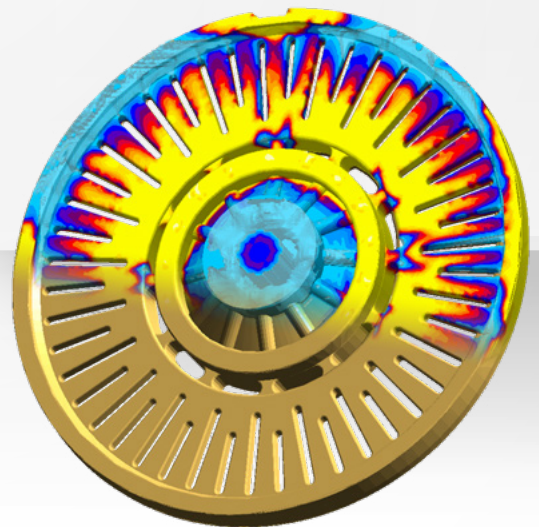


AUTONOMOUS ENGINEERING™

CORE + MOLD

- Eliminate scrapped cores before they become a reality
- Improve casting quality by improving core quality
- Balance production costs with core quality
- Quickly identify variables that impact core quality
- Consider process variability
- Consider the entire shooting and curing processes



THE MAGMA APPROACH



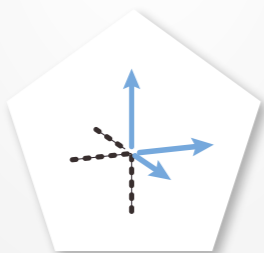
Targeted, Systematic Path to Success

Successfully navigating the highly complex core making process doesn't just happen by chance... it requires a game plan that will get you to your final goals.

The MAGMA APPROACH is that game plan. Simply put, this systematic problem solving method is not only integrated into MAGMASOFT® autonomous engineering, it is the foundation of everything we do as an organization.



SET UP YOUR
OBJECTIVES



DEFINE YOUR
VARIABLES



SPECIFY YOUR
CRITERIA



KEEP THE TASK
EFFICIENT



CHOOSE YOUR
METHOD



ACT & CHECK YOUR
IMPROVEMENTS

SET UP YOUR objectives

You work hard to produce quality cores, meet deadlines and reduce costs. Your job is complex and keeping all of the moving pieces together can be a challenge. We understand this and so does our software.

IMPROVED QUALITY

Every time a core is shot or cured the potential to create defective cores exists. With every defective core comes the threat of increased scrap rates, lower production rates, increased costs, increased lead times and unhappy customers.

ON TIME DELIVERY

Your customers are counting on the castings you provide for their finished products. To meet their goals, you need cores produced on time to make their castings on time. Castings and cores that are produced behind schedule mean lost business for your customer and your foundry.

REDUCED COSTS

Your foundry is one of many in a global industry where your customers are seeking to lower their costs and maximize their profits. To be competitive your foundry must consider the impact of costs on your bottom line including costs related to materials, labor, production rates and poor quality.



“For a couple of years we have been successfully using MAGMA C+M for our sand core shooting process. MAGMASOFT® has helped us to overcome various challenges, from initial verification of process design to an autonomously optimized process that is faster and more cost effective. Working together with the local MAGMA team, we are able to get good solutions and predictions quickly and thus are able to eliminate defects before they even happen. This improved our efficiency significantly.”

– Mr. William Hu, CAE Senior Engineer,
Nemak Nanjing Automotive Components
Co., Ltd., Nanjing, China



DEFINE YOUR

variables

To do your job successfully, you have to understand the effects that many different variables have on the core making process. From tooling and core box design to material properties and machine parameters for the shooting and curing processes.

We understand and consider these variables and how they impact your core quality, production rate and costs.

MAGMASOFT® autonomous engineering can evaluate multiple variables at the same time. These variables can include the variation of any sand core design, nozzle or vent dimensions, process parameters or materials. The software can consider all of these variables while working to achieve the objectives you have set.

