

# Process driven Material Parameter Identification and Data Management

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**Summary:**

A huge amount of effort is spent to develop new materials. To participate the innovation potential of new material property you need to feed you simulations with the appropriate material parameters. Therefore the identification of the material parameters is a key point.

As soon as material state becomes inhomogeneous in the experiment a FEM model is needed to take the inhomogeneous state into account. In addition to this, numerical methods are needed to identify the unknown material parameters.

On the other hand, it is important to know about the correlation between material parameters of the same material but of different charges. Therefore, the existing parameters need to be accessible for such kinds of investigations.

Identifying material parameters by hand and leaving the data on the disk will not lead to a satisfying understanding of the material. The innovative potential may be wasted.

The following presentation shows a concept of process driven material parameter identification for LS-DYNA with an integrated data management system. In this way the material parameters are identified in a reproducible manner and the data is accessible for all kind of future evaluation. So this directly confirms to the Six Sigma rules for the repeatability of processes.

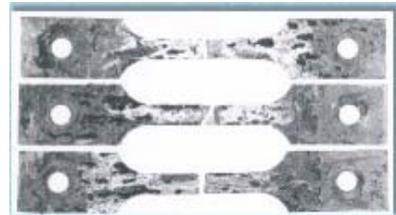
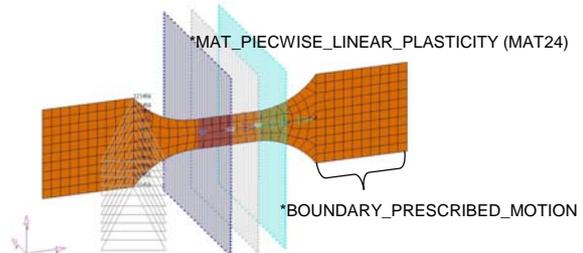
**Keywords:**

trial data, material parameter identification, data management

## Motivation



To have a complex FE-model behave like the reality, ensure that simple FE-models behave like the reality first!



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## Requirements



Requirements for a process driven material parameter identification with integrated data management are:

- The process should be useable for (nearly) all kinds of trials.
- The process should be automatic for certain trials.
- The user should deal with material related problems only – not with optimization parameters, data management stuff, ...

To ensure these requirements the tools used for this process should be deeply integrated in a pre and post processing environment. So every non material related tasks can easily be automated with the under laying functions of the pre / post system.



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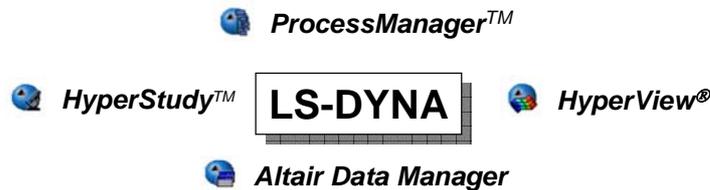
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## Tools



These requirements limit the choice of tools to realize the process:

- The Altair Process Manager was designed for leading the user through a process with pre and post processing tasks
- Altair HyperStudy is used to find the material parameters in the LS-DYNA input deck
- HyperView is used to read the trial data and the LS-DYNA results to generate a target function for the identification
- The Altair Data Manager (ADM) ensures that all data used in the process are saved in a secure manner.



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## The Process



The Process Manager leads through the following tasks:

**Trial:** load and prepare trial data; identify parameters directly; select identification target

**Simulation:** set up the simulation model; select parameters to identify; define simulation response

**Parameter Identification:** start the identification procedure; show results and create reports



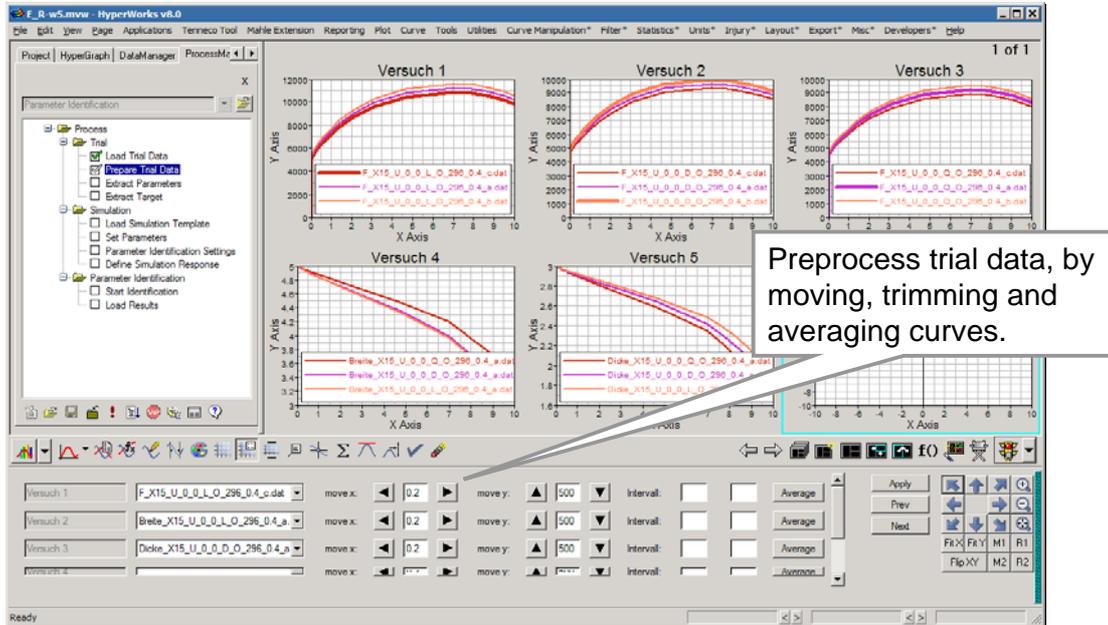
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# The Process



