tion time, designers were frustrated at having to wait several seconds for response from the graphics terminal. Having to wait on an outside agent made them feel as if they were wasting their time and weren’t actively doing something. Therefore, many people preferred to use the slower technique—manual typing—in which they controlled the pace, instead of the ultimately faster technique that caused them to wait on something beyond their control.

Rather than criticizing such aspects of human behavior, tool designers should take them into account when specifying systems. For example, in the future, Western Digital will rely on networked engineering workstations for schematic capture. Schematic systems hosted by personal computers are now available, some with a performance superior to that of systems hosted by central computers, at a much lower cost.

Disadvantages

Of course, the vendor-oriented approach is not without flaws. Since vendors must target their tools to many potential customers, their tendency is to make the tools as general-purpose as possible. Commercial tools are typically not tailored to a customer’s specific product line, process line, or—perhaps most important—the design methodology and company “culture” of the users. Such tailoring is the responsibility of the CAD group, but it is often not possible to successfully adapt a general tool to a company’s way of doing things. Poorly tailored tools may be harder to learn and may be perceived as being less natural and less coherent. The costs are inefficient use of time and greater user frustration.

Another disadvantage to a vendor-oriented system is that techniques and tools too new to be a part of vendor offerings (artificial intelligence, for example) are not available. Competitors who do their own development have an opportunity to experiment with such tools and techniques, and—when successful—to apply them to design projects.

Although some disadvantages have been noted, the VLSI CAD system described here is regularly and successfully applied to the design of Western Digital’s handcrafted components. The success of this system demonstrates that a small to medium-sized company can integrate a collection of diverse, vendor-supplied tools to provide effective CAD functionality to VLSI designers.

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