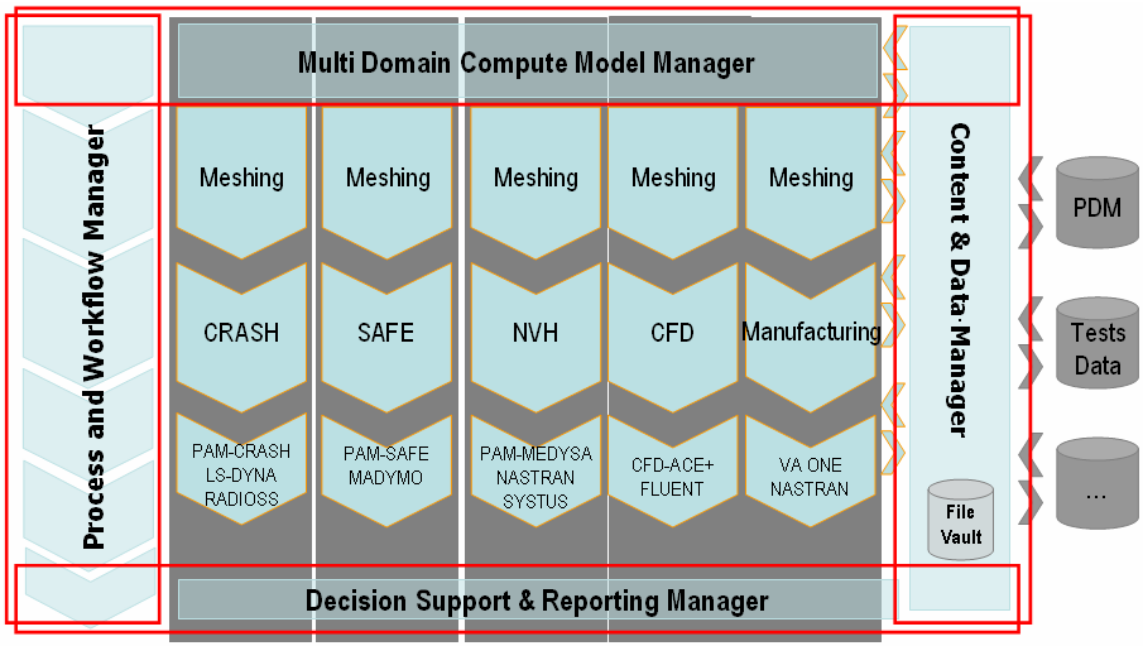
Visual*DSS* and Simulation Process Automation: ESI Group Scores with a Service Business

Michel Vrinat, PLM Research Director; Don Brown, Chairman, CPDA • August 25, 2008

Summary

The Visual Decision Support System (Visual*DSS*) from the ESI Group enables companies to build and manage simulation models for multiple domains, to automate processes and workflows, to manage simulation content and data, and to support knowledge-based decisions and automated reporting. The environment captures and automatically executes simulation processes for repetitive tasks. Templates are defined using the Python scripting language, and the task execution sequences can be described through a visual interface. The library of templates can be searched using filters and defined criteria for re-use in new projects. CAE experts define the templates and the execution sequence, so that mechanical engineers can apply the defined best practices to their everyday work.



Courtesy of the ESI Group

Discussions with four clients of the ESI Group that rely on Visual*DSS* for process management and optimization confirmed several major payoffs. International Automotive Components, North America (IACNA) would not have been able to fully simulate twenty-five head positions for crash analysis without the tool that automatically does the positioning and completes the results in one run. The time involved cut three weeks of effort to one week. NISSAN Technical Center, NA (NTCNA) now completes simulations of FMVSS 210 seatbelt analysis in half a day whereas previously it took several days for setup. NTCNA also attests to a major improvement in repeatability and reproducibility of this complex process. For Visteon, the biggest payback derived from the standardization of the process for simulating head impact on the instrument panel. Variations endemic to the

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manual process disappeared with the automation. Finally, a U.S. automotive OEM reports a savings of roughly 50% in the time required to complete side impact crash analysis. All four relied on ESI to code the solution, and three of the four relied on ESI to update the solution as the processes evolved.

Addressing Process Complexity with Visual*DSS*

Directly impacted by the increase in product complexity, the design process becomes more complicated as well, requiring the systematic use of simulation at each phase from conceptual design through detail design, and manufacturing engineering. The trend leads to ever more intricate simulation processes. Multiple steps must be executed, involving multiple solvers following elaborate and precise sequences for the tasks. A challenge arises concerning the requirements for software tools to facilitate the engineers' work and improve efficiency with the simulation processes.

