

A System of Coordination With Analysis Engineers and the Successes That Follow

Norihide Fujiyama

Senior Manager, Analysis Team Product Development Dept

KOYO THERMO SYSTEMS CO.,LTD

Abstract :

While working on the development of induction heating and struggling with the establishment of CAE technology, I was able to introduce several types of analysis software such as 3D CAD and JMAG.

Although the effects of CAE or its results were not understood at the time, I continuously made effort to build upon it's results and promoting CAE to other designers.

A dedicated analysis team was established 7 years ago for the purpose of logistics support, and at present we support various areas such as design, development and quality assurance etc..

Since the beginning of CAE introduction, my biggest issue up to this day is how difficult it is to appeal how cost-effective CAE can be.

In my lecture, I will introduce some of the early cases when JMAG was first introduced, my analysis techniques that I acquired through trial and error and the drive to promote CAE, and examples of effectively calculating fixed quantities in cost effectiveness.



JMAG User Conference 2011

Induction Heating Session

2011.12.8.

A System of Coordination With Analysis Engineers And the Successes That Follow

価値ある技術をお客様のもとへ
Value & Technology

Koyo

JTEKT Group

KOYO THERMO SYSTEMS CO.,LTD

Product Development Department

Analysis Team

Norihide Fujiyama

Today's Agenda

1. Company Introduction
2. The Story Behind CAE Introduction
3. The Role of the Exclusive Team
4. An Example of Cooperative Support in Concept Design
5. Regarding Sales Contribution Evaluations



Company Guide

- Business description: Production and sales of heat treatment industrial equipment
- Established: July 19, 1967
- Paid-in capital: ¥450 million
- Employees: 410
- Head office: Tenri, Nara

Value&Technology

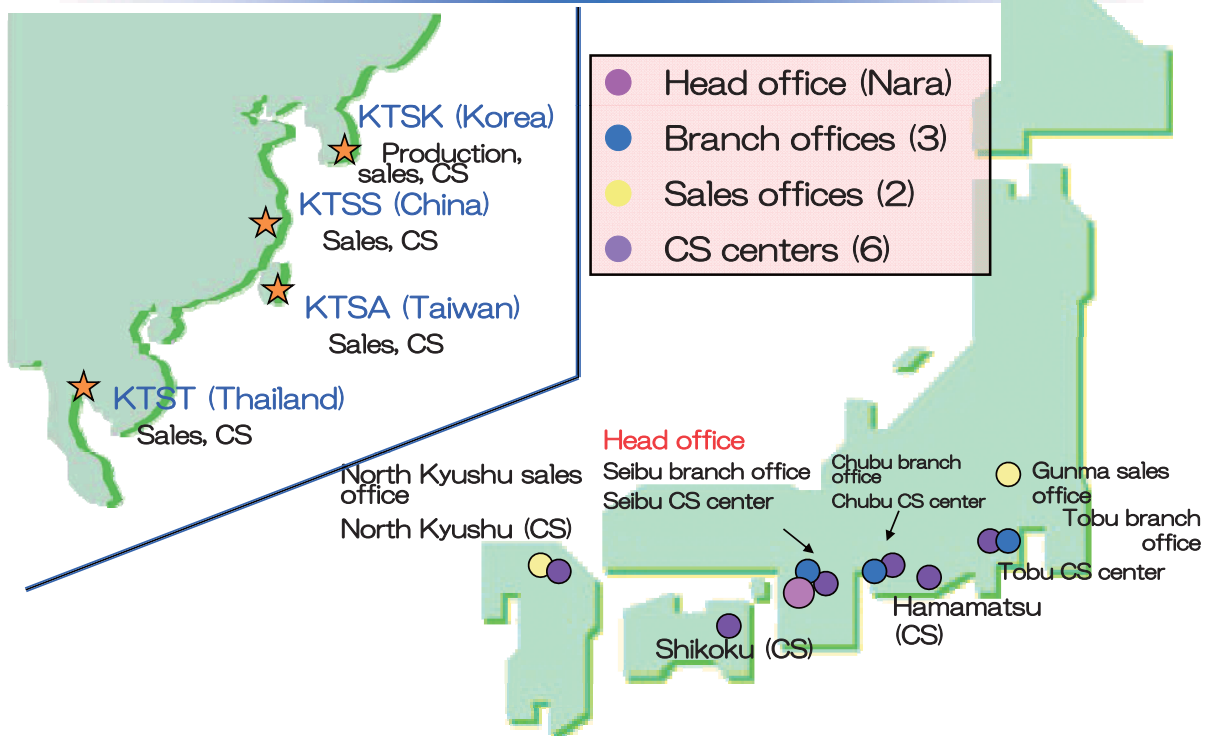
Pursuing our dreams in technology and brining products with value to you.



