KNOWLEDGE DISCOVERY AND MANAGEMENT OF ENGINEERING DATA THROUGH VISUALIZATION AND ANALYSIS

Joe Beckham
Chrysler Group LLC
Table of Contents

• Current State
• A/SP Joining Knowledge Base Project
• A/SP Joining Knowledge Base Key Functions
• System Demonstration
• Summary
Today’s technical/engineering data is:

- Massive
- Multi-dimensional
- Scattered in unorganized sources

Concern:

- Extracting relevant and useful technical information is time consuming and haphazard
Current Needs:
- Analyze large amounts of technical data efficiently
- Support real-time technical decision making
- Integrate multi-dimensional technical data
- Enable real-time and dynamic data analysis
- Enable exploratory and discovery search
A/SP Joining Knowledge Base Team

Team Leaders
- Joe Beckham, Chrysler Group LLC
- Min Kuo, ArcelorMittal

Team Members
- Jim Quinn, GM
- Raj Sohmshetty, Ford
- Ted Coon, Ford
- Weiping Sun, Nucor Steel
- Wenkao Hou, ArcelorMittal
- Yu-Wei Wang, Severstal NA
- Constantin Chiriac, US Steel
- Tom Natale, AK Steel

Contractors
- Jack Sang, AET Integration
- Cindy Jiang, AET Integration
- Kevin Mantey, AET Integration
Problem Statement

Engineers working on lightweight material application

Typical Outcomes

No Data Found
- no data available
- unable to retrieve
- unaware of data existence

Minimal Data Found
- Inconclusive
- Decision based on incomplete data set

Sufficient Data Found
- Data not structured
- Data paralysis

Risks

Loss of lightweight opportunity

Loss of time

Potentially redundant development efforts
Joining Knowledge Base

Typical Outcomes

- Data Found
  - Data structured
  - Data integrated

- Expert Advice
  - Solution exists
  - Solution can be extrapolated

- No or Minimal Data Found

Benefits

- Capture light weighting opportunities
- Reduce time
- Reduce cost

Engineers working on light weight material application
<table>
<thead>
<tr>
<th>Where We Are</th>
<th>Bridging the Gap</th>
<th>Where We Need To Be</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Data and knowledge exists in many unrelated sources and locations (reports, CDs, spreadsheets, books, papers, conversations, etc.)</td>
<td>- Enhance existing tools to integrate and logically structure the data</td>
<td>A single system to:</td>
</tr>
<tr>
<td></td>
<td>- Extracting information is time consuming and haphazard</td>
<td>- Store, organize, and rapidly retrieve relevant data</td>
</tr>
<tr>
<td></td>
<td>- Retrieving data/knowledge is difficult, leading to duplicated efforts or repeated mistakes</td>
<td>- Hold expert-validated data and knowledge</td>
</tr>
<tr>
<td></td>
<td>- Analyzing data/knowledge requires expertise that an individual project team may not have</td>
<td>- Develop new solutions through expert model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Continue to grow as new information become available</td>
</tr>
<tr>
<td></td>
<td>- Develop Advanced Search Criteria to rapidly retrieve relevant data related to current problems</td>
<td>- Highlight future technical needs and data gaps</td>
</tr>
<tr>
<td></td>
<td>- Develop capability to easily compare joining technologies, materials, designs, etc.</td>
<td></td>
</tr>
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<td></td>
<td>- Develop expert model that simulates the thought process of experts</td>
<td></td>
</tr>
</tbody>
</table>
A/SP Joining Knowledge Base Project

Project Highlights:

- An implementation of dynamic data visualization system for welding/joining technology data
- Data scope included A/SP joining technology projects from 1995 to 2012
- Phase I system was a desktop system
- Phase II is a web-based system
The following key system functions will be summarized in the subsequent slides and demonstrated in a system demo

- Data Density Map
- Data Drill-down
- Knowledge rules
- InnoViewer (additional development)
- Pivot Curve (additional development)
Data Density Map, Joining Data

- A visual and dynamic search tool
- Multi-dimensional search parameters may be dragged and dropped to change the map
- Known and unknown information can be determined at a glance

WeldEdge Online
## Data Density Map, Base Material Data

### WeldEdge Online

#### Record Count Scale

- **Project Name**
- **Thickness (mm)**

#### Grade

- HSLA340Y: GI, GA
- TRIP780: GI, GA
- DP600: GI, GA, Bare
- HSLA: Bare, EG
- HSB: AlSi
- DP780: GI, GA, Bare
- AKDQ: Bare
- RA830: GI

#### Depth Categories

- **1.5-1.99**
- **1.0-1.49**
- **0.5-0.99**
- **2.0-2.49**
- **3.0-3.49**

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Data Drill-down

Technical data details can be reviewed and compared side-by-side.
Welding schedules can be selected for a new application.

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Data Source</th>
<th>Governing Grade Category</th>
<th>Governing Coating</th>
<th>Thickness Range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>A/SP Starting RSW Schedules For AHSS</td>
<td>High Strength Steel</td>
<td>Coated</td>
<td>1.3 - 1.59</td>
</tr>
</tbody>
</table>

| Electrode Type | 4.6 mm |
| Electrode Shank Diameter (mm) | 16 mm |
| Electrode Force (N) | 4230 N |
| Weld Time (cycles) | 7 cycles |
| Cool Time (cycles) | 1 cycles |
| Hold Time (cycles) | 5 cycles |
| Number of Pulses | 3 |
| Weld Sequence | 7-1-7-1-7 |
| Weld Current | 11 kA |

For another option:

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<td>A/SP Starting RSW Schedules For AHSS</td>
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</tr>
</tbody>
</table>
• A dynamic and exploratory search tool for image files
• Multi-dimensional filter parameters are enabled
Example: Filtering to 3-Dome Projection Nuts
• A dynamic data graphing search tool for image files
• Multi-dimensional filter parameters are enabled
Example: Grouping the Curves by Loading Angle
Pivot Curves

Example: Filtering out the Higher Peak Load Curves
System Demonstration

WeldEdge Online

Materials:
- Steel
- Aluminum
- Composite

Properties:
- Tensile Strength
- Yield Strength
- Modulus of Elasticity

Testing Methods:
- Static Loading
- Dynamic Loading

Results:
- Force vs. Displacement Graphs
- Failure Analysis

Contact:
www.autosteel.org
Summary

• A suite of powerful visual data management tools
• Profound impact on how to leverage, manage and analyze massive and multi-dimensional data on real-time basis
• Tools can be customized and expanded to other engineering disciplines
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