GENESIS Structural Analysis and Optimization for Press Die

2014 VR&D User Conference @ Monterey

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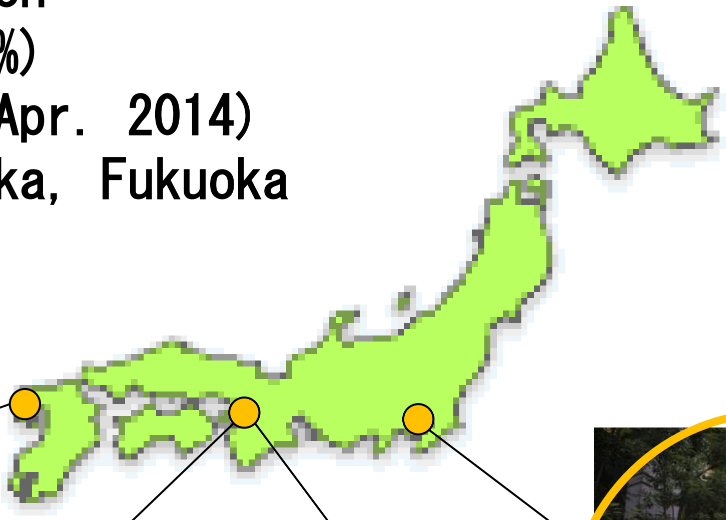
DISQUARE Corporation

Agenda

1. Introduction
2. Today’s Theme
3. Application of GENESIS to Production Engineering
4. About Practical Use
5. Conclusion

DISQUARE Corporation

Established　: 2007(Spin-off from DAIZO Corp.)
President　: Tadashi Matsuo
Common Stock : ¥410 million
Stock Holder : DAIZO (100%)
Employees　: 150(as of Apr. 2014)
Offices　: Tokyo, Osaka, Fukuoka



Oshima Shipbuilding
(Oshima, Nagasaki)

DAIZO
OSAKA SHIPYARD

Osaka Shipbuilding
(Minato-ku, Osaka)

Osaka Office
(Minato-ku, Osaka)

Tokyo Head Office
(Shibuya-ku, Tokyo)

DISQUARE Skills for Manufacturing Industry

Design and Manufacturing Process

Conceptual / Initial / Detail Design | **Product Engineering** | **Product Control** | **Maintenance**

Department

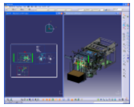
- **Sales**
- **R&D**
- **Purchasing**
- **Manufacturing**
- **Quality Assurance**

Market Research

- Making Strategy

Digital Engineering

- Styling
- 3D-Modeling
- Digital Mock up
- Knowledge Base

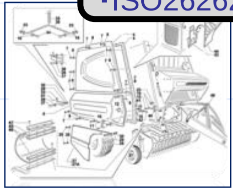


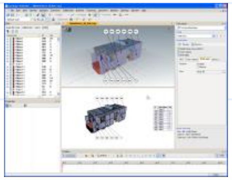
CAE

- Structural Analysis
- Motion Analysis
- CFD
- Design Optimization

Systems Engineering

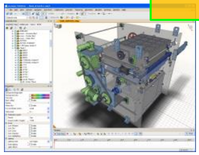
- Requirement Management
- ISO26262/DO172B





3D Data Usage

- Assembly Manual
- Sales Materials
- 3D Viewer



Digital Factory

- Process Study
- Human Work Simulation
- Factory Simulation

ERP

- Accounting Management
- Sales Management
- Production Management
- Purchase
- Logistics

Facility management

Facility management
Maintain Planning

EDII

Electronic Orders
Exchange CAD Data

<Experience in 3D-CAD and CAE>

- Became IBM Partner in 1986
- has deployed CAD/CAM/CAE with mainly CATIA
- Became VR&D Distributor in 2006
- Is supporting Genesis, SMS and VisualDOC
- Users in heavy industry, electronics, auto OEM and its supplier

