Stefan Böttinger, Bielefeld

Data integration

An example of the integration of field maps, satellite-supported software and GIS for AGRO-NET

The introduction of IT for the support of arable work began some 20 years ago with computer-based field maps. Out of the original IT reproduction of the paper version of field maps emerged, in the passage of the years, complex programs and program packets. Nowadays, nearly all the requirements that crop up with arable work can be processed with such programs. The Geographical Information Systems (GIS) appeared in the countryside in the 90s along with programs for spatially-variable cropping. In the beginning, these concentrated completely on new special aspects of agriculture. Nowadays, however, these widely-distributed programs have to be linked with existing IT solutions for field maps.

Dr.-Ing. Stefan Böttinger is development manager "Precision Farming and Logistics" with the firm Agrocom GmbH & Co, Agrarsystem KG, Potsdamer Str. 192, 33719 Bielefeld; e-mail: boettinger@agro-com.co

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The standard field maps nowadays are the result of around 20 years of development. The programs are influenced by the growing demands from practical farming and the necessity to support farmers in tasks required of them by the authorities.

Field map

The original main reason for field maps – which was to enable the noting of all activities out in the fields (what has been done, where, when and to what extent) – has been simplified by the attachment of on-board computers to agricultural equipment. In management administration, activities are planned, printed-out or transferred to the on-board computer. Data which is on paper has to be transferred into the program manually later. On-board computers receive the work plans via memory card and during the field work transfer input data with all relevant information for the field map onto this card. Through automation this data collection has achieved increased precision, the manual input of data into the program is no longer necessary.

Field maps offer the possibility of balancing nutrient applications for the optimising of crop production. Such program modules not only support the optimising of fertiliser application but also the administration tasks related to conforming to the fertiliser directives. Methods out of text books are used as algorithms for the optimising of fertilising as can also be expert programs linked, e.g., to the fertiliser industry.

For support of all activities classified under field work, field maps also offer program modules for crop storage and tenancy administration. Special modules, e.g., for sugar beet production support the import of data required for these crops such as delivery dates, price and estimates.

Based on the recorded costs and yields, field maps enable a wide variety of analyses. Field, farm and crop-specific evaluations can be calculated for one, or for several years. Additionally, most programs offer the possibility of individual evaluations over a freely-adjustable list designer. Evaluations for the complete farm and comparisons then take place over ring versions. With these, one can process as many data collections as one wishes and , through import possibilities, also data from other manufacturers' programs.

The support through field maps of EU application processes has attained special importance. The proof of area cropping can be processed into any of the different forms required by each of the federal states. Data transfer to the authorities is possible as printout or via data carrier.

The work with field maps is usually text-oriented. Basically, this is also a reason why DOS-based applications are still used nowadays. For some users, no imaginable advantage can be seen in the Windows applications. The changeover to a new program version takes place only when the user wants to extend the function capabilities for his enterprise or easier operation or when supports for the older version cease.

Programs for spatially-variable agriculture

With the beginning of the 90s the satellite-supported spatially-variable agriculture (precision farming/PF) found, bit by bit, its way out of R&D and into practical farming. The first input mapping system which was available in large quantities – on combine harvesters – required an office software for data import and export to the on-board computer on the machine, for administration of the data and for processing the raw data into yield maps. The presentation of the maps with these programs ran from simply-produced pixel maps with individual measuring points marked in colours relevant to the yield as such points, through to geostatically calculated contour-line yield maps. Data banks were mainly applied for data administration with file-oriented systems used in individual cases.

With the increasing spread of PF applications such as D-GPS based field border measuring and soil sampling, as well as spatially-variable controlling of tractors and implements, the demands also grew for a greater functional scope within such programs. Nowadays, as a rule, they support the importing and processing of the border lines of field strips, the planning of soil sampling and the importing of the results, the calculating of data from the most different sources and from different years, and the planning of spatially-variable management measures. The work with such programs is usually graphically based.

PF programs work with geographical coordinates. In that the spatially-variable field work in most cases is carried out with the help of the American global positioning sy-

