>2</sup> develops and supports software solutions for foundries and the die casting industry.

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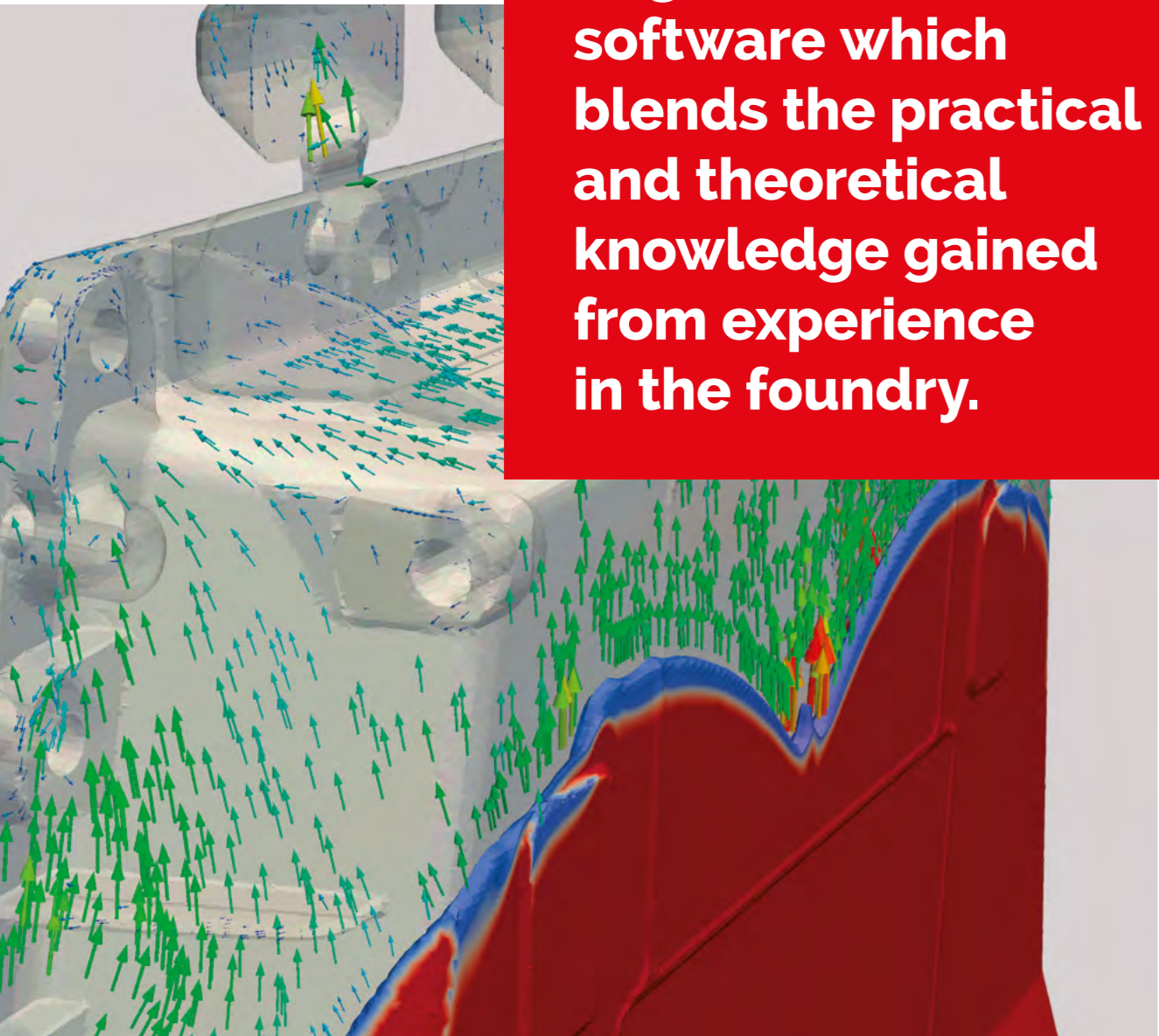
**piq2.com**

# [castle] DIE CASTING SIMULATION





**We develop cutting-edge simulation software which blends the practical and theoretical knowledge gained from experience in the foundry.**



Castle is a software application created by PiQ<sup>2</sup> for the aluminium, zinc and magnesium alloy die casting process. It allows for **accurate simulation of die performance** in all its operational phases, providing comprehensible results that can be used to optimise output.



Innovative software solution that **combines mathematical concepts** from fluid dynamic principles **with experience** gained in die manufacturing and the foundry.



**ASSISTS THE DESIGNER**  
Assists and optimizes the **dimension and shape of the gates and vents**, according to the type of casting and the expected quality specifications, number of cavities, alloy type and size of the die casting machine. **Suggests the optimum piston diameter** and **automatically fills out the machine parameters datasheet**, as a guideline to be sent to the foundry or to be used for realistic filling simulations.