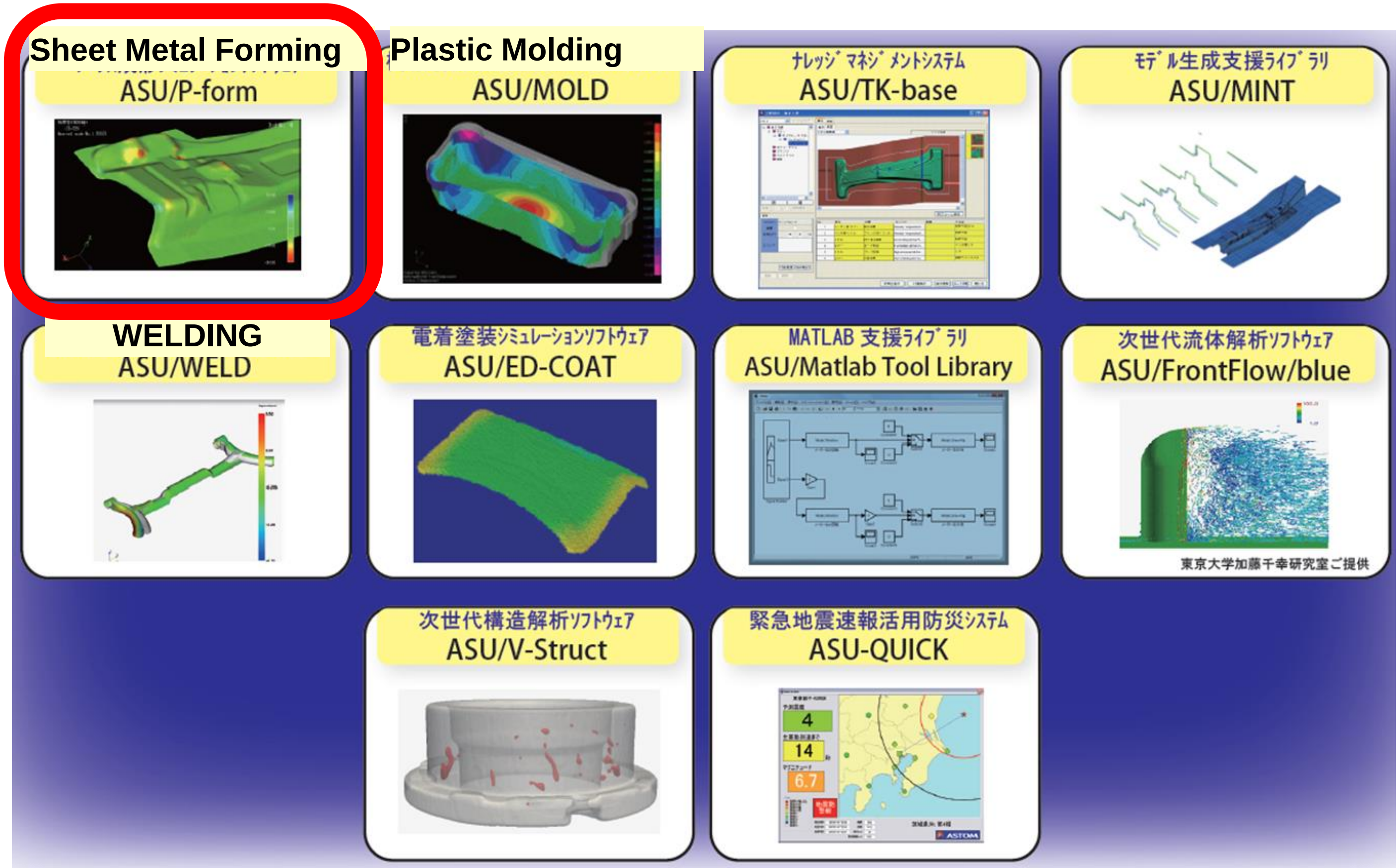
Product Data Management

- Product Data Management
- Bill of Materials

- Project Management
- System Security

Today’s Theme

■ Application of GENESIS to product engineering
=> Structural Analysis and Design for Press Die


Sheet Metal Forming
ASU/P-form
Plastic Molding
ASU/MOLD
ﾅﾚｯｼﾞ ﾏﾈｼﾞ ﾒﾝﾄｼｽﾃﾑ
ASU/TK-base
ﾓﾃﾞﾙ生成支援ﾗｲﾌﾞﾗﾘ
ASU/MINT
WELDING
ASU/WELD
電着塗装ｼﾐｭﾚｰｼｮﾝｿﾌﾄｳｪｱ
ASU/ED-COAT
MATLAB 支援ﾗｲﾌﾞﾗﾘ
ASU/Matlab Tool Library
次世代流体解析ｿﾌﾄｳｪｱ
ASU/FrontFlow/blue
東京大学加藤千幸研究室ご提供
次世代構造解析ｿﾌﾄｳｪｱ
ASU/V-Struct
緊急地震速報活用防災ｼｽﾃﾑ
ASU-QUICK
4
14
6.7
ASTOM

