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How to recognize optimization potential in electrical engineering?

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Planning and design of machine control panels are essential steps in the production of a new machine. As in all other engineering disciplines, the procedures and methods are subject to constant change. Digitalization and Industrie 4.0 are often mentioned when a new software solution is introduced or processes are modified. But what is driving this change and what opportunities exist to further optimize engineering to meet the growing demands?

A white paper from: Siemens.

Content

3 **The problem is always time**
3 Electrical planning – An important component of every machine planning
3 Engineering costs must not increase
3 What are the reasons for the growing cost pressure?

4 **The tools of an electrical planner change – that brings new opportunities**
4 ECAD tools can often do more than you think

5 **The tasks to be mastered have expanded**
5 From designer to data manager
5 Centralizing and making use of interfaces

6 **Data and tool support is an important lever for efficiency improvement**
6 Moving away from price-driven thinking to total cost of ownership
6 Can I plan efficiently with the product?
6 How efficiently can I obtain data?

7 **Optimization doesn't end with the electrical planning**
7 Taking advantage of tools for daily work
7 The journey to standard exchange formats has begun
7 Design manufacturing – The groundwork for production and assembly

8 **Summary**

8 **Further information from Siemens!**

The problem is always time

Electrical planning – An important component of every machine planning

In addition to the mechanical design and development of the automation concept, planning of the electrical power supply and distribution is the third engineering discipline involved in production of a new machine. Electrical planning ensures that all components in a machine are supplied reliably and safely with power. In most cases, it provides the framework for the automation engineer and thus specifies basic things like communication, topology and the control concept. The documentation created in the process is in effect a certificate of insurance and serves as proof that the electrical equipment of the machine is designed in conformance with the applicable guidelines and standards and that the required protection goals are met. In the end, all switching, contacting and controlling components find their place in the control panel and machine panel. Electrical planning is responsible for the engineering of the electrical equipment of the machine.

Engineering costs must not increase

Of course, the principle of keeping costs as low as possible is still in force – even in the face of ever increasing requirements. This represents a standing contradiction that increasingly poses a problem. Ultimately, more and more control panels have to be designed and built in the same amount of time. The total costs incurred for this, i.e. the total cost of ownership, can be subdivided into the following cost items:

- **Engineering** – Costs that arise during electrical design (approximately 45% on average)
- **Devices and materials** – Costs for integrated products, cables/wires and control panel materials such as metal sheets and rail systems (approximately 45% on average)
- **Assembly and wiring** – Costs for labor and materials that arise during assembly and wiring of a control panel (approximately 10% on average)

It is noteworthy that the engineering costs for a control panel account for a significant portion of the overall costs and are not permitted to increase. On the contrary, they must decrease in order to remain competitive. That is precisely what is behind today's growing cost pressure, which requires greater efficiency and optimization to counteract.

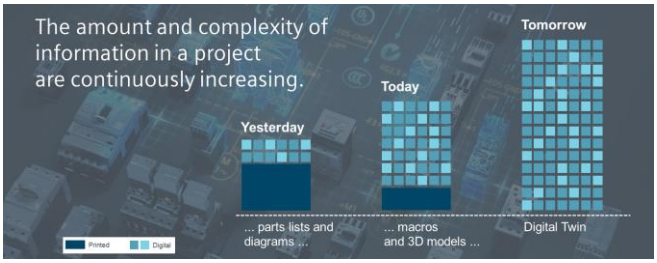
What are the reasons for the growing cost pressure?

The reasons for the increasing cost pressure are varied. In general, the complexity of the documentation to be created is constantly increasing. End customers and machine builders desire a higher level of detail, which will enable better and more independent production. This is accompanied by the trend toward outsourcing control panel manufacture to specialized control panel builders. Fewer and fewer machine builders can afford their own in-house control panel building operation. The documents for the control panel must contain detailed information that will enable the customer and supplier to reach a clear agreement on the scope of work and prevent disputes later on over any added costs incurred.

