Matthias Rothmund, Munich

Integration of Business and Process Information within Agricultural Production Systems

Currently under development are the ISO-Standard 11783 (part 10) for data transfer between management and machines for agricultural data interchange, the ISOagriNET (planned as ISO 17532) for communication between facilities and management, and agroXML for data interchange in business processes. Although all formats are based on the data interchange language XML, they are differently structured and their contents are not sufficiently coordinated. Introducing a Web Service Architecture would allow keeping the necessary specifications for different applications, without restricting the compatibility for data interchange, as well as allowing the use of specialized data services.

Dr. Matthias Rothmund is head of the development department in Competence Center Embedded Systems of OSB-AG, Klenzestraße 38, 80469 München; e-mail: *m.rothmund@osb-ag.de*

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With increasing requirements on information exchange in and around agricultural production the discussions increase on standardisation and compatibility of interfaces for data exchange and networking, too. Within the areas of production and management, various systems already exist, independently for more or less distinct tasks, but, they come from different, independent roots. The challenge for the work of future standardisation is to combine the various data exchange formats from the areas of crop and livestock farming as well as farm management and connecting consultants and institutions in a useful manner.

ISO 11783 – ISOBUS

The ISOBUS standard defines the electronic communication between tractor and implements with the help of a CAN based protocol. With this approach, various applications and implements even of different kinds can be driven and controlled via a user-interface called „virtual terminal".

The data exchange between the farm management (Farm Management Information System, FMIS) and the mobile equipment (Mobile Implement Control System, MICS) is also defined in this standard (ISO 11783, part 10). Tasks can be prepared on a desktop PC, transferred onto the machine, processed, documented and then transferred back to the PC. The data exchange format, which is based on XML (Extensible Mark up Language), also enables the application and documentation of treatment zones in precision farming. This open interface can be integrated and used by software distributors and system vendors on their application software on machines resp. PC software.

ISOagriNET

In crop farming, the compatibility of electronics and information combining different kinds and brands of equipment is a sine qua non. In livestock farming, the common use of data from various different sub systems with different degrees of independence plays a major role. ISOagriNET (*www.isoagrinet.org*) creates a data network via an umbrella „data BUS", based on Ethernet and WLAN and a protocol for data exchange.

The main goal is again the global availability and usage of once only generated information as an input for the whole system, as well as the availability of data for management applications [2]. Examples for such applications are the use of data from milk production quantities for controlling the feeding process, or, interconnect subsystems in the breeding of calves for an improved feeding and health management [3].

For achieving this goal a common data model for different applications in crop farming is necessary. This model is being developed with previous data exchange formats in mind, such as (ADIS/ADED) based on XML (XML/ADED). The work on ISOagriNET shall lead to an international standard called ISO 17532.

agroXML

ISOBUS and ISOagriNET are mainly built for the communication with or within technical processes for controlling and documenting purposes. Therefore, their content and structure has to satisfy those requirements. Besides that, there is the requirement of exchanging data with various different partners in the business chain such as consultants, contractors, users, authorities. The industrial standard agroXML, which was mainly developed by research institutes and software developers under the lead of the German KTBL institute, fulfils this additional requirement. Based on XML a complex data scheme was developed which could generate documents for specific cases.

The difficulties in this is to establish a proper representation of „farming" bearing in mind spatial data in one data scheme and maintaining many lists like for example pesticides and species [1]. Given the fact that already in Germany, due to the federal system, many problems occurred while defining the structural content of the data format, such as production units, subsidy regulations, a much more international contribution would be an even more challenging task.

Commonalities and limitations

In order to reduce the complexity of the data model and to restrict its following data processing the exchange formats of ISOBUS and ISOagriNET are quite specific to the production process in the crop and livestock production. For example, it is very important to represent correctly the geometry between tractor and implement for working with treatment zones, but, not for the exchange of an application map to a consultant or contractor.

At the same time, there is certain amount of customer specific or accounts specific data necessary, which has no relevance to performing the task itself. The attempt to develop a general data exchange format for the whole area of farming would fail on the variety and number of different requirements.

Nevertheless, there is also data that is needed from both areas, business and process. Examples are machine identification, yield and application data, area or circumference data as well as customer records. Up until now there was no common data model available for these commonalities.