Best known for its PAM-CRASH and PAM-STAMP products, the ESI Group recently introduced its Visual*DSS* framework to facilitate knowledge capture and process automation. As a software supplier for the simulation of prototypes and manufacturing process engineering, ESI's suite of industry-oriented applications simulates a product's behavior during testing. The approach fine tunes the manufacturing processes while optimizing the desired product performance, and evaluates the impact of the surrounding environment on product usage.

CPDA interviewed four of ESI's customers to evaluate the technology and better understand its applicability and added value. These customers clearly value the process automation. Perceiving themselves as simulation analysts rather than software developers, they contracted with ESI for the coding of the tools. Indeed, ESI has developed a service business to address these customers' needs.

The service business of capturing simulation processes and delivering ready-to-use tools for end users represents a business opportunity for CAE vendors. Users will have to clearly define their needs and requirements in a concise manner, and establish a consensus for a standard process across the company. However, this may be easier for a small company or small workgroups in larger companies to achieve than for large firms targeting tools to serve the worldwide extended enterprise.

Many medium-sized companies and analyst workgroups in large companies are not interested in investing the time and resources to code their processes using workflow tools, templates, or scripts if the exercise appears too complicated, whether it be at the beginning of a project to define the initial process, or later when adjusting and optimizing the process for changes or extension in scope. Medium-sized companies and analyst workgroups

generally classify themselves as simulation experts rather than software developers; and may favor outside development services for software coding.

Large organizations supporting software development internally may prefer to maintain ownership of the process within the company and to control its evolution. Nonetheless, the IT support groups within these large organizations do face a challenge in fully understanding the varying technical requirements for simulation that ranges across multiple and distinct disciplines such as NVH, CFD, and crash. Moreover, the simulation groups within those large organizations may prefer to contract outside development services either because of perceived higher quality or because of scheduling issues in regards to completing the development on a timely basis. For example, crash groups in a major U.S. OEM and at Nissan U.S. contracted with ESI, as highlighted below.

A graphical environment is available for the purpose of developing templates, and customers may create their own templates internally. Visual*SDK* (Visual Software Development Kit), allows analysts as users to drag and drop macros from a database into a template. "Super-users" with software skills may create their own new macros to add to the database using a scripting language. ESI's own engineers use Visual*SDK* when contracted to implement new templates for customers.

In general, these ESI customers are interested in increasing synergies by sharing best practices within and across workgroups and through efficiency gains from pure automation. Foremost to the development process, the challenge often starts with the need to reach agreement on the definition of the process between the domain experts and the major users. This step is necessary to produce a sustainable method and typically requires a significant investment in time. After an approach has been agreed upon, clients will then engage ESI's technical resources for development.

The ESI solution targets different levels of process automation, very much like other tools on the market.

- The first level concentrates on the sequence of execution of simple simulation tasks such as the collection of input files, formatting the files for a solver, running the solver, collecting output files, and producing a report according to a standard template. This level of process automation is not difficult to define for the user and should be very simple to implement and automate with simulation tools.
- The second level follows a precise method to achieve the verification of product performance according to specific rules derived from regulations or from a company's definition of best practices. This verification may require the use of multiple solvers and the creation of multiple models. Here, the process may be a little trickier to define. It may also become harder to achieve consensus across the company. The coding, including the integration of multiple solvers, will also

involve more technical sophistication and IT skills. Many medium-sized companies and analyst workgroups in larger companies may prefer to contract for these services externally. To a degree, the external sourcing may better serve the internal CAE experts, who may represent a precious resource that should not be used as software programmers.

- The third level involves the integration of the simulation processes with the overall development effort, including configuration and change management. Then the results of simulation may be applied early in the development effort to drive design. Catching design updates and changes early produces major savings in comparison to changes instituted late in the process. At this level, workflow development capabilities are definitely required. A full understanding of the scope of PLM is very much needed. Again, today many simulation groups do not have the resources or capabilities to address these needs.

Testing for Head Impact on the Dashboard at IAC

IAC (International Automotive Components) is a $5.3 billion global interiors supplier that comprises the former operations of Lear's Interior Systems Division and Collins & Aikman's Flooring & Acoustics group. As a user of Visual*DSS*, IAC was investigating an approach to automate interior design while following regulatory requirements and meeting customer needs. Head impact compliance represented a particular priority.

Time savings "can be tremendous;" from three weeks the effort has been cut to one week. The FEA engineer completes higher quality work with greater consistency, without going through a time-consuming process. IAC has five FEA experts in total working in the area, and these resources are critical.

IAC worked in close cooperation with ESI to develop a specific application. Capturing the process was not the issue. Rather, the value of having ESI develop the solution derived from the full integration of all the wrappers needed for the simulation codes involved, such as LS-DYNA.

