

SECTION 5

# Ergonomics & Styling



# The electronic wave

**DIGITIZATION IS SWEEPING THROUGH TRADITIONAL INDUSTRIES, IMPROVING PRECISION AND MAKING IT EASIER TO AUTOMATE FUNCTIONS**

▶ The forestry was an early adopter of electronics in harvesters and forwarders. Now mining and agriculture communities are exploring how to improve their vehicles with electronic controls. A bigger wave of digitized controls for all kinds of vehicles has begun. Caldaro has been preparing for this since the 1990s. Other companies want to catch up.

The first steam-powered excavator was invented in 1796 in England, followed by the steam shovel in 1839 and the diesel-powered excavating shovel in 1930. However, they still needed a cable-lift arrangement to move the shovel. During the 1960s hydraulics transformed the design of cranes and excavators, and it took only a decade to replace almost all cable machines with hydraulic machines. This led to higher productivity, better cost-effectiveness and more durable equipment.

The next step was to control the hydraulic valves with electric joysticks. Caldaro excelled at designing small joysticks with

superior ergonomics. The development that started in the 1990s has evolved into an electronic process with a controller between the joystick and the hydraulic valves.

### The joystick and operating dynamics

“I was already thinking about joysticks and the coming electrical possibilities back in 1987,” says Tomas Pehrsson, board member with Caldaro. “In 1993 Maths Wahlbeck and I founded Caldaro. The first electrical joystick we sold for vehicles in serial production was for a forestry machine made by the Swedish company Rottne in 1994.”

Digitalization has since revolutionized the industry and it is now used in all kinds of heavy-duty vehicles. The big advantage is improved precision in situations where more control is required such as digging ditches or working in urban environments.

Digitalization makes it easier to automate functions. Today at the touch of a joystick a the harvester falls a tree, removes the limbs and cuts it into pieces.



**MAIN:** Operator controlling Scooptram ST14 from mobile operator station with a Caldaro joystick C15 Viper Compact.

**LEFT:** Joystick box with CANOpen interface and dual independent output signals critical functions





**Demands of working environment force development**

The Swedish working environment pushed the need for better-designed cabins. The reality of hydraulic systems is that hoses and connectors will leak over time and hoses take up a lot of space. The joystick grips that control the hydraulic valves demand more muscle power compared to working with electronic joysticks. Electronic components are cleaner, neater and easier to move with little effort. Furthermore, they allow machine designers to develop computer-aided control, resulting in higher efficiency and precision.

“Most forestry machines in Sweden are owned by private entrepreneurs,” says Tomas. “Since the operator owns his own machine he tends to work very long days and has high demands for his working environment. They don’t like to breathe in the oil mist, for example.”

These special conditions mean that the makers of forestry machines had to be on their toes to deliver the best machines in their local market, while other companies around the world could continue to offer hydraulic machines. The digitalization of controls is now catching up, partly because regulatory demands for the working environment are getting more stringent.

**Mining safer with digital solutions**

Mining means heavy usage and a tough environment for both man and machine. Safety is the highest priority. The drill rigs need to endure high moisture, temperature changes, dust and chemicals. All drill rigs are hydraulic, but the steering and machine control have changed to electronic joysticks in most machines over the last 10 years.

“We want to create a platform with proven solutions that are reusable in many of our products,” says Jan Knutsson, hardware development manager at Epiroc, a Nordic world leader in drill rigs. “Electronic, digital solutions are beneficial for many reasons. For one, it makes it easier to provide spare parts, since one article can be used for many applications. A rig’s behavior is defined in the software, which makes spare parts more generic. Easier troubleshooting of the machines is another benefit.”

Today it’s normal that a machine works autonomously during common tasks such as a haulage from A to B. When it’s time to load or drill, an operator takes command remotely. In many mines, a single operator in a safe control room controls several machines.

**Smart and elegant controllers**

By now, most machine manufacturers understand that electronic controllers and joysticks turn the cabin into a cleaner and safer working environment. However, there are many further possibilities, for example the way the driver can personalize settings and make the machine adapt to his particular way of reacting. Another clever example is how the electrification of the brake

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system makes it possible to store the energy from braking or lowering the loads for later use, which saves fuel.

One reason why digitalization is speeding up among machine manufacturers is the development of more advanced controlling systems. CAN (Controller Area Network) systems connect several parts in an internal network, making it a more straightforward process to transfer signals directly with less disturbance and over longer distances. Now it's much easier to program the movements of a boom or crane tip with ultimate precision.

Tradition and old habits cause suspicion among some machine operators who claim they prefer hydraulic machines because they can feel when an excavator bucket hits a stone. With a digital controller, it's possible to program the machines so that you get a vibration in the joystick if the bucket grab hits a stone; this way you can still 'feel' it in your hand. You can also schedule a crane to slow down the crane tip before it stops. Essentially you can instruct the crane to move from A to B and the controller station is programmed to compensate for pendulum movements or the wind. This is similar to how some computer games work, meaning the younger generation of operators is already prepared for this.

### What the future holds

You don't have to be strong to operate huge machines any longer, and overall ergonomics get better with electronic controllers. It's comfortable for the operator to have personalized settings and when the operator gains more control it makes the working environment safer.

"When I started to work at Caldaro nine years ago, the bigger excavator manufacturers asked some general questions about electronic controlling," says Erik Kauppi, sales engineer at Caldaro. "Today, I get more specific questions about turning from grips on pilot valve to full electrical controlling by joystick. To me, it's a clear signal that the development of heavy-duty machines is moving to electronic controlling and electric power."

The forest industry is also leading the way in using the web. Operators have a special social network enabling them to connect with colleagues, which is valuable since their job can be quite lonely. It doesn't stop there; even the machines communicate with each other. Today a forest machine can tell the pulp mill how much wood it has cut down so it knows when to send out trucks to pick it up.

"Many companies are testing autonomous vehicles on gated industry areas, but I believe it will take a few years before we see fully autonomous electric vehicles on the roads," says Pehrsson. "There will always be areas where big machines will have to operate even though it's off the electric grid. Even so, the battery producing branch of Addtech is noticing an increase of interest in this area. For me, it's necessary to have



RIGHT: Joystick grip Viper XT with robust joystick base C14 with J1939 protocol

## "THE FIRST ELECTRICAL JOYSTICK WE SOLD WAS FOR A COORDINATE MEASURING MACHINE IN 1987"

Tomas Pehrsson, co-founder, Caldaro

a sense of technological empathy, to really understand how tech works in the hands of humans, so it will be appreciated and offer a feeling of ease and safety. That's why it was important for me to initiate Caldaro's development of joysticks that could be used in electric controllers back in the 90s. We have

gained a lot of knowledge and experience since then." **iVT**

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