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Title:	VRWP: Virtually Guided RSW Weldability
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Problem:

Data-driven weldability prediction can improve product realization efficiency but is being underutilized for several reasons. First, historical data collected from physical testing often does not fit a new design's specific requirements (*e.g.*, for a new material joining combination). Second, the existing historical (or legacy) data is often distributed and documented in nonstandard formats that are difficult to interpret and share. Third, welding process has high variability due to the properties of welding materials (e.g., varying compositions and heat- treating histories) and the complexity of welding processes. Material parameters for RSW processes are particularly complex (e.g., coating condition, surface roughness, etc.) and the quality of RSW processes can be inconsistent. These inconsistencies are significant and a well-known reliability issue (Xu *et al*. 2009), which makes predictive modeling for RSW processes problematic.

Summary:

Wayne State University, in collaboration with Ford Motor Company, has realized a ***Virtual RSW Weldability Prediction (VRWP)*** environment for RSW metal joining processes. The VRWP is a virtual framework that guides weldability qualification to allow OEMs and suppliers to rapidly converge on the feasibility of RSW weldment designs during the early development stages of new product designs. The virtual framework consists of:

- *A sharable database and architecture for dynamic multi-dimensional and multi-step RSW data* to capture formal representations of weldability knowledge that can be updated, shared across the supply chain, and (re)used to improve the weldability prediction.
- *Guided weldability testing to control RWS data for emerging, advanced material characteristics* for reducing data variability and improving process reliability. In practice, raw data acquired from welding processes are generally collected manually by welding experts based on his/her domain knowledge. This manual process is very time-consuming and prone to errors. Additionally, the manually captured knowledge may be incomplete and may have a negative effect (i.e., noise) on achieving accurate prediction models.
- *Prediction models that can overcome the data challenges of accurate weldability prediction.* Guided weldability prediction can be used by expert and non-expert engineers to provide analysis and visualizations that can reduce the number of tests required for qualification. Several methods (e.g., machine learning) can be used for extracting knowledge from existing OEM data and new AHSS data that can increase prediction accuracy and computational efficiency.