

## Using free LLM Tools for simple savings calculation



## Data, Information, Knowledge Digitalization and Industry 4.0

Jan Eilers - with the input of Dr. Marcus Schopen (MAGMA GmbH)

# AI tools (LLMs) & usage example

# AI tools (LLMs)

Which tools are commonly used?

- ▣ ChatGPT (Open AI)
- ▣ Gemini (Google)
- ▣ Copilot (Microsoft)
- ▣ Grok (X / Twitter)
- ▣ Perplexity, Dall-E, deepseek, Claude, Canva, browseAI, Midjourney

일반적으로 사용되는 AI 툴

# MAGMA ECONOMICS

## What data do we need?

Name	Value
Material Costs	f(x) 466.2611 €
▶ Price-Liquid-Iron	f(x) 258.8645 €
▶ Price-molding sand	f(x) 47.1115 €
▶ Price-Core sand	f(x) 12.3909 €
▶ Price-Chills	f(x) 78.1552 €
▶ Price-Feeders per volume	f(x) 57.949 €
▶ Price-Sleeves per piece	f(x) 57.96 €
▶ Price-Filters	f(x) 11.79 €
Production Costs - labor	f(x) 460.8644 €
▶ Moulding	f(x) 272.3741 €
▶ Core making	f(x) 62.2231 €
▶ Cleaning	f(x) 126.2673 €
▶ Annealing	f(x) 54.8128 €
Production Costs	f(x) 927.1255 €
Production Costs per kg	f(x) 1.5223 €/kg

Material	Mat ID	Volume (cm <sup>3</sup> )	<sup>1</sup> Mass (kg)	<sup>2</sup> Mass (kg)	Cast Contact Area (mm <sup>2</sup> )
Cast Alloy		98970.18	677.92	702.20	44886.80
Casting		85752.73	587.38	608.42	0.00
Casting ID 1		85752.73	587.38	608.42	0.00
Casting System		13217.45	90.54	93.78	44886.80
Feeder ID 3		4574.97	31.34	32.46	22443.40
Feeder ID 1		4067.72	27.86	28.86	0.00
Feeder ID 2		4574.75	31.34	32.46	22443.40
Filter		508.48	-	-	22613.00
Filter ID 1		508.48	-	-	22613.00
Sand Mold		691556.00	1036.67	1036.67	1417942.29
Cope Box ID 1		295733.44	443.32	443.32	846445.70
Drag Box ID 1		395822.56	593.35	593.35	571496.58
Core		85300.90	234.41	234.41	1011447.85
Core ID 1		85300.90	234.41	234.41	1011447.85
Sleeve		5250.52	4.86	4.86	26457.09
Sleeve ID 3		1739.46	0.82	0.82	8819.03
Sleeve ID 1		1771.56	1.43	1.43	8819.03
Sleeve ID 2		1739.49	2.62	2.62	8819.03
Chill		18413.96	116.81	116.81	578653.34
Chill ID 1		15303.55	109.35	109.35	520152.64
Chill ID 2		3110.41	7.46	7.46	58500.71

<sup>1</sup>Mass at initial temperature  
<sup>2</sup>Mass at ambient temperature

Export Close

데이터 확보를 위한 LLM 활용  
 Ex)Economics

# AI tools (LLMs) & How usage basics (prompting)

Still in discovery & development phase

So what is our experience?

- ChatGPT (Open AI)
  - great to use for everyday questions, research, brainstorming, creative work (marketing), helping to phrase emails, make translations, etc.
- Grok (X / Twitter)
  - useful when it comes to cost calculations and using it to get technical data and input

각각의 장점이 있는 LLM

ChatGPT: 일반적인 질문, 브레인스토밍, 마케팅, 이메일 작성, 번역

Grok: 비용 계산이나 기술 데이터 및 자료 수집에 유용

# A Thixo Example

# Thixo Example

A more detailed description:

MAGMA ECONOMICS 데이터 확보를 위한 LLM 활용 사례  
- Thixo 제품의 제조 비용 질문



What is the average manufacturing cost of a thixo molding part with AZ91D material on a suitable Yizumi machine with a short weight of approximately 1.5kg and production volume of 600,000 parts over 3 years? - with 80% yield due to runners and gating and 30% reject rate due to casting defects?

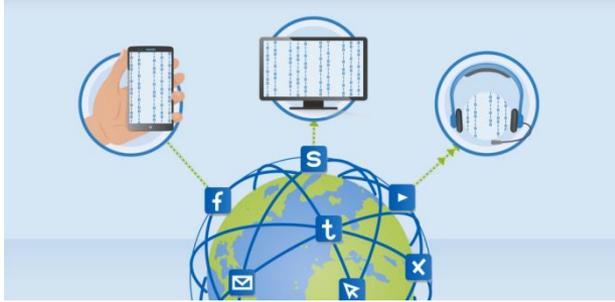
What is the average manufacturing cost of a thixo molding part with AZ91D material on a suitable Yizumi machine with a short weight of approximately 1.5kg and production volume of 600,000 parts over 3 years? - with 80% yield due to runners and gating and 30% reject rate due to casting defects?