2011.12.8. JMAG User Conference 2011


N.Fujiyama 3

Sales, CS, and Overseas Offices




2011.12.8. JMAG User Conference 2011


N.Fujiyama 4



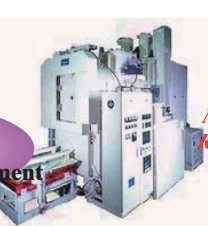
Various Types of Heat Treatment Equipment




Moldatherm Heater
A very high efficient heating element and functional insulation vacuum-molded into a single-bodied heater unit.



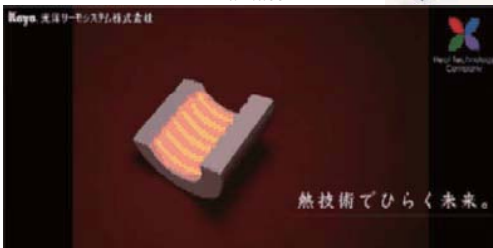
Heat Treatment Industrial Equipment
KCF Carburizing Furnace
Vacuum Carborizing Furnace




Product Development Department
Medium, long range R&D themes
AE Technology




FPD Equipment
Clean Batch System




Electronic Industrial Furnace Equipment
Mesh Belt Conveyor Furnace



Scientific Heating Equipment
Small Mesh-belt Conveyor Furnace
Tube Furnace




PDP Equipment
Roller Hearth Continuous Furnace



Semiconductor Equipment
Induction Heating High Speed Heat Up and Cool Down Equipment

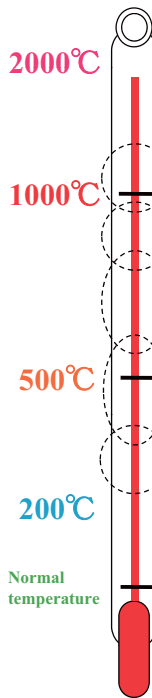
2011.12.8. JMAG User Conference 2011

N. Fujiyama 5



“Heat Transfer and Flow” is the eternal challenge that gives us headaches.

On the front...



2000°C Vacuum sintering
1000°C Semiconductor wafers
Carburizing and tempering
Ceramics, glass
500°C Solar batteries
Semiconductor wafers
Glass basal plates for FPD, and PDP
200°C
Normal temperature

◎ Equipment designers' worries...?

How much **time** do we need for **heating**?

How should we heat it to make it **uniform and even**?

How does it **flow** at high temperatures?

What kind of **concentration distribution** does the atmosphere gas have?

What kinds of transformations will **distortions from heat** have?

I'd like to do **actual machine verification**, but...!?

Measurement equipment limits
Visualization is tough
No time or money

We must break away!

