Centralized vs. Decentralized: Choosing the Right Type of Motor Control System

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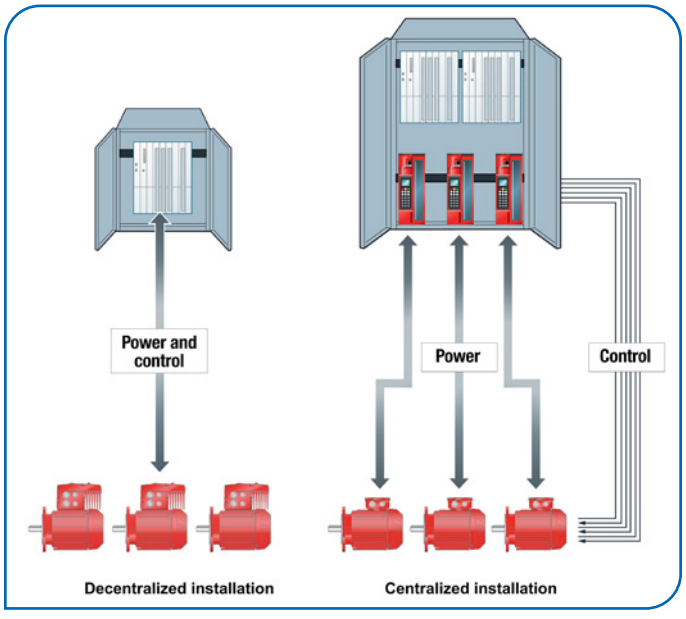
Are you looking for one simple formula to help you choose between centralized and decentralized motor control? Unfortunately, such a formula does not exist. However, evaluating the overall size of the system, comparing labor and material costs, and maintaining flexibility can help guide engineers in the right direction. Designing with the correct architecture in mind from the start allows for more flexibility in the future. Let's look at each control type to help decide which is best for your application and work site.



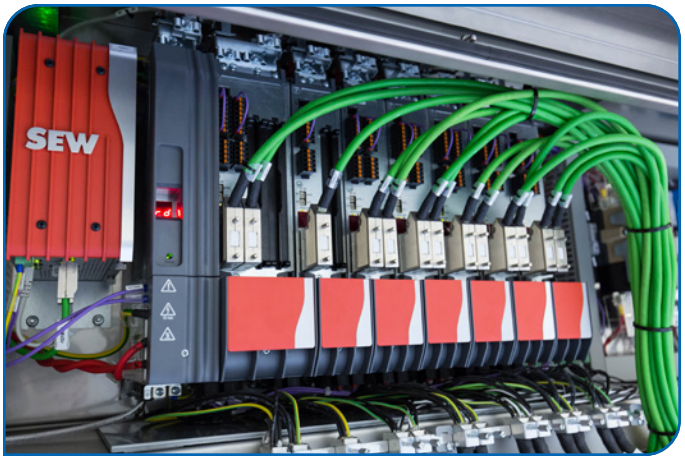
Power and control cabling can be a determining factor when designing a motor control system. The project footprint and number of control axes are common cost considerations. (Image courtesy SEW-Eurodrive)