MATERIAL

- Sand type
- Sand grain size and distribution
- Sand density and permeability
- Gas type for cold box binder systems

CORE BOX LAYOUT

- Vertical or horizontal parting
- Core and core print design
- Shooting nozzle shape, size and location
- Vent type, size and location
- Sand hopper size and percentage full

PROCESS PARAMETERS

- Shooting pressure
- Sand flow in nozzle and sand hopper
- Phenolic Urethane Cold Box binder systems:
 - Curing gas amount
 - Gassing time and pressure
 - Purging time and pressure
- Inorganic, shell and hot box binder systems:
 - Core and core box heating
 - Blow plate and nozzle cooling
 - Binder water percentage
 - Air temperature and pressure

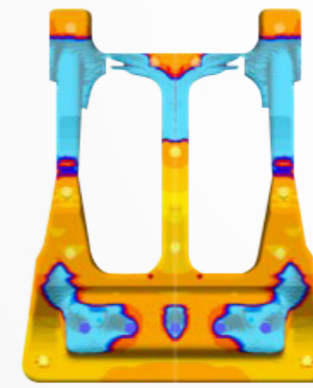
SPECIFY YOUR

criteria

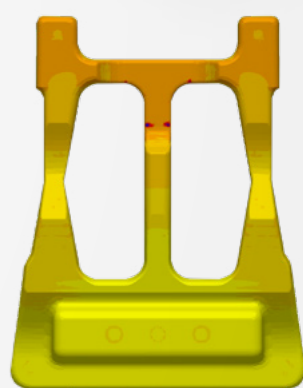
Before a problem can be solved, it must first be quantified and properly understood. MAGMASOFT® considers your entire process and provides quantitative results that measure progress.

CORE SHOOTING

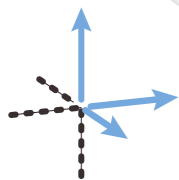
When sand is shot into a core box, there are many opportunities for defects to occur. Analyzing the core shooting process using MAGMA C+M allows you to avoid defects such as lack of fill and poor sand compaction or low density areas. These core defects can lead to costly core breakage and casting defects.



Production core with poor compaction and the corresponding sand fraction result



Production core with improved sand compaction and the corresponding sand fraction result after optimizing the tooling