Excessive quality Quality complaints

Intuition
Experience
Confidence

2011.12.8. JMAG User Conference 2011

N. Fujiyama 6

Now, for our role



Analysis Support, Promotion, and Education

The 3 Pillars

- (1) Analysis support through cooperation between the analysis designers and each department

Adjusting speed and precision according to the other party

- (2) Education and promotion from the analysis designers

Planting awareness and managing the environment through analysis techniques

- (3) Educating by level (management, administration, and operations levels)

Producing effects that establish an aim



Realizing CAE's Effects

Trust and Solidarity

(1) Analysis support through cooperation between the analysis developers and each division

They won't understand what they can do with CAE or how to use it to begin with

We'll just have to meet halfway

The spread of designer CAE

Pieces of information from outside

But...

- Even if I want to, I'm busy
- I don't know when to use it.
- I can't bring it out because I feel uneasy
- I didn't want to use it to begin with

But it's easy!

It's fast!

With this With that

No experiment No trial product

...

Designer
Analyst
Cooperation Support

In reality...

- Knowledge and experience are necessary
- A trade-off between precision and time
- Simplification of phenomena
- Confirmation of actual measurements is necessary

They come to realize ways of using CAE that they had thought about but had never seen



2011.12.8. JMAG User Conference 2011

N.Fujiyama 9

Adjusting Speed and Precision According to the Other Party

Let's try using CAE again

I'll try using CAE by myself

Winning over the supervisor's trust

Concept design

Narrowing down ideas, pointing to a direction

Detailed design

A foundation for fixing the specs and a support for the numbers

R&D

Predictions of unknown phenomena and an appendix for theoretical foundations

Service

Assistance in determining the causes of trouble, confirming the validity of countermeasures

Sales

Helping enhance presentation materials
the inside of a hot furnace

Speed

Precision

Precision

Speed

Precision

Speed

Realizing

Speed

Immediate response, turning a pinch into a chance

Customers will find it useful and order, both now and next time!

Customers will definitely make requests! ⇒ Overwhelming benefits

Winning over the customer's trust



2011.12.8. JMAG User Conference 2011

N.Fujiyama 10

Design Competence is Necessary for the Analysis Side, too!

(A sense of discomfort)

Not making the other party feel a burden by cooperating tightly with them

Gaining their trust

Quickly! Clearly! Accurately!

Immediately understanding what the designer is saying

➡ The ability to see into their intentions, character, and things they are not yet aware of



Putting together phenomena for simulations that get to the root of the problem

➡ The ability to convert design words to the analysis problem

Judging whether the analysis is possible

➡ The ability to understand potential through skills and resources

Calculating the time necessary for analysis

➡ The ability to prepare an analysis plan that fits the design process

Absolute attendance for design meetings, always extract analysis support items



Always move as one until you reach the goal
(Communication between the designers and the analysis developers)



IH Hotplate Concept Design

A Cooperation Support Case Study



The Difficulties of IH Parametric Experiments

Parameters	Experiment Confirmation	Simulation
① Power-supply frequency	Hard (Associated with remodeling the inverter)	Easy (Only changing the settings)
② Hot plate geometry	Hard (Multiplying the test production cost)	Easy (Only changing the settings)
③ Coil-hot plate distance	Normal (Time and effort for setting up the experimental equipment)	Easy (Only changing the settings)
④ The current value for each turn	Hard (Accounting for influence from mutual interference)	Easy (Only changing the settings)

- ① Inverter remodeling: About 1 million Yen (Time: about 1 month)
 ② Graphite slab (Hot plate): About 1 million Yen per slab (Delivery period: about 1 month)
 ③&④ A huge amount of time and effort for experiment and organize data

The effects of reducing costs and improving experimental efficiency are unlimited!

