New Application Oriented Workflow in LS-PrePost for Short Time Dynamics with LS-DYNA

Daniel Hilding[1], Anders Jernberg[1]

[1]Ansys, part of Synopsys

1 Introduction

High-resolution virtual high-speed dynamic testing is key for product development within aerospace & defense. Ansys's flagship solution in this area is LS-DYNA® [1].

LS-DYNA has a wealth of multi-physics solvers and industry specific features and offers extensive user control. This wealth of features and user control can pose a challenge for users when building simulation models for LS-DYNA: How to set up an LS-DYNA model quickly and in line with good practice?

Here we will present recent developments in LS-PrePost to address this challenge, aiming to make it easier for both novice and experienced users to set up LS-DYNA models for popular applications. We would like to point out that the new developments allow users to easily and without coding extend the graphical user interface in LS-PrePost to automate repeated tasks and set up multi-physics models.

In this work, the focus is on the keyword method, see Section 2, and improving the workflow to set up models of small to medium complexity. Such LS-DYNA models are common in many industries, including aerospace & defense.

2 Current situation for setting up models in LS-PrePost for LS-DYNA

The two main methods to set up models in LS-PrePost are:

- Keyword method: It gives the user access to all features in LS-DYNA using the *keyword manager* combined with labour-saving *smart tools* like *Create Entity* and *Part Data* to automate keyword creation and editing.
- Solution explorer: Physics and application oriented set up that hides the underlying keywords from the user.

In this work the focus is on the keyword method.

3 The challenge for the user and addressing them

The workflow from CAD to postprocessing for a typical LS-DYNA simulation is shown in Fig. 1 below. CAE engineers, regardless of background, are typically well experienced in tools for CAD cleanup and meshing. It is also our experience that many users find it is easy to learn how to run and postprocess LS-DYNA simulations using Ansys solutions.

Let's take a closer look at the step "Set up LS-DYNA physics" in Fig. 1: Here, the physics for the meshed parts is to be set up to create the complete simulation model. This typically involves the tasks below:

- Part setup: Material and element assignment
- Create contacts and tied interfaces
- Create connections/joints/adhesives/bolts including pretension
- Set up multi-physics solver(s) including related mesh and volumes
- Set up application/industry specific features
- Set up the load case: boundary and initial conditions
- Set up the FEM/structural solver (explicit, implicit)
- Set up output data
- Set up solver process parameters, e.g., multi-step or multi-case
- Renumber the model (for collaborative model building)

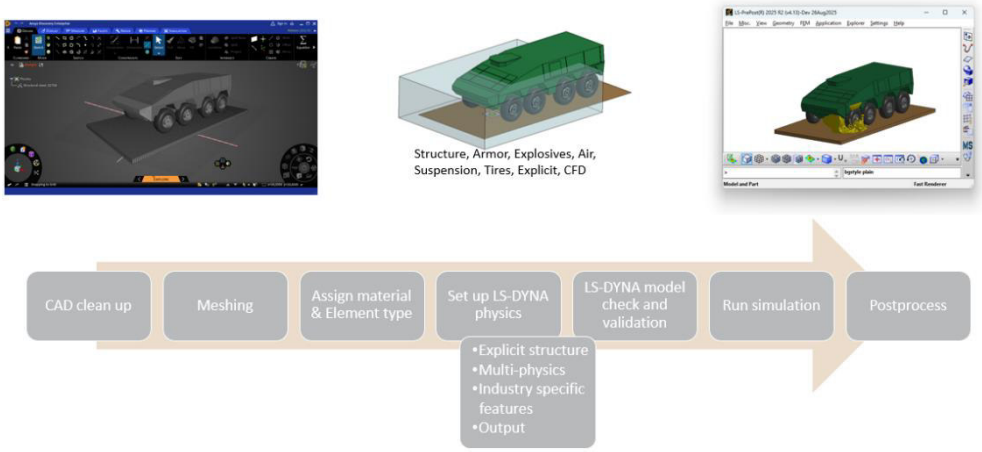

Fig.1: Workflow from CAD to postprocessing for a typical LS-DYNA simulation.

In our experience, the challenge is often the step “Set up LS-DYNA physics”, see Fig 1, and involves:

- Finding the keywords for the application, material or solver.
- Determining the application specific good practice settings for the solver, feature or output.
- That each solver or feature often requires many keywords to be created, this takes time and can be error prone.
- Setting up repeated analyses of the same type quickly and consistently.