# Data, Information, Knowledge Digitalization and Industry 4.0



# Introduction

## Change in communication



Human/human communication is becoming increasingly digital

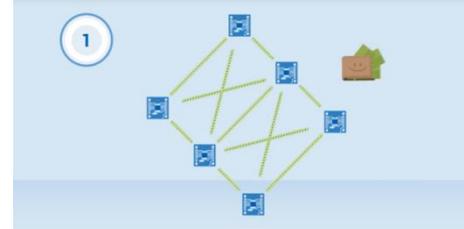


Human/machine communication is changing -  
Machines communicate with each other

산업의 차원을 변화시키는 디지털화



Favoring Factors



**Sensors** are becoming smaller, more powerful and cheaper



**Computing power and data storage** are becoming more powerful and cheaper

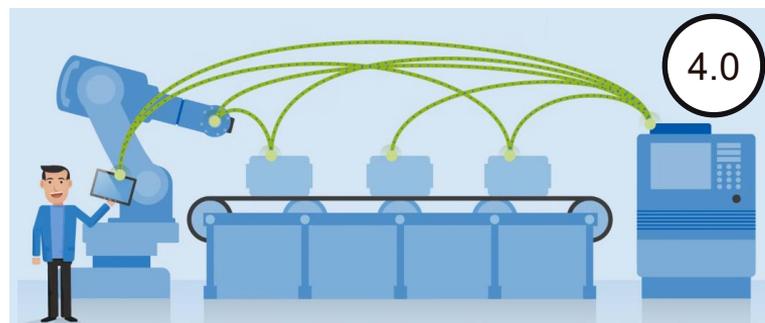
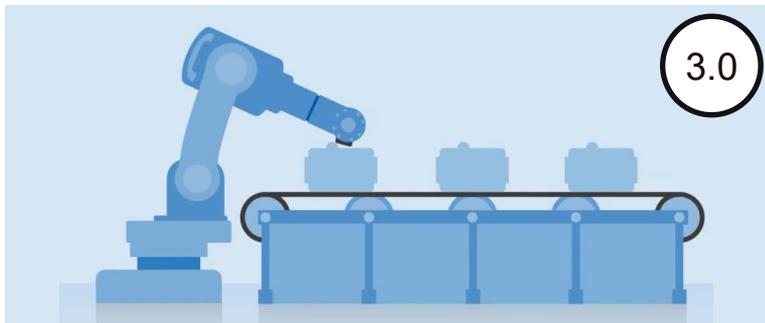
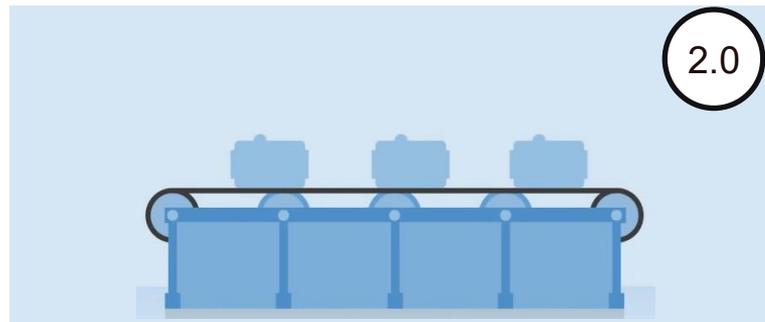


Global **networks** enable **location-independent communication**

# Why 4.0?

## The four industrial revolutions

산업 발전의 역사



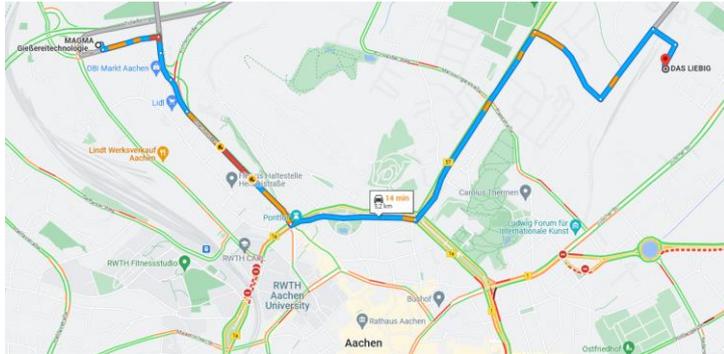
# Terminology I



## Digital shadow 디지털 새도우

- Digital **recording** of a **real existing** object

실제 존재하는 객체의 데이터를 단방향으로  
디지털 모델에 기록



## Digital twin 디지털 트윈



- Virtual replication through process and simulation **models** of the real existing or **not yet existing** object

현실의 시스템을 가상 조건에 복제하여 양쪽이  
서로 데이터를 주고 받으며 실시간으로 동기화 되는 모델



# Terminology II



## Data 데이터

- Sequence of different symbols and signs
- No meaning without context

데이터 그 자체로는 의미가 없음  
그저 수치일 뿐

## Information 정보

- Data is put into context, processed or linked with each other  
→ Information

데이터를 맥락에 맞춰 해석한 것이 정보

## Knowledge 지식

- Linking and processing information also with experience

정보를 경험과 연결하여 처리



Making decisions,  
creating value!

