Building Simulation Reports Efficiently

"The challenges of reporting"

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Virtually all simulation engineers are faced with the need to document the outcome and results of their simulations. There is an increasing demand to communicate engineering information, before, during and after the project, but also in the sales and marketing activities of engineering products and services. In most cases, both textual reports and presentation materials are required.

Most companies, large or small, have their own customized work flow and set of tools to create reports and presentations. In addition, most companies have strict requirements for the layout of reports.

Building a comprehensive simulation report is a time consuming task. Studies from simulation projects indicate that 20 - 45 % of the time spent on this task is devoted to interpretation and documentation of the project results. Consequently, there is significant potential to reduce the time in this phase of the project. By setting up an efficient process for creating reports using industry standard reporting tools, the engineers will be able to devote more time to the engineering tasks. This article highlights four important challenges in building high quality simulation reports and also points to technical solutions to improve efficiency in this process. The four challenges are:

1. Collecting and storing engineering report content.
2. Using industry standard editing tools and report formats.
3. Automated and interactive report building using one tool
4. Using interactive 3D content in reports

Challenge 1: Collecting and storing engineering report content

A critical and often time consuming task is to draw information from the engineering applications, e.g. a pre- and post-processor, to the report editing tool. Creating the required images, plots, tables and other engineering information takes a substantial amount of time, and a copy-and-paste approach can be a major source of error. Figure 1 illustrates the typical data and process flow in capturing and storing report content. In comprehensive reports, the amount of information that needs to be transferred from the engineering application to the reporting tool can be substantial. Most engineering applications have limited or no support for capturing, storing and archiving information intended for reports and presentations. A frequently used method is to apply a screen capture utility to transfer information between the engineering application and the editing tools, often resulting in fragmented and distributed information. Such a technique does not allow for taking advantage of the characteristics of the information – 2D or 3D, tabular information, images only, single numeric values, etc.

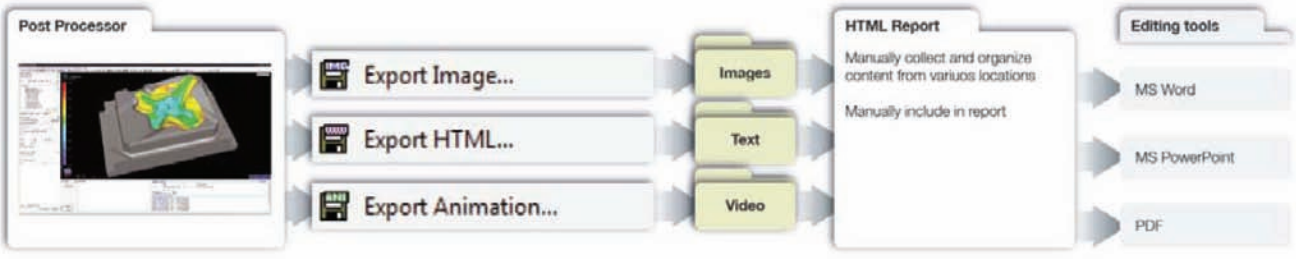

Figure 1: The Classical Process and Data Flow in Building Simulation Reports.

Building a bridge between the engineering application and the reporting tool that allows information to flow with as little human intervention as possible, increases the efficiency and improves the quality of the report. In addition, the report content should be collected and stored in an archive with viewing functionality. This gives the user a good and continuous overview of the information which is prepared and ready for the report.

Challenge 2: Using industry standard editing tools and report formats.

Over 95% of the computer install base is Windows or Mac OS based PCs. 80-85% of these computers have MS-Office installed. More interesting is that over 90% of all simulation engineers are using MS Office or Open Office to document and present their simulation projects. Even though Open Office is a viable and growing alternative, it is safe to say that MS Office is established as a de-facto industry standard for document generation in the typical engineering project. The majority of engineering applications on the market have limited or no direct support for building reports using standard tools such as MS Office or Open Office. The ideal situation for the simulation engineer would be to have direct integration of their reporting tools with their engineering application. In the foreseeable future this is not a realistic scenario due to the complicated tasks of achieving tight integration of e.g. Microsoft Office into a PLM system or pre- or post processor. Hence a loose coupling, whilst maintaining the major advantages of a tight integration, seems to be a reasonable compromise in order to obtain efficiency, flexibility and ease of use. Figure 2 shows a loosely coupled architecture, also suggesting a bidirectional interface between the content repository and the engineering tool. Such an architecture allows for swift and easy content modification.