To address these challenges, we are working on improving the workflow for setting up the LS-DYNA physics. Here we will present two recent developments: Templates and Keyword Filter. For the template functionality, we see that it can help with at least the underlined tasks below:

- Part setup: Material and element assignment
- Create contacts and tied interfaces
- Create connections/joints/adhesives/bolts including pretension
- Set up multi-physics solver(s) including related mesh and volumes
- Set up application/industry specific features
- Set up the load case: boundary and initial conditions
- Set up FEM/structural solver (explicit, implicit)
- Set up output data
- Set up solver process parameters, e.g., multi-step or multi-case analysis
- Renumber the model (for collaborative model building)

4 Templates

The purpose of templates is to automate repeated tasks in LS-PrePost. Templates include documentation and are easy to use, create, distribute, and install. Templates require no coding – it is sufficient to know the LS-DYNA keyword format. The goal is that templates for popular tasks are included by default and that, as time goes, by more templates are added based on user feedback.

Templates can be used to:

- Setting up a part of or a whole simulation model, e.g., set up the control and output for the explicit solver, set up an impact analysis, set up a complete tensile test.
- Add features to a model, e.g., an S-ALE volume, a Particle blast load.
- Distribute a component, e.g., Bird model for aerospace impact tests, Material model.

Templates are standard LS-DYNA keyword files. This implies that they are compatible with many future and past LS-DYNA versions.

4.1 Example use of templates

The example in Fig. 2 below shows how to use two templates to quickly set up an angled impact analysis starting with the meshed parts. The use of templates for steps 3 and 4 reduces the total set up time from around 1h down to less than 5 minutes. The templates used in this example are built in.

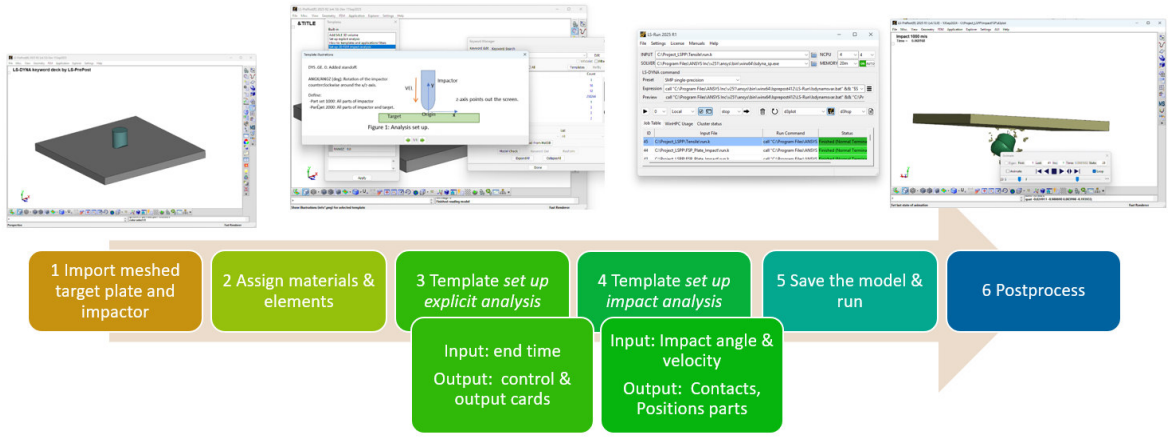

Fig.2: Use of templates to set up an impact analysis

The example in Fig. 3 below shows how to use a template to set up a complete ready-to-run tensile test, ASTM E8 0.5in round specimen, for a user specified material model. Using this template takes less than 1 minute compared to at least 1 h to set it up manually.

