



11-13 September / Eylül 2014
TÜYAP Fair, Convention & Congress Center, **İstanbul**

7th International Ankiros Foundry Congress
7. Uluslararası Ankiros Döküm Kongresi



«MAGMASOFT ile Döküm Tasarım ve Parametrelerinin Otomatik Optimizasyonu»

«Optimization of Casting Design and Parameters With MAGMASOFT»

Birgi Özçelik
(Magma Bilişim)

6.Oturum: Süreçler ve Kontrol

6th Session: Process and Control

Oturum Başkanı/Session Chairman: Dr. Önder Orhaner (Akdaş Döküm San. Tic. A.Ş.)



MAGMA *Dökümün Büyüsü*

MAGMA⁵
Sağlam ve Verimli Dökümler



MAGMA⁵ Rel. 5.3

Yeni sürümde neler var?

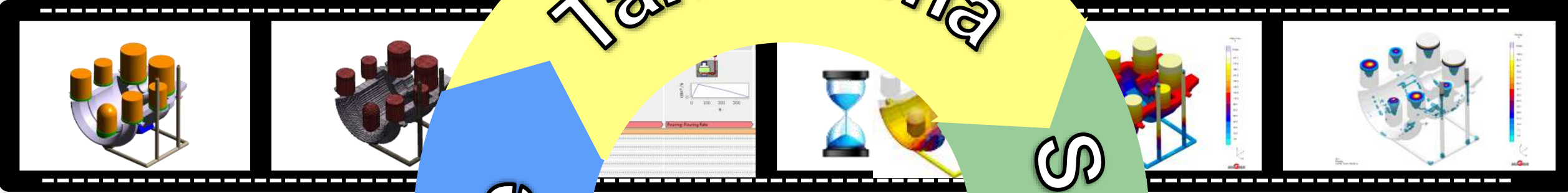


Simülasyon ile ne olacak?

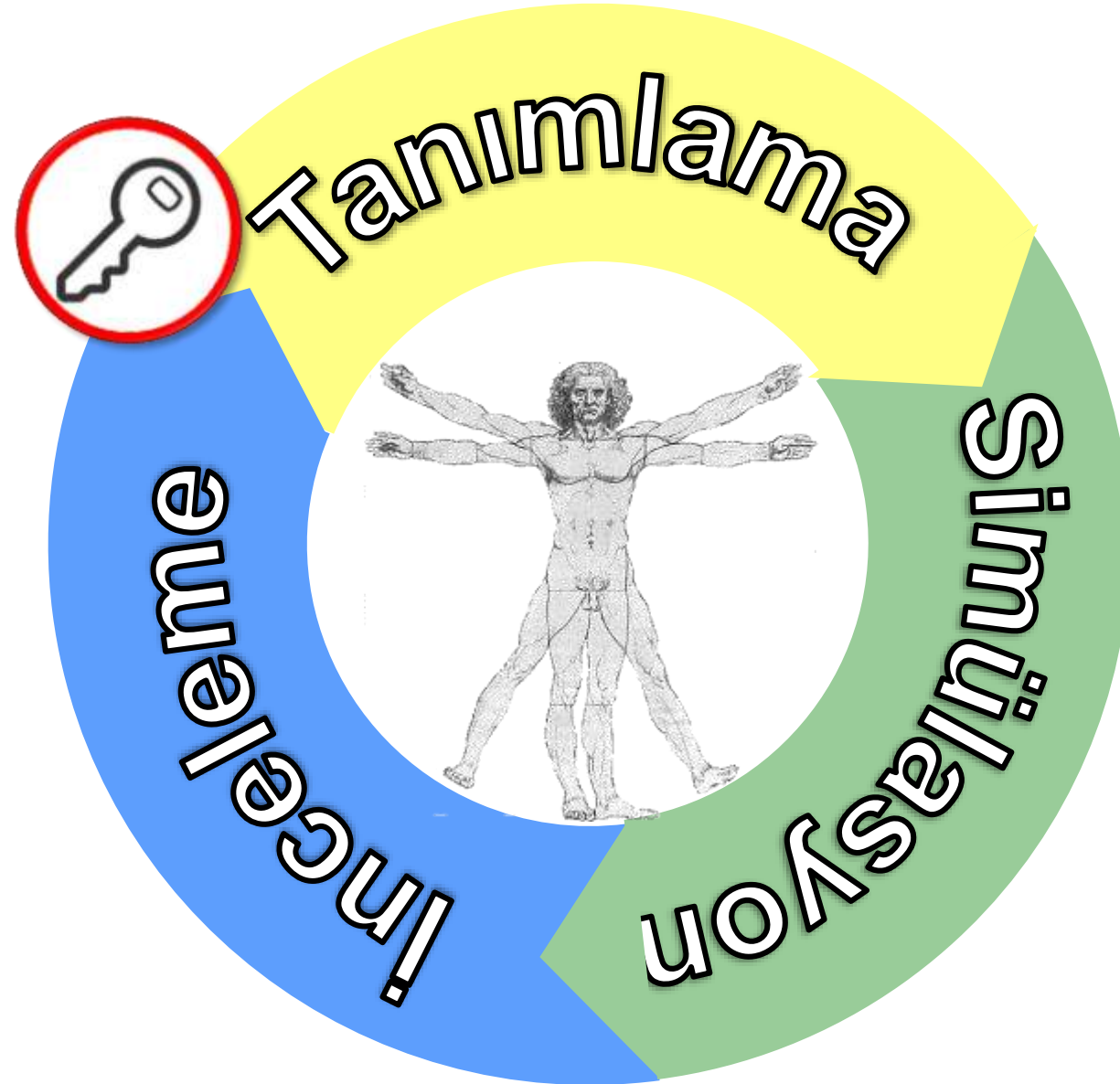
Tanımlama

Simülasyon

İnceleme



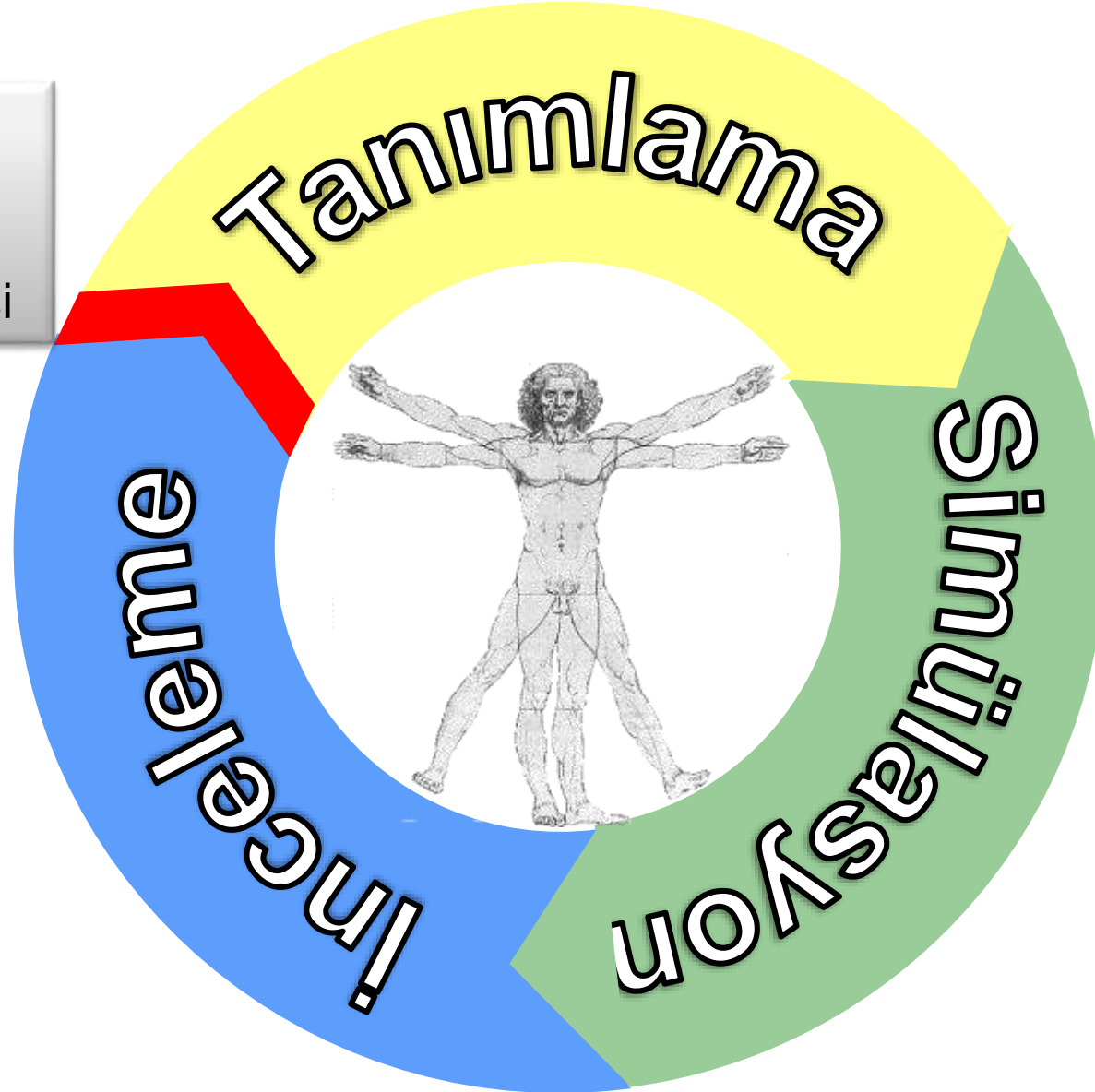
Simülasyon ile ne olacak?



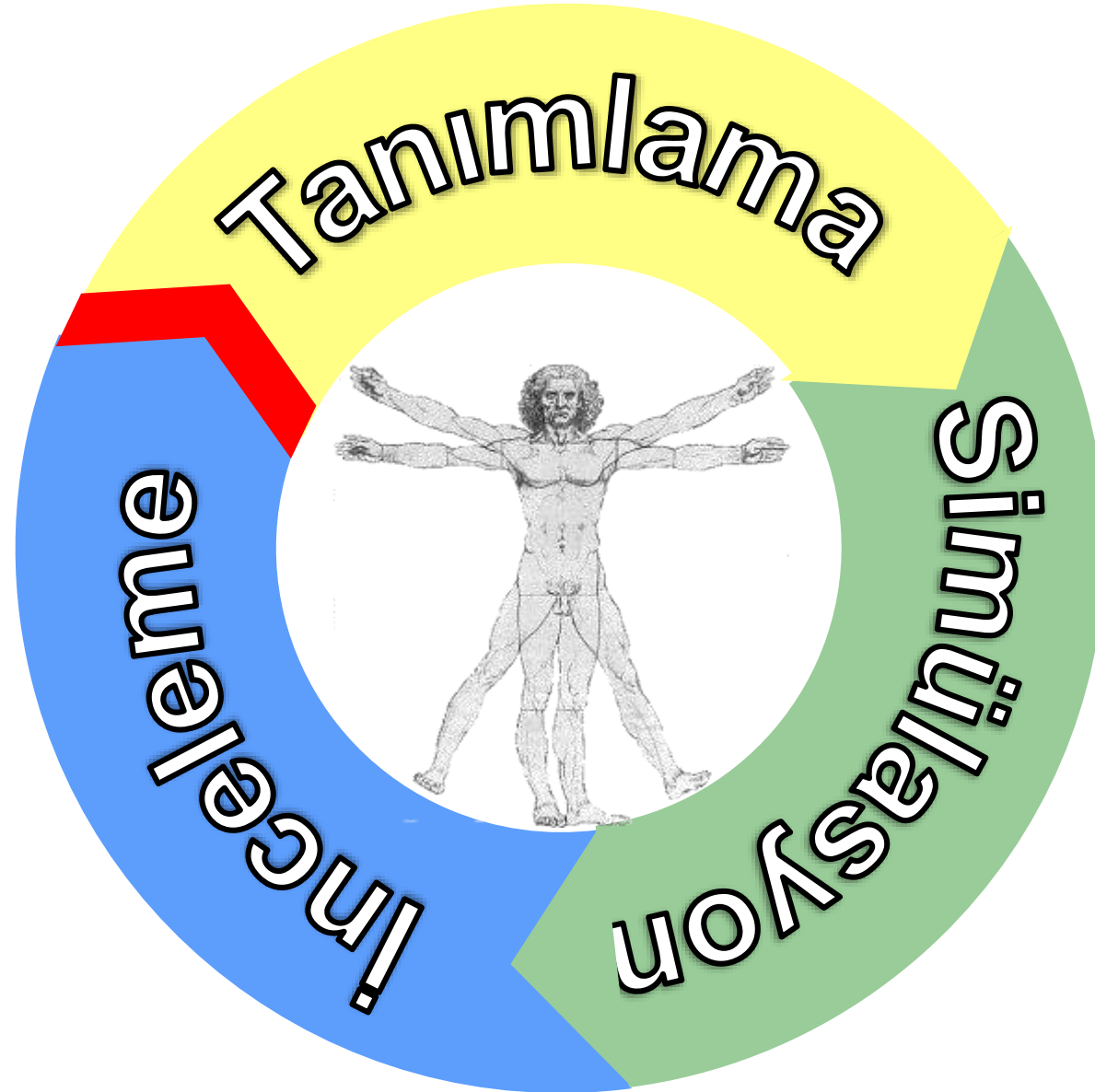
Optimizasyonu Entegre Etme



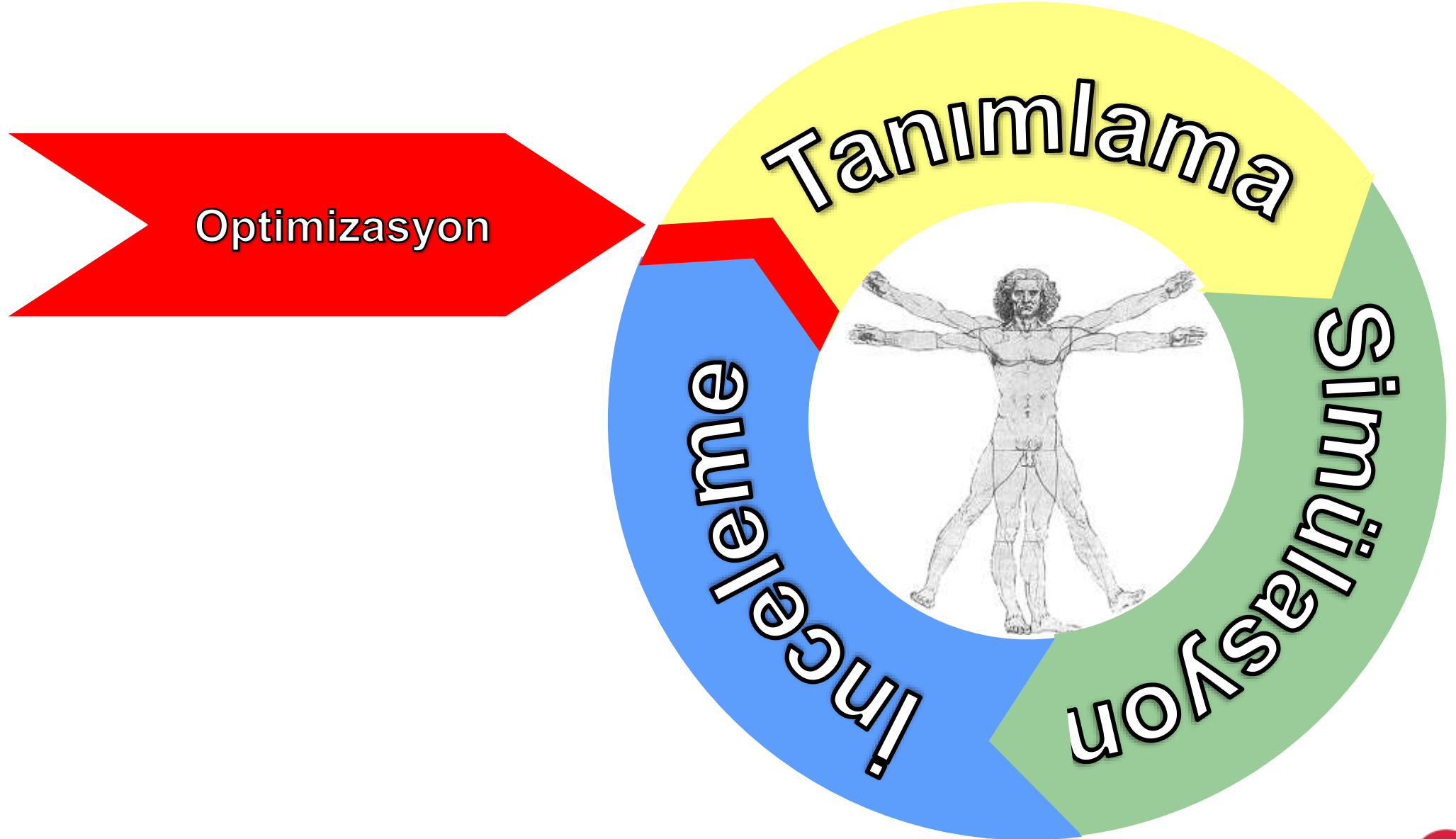
Tanımlama ve iyileştirmelerin bir sonraki versiyonlar için otomatikleşmesi



