COST REDUCTION THROUGH ELECTRICAL CAE

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Abstract – Whether they compete at a regional, national or global level, today's manufacturers and automation suppliers are faced with the same challenge – They must be faster, cheaper and better or they will quickly be out of the race. They must look for ways to increase productivity through high value-added products to meet their customers' specific requirements. In the electrical engineering field, one way to achieve automation is through a computer-aided-engineering (CAE) software solution developed precisely for generating wiring diagrams. Benefits of advanced controls hardware design and documentation software are clear. They increase efficiency to yield a fast ROI; significantly reduce or eliminate costly rework by enhancing quality; provide corporate wide uniformity through standardization; offer high degree of flexibility to meet virtually any country, industry or customer specific requirement; have the ability to interface with other enterprise systems due to their open structure; go beyond just the design capability by generating important data for use in other functional areas such as purchasing, quoting and manufacturing. While some of these may not be new concepts, not all products in the marketplace are the same and care must be taken to ensure that the corporate and customer objectives will be met when choosing electrical CAE software.

I. INTRODUCTION

It wasn't that long ago that the design and automation industry had undergone a revolution. This was a bit of a technical revolution as the engineers, designers, and detailers started to take advantage of the introduction of personal computers to the workplace. Mechanical Engineers began to embrace Computer Aided Design (CAD) packages to represent the complex drawings for their products that they were designing. New CAD packages have provided Mechanical Engineers great power and flexibility in the representation of details associated to design. As Mechanical Engineers adopted these software packages, Electrical Engineers, designers and detailers were soon to follow - the beginning of the CAD revolution.

Electrical Engineers were drawing schematics on paper with lines and circles and needed the ability to leverage the work they had created. It was only a natural migration for the Electrical and Controls industry to adopt CAD. The majorities of the market turned to AutoCAD and a few other CAD systems and quickly adopted these systems to control and house libraries, references, and provide a mechanism to reduce cost. For over 2 decades this has been the overwhelming standard for the delivery of controls and electrical drawings.

The automation industry is now at the foothills of another paradigm shift, the CAE revolution.

II. WHAT IS CAE?

Computer Aided Engineering (CAE) is more than the drawing of lines and circles to represent a product or concept. CAE is using the power and convenience of design tools in a computer based environment. Electrical CAE is the best collection of tools to allow the designer to do his value added work real-time and online without having to draw and design on paper, hand to the CAD department,

have it returned, redline the prints, resubmit to CAD, and repeat until correct. E-CAE is the essential tool for Electrical or Controls Engineers or Designers to do their job faster and more accurate.

CAE solutions provide more than a schematic design environment, they should also provide the complete support for all of the necessary documentation such as Bill of Materials, Terminal Diagrams, Wire Lists and Tag Lists, just to name a few.

III.   THE REVOLUTION

The U.S. Automation Industry has seen the introduction of a handful of products to the market during the last 10 years that have been poised as leaders in the E-CAE world. Only now with the globalization and strong needs for cost reduction are companies beginning to see the value and necessity to join this revolution. EPLAN, for example, has been a preferred standard in Europe for over 20 years since the Europeans adopted the CAE philosophy as a way of doing business. This has provided them with the advantages for many years in the efficiencies of Electrical Design. The globalization of design and automation has made it critical for U.S. companies in particular to reduce cost and increase quality to stay competitive. It is no longer acceptable to avoid changes to our design processes and procedures.

In the U.S., this revolution has been a challenge for Engineers and Designers to embrace. To avoid making this revolution difficult, we must adopt the paradigm shift and see the value of E-CAE. The philosophy of E-CAE products in the workplace will change the way we do business. CAD departments and detailers were once a learning arena for upcoming engineers. The amount of detail and non-value added reports and deliverables have made it very difficult for CAD operators and detailers to learn the fundamentals of design. Instead they have been focusing on the drawing of schematics. If your company utilizes the concept of a drafting, detailing or CAD departments, they are likely to be retrained and more productive as value added providers. The outcome is not the elimination of people, but rather the retention and growth of them. Moving our design community to a more hands on environment while reducing errors and miscommunications in the process are just a few of the key intrinsic benefits of a true E-CAE product. No longer is it good enough to maintain the traditional practices of the old.

IV.   E-CAE DESIGN AND DOCUMENTATION

E-CAE is much more than a CAD package. E-CAE offers the ability to do design work on the PC while automatically creating the background data necessary to eliminate many mundane tasks. In today's environment of high expectations, the details are where the majority of time is spent and errors are made. For example, we see tremendous time wasted in the assignment of part numbers. E-CAE solutions provide the designer with the ease of assigning part numbers directly to a symbol in the schematics. Once assigned, the part number stays associated to that symbol throughout the schematics.