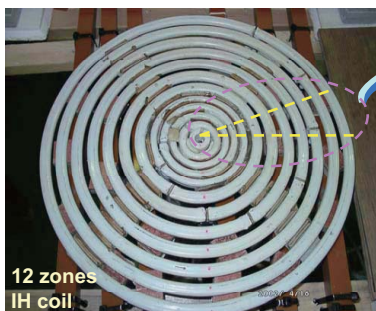


2011.12.8. JMAG User Conference 2011

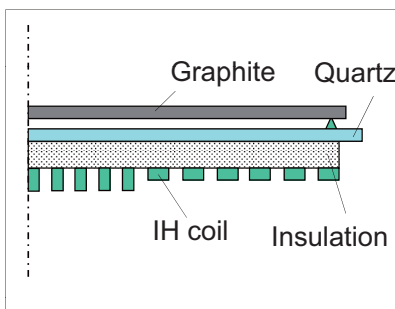
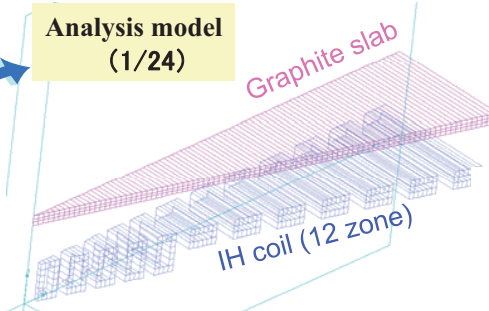
N.Fujiyama 13

Analysis Case Study: Induction Heating of a Plate

Joint development with Mitsui Engineering & Shipbuilding Co., Ltd.



Analysis model
(1/24)



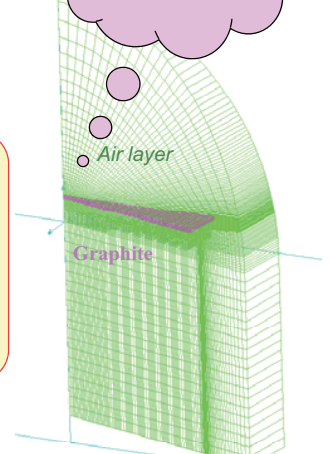
A cross-section of the experimental equipment

Uniform heat virtual experiment parameters

- Power-supply frequency
- Graphite geometry
- Graphite and coil distance
- Each zone's current value

The points are speed and uniformity!

Because it sufficiently accounts for diffusion of the magnetic flux into the air



The entire analysis model

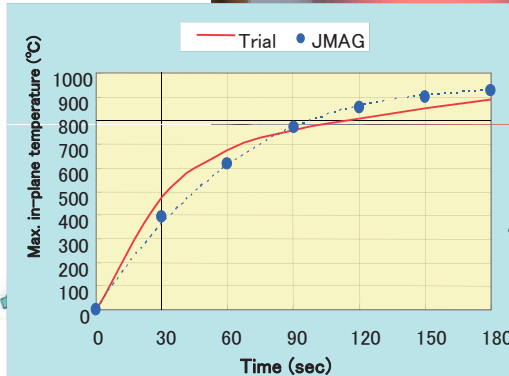


2011.12.8. JMAG User Conference 2011

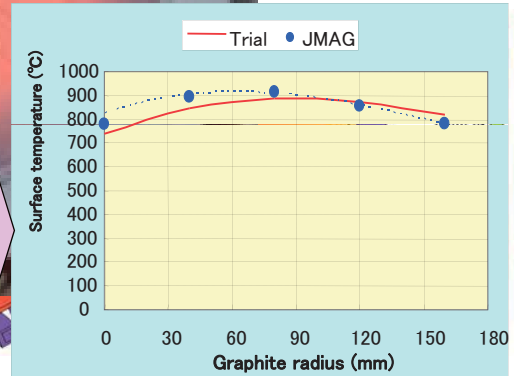
N.Fujiyama 14

Confirming Validity

The appearance during heating



Heatup characteristic comparison
(In-plane max. temperature)



Radial direction temperature distribution comparison
(After 180 seconds)

Good results,
with a difference of
under 10%



Results and Analysis

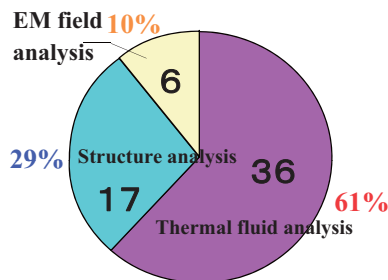
Regarding Cost-Benefit Performance



Doing This Much by Myself in the 2nd Year After Introduction!

