Toward New Automotive Steel Developments Driven by Big DATA & A. I.

Supporting Faster & Smarter CAE of Automotive Body Structures

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material insights

GREAT DESIGNS IN STEEL™

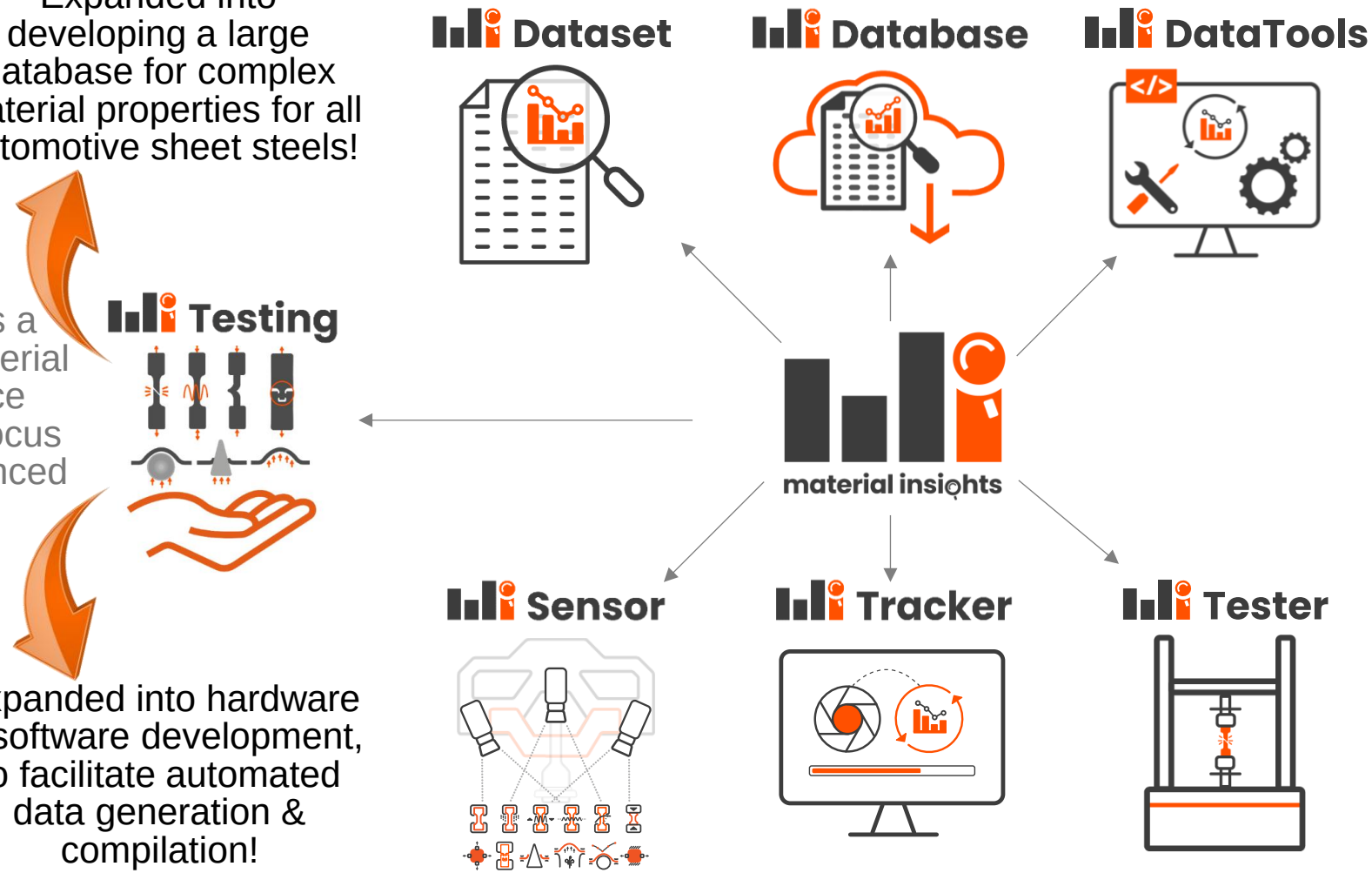
Who We Are … Our Involvement in Big Data & A.I.

We are a "Data-Centered Company" that offers several products all cohesively integrated to provide access to high quality "material data" for research & development purposes (focus on CAE).

Expanded into developing a large database for complex material properties for all automotive sheet steels!