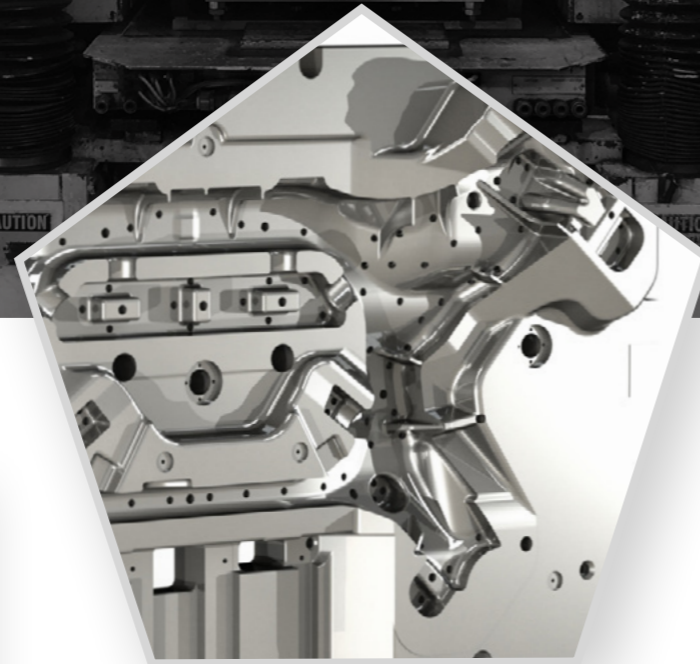


SPECIFY YOUR criteria

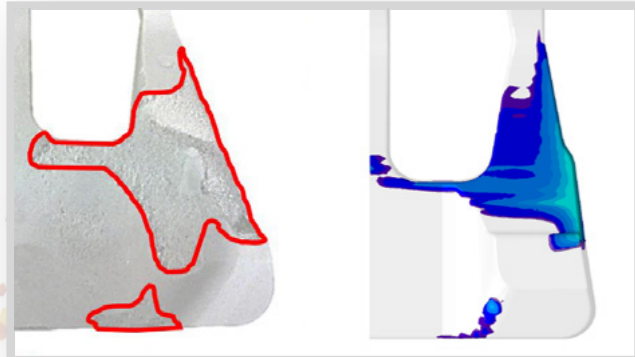
CORE GASSING: PHENOLIC URETHANE COLD BOX BINDER SYSTEM

During the gassing of cold box binder systems there are many factors that influence defect formation, such as: the type of catalyst being used (i.e. DMEA, DMPIA, TEA, CO₂, SO₂, etc.), the core box geometry, vent and gassing nozzle layout and the gassing and purging times and pressures.

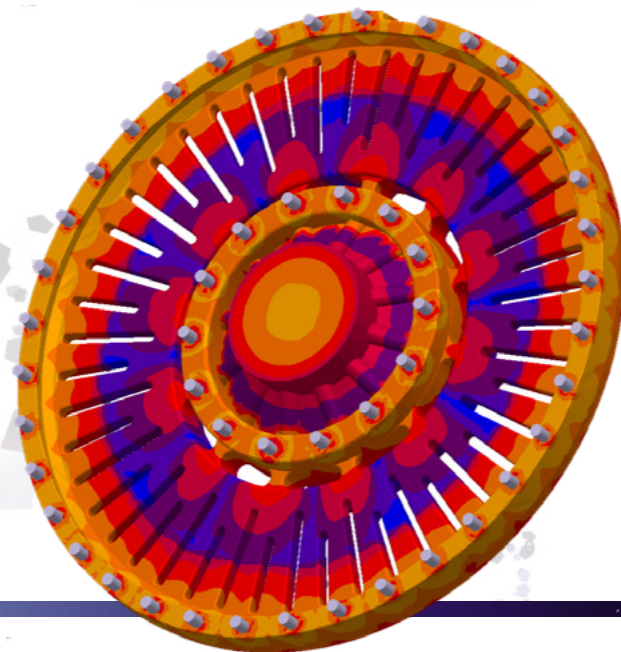
MAGMASOFT® considers each of these variables when predicting core gas flow and reaction with the binder. This allows for the prediction of uncured areas of the core and may lead to opportunities to shorten gassing cycle time and reduce catalyst usage.



PREDICT



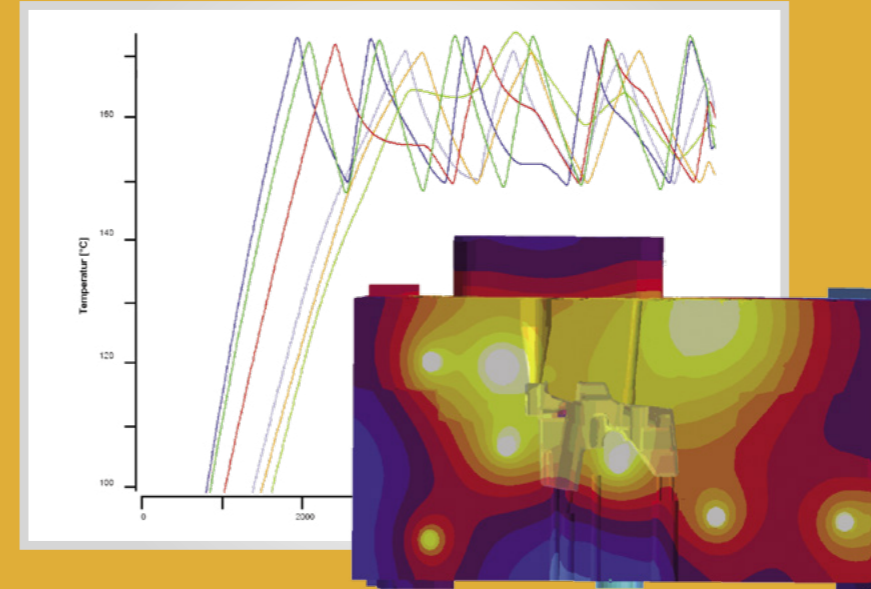
Uncured regions of a production core are circled in red (left), areas of low binder gas adsorption are shown in blue (right)



