Panel discussion of the *Club of Bologna* on future tractors in Bari 2025

By moderator *Karl Th. Renius*, TU Munich, Germany

On 11 October 2025, **a panel on future tractor design**, arranged by *Giuseppe Gavioli*, a member of the Management Committee of the *Club of Bologna*, took place in Bari as part of the 34th Full Member Meeting. Representatives from **J. Deere** (*H.-J. Nissen*), **AGCO** (*Dr B. Pichlmaier*), **CNH** (*S. Fiorati*) and **Kubota** (*F. Zerbino*) were in attendance. This is a brief summary of the results.

The **standard tractor design** will continue to be the leading model for the next generation. However, tractor-implement combinations and designs for driverless operations should be further automated due to **labor shortages** in industrialized countries, as well as by **economic factors**.

In the near future, **the cab will generally not be removed** from driverless versions so as not to lose the tractor's ability to **transport** goods (or robots), change fields and **travel** to and from the farm.

Joystick steering may gain importance if problems of emergency steering can be solved economically. Undercarriage designs with **pull-in-turn traction** are gaining importance as they improve both mobility and performance, save fuel and reduce tire wear. **Automatic steering** in the field is well introduced; however, **automatic headland operation** is not. According to farmer comments, programming is still too complicated, should be simplified, mainly regarding smaller plots.

There is still potential for improved **tractor hydraulics,** for example, regarding dynamics and efficiencies. Fendt announced in 2025 replacing the analog hydraulic **LS line** (implement to tractor) by digital ISO BUS signals along with pressure sensors on the implements. This is of interest for **power-beyond** hydraulics (ISO 17567) which have directional LS-valves placed on the implements.

C**ommunication between neighboring field machinery** for automatic "synchronization" is not yet very satisfactory. **ISO BUS** (ISO 11783) is widely accepted, its performance sometimes falls short of expectations. The **AEF** (**A**gricultural Industry **E**lectronics **F**oundation) is collaborating with the relevant industries, working on this and other developments in electronics for the next generation. However, larger interface improvements (and their standardization) take usually a long time.

Field robots, with usually electric drives, are recommended, but doubts remain about **including heavy soil tillage** in their duties as their development seems to be mainly driven by the need to simplify seeding and replace chemicals, for example through electro-mechanical weeding. Their design must be able to **move** them to or from the field or to be able to be **pulled**.

Electric tractors have a future with rated power of up to about 75 (100) kW. As noted in ASABE Distinguished Lecture No. 45 (USA 2025) by *B. Pichlmaier* and *M. Ehrl*, **larger power levels are not recommended** as these require **disproportionately larger batteries**. Based on data collected in-house, this is due to **higher average power usage** within the duty cycle (e.g. for tillage or heavy transport) and **more working hours per day**. Broad general fundamentals of e-tractors and detailed specifications of the Fendt e107 (in series from 2024) are also presented in this Lecture.

While **electric vehicle drives** are becoming more common, the structure of **electric power trains for tractors** is still under discussion, even with many proposed variants. The panel addressed **three categories:** individual **electric wheel drives**; **electric axle drives**; and **electric central drives.** Replacing only the diesel engine with electric components, as most companies initially did, reduces investment and risk, but the previous transmission (and its cost) remains. Therefore, most of the panel's experts favor a second generation with **central electric motors.** The **ground drive** should be combined with a mechanical transmission with at least **two ranges**. This would favor high-speed electric ground drive motors (which are lighter and cheaper) and slightly improved energy efficiciencies. It was noted that a similar structure had recently been developed in Germany for the electric power trains of commercial trucks.