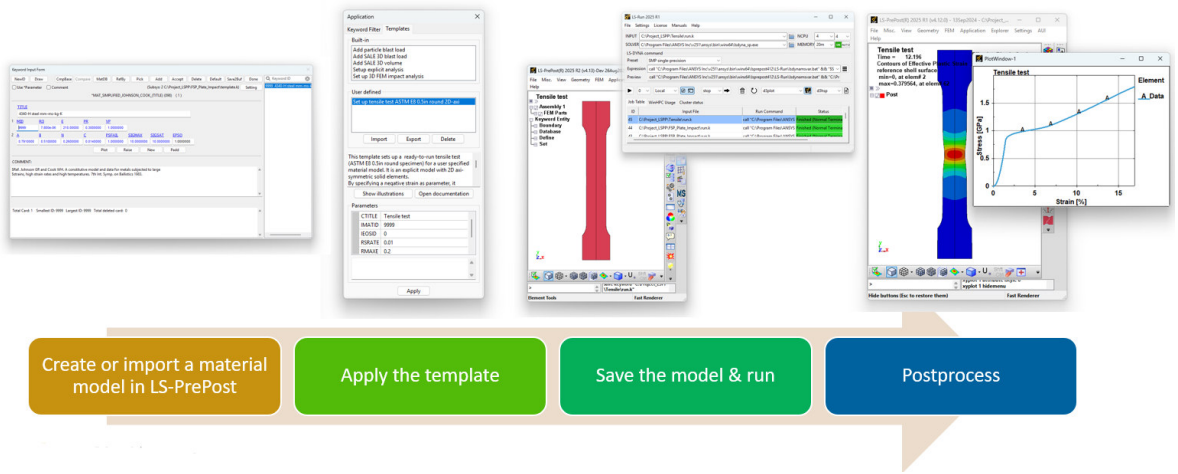

Fig.3: Using a template to set up a ready-to-run tensile test.

4.2 Details on using a template

Open the template view in the Keyword manager by pressing the *Templates* button and then select the template you want to use or optionally first import a user-defined template, see Fig. 4 below.

To use a template, first read the documentation, set the parameters, and then press *Apply*. When you press *Apply,* all the keywords in the template file (*tmp.k*) are created in LS-PrePost with the specified parameters set and placed in an include file for transparency. Then proceed as normal, e.g., save the model and run it in LS-DYNA, or modify the created keywords as needed using the keyword manager.

A template is a parameterized keyword file, and you can therefore use the created model directly for parameter studies or optimization in optiSLang. You can change the parameters in the Keyword editor.

4.3 Creating a template

Create a folder with a reasonable name e.g., “Tensile test”. In the folder create the files shown in Fig. 4 below.

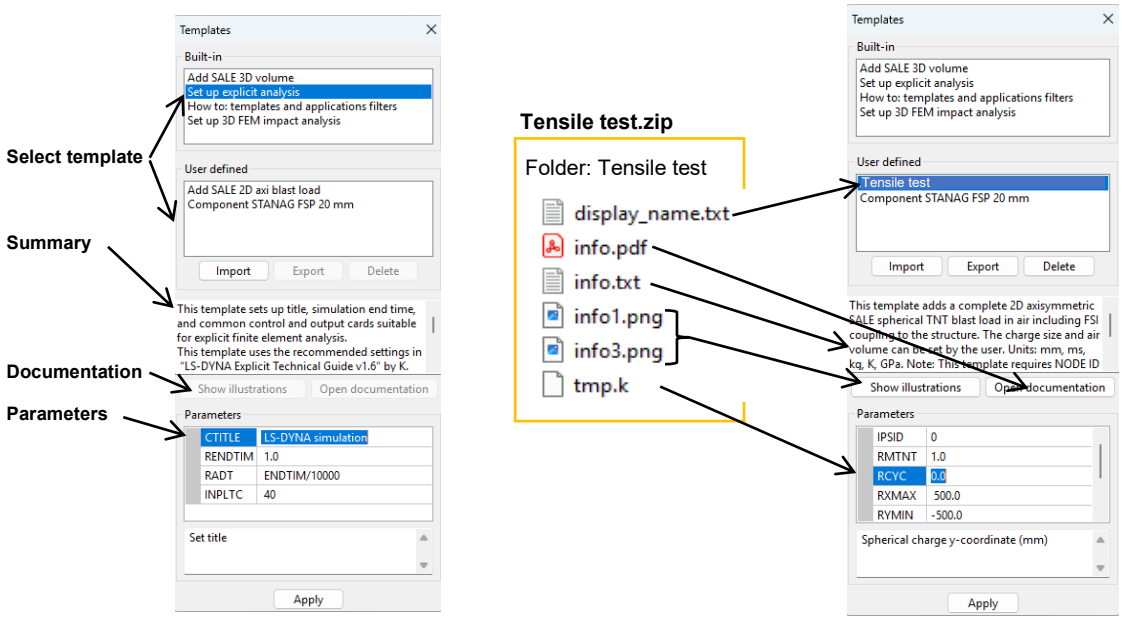

Fig.4: To the left the template window is shown and to the right the relation between configuration files and template window is shown.

The file *display_name.txt* gives the name of the template shown in LS-PrePost. The documentation files *info.pdf* and *info*.png* are optional.

