Design to Cost

Dr Hans Sippel from CAEvolution in Germany and Dr Mike Sheh from Engineous Software, discuss functional requirements and cost trade-offs using parameterized vehicle concepts in the early design phase.

Affordability is one of the key issues for design engineers and manufacturers of new car body models. Today, many vehicle development projects failed to enter the production phase because cost was not factored into the early development phase and it was only realized later that the vehicle program could not meet the projected financial targets. Likewise, many vehicle projects that went into production with severe cost and manufacturing constraints and failed in the market place because of limited improvement in vehicle functionality or performance. Either case is due primarily to the lack of understanding of cost and performance relationship and engineering alternatives during the vehicle development cycle.

To stay competitive, it is becoming vital to include cost engineering at every stage of a new program to ensure success in achieving performance targets while managing cost. Cost engineering has been applied in recent years starting in the defence industries (Ref 1) and researched continuously by academia (Ref 2).

Understanding the impact of critical cost elements on design features is the first step in managing the overall cost of a new car body design. Cost estimates need to take into account changes in technologies such as choosing different powertrain configurations, new materials e.g. metals, composites, foams etc., as well as associated manufacturing processes, repair methods, and re-cycle methods, in the early design phases.

Several enabling technologies have been developed over the years such that it is now possible to bring cost engineering into the current simulation-based development process for vehicle body structure in the early concept stage. These include:

1) Reasonably accurate performance models based on finite element techniques
2) Capable cost estimating tools, both commercial (Ref 3, 4) or in-house developed tools.
3) Parametric concept development system (Ref 5) that allows for fast change of concept geometry and the associated computational models.
4) A process integration and computational framework that can flexibly integrate simulation models and cost models into a simulation-based design iteration loop to study cost-performance trade-off.(Ref 6)

As an example, Reference 7 shows a project of designing an Unmanned Aero Vehicle (UAV) while engineering performance targets and cost are studied together to achieve the most effective design.

Figure 1 shows a schematic workflow of such system that can be applied to automotive body design. The iSIGHT-FD system was used to integrate the parametric body architecture concept modelled using SFE Concept. Changing the architecture features will trigger changes in cost estimates of materials and manufacturing. This can be done either using an in-house EXCEL data sheet or commercial cost estimating tools (Figure 2).

