Automatic Processes for Multiple Analyses

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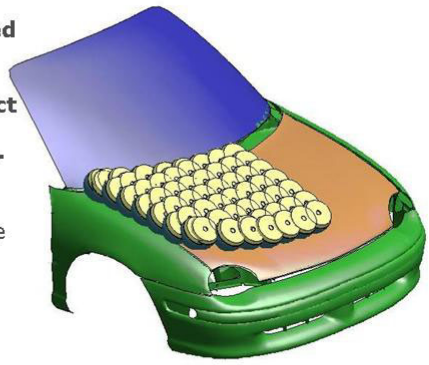
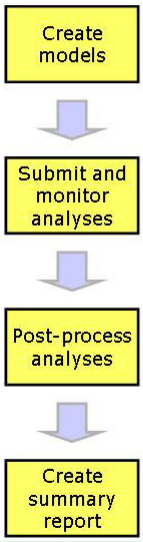
Introduction

- **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.

We want to do this automatically:



Create models for multiple loadcases using Oasys Primer in a one-hit batch process

Submit the whole set of analyses in one operation, and monitor their progress using Oasys Shell

Post-process analyses automatically without user intervention using Oasys D3Plot, Oasys T/HIS and Oasys Presenter

Create a summary report automatically with Oasys D3Plot, Oasys T/HIS and Oasys Presenter

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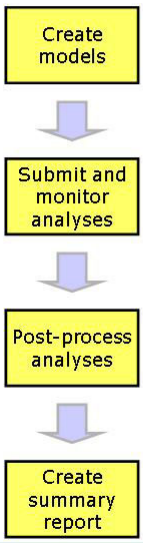
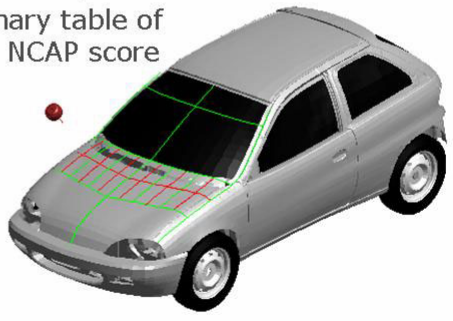
Example 1: Pedestrian analysis Objective



- **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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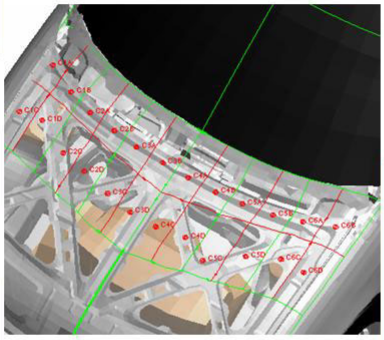
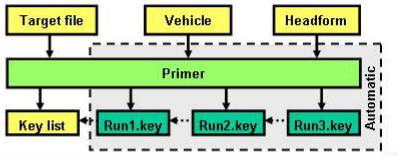
Example 1: Pedestrian analysis

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

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






```
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

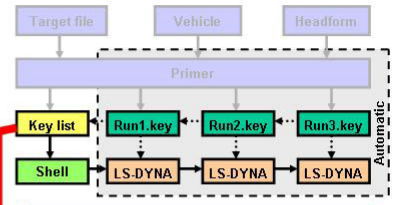
Target file

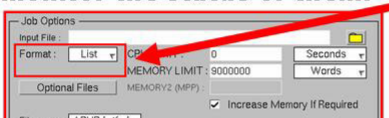
- Primer automatically depenetrates the head

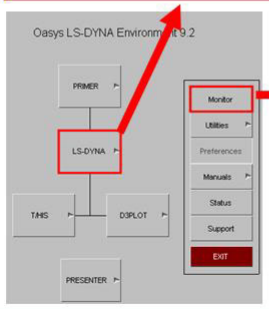
Example 1: Pedestrian analysis

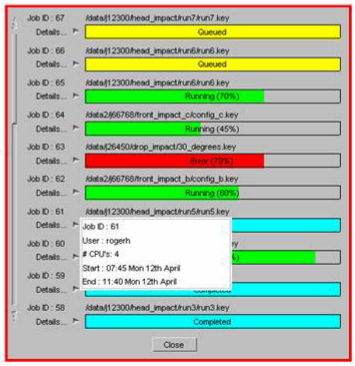
Oasys Shell can now submit a list of jobs simultaneously and monitor the status of them.