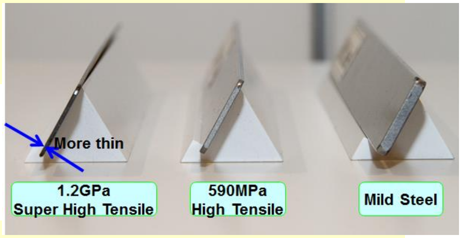
ASTOM R&D has own software products for product engineering

http://www.astom.co.jp/

Today’s Theme

■ Application of GENESIS to Press Die Design

Demand on lighter structure of products using sheet metal
=>Adoption of high-tensile steel plate

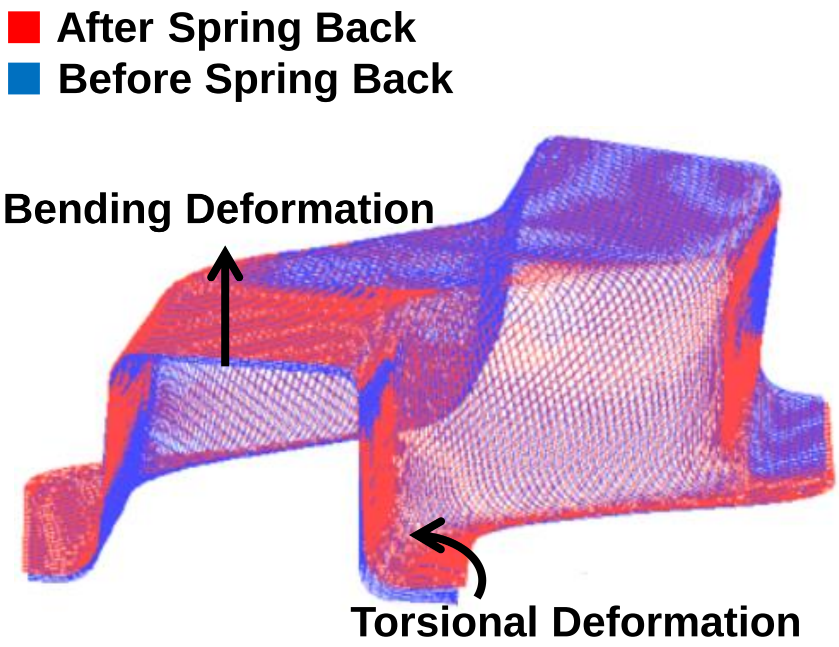

More thin
1.2GPa
Super High Tensile
590MPa
High Tensile
Mild Steel

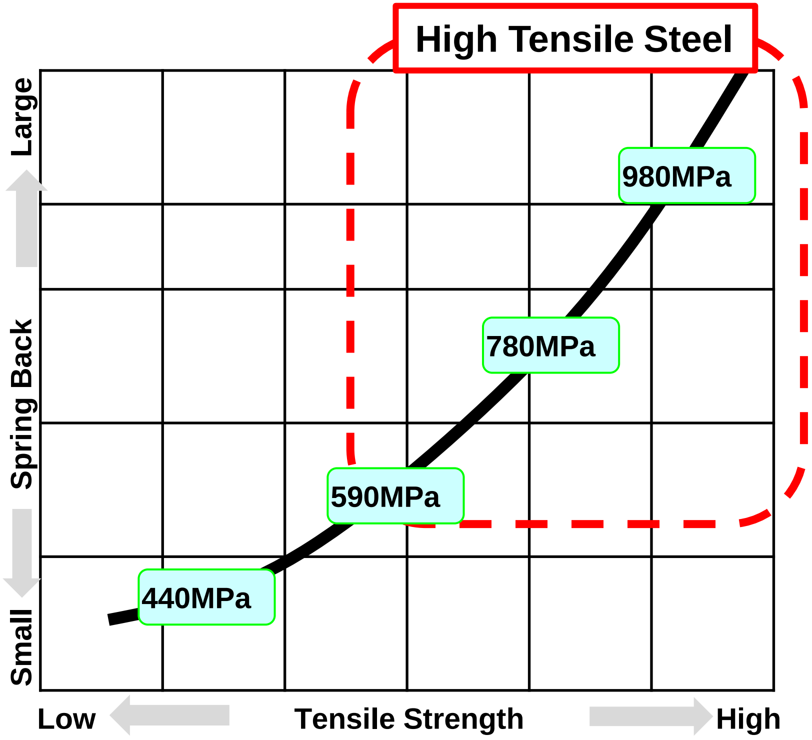
Needs stiffer die
=>Uses GENESIS structural analysis and design

Proposal Solution
=>Will be possible to use existing press equipment

Issue about Using High-tensile Steel Plate

■ Spring back of High-tensile steel plate is larger.