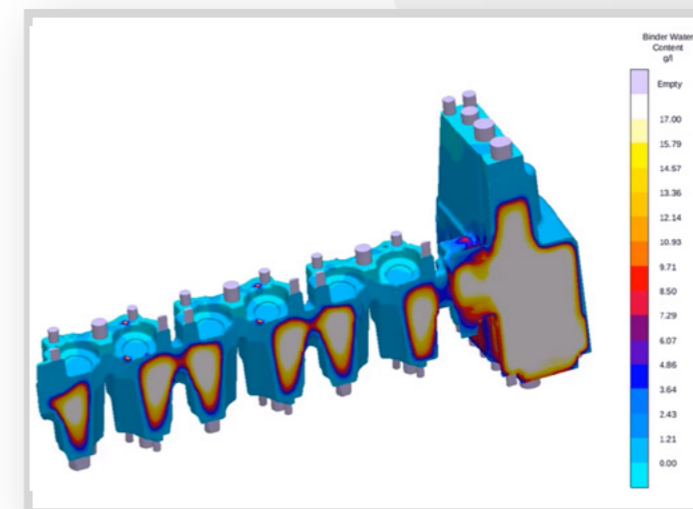
Binder gas adsorption result for a brake disc core

CORE CURING: INORGANIC BINDER SYSTEMS

When curing inorganic binder systems it is critical that all moisture is removed from the core in order to get the binder system fully cured. If the system is not fully cured the core will be at risk of breaking or producing gas defects during the casting process. By observing the core box heating and cooling over multiple cycles it is possible to optimize cycle times and reduce energy costs.



Temperature history at control points as well as temperature distribution in core box and core



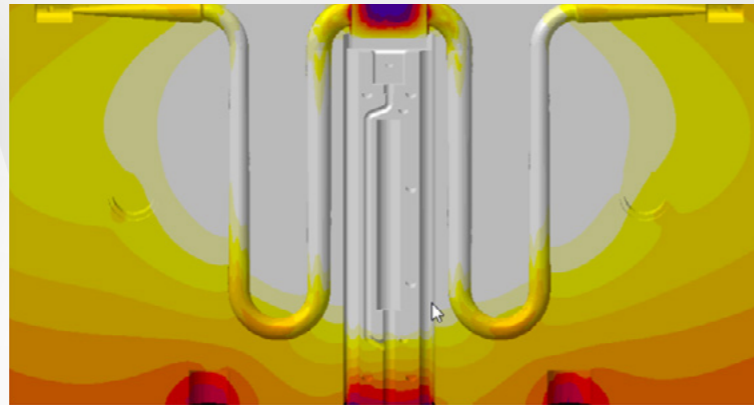
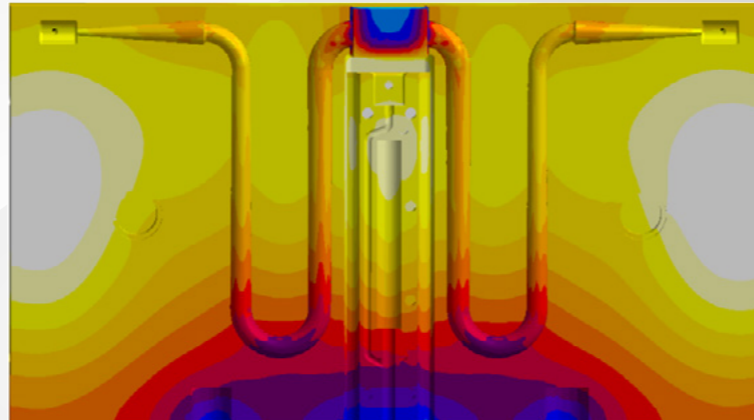
Water content of an inorganic core during curing