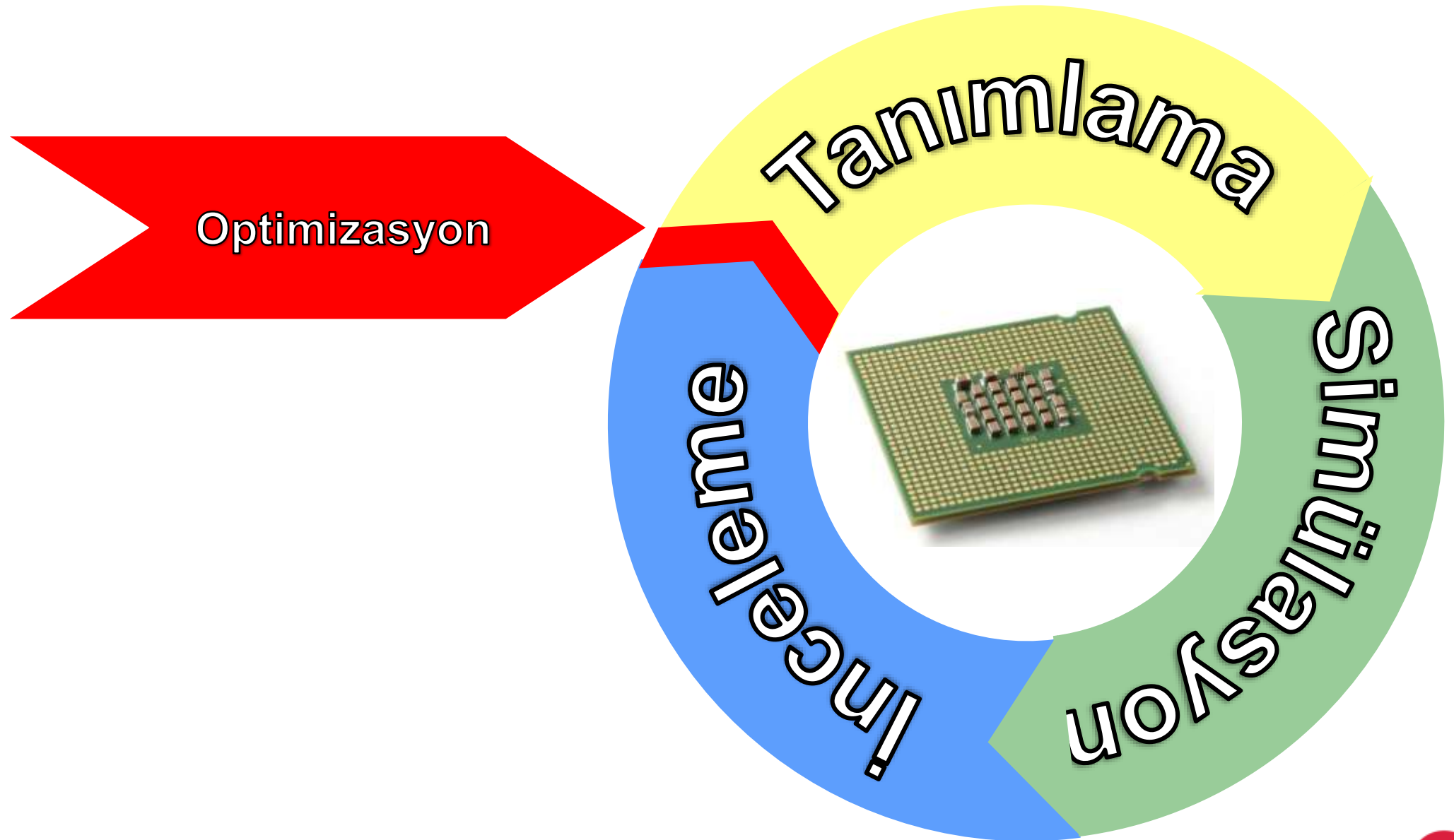
Optimizasyonu Entegre Etme



Optimizasyonu Entegre Etme

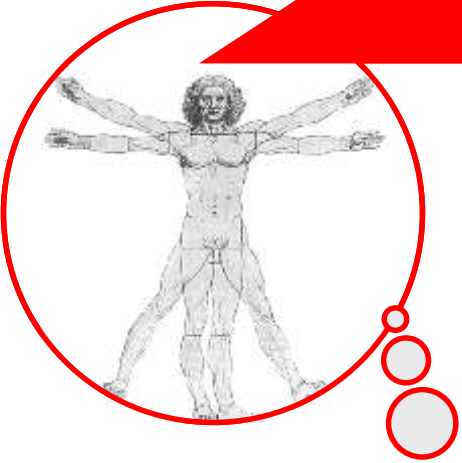


Optimizasyonu Entegre Etme

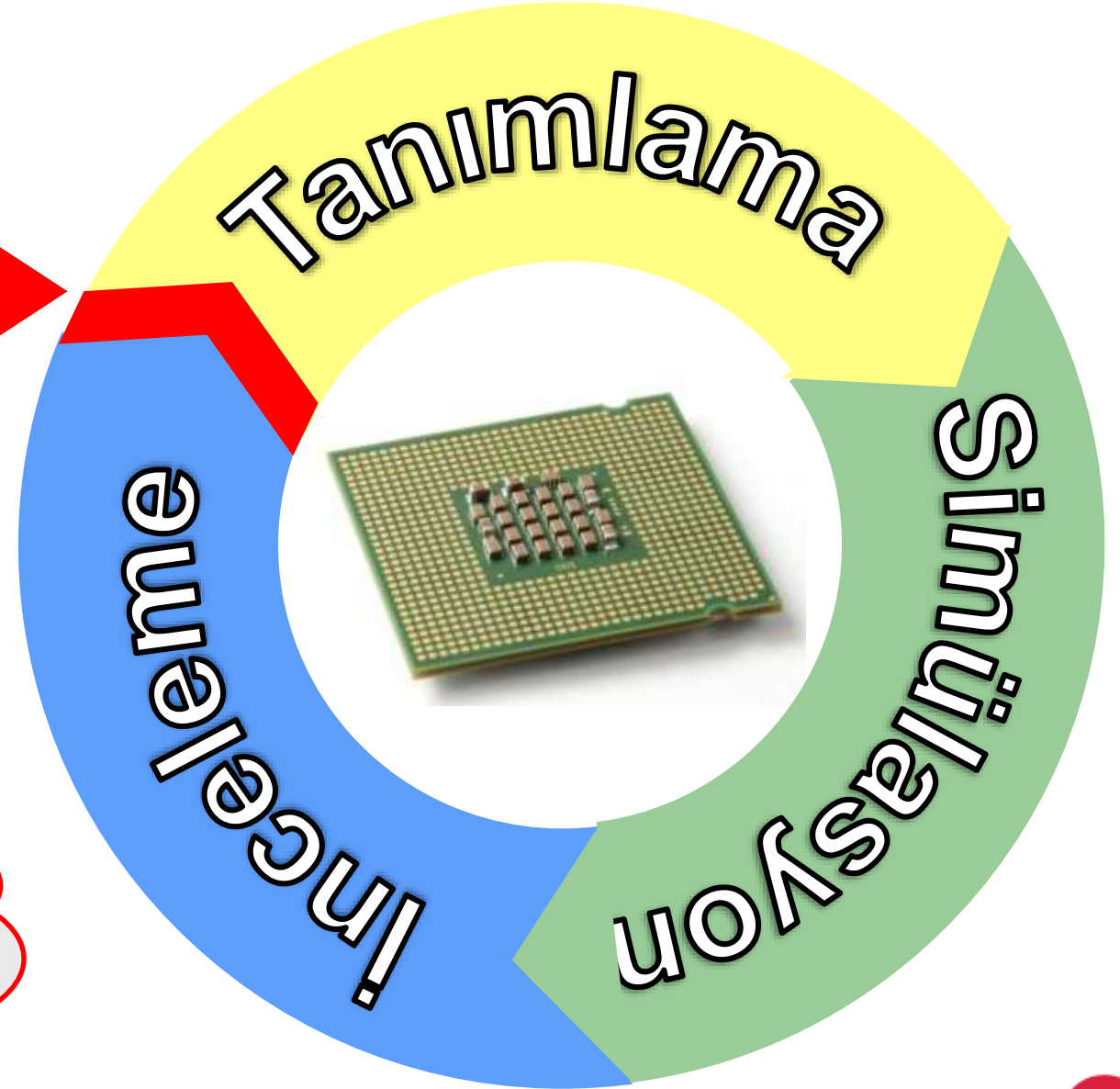


Optimizasyonu Entegre Etme

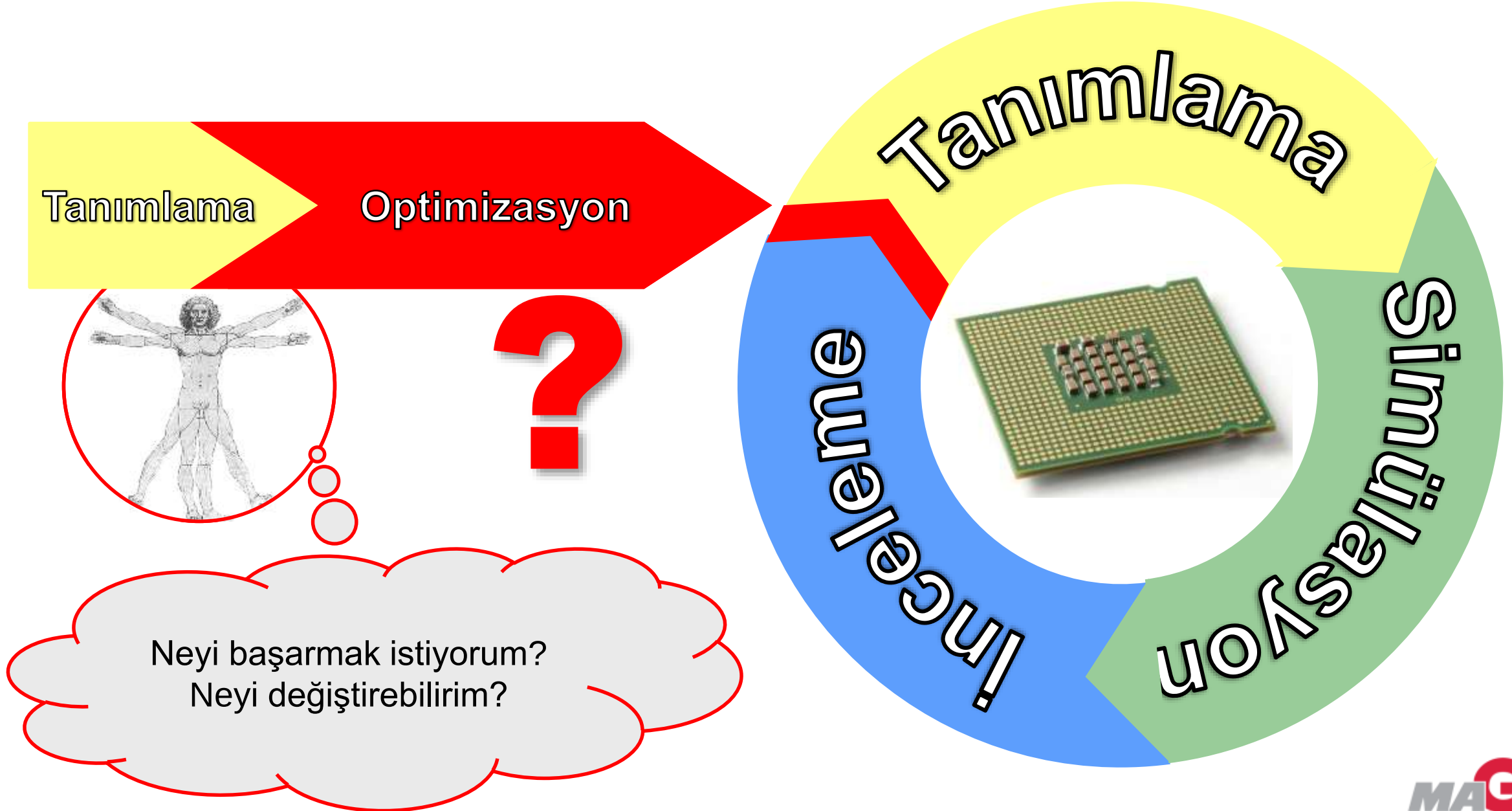
Optimizasyon



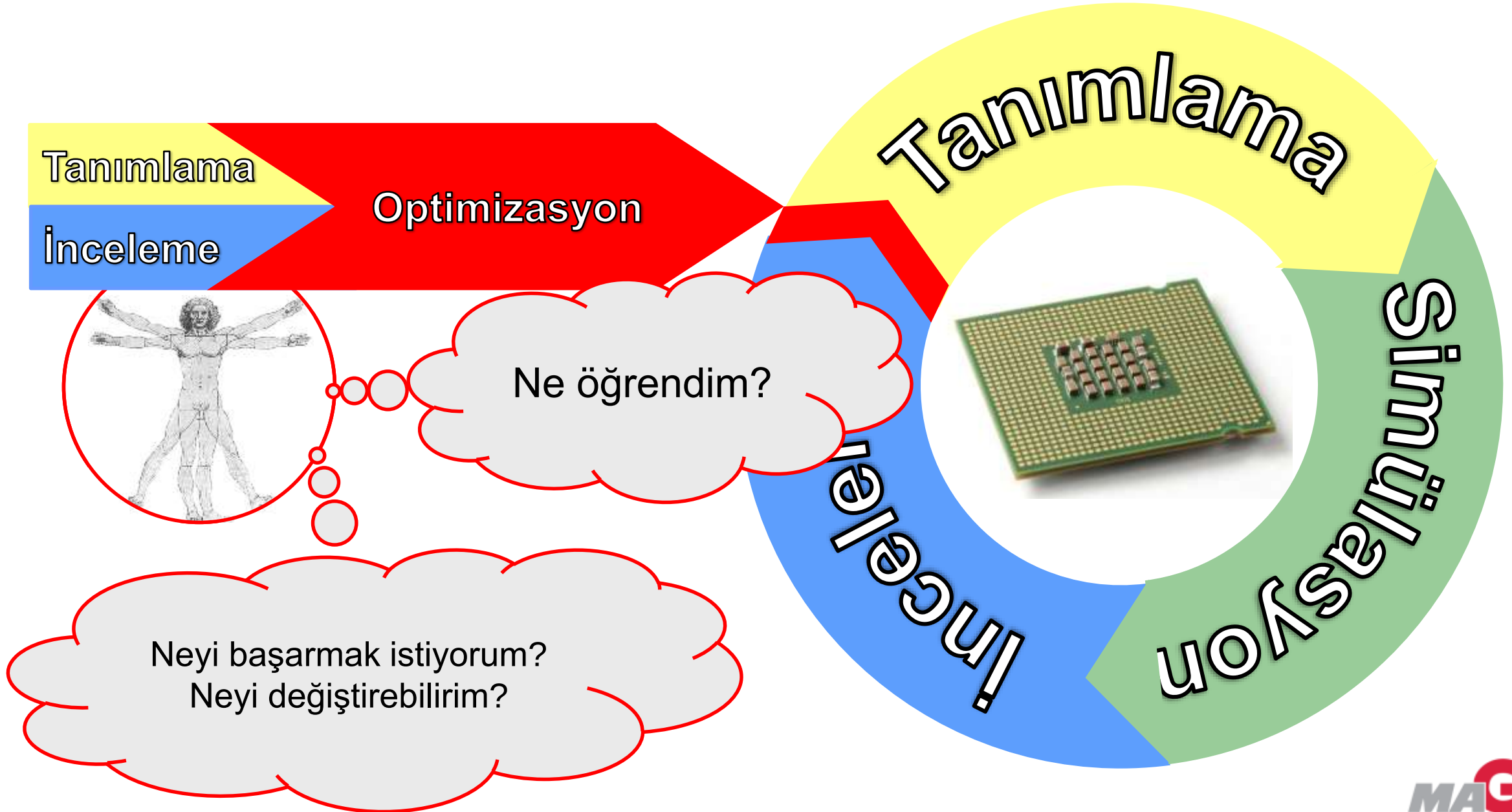
Neyi başarmak istiyorum?
Neyi değiştirebilirim?



