



# Virtual Joining Portal

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**A new service from EWI which combines**  
**Welding Procedure Database**  
**Welding Management**  
**Supercomputer Architecture**  
**Numerical Analysis software**  
**Internet Delivery**

# Two of the important challenges faced by ship building:

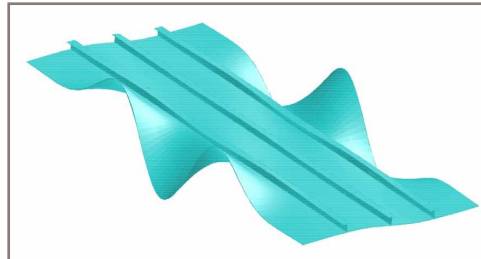
- Welding related distortion, shrinkage and dimensional instability
  - Acute with thin-sheet high-strength steels
  - Extensive and expensive re-work
  - Difficult to predict and design against these effects
- Management of Weld Procedures and Qualifications
  - Ship building involves extensive geometry, material and process conditions
  - Difficult to track and maintain welding procedures for 100s of designs



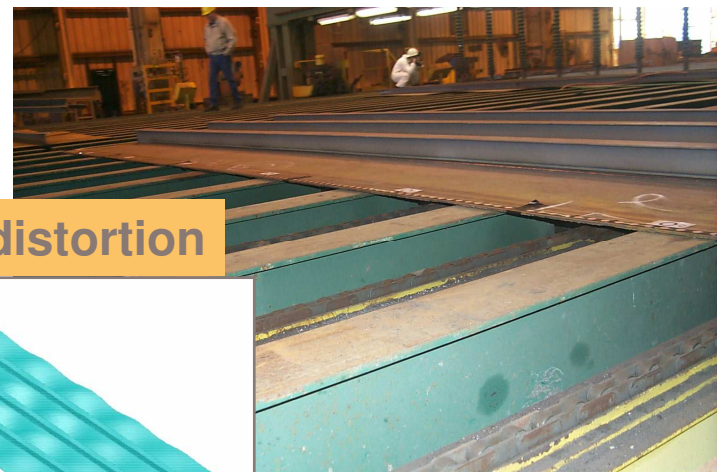
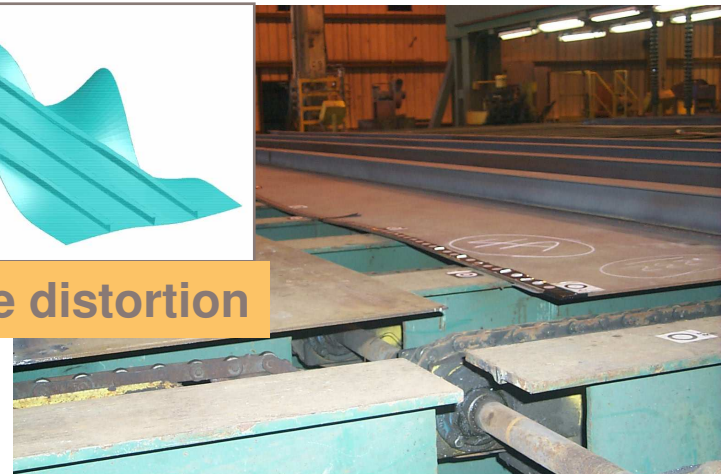
# Challenge 1: Distortion, Shrinkage, Residual Stress and Hard Microstructure

# Computational modeling helped to minimize distortion in ship building:

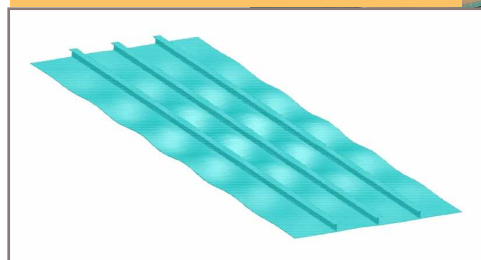
- Distortion, shrinkage, dimensional tolerances leads to extensive re-work:
- EWI and other organizations have developed tools to predict distortions
- Thermal tensioning procedure was developed by using these tools.