**PERSONALISED MACHINE DATABASES**  
Provides a **complete modelling service of a machine's equipment**. The machine is described in terms of its geometry, its closing force and based on its performances and injection dynamics. Verifies if equipment is able to reach a pre-determined parameter, adapting the calculation to the actual machine performance and suggesting the best compromise.

## + MAIN FEATURES

- **Direct data entry** from the die geometry (volume, density, surface areas).
- Provides **highly practical results in real time**. Preparation of the model and optimization calculation are rapid.
- Evaluates **critical** design features and process **reliability**.
- **Calculates optimum injection parameters** to improve productivity, reduce setup time and maximize part quality.
- **Interactive practical suggestions** help to optimize the die and the process. Able to predict the real working scenario of each given die on each specific machine.



**ASSISTS THE FOUNDRY**  
Enables **any defect** verified in production to be **identified** as a result of the die, the machinery or the process, and to indicate any potential corrective action. **Helps to maintain casting quality** over time and **reduce the impact of fluctuations** in process parameters which are difficult to control. **Assists in reducing die wear** and metallization phenomena.



**STEADY STATE CALCULATION**  
Provides a **complete map of flow pressure and speed** which helps to identify the trajectory of metal flow, any turbulent flow, gates which aren't working as expected, air traps and bottlenecks.



**TRANSITORY, TWO-STAGE CALCULATION**  
The software allows the operator to **optimize** the **first phase** speed profile to reduce air entrapment, and to define the optimum settings for the start of the **second phase** for a more uniform filling of cavities.



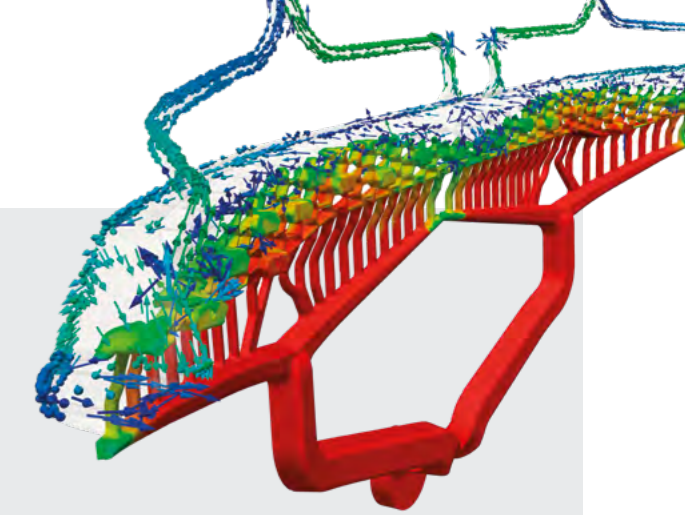
**Dual-phase solution:** simulates the combined action of a liquid (metal) and a gas (air), two elements with very different behaviour and density. Prepares the mesh calculation and sets up the simulation in a few minutes from any kind of geometry.



**HYBRID MESH**  
The **internal mesh** is made up of **regular hexahedrons** (with a high level of accuracy and calculation speed), whilst **elements close to the surface** are adapted in order to **replicate the exact original CAD geometry**. To improve the modelling and capture detailed elements, the mesh can be refined in localized, more intricate areas.



**PARALLEL CALCULATION**  
It's possible to launch **calculations in parallel on multiple processors**, exploiting 100% of CPU performance. This represents a significant time saving and the possibility of obtaining results which are compatible with development requirements.



## + MAIN FEATURES

- **Complete 3D CAD modelling functions**, to quickly modify the geometry of the casting.
- **Easy preparation and setup** for calculations.
- **Unlimited parallel, multi-processor calculations** without additional costs.
- **Extremely accurate results** to easily identify conditions which may result in early deterioration of the dies.
- **Highly automated hybrid mesh** - the fast, powerful parallel calculation is carried out by the CPU and reduces manual work/input to a minimum.



**BIPHASIC SIMULATOR**  
**Air, liquid metal and their emulsion can be modelled simultaneously.** The behaviour of the air flow during filling can be simulated so that even the smallest air entrapments can be identified, avoiding blisters and surface defects, to optimize the shape, section and design of the ventings as well as the injection profile.



**SOLIDIFICATION SIMULATOR**  
Allows the user to **take into account potential interactions** between the porosity generated during filling and the ones deriving from the solidification process.

## + MAIN FEATURES

- **Validation and optimization** of the casting runner geometry.
- Preparation of model and simulation in a **few minutes**.
- **Intuitive visualization** of the flow of metal in the channels.
- **Verification of the correct sizing** of the gates and the metal flow direction entering the cavity.