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



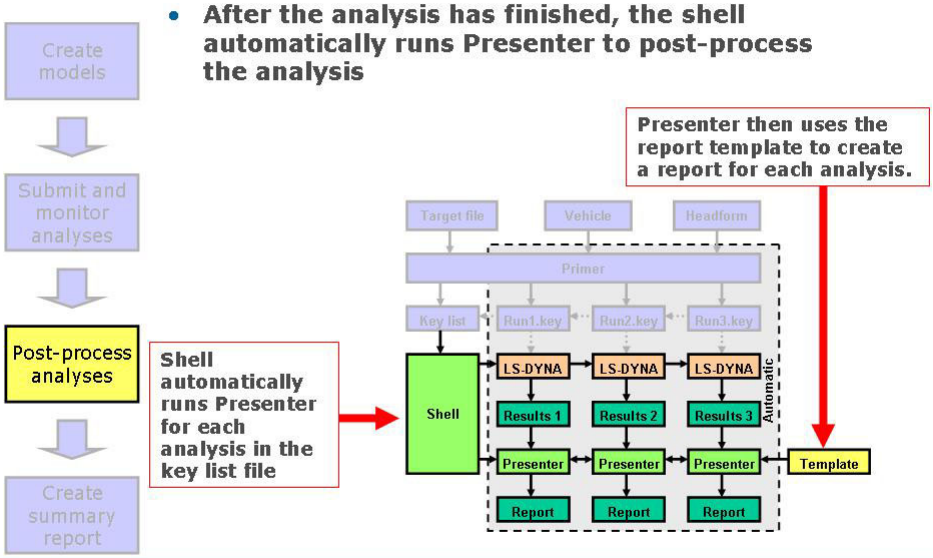






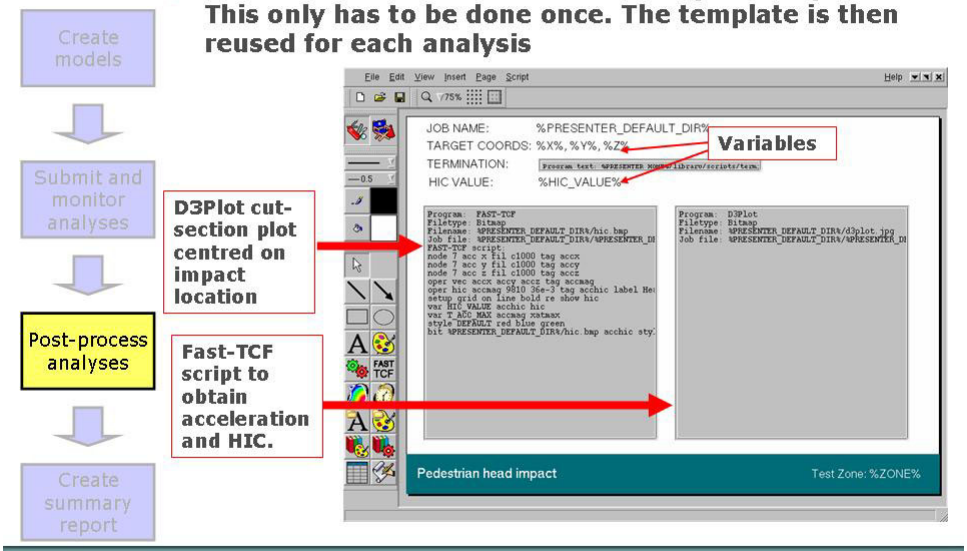
Example 1: Pedestrian analysis

- After the analysis has finished, the shell automatically runs Presenter to post-process the analysis



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

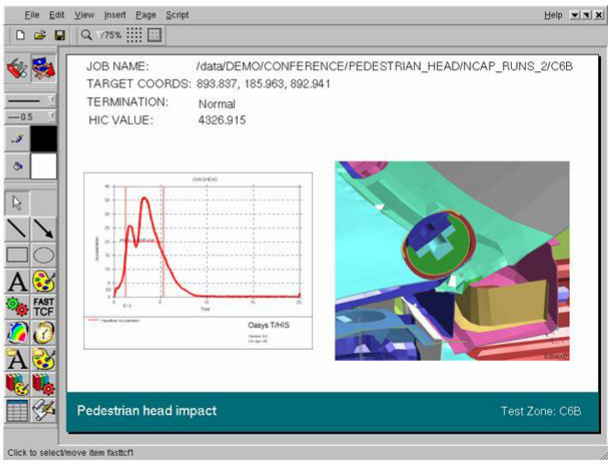


Example 1: Pedestrian analysis

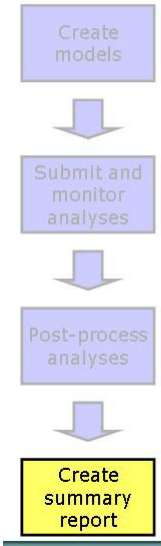
