Automatic processes for multiple analyses

4th German LS-DYNA Forum 2005

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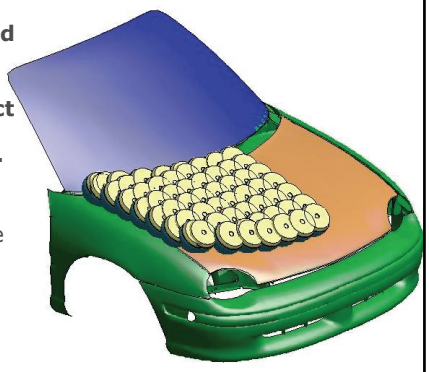
Contents

Introduction

- **Significant amounts of time are wasted creating and processing multiple loadcases that are virtually identical.**
- **For example, pedestrian bonnet impact may require over 100 analyses to be set up, submitted and post-processed.**
- **Approximate timing for manual method:**
  - 10 minutes per analysis to position the headform and depenetrate from the bonnet
  - 1 minute to submit
  - 10 minutes to check and post-process per analysis
  - 4 hours to collate results, calculate NCAP score and generate report
  - Total **39 hours** for 100 analyses, per design iteration
- **Total man-time for automatic method: 10 minutes per design iteration**



This paper shows software capabilities that are currently under development, and will be released in Version 9.2 later in 2005.

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We want to do this automatically:

Create models	**Create models for multiple loadcases using Oasys Primer in a one-hit batch process**
Submit and monitor analyses	**Submit the whole set of analyses in one operation, and monitor their progress using Oasys Shell**
Post-process analyses	**Post-process analyses automatically without user intervention using Oasys D3Plot, Oasys T/HIS and Oasys Presenter**
Create summary report	**Create a summary report automatically with Oasys D3Plot, Oasys T/HIS and Oasys Presenter**

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Example 1: Pedestrian analysis Objective

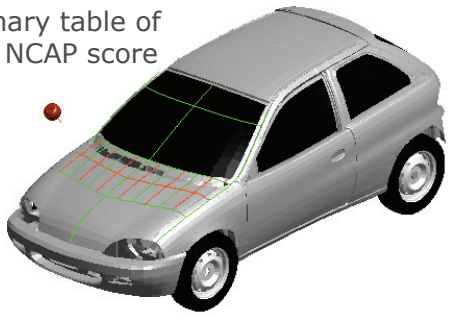
Create models

Submit and monitor analyses

Post-process analyses

Create summary report

- **Start from a list of impact points**
- **Automatically:**
  - Position head & assemble models
  - Submit to LS-DYNA
  - Post-process each analysis
  - Generate a summary table of results; calculate NCAP score



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Example 1: Pedestrian analysis

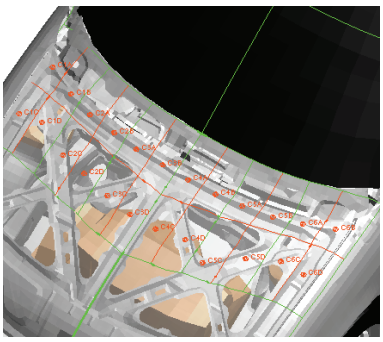
Create models

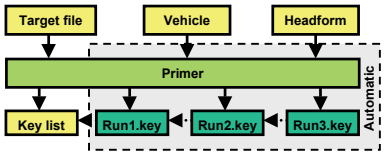
Submit and monitor analyses

Post-process analyses

Create summary report

- **Target file allows Primer to create multiple analysis files with one click**






```
Type,PEDHEAD
Model,/data/PEDHEAD/biw.key
Impactor,/data/child_head.key
Orient,node 1, node 2
Name,childhead
C1A,900,1393
C1B,841,1276
C1C,694,1399
C1D,703,1309
...etc
```