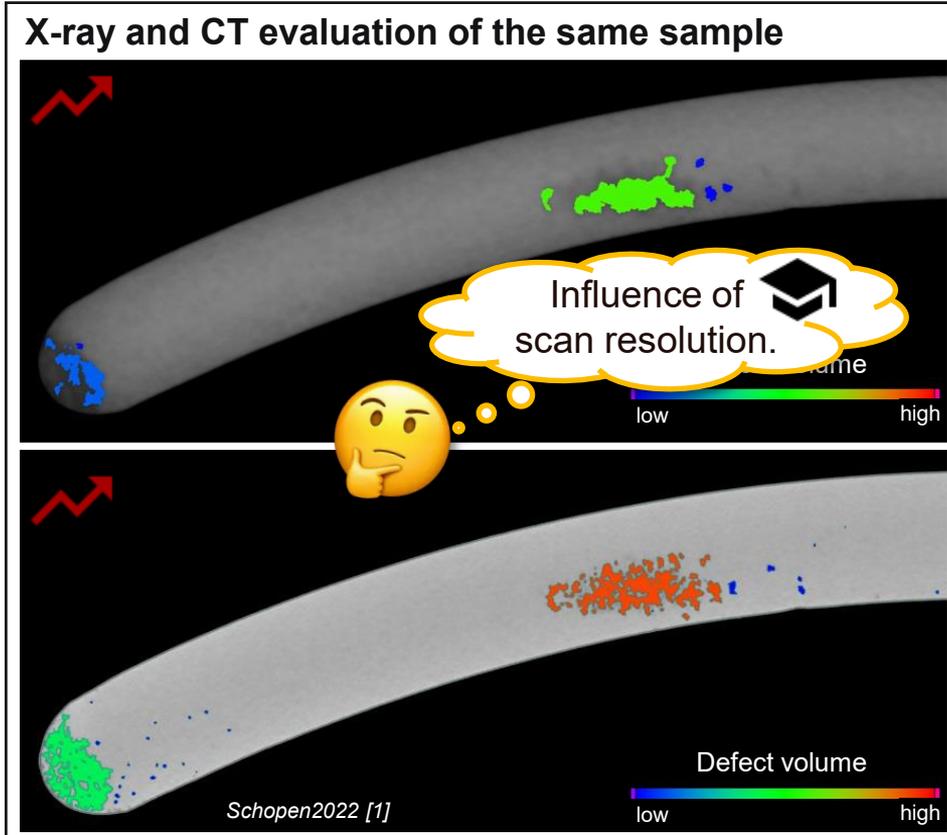


# Data collection

데이터 수집에서 측정 방식 이해의 중요성  
- 같은 것을 측정하더라도 다른 결과를 얻을 수 있음



Consideration of the measurement technology is essential!



# Communication and transparency

Preparation and selection of data for different levels/customers





**MAGMASOFT**<sup>®</sup>  
autonomous engineering

# Digitalization and Industry 4.0 @ MAGMASOFT<sup>®</sup>



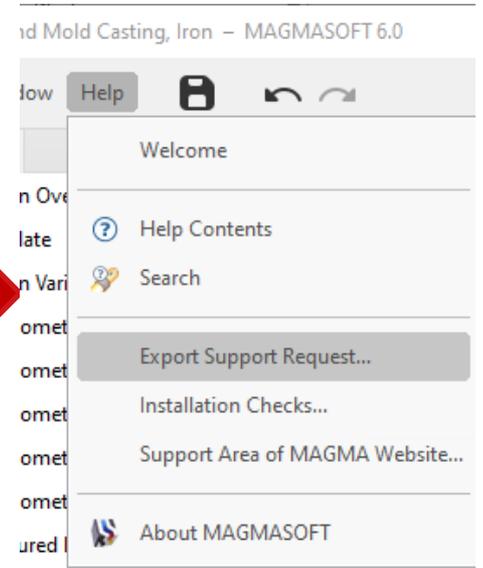


# Support Call

## Provision of needs-based information

고객사 -> MAGMA 정보의 연계를 위한 기능  
- "Export Support Request"

How did that work again with the evaluation area?