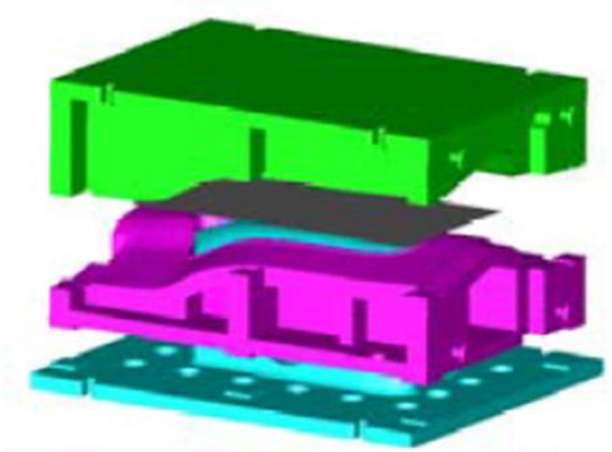

🟥 After Spring Back
🟦 Before Spring Back
Bending Deformation
Torsional Deformation



Improvement of prediction accuracy of spring back is important

Issue about Prediction for Die Deflection

- **Larger die has deflection**
- **In case of high tensile steel plate, stronger reaction forces of sheet metal pushes dies**



- **Sheet metal forming analysis**
  - **Assumption that Dies are rigid body**
  - **Assumption that Dies uniformly contacts sheet metal**

Difference: Stiffness of Die

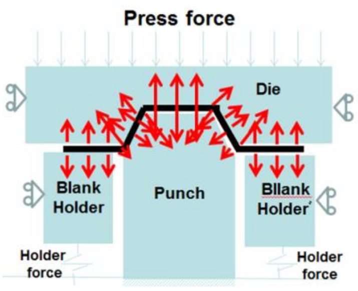
- **Actual press forming**
  - **Dies occurs elastic deformation**
  - **Dies non-uniformly contacts sheet metal**

  =>Cannot ignore Reaction forces from sheet metal

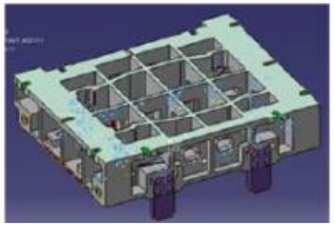
Needs structural analysis of elastic deformation of dies with considering of reaction forces from sheet metal

Solution Approach

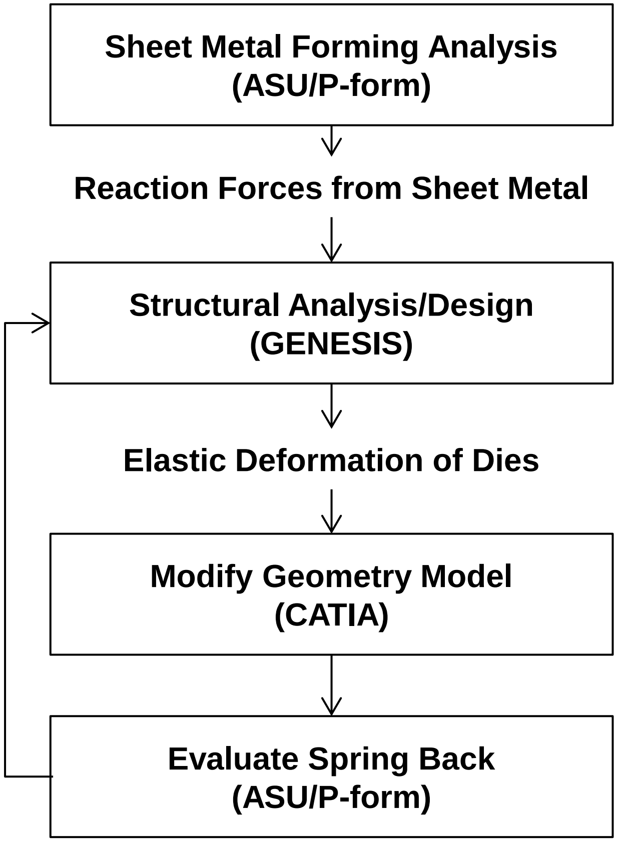
■ Minimize Die's deflection by Genesis Structural Analysis/Design