- When the report is generated, T/HIS and D3Plot are automatically run.

Output can be saved as:
- html
- postscript
- pdf
- vba macro

or printed



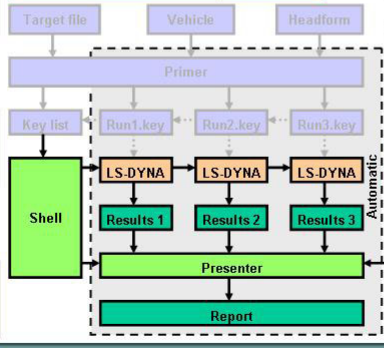
Example 1: Pedestrian analysis

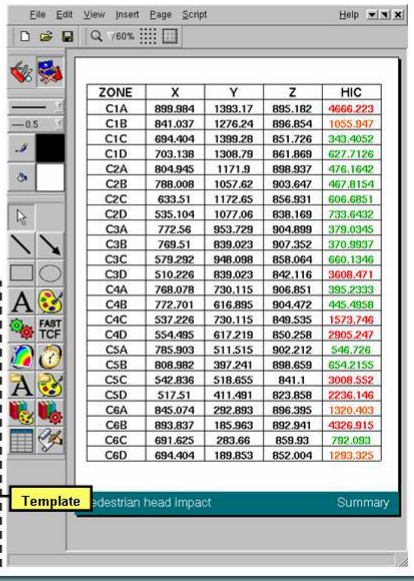


A table is automatically generated from the results.

Each column contains the values of a variable selected by the user; each row corresponds to one analysis.

Conditional formatting is applied to highlight points where the result is poor.





