

Streamlining the Integration of Electrical and Mechanical Design Data and Processes between OEMs and Suppliers

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ABSTRACT

For some years, OEMs and suppliers have been using CAD tools to improve efficiencies in both mechanical design and electrical design. Modern CAD tools have evolved from simple drafting and documentation towards specialized tools for each task – mechanical layout, mechanical styling, electrical design, manufacturing design, and so on. There is often a significant overlap between the data-scope of each of these tools, but, without good integration facilities, engineers must re-key the same information in each of the different tools: this is both time-consuming and error-prone.

This paper examines, and illustrates, the issues, technologies and processes that are available to improve the integration between mechanical and electrical CAD tools, and between OEMs and their suppliers.

INTRODUCTION

Competitive market pressures are forcing OEMs towards ever-shorter product development time-frames. The drive for efficiency has seen new technologies being introduced, and, with each new improvement, the focus has moved to a fresh bottleneck. Modern CAD tools have evolved from simple drafting and documentation towards specialized tools for each task – mechanical layout, mechanical styling, electrical design, manufacturing design, and so on. The drive towards better productivity within the context of a particular design step has improved efficiencies, but in some cases it has exposed further problems relating to integration of the tools in the design flow.

Figure 1 illustrates a typical electrical design flow beginning with electrical wiring design, through to the harness engineering stage, with the creation of harness schematics drawings and their corresponding physical formboard layouts. In an ideal world data will flow effortlessly between each step in the process, but there are many obstacles to this ideal process, caused by several factors:

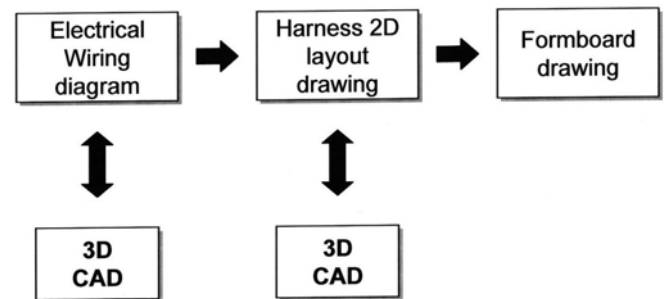


Figure 1 – Typical electrical design flow

ABSENCE OF AN INTEGRATED DATA FLOW

The creation of specialized tools to support individual steps in the design process has not always been matched with a corresponding capability for the tool to work with other tools in the process. Many tools have been designed to satisfy a narrow view of the traditional electrical design process. For example, in the 1980s, the output from the electrical wiring process was a physical diagram and many modern tools continue to focus on the diagram as the output without recognition that upstream and downstream attribute relationships and dependencies should be maintained – the expectation with these tools is that, once the drawing is completed, it can be “thrown over the wall” to the next design group in the process.

ABSENCE OF A COMMON PARTS LIBRARY

The tools used at each step of the design process will refer to the same parts but will have differing ‘world-views’ of the part definitions – a connector in a 3D CAD model is unlikely to contain cost information; a connector in a costing system is unlikely to have links to a corresponding CAD model. As a consequence, it is not uncommon to find each tool in the design flow defining and maintaining its own description of a particular part independent of any other tools. Each designer believes he is working at optimum efficiency – because irrelevant data relating to other steps in the process does not need to be captured or defined – yet at the end of the day, there are huge inefficiencies because many of the tools

are sharing overlapping information about the same components and the same data is being defined in several places. Worse still, individual designers may mis-type critical data causing further problems during transfer of data from one tool to the next. Engineering design changes cause further problems as a change must be implemented at each step, when, in a better integrated process, the change could be entered just once in the common parts library and it would automatically propagate to each of the design steps.

INCOMPATIBLE TOOLS AND DATA FORMATS

Tool incompatibility can exist both within organizations and between organizations. Incompatibility within organizations can occur when design processes are implemented as a sequence of discrete steps, each with its specialized design tool, and input and output artifacts. Frequently these steps are highly optimized and appear perfect when viewed from within the individual groups – yet the inefficiencies and costs can be hidden by rigid organizational boundaries resulting in an incomplete appreciation of the degree of duplication occurring at each step.

Tool incompatibility between organizations is even more common, yet for many companies, the duplication of effort is seen as natural and normal, and is perceived as having little impact on cost or timing. It is not uncommon for suppliers to receive a customer drawing and redraw it in their own system because the scope and content of the customer drawing is incompatible, incomplete, or incorrect.

STREAMLINING THE PROCESS

Figure 2 illustrates a software architecture that addresses many of the issues of process and data integration for both manufacturers and their suppliers.

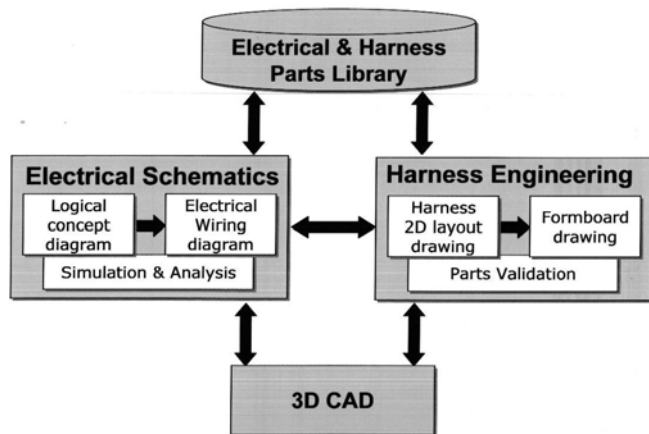


Figure 2 – Tool integration in a streamlined design flow

A key element in this architecture is the support of streamlined “data-flows” between tools rather than the “disconnected” approach frequently found with the process described earlier (Reference 1).

Streamlined design processes address several key issues in the traditional electrical design process:

- Shared part libraries
- Transparent data flows between wiring and harness without the need for re-entry of data
- The ability for electrical designers to transparently access 3D CAD data
- The ability for electrical designers to access downstream manufacturing part selection and validation tools to ensure that the design is correct and manufacturable before it is released to the manufacturing organization

With the streamlined data-flow approach, part definitions and design artifacts, such as drawings, are managed at each stage in the process to include both their basic engineering attributes such as part-number, cost and weight, and other attributes relating to their role in the design process, such as release-levels – draft, production, released, frozen, obsolete, etc. These attributes are propagated across tools to ensure that changes are implemented efficiently and correctly, without requiring individual designers to make the same change in several tools.

Streamlined data-flows also make use of common part definitions and data structures - this allows the software to operate with a higher level of automated “reasoning” on each of the design entities. The common definitions can contain information about the relationships between parts and their individual roles at each step in the design process. For example, a harness connector is a complex assembly of terminals, and related parts, and each of these sub-parts has a complex relationship with the wires that terminate inside each of the connector’s cavities. A simple change to a wire can initiate a cascade of changes to other parts within a connector, potentially changing the specification and part-number of the “parent” connector itself.

Streamlined data-flow tools model these relationships, almost unseen by the designer, ensuring that the connector definition is both correct, and correctly implemented at all steps in the process. This is a significant improvement compared with disconnected tool architectures, where the dependencies and relationships between parts may only be recognized at a late stage in the prototype manufacturing stage, prompting costly rework.