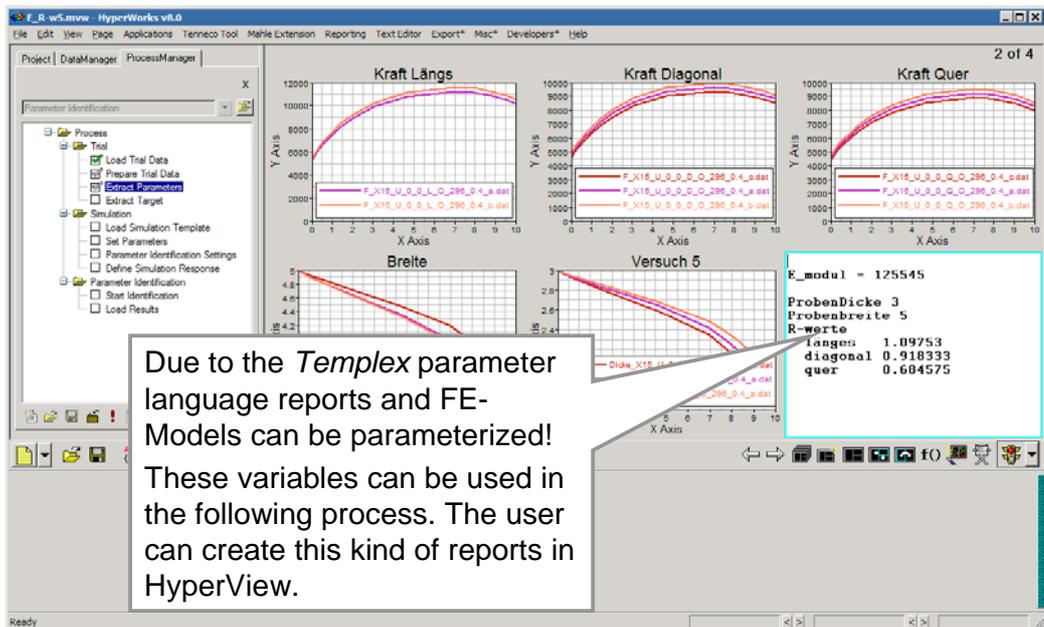
## Task: Trial – Prepare Trial Data



# The Process



## Task: Trial – Extract Parameters



Due to the *Templex* parameter language reports and FE-Models can be parameterized! These variables can be used in the following process. The user can create this kind of reports in HyperView.

# The Process



## Task: Simulation – Parameter Identification Settings

Parameter	Identify	Type	Modelvalue	Trialvalue	Min	Max
dicke	<input type="checkbox"/>	Model	3.0		1.0	5.0
emodul	<input type="checkbox"/>	Model	210000.0	125545	180000	300000
verschiebung	<input type="checkbox"/>	Model	10		1.0	20
k	<input checked="" type="checkbox"/>	Kurve sigma	1.1		0.9	2.0
n	<input checked="" type="checkbox"/>	Kurve sigma	1.7		0.7	2.7

- Parameters in the FE model – like metal sheet thickness, hardening coefficient, ... – are identified
- Parameter values calculated from trial data can be taken
- Parameters to identify can be chosen

# The Data Management



These tasks lead to a running HyperStudy process to identify the unknown material parameters. The Altair DataManager works completely in the background.

**Save trial data:** save the original data and the preprocessed trial data

**Save Simulation:** save the FE-model and the initial parameters

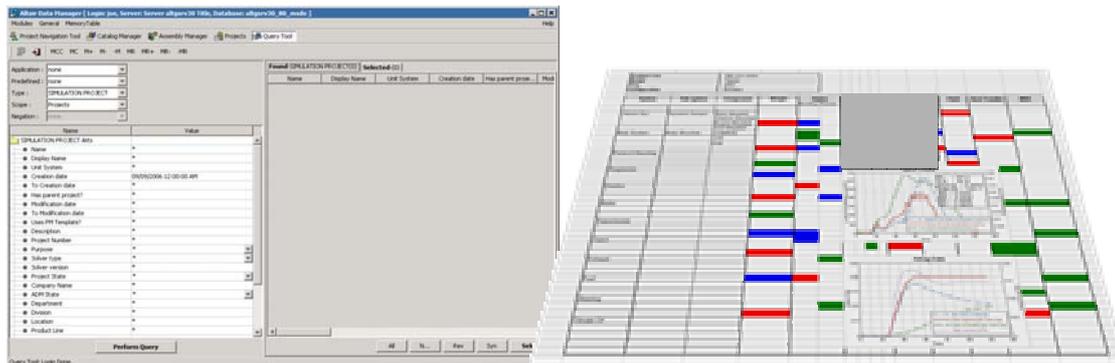
**Save Parameters:** save the identified parameters; automatically set metadata for future interpretations

## The Data Management



The ADM saves the data and allow the user to search for material data for his simulation.

With these data dashboards can be created with information about the material data correlation.



Query Tool

Future Dashboards in Webclient



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## Conclusion



- Process driven material parameter identification with integrated data management makes your work efficient.
- The process can handle each kind of parameterized FE and trial data and is completely open.
- The process can be automated for repetitive parameter identification for similar trials.
- The Altair *Templex* allows a parameterization for reports and FE models. The user is supported by a Templex editor and HyperGraph to create parameterized reports and FE models.
- Getting access to all identified parameters by the Altair Data Manager, gives you the possibility to correlate the results and get a deeper understanding of the material properties.
- A deeper understanding of the material properties opens up the innovative potential of new materials in your simulations!



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