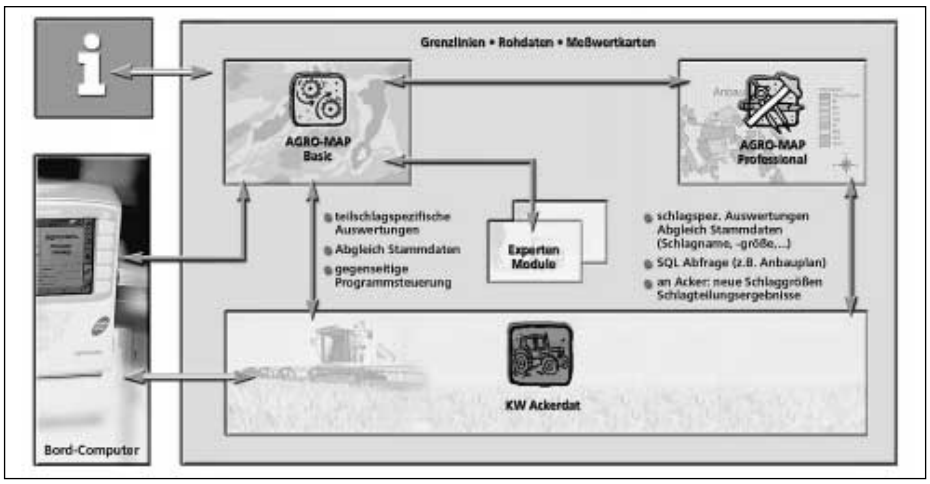

Fig. 1: Example of the structure of an integrated software package for agriculture

stem Navstar, these programs calculate with the WGS-84 co-ordinate system. For easier readability of the presentation and printout, the results are often transformed into a metric system.

Geographic information systems

Since around 1993, there has been a necessity, especially in eastern German farms, to record the administrative and land-ownership details for the area farmed. The Geographical Information System (GIS) found its way into agriculture in order to support such requirements. This software supported the import of already existing map material, the vectoring of grid information and the cutting out of overlapping structures. In association with the import of GPS supported field area measurements this allowed the fundamental information for EU farm cropping area certification to be secured with acceptable effort – even where large farming businesses were concerned. The identification of an officially recognised area of land, or a piece of this land, within a field strip, as well as measurement of its area, is very simple with such programs, as long as the basic information is available.

GIS can work from the home with the most different co-ordinate systems and projections and carry-out transformations into other co-ordinate systems. The fundaments for this, and information to help understand the relevant terminology in these software products, is usually not available for the person working in agriculture. For this reason, the development requires that the terminology of the GIS be adjusted to suit the user. One can then work with 'area', 'field strip' or 'field strip section' instead of respectively 'layers', 'attributes' or 'themes'. GIS can also be used for processing PF tasks. Based on the available GIS functions and co-ordinate transformations the tools for these tasks must, through appropriate extensions, be available in the programs.

Integration of GIS, PF software and field maps

Based on the described capabilities of these three program packets it is clear that the functions partly overlap and that the programs often use the same data for different tasks. For this reason the integration of these programs into a new program packet is attractive in order to:
- avoid duplicated input of data
- unite existing functions
- achieve comparisons of information and data between the programs, and
- enable new functions.

Using the example of the solutions selected by the company Agrocom for the AGRO-NET which was established from the integration of the field map KW-Ackerdat, the PF software AGRO-MAP Basic and the GIS AGRO-MAP Professional, the advantages which spring from this will be demonstrated. The principal structure of the integrated software is shown in *figure 1*. The user can choose the most suitable combination for the purpose in-hand or extend already existing programs with others. Constructing in this modular way makes possible the step-by-step and customised creation of the IT solution for every farm.

It is securely established through the association between field maps and GIS, through reciprocal data bank access (reading only) and transfer tables, that the identical field and strip structure is being used in both programs. Alterations, perhaps through graphically-supported field divisions in GIS, would be transferred to the field map with the new parameter input and field area details. Pre-defined field-specific information requests and freely-adjustable questions via a GIS Query Manager allow whole-farm evaluations and presentations. Questions can take the form of, e.g., the graphic cropping plan or the identification of all WW-fields with yields of > 8t/ha.

The basic information is also compared between field maps and PF software. New functionalities are created through a reciprocal program control. So, e.g., can it be possible to take details form the yield map direct in the physical recording for the respective field. For the creation of a spatially-varied gross margin map, the field-based individual values of the field map are replaced by spatially-variable figures from the PF software. Through the linking to the PF software of external expert modules from other suppliers can, e.g., different fertilising strategies be run through and their economical results determined.

The association between PF software and GIS enables the simplified exchange of data used in both programs. If a user supplements the system used up until now with a second program then the transfer of already present information can take place without problem. And this applies not only to the transfer of unprocessed data such as border lines but also the transfer of data that has been already processed for maps.

All three single programs offer further access points for the import of external information. Through the integration, this information is available over the identified access points for use by the other programs as well. Linking with the on-board computer is possible from the field map or PF program. If both programs are installed, then the linking is only carried out from the field map.

Summary

Historically, three different programs have developed for the computer-technical support of field work. Nowadays, the developer is required to integrate these solutions into one larger whole. The presented solution for the integration takes account of the historically-grown store of data which has usually been amassed by individual clients and offers these clients a step-by-step and customised extension of the software functional capabilities.