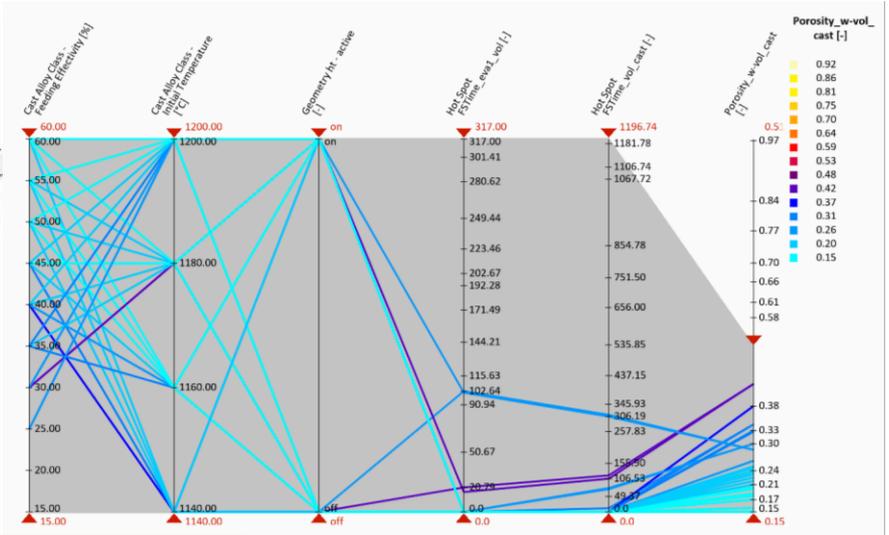
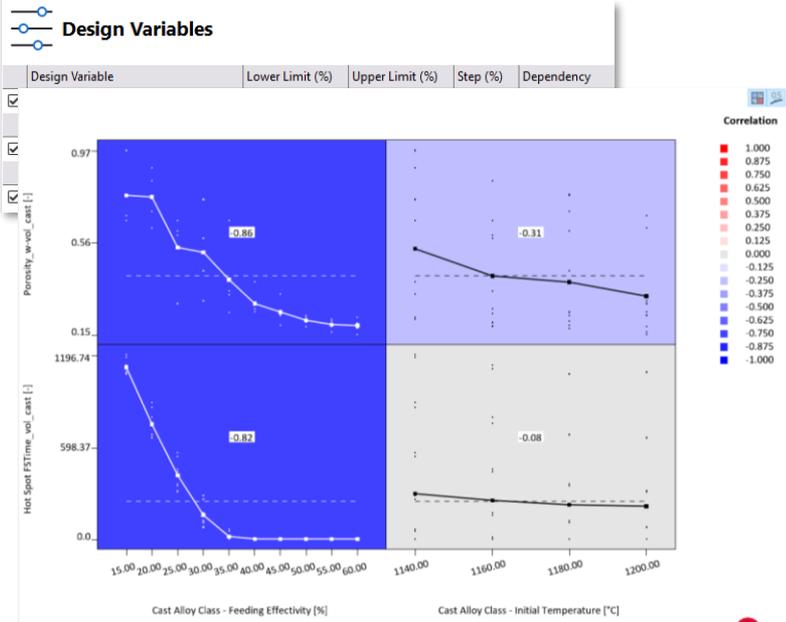
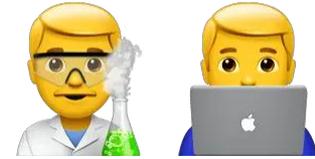


# Design of Experiments

데이터 -> 정보 -> 지식 연계



## Identifying correlations and defining threshold values

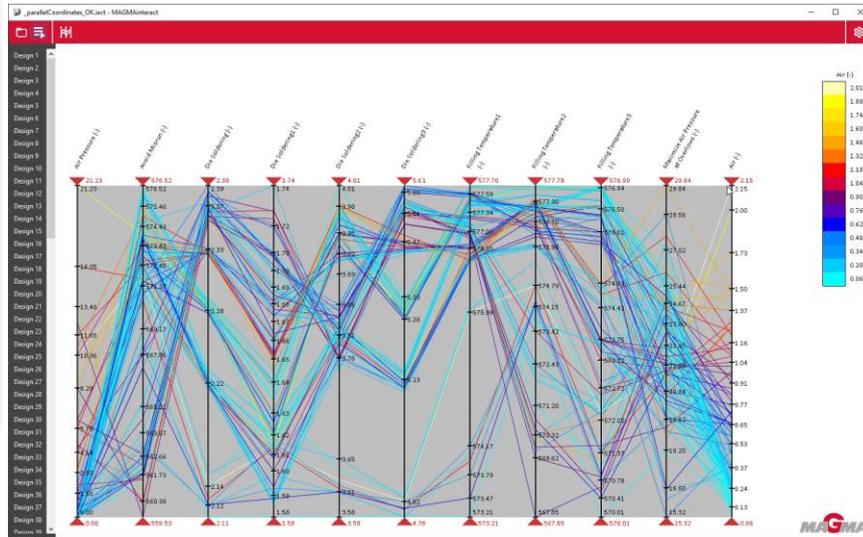
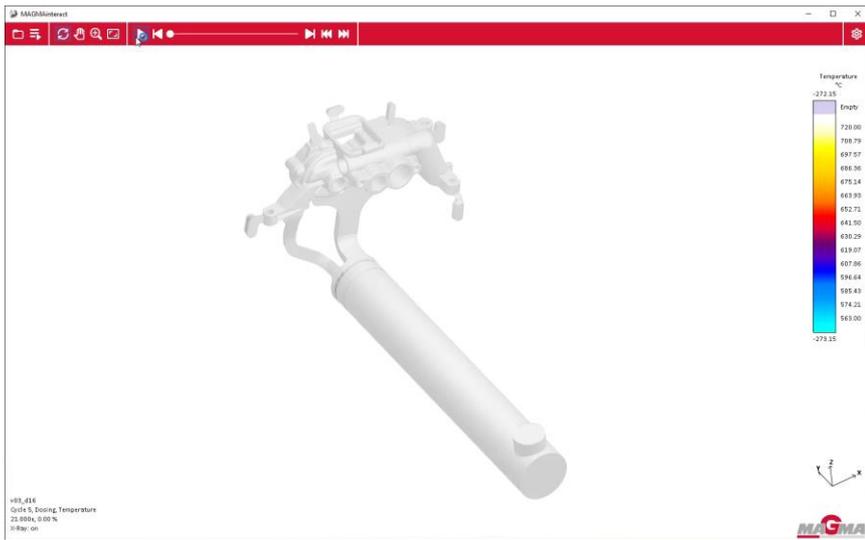