Press force
Die
Blank Holder
Punch
Bllank Holder
Holder force
Holder force

Load Condition



Modify Geometry



Sheet Metal Forming Analysis (ASU/P-form)

Reaction Forces from Sheet Metal

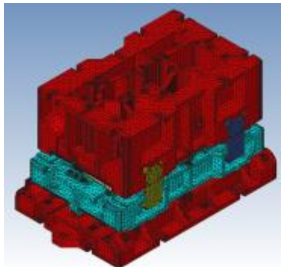
Structural Analysis/Design (GENESIS)

Elastic Deformation of Dies

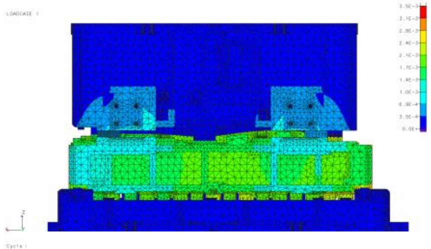
Modify Geometry Model (CATIA)

Evaluate Spring Back (ASU/P-form)

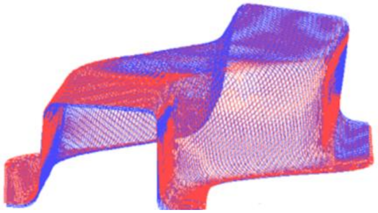
Sheet Forming Simulation



Structural Analysis



Evaluate Deflection

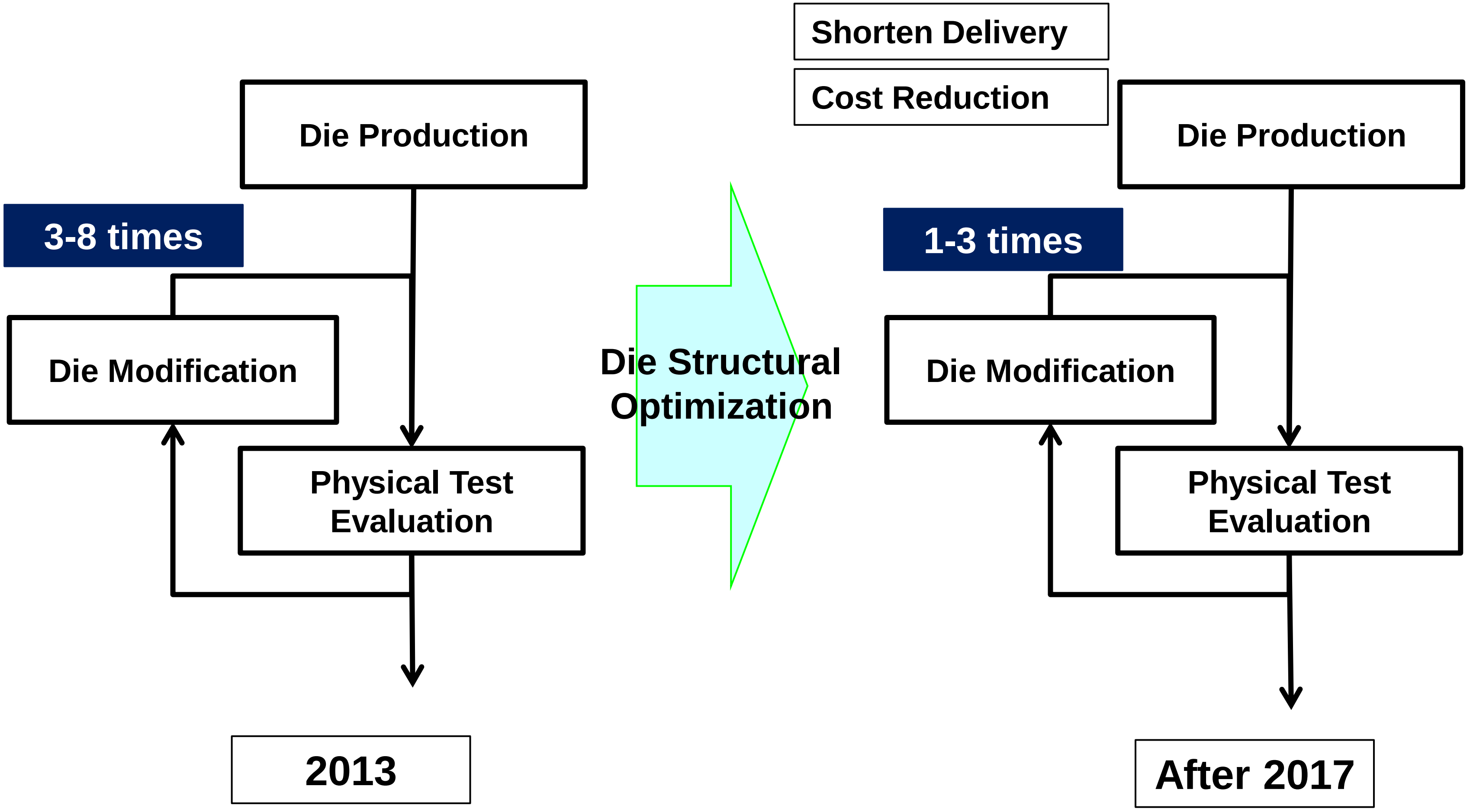


Evaluate Spring Back

Stiffened die makes possible to use existing press equipment.

Target: Reduction of Iteration numbers of die modification

- **For Super High tensile steel plate(>980MPa) ; Reduction will be over 50% after 2017**