**Extensive distortion**



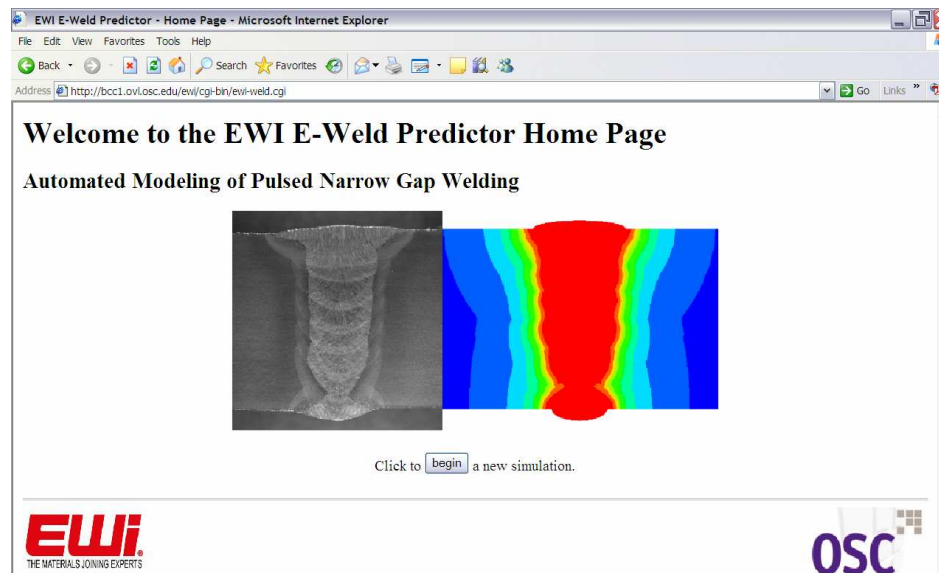
**Minimal distortion**



# Bottleneck for use of computational modeling:

- Deployment of the model in their own companies as desktop applications is difficult
- Models should be easy to use and accessible to the welding engineers and should be rapid
- Usage as simple “what-if” scenario without searching for that 100% accuracy!
- Automatic analysis and reporting
- Usage as a way of technology retention and transfer in legacy systems
- Models should not need a full-time FEA expert

# EWeldPredictor<sup>©</sup> Technology:



Typical analysis time for existing capability = 8 hrs

New EWI/OSC service offering: 3-5 minutes.

- Three different expertise are coupled.
- EWI
  - Weld simulation knowledge
  - Validated by US Government projects
- OSC
  - Supercomputing resources
  - Internet software
- ABAQUS
  - Finite element software expertise
- New direction in the industry
- Being deployed for ESI & LANL already

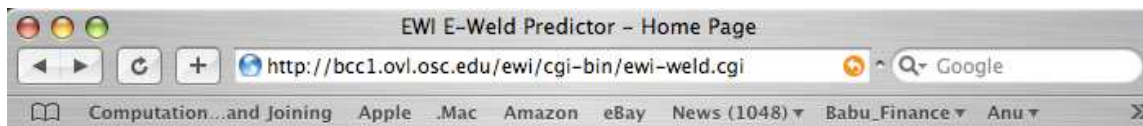




# 7 seconds tour of the EWeldPrecitor© service

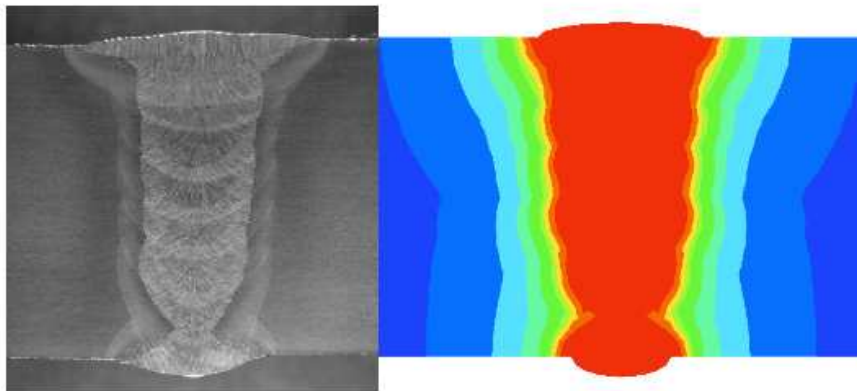
Overview of the service

# Step 1: Application



## Welcome to the EWi E-Weld Predictor Home Page

Automated Modeling of Pulsed Narrow Gap Welding



Click to  a new simulation.

