

# NEW TOOLS ANSWER OLD ISSUES IN WIRING HARNESS DESIGN

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A U T O M O T I V E

W H I T E P A P E R

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## ABSTRACT

Building automotive wiring harnesses is a tough business; one in which only the strong survive. Harness makers must deliver products that are ever more complex. They also must offer steadily improving quality. And of course, a lower price tag! Standing still is not an option when competitors are clawing at one's market share.

To remain competitive and preserve margins, harness makers must continually innovate in all areas of their business. This article looks at some key design process issues facing automotive harness makers, and assesses the impact upon their businesses. We will see how some innovative software solutions are helping harness manufacturers solve some thorny technical problems.

## DESIGN FLOW ISSUES AND THEIR BUSINESS IMPACT

The high-level flow shown in Figure 1 describes the inputs into the harness design process, which is normally undertaken by the harness supplier. Four types of input data merge within a harness design software application:

- Wiring data, which originates from the vehicle electrical design;
- Physical harness information (branch geometry, coverings, clips etc), which originates from the mechanical design domain;
- Configuration data that describes option relationships and hence describes variable content within the harness;
- Component data derived from a library of approved components.

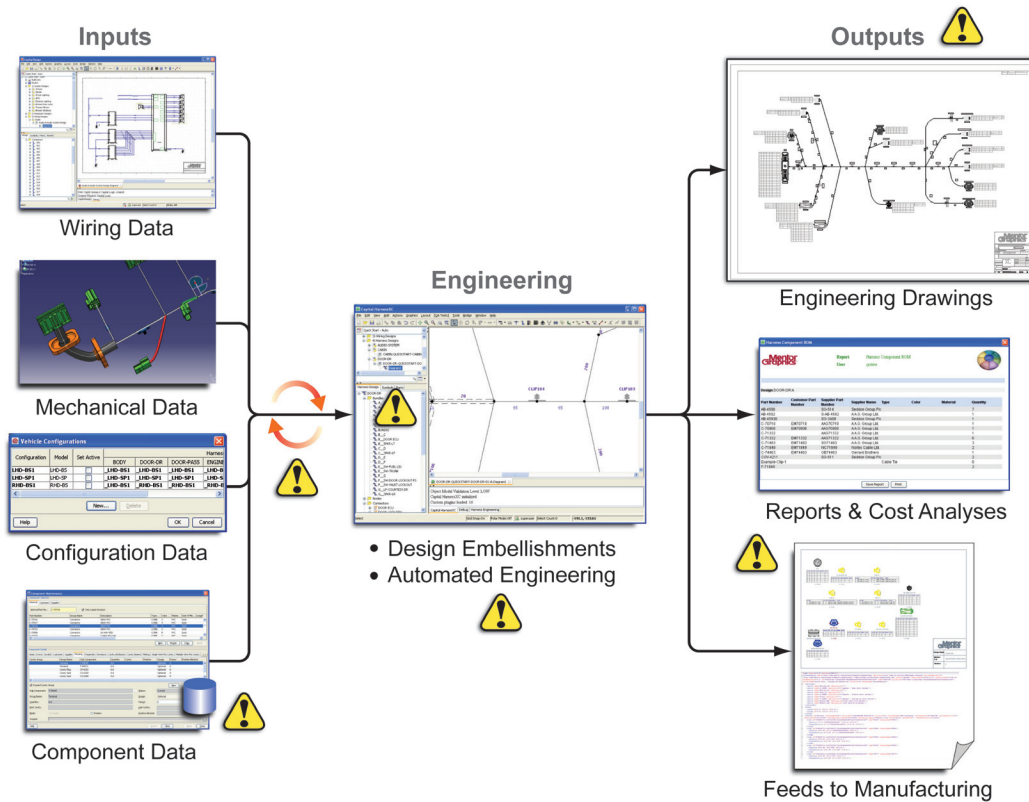


Figure 1

The design process brings these inputs together in digital form, and the design is then “enriched” and validated using a combination of manual and automated processes. Examples of design enrichment include selecting specific components and making adjustments to reduce the cost of manufacturing.

Once the design is complete a range of outputs can be generated based on this digital prototype. These include harness prints, cost analyses and data feeds to downstream processes such as ERP systems. With some pragmatic scrutiny, certain “pain point” (potential areas of process improvement) are easily identified. Let’s take a look at a few of these key issues—identified in the graphic by the warning symbol—and review each in turn.