IAC receives specifications from an OEM, based on federal requirements. Engineers then must translate the specifications into interior design requirements, which are contained in a PDF document that is sometimes used directly as a customer contract. Monthly meetings are organized to discuss enhancements. With the ESI Group, they were able to define the inputs and outputs required to execute the sequence of codes with the appropriate parameters and data, according to the requirements. While the core of the application has been developed by ESI, the enhancements to the user interface have been developed and applied directly by IAC, which relied on Python scripting to code the dialog boxes and format changes.

The execution process is fully automated beginning with the input of CAD data from CATIA V5 or NX, and extending through the requirements for analysis. Head positioning must be defined to create the necessary input for the dynamic solver (LS-DYNA) to produce a standard report as PowerPoint or Word documents. Multiple solvers are involved – not all from ESI – which are all integrated in the process, as defined and coded by ESI.

For process optimization, Finite Element expertise is still required to control the inputs and the results. The benefits of using ESI's Visual*DSS* derive from the dramatic reduction in engineering hours involved. It would be impossible to do as much simulation as required without the tool. In just one run, the software tool studies twenty-five different head impact positions on the dashboard. Moreover, standardized results are obtained, without variations caused by human error.

Since January of 2008, the software tool has been used in two different instrument panel programs. It will be extended to all instrument panel impact programs, encompassing a total of ten projects per year.

The process includes parameters to adapt to the regulations that may be involved for individual countries. It can adapt to any new regulations in terms of changing the input values, but not the process. The existing code cannot be applied to other vehicle parts, but only those involved with the instrument panel, pillar, or other specific interior parts.

Seatbelt Anchorage Analysis at NTCNA

Nissan Technical Center, NA (NTCNA) has developed process automation for FMVSS 210 Seatbelt analysis. The main purpose of this development is to ensure the repeatability and reproducibility of this complex process, and to optimize the labor-intensive process to save lead time. The main functions in the process include body block positioning with seat morphing, seatbelt creation and routing, loading cable creation and report generation. NTCNA expects a substantial improvement in efficiency with major savings in time.

NTCNA also has conducted the evaluation for simulation data management under the Visual*DSS* environment with the developed automation tools. The immediate interest was to create a master body-in-white model from an existing full vehicle model, and to update design changes to different disciplines covering areas such as Roof Crush, Seatbelt Anchorage, and Side Impact. Each required technical function was validated successfully with the approach. The stability, however, remains an issue in running such large scale models on servers with only moderate performance.

Standardizing Head Impact Simulation at Visteon

The experience at Visteon in the group working on Interior Product Development with ESI and Visual*DSS* parallels both of the other two users participating in the discussions. In the upfront analysis for safety and structural integrity, Visteon relies on many CAE tools to reduce overall cost such as LS-DYNA, MSC Nastran, and PAM-CRASH. ESI provides tools for safety and structures, with particular capability in addressing head impact on the instrument panel. Visteon needed to reduce error levels and variations in the results for analysis by automating the process. The solution was to build templates within Visual*DSS* that ensure that the engineers do not take steps in the simulation out of order. The approach reduced errors, as confirmed by tests with several engineers completing the same analysis manually and then using templates. The variations in the manual process disappeared with the automation.

The flow chart of the existing process was given to ESI to code in Visual*DSS*. Formal SAE process steps were used to develop the flow chart. The description was also provided in Word and PowerPoint files. Only one project had been completed at the time of review, and it took a few months to finalize. The process defines an input deck for a solver, runs the simulations, and then reads the result back and generates the report in PDF format. If a modification in the design is made, the whole report has to be regenerated. The same process is used for all cars or trucks.

Modifications to the process are communicated back to ESI to implement with the templates. Visteon considers this to be a satisfactory approach.

Simulation Data Management is all manually done by the engineers in folders on their desktops. Visteon has reviewed the simulation framework offerings from three vendors that support data management, including ESI. The choice had not yet been made at the time of discussions because the solution chosen would have to be supported world wide, and the process to be applied worldwide had not been formalized.

Major Automotive OEM

A major U.S. OEM also relies on ESI to code a solution as well as supporting updates for optimizing crash runs with LS-DYNA. Side impact analysis requires the precise positioning of a dummy and the seat to meet regulatory requirements, involving significant time requirements. An estimated 50% of the time to assemble the model is now saved with the tools provided and supported by ESI. Indeed, without the level of automation provided by ESI's tools, it would not be possible to study all the alternatives in the given time frame. Overall, the OEM reports a savings of roughly 50% in the time needed to complete side impact crash analysis. While the approach is currently applied to one platform, it could apply to all platforms a year from now.