# Step 2: Geometry

EWI E-Weld Predictor - Pipe Dimensions

http://bcc1.ovl.osc.edu/ewi/cgi-bin/ewi-weld.cgi

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### Pipe Dimensions

Pipe Outer Diameter  inch  mm

Wall Thickness  inch  mm

Pipe Material

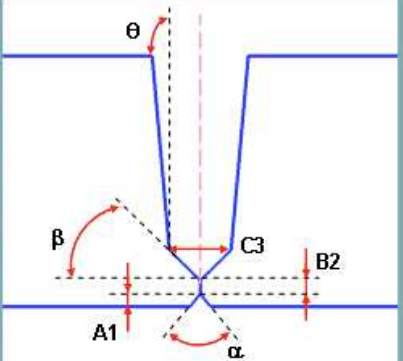
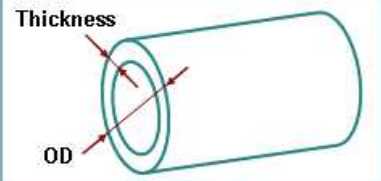
### Joint Design

A1  inch  mm  $\alpha$   degree

B2  inch  mm  $\beta$   degree

C3  inch  mm  $\theta$   degree

Undo Next Quit



# Step 3: Process

Pass	Current (A)	Voltage (V)	TS (mm/s)	Pre/Inter-pass Temp. (F)	Pre/Inter-pass Temp. (C)	WFS (mm/s)	Heat in. (kJ/mm)
Int. root	178.0	20.5	11.83	212	100	51.2	.31
Hot pass	179.0	21.5	8.00	221	105	130.9	.48
Fill 1	177.0	22.0	7.58	221	105	130.9	.51
Fill 2	176.0	22.0	7.83	230	110	130.9	.49
Fill 3	176.0	23.0	7.67	221	105	130.9	.53
Strip	176.0	23.0	8.00	230	110	130.9	.51
Cap	145.5	24.0	8.33	221	105	146.6	.42

Pass	Height (mm)	Width (mm/s)
Int. root	0.813	5.600
Hot pass	4.607	
Fill 1	3.266	
Fill 2	2.871	
Fill 3	2.704	
Strip	2.420	
Cap	1.233	9.400

The diagram illustrates the cross-section of a multi-pass weld. The weld is composed of several distinct layers: a central 'Root' at the bottom, followed by a 'Hot' pass, three 'Fill' passes (Fill 1, Fill 2, Fill 3), a 'Strip' pass, and a final 'Cap' at the top. The diagram includes various dimension lines to specify the geometry of each layer, such as 'Width - cap', 'Height - cap', 'Height - strip', 'Height - fill 3', 'Height - fill 2', 'Height - fill 1', 'Height - hot', 'Width - root', and 'Height - root'.

Buttons: Undo, Back, Estimate, Next, Quit

# Step 4: Decide on purchase

EWI E-Weld Predictor - HPC Login

http://bcc1.ovl.osc.edu/ewi/cgi-bin/ewi-weld.cgi

Google

Computation...and Joining Apple .Mac Amazon eBay News (1048) Babu\_Finance Anu Apple (10)