The communication portion of the integrated components is continuously increasing. What was once a "simple" controller now includes measuring and monitoring devices for tasks such as energy monitoring or condition monitoring. That makes planning even more complex and time consuming. But such communication is essential for Industrie 4.0 capable plants.

Not mentioned up to now are the changes taking place in the assembly and wiring of a control panel. An increasing degree of automation can also be seen here, such as prefabrication of cables and automated machining of sheet metal parts. This calls for even more data and details to be included in the plan.

Last but not least, demands on service have increased. Maintenance personnel must receive all the necessary information for a component replacement quickly and efficiently. In this era of just-in-time production, long machine downtimes have a much greater impact than they did just 10 years ago. This means that poor documentation can lead to longer outages, which can reflect negatively on the reputation of a machine builder.



Complexity, automated assembly and production and demands on service and maintenance increasingly call for documentation with high-quality, digitally processable information and thus also for efficient engineering.

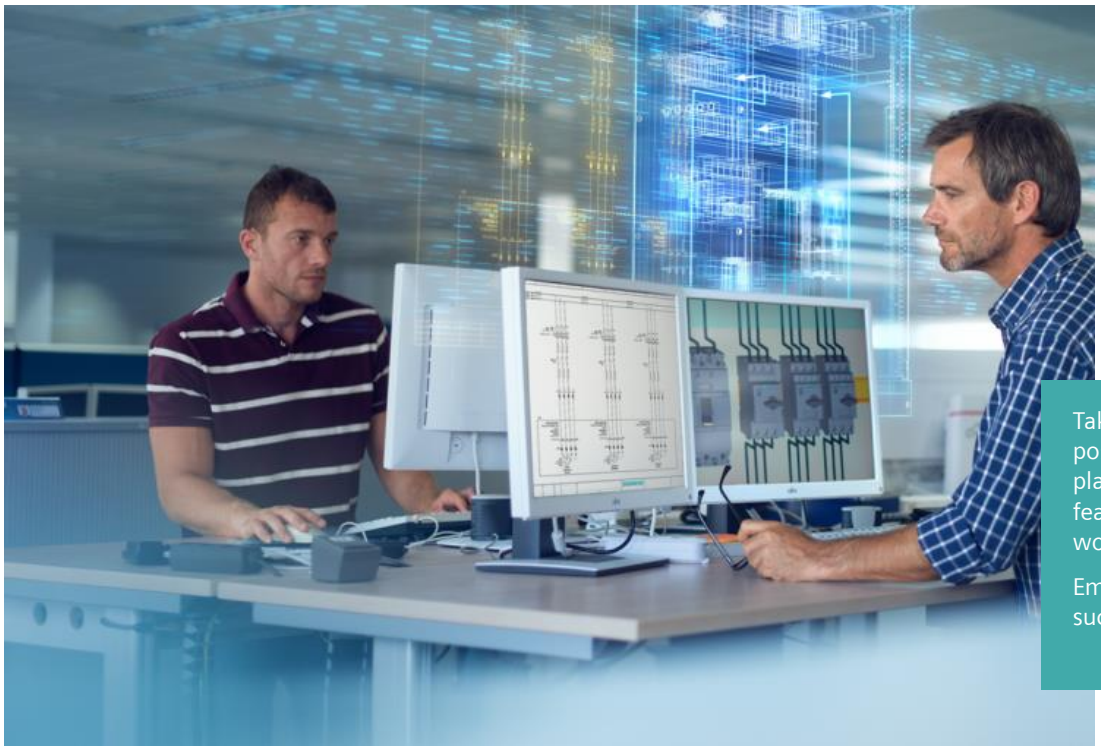
The tools of an electrical planner change – that brings new opportunities