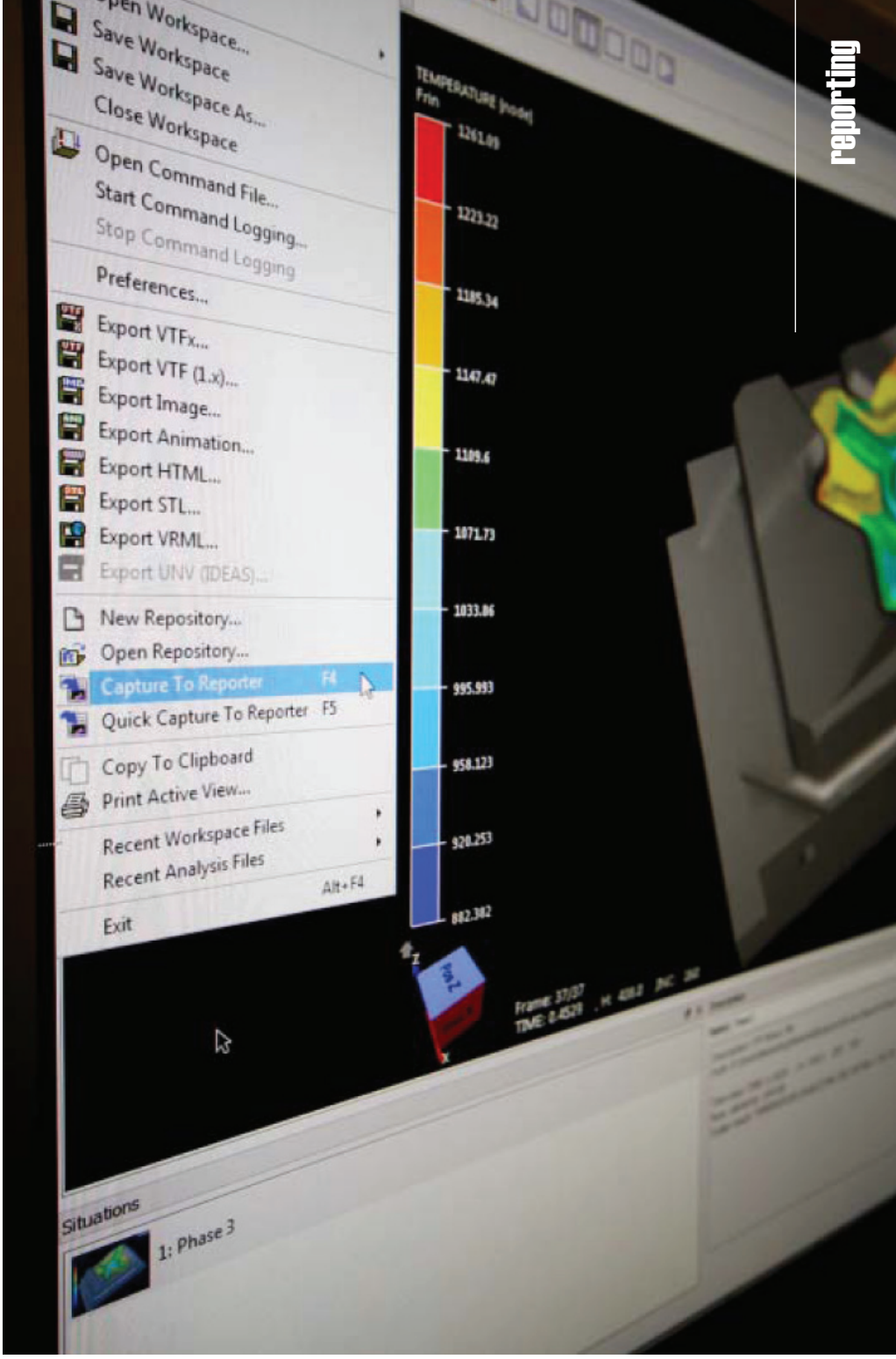

Figure 3: Capture of Information from Post-Processor

Standard editing tools such as MS Office and Open Office have functionality for setting up document templates. By using

Figure 2: Report Builder software architecture

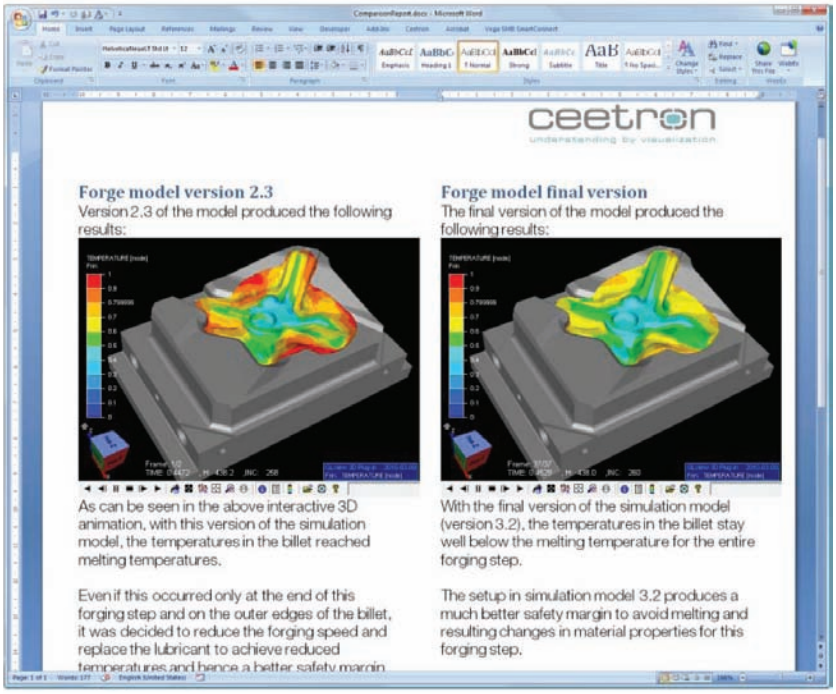

Figure 4: Interactive 3D content in MS Word report.