Benefits only through linking data to information and knowledge! 😊

| Hot Spot FSTime_w_vol_cast [-] |
|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1196.74                        | 1181.78                        | 1106.74                        | 1067.72                        | 854.78                         | 751.50                         |
| 598.37                         | 1067.72                        | 1067.72                        | 1067.72                        | 656.00                         | 656.00                         |
| 0.0                            | 854.78                         | 751.50                         | 656.00                         | 535.85                         | 437.15                         |
|                                | 437.15                         | 345.93                         | 306.19                         | 257.83                         | 207.61                         |
|                                | 207.61                         | 155.90                         | 106.53                         | 56.77                          | 0.0                            |
|                                | 0.0                            | 0.0                            | 0.0                            | 0.0                            | 0.0                            |



## Sharing results with internal and external customers



Interact: MAGMASOFT의 결과 Viewer 프로그램  
- 의사소통 도구로 활용



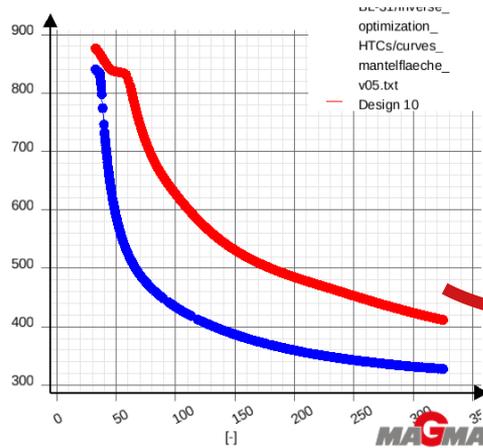
# Inverse optimization

## Determining simulation parameters

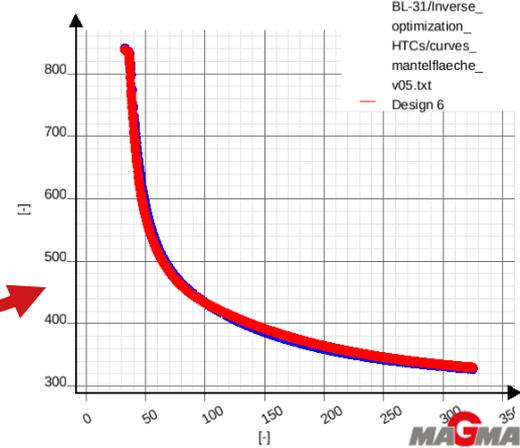
MAGMASOFT에서의 디지털 트윈  
- Inverse optimization을 통한 디지털 트윈 달성

- measurement (digital shadow)
- simulation (digital twin)

# INVERSE OPTIMIZATION



Material data or Simulation boundary conditions



cmp. temperature curves

Heat transfer coeff.

