ISOBUS meets the farmer: Multi-manufacturer ISO-Terminal

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Abstract

The ISOBUS is a basic standard for agricultural machines to implement innovations and fulfil economical, ecological as well as consumer protection boundary conditions. In practice, however, incompatibilities in cross-manufacturer equipment as well as inhomogeneous usability concepts have demonstrated deficits in putting ISOBUS into practice. Thus an initiative of several companies has resulted in the first worldwide multi-manufacturer concept of a user-friendly application of ISOBUBS compatible agriculture machines. In order to demonstrate and realize the concept, a new state-of-the art ISOBUS terminal has been developed, thereby fulfilling all boundary conditions for the implementation of the usability concept, such as menu structure, navigation, ergonomics and hardware aspects (display, interfaces, safety). As a consequence the same hardware terminal can be used for different machines of different companies with the same usability concept. In first cross-manufacturer tests – including competitors – the concept and terminal has been successfully tested by all combinations of terminals and implements involved.

ISOBUS: The state of the art

Electronics has become a core competence in agriculture and a major impact on innovations with respect to economical as well as ecological benefits. Due to the nature of electronics and software, manufacturer of agriculture equipment have to adapt to the complexity and flexibility of electronics and software. The usability of these systems by the farmer under various conditions is a major challenge of this change in agriculture engineering. As a first step of standardization the ISOBUS communication protocol, based on the international standard ISO 11783, has been introduced after a long period of discussion [1]. However, in

practice a manufacturer-independent tractor-implement communication is still a significant problem [2]. This includes the company- or even machine-specific terminals, different user control concepts as well as incompatibilities of the technologies and data.

Moreover, one of the conclusions of the collaborative research project “pre agro” has identified this aspect as a major hindrance for the transfer of research results into products in precision farming technologies [3]. An example of a research work using ISOBUS compatible equipment in research is given in [4]. Haapala et al. [5] have pointed out that usability of an ISOBUS VT (virtual terminal) is a major factor when customers consider if a new product or method is taken into wide use or not, in particular for complex mobile agricultural machines. An “increased commitment of all those involved in industry, test institutes and associations” [2] is necessary to solve this bottleneck. There is a strong need for international initiatives, such as cooperating working groups from the VDMA (German Engineering Federation), the AEM (Association of Equipment Manufacturers) or the recently started "Agricultural Industry Electronics Foundation (AEF) and the registered association “Competence Center ISOBUS e.V.” recently founded by the author’s companies. A first step is the technical compatibility of each ISOBUS terminal with the electronic control units (ECU) of the agricultural implements. Instead of using a separate terminal for each implement, the standardization should result in just one terminal. Moreover, cross-manufacturer combinations of an ISOBUS terminal and ECUs as shown in figure 1 – even between components of competitors – should not result in a limited functionality. However, having a focus on the user’s demands, namely the farmer or the contractor, the technical compatibility is just one aspect of manufacturer-independent usability concepts [5].

Fig. 1: Cross-manufacturer combination of an SOBUS terminal and control units (ECU)

Multi-manufacturer usability concept

It is a high challenge to design a human-machine interface with the same user concept for a broad range of applications (such as fertilization, tillage or harvest) as well as for different manufacturers. The best way to avoid incompatibilities due to both aspects, different applications and manufacturers, is a cross-company initiative including competitors. The cooperation of the companies and users is a promising option for a user friendly design (including "Plug and Play") by detecting design deficiencies and incompatibilities in the development stage rather than in the product stage. In an intensive multi-manufacturer development within the "Competence Center ISOBUS e.V.(CCI)" the authors have designed a multi-manufacturer usability concept for different agricultural applications. In order to demonstrate the resulting compatibilities and user orientation of the concept in practice a new high-level ergonomic ISOBUS terminal has been realized (see below). In order to design the uniform control concept it was necessary to agree upon all relevant aspects, such as the menu structure, menu navigation, mask design, input options, pictograms and icons for symbolizing the tasks and positioning of the functions. Examples are shown in figure 2.