ECAD tools can often do more than you think

As the challenges with respect to costs and the associated time pressure increase, the use of tools for daily work is also changing. Only a few years ago, a "drawing" was the main vehicle for creating electrical plans. ECAD programs offered functions for easy and precise placement of circuit diagram symbols and their interconnection. However, that alone was soon not enough for efficient working. The concept of object orientation was then added to the software. A placed symbol is no longer just a collection of drawn lines. Rather, it is one of many views of a device that is to be integrated later in the real control panel. To create a plan that is as exact as possible, you always need various representations of a device. In the circuit diagram, for example, one places a coil. In the assembly plan, it is a true-to-scale drawing, which shows the dimensions of the device. For the software, however, it is only different views of one and the same object. With the object orientation and the automation functions available in practically every ECAD software, it is possible to take advantage of many benefits for daily work. That starts with generating

From simple output lists and automatic renaming or displaying and hiding of layers all the way to complete modular engineering. When using a new software, many users unfortunately do not change their habits. In exaggerated terms, these users simply continue to draw with the new software as before. A new software is also intended to simplify daily work. The investment, which often represents a heavy burden for the company, would not be justified.

One should attempt to ensure that the possibilities of the software are also taken advantage of. Even if this means extra effort for the time being or even a training course, it will certainly be profitable in the subsequent project and the learning effects will pay off. This requires you to leave your comfort zone. But, the first time the motor feeder or supply no longer has to be drawn or copied but only configured and generated, you will quickly want more.



Take full advantage of the possibilities of your electrical planning software. Many features that can facilitate daily work often go unused.

Embracing change is the key to success here.

The tasks to be mastered have expanded

From designer to data manager

All the above-mentioned reasons for increased time pressure in electrical planning are external in nature and dictated by the customer. There are many other factors that come along with the ongoing digitalization in electrical engineering that must be overcome.

The daily work of electrical designers should generally consist of planning activities. More and more, however, activities also include downloading, storing, processing and backing up data. To some extent these are classic activities from the field of data management. They have to be done but are not directly remunerated.

Also here is it necessary to work as efficiently as possible and to lose as little time as possible. However, these activities often receive little or no attention. That can lead to problems in the long run. The longer one delays addressing these problems, the longer it will take to correct them.

Centralizing and making use of interfaces

In any event, one should devise and implement a plan for handling data. For example, if a company has more than one electrical designer, it is worthwhile to relocate the product databases to a central server or repository. In this case, data only have to be maintained and imported once and every user can access data of the same quality.

Because the engineering process is closely tied to other processes in the company, such as procurement, storage, project-specific provisioning, assembly and inspection, it is useful to connect these processes electronically. All the commonly used ECAD systems are able to connect to typical Enterprise Resource Planning (ERP) systems (for example, EPLAN connected to SAP).

This makes it easier to calculate the price of a control panel, for example. Prices are transferred from the ERP system to the product database of the ECAD solution. The ECAD system can integrate the prices in outputs and reports.

In summary, once again there are many opportunities available that will entail extra effort to begin with but will pay significant dividends in the medium term.

Data and tool support is an important lever for efficiency improvement

Moving away from price-driven thinking to total-cost-of-ownership

All companies generally operate as economically as possible. Besides the functionality and quality of a device or component, its price is a major criterion for choosing it for the control panel. Nevertheless, a favorable purchase price does not automatically lead to an economical control panel.

The electrical planner works with a particular product long before it is purchased or integrated. Unfortunately, the burden imposed by a component on the electrical planning is often neglected in the purchasing decision. The manual creation of a complete dataset for a new project in the ECAD software takes more than 2.5 hours on average. The ability to use existing data of the manufacturer is thus all the more important. If suitable engineering data is not available or is incomplete, the effort involved for manual creation of the product data can add up quickly. What appears to be a favorable price can lead directly to increased engineering effort.