The template is defined in the keyword file *tmp.k,* all ***PARAMETER_EXPRESSION** keywords in *tmp.k* that adhere to the form below are shown as parameters to be set by the user:

```
*PARAMETER_EXPRESSION
$Text: Set simulation end time
RENDTIM, 1.0
```

Here, 1.0 is the default value presented to the user. If the parameter does not contain the line starting with *$Text:* then the parameter is not shown to the user (thus you can choose the parameters the user can set).

When you are done, compress the folder *Tensile test* to a zip file. The resulting *Tensile test.zip* is the final template ready for use in LS-PrePost and ready for distribution.

Look at the built-in templates, see the section “Location of templates” below. For instance, the template “Set up explicit analysis” creates the standard control and database output keyword cards for an explicit analysis. An existing template can also be a good starting point for creating a new template.

4.4 Location of templates

Location of user templates:

- Windows: %APPDATA%\LSTC\templates\kwtemplate, just paste %APPDATA%\LSTC\templates\ in the filer explorer and create the folder *kwtemplate* if missing.
- Linux: $HOME/LSTC/templates/kwtemplate

Location of built in templates: <LS-PrePost installation folder>\templates\kwtemplate

4.5 Tips

Templates are more powerful than one might first think, for example parts can be moved, rotated, and duplicated using commands such as **`*PART_MOVE`**, **`*PART_DUPLICATE`** (also for only moving parts), and **`*CONTROL_FORMING_AUTOPOSITION_PARAMETER_SET`**.

Templates can also be used to standardize the setup of loads or control and output cards, to save time and increase consistency. Templates can be used to automate the setup of multi-physics components, e.g., particle blast, ICFD, SPH, and SALE, making these methods more accessible for users who are not experts on multi-physics.

5 Keyword filter

The keyword manager organizes the 3000+ keywords in alphabetical order. The new Keyword filter organizes the keywords in subject categories making it easier to find the keyword you need for your application. In addition, deprecated keywords can be hidden.

Use the keyword filter to show only the keywords for a given application, e.g., SALE, SPH, explicit analysis, particle blast.

5.1 Using the keyword filter

Open the keyword filter by enabling the *Filter* check box in the Keyword Manager, see Fig. 5 below. Here you will see several categories of keywords. Each leaf in the tree is a group of keywords. The keyword manager will only show the keywords in the marked leaves – this makes it easy to identify the keywords for your application or material such as ceramics or polymers, see Fig. 3 below.

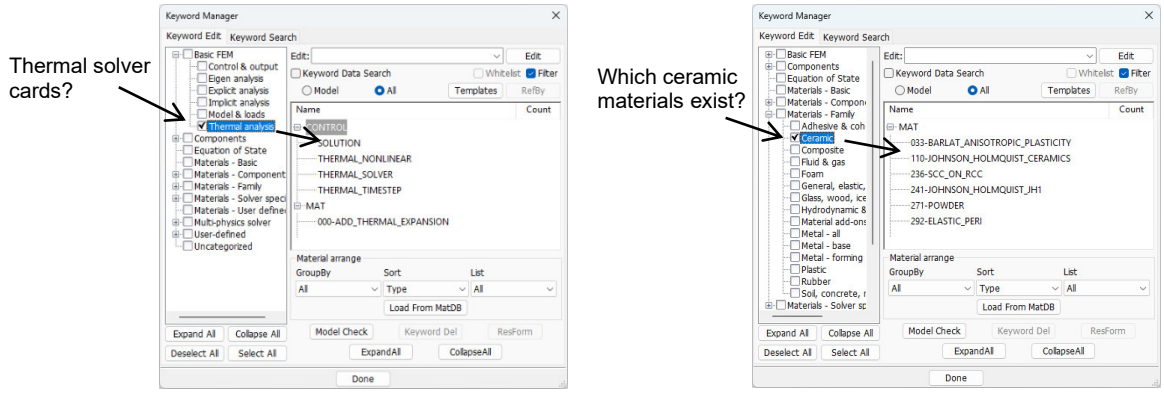

Fig.5: Example use of filter to find keywords.

Note that a leaf marked in blue means that there are keywords in the loaded model that belong to this leaf. Example: the model in Fig 6. below, contains e.g., “Control & output” keywords but not “Thermal analysis” keywords. The “Uncategorized” category includes all keywords that are not present in any filter category. This gives the user a quick overview of the content of the model.