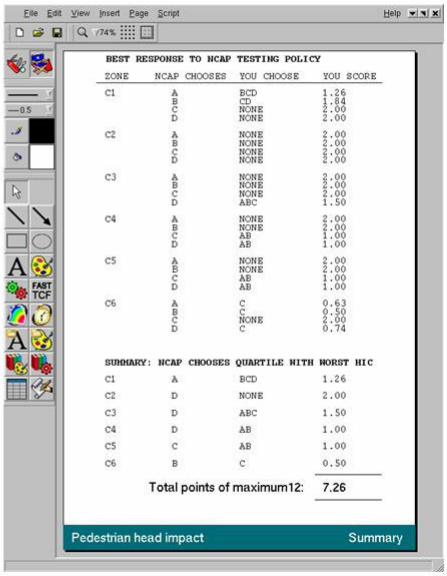
ZONE	X	Y	Z	HIC
C1A	899.984	1393.17	895.182	4666.223
C1B	841.037	1276.24	896.854	1055.947
C1C	694.404	1399.28	851.726	343.4052
C1D	703.138	1308.79	861.869	627.7126
C2A	804.945	1171.9	898.937	476.1642
C2B	788.008	1057.62	903.647	467.8154
C2C	633.51	1172.65	856.931	606.6851
C2D	535.104	1077.06	838.169	733.6432
C3A	772.56	953.729	904.899	379.0345
C3B	769.51	839.023	907.352	370.9937
C3C	579.292	948.098	858.064	660.1346
C3D	510.226	839.023	842.116	3608.471
C4A	768.078	730.115	906.851	395.2333
C4B	772.701	616.895	904.472	445.4858
C4C	537.226	730.115	849.535	1573.746
C4D	554.495	617.219	850.258	2905.247
C5A	785.903	511.515	902.212	546.726
C5B	808.982	397.241	898.659	654.2155
C5C	542.836	518.655	841.1	3008.552
C5D	517.51	411.491	823.858	2236.146
C6A	845.074	292.893	896.395	1320.403
C6B	893.837	185.963	892.941	4326.915
C6C	691.625	283.66	859.93	792.093
C6D	694.404	189.853	852.004	1293.325

Example 1: Pedestrian analysis

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

A user-supplied script has been employed here to calculate NCAP score for the child head impact zones.

Scripts can perform mathematical and logical operations based on values in Presenter Variables, which in turn are extracted automatically from the analysis results.



Example 1: Pedestrian analysis

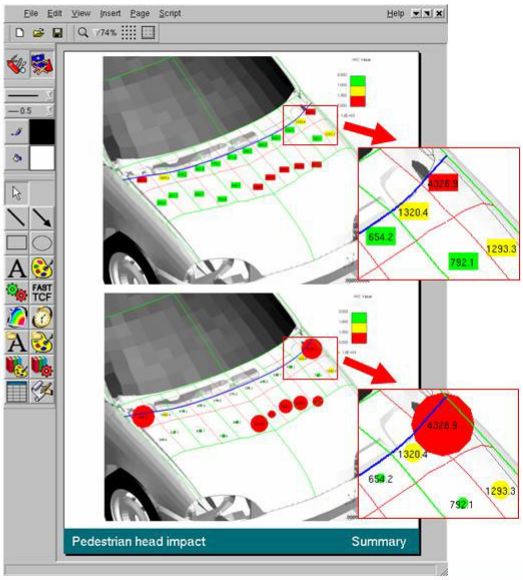
Create models → Submit and monitor analyses → Post-process analyses → Create summary report

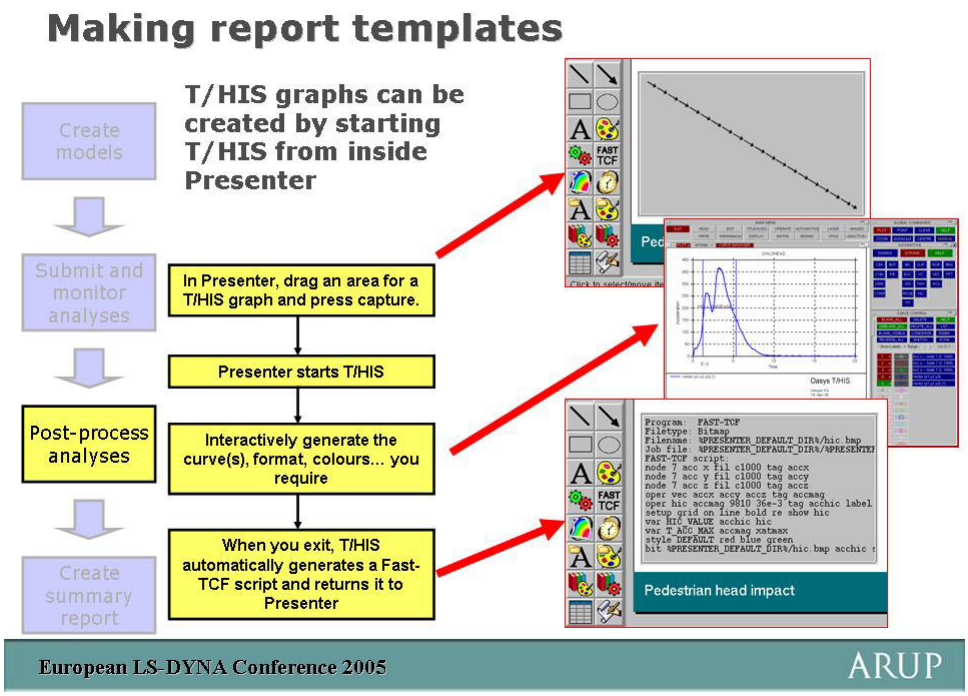
Presenter passes a list of coordinates and HIC values to D3plot. An image showing the HIC values at each impact location is automatically inserted into the report.