SPECIFY YOUR

criteria

CORE CURING: SHELL AND HOTBOX BINDER SYSTEMS

Shell and hotbox binder systems require all sections of the core to remain above a critical temperature for a critical amount of time. If the core is under cured it will be at risk of breaking and uncured binder may create gas defects during the casting process. Simulating the core box heating and cooling during multiple cycles allows for the optimization of heating element locations, cycle times and energy costs.

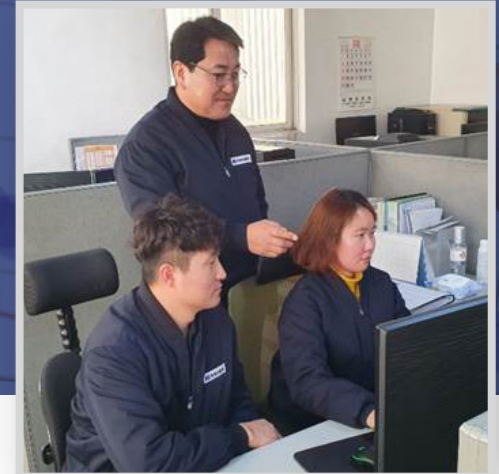


The bottom of the "U" section is not getting hot enough (top), after making modifications the entire core is getting fully heated (bottom)

KEEP THE TASK

efficient

Time and engineering resources are at a premium. You need tools that allow your entire organization to be as productive as possible.



MAGMASOFT® DESIGN TOOLBOX

MAGMASOFT® gives you tools that will save you time and help you to work as efficiently as possible, including:

Tools that save set-up time:

- A library of premade vents and sand types
- Quick and easy meshing of any geometry
- Automated geometry changes when testing different design variables

Tools that save calculation time:

- A queuing system for prioritizing and scheduling multiple simulations or virtual experiments
- Ability to run multiple designs in parallel to reduce processing time
- Scalable multi-processor performance for faster runtimes

Tools that save time analyzing results:

- Data analysis tools for quickly identifying significant variables in virtual experiments
- Comparison of results from multiple designs in multiple views simultaneously
- Automated image and movie generation

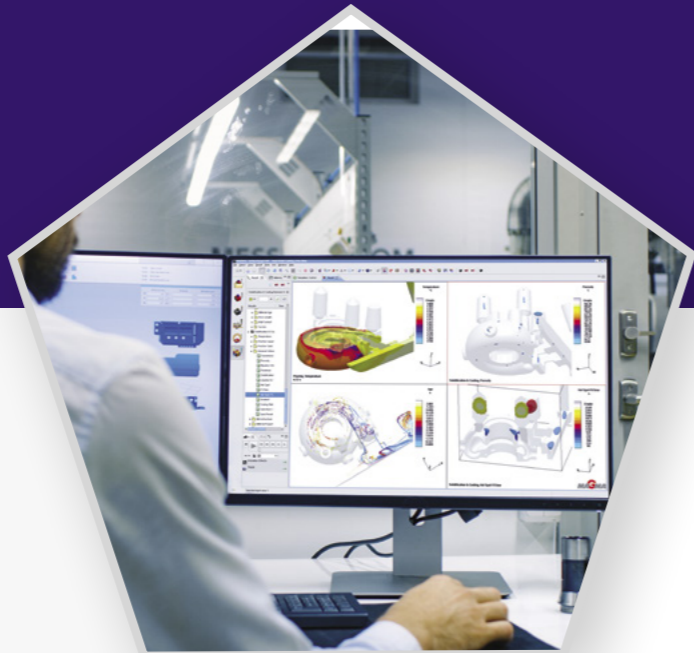
"We use MAGMA C+M to analyse defects and optimize our core shooting processes. It is an essential tool in our day-to-day production as it provide fast and reliable simulation results. We are happy with the technical support provided by MAGMA team, not only for questions relating to the usage of the software itself but also their recommendation and advice on how to optimize our processes."