Shorten Delivery

Cost Reduction

Die Production

3-8 times

Die Modification

Physical Test Evaluation

2013

Die Structural Optimization

Die Production

1-3 times

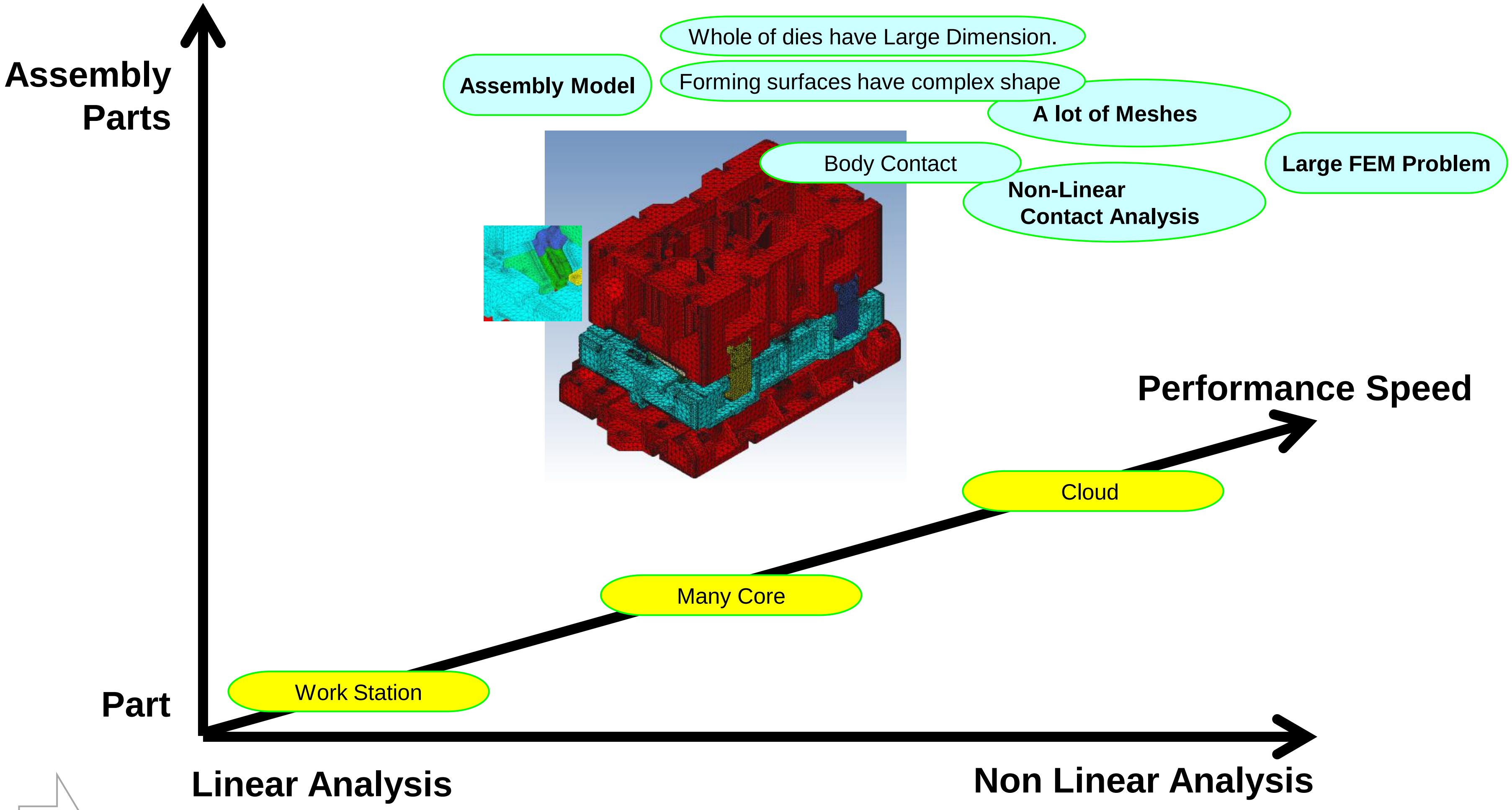
Die Modification

Physical Test Evaluation

After 2017

Requirement for Practical Use

■ Die Analysis/Optimization :Large FEM Problem



Assembly Parts

Part

Linear Analysis

Non Linear Analysis

Performance Speed

Work Station

Many Core

Cloud

Assembly Model

Whole of dies have Large Dimension.

Forming surfaces have complex shape

A lot of Meshes

Body Contact

Non-Linear Contact Analysis

Large FEM Problem

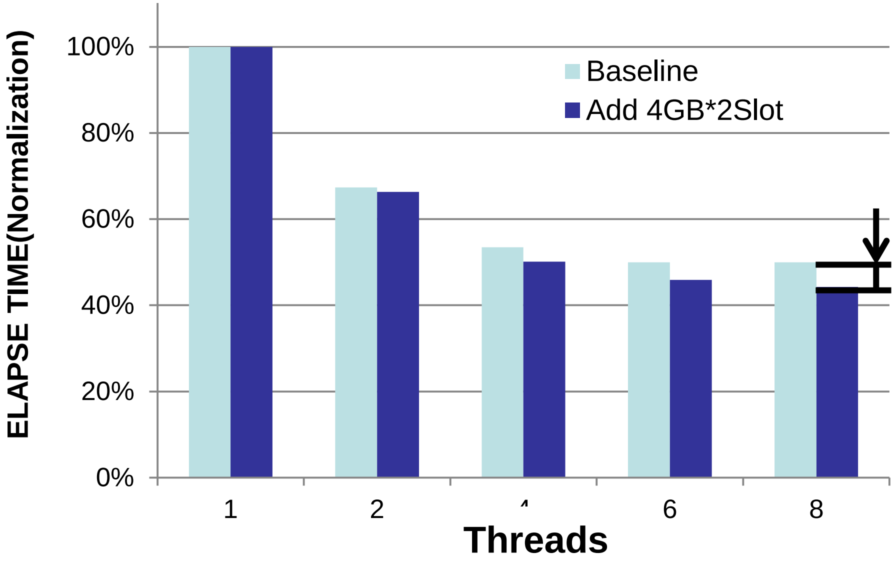
Require the environment for handling large FEM Problem

Thinking about SMP Performance

- **SMP performances are like Baseline when threads is changed.**
  => Performances are not grow when threads number is over 4.

- **Observed the effect of memory bandwidth by adding memory.**
  =>Very simple test however we got 12% of improvement (8thread).

OS：Cent OS 6.5 64bit
CPU： Intel X5675 @3.07GHz×2　12Cores



Improvement;
12% at 8 threads

Would like to try virtual technology that extends available memory.

Conclusion

- Described an innovative design process for press die using Genesis and ASTOM/P-form.
  - Continues to research in order to satisfy target of 2017.

- Also described simple test for improvement of performance.
  - It showed bandwidth is effective.

- Would like to try virtual technology that extends available memory.
  - Would like to report to VR&D and discuss it.

Special thanks to;

Masakatsu Tsuneki, ASTOM R&D.

Kazuhiro Kooriyama, Automotive Design Solution,Inc.

Toshihiro Ueda, DISQUARE, Corp.

Thank You.

DISQUARE Corp.

www.di-square .co.jp