Optimizasyonu Entegre Etme



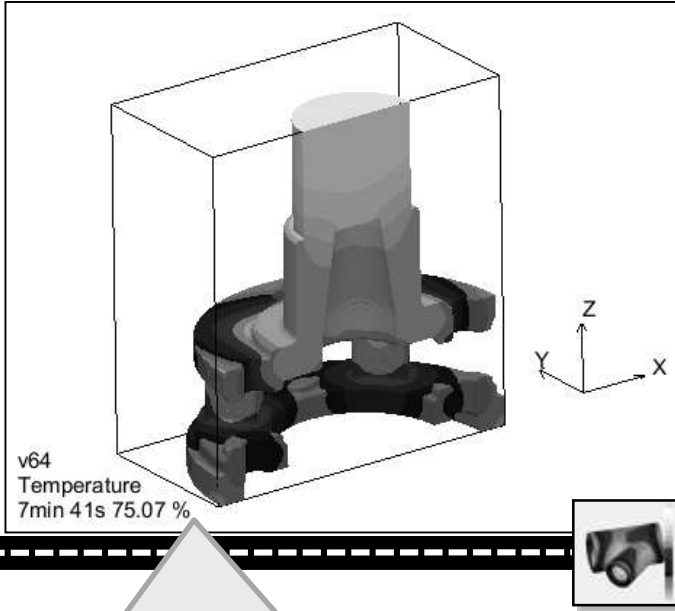
Optimizasyonu Entegre Etme



Bilgi Toplama

Sonuçların İncelenmesi

Rel. 4.4

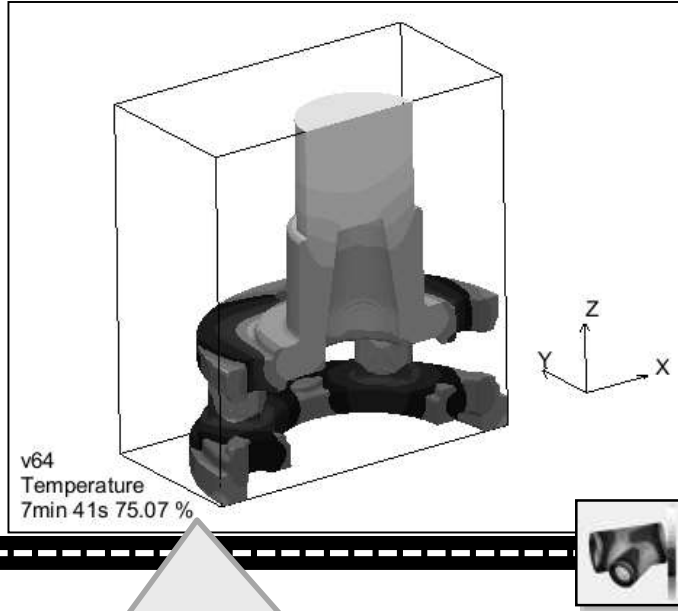


Tek bir sonucun
incelenmesi

Bilgi Toplama

Sonuçların İncelenmesi

Rel. 4.4



Tek bir sonucun
incelenmesi

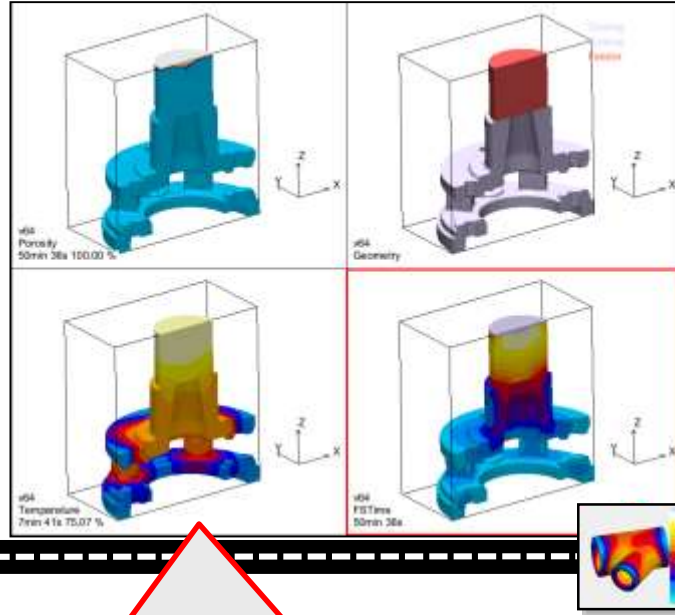
Bilgi Toplama

Sonuçların İncelenmesi

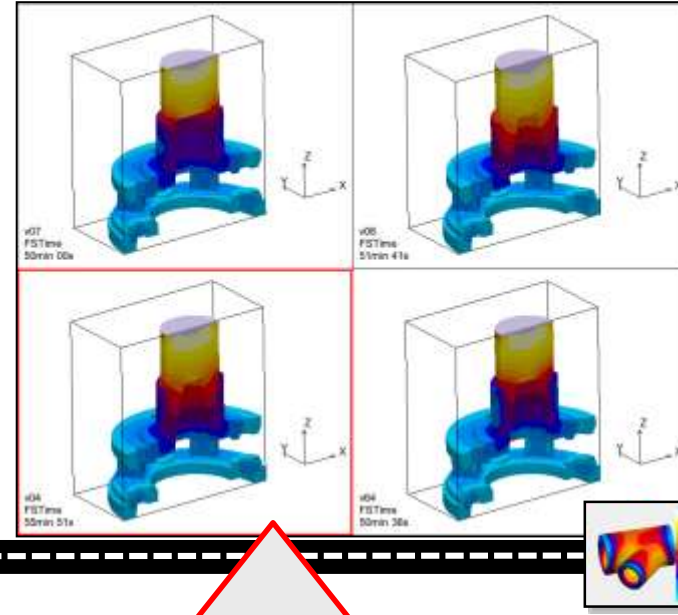
Rel. 5.0 & 5.1

Rel. 5.2

Rel. 5.3



Tek bir versiyon için farklı sonuçların incelenmesi



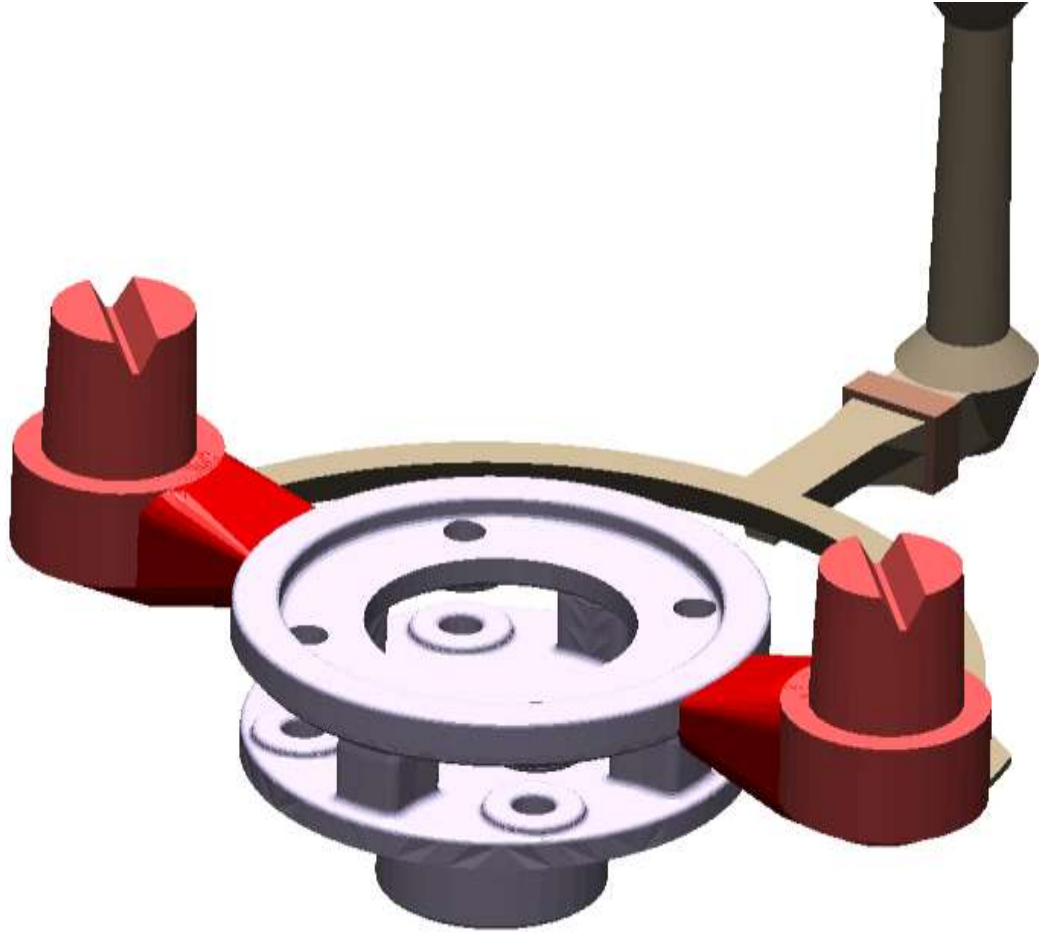
Farklı versiyonlardan sonuçların incelenmesi



Grafiksel ve İstatistiksel Araçlarla Sonuçların Değerlendirilmesi

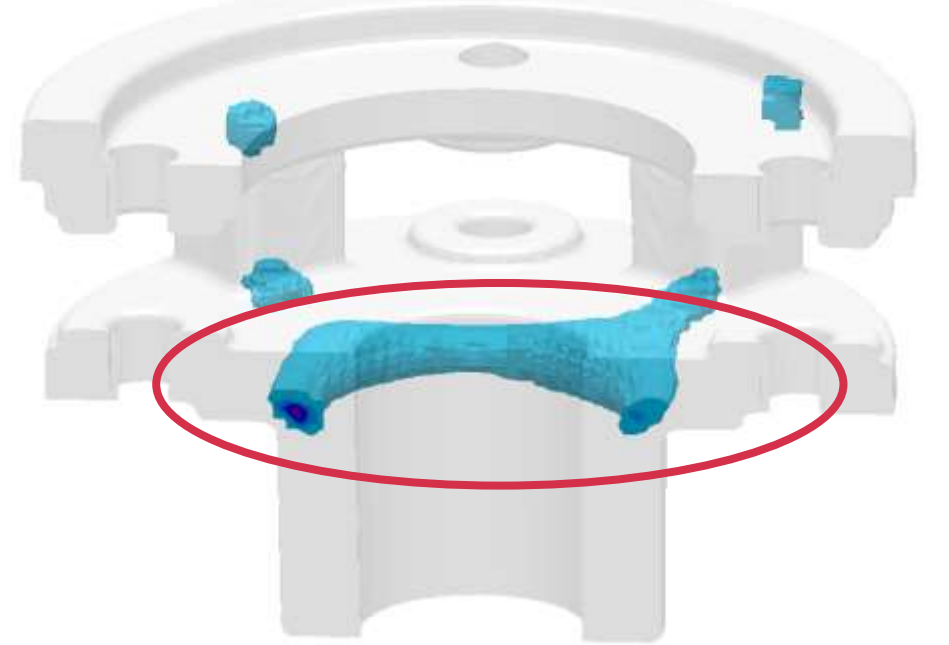
Optimizasyon Örnek

“Sanal Dökümhane” Dökme Demir Parça „Planet taşıyıcı”



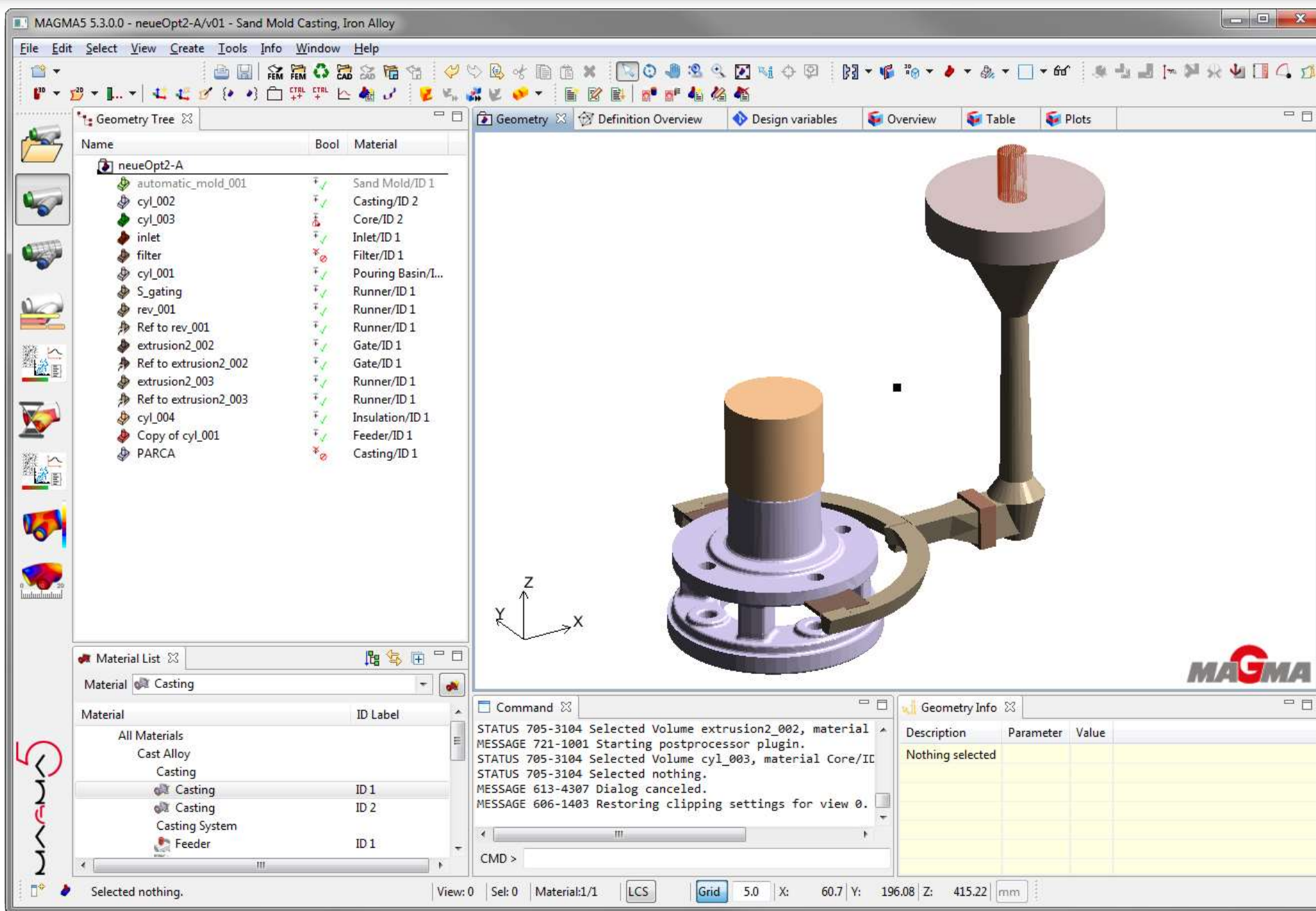
İlk Yolluk ve Besleyici
Tasarımı

Hata Haritası „Porozite”