- Mr. Hyun Sik Park, Director,
R&D Department, Dongnam
Ind. Co., Ltd., South Korea



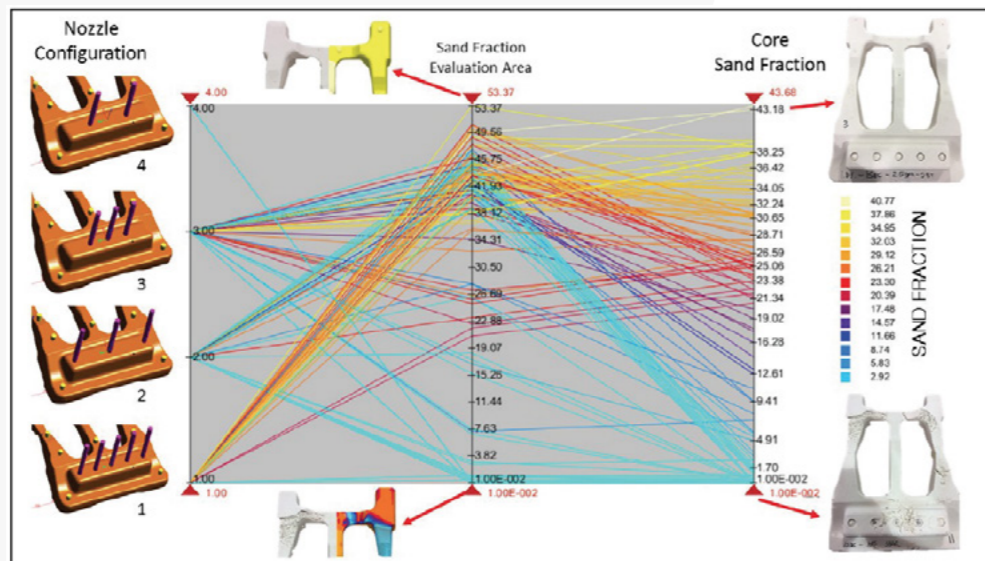
CHOOSE YOUR method

Every project presents unique challenges and requires different strategies to reach your goals. MAGMASOFT® autonomous engineering provides different strategic approaches for each unique project.



CUSTOMIZE YOUR STRATEGY

- Using MAGMASOFT® you can easily define goals using single simulations, design of experiments and optimizations that consider multiple designs at once.
- The influence of many variables can be quickly analyzed when running design of experiments or optimizations.
- Numerical objectives and automated setup help to quickly identify designs that meet competing objectives (i.e. binder curing vs. curing gas consumption).
- Each strategic approach can be used at any stage of product life cycle including:
 - New core and core box development
 - Trouble shooting current production
 - Continuous improvement



The parallel coordinates plot shows the impact that shooting nozzle area has on the sand fraction result for this core

ACT & CHECK

improvements

Success requires more than just Autonomous Engineering™... it requires a team of professionals to help you reach your goals.