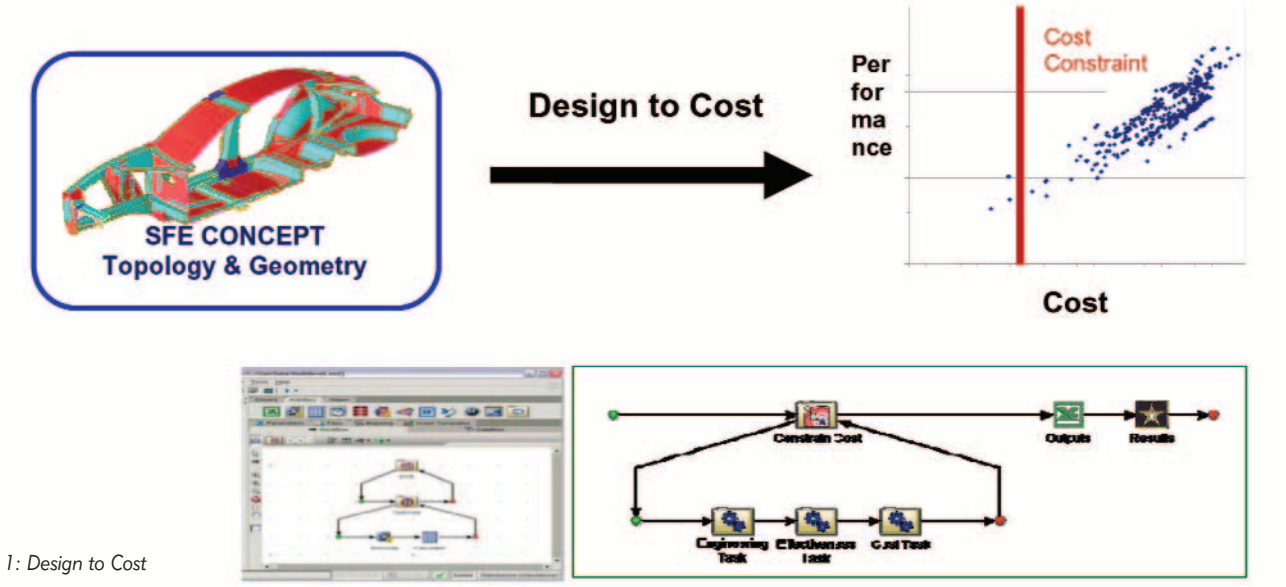

Figure 1: Design to Cost

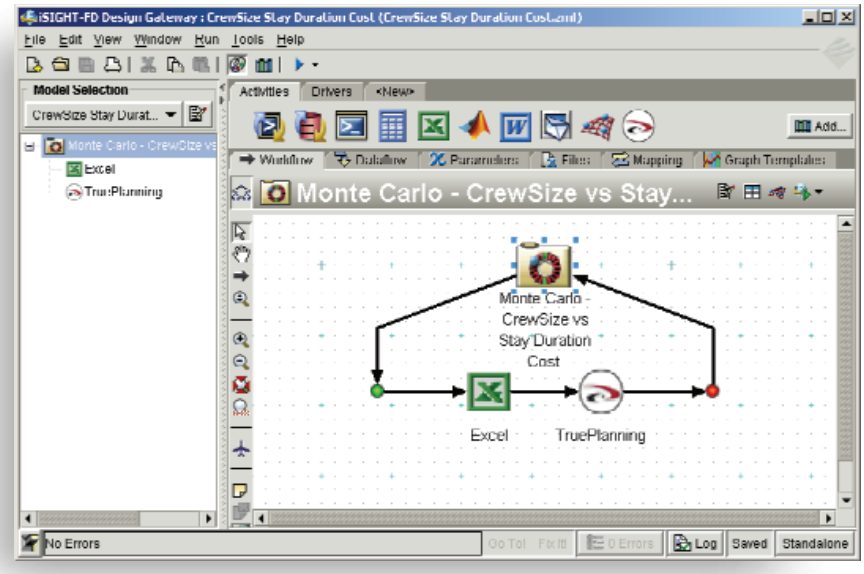

Figure 2: Creating a Workflow in iSIGHT-FD Under Consideration of Design to Cost

Similarly, other in-house computational tools can be integrated.

Design studies such as DOE, Optimization, and Monte Carlo simulation can then be used to explore decision factors. For example, what parameters have the most influence on responses? There are many ways to show such result. Figure 3 is an example of a correlation map.

The map is to graphically show the relationship (i.e. correlation) between design variables and responses.

In summary, cost should no longer be just the responsibility of manufacturing or purchasing. In order to have effective and realizable design concepts, cost models need to be integrated in the early simulation-based design iteration loop.

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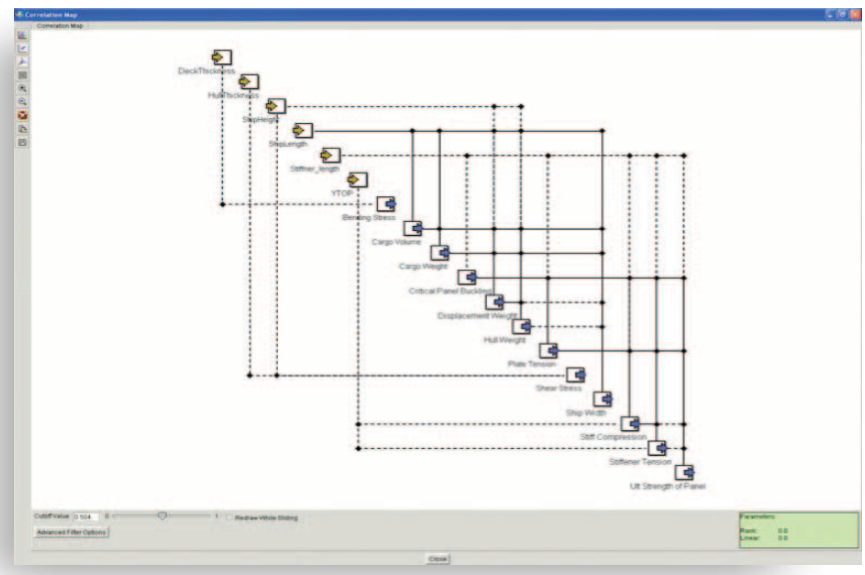

Figure 3: Correlation Map

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