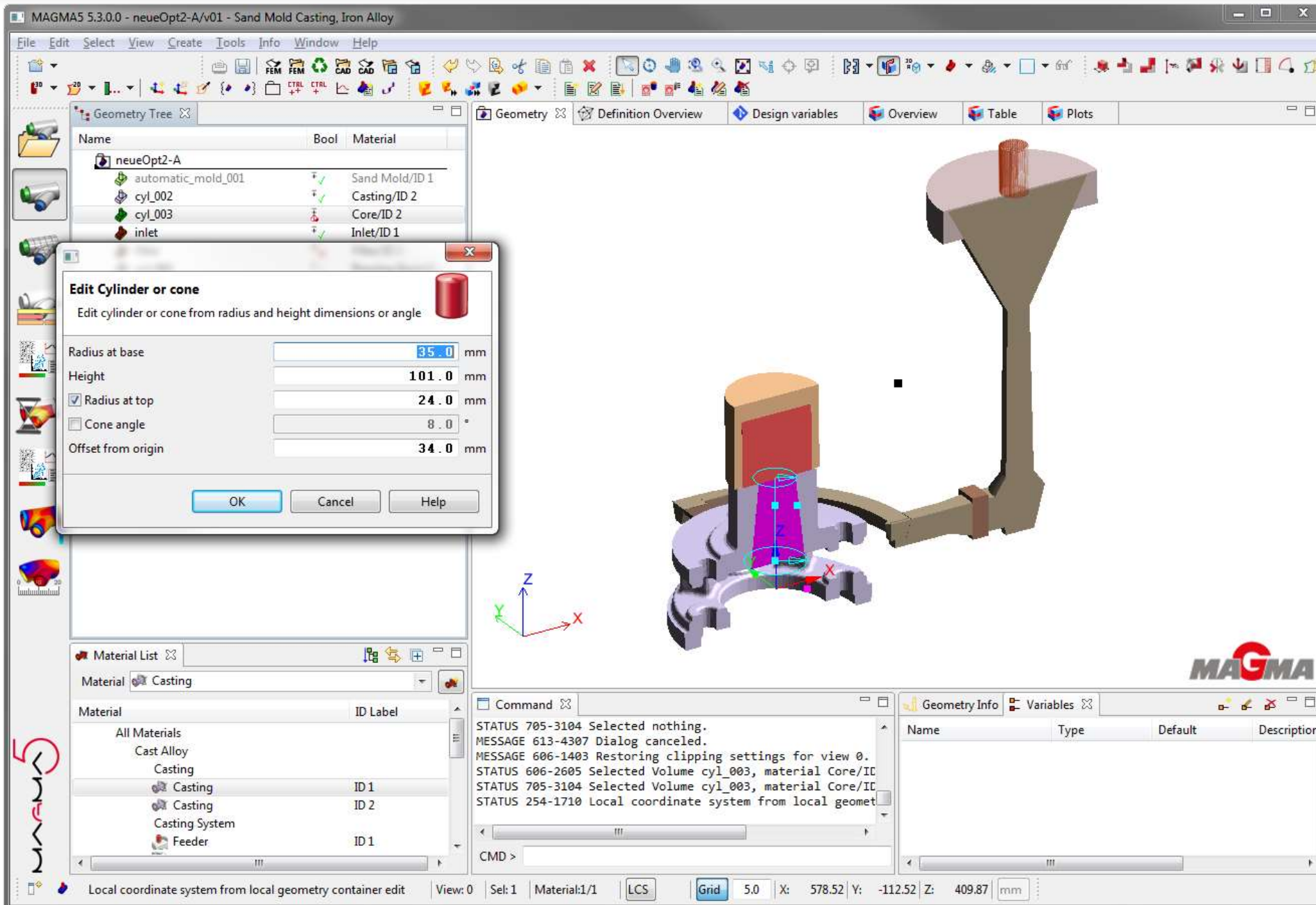


- Hedef:
 - Flanş bölgesindeki porozitelerin giderilmesi
 - Prosesi etkileyen şartların etkilerinin incelenmesi

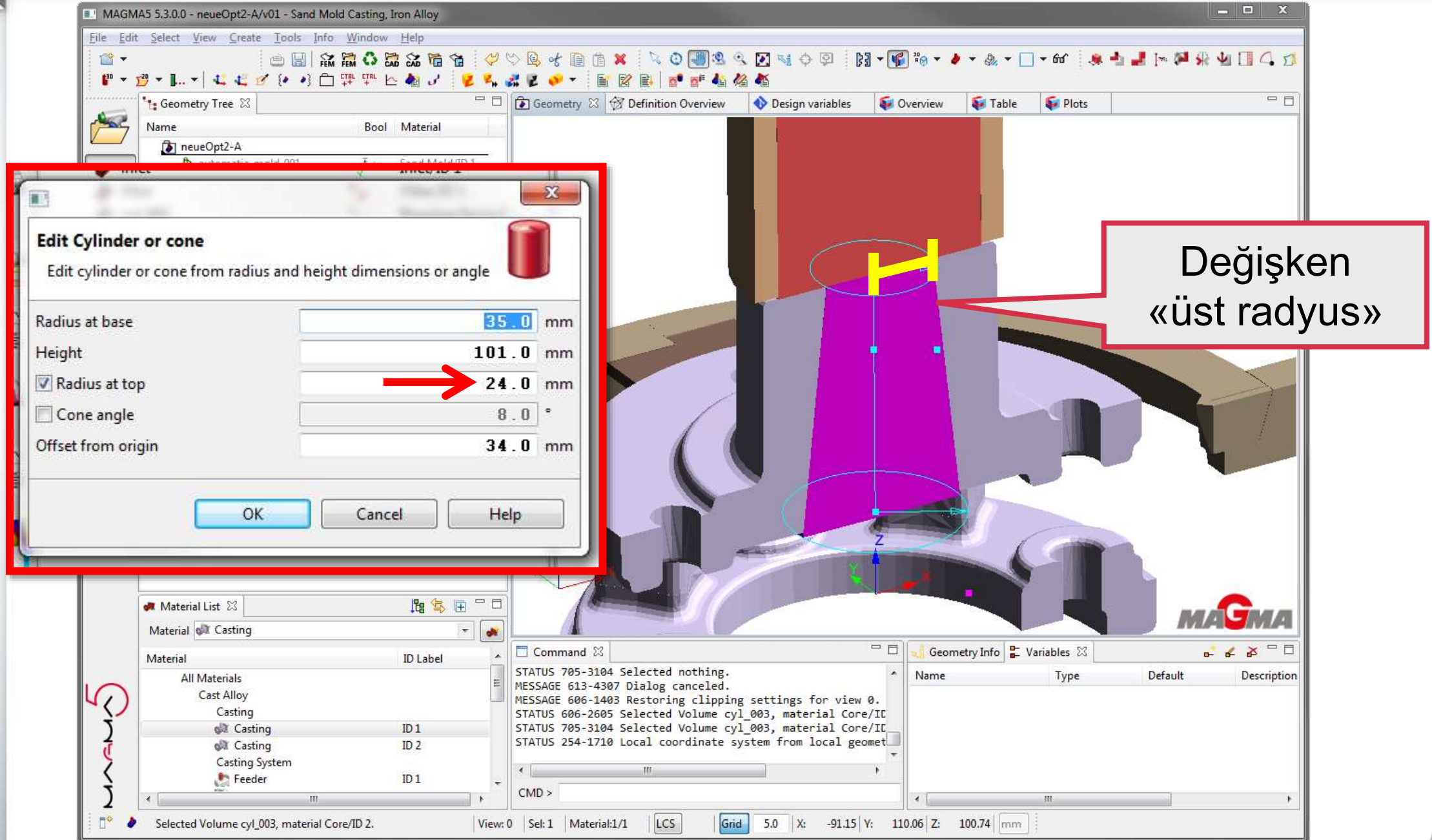
Optimizasyon Geometri



Optimizasyon Geometri



Optimizasyon Geometri



Optimizasyon

Proses Tanımlamaları

MAGMA5 5.3.0.0 - neueOpt2-A/v01 - Sand Mold Casting, Iron Alloy

File Edit View Create Tools Info Window Help

Definition navigator

- Material Definitions
- Heat Transfer Definitions
- Casting Process
 - Preparation
 - Coating
 - Melt Treatment
 - Pouring
 - Tilt
 - Solidification & Cooling
 - Rollover
 - Active Feeding
 - Top Off Feeders
 - Shake Out
 - Removing Casting System
 - Quenching
 - Treatment after Casting
 - Machining After Casting
 - Heat Treatment
 - Machining After Heat Treatment
 - Stress Material Selection
 - Result Definitions
 - Simulation Settings

Geometry Definition Overview Design variables Overview Table Plots Mesh Casting Process

Casting Process	ID	Preparation	Pouring	Solidification & Cooling
Casting Process Cast Alloy : GJS-400		  		
		Melt Treatment		
		Preparation		Pouring: 0.0 s
		Stop Solidification & Cooling process: as soon as		
		Casting Process		
Cast Alloy				
Filter				
Sand Mold				
Core				
Insulation				

Problems

Description	Resource
-------------	----------

Optimizasyon

Yeni Perspektivler

The screenshot displays the MAGMA 5.3.0.0 software interface for Sand Mold Casting, Iron Alloy. The main window is titled 'MAGMA 5.3.0.0 - neueOpt2-A/v01 - Sand Mold Casting, Iron Alloy'. The interface includes a menu bar (File, View, Tools, Info, Window, Help) and a toolbar with various icons. The left sidebar contains a tree view with the following sections:

- Optimization Overview
 - Definition Overview
 - Design Variables
 - /geometry/cyl_003/-r2
 - /geometry/cyl_003/-ang
 - /geometry/cyl_003/-offset
 - /geometry/cyl_003/r1
 - /geometry/cyl_003/h
 - Objectives
 - Objective1
 - cEQUI
 - Constraints
 - Settings Overview
 - Start sequence
 - Algorithm
 - Keep Results

The right pane shows the 'Design Variables' tab, which contains a table with the following data:

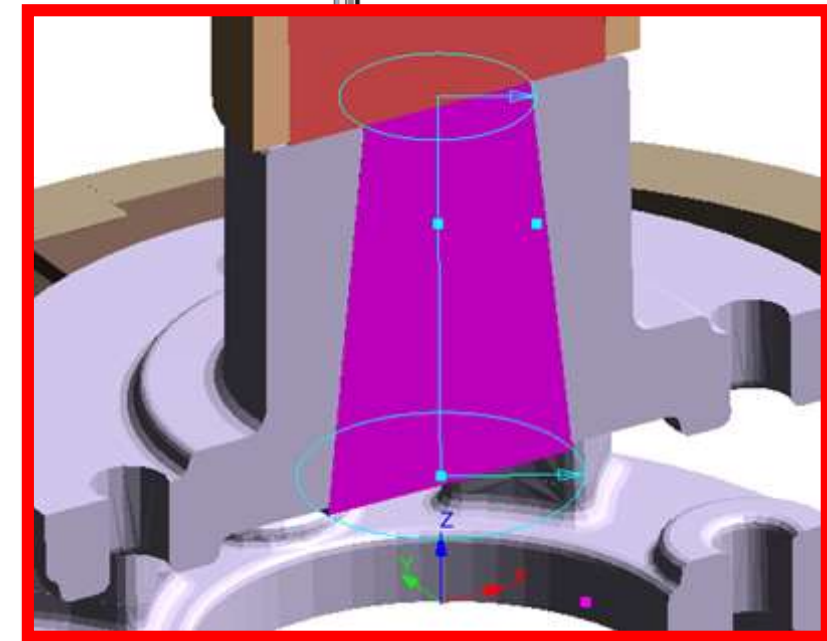
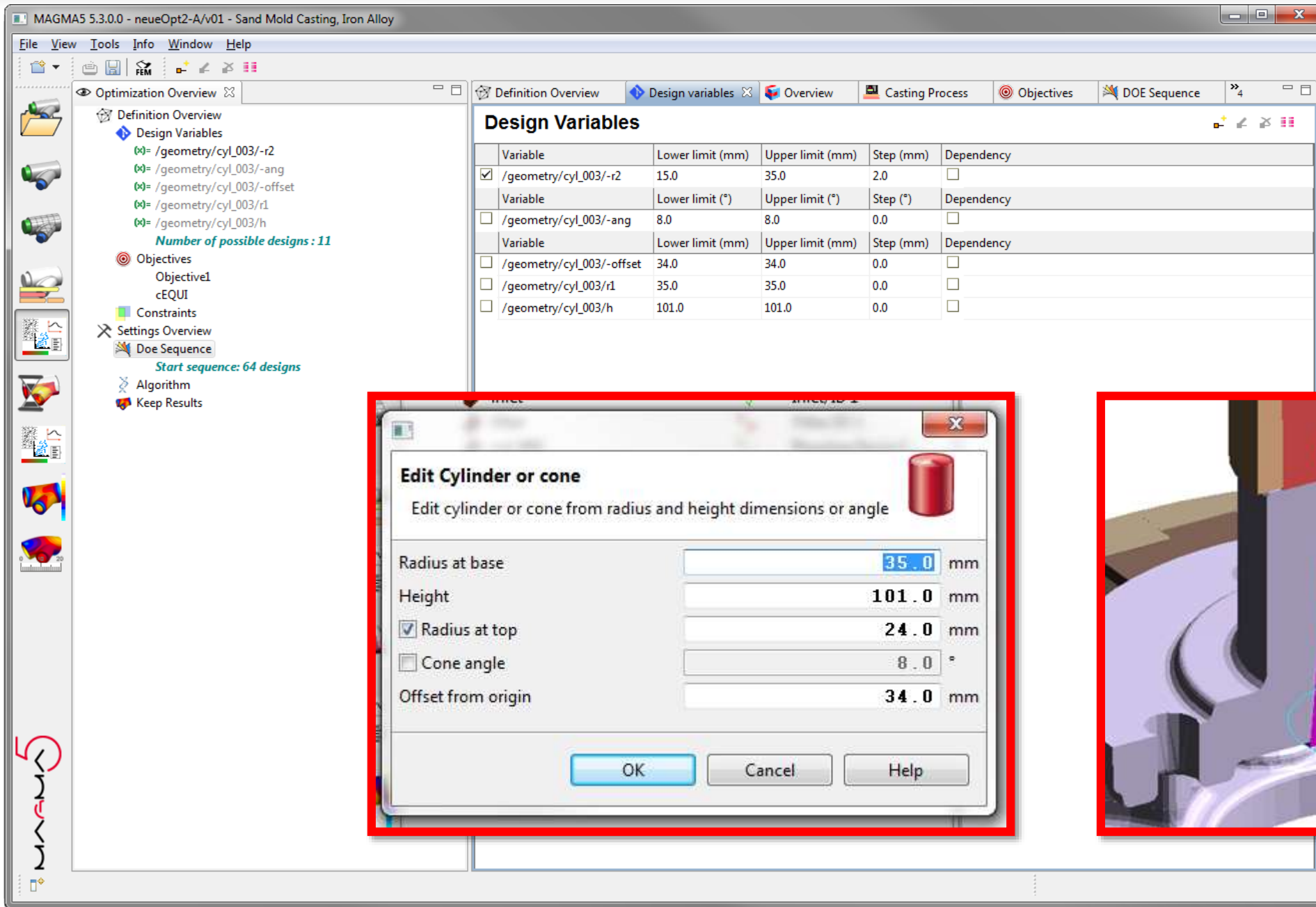
Variable	Lower limit (mm)	Upper limit (mm)	Step (mm)	Dependency
☒ /geometry/cyl_003/-r2	15.0	35.0	2.0	☐
Variable	Lower limit (°)	Upper limit (°)	Step (°)	Dependency
☐ /geometry/cyl_003/-ang	8.0	8.0	0.0	☐
Variable	Lower limit (mm)	Upper limit (mm)	Step (mm)	Dependency
☐ /geometry/cyl_003/-offset	34.0	34.0	0.0	☐
☐ /geometry/cyl_003/r1	35.0	35.0	0.0	☐
☐ /geometry/cyl_003/h	101.0	101.0	0.0	☐

Two red callout boxes are overlaid on the image:

- A box labeled 'Optimizasyon Tanımlamaları' (Optimization Definitions) points to the 'Design Variables' section in the left sidebar.
- A box labeled 'Optimizasyon İncelemeleri' (Optimization Analyses) points to the 'Start sequence' section in the left sidebar.