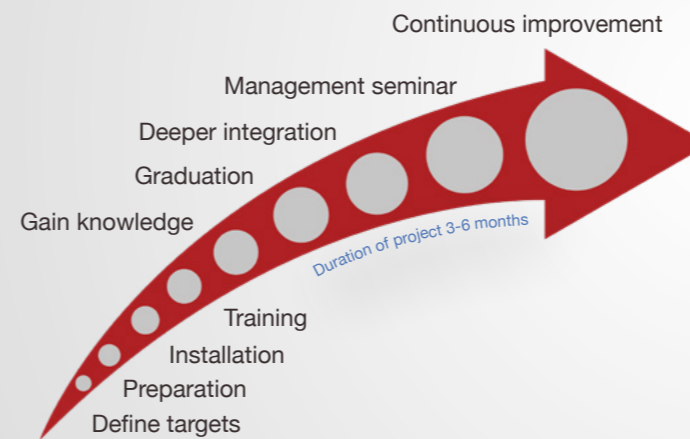
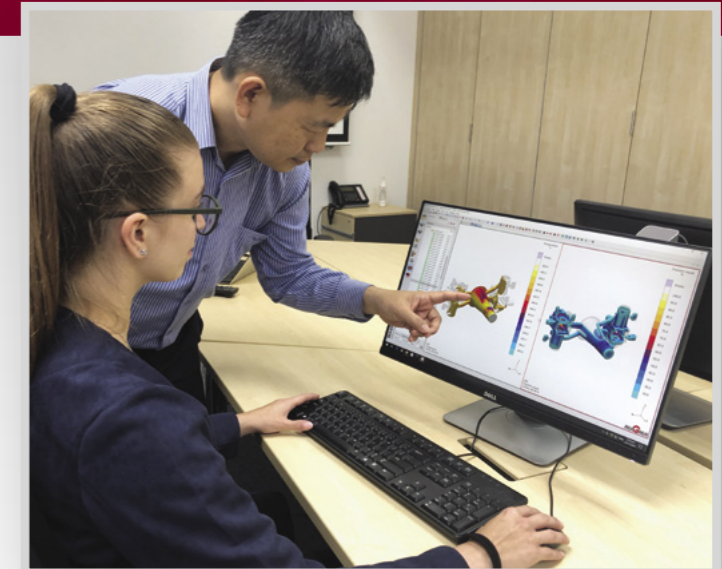
MAGMA provides this team. With our implementation plan, **MAGMASupport**, **MAGMAproject** and the **MAGMAacademy**, we are here to support you every step of the way.

IMPLEMENTATION PLAN

The implementation of MAGMASOFT® autonomous engineering begins with a customized plan that your dedicated Account Manager will review with you on day one.

This plan covers all pertinent information for successfully launching MAGMASOFT® within your organization, including:

- Appropriate software modules
- Hardware requirements and configuration
- Installation & assistance
- Comprehensive training
- Graduation project
- On-site training
- Management seminar



TECHNICAL SUPPORT

Once MAGMASOFT® has been successfully launched at your organization, the implementation plan will transition into an ongoing development plan. Our goal is to establish a long-lasting partnership between MAGMA and your organization.

Our support staff are metal casting experts with a combined industry experience of over 200 years. Our dedicated support engineers will work with you to make sure your organization is consistently meeting its goals, day after day, year after year.



MAGMAacademy

MAGMAacademy is a training and continuing education program at MAGMA. All training and ongoing learning relating to MAGMASOFT®, seminars and workshops are done through MAGMAacademy.



The MAGMAacademy invites non-customers to most of our workshops and seminars, please check out the MAGMAacademy section of our website for more information.



MAGMA interact®



MAGMAinteract® is the 3D-viewer software for visualization of MAGMASOFT® results. It enables the intuitive display of information exported from MAGMASOFT® results within an organization, with suppliers and customers. It also allows quick and easy presentation of information which creates the basis for sound decisions.

Free Download at magmasoft.com.sg/interact

MAGMAproject

Metal Casting Project Engineering Service



MAGMAproject is our engineering service that we provide to everyone who is seeking a comprehensive solution on process optimization using our well proven MAGMA APPROACH methodology together with our experienced foundry engineers, metallurgists and mechanical engineers. We perform several hundred industrial projects yearly around the globe.

Our experts use the full range of the MAGMASOFT® product portfolio to provide solutions. We can help you to:

- Identify the root causes of defects and resolve them
- Improve casting quality
- Increase yield
- Optimize casting parameters
- Reduce production costs
- Get new product knowledge and venture into new markets

We compile and document step-by-step improvements and potential solutions - from a simple solidification simulation to full factorial design of experiments (DoE) or an autonomous optimization of your casting process.



MAGMASOFT®
autonomous engineering