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.




Making report templates
Create models
Submit and monitor analyses
Post-process analyses
Create summary report
T/HIS graphs can be created by starting T/HIS from inside Presenter
In Presenter, drag an area for a T/HIS graph and press capture.
Presenter starts T/HIS
Interactively generate the curve(s), format, colours... you require
When you exit, T/HIS automatically generates a Fast-TCF script and returns it to Presenter
Pedestrian head impact
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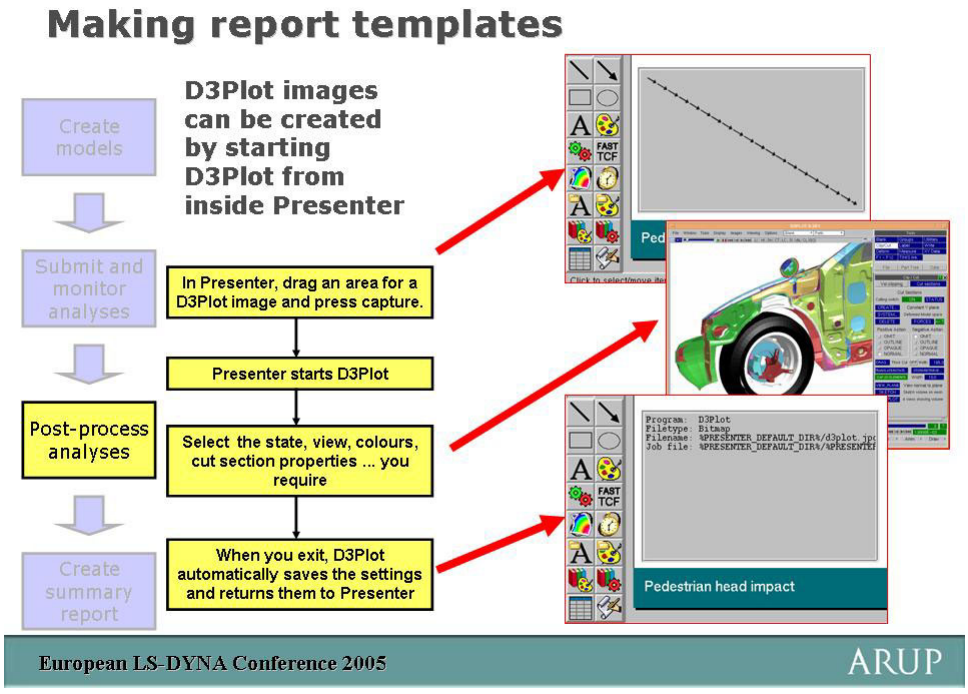
Making report templates
Create models
Submit and monitor analyses
Post-process analyses
Create summary report
D3Plot images can be created by starting D3Plot from inside Presenter
In Presenter, drag an area for a D3Plot image and press capture.