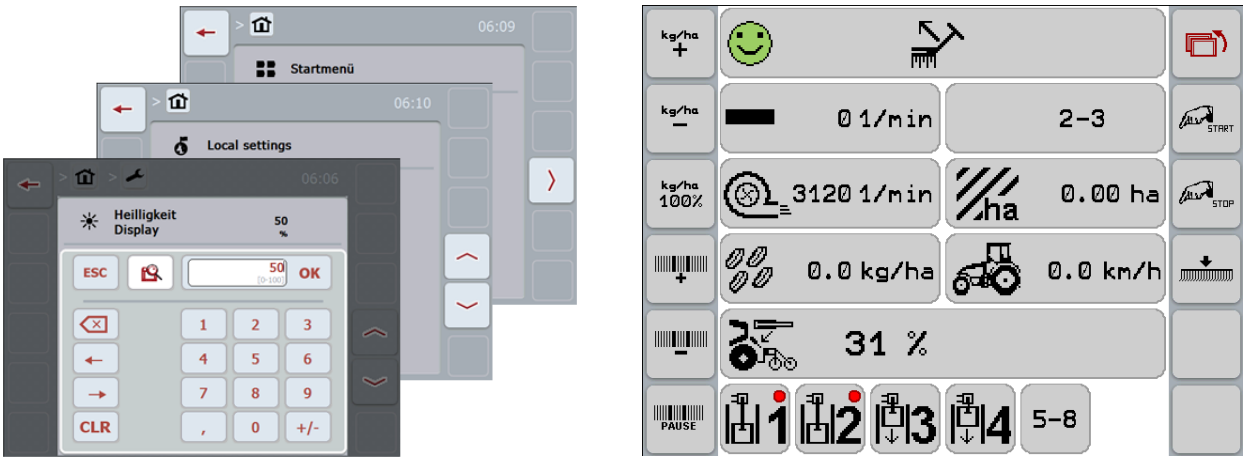

Fig. 2: Aspects of the uniform control concept (examples): identical menu structure, masks and input options (left); identical pictograms and positioning (right)

The solution is based on intensive discussions and conclusions about the user concepts for different machines for the same application (such as fertilizers from Amazone and Rauch or ploughs from Kuhn and Lemken) as well as for different applications (such as potato harvester from Grimme and forage wagons from Krone). By using experiences from the application as well as from the development of agricultural machines, a broad range of agricultural

processes is represented. Each company has realized applications for their specific agricultural implement, all based on the same usability concept agreed upon in the CCI. This multi-manufacturer development is a significant step in the evolutionary process of a uniform control concept and thus a large step to turn ISOBUS into practice.

CCI ISOBUS Terminal

As mentioned above an innovative terminal – "CCI ISOBUS-Terminal" - has been designed and realized in order to prove the usability concepts in practice. With respect to the hardware the following elements have been integrated: a touch screen display with an ambient light sensor for background illumination control, an incremental encoder, softkeys with option for one-hand operation as well as interfaces and storage options for state-of-the art bus systems and video (see figure 3). An additional Aux-Box can be attached for further user control elements (example: analog joystick).

Concept	Uniform user control concept (identical menu system for different applications, identical masks for setup and input, identical pictograms and positioning)
Menu	Intuitive menu navigation and input via touch screen, softkeys with option for one-hand operation, incremental position encoder
Software	Operating system Windows CE, ISO VT, driver for implementation of the ISOBUS interface on the electronic control units (ECU), ISOBUS task controller (examples: operating data logging and data management, site-specific applications, section control, parallel tracking, ISOBUS XML)
Interfaces	CAN, tractor signal socket ISO11786, RS232, LIN, Video, USB, WLAN, Bluetooth, Ethernet, audio out
Display	8,4" color TFT touch screen, resolution 640 x 480, ambient light sensor, 750 cd/m^2 with background illumination
Safety	ISOBUS-Stop-Button for defined shutdown operation
Optional Equipment	Aux-Control-Box

Table 1: Characteristic information about the CCI ISOBUS terminal

Fig. 3: Hardware of the CCI ISOBUS terminal (examples): interfaces (left), buttom for switching to the one-hand operation mode (center), USB storage

Moreover the ISOBUS-Stop button allows a defined shutdown of the processes, this functionality is presently implemented in the ISO 11783 standardization. The software includes the ISOBUS task controller for various applications, such as site-specific GPS-based operation or data logging. Characteristic information of the CCI ISOBUS terminal is summarized in table 1.

Figure 4 shows the CCI ISOBUS terminals of the companies Lemken, Rauch, Kuhn, Krone, Amazone and Grimme, all with the same hardware, but different foils with the corresponding corporate designs. The terminals have been connected to different agricultural implement in a cross-manufacturer test (6 terminals x 6 implements = 36 combinations) resulting in a completely successful operation.

Fig. 4: CCI ISOBUS terminals of the companies Lemken, Rauch, Kuhn, Krone, Amazone and Grimme (same hardware, different foil with corporate design)

Outlook

The first worldwide multi-manufacturer concept and realisation of a usability concept for ISOBUS compatible agricultural implements is considered as a large step to turn ISOBUS into practice and thus improve the international acceptance. It even goes further as ISO 11783 and will serve as an input for the implementation of these aspects. Moreover, it will help to take out standardization aspects from product advertisement, thereby focussing on the user benefit based on the technical functionality. The concept will help farmers and contractors to benefit from innovative technologies in agricultural engineering in practice.

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