minimized deviation

# Virtual die casting machine



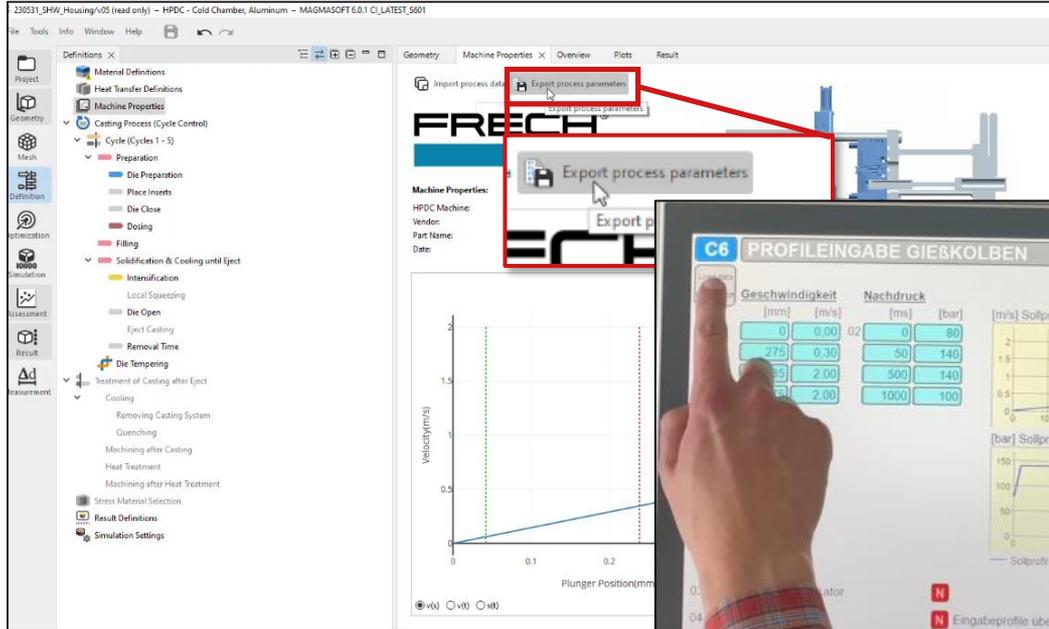
Cooperation partners:



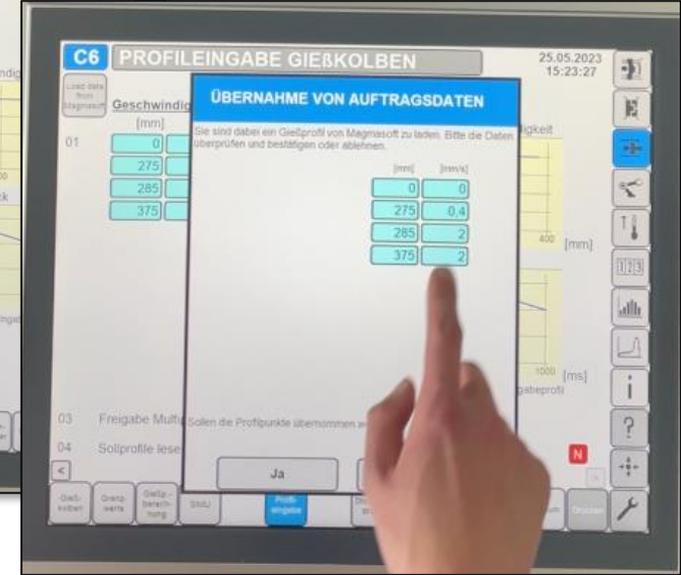


# 1. Simulation starts Production

Automated transfer of simulation parameters to the die casting cell



MAGMASOFT 설정 변수를 다이캐스팅 장비로 연계하는 인터페이스 개발

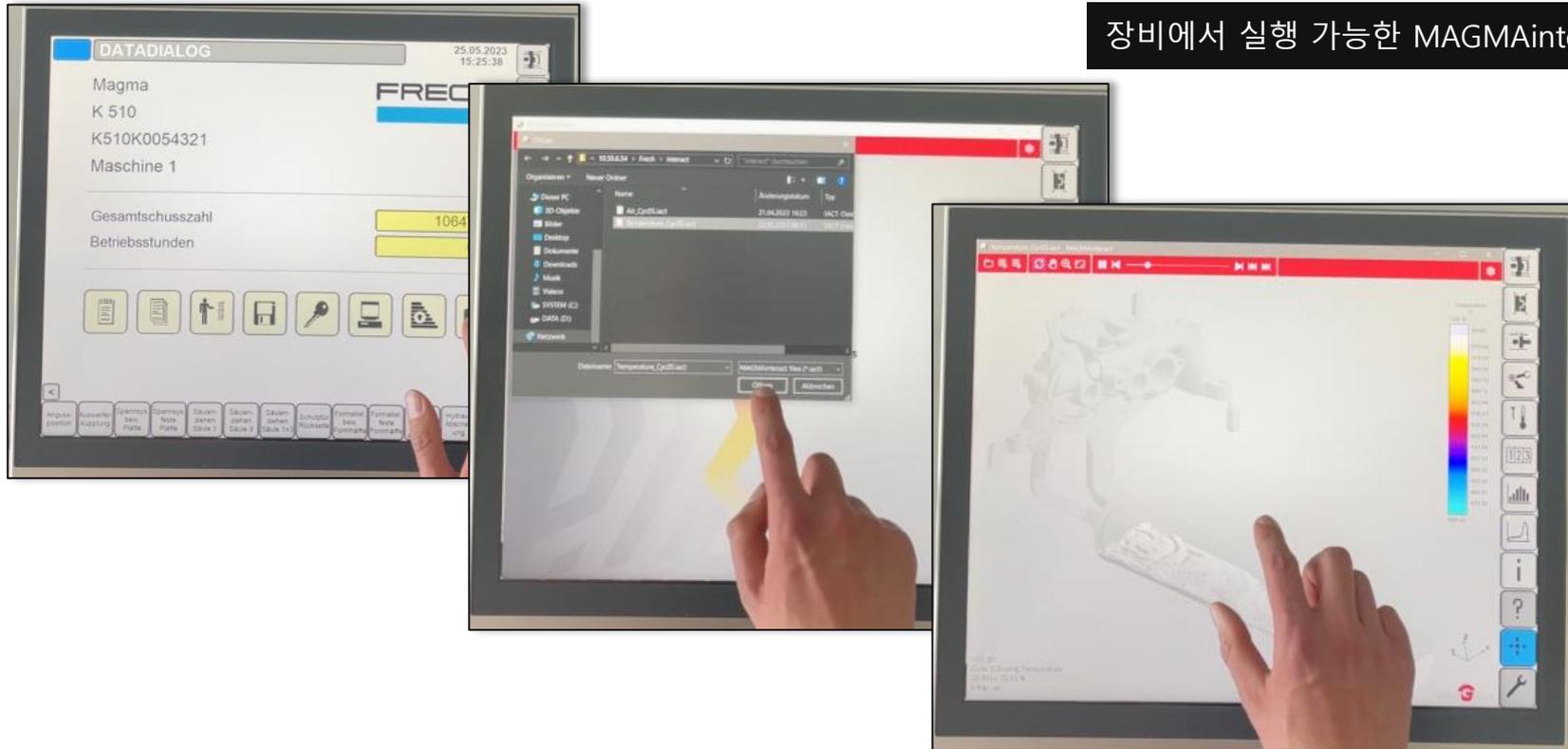




## 2. MAGMASOFT® meets Shopfloor

3D visualization of simulation results directly on the machine

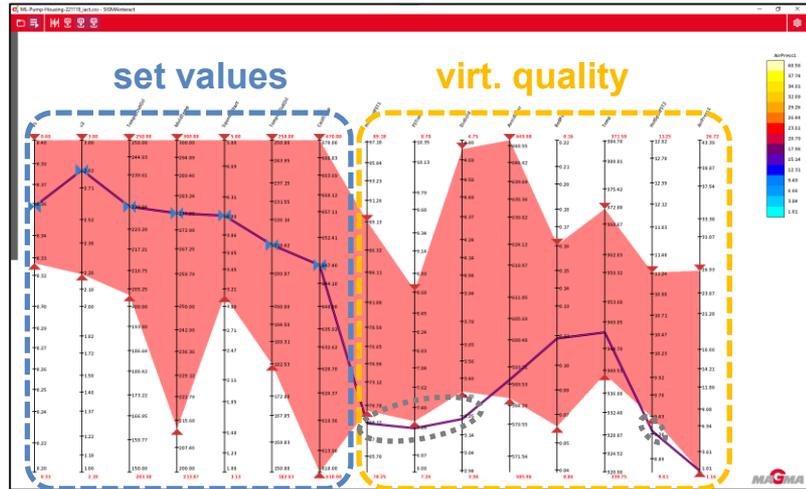
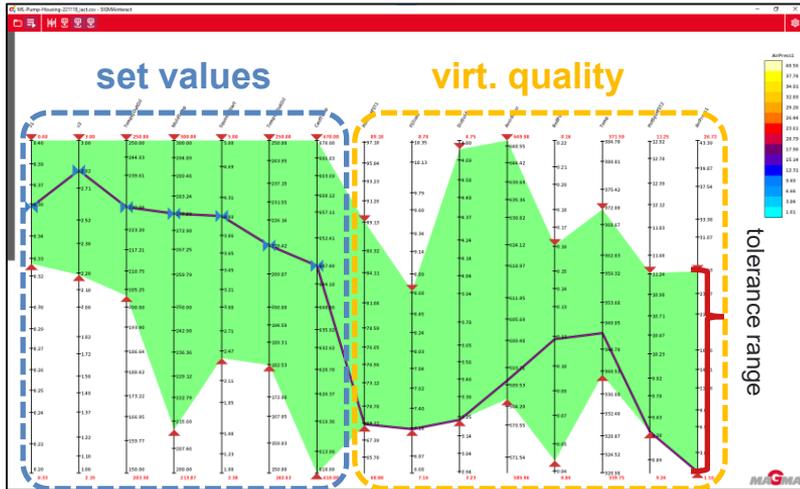
장비에서 실행 가능한 MAGMAinteract



# 3. Online quality forecast

Huge DoE (~200 designs) trains regression algorithm

해석 장비 연계 DOE 진행  
- 생산 중 실시간 적용





# 4. Feed back data

## Use real process data – without "typing"

장비 데이터 -> MAGMASOFT 연계

The screenshot illustrates the workflow for importing real process data into MAGMASOFT. It shows the 'Machine Properties' dialog with the 'Import process data' button highlighted. An 'Open' dialog displays a file explorer view of a directory containing numerous CSV files. A 'Filling' dialog is open, showing 'Imported curve' graphs for Velocity (m/s) vs Time (ms) and Plunger Position (mm) vs Time (ms). A data table on the right lists time and plunger position values.