We started as a specialized material testing service provider with focus on DIC & advanced techniques!

Expanded into hardware & software development, to facilitate automated data generation & compilation!



A.I. for predicting complex material behaviour using simple inputs (focus here)!

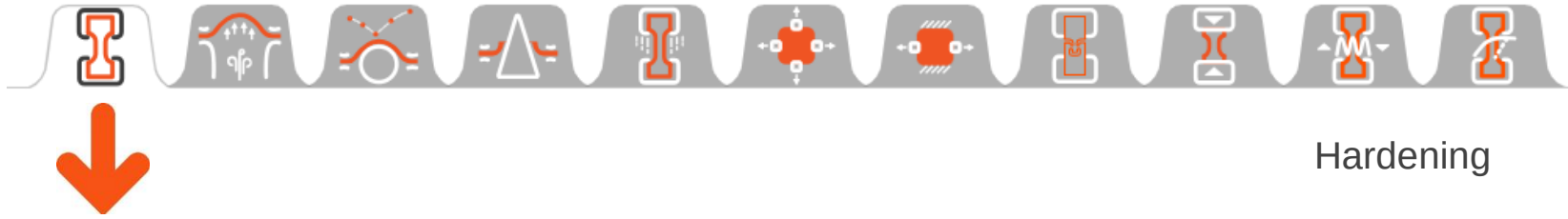
With the availability of Big Data, it was possible to develop & train A.I. models to serve various purposes…

A.I. for investigating material deformation & failure (partially covered in other presentations)!

First Comes Data …

GDIS

- **Generated the largest & most comprehensive R&D-level database for automotive steel grades …**
- Covered all possible test types & loading conditions …
- Maximum outputs per test!
- FEA Outputs (for direct feed into CAE tools)…



Fracture Strains (Local Strains Around Fracture Point)

COLUMNS Export

[2mm]			[1mm]			[0.5mm]		
Maj.	ε Min.	ε Eff.	ε Maj.	ε Min.	ε Eff.	ε Maj.	ε Min.	ε Eff.
540	-0.219	0.543	0.597	-0.218	0.605	0.594	-0.207	0.603
512	-0.199	0.516	0.571	-0.206	0.579	0.574	-0.194	0.583
550	-0.209	0.555	0.609	-0.214	0.618	0.607	-0.219	0.615
534	**-0.209**	**0.538**	**0.593**	**-0.213**	**0.601**	**0.591**	**-0.207**	**0.600**
020	**0.010**	**0.020**	**0.019**	**0.006**	**0.020**	**0.017**	**0.012**	**0.016**
533	-0.222	0.536	0.578	-0.213	0.585	0.577	-0.206	0.584
495	-0.235	0.496	0.551	-0.242	0.553	0.568	-0.244	0.569
599	-0.258	0.601	0.650	-0.250	0.656	0.642	-0.235	0.649
543	**-0.238**	**0.544**	**0.593**	**-0.235**	**0.598**	**0.595**	**-0.228**	**0.601**
052	**0.018**	**0.053**	**0.051**	**0.019**	**0.053**	**0.040**	**0.020**	**0.042**
515	-0.237	0.515	0.560	-0.256	0.561	0.552	-0.248	0.553
491	-0.223	0.491	0.523	-0.234	0.524	0.533	-0.238	0.534
497	-0.226	0.497	0.536	-0.229	0.538	0.530	-0.227	0.532
501	**-0.229**	**0.501**	**0.540**	**-0.239**	**0.541**	**0.538**	**-0.238**	**0.540**
012	**0.007**	**0.012**	**0.019**	**0.014**	**0.018**	**0.012**	**0.011**	**0.011**