Target zone name, X Y coords

Target file

- **Primer automatically depenetrates the head**

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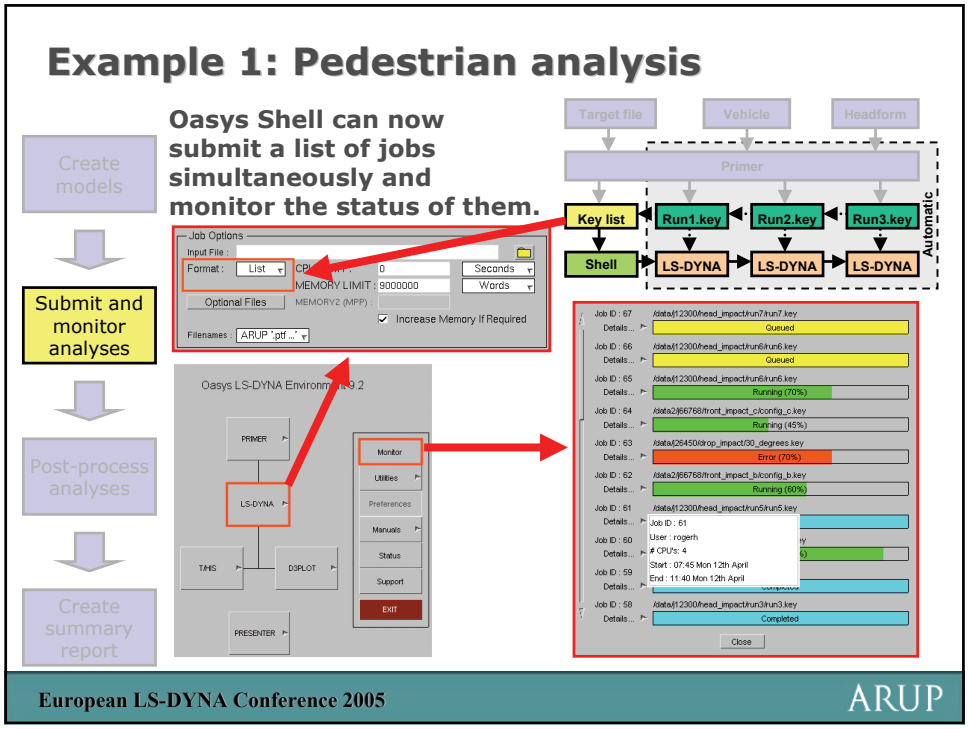
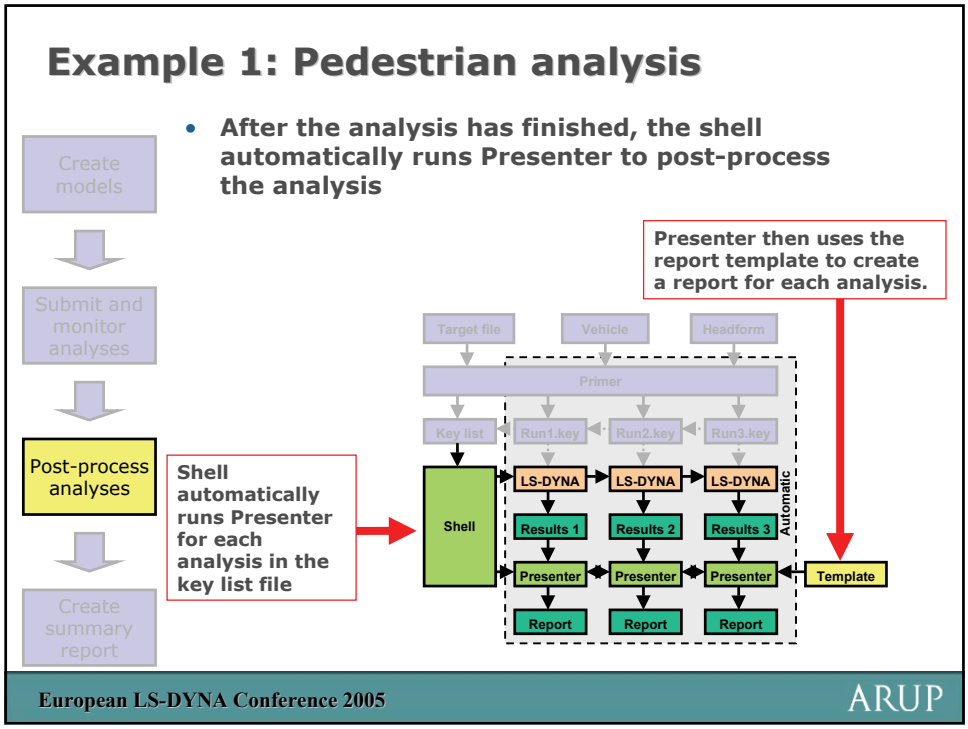