**User account details for HPC login:**

**System** kodos.sf.osc.edu

**User Name** ptest

**Password** .....

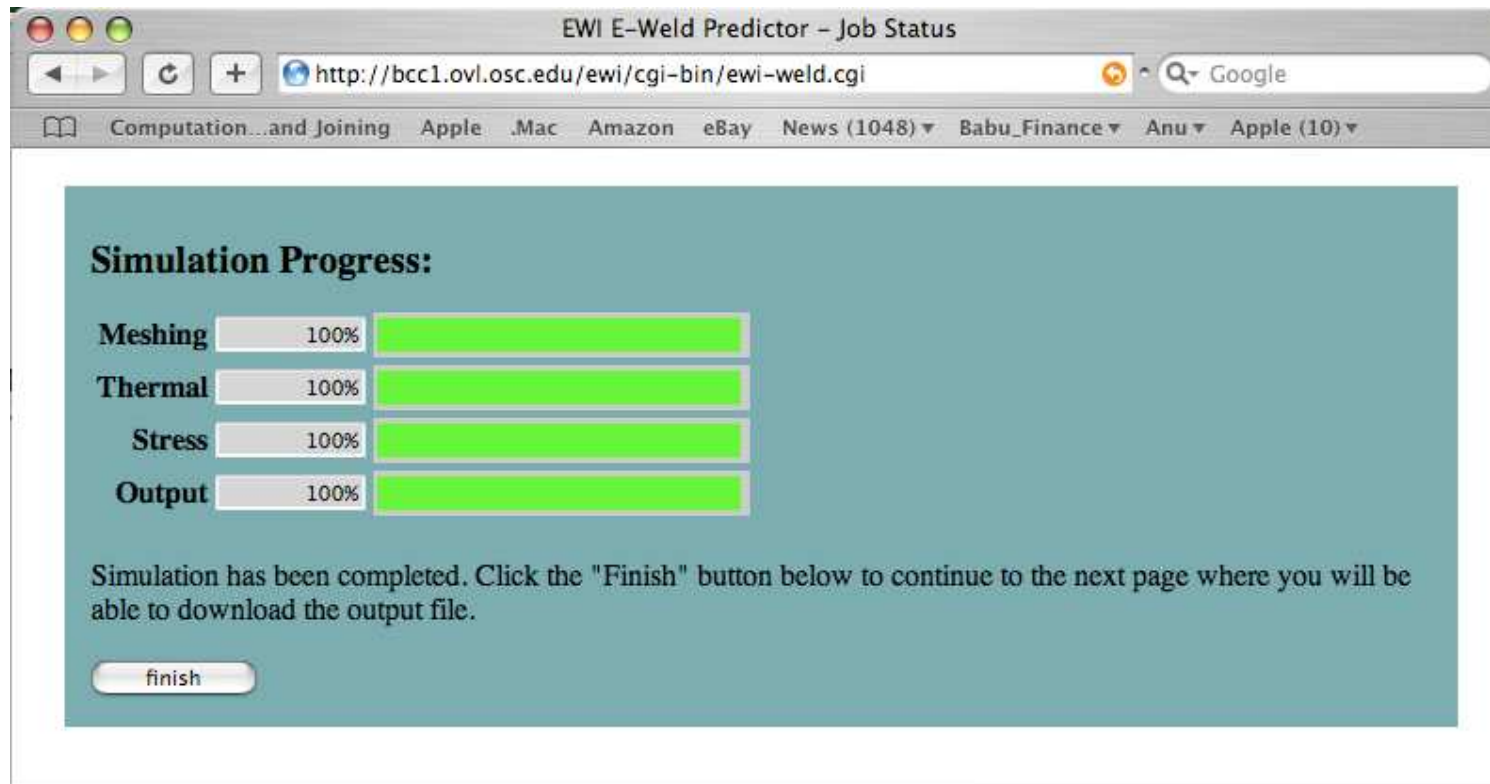
**Queue** abaqus

**Priority Service** Standard - \$\$

**Description** My weld simulation

back submit quit

# Step 5: Progress



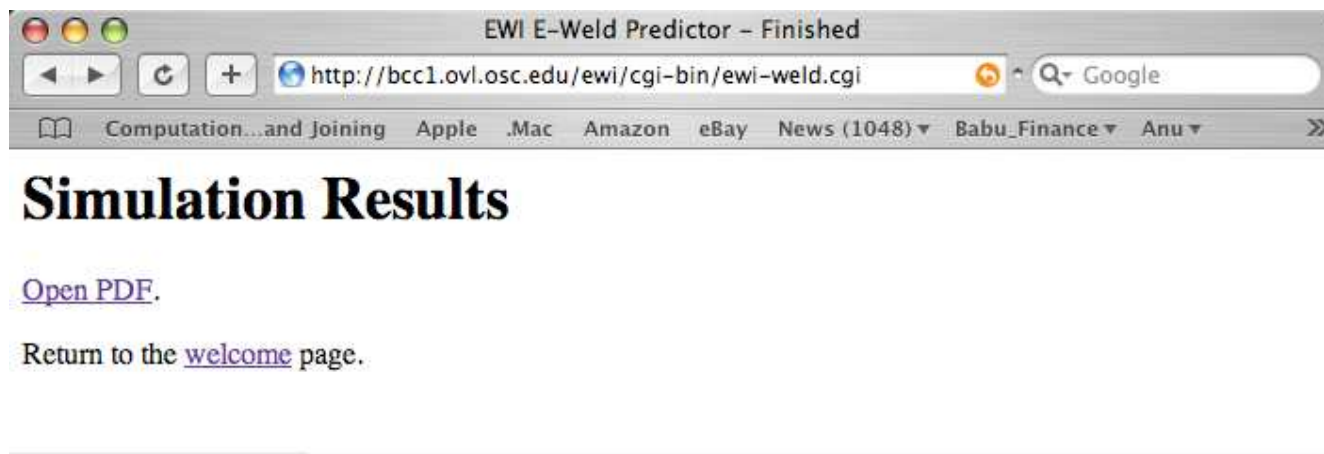
The screenshot shows a web browser window titled "EWI E-Weld Predictor - Job Status". The address bar contains the URL "http://bcc1.ovl.osc.edu/ewi/cgi-bin/ewi-weld.cgi". The browser's bookmark bar includes "Computation...and Joining", "Apple", ".Mac", "Amazon", "eBay", "News (1048)", "Babu\_Finance", "Anu", and "Apple (10)".