Hill 48-3R Model Parameters

COLUMNS Export

F	G	H	N
0.481	0.563	0.437	1.420

Barlat YLD89 Model Parameters

COLUMNS Export

a	c	h	p
1.089	0.911	0.958	0.945

Barlat YLD2000 Model Parameters

COLUMNS Export

α1	α2	α3	α4	α5	α6	α7	α8
0.898	1.004	0.869	0.965	0.977	0.758	0.952	1.112

Hardening

Anisotropy

Rate Sensitivity

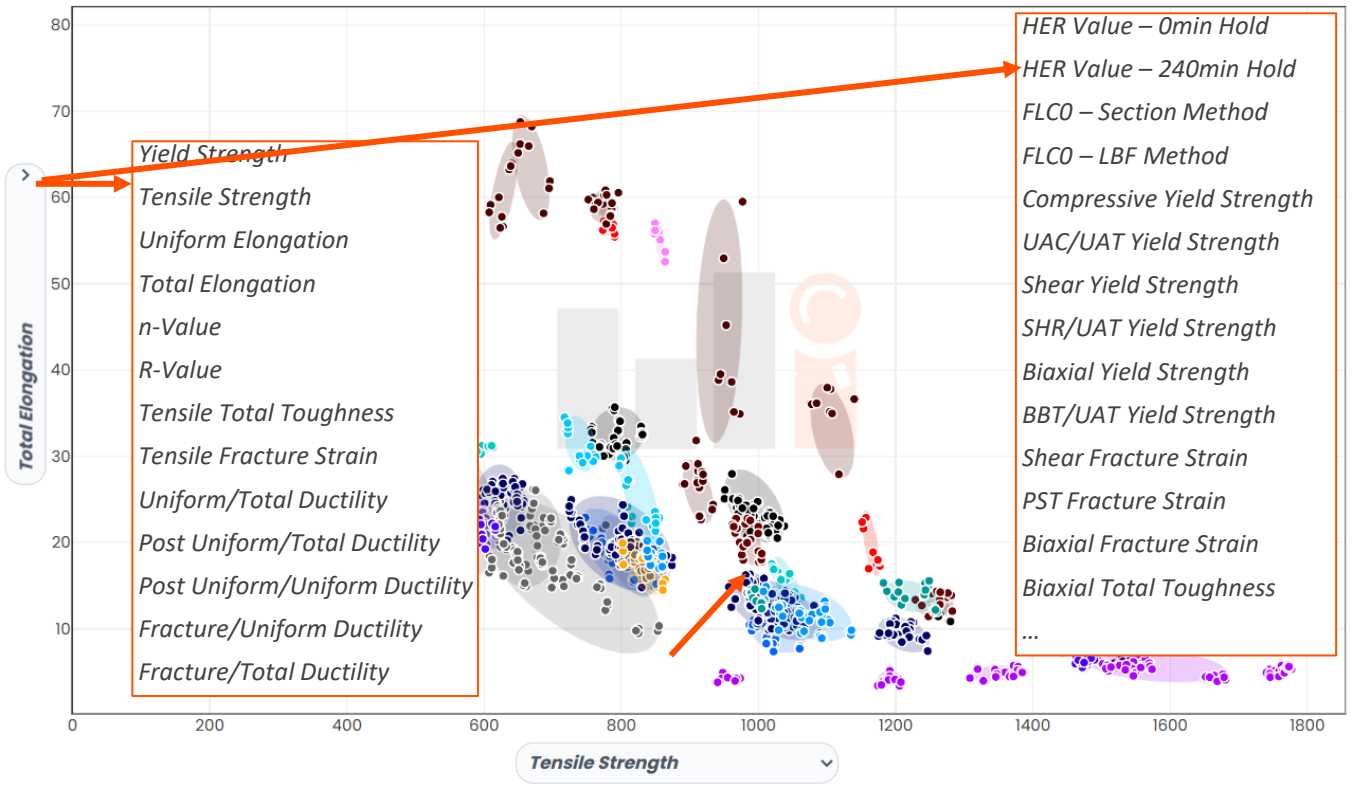
Forming

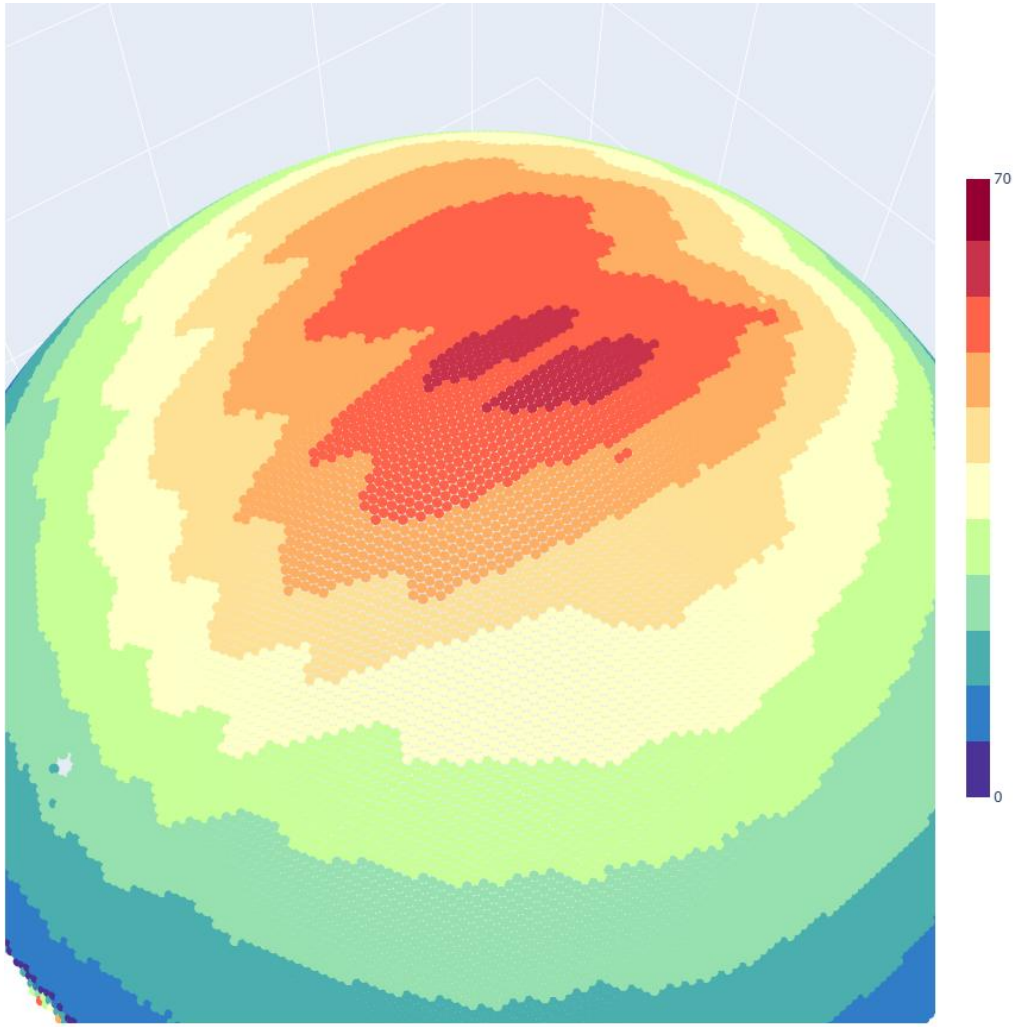
Fracture

Springback

Then Big Data …

- From a simple “Banana Chart” to complex “Data Maps” …
- From complex “Data Maps” to detailed “Datasets” …
- From detailed “Dataset” to comprehensive, consistent R&D-worthy Database …