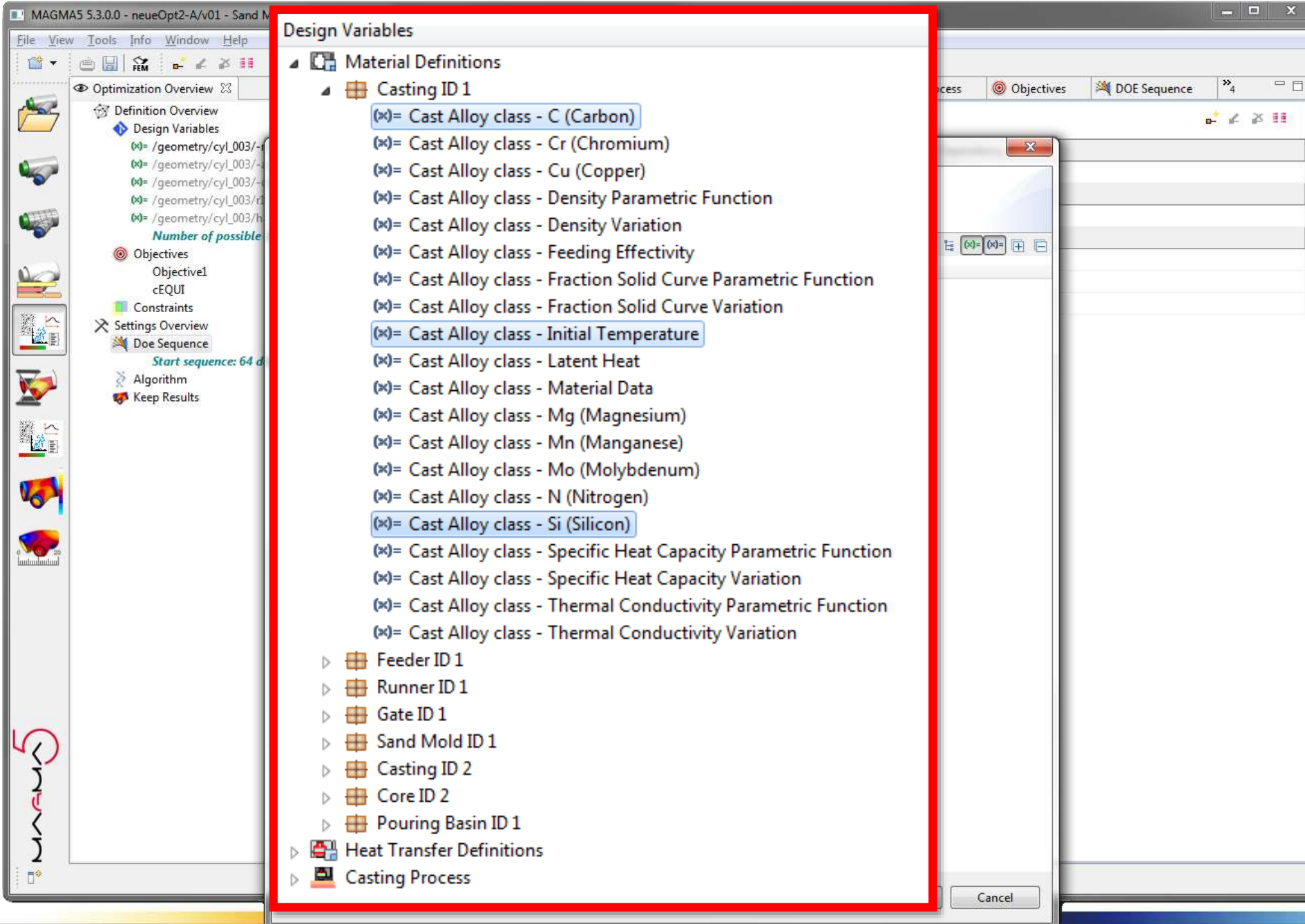
Optimizasyon

Yeni Perspektivler



Optimizasyon

Neyi değiştirebilirim? (Dizayn Değişkenleri)



Optimizasyon

Neyi deęiřtirebilirim? (Dizayn Deęiřkenleri)

Design Variables

Variable	Lower limit (mm)	Upper limit (mm)	Step (mm)
☒ /geometry/cyl_003/-r2	15.0	35.0	2.0
Variable	Lower limit (°)	Upper limit (°)	Step (°)
☐ /geometry/cyl_003/-ang	8.0	8.0	0.0
Variable	Lower limit (mm)	Upper limit (mm)	Step (mm)
☐ /geometry/cyl_003/-offset	34.0	34.0	0.0
☐ /geometry/cyl_003/r1	35.0	35.0	0.0
☐ /geometry/cyl_003/h	101.0	101.0	0.0
Variable	Lower limit (%)	Upper limit (%)	Step (%)
☒ Cast Alloy class - C (Carbon)	3.0	3.8	0.1
☒ Cast Alloy class - Si (Silicon)	0.5	2.5	0.25
Variable	Lower limit (°C)	Upper limit (°C)	Step (°C)
☒ Cast Alloy class - Initial Temperature	1250.0	1450.0	25.0

Radyus

Alařım

Döküm Sıcaklıkları

Proses Optimizasyon

Sanal DoE

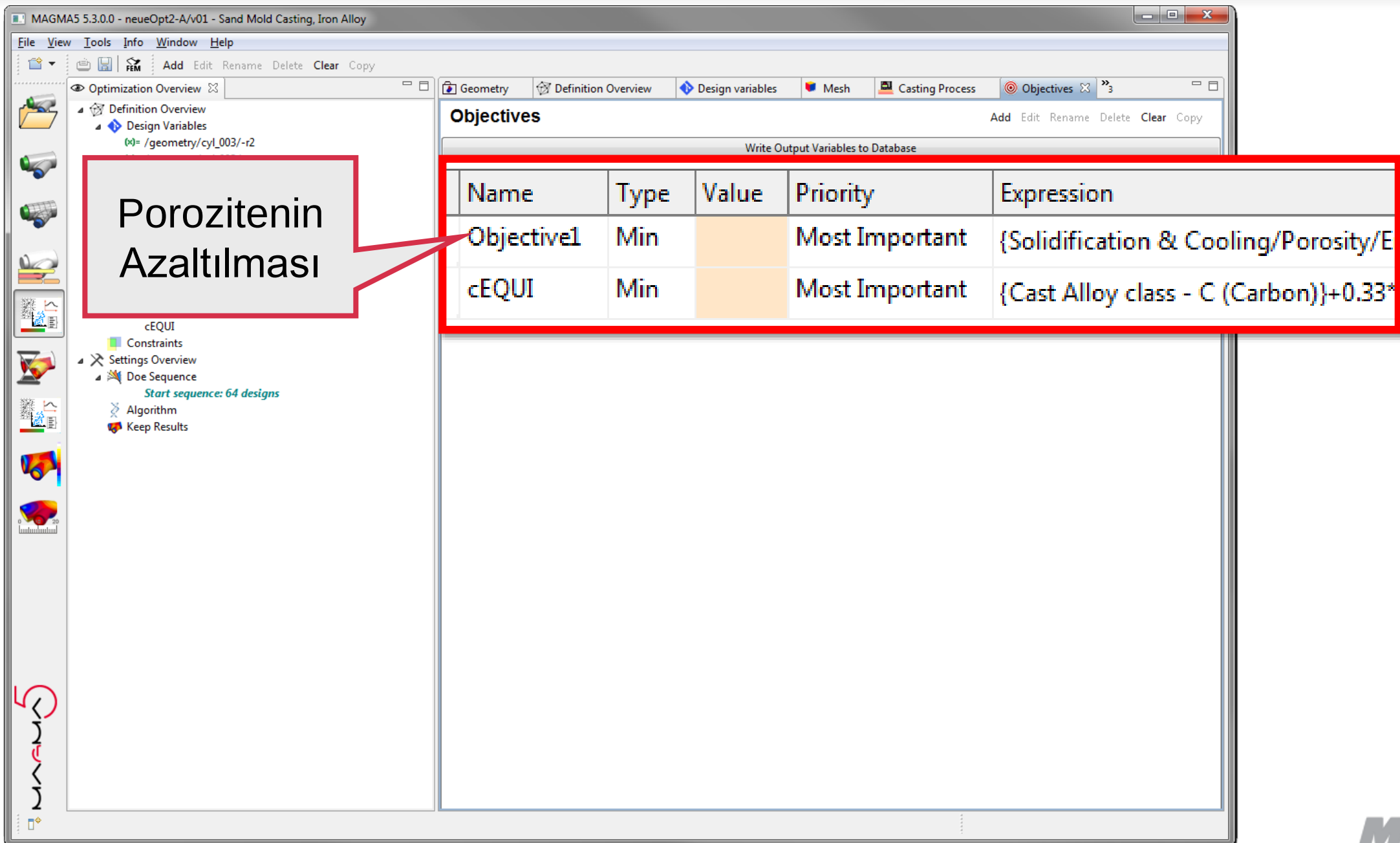
Proses parametresi	Üst Limit	Alt Limit	Aralık
C-İçeriği	3.0%	3.8%	0.1%
Si-İçeri	0.5%	2.5%	0.25%
Döküm Sıcaklığı	1250°C	1450°C	25°C

Toplam $9*9*9 = 729$ kombinasyon!

MAGMA⁵ program içerisinde bulunan optimizasyon algoritmaları ile toplam deney sayısını 24'e düşürebilir!

Optimizasyon

Hedefler

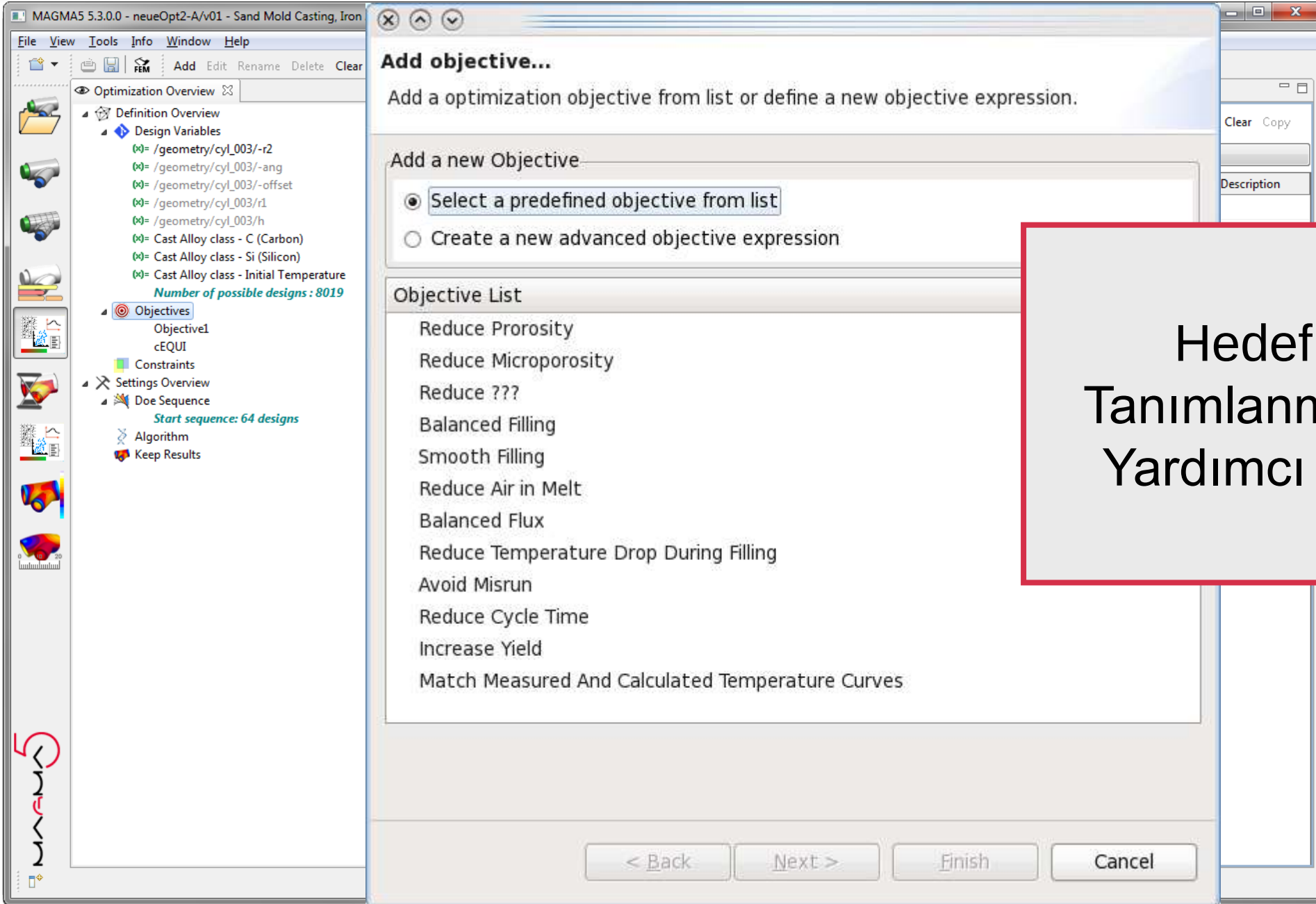


The screenshot displays the MAGMA5 5.3.0.0 software interface for Sand Mold Casting, Iron Alloy. The 'Objectives' tab is active, showing a table of optimization goals. A red box highlights the table, and a callout points to the first objective, 'Objective1', with the text 'Porozenin Azaltılması' (Reduction of Porosity).

Name	Type	Value	Priority	Expression
Objective1	Min		Most Important	{Solidification & Cooling/Porosity/E
cEQUI	Min		Most Important	{Cast Alloy class - C (Carbon)}+0.33*

The interface also shows a sidebar with 'Definition Overview' and 'Design Variables' sections. The 'Design Variables' section lists 'cEQUI' and 'Constraints'. The 'Settings Overview' section includes 'Doe Sequence' and 'Algorithm'. The 'Keep Results' section is also visible.

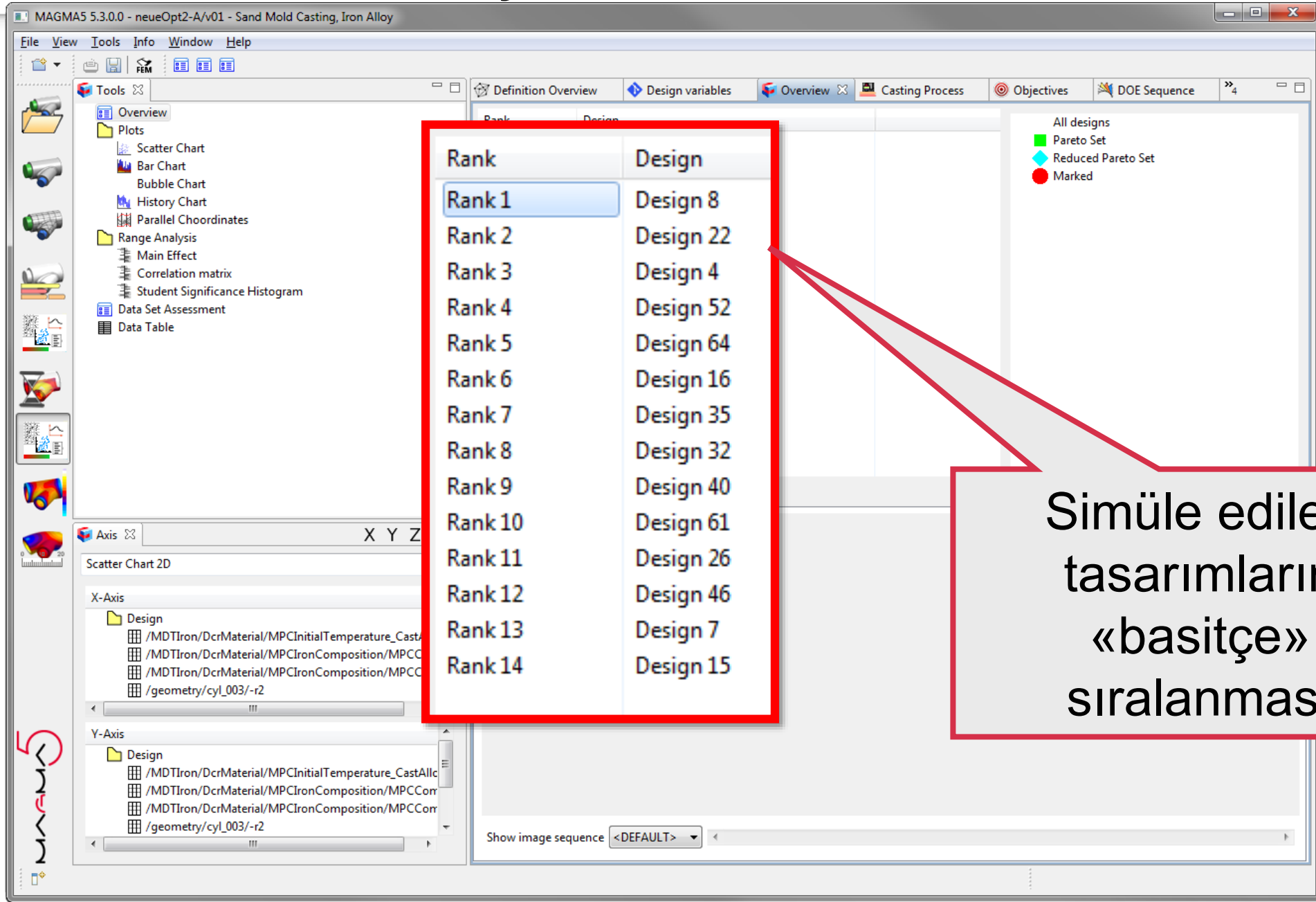
Optimizasyon Hedefler



Hedeflerin
Tanımlanması İçin
Yardımcı Araçlar

Optimizasyon

İnceleme – Genel Bakış



Optimizasyon

İnceleme – Genel Bakış

The screenshot displays the MAGMA 5.3.0.0 software interface for a sand mold casting optimization project. The main window is titled "MAGMA5 5.3.0.0 - neueOpt2-A/v01 - Sand Mold Casting, Iron Alloy". The interface includes a menu bar (File, View, Tools, Info, Window, Help) and a toolbar with icons for file operations and analysis tools.