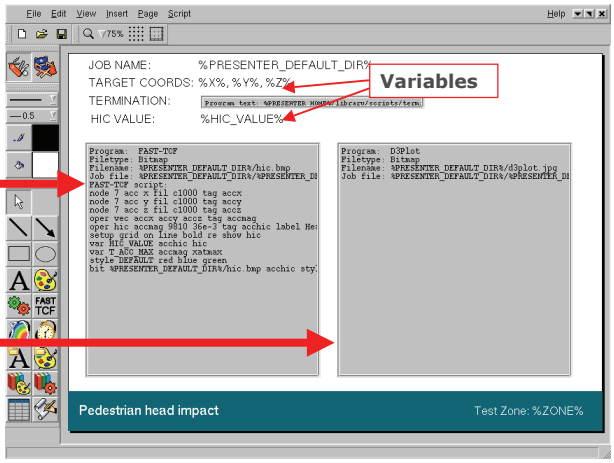
Example 1: Pedestrian analysis

- Presenter can be used to create a report template. This only has to be done once. The template is then reused for each analysis

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

Fast-TCF script to obtain acceleration and HIC.

D3Plot cut-section plot centred on impact location



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Example 1: Pedestrian analysis

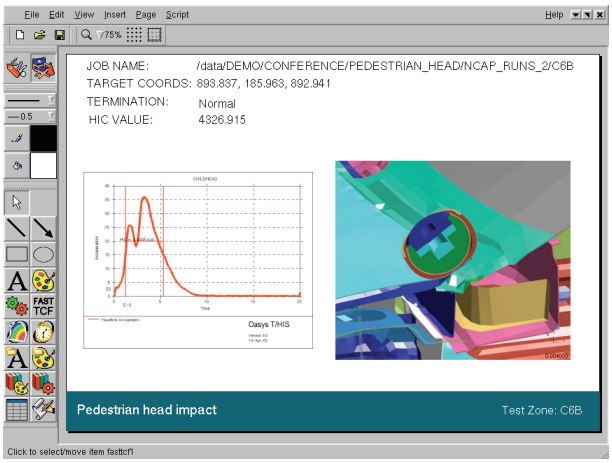
- When the report is generated, T/HIS and D3Plot are automatically run.

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

Output can be saved as:

- html
- postscript
- pdf
- vba macro

or printed



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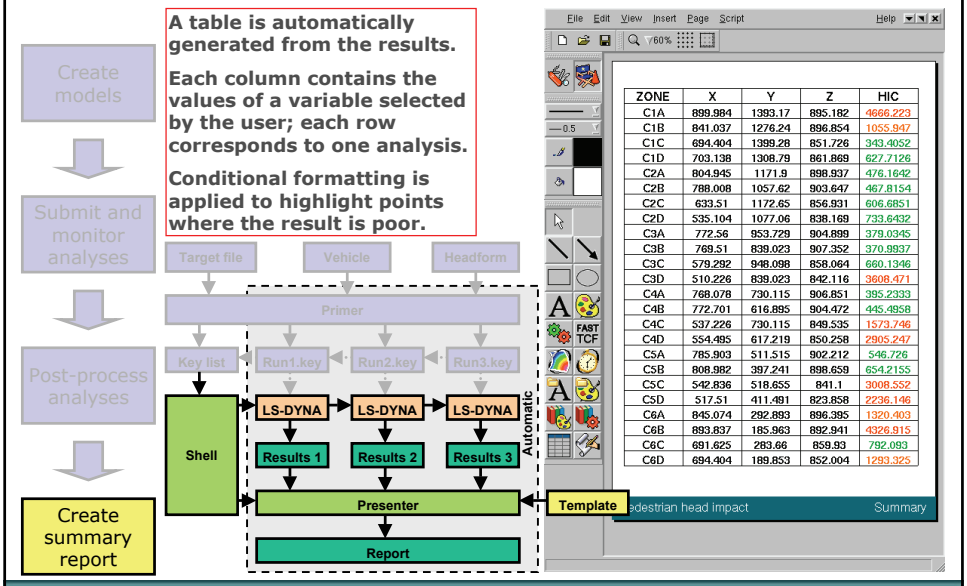
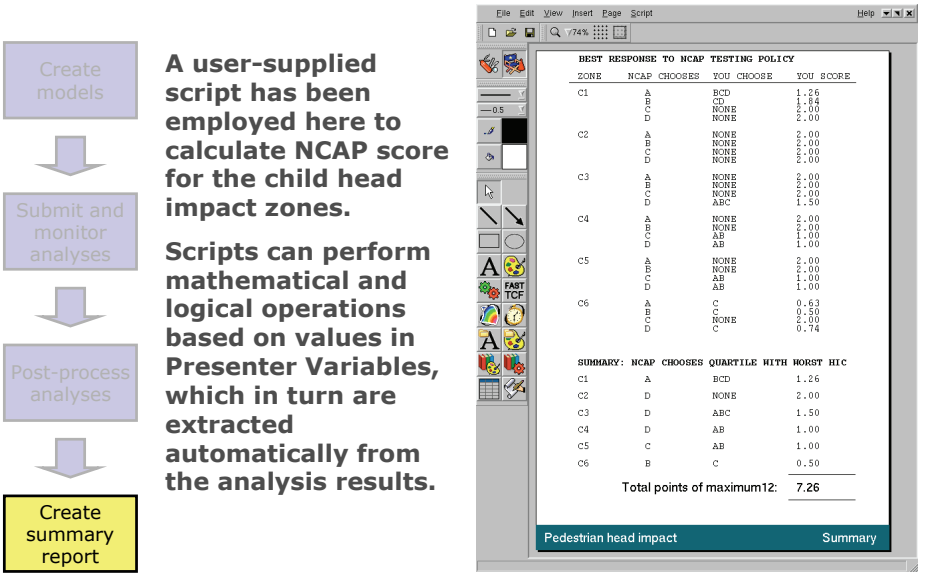
Example 1: Pedestrian analysis



Example 1: Pedestrian analysis



Example 1: Pedestrian analysis

Create models

Submit and monitor analyses

Post-process analyses

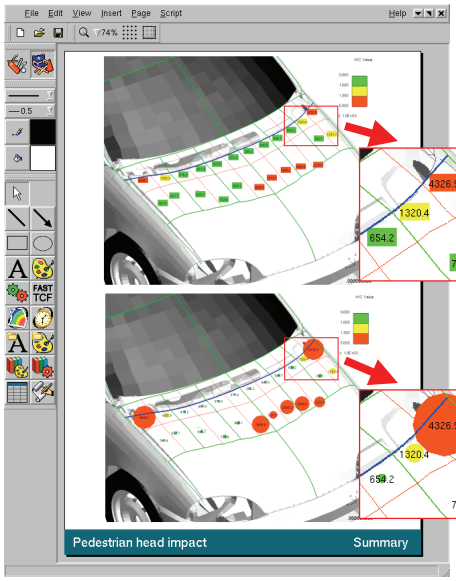
Create summary report

Presenter passes a list of coordinates and HIC values to D3plot. An image showing the HIC values at each impact location is automatically inserted into the report.