Time (ms)	Plunger Position (mm)
0.0	0.0
5.0	5.0
44.02	7.08
67.1	9.11
92.5	11.13
104.99	12.17
129.59	14.21
153.28	16.31
154.52	18.41
186.54	19.41
199.59	20.42
228.26	22.51
251.61	24.55
272.6	26.61
282.17	27.63
302.13	29.66
315.66	30.71
336.79	32.79
359.3	34.85
381.56	36.96
390.79	37.96
409.85	40.03
418.12	41.05
438.32	43.13
448.51	44.16
469.06	46.19
489.79	48.2
497.85	49.23
515.14	51.3
532.06	53.42
540.31	54.43
549.17	55.47
565.85	57.5
574.62	58.64
583.92	59.64
602.36	61.69
620.4	63.73
637.15	65.79
652.61	67.84
667.25	69.86
682.79	71.96
690.75	73.0



# 5. Import of statistical data

## Importing the real process window into MAGMASOFT®

센서 기술 확보

4715

Zyklusstartzeit: 14:26:24 Dauer letzter Zyklus: 40.0 s Maschine: 1/123

	Nummer	Schlüssel 1	TZ[s]	V1[m/s]	V2[m/s]	VA[m/s]	CP[mm]	FB[mm]	SZ[mm]	TG[ms]	SJ[mm]	SG[mm]	BT[mm]
2023-06-06 13:50:10	4901		40.00	0.280	3.08	955.05	279.5	459.35	199.50	8.75	1.50	479.00	25
2023-06-06 13:50:50	4902		40.01	0.280	3.09	959.32	279.5	460.00	200.15	8.75	1.55	479.65	25
2023-06-06 13:51:30	4903		40.00	0.280	3.15	988.05	279.5	463.85	204.00	8.75	1.55	483.50	25
2023-06-06 13:52:10	4904		40.01	0.280	3.06	960.34	279.5	458.15	198.30	9.00	1.55	477.80	25
2023-06-06 13:52:50	4905		40.01	0.280	3.02	949.07	279.5	455.85	196.00	9.00	1.50	475.50	25
2023-06-06 13:53:30	4906		40.01	0.280	2.98	936.73	279.5	453.30	193.45	9.00	1.50	472.95	25
2023-06-06 13:54:10	4907		40.01	0.280	2.93	920.05	279.5	449.75	189.90	9.00	1.60	469.40	25
2023-06-06 13:54:50	4908		40.01	0.280	2.89	907.93	279.5	447.25	187.40	9.00	1.55	466.90	25
2023-06-06 13:55:30	4909		40.01	0.280	2.86	899.20	279.5	445.55	185.70	9.25	1.50	465.20	25
2023-06-06 13:56:10	4910		40.01	0.280	2.86	897.57	279.5	445.10	185.25	9.00	1.60	464.75	25
2023-06-06 13:56:50	4911		40.01	0.280	2.84	892.92	279.5	444.15	184.30	9.25	1.55	463.80	25
2023-06-06 13:57:30	4912		40.00	0.280	2.78	872.05	279.5	439.85	180.00	9.25	1.55	459.50	25
2023-06-06 13:58:10	4913		40.01	0.280	2.71	851.84	279.5	435.70	175.85	9.50	1.50	455.35	25
2023-06-06 13:58:50	4914		40.01	0.280	2.69	844.42	279.5	434.20	174.35	9.50	1.60	453.85	25
2023-06-06 13:59:30	4915		40.01	0.280	2.65	836.89	279.5	432.60	172.80	9.50	1.50	452.25	25

Grenzen für TZ  
Min 2 = 0  
Min 1 = 0  
Max 1 = 0  
Max 2 = 0

von: 2023-06-06 06:00:00  
bis: 2023-06-06 14:00:00  
Messungen  
Maschine 1

Create design variables from statistical data

**Create design variables from statistical data**  
Import statistical data and apply values to new or existing design variable definitions

Load data from file...

Dataset: 1 of 4

**ELECTRONICS**

File: P:\c.ophoven\gifa.csv  
Machine type: Gauge  
Machine name: CQC - Cast Quality Control Messsystem  
Tool: Tool SHW-Gehäuse-1234  
Part name: SHW-Gehäuse  
Date: Thursday 2023-03-17 17:23:45

Measured data:

Velocity [m/s]

Shot

0.2934 m/s  
Set as upper limit  
Set as lower limit

Map to design variable in project

Design variable: Filling - First Phase - Final Plunger Velocity

Upper limit: 0.5 m/s Project values: 0.5 m/s  
Lower limit: 0.2 m/s Project values: 0.2 m/s  
Step size: 0.3 m/s Project values: 0.3 m/s  
Number of steps: 1 Project values: 1

Save values in project version

Close

# Thank you for your attention.

Jan Eilers

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Web: [magmasoft.com.sg](http://magmasoft.com.sg)



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