> *Function: Notes of S. Fountas et al.(2015)*
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Background

As the key factors for the success of agriculture nowadays are:

- timely information
- elaborated decision making

This paper presented a targeted review of current situation and future perspectives of Farm Management Information System(FMIS) from both an academic and commercial.

- The academic analysis: covers mainly the areas of systems architecture, applications, FMIS in Precision Agriculture (PA) and future trends.
- The commercial analysis: covers the FMIS currently implemented and in commercial.

Aim of this paper

The aim of this study was therefore to evaluate current FMIS designs and solutions available for farm businesses from both academic and commercial points of view in order to extract future needs and correspondence with current developments, both in terms of research development and commercialization.

Organization of this paper

The first section:

- presents the methodological approach for the selection of the agricultural domain;
- the procedure adopted to select the relevant scholarly contributions to FMIS development;
- the procedure adopted for the identification of commercial FMIS and the subsequent clustering procedure.

The second section:

- presents a targeted review of **academic FMIS** concepts and solutions.

The last section:

- presents **commercial FMIS**, showing a possible division in groups created through a two-step clustering analysis focusing on functions currently offered.

Methodology

The academic FIMS

The methodology for the academic FIMS review has a principle
of using selective keywords for the search in international academic databases. The specific keywords were:

- (i) farm management information system,;
- (ii) farm software,;
- (iii) decision support systems for agriculture;
- (iv) information management in agriculture,
- and combinations of the formers.

The commercial FIMS

Data Collection

The selected FMIS were focused on crop production and were centered on the farm manager as the primary user. Initially, to find relevant commercial applications, international FMIS vendors using English as the main language were selected. This allowed collecting data from United Kingdom, United States, Canada and Australia, as well as from other global software houses which provide their applications in English and have an English-based website. Then, the research encompassed also FMIS as representative of the larger European agricultural software market, made of mid and small companies which require applications in their native language. Therefore we collected data about products provided in French, German and Italian, because at least one of the authors has a good command over these languages (Table 1). The data were retrieved through a structured approach: First, we ran a web search in the country-specific languages using different keywords (e.g. farm management, farm software, agricultural management) to create an initial group of applications; secondly, we checked web portals dedicated to farmers; and finally, we validated our group of applications with the top three farmer unions in each country. The information retrieved from the software developers was analyzed using software demo versions when available. In 22 cases, the information provided from the website about the functions was ambiguous. Therefore, phone calls were made to the software vendors to collect the necessary information from a sale representative or technician. In total, 141 commercial FMIS from 75 different software vendors were analyzed according to services they offer to their respective users. The selected software applications were computer based (i.e. enabling farmers to organize work from the farm office) and supported web-based and mobile applications.

The review of commercial solutions involved the analysis of 141 international software packages, categorized into 11 functions.

Clustering analysis

Based on the data collected:

Table 2
Countries of origin for the commercial farm management information systems.

Function title	Function description
Field operations management	Includes the recording of farm activities. This function also helps the farmer to optimize crop production by planning future activities and observing the actual execution of planned tasks. Furthermore, preventive measures may be initiated based on the monitored data
Best practice (including yield estimation)	Includes production tasks and methods related to applying best practices according to agricultural standards (e.g. organic standards, integrated crop management requirements). A yield estimate is feasible through the comparison of actual demands and alternative possibilities, given hypothetical scenarios of best practices
Finance	Includes the estimation of the cost of every farm activity, input–outputs calculations, labour requirements, and so on, per unit area. Projected and actual costs are also compared and input into the final evaluation of the farm's economic viability
Inventory	Includes the monitoring and management of all production materials, equipment, chemicals, fertilizers, and seeding and planting materials. The quantities are adjusted according to the farmer's plans and customer orders. A traceability record is also an important feature of this function
Traceability	Includes crop recall, using an ID labeling system to control the produce of each production section. Traceability records related to the use of materials, employees, and equipment can be easily archived for rapid recall.
Reporting	Generally includes the creation of farming reports, such as planning and management, work progress, work sheets and instructions, orders purchases cost reporting, and plant information
Site specific	Includes the mapping of the features of the field. The analysis of the collected data can be used as a guide for applying inputs with variable rates. The goal of this function is to reduce or optimize input and increase output
Sales	Includes the management of orders, the packing management and accounting systems, and the transfer of expenses between enterprises, charges for services, and the costing system for labour, supplies, and equipment charge-outs
Machinery Management	Includes the details of equipment usage, the average cost per work-hour or per unit area. It also includes fleet management and logistics
Human resource management	Includes employee management, including, for example, the availability of employees in time and space. The goal is the rapid, structured

	handling of issues concerning employees, such as work times, payment, qualifications, training, performance, and expertise
Quality assurance	Includes process monitoring and the production evaluation according to current legislative standards

Cluster analysis was used to group current commercial FMIS as well as examine possible avenues for further development.