Several formats are available.

In the top image the value is given in a box coloured by HIC

In the bottom image the size of the circle is also proportional to the HIC value.



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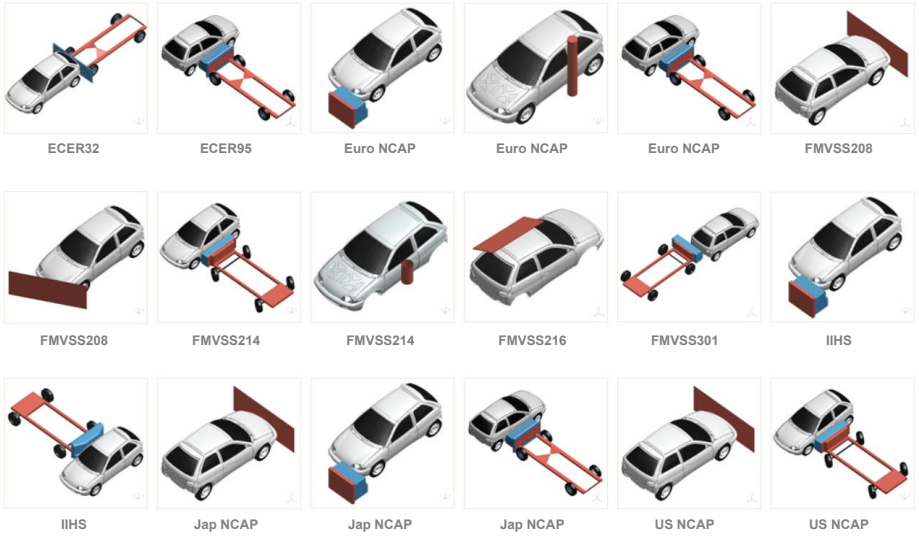
Example 2: Multiple crash cases



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Example 2: Multiple crash cases

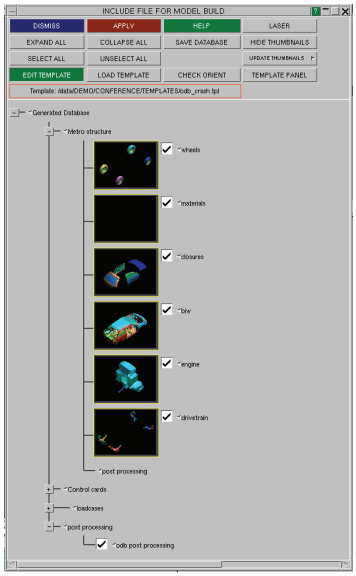
Create models

Submit and monitor analyses

Post-process analyses

Create summary report

Previous versions of Primer enabled the user to build a single model by using a database and a template to select INCLUDE files for each loadcase.



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Example 2: Multiple crash cases

Create models

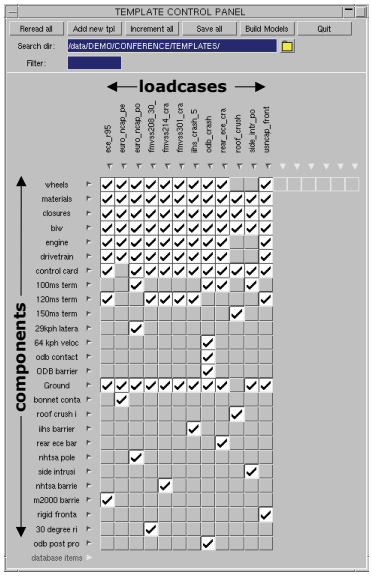
Submit and monitor analyses

Post-process analyses

Create summary report

Now multiple templates can be created and edited in a single menu.