The left sidebar contains a "Tools" panel with the following options:

- Overview
- Plots
 - Scatter Chart
 - Bar Chart
 - Bubble Chart
 - History Chart
 - Parallel Coordinates
- Range Analysis
 - Main Effect
 - Correlation matrix
 - Student Significance Histogram
- Data Set Assessment
- Data Table

The main workspace is divided into several tabs: "Definition Overview", "Design variables", "Overview" (selected), "Casting Process", "Objectives", and "DOE Sequence". The "Overview" tab displays a table of ranked designs:

Rank	Design
Rank 1	Design 8
Rank 2	Design 22
Rank 3	Design 4
Rank 4	Design 52
Rank 5	Design 64
Rank 6	Design 16
Rank 7	Design 35
Rank 8	Design 32
Rank 9	Design 40
Rank 10	Design 61
Rank 11	Design 26
Rank 12	Design 46
Rank 13	Design 7
Rank 14	Design 15

To the right of the table is a legend for "All designs":

- Pareto Set (green square)
- Reduced Pareto Set (blue diamond)
- Marked (red circle)

Below the table, there are tabs for "images" and "saved plots". The "saved plots" tab is active, showing a "Scatter Chart 2D" plot. The X-Axis and Y-Axis are both set to "Design". The X-Axis list includes:

- /MDTIron/DcrMaterial/MPCInitialTemperature_CastAlc
- /MDTIron/DcrMaterial/MPCIronComposition/MPCCorr
- /MDTIron/DcrMaterial/MPCIronComposition/MPCCorr
- /geometry/cyl_003/-r2

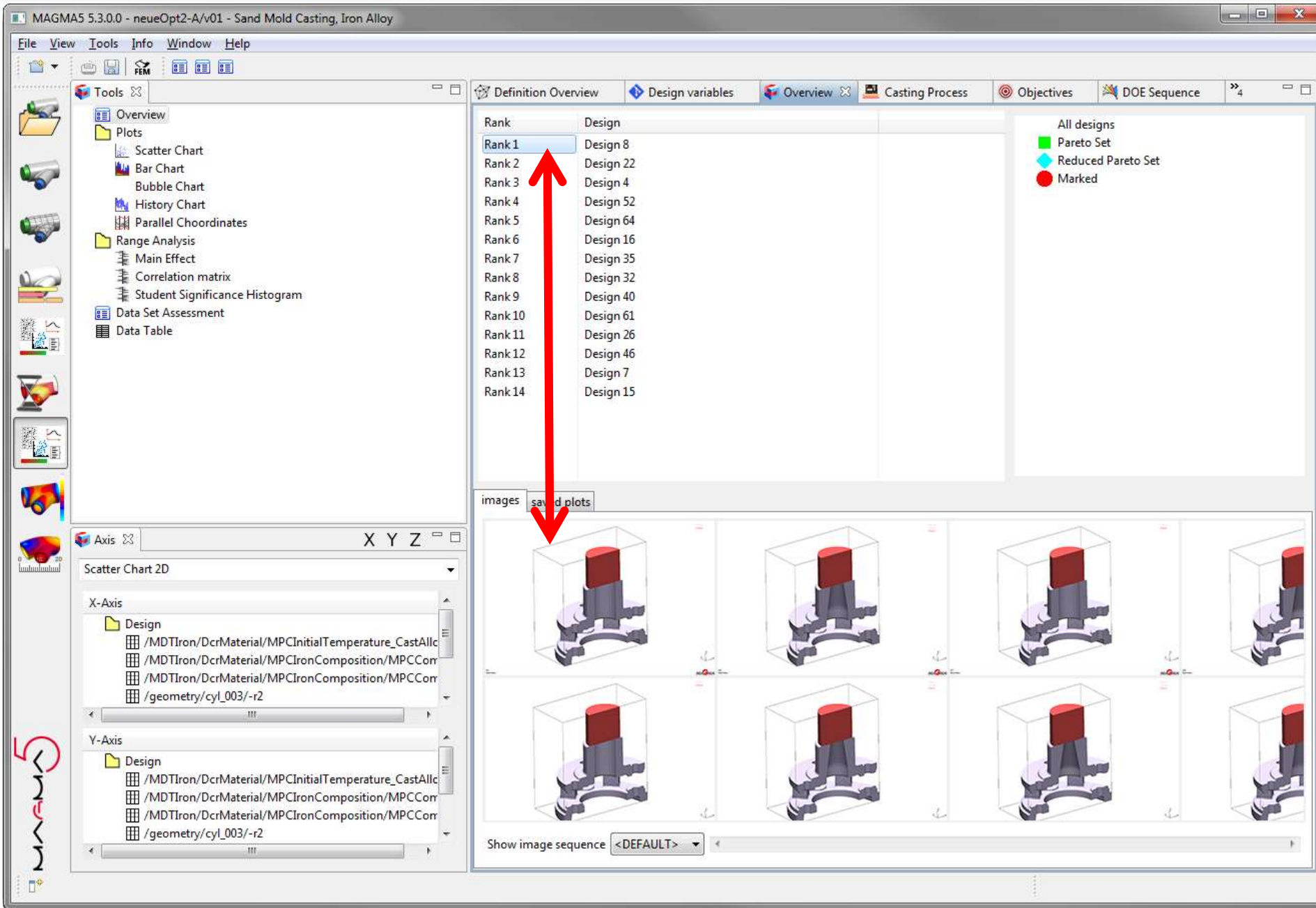
The Y-Axis list includes:

- /MDTIron/DcrMaterial/MPCInitialTemperature_CastAlc
- /MDTIron/DcrMaterial/MPCIronComposition/MPCCorr
- /MDTIron/DcrMaterial/MPCIronComposition/MPCCorr
- /geometry/cyl_003/-r2

At the bottom of the "saved plots" tab, there is a "Show image sequence" button and a dropdown menu set to "<DEFAULT>".