Another example is the assignment of device tags and wire numbers.   Historically a time consuming and error prone task, device tags and wire numbers can now be generated automatically and updated seamlessly when devices are moved or changed within the schematics. E-CAE products boast such

simple improvements to productivity as automatic line break when a symbol is inserted and automatic line connection when it is removed. Similarly, cross-referencing has also been a difficult and time-consuming task that was highly prone to errors. Designers would often move a component and inadvertently forget to update the cross-reference(s).

Another common problem is the tracking of contacts used on a contactor. How often has a set of schematics been sent to the panel shop for build, only to find out that the wrong relay was ordered and you cannot get the correct part for 3 weeks? This is not only frustrating, but also time consuming and potentially detrimental to a project timeline. E-CAE can track the use of your contact assignments against their appropriate contactors. You even have the ability to ensure that you do not assign additional contacts to a contactor that does not have the appropriate contacts available.

Have you ever had a set of schematics sent to the panel shop for build, only to find out that the designer accidentally missed a component on the Bill of Materials? This creates another delay in the panel build, negative implications on overall project timing, expediting fees, and a general scramble in the purchasing department. E-CAE has the solution for you to ensure that all components are placed in the appropriate panel, eliminating the last minute scramble and runaround for the missing component. Bill of Materials management can take significant time and frustration that is unnecessary with the use of today's automation tools.

Creating terminal charts can take a significant amount of time. Many companies have left the documentation go incomplete until the panel shop completes the wiring and documents that information backwards into the design. Most of the time these modifications are not documented back into the schematics and the equipment is delivered with incomplete documentation. This makes troubleshooting and maintenance a nightmare once the equipment is in production. E-CAE can provide you with automated terminal charts specific to the designer's requirements without adding painful hours of mundane work.

V. STANDARDIZATION

We have all felt the need and pressure to standardize. Standardization is one of the keys to successful cost reduction. Reduction of cost through standardization is realized on many different levels. Cost control through the simple ability to leverage your purchasing strength with common suppliers and systems is a key benefit. Standardizing on controls architectures, component suppliers, drawing practices, naming conventions, and countless details will provide your company with the strength in negotiations. When this type of exercise is complete, the ability to reduce downtime, train your startup and maintenance staff concisely and achieve better productivity will be reached.

The effort to standardize is difficult enough. The application question becomes how do I document and live to this new environment? The answer is E-CAE. In the development of standards, libraries, macros, drawing specifications, BOM management, and symbols are created. These vital components need to be managed and controlled in your corporate and supplier communities. E-CAE provides not

only the mechanism to store these documents, but a means to assemble them quickly and automatically in the development of specific schematics for your equipment.

VI. INTEGRATION

Your E-CAE solution should be just that - a solution, an integrated solution to resolve the inconsistencies in quoting, design, purchasing, manufacturing, and maintenance. The right product will provide the full integration into your corporate and supplier environments. Every time an individual's finger hits the keyboard, there is a margin for additional error to be introduced into the design and build cycle. To get the most out of your E-CAE investment you should take advantage of the integration capabilities into the corporate processes. The schematics produced today are laden with valuable and necessary information for purchasing, manufacturing, and maintenance personnel. Why should you recreate this information that the engineering department worked so hard to perfect? The answer is – you shouldn't. Within a database environment that runs as the core to your E-CAE package, there is the ability to import and export vast amounts of data. Choosing a product that gives you the capabilities to leverage the information you already have and take advantage of the information you will assemble in the creation of schematics is key to maximizing your return on investment. You should fully consider how to leverage the E-CAE system to provide data to the purchasing department for the procurement of material. With complex part numbers that are not easy to remember, not to mention type in, an integrated solution to purchasing is critical. There is no longer a need to hand off a printed BOM to the purchasing department for them to type into the purchasing system. There is a redundancy here that wastes time and introduces the risk of mistyping a component part number.

Have you ever considered the time that is wasted in the handoff of schematics from engineering to manufacturing? The time spent for an electrician to create a point-to-point wiring list for the assembly of a panel could take 8 hours or more. Why not leverage the work that was already done and extract that information from the schematics. This provides the panel builders a detailed list of what the designer intended when designing the prints. I have seen during the buyoff of panels, on a number of occasions, the distribution of power run from a distribution block to a fuse block then daisy chained to the next fuse block and so on, creating a fuse out of the wire. Obviously, the correct way would have been to run individual wires from the distribution block to the fuse blocks separately. The deliverable from your schematics can pinpoint the designer's intentions and save time in the costly rework.

Manufacturing of panels and equipment expends a lot of hours in the labeling and tagging of components and equipment. This is one more example of the integration of an E-CAE solution that should be exploited. Information for those tags that are created already exists in the schematics. The designer has already done the work to provide device tags, wire numbers, component naming, engraving text, etc. This information can be exported to a format compatible with today's tagging systems and reduce not only the redundancy but also the tendency for error in recreating and retyping it. Likewise, part numbers and details can be exported for use by the maintenance department.