All of the loadcases can be built with a single click, leading to a set of master models in separate directories.



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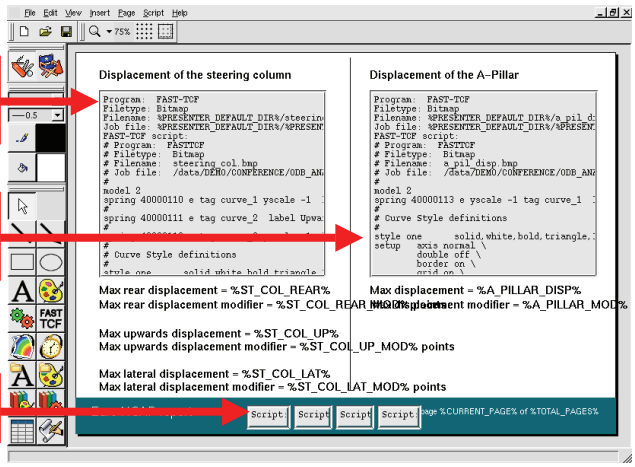
Example 2: Multiple crash cases

Individual Presenter templates are used for each loadcase to extract the relevant data. e.g. ODB

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

- **Fast-TCF script to obtain steering column motion**
- **Fast-TCF script to obtain A-pillar displacement**
- **Presenter scripts process information**

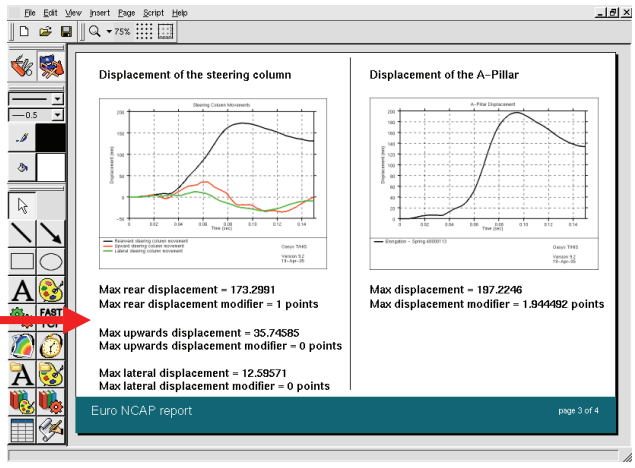


Example 2: Multiple crash cases

Generated report for ODB with results calculated

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

- **Presenter scripts have calculated NCAP modifiers from data**

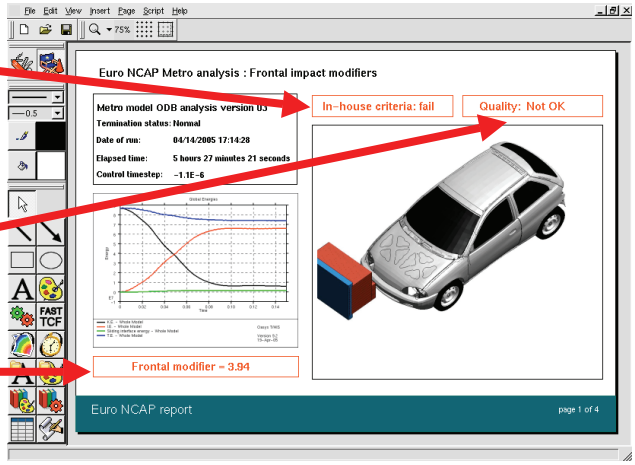


Example 2: Multiple crash cases

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

Generated report for ODB with total modifier and analysis quality

- In house criteria: pass/fail from user-supplied script
- Quality of the analysis (in this case, "Not OK" because of energy imbalance)
- Modifier calculated by Presenter