document templates, companies and organizations can create report templates in line with the company profile. Even more important is that a report template can contain a description of the work flow of the engineering process. This will ensure that all steps in the engineering process are completed before the simulation report is finalized.

The use of MS Office and Open Office in an organization automatically enforces the use of the accompanying document formats of these tools. Formats and tools are often tightly coupled, but Open Document Format (ODF) is an initiative to allow companies to separate editing tools from report formats. So far this initiative has fallen short as Microsoft have created their own variant of ODF.

The Report Builder architecture illustrated in Figure 2 combines a functional integration of the report editing tool and the engineering application, while still allowing the company standard editing tools and templates to be used.

Challenge 3: Automated and interactive report building using one tool

Reports from simulation projects can be very different in terms of format, size and content. Some reports can be produced more or less automatically, while others require a lot of interactive work by the engineer.

As an example, consider an OEM company in the automotive industry that produces a specific part in various configurations, and needs to simulate and report the properties of each configuration to the customer. The accompanying reports follow a detailed specification, and the steps needed to produce them are highly repetitive for each configuration of the part. As a consequence, the report content can be drawn more or less automatically from a simulation database – if the necessary tools are available and automation is supported. However, past experience has shown that automatic report generators do not have the required flexibility, and that general word processing tools provide limited or no support for automation and integration with the engineering tools.

Now, consider the same company implementing new routines or equipment in their production line. Simulations are required to test the properties of the parts following the new production process. Reporting the outcome of such a simulation project will require a totally different level of involvement and interaction by the engineer than the previous example, and automating the report generation is not an alternative in this case.

The task can be made easier, though, by providing the engineer with features that will enable easy capture of the necessary information, and a single storage point that also provides a full overview of all collected content for the report.

A powerful reporting tool must be able to handle both an interactive approach and a fully automated approach – and preferably combinations of the two.

Challenge 4: Including interactive 3D content in reports

Traditionally, a large number of images are used in reports to depict, for example, the analysis setup, relevant result mappings at different time-steps and from different view angles. Producing such images and making sure that all relevant images are available is a time-consuming task.

Reports in electronic formats open up a whole new spectrum of advanced information which can be contained within the report. In a simulation report, full 3D models and results are an obvious extension. The recent open XML based formats such as ODF and OOXML provide software developers with a mechanism to embed 3D information directly into reports. This will enable the recipient to explore the model in full 3D, providing increased understanding and making more data readily available. This can significantly reduce the need for multiple images (and videos), adding flexibility and the ability to answer ad-hoc questions.

Concluding Remarks

Several CAE software systems come with report generation features integrated. However, it seems that few, if any at all, have had a significant take-up in the market. Some software vendors have even removed their reporting systems due to lack of success. We believe that an important reason for this is the limited flexibility of these systems to customize reports, and lack of integration with industry standard report editing tools such as Microsoft Office or Open Office.

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company standard editing tools and templates to be used. Building a bridge between the engineering applications and the reporting tool that allows information to flow with as little human intervention as possible increases the efficiency and improves the quality of the report. In addition, the report content should be collected and stored in an archive with viewing functionality. This gives the user a good and continuous overview of the information which is prepared and ready for the report.

By combining the report building process with a software architecture as illustrated in Figure 2, simulation engineers can build high quality reports using their preferred editing tools and templates with significantly less effort. In addition, CAE software vendors and engineering companies can take full advantage of the latest technological development in mobile devices such as iPhone and iPad to read simulation reports including advanced interactive content.

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Fact box:
The Open Document Format for Office Applications (also known as OpenDocument or ODF) is an XML-based file format for representing electronic documents such as spreadsheets, charts, presentations and word processing documents. While the specifications were originally developed by Sun Microsystems, the standard was developed by the OASIS Open Document Format for Office Applications committee.

With Office 2007, Microsoft adopted the XML based data representation and is currently using a customized version of ODF (Office Open XML, also informally known as "OOXML" or "OpenXML") in their docx, pptx and xlsx formats. OOXML was originally developed by Microsoft for representing spreadsheets, charts, presentations and word processing documents. The Office Open XML specification has been standardised both by Ecma and, in a later edition, by ISO and IEC as an International Standard.