Potential solutions

Since it is not useful to define a complete and common data structure for all production and management areas of agriculture, there are two different approaches possible:

- integration of ISOBUS (ISO 11783) XML and XML/ADED into the agroXMLscheme, or,
- development and maintenance of „mapping“ interfaces for transferring data into the different formats of the other standards.

Since all of the mentioned data formats are based on XML, an integration of process oriented data from ISOBUS and ISOagriNET into the agroXML scheme should be possible. This could be achieved, for example, by introducing new XML elements such as <ISOBUS></ISOBUS> and <ISOagriNET ></ISOagriNET> into agroXML and a reference to these name spaces. The whole XML structure of the given format in ISOBUS- and ISOagriNET could be pasted inside these new elements. The ISOBUS- and ISOagriNET files will still be usable independently of agroXML.

In case of continuing, the independent development like so far, information from one data format must be „translated“ into the other format. In order to achieve this kind of work, the mapping interfaces to be developed need to have a certain kind of intelligence since the data due to structural differences cannot be simply matched into the other format. [4] have already developed such a mapping-interface based on a web-application.

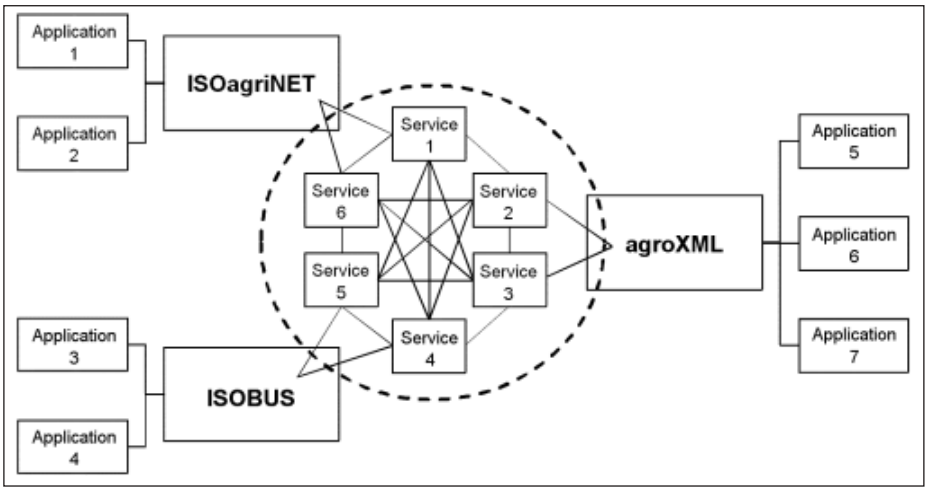

Fig. 1: Linking different „data spheres“ in an service oriented architecture

An SQL database layer is used on either side (ISOBUS and agroXML) to represent the structure of the formats. Specifically programmed mapping objects handle the exchange or translation between the involved layers in the data base. Since not all data formats consist of the same compulsory elements, it may be necessary to use additional information or manual additions.

Software developers, depending on their area, will be forced to implement either the ISOBUS and agroXML or ISOagriNET and agroXML or all three interfaces. These mapping devices will have to be maintained and further developed with accordance to all involved standards.

Distributed competences in a web-based environment

Currently being developed standards for web-based exchange of (geo-) data enable more and more to organise different tasks of data processing and administering (OGC-WEB Services, SOAP) in distributed systems. This opens the road for splitting complex tasks into reasonable-sized subtasks, so called services, and therefore using highly specialised know-how in the data processing itself, but, mainly in the system development and maintenance.

Treatment zones in precision farming can serve as an example for such a service-oriented architecture: the amount of fertilizers to be used on a part field could be the result of the interaction of services such as „process data“, „geo-data“ „yield maps“, „weather data services“, „soil“ and „application maps services“.

In a similar manner, such services could also process and deliver data for authorised business partners. First, a specific XML based exchange data document must be established for every bilateral connection, but only once, and then, after that document is known to both parties, all data requests and data upload could be done automatically.

Conclusions

At this point of time all standardisation efforts in the agricultural process- and business communication are very much independent and uncoordinated. They need either more integration and coordination, or a common umbrella architecture with a service-oriented approach for interacting as a system (*Fig. 1*).

With the help of standardised web services it is possible to use different, even very specific types of data structures, without endangering the compatibility of data exchange in the over-all system. Also for this approach, more harmonised data structures need to be achieved, but more important, coordination for the content of the various data formats is necessary. A complete unification or standardisation, which is very difficult, is no longer needed.

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