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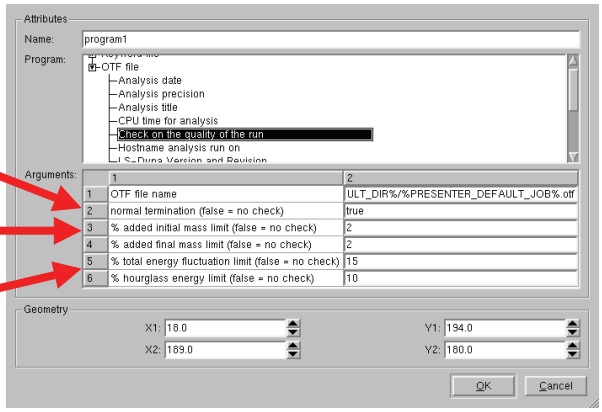
Example 2: Multiple crash cases

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

The quality of the analysis is determined by a (customisable) script in Presenter, using energy balance, termination and added mass.

- Normal termination check
- Added mass check
- Energy checks



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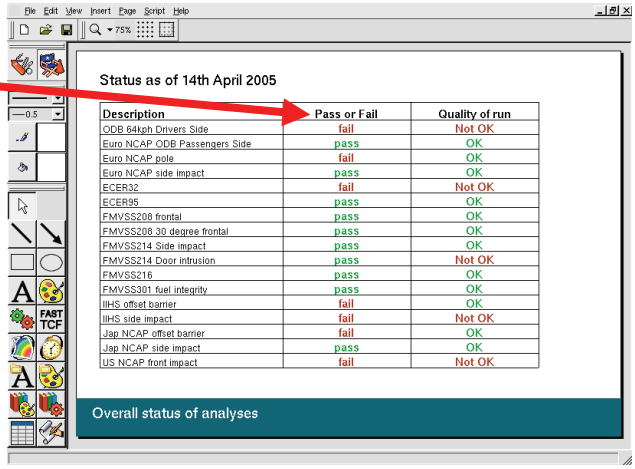
Example 2: Multiple crash cases

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

A table is automatically generated for all the crash cases, giving the analysis quality and pass/fail criteria.

Conditional formatting is applied to highlight crash cases where the performance criteria were not met.



Status as of 14th April 2005

Description	Pass or Fail	Quality of run
ODB 64kph Drivers Side	fail	Not OK
Euro NCAP ODB Passengers Side	pass	OK
Euro NCAP pole	fail	OK
Euro NCAP side impact	pass	OK
ECER32	fail	Not OK
ECER95	pass	OK
FMVSS208 frontal	pass	OK
FMVSS208 30 degree frontal	pass	OK
FMVSS214 Side impact	pass	OK
FMVSS214 Door intrusion	pass	Not OK
FMVSS216	pass	OK
FMVSS301 fuel integrity	pass	OK
IIHS offset barrier	fail	OK
IIHS side impact	fail	Not OK
Jap NCAP offset barrier	fail	OK
Jap NCAP side impact	pass	OK
US NCAP front impact	fail	Not OK

Overall status of analyses

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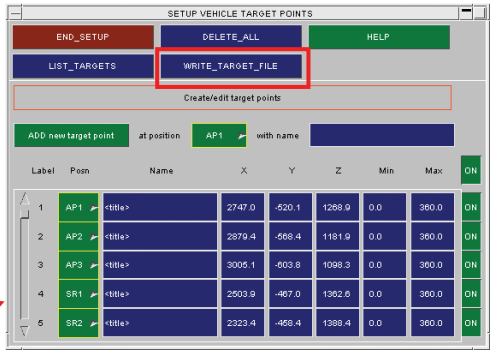
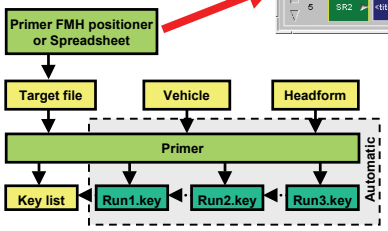
Example 3: Interior head impact