### **WHEN DESIGN DOMAINS DON’T SPEAK THE SAME LANGUAGE**

The richness and quality of data that harness suppliers receive varies from customer to customer and project to project. Often the merging of wiring data and mechanical data is especially problematic. Design objects may be named or represented differently between these two domains, or objects in one tool not represented at all in the other. This causes synchronization issues that force harness suppliers to manually re-enter the correct data. Failure to reuse available information is highly process-inefficient; complex design entry is laborious and time-consuming, and it adds the risk of error as well.

### **EVERYTHING CHANGES BUT CHANGE ITSELF**

A related task when combining design data is the addition of design changes. This of course needs to be done efficiently and robustly. It is commonly accepted that authoring the initial harness design represents only about 20% of the effort over the design life cycle. The remaining 80% is consumed by implementing design changes... which are often both late and urgent! Poor management of design changes causes unnecessary costs and introduces significant quality risks.

### **OLDER AUTOMATION SCHEMES MAY HAVE HIDDEN COMPLICATIONS**

Many companies rely on in-house tools to help automate the harness engineering process. The cost of developing and maintaining these tools is high, and in any case is not normally a core business competency. Many such tools are based on old software technology and may require porting to modern platforms or worse, complete redevelopment. Consequently, wire harness suppliers are increasingly turning to commercially-available off-the-shelf (COTS) design tools sourced from dedicated software vendors.

Unfortunately some of these COTS solutions lack important functionality such as composite/modular design or the ability to fully detail the harness in preparation for manufacture. Some even lack the appropriate graphical output formats. Fine-tuning COTS offerings to meet specific needs can mean customization. And that is expensive!

### **UNDERESTIMATED PROJECTS ADD UP TO OVERESTIMATED PROFITS**

Harness manufacturing is a relatively low-margin business. It’s essential that harness suppliers fully understand the cost of their harness designs in terms of both material cost and labor time. Costing errors in commercial quotes can diminish profit margins or even turn them into losses. Despite this commercial impact, harness suppliers’ costing procedures are sometimes too simplistic, too reliant on manual intervention, or too slow to be competitive.

### **COMPONENT LIBRARIES JUGGLE MANY VARIABLES**

Effective management of component data is critical. Harness suppliers need to manage multiple “component profiles” as component usage and the number of approved configurations varies among their end customers and even from project to project.

Many component library systems are unable to manage these subtleties and harness makers are forced to create multiple customer- or project-specific libraries. Here again they can run into synchronization issues and they also

risk duplicating efforts across multiple libraries. Worse, the harness suppliers can lose sight of which components are being used in quantity and thereby miss an opportunity to fully leverage their purchasing power.

### IMPERFECT INTEGRATION

Tight integration with enterprise systems such as PDM, MRP/ERP and production equipment allow organizations to make maximum reuse of the harness design data. Eliminating manual 'swivel-chair' data re-entry makes for an efficient, low-risk process. But surprisingly the reality is that data feeds sent to downstream applications—like the earlier data inputs into the flow—are often accomplished manually, using only the 'dumb' harness drawing as the input!

Moreover, the completed harness design sometimes must cross organizational boundaries, for example as a return data feed to the OEM customer or to subcontract manufacturers. In this day and age there is no excuse for being unable to transfer data electronically for reuse in other systems.

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## COMMON TOOLS AND PROCESSES POINT TOWARD A SOLUTION

One valuable improvement a harness manufacturer can make is to adopt common tools and processes across the entire business. This is the path to efficient resource usage. As demand fluctuates across the serviced OEM customer base, engineers can switch from one business unit to another, using the same tools with minimal retraining or none.

Tool and process unification is remarkably difficult at the boundary between the supplier and the OEM customer. Failure to standardize on uniform tools can lead to less lean, less flexible organizations with additional cost overhead. In the absence of industry-wide standards, OEMs have developed their own specific drawing and data formats, and may even impose the use of particular software tools. Some initiatives, such as the KBL format now common in Germany, are making progress but much more work is required in this area.

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## A NEW GENERATION OF COTS HARNESS DESIGN TOOLS EMERGES

COTS harness design tools have been available for several years, and typically have been designed around a key sponsor-customer flow. Normally stable, mature products, they perform well within their dedicated flow. However, when attempting to deploy these tools more widely, perhaps as part of a common "tools and processes initiative," they lack flexibility. Implementing new requirements often leads to expensive customizations or costly add-on modules that can over-complicate the software.