Presenter starts D3Plot
Select the state, view, colours, cut section properties ... you require
When you exit, D3Plot automatically saves the settings and returns them to Presenter
Pedestrian head impact
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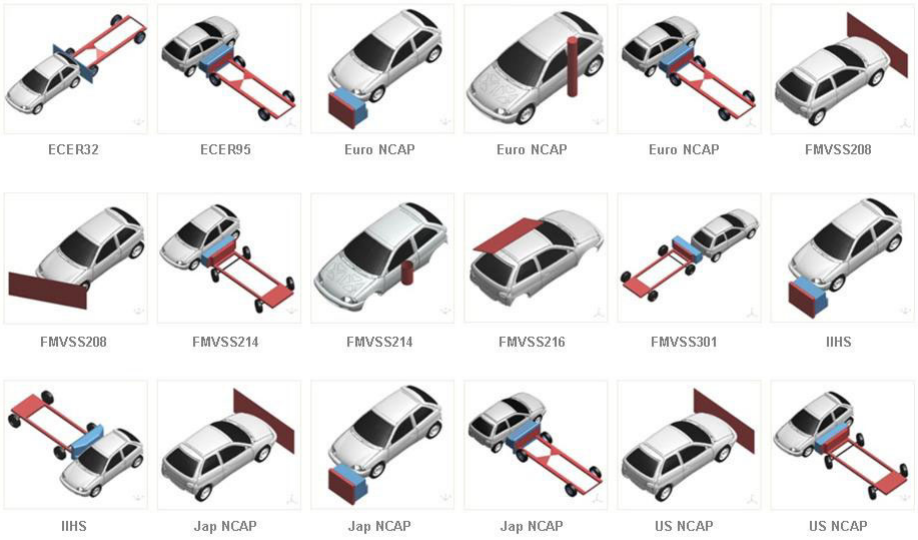
Example 2: Multiple crash cases



Example 2: Multiple crash cases

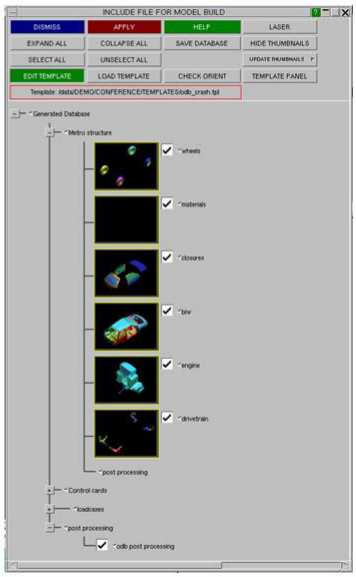
Create models

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.



Example 2: Multiple crash cases

Create models

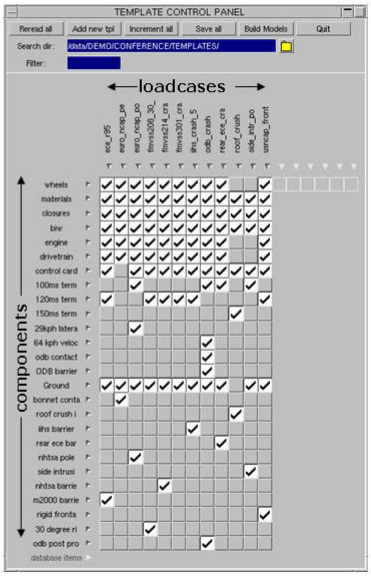
Submit and monitor analyses

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.