For your E-CAE package to be a solution and not just a replacement for the CAD system you are utilizing today, the integration into these types of systems is critical. You will certainly see benefits within the design environment, but making your E-CAE investment a total revolution will require the need to set aside the old thinking, get outside the box, and integrate.

VII. CHALLENGES

The challenge associated with the integration of E-CAE within your organization is simple – People. People are the only asset that you have in the design, manufacturing, and maintenance of equipment. While I worked at General Motors I sat on a number of different specification development teams. The common thread to the hindrances we had in agreeing on solutions for communization was people's tendency to do things the way we always have…. just because. I would often challenge an individual's position or stance on any given topic. If there is a good reason not to accept a change, then let's hear it and confront the facts. Most confrontations drew the same conclusion, the company had implemented a specification requirement based on an odd case of misunderstanding that happened years ago, or based on a technology that we no longer even used. My point is that we were stuck in our ways because it was the only thing we knew. It was a challenge to change that mentality and really see the benefits that change had to offer.

We never want to make a change just for the sake of change. It is important to realize the benefits of changes. Changes cause disruption in the workplace and the processes we enforce there. However, if the outcome is one of a stronger work environment, lower cost and higher quality then the disruption is worth the return we get after it is over. Introducing an E-CAE product into the work place is a paradigm shift. It requires the commitment of management and staff equally. As with any new technology, there is a learning curve required that can only be tackled head on. Many companies have started the endeavor, but when timelines were tight, or staffing changes occurred it was easiest to go back to the old ways… just because. The challenge lies in embracing the technology and exploiting it to the fullest.

Accepting the fact that E-CAE is an investment is also a critical requirement for success. Understanding the investment in software, training, and any development that may be necessary for your applications is a key to seeing the benefits. Simply handing a new tool to an engineer that is likely already overburdened due to budget and headcount reductions in conjunction with compressed timelines will not reap a positive benefit. Invest the necessary time to train your people and get real experience on projects.

VIII. CHOOSING THE RIGHT PRODUCT

It goes without saying that choosing the right product is important to your company. Some of today's products are a collection of tools that were developed for a small group of customers and marketed and grown from that beginning. EPLAN has been in existence since the birth of E-CAE over 20 years ago. It is critical to have a product that is robust and comprehensive enough to meet the needs of your company

today and still have the flexibility to grow with you. A few features to consider in your selection should be the ability to represent both the electrical schematic portion of your projects and any pneumatic, hydraulic or lubrication requirements you may have.   The selection should be able to meet your requirement for the panel representation of your design.   Many packages today are too easy to "trick" into squeezing components into areas they really do not fit. For example, I have seen detailers scale a series of fuse blocks just a fractional amount, but that scaling made the layout impossible to build. The fuse blocks were hanging off the back plate. This simple trick of "tricking" your components to fit on the back plate can cause significant time delays and additional cost incurred if a new enclosure or components are required. The error also has to be corrected in the drawings after the fact. You should feel comfortable that the design's integrity can't be accidentally jeopardized. Printing and export features should be easy and quick.   With the common interfaces available today, you shouldn't have pains in printing your schematics.   It should be as easy as point, click and print.

One question you should ask in this global economy is what standards do you need to design in today and in the future? The product you choose will likely have to support IEC and JIC symbols as well as drawing in the DIN or JIC standards. What language do you require as globalization and the need to design and ship products all over the world increases? Do these languages have to be supported in just documentation or also in the design environment? Don't make the mistake of limiting your options by neglecting to ask these kinds of important but often overlooked questions.

Do your homework to ensure the product you choose can meet the flexibility requirements of your design environment. The right product will meet your needs to be flexible enough to provide different wiring number and device tag formats, easy symbol editing and creating, keyboard and menu customizations, and a powerful application programming interface (API).

IX. SUMMARY

In his book "An American Tale", John Maynard Keynes states: "The difficulty lies, not in the new ideas, but in escaping the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds." E-CAE isn't a new idea. The first E-CAE product was introduced in Germany over 20 years ago and provides the foundation still used today by over 60% of European companies that compete in diverse industries such as manufacturing, pharmaceutical, automotive, energy, food and beverage, machine building, and many more to list here. For a society that was first introduced to E-CAE as a giant leap from paper drawings to the digital era, adopting the benefits of such a revolutionary product was imminent. For those around the globe that see E-CAE as a new idea, John Maynard Keynes could not have stated our challenges more eloquently.

Globalization and the constant need to reduce cost are inevitable. The decision is a simple but conscious one, you either embrace the technology that is available and necessary to survive, grow, and succeed or you simply will not be in business much longer.