Operating Period
2003 Results
(April 2003 - March 2004)

Number of internal analysis request themes

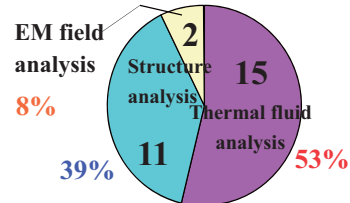


Total number of request themes: 59



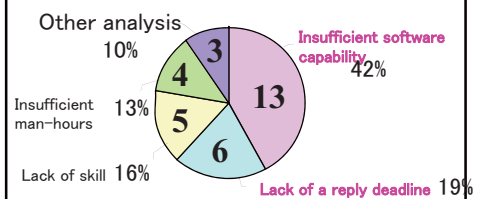
Completion rate
approx. 48%

Contents of themes with **completed** analysis



Total number of completed themes: 28

Contents of themes with **uncompleted** analysis



Total number of uncompleted themes: 31



Aiming for a Cost-Benefit Evaluation... (In early use)

2003: Against the 28 themes with complete analysis

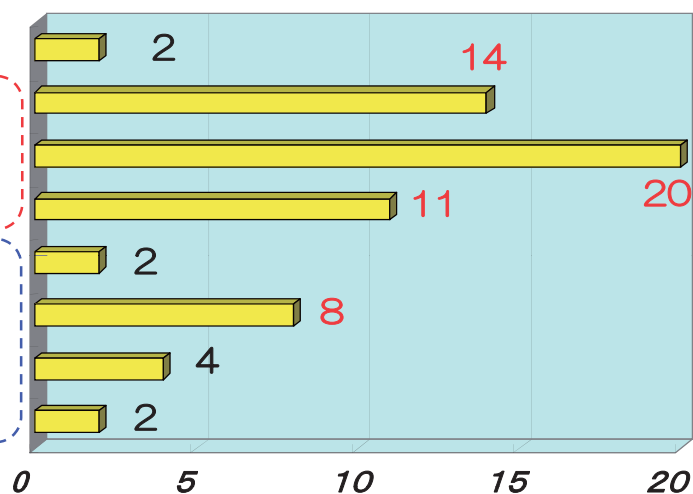
Qualitatively surveying the results from the departments that requested analysis

(Multiple answers per theme)

SBD Outcomes!

- Zero benefit
- A reference for changing the design next term
- A clarification of guidelines and direction
- A clarification of experimentally difficult items
- My customers trust me
- Early/advanced solutions to problems
- Shortening completion times for design and trial production
- Cost reduction

Management contribution CAE



Points that Produce Management Contribution with CAE!!

● Cooperative support

- Deciding on precision or speed to suit the other party
- Communication

● Technical support (maintenance) is vital!

- Human and trusting relationships (Sales, tech)
- The user's point of view
- Footwork

● Education/Progress

- Only for those who are eligible
- Determine the application range
- Arrange the environment
- Persistently follow up

There is no easy cure!

Steady effort

Building up results

● An advisor is necessary!

Make an ally!

If there's no one in-house then look outside:

- ◆ SBD Users Technical Research Conference
- ◆ SWJUG / SWCN
- ◆ CAE Forums ...etc

● Effect appeal

- Narrow down the eligibility
- Narrow down the targets

From: KKE VISION 2007 Keynote Speech "Educating Thought Leadership"
Ikujiro Nonaka (Hitotsubashi Graduate School, Professor Emeritus)

The stake that is too tall cannot be driven down!



Never give up, no matter what!



2011.12.8. JMAG User Conference 2011

N. Fujiyama 19

Hosted by JSOL Corporation

JMAG User Conference 2011

Induction Heating Session

*Mechanisms for Cooperating with Analysis Developers...
And the Successes that Come From Them*

The end

Thank you for your attention