Centralized Motor Control

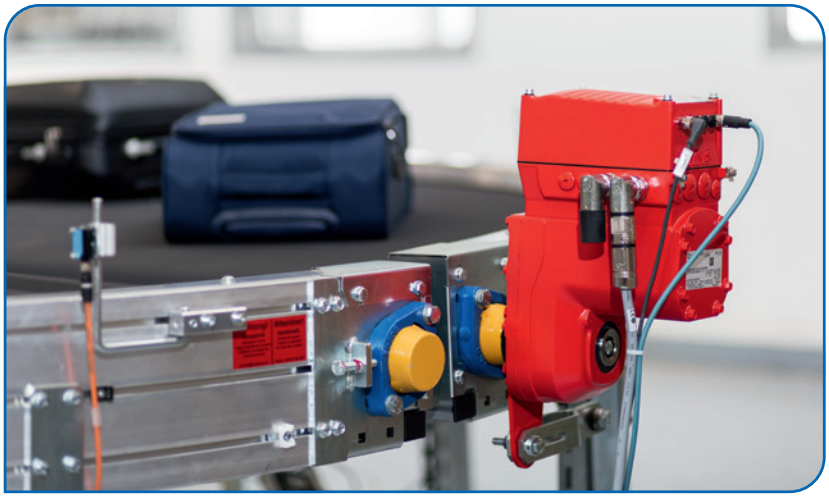
What is a centralized system? As the name implies, the controls for the system are centrally located, generally in an enclosure or multiple enclosures. Oftentimes some facilities will have electrical vaults, motor control centers, and even e-houses that centrally contain the controls for their systems. As you look into each of these centralized concepts, whether they are small or large, generally all of the system's peripheral devices are terminated in one location. For example, in a distribution center with multiple conveyors, the conveyors' system controls can be found in large control panels near the equipment—or sometimes far away from the equipment—depending on the application and environment, as well as the installation site itself. These centralized systems often contain electrical cabinets (See image bottom right) that house the PLC, motor controls, and branch circuit protection for all of the equipment. Each of the individual devices in the system are wired and connected directly back to a central point; these systems are generally designed for dedicated purposes.

When laying the foundation of a new project, it is important to know what key factors should be considered when deciding if a centralized system is the right fit. Certainly, the first thing to consider is the size of the system itself. Centralized systems tend to take up a lot more real estate in a facility when compared to a decentralized system, giving a centralized system a disadvantage. Ideally, it is best to keep a centralized system small in terms of the number of devices connected to it. This would help in keeping the cost of the installation low and manageable. The installation on a large-scale centralized system can be very overwhelming due to the cost of materials and labor to wire everything back to a central point. However, the environment of the application also plays a role in choosing whether a centralized system is right for the application. If your application requires your equipment to be in harsh environments with harmful liquids, hazardous gases, high temperatures or sometimes even washdown requirements, a centralized approach can be a more appropriate method to meet these requirements. Centralized systems can offer a great deal of protection against environmental challenges, making them a more appropriate choice.

If flexibility and expansion are important for the application, that can be a challenge for a centralized system. When



Typical centralized control cabinets house the motor controls, PLC, and circuit protection. Motors and other devices are wired back to this central point. (Image courtesy SEW-Eurodrive)



Decentralized control can include add-on components mounted on or near the motor. This modular installation can include onboard variable-frequency drives (VFDs), I/O ports, and various fieldbus options. (Image courtesy SEW-Eurodrive)

designing the system, you must have a good idea ahead of time for what the additions will be in the future. Centralized systems are often times not modular or expandable. If an application calls for these characteristics, it can oftentimes cost more to make a centralized system flexible. Generally, a centralized system is designed for a dedicated purpose and is usually not altered or added to after the fact.

Maintenance and troubleshooting is another area to consider when deciding if a centralized approach is right for a given application. With anything, maintenance is the key to the life of the hardware within the system. Centralized systems will typically have some form of thermal management on them. It may be a simple filter fan or a form of a closed loop cooling method like an air conditioner, an air-to-air heat exchanger, an air-to-water heat exchanger, etc. No matter what cooling device is used, it needs routine maintenance to keep it and the system up and running. Maintenance and troubleshooting go hand-in-hand with these systems. If a centralized system is not maintained properly, it would be very tough for a technician to identify any problems. Keeping these systems clean will provide easy maintenance and troubleshooting if a problem should arise. Ideally, in a centralized system, if there is an issue a technician can look at a central location to identify the problem in the system.

Common applications that utilize a centralized system include small conveying processes, packaging equipment, palletizers, food and beverage processing, material handling, dedicated manufacturing machines, and processes apart of larger manufacturing systems.