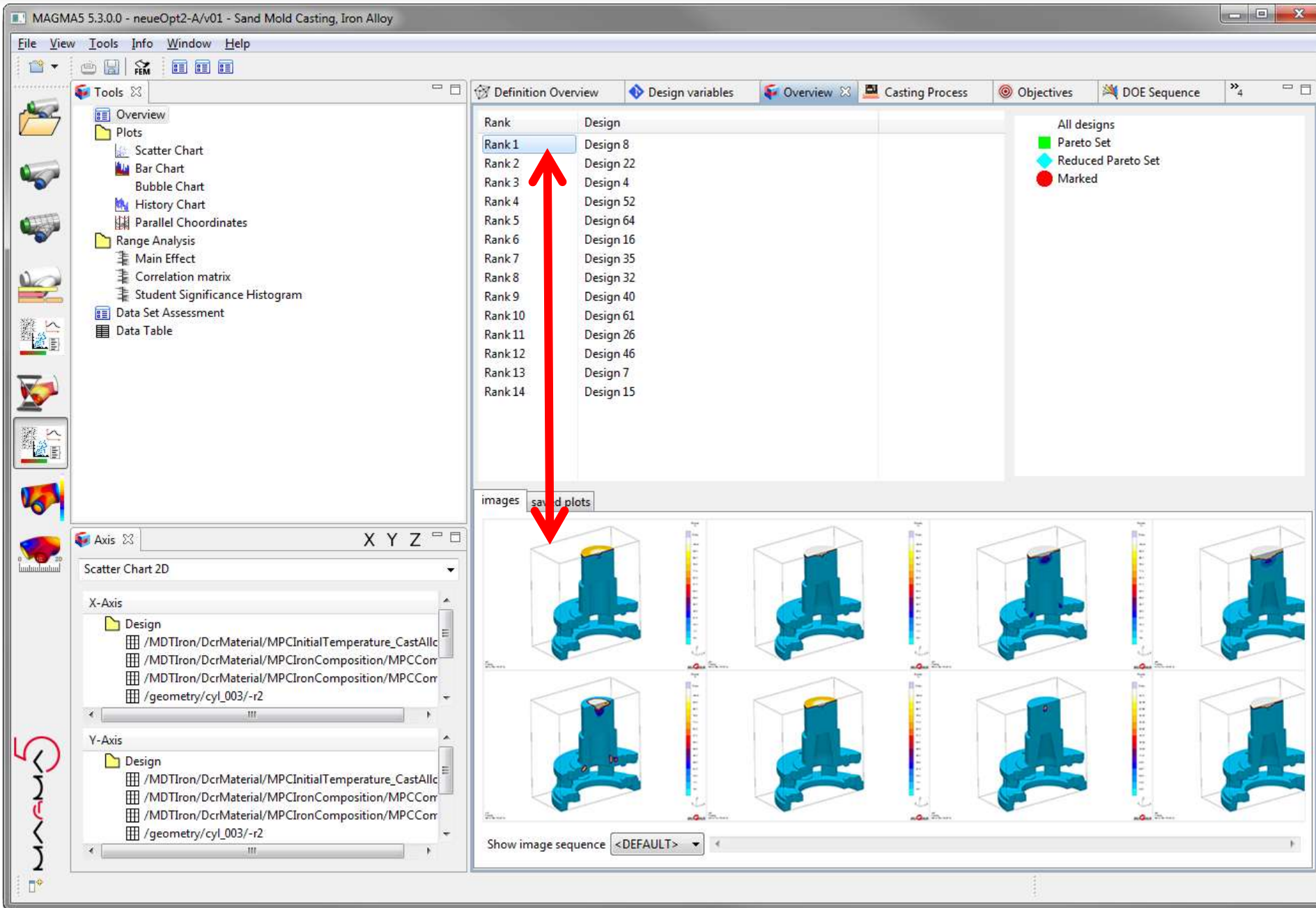
Optimization

İnceleme – Sonuçların Eşleştirilmesi

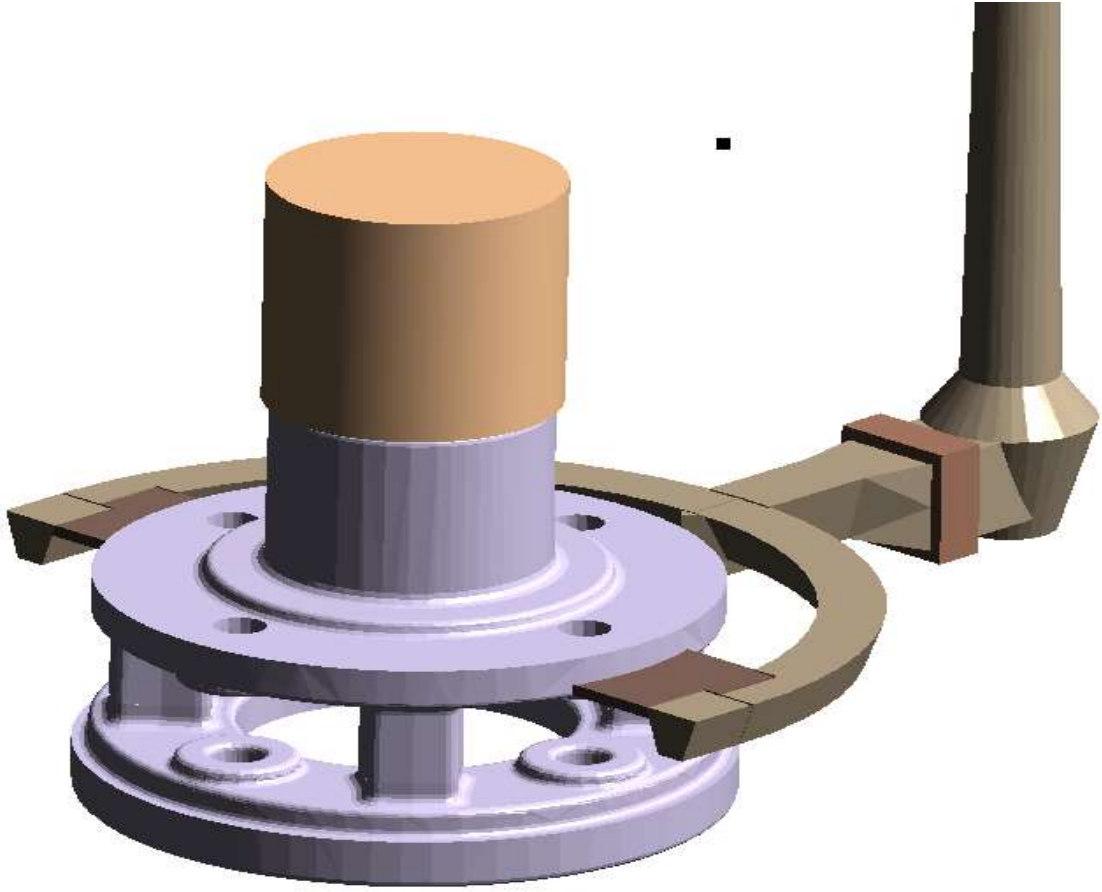


Optimization

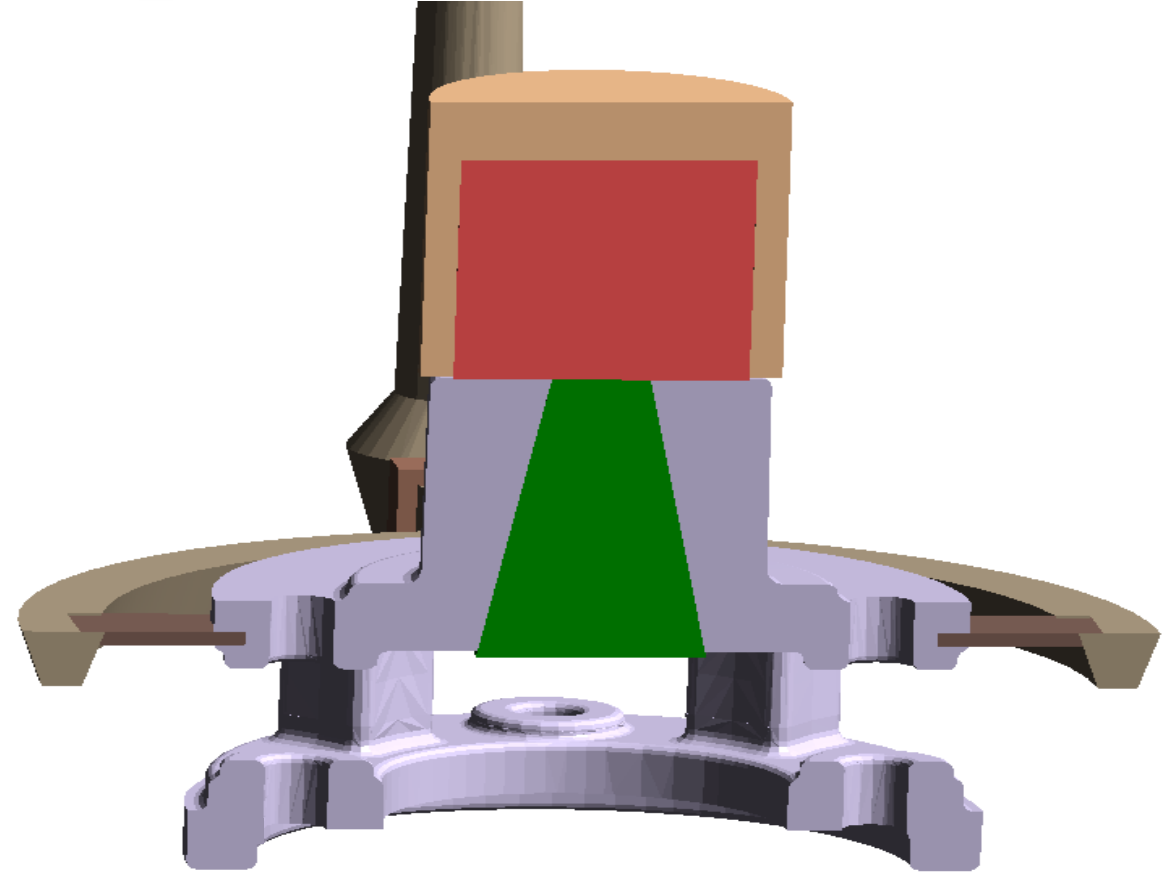
İnceleme – Sonuçların Eşleştirilmesi



Optimize Edilmiş Yolluk & Besleyici Sistemi



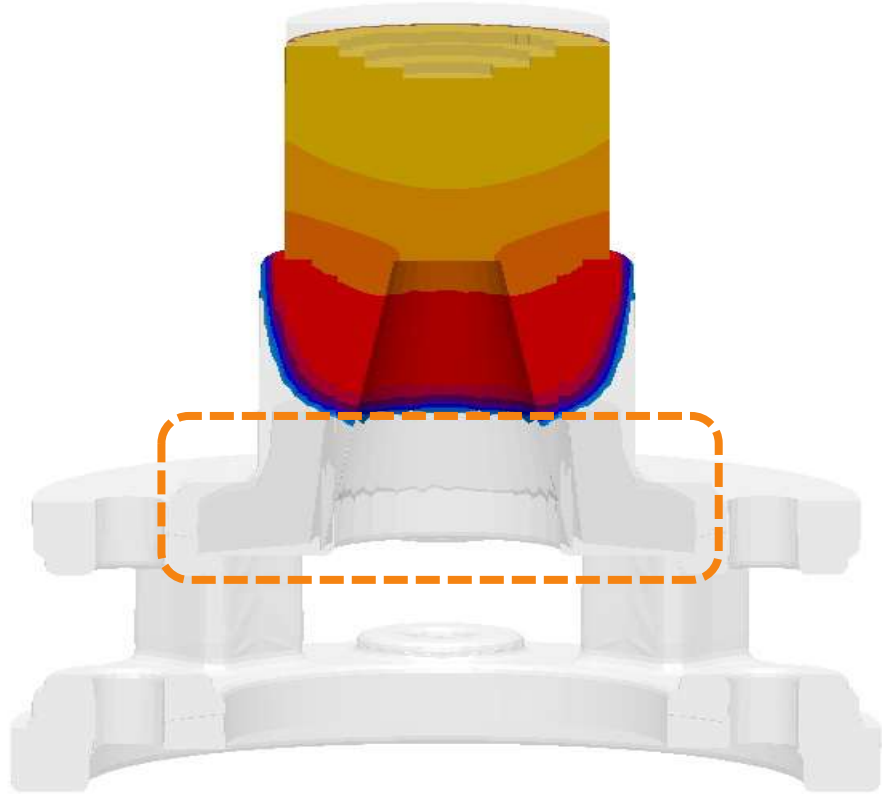
Optimize Edilmiş Tasarım



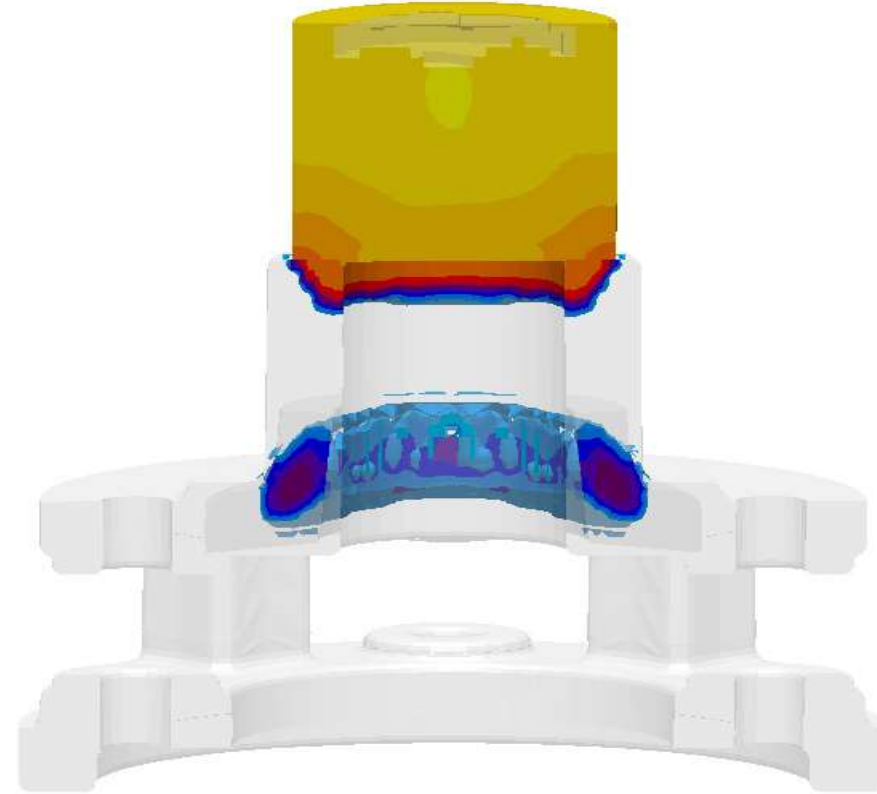
İşleme Eklenmesi

DOE 24 Tasarım (Dolum ve Katılaşma)