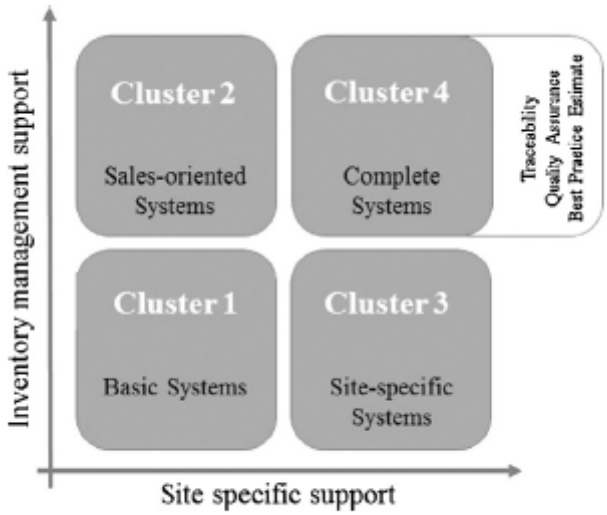

Fig. 6. Cluster categories.

Conclusion and Suggestion

Conclusion

Academic research

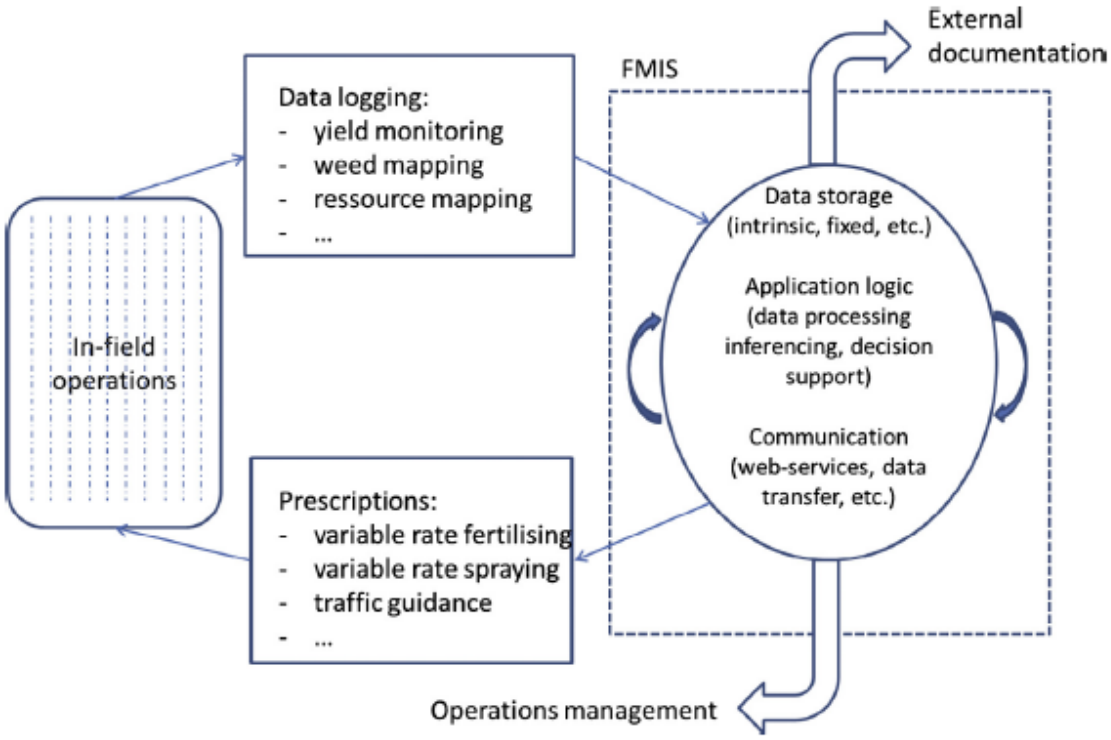

Fig. 1. Conceptual outline of precision agriculture FMIS.

Results indicated that on the question of academic research and its ability to accommodate advanced systems like PA, **academic research tend to analyze more complex systems, capturing new trends involving spatial and temporal management, as well as distributed system involving internet of things, future internet and web services**.

Commercial application

The commercial applications tends to focus on solving daily farm tasks and aim to generate income for the farmers through better resource management and field operations planning. In terms of the commercial applications being able to

adopt the innovations from research, this is the case to a large extent but it is foreseen that **software vendors must put extended efforts on adopting the more advanced systems and closely cooperate with academia in order to accommodate the requirements from, for example, PA**.

Suggestion

Key research representing areas for further development and improvement for currently available academic and commercial applications include:

- improvements in technology, adaptation motives, hindrances;
- specific new functionalities;
- greater emphasis on software design governed by usability and human-computer interaction.