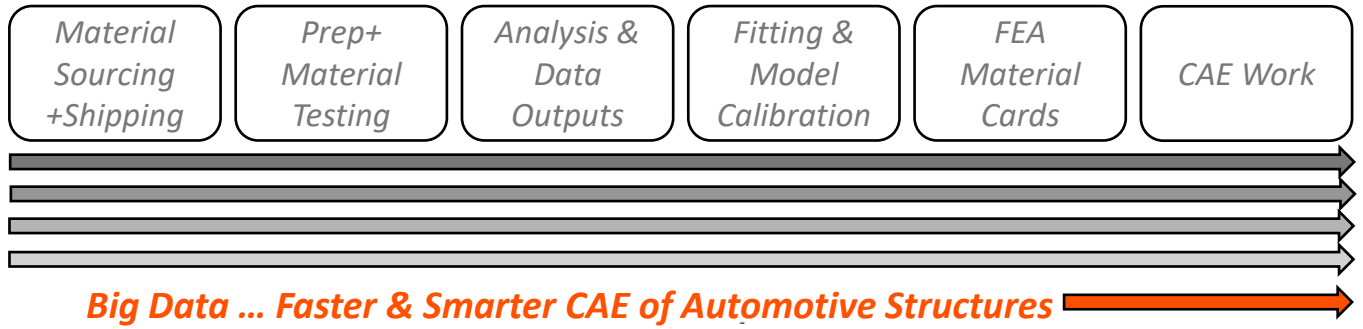




Big Data Facilitates Next Generation CAE Work …

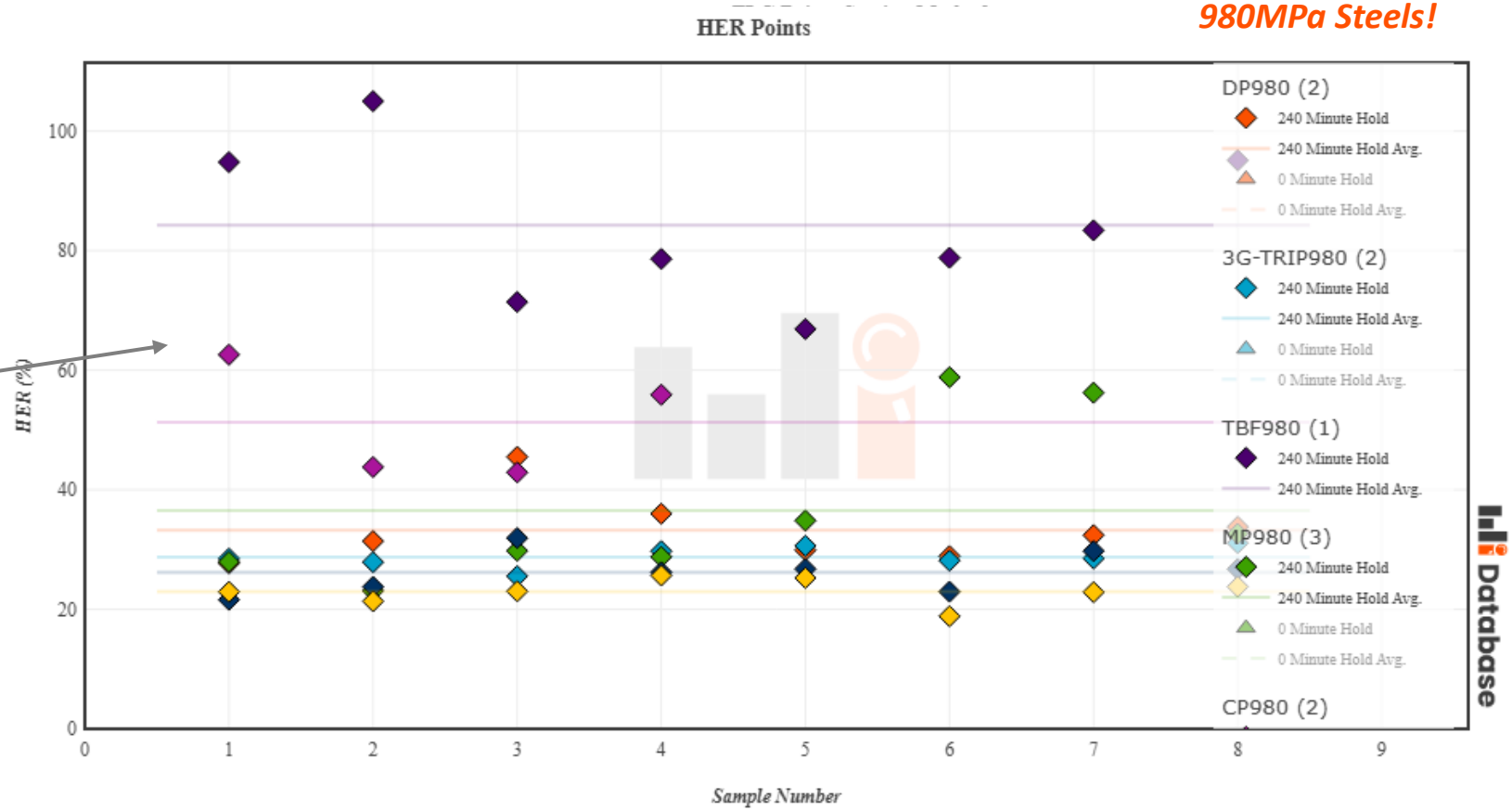
- **Considering replacement steel grades for CAE work is much faster & more efficient!**
  - Accessing a large # of steel grades
  - Proper screening of materials
  - Consideration of all loading cases
  - Consideration of relevant CAE data (forming, crash, etc.)
  - Reducing cost (characterization/modeling)
  - Reducing design & development cycles!
  - Targeted CAE efforts!