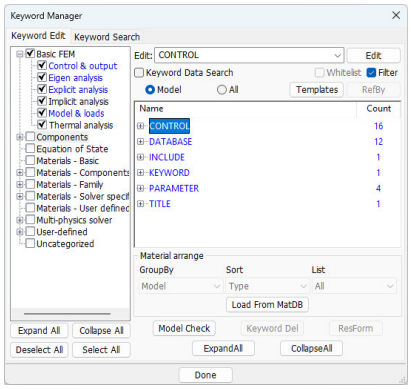

Fig.6: Blue marked filter categories are keywords present in the model.

5.2 Creating application keyword filters

You can create your own application filter. Place your application filters here:

- Windows: %APPDATA%\LSTC\templates\kwfilter, just paste %APPDATA%\LSTC\templates\ in the file explorer and create the folder kwfilter if missing.
- Linux: $HOME/LSTC/templates/kwfilter

5.3 Example – create your own keyword filter

Create the file Wear.txt with content, see Fig. 7.

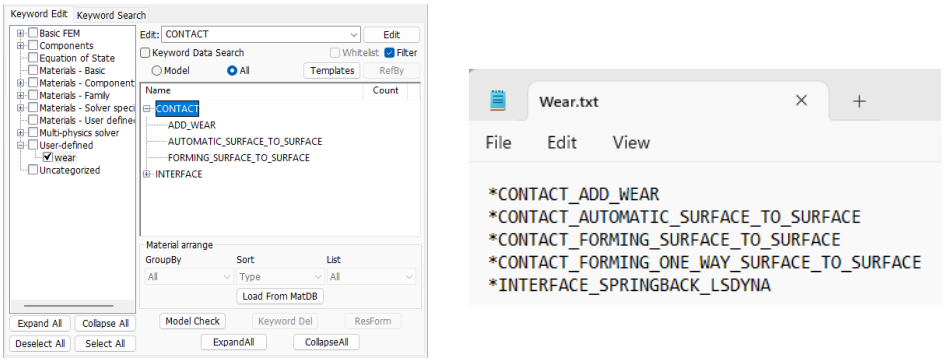

Fig.7: The keyword filter menu to the left and keyword filter definition file to the right.

Place the file *Wear.txt* in the folder *User-defined* in the folder *kwfilter*, see Section 5.2. If the folder *User-defined* is missing, then create it. This creates the category *User-defined* in the keyword filter and the leaf *Wear* (see above right image). The file *Wear.txt* is simply a listing of all the keywords that belong to the leaf *Wear*. For the changes to take effect, restart LS-PrePost.

A list of keywords for an application can be created from existing models using *grep * model.k | sort -u* in Linux and *more model.k | findstr /b "*" | sort /unique* using Windows CMD. Or by starting with a complete list of LS-DYNA keywords that can be output by LS-PrePost using the command *keyword listalltofile filename.txt*, see Fig. 8.

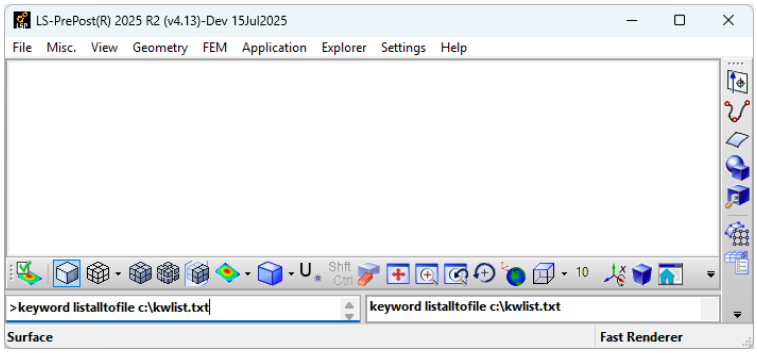

Fig.8: Create a list of all keywords

6 Try out the templates and keyword filters

To try out the templates and keyword filter, use LS-PrePost version 4.13 1Oct2025 or later. The template *How to: templates & keyword filter* and its built-in documentation contain all you need on how to use and create templates and keyword filters.

7 Summary and outlook

We have presented two developments for an improved application-oriented workflow for LS-PrePost, both aiming at making it easier and faster to set up LS-DYNA models according to good practice using the keyword method.

We would like to point out that the new developments allow users to easily and without coding extend the graphical user interface in LS-PrePost to automate repeated tasks and set up multi-physics models.

Going forward, we are looking at identifying and removing additional bottlenecks in the workflow for setting up LS-DYNA models in LS-PrePost using the keyword approach.

8 Acknowledgement

This work is a joint effort of Ansys's teams for *high-speed dynamic applications* and *LS-PrePost development*.

9 Literature

[1] LS-DYNA Keyword User's manual, Vol I-III, Ansys 2025