Example 2: Multiple crash cases

Create models

Submit and monitor analyses

Post-process analyses

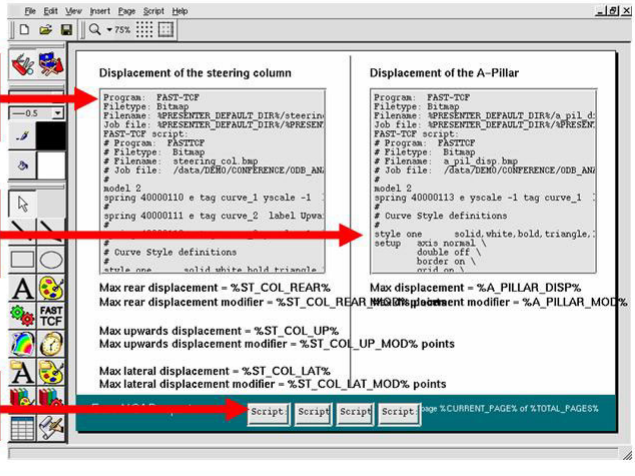
Create summary report

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

Fast-TCF script to obtain steering column motion

Fast-TCF script to obtain A-pillar displacement

Presenter scripts process information

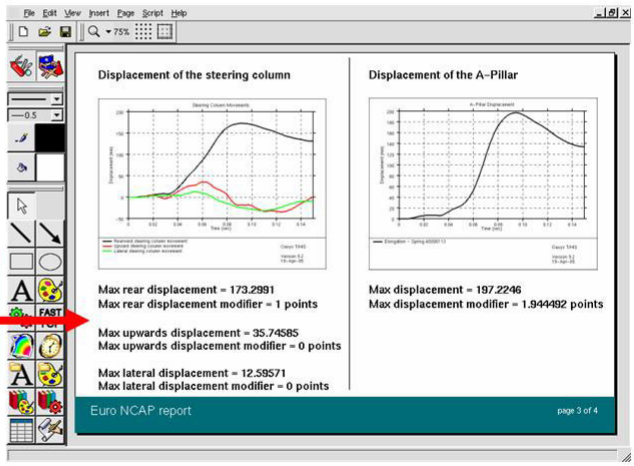


Example 2: Multiple crash cases

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

Generated report for ODB with results calculated

Presenter scripts have calculated NCAP modifiers from data



Example 2: Multiple crash cases

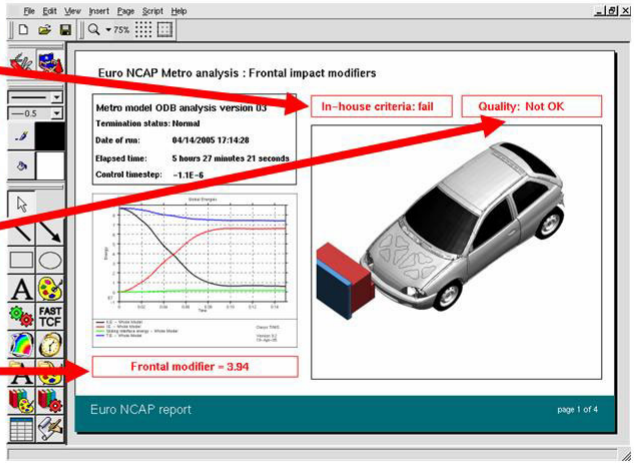
Create models → Submit and monitor analyses → Post-process analyses → Create summary report

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



Example 2: Multiple crash cases

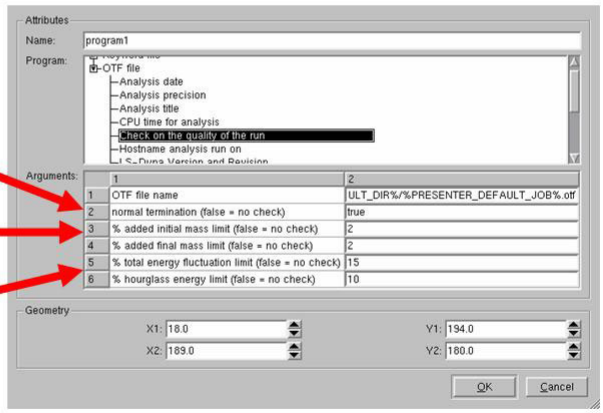