Courtesy of Volvo



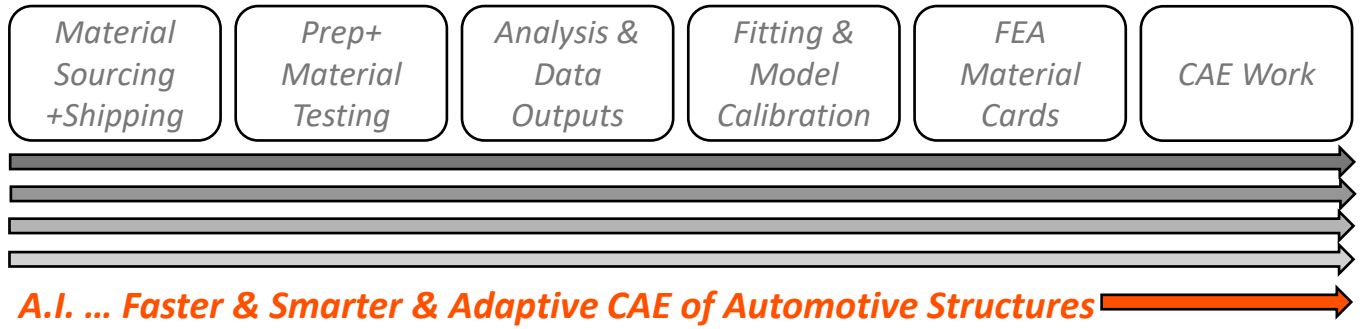
Big Data … Faster & Smarter CAE of Automotive Structures

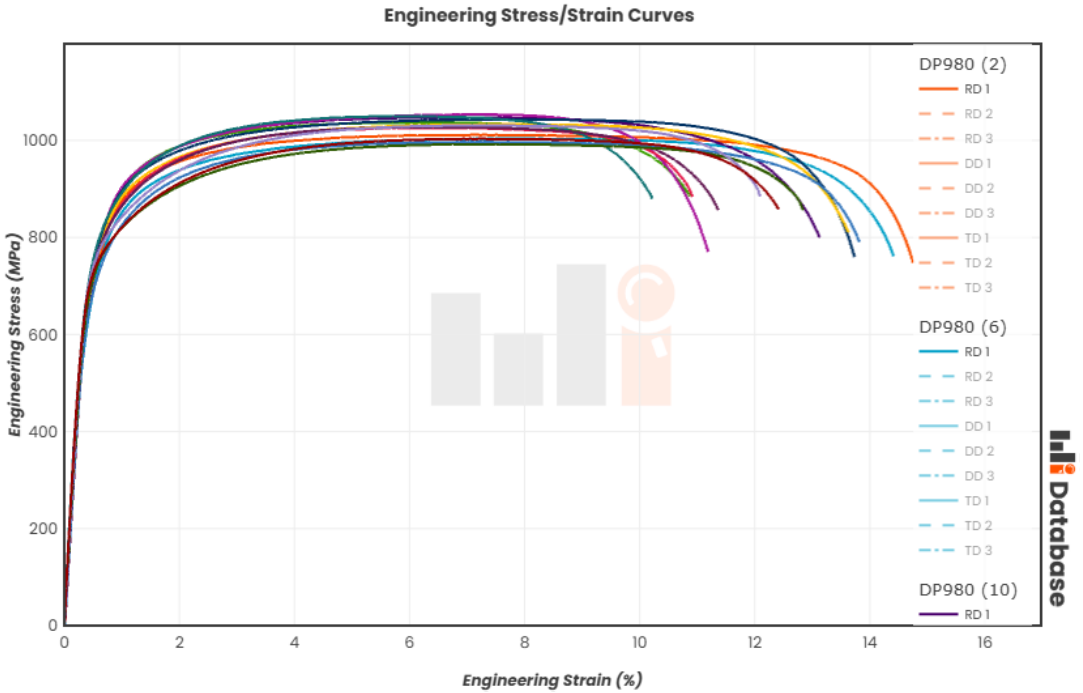
980MPa Steels!