Decentralized Motor Control

What is a decentralized system? Simply put, the motor control functions are removed from a central control cabinet and distributed close to the motors. Add-on drive components can also be integrated into a unit that is mounted on or near the motor in the field. Those components can include variable-frequency drives, motor starters, I/O, disconnects, integrated brake and overload control, fieldbus, power, and safe stop functionality. The automotive industry was one of the first to adopt this concept in North America, because it simplified production-line changes and reduced vehicle manufacturing and engineering costs. Decentralized control systems eliminate the long cable runs that are expensive to install, easy to damage, and time-consuming to change.

Similar to centralized control, decentralized systems rely on a few factors that help engineers decide if it will be the best fit for their application. The machinery footprint is often considered first. Both the floor space required for the machinery and the number of axes being controlled will help dictate whether or not a decentralized control system will be ideal. Applications that require cable runs that cover significant distance or applications with more than 10 axes are perfect opportunities to implement a decentralized control system. Another point to consider is local control requirements. Local control is possible in decentralized topologies because operators have access to motor control functions directly at the machine. This functionality is exclusive to decentralized systems so it should be included in your decision making process on control system topology.

Environmental conditions also play a hand in determining if a decentralized control system will work for your application. Centralized installations provide the best protection in the most challenging environments, but decentralized systems provide decent protection as well. Decentralized equipment typically has higher IP ratings than traditional cabinet components to compensate for washdown and other corrosive environments typically found closer to the production line. However, it can be difficult to meet all of the challenges that can be associated with a decentralized solution. In the harshest environments, costs can quickly rise if you need to control the temperature of electronic components. In some cases, it is more efficient to regulate a centralized cabinet with heaters, air conditioners, fans, and weatherproof panels.

Flexibility and modular configuration are the most beneficial features of a decentralized system. If your goal is to future-proof your application, choosing a decentralized layout will provide the most flexibility when processes or configurations change, since control functions are located in close proximity to motor location. With the modular configuration of decentralized systems you can also easily grow or reduce a system simply by removing or adding sections to an application. For example, in a conveying application it would be

possible to add additional conveyors sections or even reconfigure existing conveyors to fit a new layout without the hassle of having to redesign a centralized panel to accommodate for the growth of the system. The bottom line is that this allows engineers to create new machines, or add-on sections from already developed modules, making the application more efficient.

Advantages of a decentralized method of motor control are often determined by the application footprint and number of motors. Applications with 10 or more motors are ideal for a decentralized drive configuration. In applications that contain a considerably larger number of motors, implementing a decentralized control system often yields the greatest cost savings. Installation costs are greatly reduced by avoiding expensive cable runs and labor associated with a centralized motor control system.

Another feature of a decentralized control system is lower maintenance costs. Troubleshooting can be easier and less labor intensive since technicians no longer have to be stationed at both the control panel and the machine to identify and correct problems. Cabling and communication errors are easier to diagnose at the unit, since many manufacturers locate a fault-code LED display on the front of their units. Pre-wired plug connectors can also reduce costs by reducing the disconnection time and lock-out/tag out safety issues associated with conduit box connections. Plus, fewer wires from a central location to motors results in less potential for cross-talking noise and electromagnetic interference which is a major source of machine downtime.

Across many industries, decentralized designs are now used for a variety of applications such as rotary and lift tables, automotive assembly, food and beverage processing, packaging, warehouse logistics, and other material handling applications.

Which system is best for my application?

In summary, although the last decade has brought an increase in moving to decentralized motor control installations, using the traditional centralized cabinet enclosure can still be a viable option. There are benefits to each, and the decision on which way to go should not be a quick one. To find your best option, common considerations include the number of motors in use, the length and cost of cable runs, space savings, equipment cost comparisons, point-of-axis control needs, and flexibility for future expansion. Comparing the pros and cons of these options can help guide your choice in motor control options. **PTE**

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Applications that have long cable runs and multiple axes are typically the best opportunity for a decentralized control installation. Machine expansion can also be easier and less expensive. (Image courtesy SEW-Eurodrive)

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