**Simulation Progress:**

Meshing	100%	<div style="width: 100%; background-color: #00FF00;"></div>
Thermal	100%	<div style="width: 100%; background-color: #00FF00;"></div>
Stress	100%	<div style="width: 100%; background-color: #00FF00;"></div>
Output	100%	<div style="width: 100%; background-color: #00FF00;"></div>

Simulation has been completed. Click the "Finish" button below to continue to the next page where you will be able to download the output file.

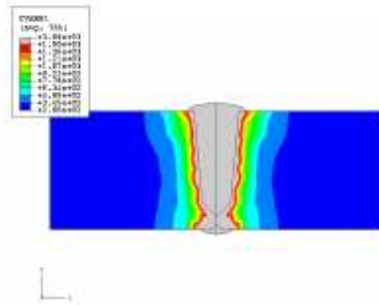
# Step 6: Results



# Step 7: Report is created

## Section 2 - Thermal Analysis

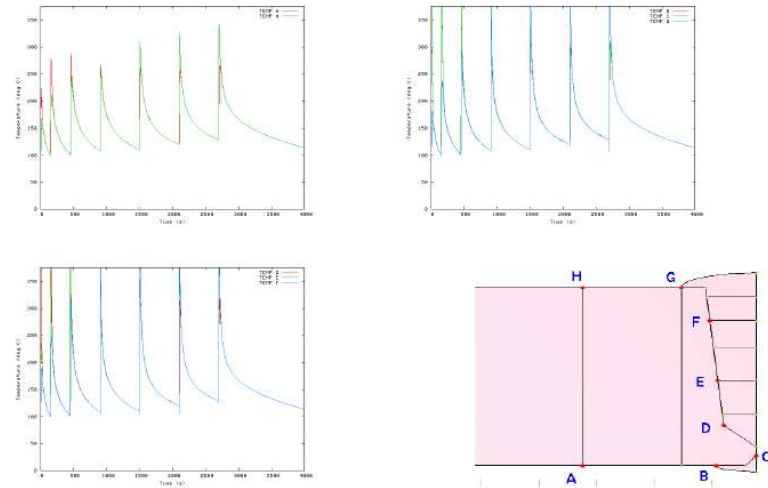
Distribution of peak temperatures



Average cooling rates between 800 and 500 °C. Zero cooling rate means that the peak temperature at that monitoring location is less than 500 °C.

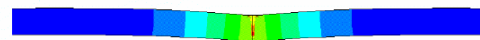
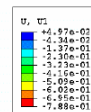
	A	B	C	D	E	F	G	H
Int. root	0.0	113.3	135.3	51.9	0.0	0.0	0.0	0.0
Fllet pass	0.0	55.4	64.7	76.5	0.0	0.0	0.0	0.0
Fill 1	0.0	17.2	24.0	50.6	94.3	0.0	0.0	0.0
Fill 2	0.0	0.0	0.0	0.0	120.4	0.0	0.0	0.0
Fill 3	0.0	0.0	0.0	0.0	56.1	81.8	23.6	0.0
Strip	0.0	0.0	0.0	0.0	72.4	66.9	66.9	0.0
Cap	0.0	0.0	0.0	0.0	0.0	53.4	60.6	0.0

## Thermal cycles at different monitoring locations



## Section 3 - Stress Analysis

Distribution of radial displacements (mm). The deformation is magnified by 10 times.





# Challenge 2: Extensive Welding Procedure and Data

# Large number of welding procedures exist across the organization

The image displays four overlapping technical documents related to welding procedures:

- Preliminary Welding Procedure Specification (WPS):** A form for defining welding parameters, including material specifications, welding process, and heat treatment details.
- Welding Procedure Qualification Record (WPQR):** A record of the qualification test, detailing the test results and the welder's performance.
- Welding Production Test (WPT):** A test record for production welding, including material specifications and test results.
- Welding Instruction (WI):** A detailed instruction for the welding process, including material specifications, welding parameters, and heat treatment instructions.