Recognizing this, harness suppliers are today adopting various 3rd-party software solutions in an effort to become leaner and to focus on core competencies. Now a new generation is of tools from these suppliers is coming to market.

This emerging generation of harness design applications brings a different approach to solving the problems summarized above. These tools have been designed from the start to be flexible. They provide powerful standard functionality coupled with the ability to adjust the tool's automated behavior, reports and graphical outputs.

### SMARTER GRAPHICAL OUTPUTS

No industry standard exists for harness drawings so harness suppliers must support multiple graphical formats if they serve more than one OEM customer. Choosing a single harness design tool is a particular challenge when this is the case.

The arriving generation of harness design tools provides a solution in that it allows users to configure all aspects of the graphical output. This graphical configurability covers more than just the simple tasks, like controlling fonts and line-styles or automatically placing data tables. The latest applications provide much more sophisticated graphical styling technology. Some include query engines that can be used to enable the information displayed on the drawing dynamically change in step with the underlying design data. For example, flag notes can be automatically displayed where a connector is required to use gold plated terminals.

### WEB-SAVVY DATA FORMATS

To support multiple report formats, new-generation tools typically make use of XML to communicate design content. In more advanced cases both the data for the harness itself and its graphical image are conveyed via XML. The advantage of using XML is that it is designed specifically to enable different applications connected via the Internet to talk to each other. It is a self-documenting format that is easy to understand and easy to transform (at low cost) into any format a target system may require.

### “TUNABLE” APPLICATIONS

The most modern design applications allow the processing behavior of the application to be tuned using rules. These rules may be configured to enforce particular end-customer constraints or apply the know-how of the supplying organization. For example, the rules might specify a reliability constraint such as prohibiting splices containing more than six wires. Similarly, they may support a safety constraint such as requiring all signals in safety-critical systems to pass through wires fitted with gold plated terminals. The rules can equally well apply a manufacturability constraint such as forbidding taping between bundle breakouts less than 100 mm apart.

This rule capability is often extended via an extensible design-rule checking function. Companies can build their own checks, essentially capturing their “intellectual property” describing their particular harness fabrication methods. This ensures that identified failure modes are designed out automatically from the beginning in new designs, thereby increasing overall product quality and reducing exposure to warranty claims.

### REUSABLE DATA

Being able to reuse design data automatically and extensively is a key objective that provides measurable process efficiency and quality benefits. In addition to using XML, new-generation applications leverage web technologies such as service-oriented integration architecture (SOA) to simplify integration with the corporate IT ecosystem (PDM, MRP etc). The pluggable nature of SOA means that once the protocols are established, new integrations can be implemented quickly and maintained with minimal expense.

### CONFIGURABLE CHANGE

Effective management of design changes in the flow remains a major challenge. Design changes occur very frequently, and harness suppliers want to quickly understand and validate incoming changes, and apply them efficiently and robustly. The process needs to be simple, but at the same time should reconcile the potentially conflicting data originating from the several input sources. Just as important, value-added design enrichment at the harness level must not be over-written by new incoming data. Earlier harness design applications simply can't effectively address these requirements, forcing suppliers into manual or semi-manual design change processes.

The latest harness design tools provide sophisticated change management capabilities that were once only a dream. They enable organizations to configure the way the application should respond to design changes derived from diverse import sources. These design change policies vary by OEM customer and/or project, and can be very detailed in nature. For example, it is possible to declare that the incoming wiring data is master of wire gauge, that the incoming mechanical data is master of branch length, and that the harness design tool is master of wire color and manufacturing wire length adjustments.

Innovative reporting features enable users to understand easily the nature of each change and protect unchanged data. Incoming design modifications can be effectively merged with the value-added harness engineering work from the preceding harness design revision without risk of data loss.

## SUMMARY

Over the past 10 years the wire harness industry has witnessed a transition from in-house design tools to solutions provided by specialist software vendors. This shift has provided important cost savings and at the same time enabled important new capabilities in areas such as modular harness design and detailed costing. Even so, there is room for further advancement. Some important flow issues still await resolution.

Software vendors are responding to this challenge with an all-new generation of harness design tools. These inherently flexible tools offer powerful new capabilities in areas such as drawing styling and change management, and use modern web-based technologies to change the economics of data integration. Successful adoption of next-generation tools will enable harness makers to achieve higher levels of performance and keep their competitors at bay.

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