Therefore, the following questions should always be asked when making a purchasing decision on a component in the control panel:

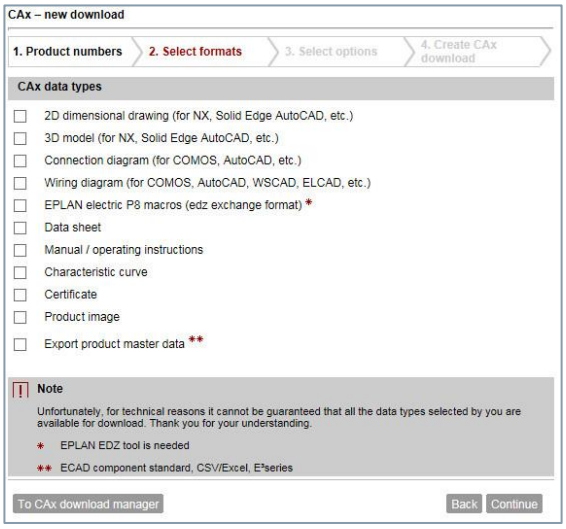
Can I plan efficiently with the product?

The availability of data for the utilized planning software can save a lot of time and effort. CAE data provided by the manufacturer, such as product data, circuit diagram symbols, macros or DXF drawings, can be easily integrated directly into circuit diagram planning. This eliminates the need for manual, time-consuming creating and importing of data. ECAD systems frequently offer complete data packages for this, which can be downloaded via their own data portals. The use of these data portals is a convenient option for users and also comes with the advantage that many different device manufacturers are represented. For example, Siemens makes available its product data and graphics in all commonly used data portals such as the EPLAN data portal, wscaduniverse.com and Traceparts. In doing so, it eliminates the need to search for this information on the manufacturer's website.

The mere existence of product data is not sufficient, however. The important thing is that it contains the right information. Every electrical planner has different needs. Some create the control panel layout in 2D and need DXF or 2D representations or the component dimensions for this. Others have already migrated to 3D and would like to take advantage of other opportunities such as virtual wiring or automatic drilling and milling. It is well worth it to take a closer look at whether adequate data exists for your engineering process.

How efficiently can I obtain data?

Downloading product data for the planning software via an integrated data portal is, of course, the most convenient way. However, you often need more documents such as manuals and certificates. Or, in some cases, the CAE software does not have an integrated data portal. At that point, you have to make your way to the manufacturer's website to download specific documents. Quick access to information can also be an advantage here. It can take a long time to download documents, say for 50 products. Siemens is committed to making access to technical documents as easy as possible. With the CAx download manager, documents and CAE data can be downloaded quickly and easily in a single data package. This means a few clicks instead of tedious and time-consuming searching for individual data. This once again saves time and money during engineering and, not least, stress on the part of the electrical project engineer.



The wizard guides the user step by step through the CAx download manager.

Optimization doesn't end with the electrical planning

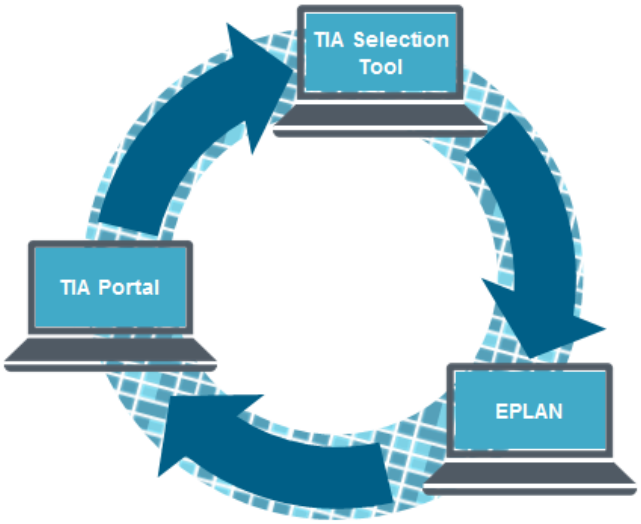
Taking advantage of tools for daily work

Daily work in electrical engineering is multifaceted. A lot of small tasks must be completed before everything fits together as a whole. Common individual tasks include product selection, cable dimensioning and incoming unit design. Other tasks include the temperature rise analysis, short-circuit rating verification, safety category determination and assembly of the final documentation.