- How can we keep track of all these procedures?
- How can we access these procedures over the internet?

# Merging of Data and Modeling

Virtual Internet Portal

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Welding  
Procedure  
Database

Welding Process,  
Microstructure and Property  
Simulation

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Shipyard Hosting

EWI Hosting

- This tool allows for welding engineer to work off existing procedure and explore the process parameter scope easily



# Current Customers of WeldEye





# Future Direction:

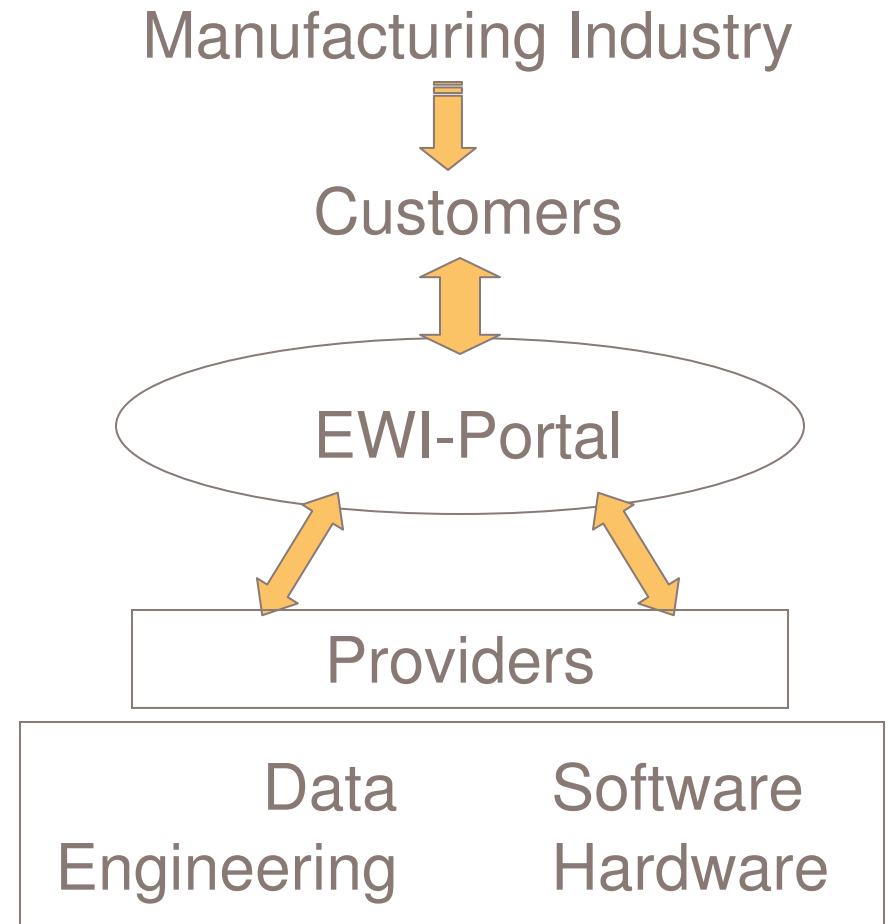
# Value Proposition for Internet Portal



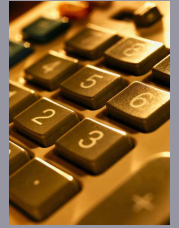
- Online simulation for welding engineers
  - You do not need PhD in finite element analysis
- Increase accessibility of Data and Simulation
  - Engineering, Software, Hardware, Internet
- Reduce the complexity
  - Simple interface
- Knowledge Retention
  - No reinvention
- Endless cycle of weld procedure development
  - Cost savings:
- Creating Standard
  - Common framework

# Summary

- EWI customers can access weld simulation over the internet
- EWI service provides cost-avoidance by
  - Reducing the experimental developmental cost
  - Reduces extensive investment on weld simulation
  - Immediate simulation results



# Proposed Service Offering



- Pay per calculation model
  - 1 calculation= 200 dollars
- Block time model (P.O upfront)
  - 1 week :
    - Max. runs = 40; BTM1 = \$5,000;
  - 1 month:
    - Max. runs = 160; BTM2 = \$15,000;
- Customization possible upon request

# Virtual Joining Portal

WeldQuest (Virtual Joining Portal)