Create models → Submit and monitor analyses → Post-process analyses → Create summary report

Target file can be written from Primer (or from a spreadsheet) to allow all analyses to be submitted and processed in a similar way to pedestrian analyses described earlier





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Example 3: Interior head impact

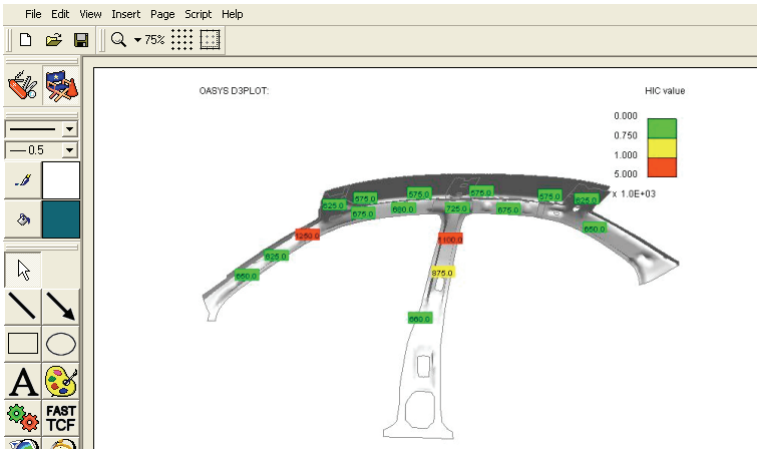
Create models

Submit and monitor analyses

Post-process analyses

Create summary report

Presenter and D3Plot automatically generate plot showing HIC values for each location.



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Example 3: Interior head impact

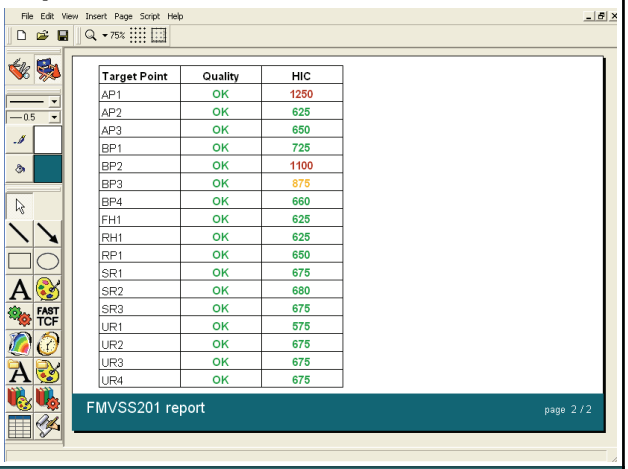
Create models

Submit and monitor analyses

Post-process analyses

Create summary report

A table is automatically generated, containing one row per analysis; here, the table has been set up to show analysis quality and HIC.



Target Point	Quality	HIC
AP1	OK	1250
AP2	OK	625
AP3	OK	650
BP1	OK	725
BP2	OK	1100
BP3	OK	875
BP4	OK	660
FH1	OK	625
RH1	OK	625
RP1	OK	650
SR1	OK	675
SR2	OK	680
SR3	OK	675
UR1	OK	575
UR2	OK	675
UR3	OK	675
UR4	OK	675

FMVSS201 report page 2 / 2

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Summary and Conclusions

- **Three examples of automatic processes for multiple analyses have been shown.**
  - Pedestrian bonnet impact
  - Multiple crash loadcases
  - Interior head impact
- **Using Oasys Primer, Shell, D3Plot, T/HIS and Presenter, the man-time taken to process multiple analyses can be reduced from days to a few minutes.**
- **Any type of repetitive analysis process with LS-DYNA can be automated in this way, including user-generated scripts where needed**
- **The software capabilities described in this paper are under development, and will be released with version 9.2 later this year.**

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