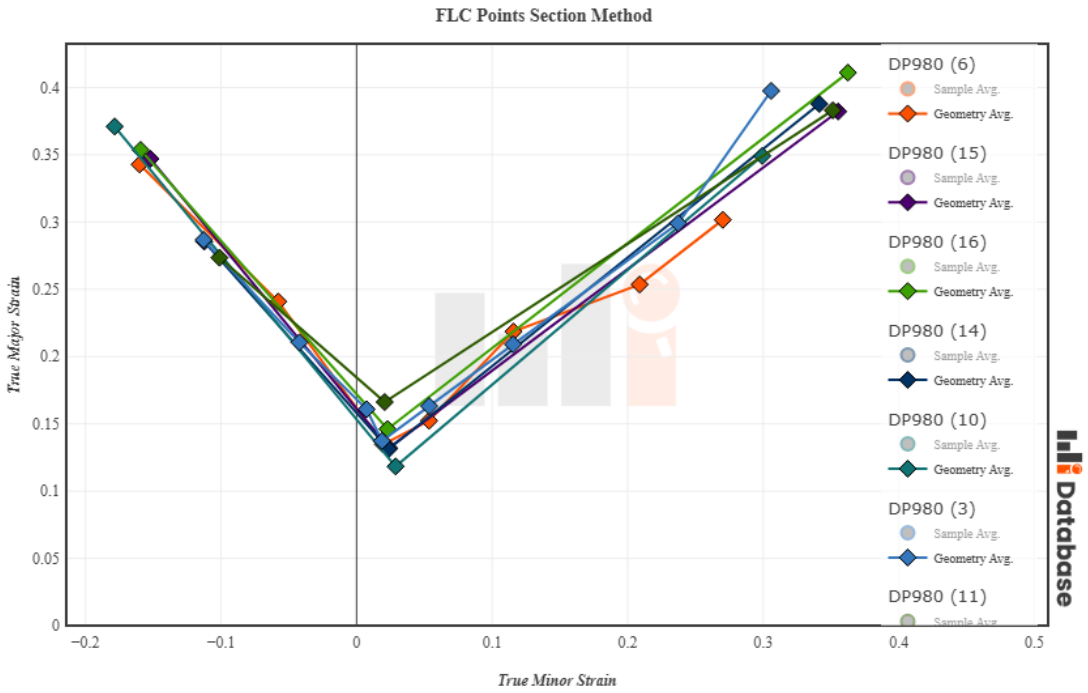
A. I. Further Facilitates Next Generation CAE Work …

- **Simple inputs can yield complex data & FEA parameters to boost efficient CAE!**
  - Input data for a large # of steel grades
  - Consider as many grade variations as possible
  - Link tests types, loading cases & relevant metadata
  - Goal: a tool where simple input of tensile properties* can yield complex material data … & all FEA parameters to run Forming Simulations (plasticity, anisotropy, forming & springback)