Create models → Submit and monitor analyses → Post-process analyses → Create summary report

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

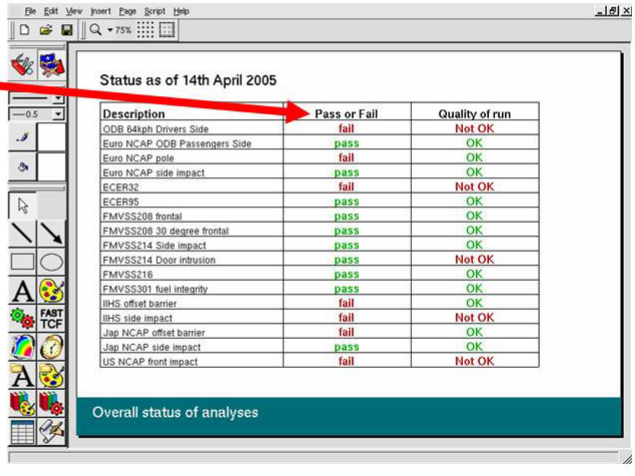


Example 2: Multiple crash cases

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

Example 3: Interior head impact

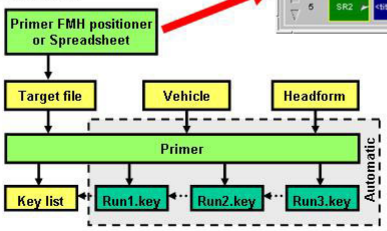
Create models

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



Example 3: Interior head impact

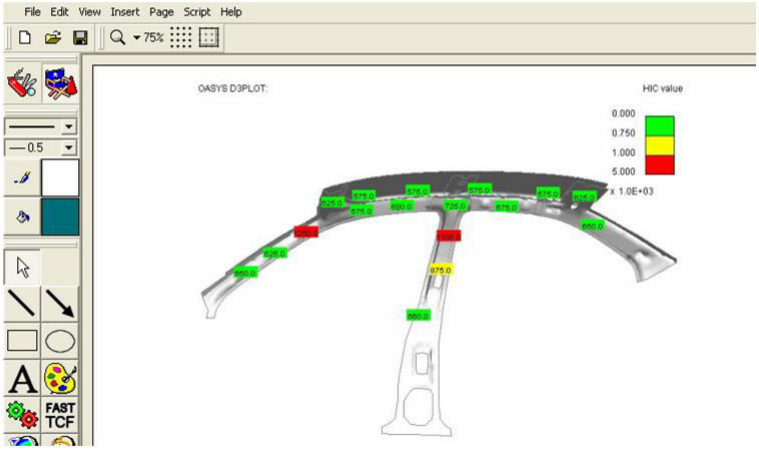
Create models

Submit and monitor analyses

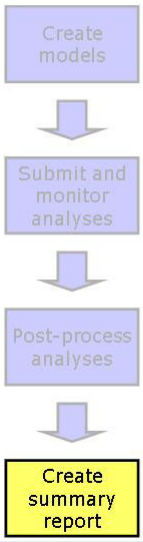
Post-process analyses

Create summary report

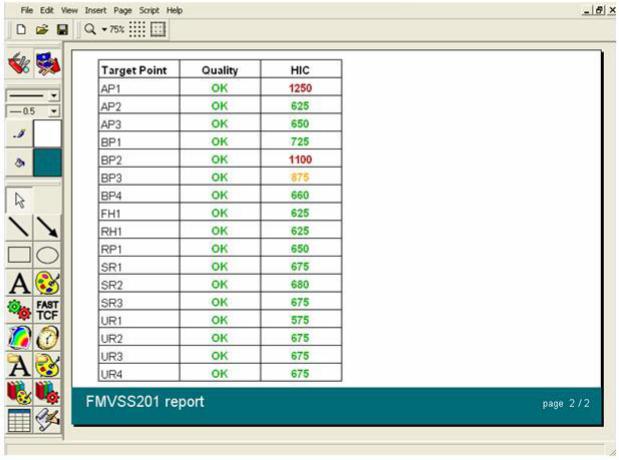
Presenter and D3Plot automatically generate plot showing HIC values for each location.



Example 3: Interior head impact



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

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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.**