İşleme Payı ve İşleme Payı Olmadan Katılaşma

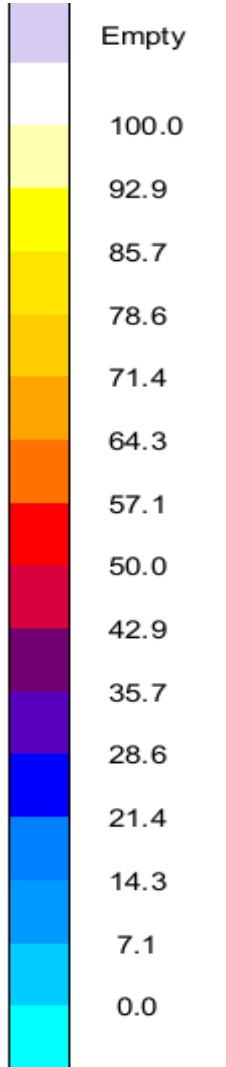


v03
Fraction Liquid
22min 13s 9.98 %



v04
Fraction Liquid
7min 17s 9.98 %

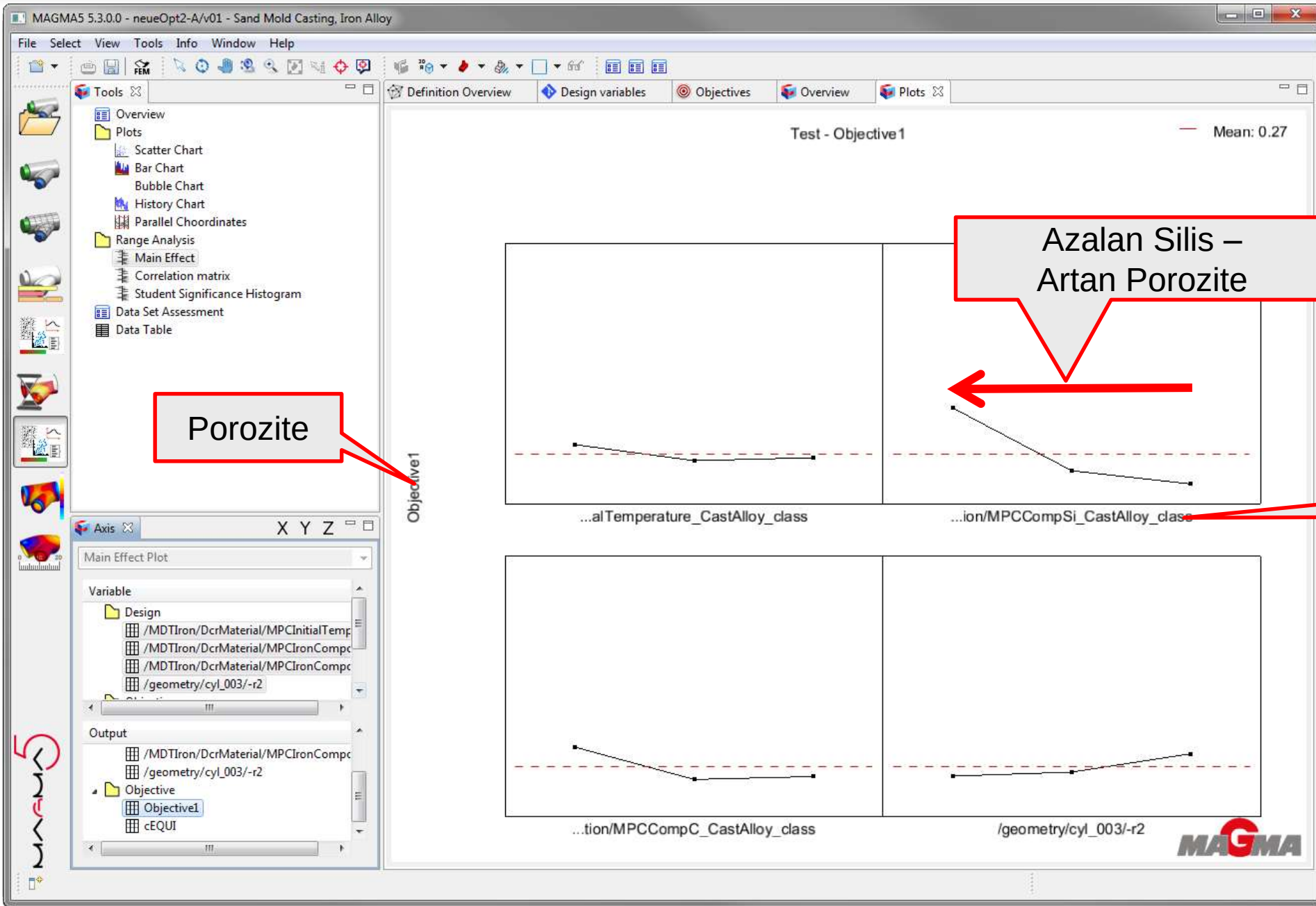
Fraction
Liquid / %



MAGMA

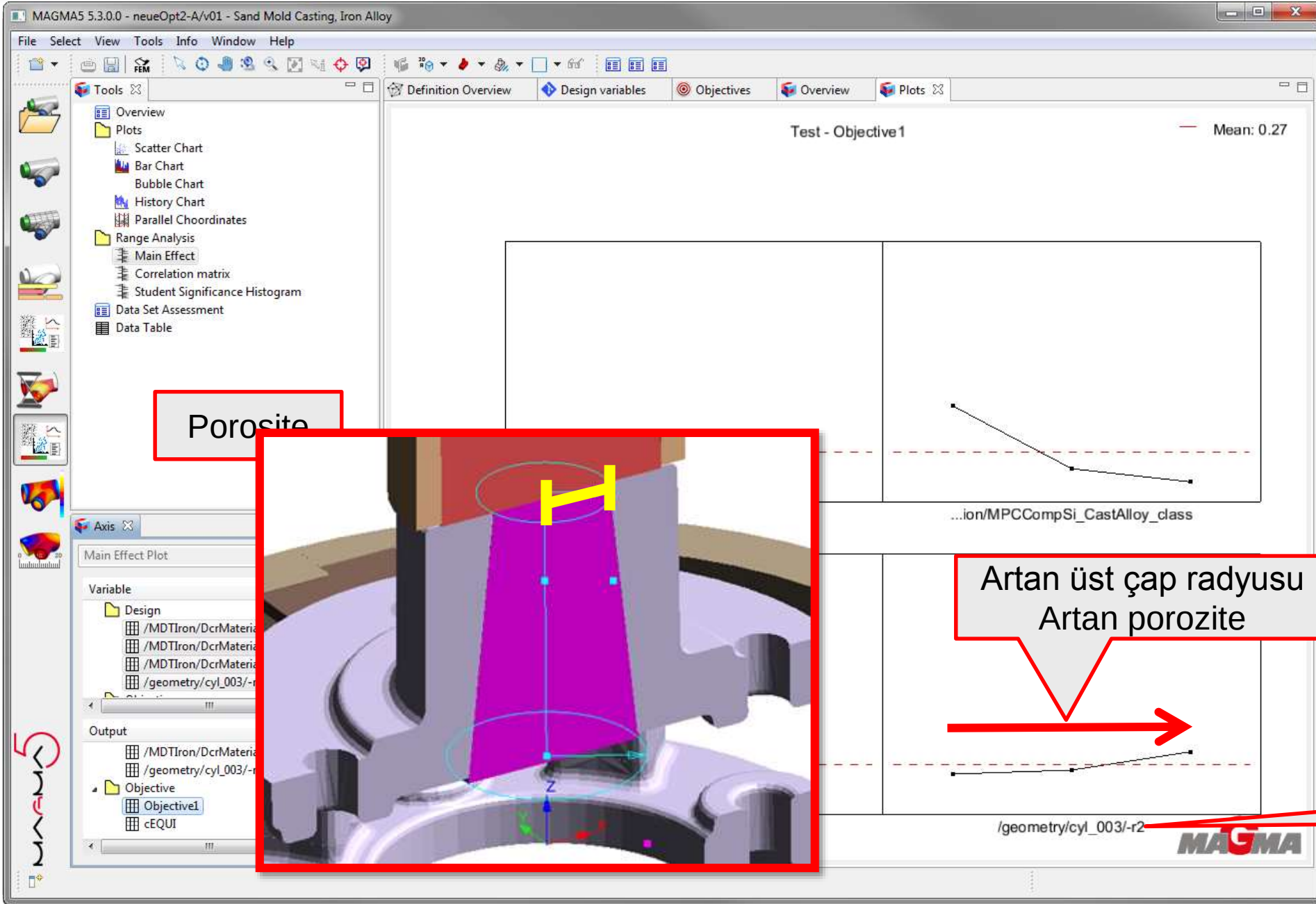
Optimization

İnceleme – Ana Etkiler



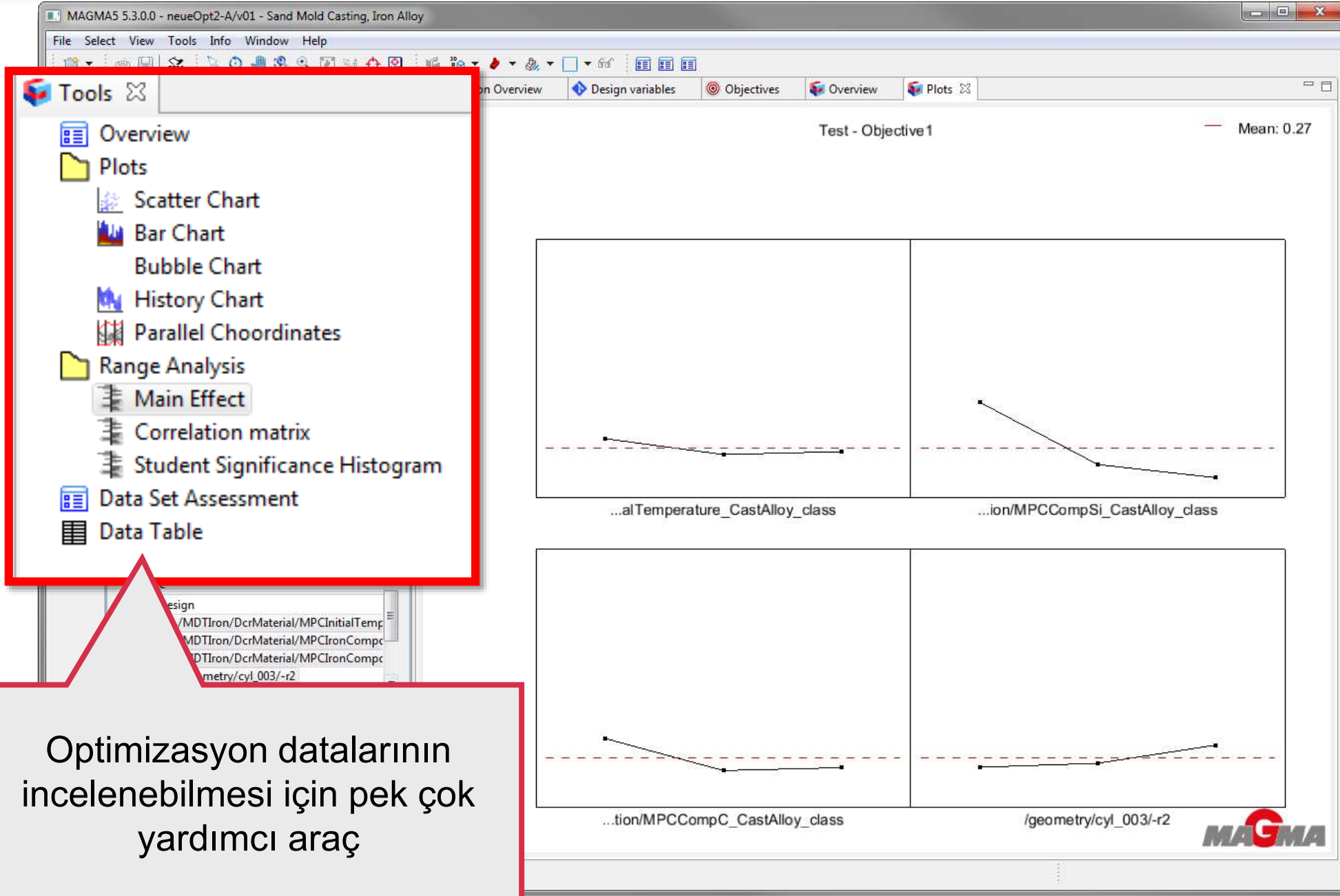
Optimization

İnceleme – Ana Etkiler



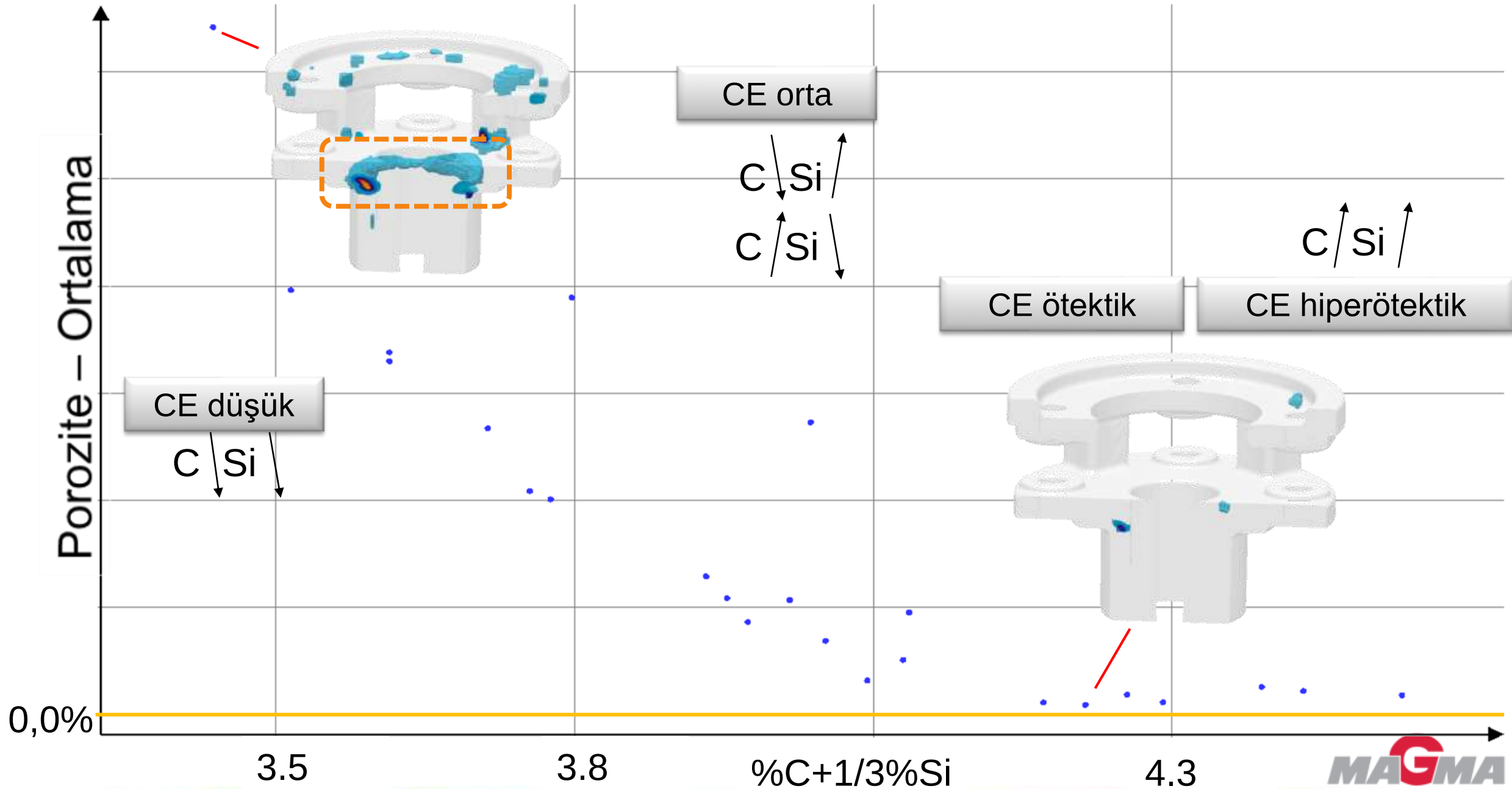
Optimization

İnceleme – Ana Etkiler



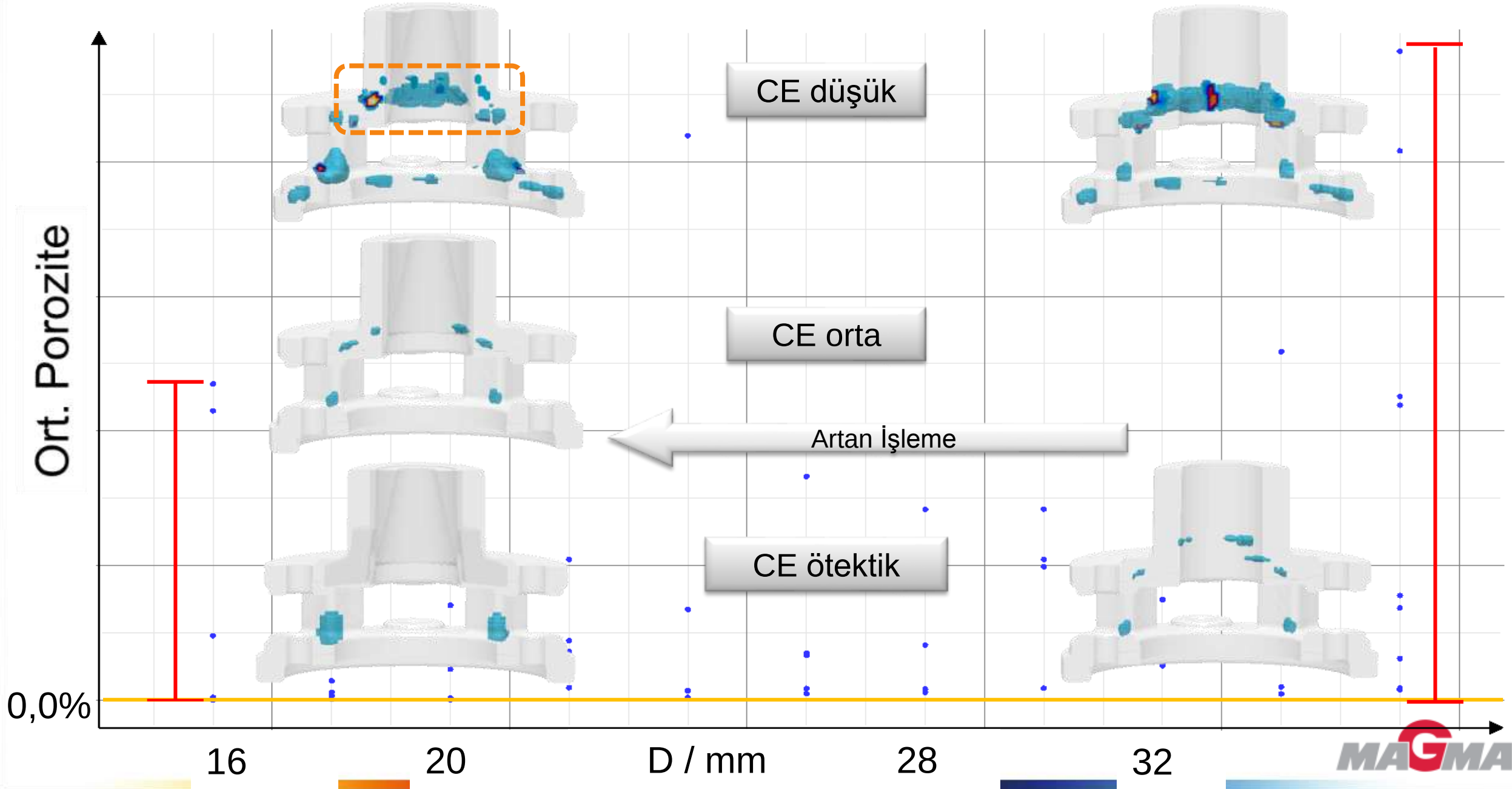
Sanal Dökümhane

Karbon Eşdeğerinin Ort. Poroziteye Etkisi



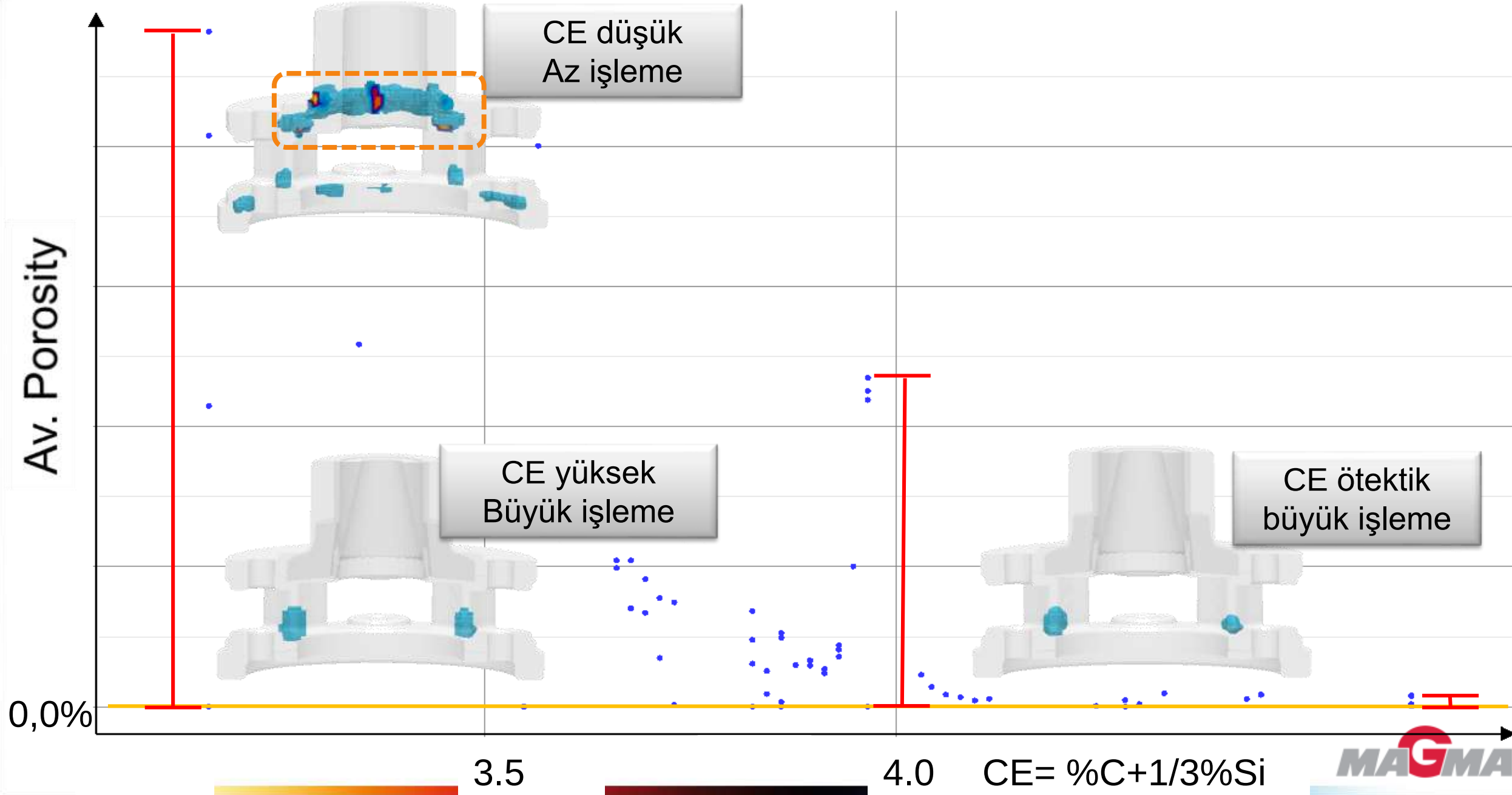
Sanal Dökümhane

Üst Çapın Ort. Poroziteye Etkisi



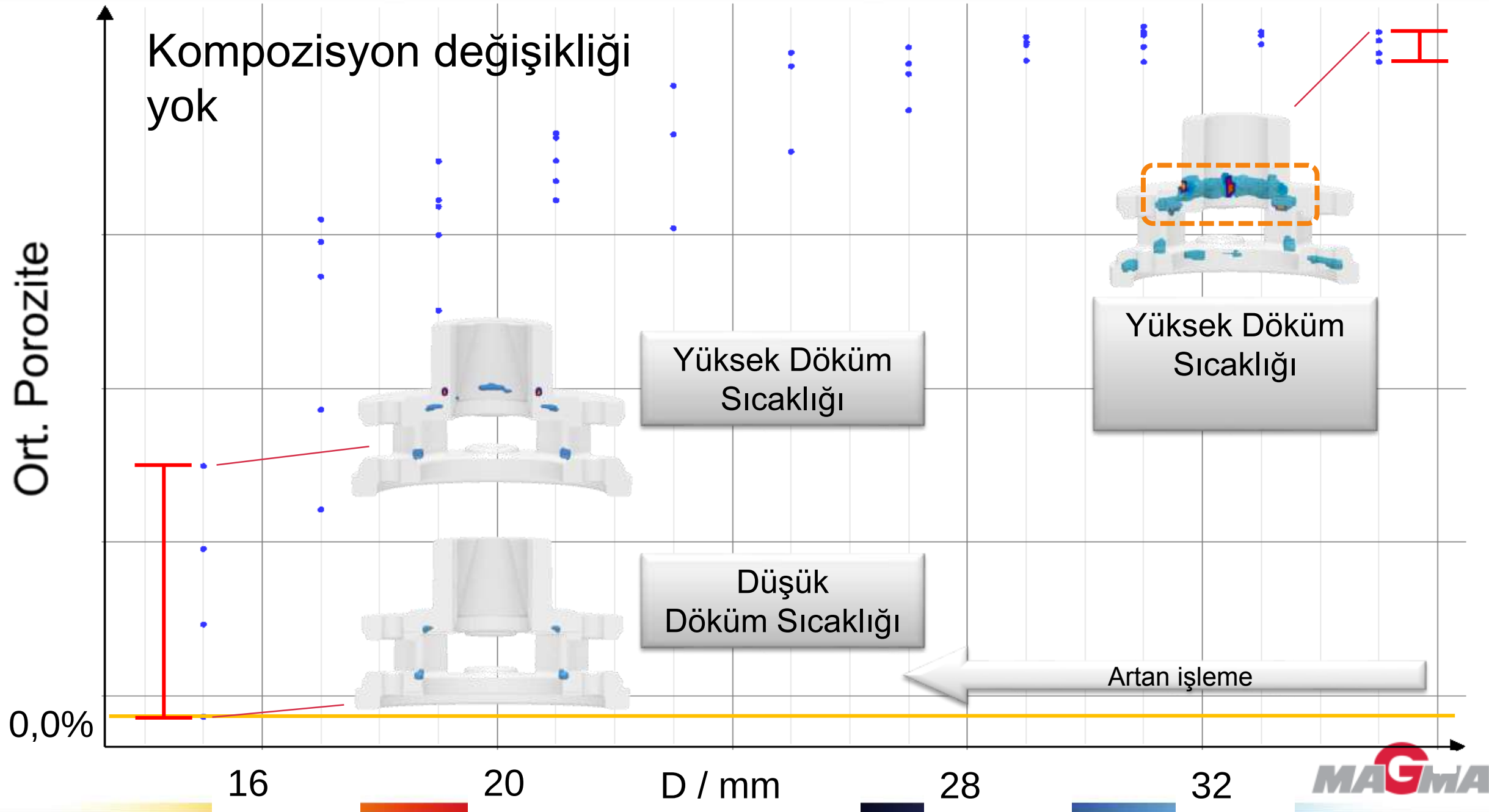
Sanal Dökümhane

Karbon Eşdeğerinin Yeni Metotta Ort. Poroziteye Etkisi



Sanal Dökümhane

İşleme ve Döküm Sıcaklığının Etkisi



Özet

- Her yeni versiyonda sonuçların tek tek incelenip, yapılacak değişikliklerin kullanıcı tarafından yeni verilerin girilmesi, MAGMA5.3 ile tek bir seferde olacak, ilerleyen versiyonlarda veriler «otomatik» olarak güncellenecektir.
- Girilen değişkenler ve programa verilen hedefler doğrultusunda MAGMA5.3 proses iyileştirmelerini «otomatik» olarak yapacaktır.
- Program içerisinde bulunan araçlarla prosese hakimiyet sağlanıp, istatistiksel bir «know how» oluşacaktır.

Teşekkürler!