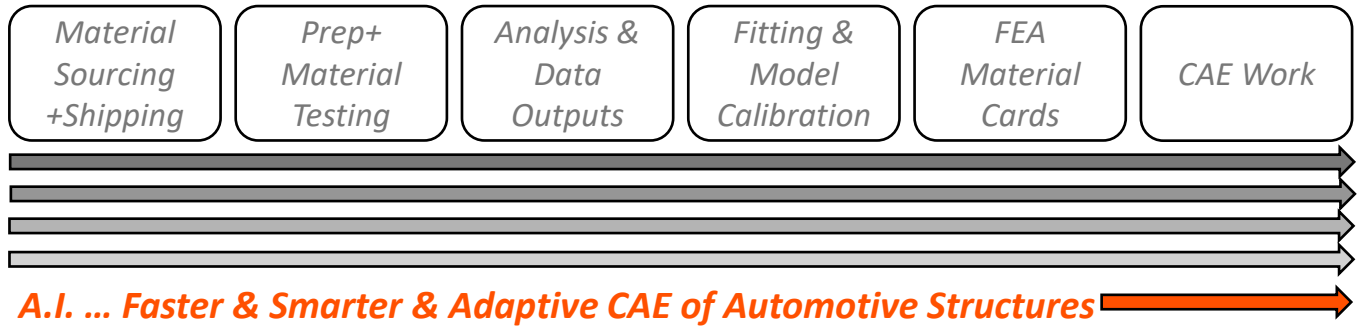


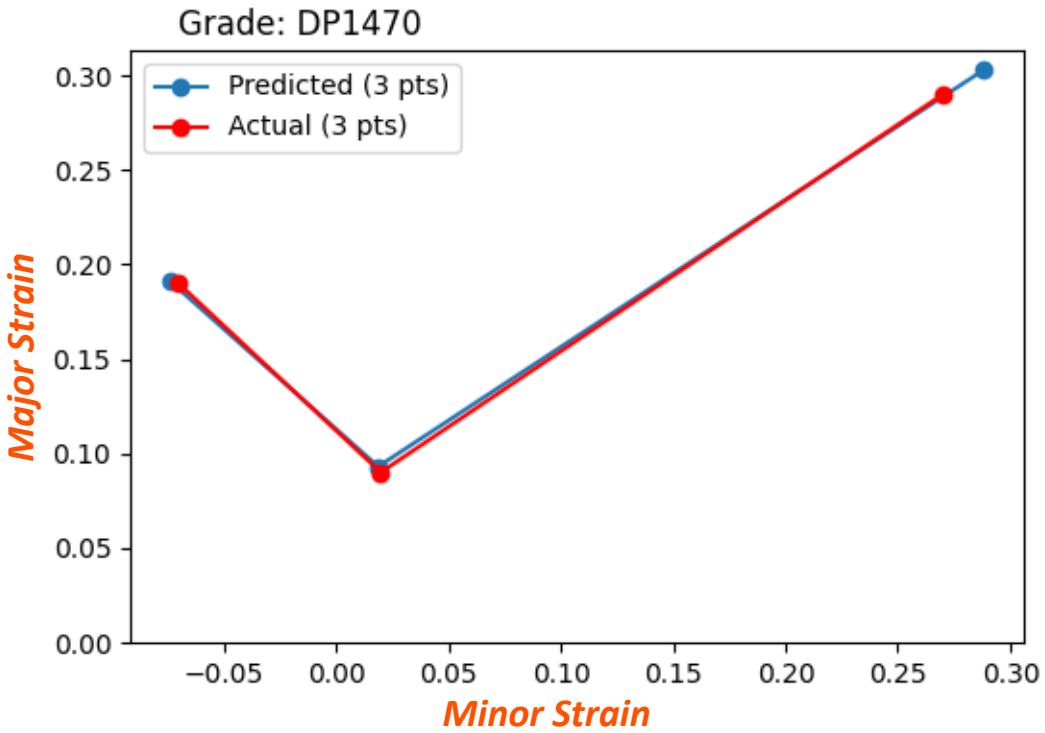
Develop, train & refine Artificial Intelligence models that link A to B, C, D …

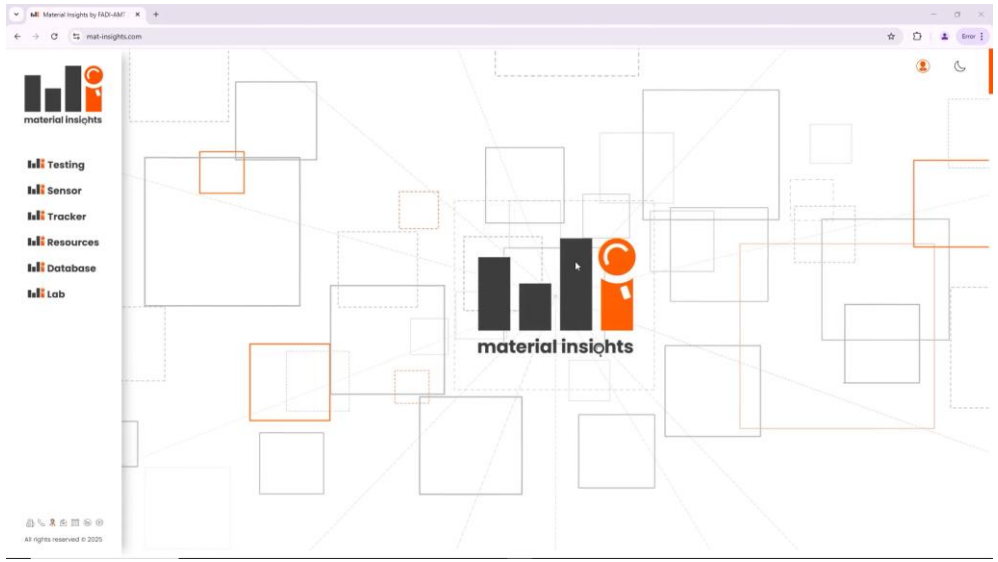


A. I. Further Facilitates Next Generation CAE Work …

- **Simple inputs can yield complex data & FEA parameters to boost efficient CAE!**
- Example: predicting FLCs based on simple tensile mechanical properties or even tensile flow curves!
- Model can provide all FEA material card parameters for running forming simulations (without springback)
- We are expanding it to account for springback!
- Why adaptive? Not bound by what exists today!







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Thank You!

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