Some device manufacturers offer tools that are very helpful to you in accomplishing the respective tasks. Integrating these tools into daily work processes allows the effort required for many tasks to be reduced to a minimum. Moreover, this also creates a certain level of uniformity, which is the basis for modular engineering and automated processes. A tool always outputs things the same way every time no matter who is using it. Subsequent work steps can be adjusted to these standard outputs. The TIA Selection Tool and the SIMARIS therm tool in combination with an ECAD system show an example of what this uniformity can look like. Practically all switching, contacting and controlling components in a control panel can be selected using the TIA Selection Tool. The selected products can be exported using the export function and imported into the ECAD system. Work can continue in the ECAD system until the time for the temperature rise analysis is reached. The list of products is then exported from the ECAD system and imported into SIMARIS Therm. SIMARIS Therm calculates the heat balance and outputs a corresponding report that can be added to the verification documents. The temperature rise verification is now available and the heat dissipation concept to be implemented is known. Besides the above-mentioned tools, Siemens offers other useful tools, for example, for short-circuit calculation, cable dimensioning and customized documentation generation. These tools are available for free download at usa.siemens.com/controlpanels. It can thus be worthwhile to take a look at each of the manufacturer tools.

The journey to standard exchange formats has begun

The electrical design is, of course, not the only development step in the production of a machine. It is closely linked with its neighboring engineering disciplines: mechanical design and automation. Changes often occur up to the last minute and then still have to be incorporated in the documentation. Fast and easy transfer of data and information is thus important. Here, the best solution is also to set standards and consistently use them, be it an agreed actuator/sensor/load list that becomes more and more detailed as the project progresses or a tool interface that enables easy data exchange between the electrical planning and automation disciplines. One possible example of such a tool interface is AML (Automation Markup Language). AML allows the transfer of a complete PLC hardware configuration. The neutral data format, which was jointly developed by a large group of manufacturers, can already be used by some engineering tools today. For example, AML can be used to exchange data between the Siemens TIA Portal and EPLAN Electric P8. It is even possible to transfer a hardware configuration from the TIA Selection Tool to EPLAN or TIA Portal. This data format is clearly versatile, has a future and is already replacing some time-consuming Excel-based data exchanges today.



Design manufacturing – The groundwork for production and assembly

The plan is implemented in reality with the construction, fitting and wiring of the control panels. The more precisely engineering is performed and the more details are included in the plan, the faster and easier it is to produce the control panel. Productivity is already at a very high level today, and further optimizations are difficult to achieve.

One possibility for optimization might be the changeover to 3D design for control panel building. But does 3D have any advantages over 2D? Apart from collision detection, a pure 3D model offers no significant advantages initially. Only additional information, such as the coordinates and direction vectors of device connections or the "drilling template", provides engineers with new opportunities for savings later on during control panel building. Placement information for mounting rails and docking points for accessories also ensure more efficient assembly. Only this additional information enables advantages such as virtual wiring: the software generates a list of all cables with length information that is accurate to the millimeter. This list can be used in production to have all cables automatically prefabricated. The fitter then only has to install and connect the cables. The same advantage is

achieved with drilling information, as this allows fully automated drilling and milling of a mounting panel.

When it comes to optimizing electrical engineering through the use of new technologies, the concept of total cost of ownership applies. Optimizations are frequently only achievable when collaboration of individual activities is improved even if it means increasing the efforts for an activity.

Summary

Electrical planning can be complex and multifaceted. There are many possibilities for improving efficiency. The use of previously unused ECAD software features or the setup of an optimized data management is already a good first step. The CAx data from Siemens, which can be downloaded quickly and easily with the CAx download manager, includes many documents and other types of data needed during the course of electrical project engineering and documentation creation.

Last but not least, measures such as standardization and modularization of engineering and a changeover to 3D design for control panel building open up further potential. Tools like the TIA Selection Tool, SIMARIS therm and SIMARIS design can also be integrated into your daily work processes for process optimization.

Further information from Siemens!

Siemens keeps you up to date.

You will find constantly updated information related to digitalization in engineering at usa.siemens.com/controlpanels.

In addition, you will find comprehensive information on expert know-how" and our aligned product and system portfolio on our market portal usa.siemens.com/controlpanels.

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