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Traceability in Pig Production

Using software and electronic control components for process control and management is state of the art in pig production. Using electronic aids will allow in the future an efficient documentation and hence a simpler and prompter traceability of animals and food. For networking of hardware and software, there is considerable need for development in pig husbandry. A standardization of communication standards is being pushed ahead. More research must be done for a comprehensive documentation as well as for accessibility and traceability, to attain simple and transparent systems.

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Information technologies are increasingly used in modern animal housing systems to automate and to network systems. The objective is here – by allowing traceability and process control – to attain additional benefits for humans, animals and environment.

But the recording of individual animal data and environmental factors is expensive and automated monitoring and process control is still not feasible everywhere. It is challenging to network autonomous and company specific systems like ventilation or feeding devices, sensors or measuring technology, but also the transmission of collected data into different formats, which is received and saved, is difficult. These raw data has to be processed and saved efficiently, without any losses of information.

The main objective of this project "Information and Data Acquisition in Animal Housing Systems" is to build an IT-system, called Farming Cell, which collects, transmits and consolidates all data, generated in the animal husbandry system. Furthermore these data are transformed into information, primarily to ensure traceability of animals and their products and for documenting a sustainable production process, with regard to animal welfare and environmental protection.

The Farming Cell integrates all devices, management software and quality management systems. Open interface and communication standards like agroXML and ISO-agriNET are used for integrating and enabling data transmission to external bodies, like the HIT-database (HIT = origin securing and information about animals), the States Associations on Yield recording in Animal Production, practicing veterinarians, the Veterinarians Chamber or Association and accredited organizations.

Data transmission and communication

The IT FoodTrace research project aims to develop the first sustainable, integrated, IT-system for meat and meat-product based foods without structural breaks and barriers [1]. In order to achieve this goal, farm networks with professional electronic data storage like a Farming Cell have to be invented

and implemented. Due to the incompatible soft- and hardware products from different companies it is hard to set up integrated systems. Customized solutions for recording and documenting animal production exist, e.g. in some research farms, but in practice there are only a few systems, which link up separate standard software and hardware.. To develop networks further, there are efforts to improve data communication and to increase compatibility between company specific solutions at the farm level.

ISOagriNET will be an international standard, which integrates and networks devices on farms. Goals are in detail:
- enhance data transmission in between on-farm devices;
- improve data transmission to partners through the Internet;
- optimize data communication to improve controlling and regulating of on-farm processes;
- implement demand-oriented services in farm networks [3].

Hard- and software products are available on the market, which network management, feeding and ventilation systems. One example is the PIG-NET, which was invented some years ago. It uses individual gateways to link up devices of partners [4].

In order to improve farm networks and reduce incompatibility there are efforts to invent open data communication standards. Data transmission between separate software products, partners, bodies or administration will be advanced by using agro-XML. This is an open source product, which will harmonize individual programmed gateways for communication and thus improve data transmission. Currently new XML-schema and data models for livestock systems are under development. They will be available within a foreseeable time period. A XML-Schema for plant production already exists and enables a compatible data transmission to the EurepGAP database [2]

Network in a Research Farm

Fig. 1 displays the model of the hardware network of the IT-system in the research farm. It is called Farming Cell and integrates
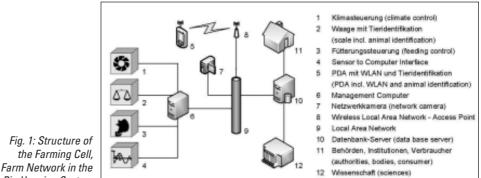
devices, sensors and services. The management computer serves to control or connect the ventilation system, the scale with electronic animal identification, the feeding system and the sensors for temperature, humidity, activity, CO_2 or NH_3.

This computer has to save temporarily all data in different software products, enables limited data exchange and is responsible for data transmission to the database. In order to allow data interchange between applications and to control devices, some questions have still to be answered. It is important to know, which data at what time is needed by different applications and how it has to be transmitted efficiently. For process documentation and video analysis, network cameras are used. Additionally PDA's with electronic animal identification devices enable mobile data acquisition and data transmission via a wireless local network interface.

The central data base serves on one hand scientific purposes and on the other hand processed information will be provided for traceability and documentation through agro XML gateways to bodies or to public authorities. Currently the implementation of the central database and the management computer as well as software integration on each system is pushed forward. To set up the database management system and a schema, data flows and quantity structure of data have to be generated. It is also studied how much storage capacity is available in software products and how this can be integrated into the Farming Cell.

Challenges during Implementation

During the implementation process, there were many constraints to struggle with. The companies, which manufacture technical equipment for pig housing systems are using different kinds of standards for communication like EIA-232, EIA-458 (serial port) or LonWorks as networking platform. Therefore, adapter and converters to transform hardware interfaces from serial to ethernet or LON to ethernet standard are used, to link up devices to the management computer. Drivers were installed to transform different in-

Fig. 1: Structure of the Farming Cell, Farm Network in the Pig Housing System

1 Klimasteuerung (climate control)
2 Waage mit Tieridentifikation (scale incl. animal identification)
3 Fütterungssteuerung (feeding control)
4 Sensor to Computer Interface
5 PDA mit WLAN und Tieridentifikation (PDA incl. WLAN and animal identification)
6 Management Computer
7 Netzwerkkamera (network camera)
8 Wireless Local Area Network - Access Point
9 Local Area Network
10 Datenbank-Server (data base server)
11 Behörden, Institutionen, Verbraucher (authorities, bodies, consumer)
12 Wissenschaft (sciences)

terfaces and signals. Additional sensors are connected with analog-to-digital converters, either to the management computer or directly to individual devices as input signal. The integration of many devices into the IT-system or the installation of software has to be done by hand by trained and experienced persons with very good IT-skills.

Many components, devices and control units are under development to meet the ISOagriNET standard. Thus, they are not yet available on the market and are restraining an automated integration of devices and software to the over all Farming Cell and management computer. To get around this restriction, gateways for data transmission and communication have to be created. Many devices and equipments can be controlled individually by software from the producers. With these programs the hardware can be operated from any computer over the internet, remote maintenance and remote inquiries can be performed. By knowing these potentials but also challenges there are several advantages and disadvantages for the implementation of a Farming Cell *(Table 1)*.

Conclusion and Outlook

The integration of different hard- and software components produced by many companies to build an over all IT-system is very complex, mainly due to incompatibility. The development of standard and open source gateways is supported by companies and bodies. With these products, companies can develop new and improved systems, which are able to communicate easily with each other.

There is still a lot of research needed to

standardize soft- and hardware systems on farms. The need and the necessity to put this goal into practice is understood and pushed forward.

Traceability in pig housing systems does not necessarily imply electronic documentation. But there are many advantages, e.g. improved speed and effectiveness for data analysis. Thus, central database or management systems will become more important. The implementation and operation of these systems need experts with very good technical and computer skills. Not every farmer will be able to handle these complex systems, but in larger farms, if there are computer or office specialists, there will be great potential for efficient data management and analysis.

Scientist and experts ask for, but also promote farm networks in livestock systems. This project contributes to a sustainable and integrated IT-system for traceability of meat and meat-product based foods without structural breaks and barriers within a heterogeneous hard- and software world.

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Advantages	Disadvantages
redundant data input and faults are avoided	implementation and operation need experts
automation of process documentation is simplified	there is no plug-and-play principle implemented
availabilty of electronically stored data is enhanced	only few products for network applications exist on the market
data analysis for different purposes, like traceability is easy to realize	data security has to be guaranteed
Working time and production costs can be reduced	investments for hard- and software increase

Table 1: Advantages and disadvantages of a „Farming Cell"