



**POTENTIAL MAJOR GNSS APPLICATION AND MAJOR BARRIERS
TO GNSS USE**

FIELDFACT GNSS AGRICULTURE BARRIERS ADOPTION

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EXECUTIVE SUMMARY

This document reports on the identification of major Potential GNSS application and barriers to GNSS use in the agricultural community relating to aspects of technology, Market, Regulation, Standards and Certification; and Awareness and Training.

The FieldFact project explicitly addresses issues of Standards and Certification and Awareness and Training; therefore these aspects are reported in separate FieldFact deliverables. As potential applications are being addressed in the Critical Analysis Report of the project, this document reports on major obstacles for GNSS penetration originating from technology, market and regulation.

The EU Regulation provides for an important driver for location based services as they are explicitly and implicitly specified in the various Regulations of the Common Agricultural Policy. As a common regulation applies to all farmers that apply for EU aid, this further supports the case for the various aspects of standardisation of GNSS use.

As the identified agricultural GNSS applications are not critical in respect of human life or national security there are no legal barriers to its expanded use over Europe.

The availability of devices and dedicated software applications in various price ranges indicate that there are few technological or market barriers that prevent the agricultural sector from applying GNSS technology. In fact the major barrier for an GNSS application seems to originate from the real or perceived obstacles of the farmer and contractor community.



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1 INTRODUCTION

1.1 Purpose and scope

The report describes the work done to identify and discuss the potential major GNSS applications in the sector of agriculture and the major barriers to use GNSS in this business sector.

This document addresses the tasks defined for Work Package 1 in the Financial, Management, and Administrative Tender 2007 of the FieldFact project and responds to the objectives and actions defined in the Statement of Work:

- OBJ-7: To assess the major EGNOS/Galileo applications in this user community domain against all the different technical and non-technical aspects.
- ACT-25: The Project shall identify the remaining open points and barriers for the complete uptake of EGNOS/Galileo applications for the addressed user community.
- ACT-26: The identified open points and barriers will be mapped against the applications enablers:
- Technology;
 - Market;
 - Regulation;
 - Standards and Certification;
 - Awareness and Training;

This document focuses on the ACT-26 and gives description what are the main potentials and constraints for GNSS usage in the agriculture sector. OBJ-7 and ACT-25 are reported by other deliverables of the FieldFact project and referenced in the chapter below.

1.2 Intended audience / Classification

This Potential major GNSS application and major barriers to GNSS use report is designed primarily as a document creating a basis for successful promotion of GNSS use in the agricultural sector and to support the development of FieldFact demonstrators which are supposed to assist the GNSS promotion activities of the FieldFact project.

The document doesn't contain any confidential or commercial information and can support external readers in forming a vision of the major potential GNSS application and barriers to GNSS use in the agricultural community and is therefore classified as public.

1.3 Associated documentation and references

Deliverables of the FieldFact project are associated documentation to this report, in particular the Requirements Report (D2.1), the Critical Analysis Report (D2.3), Requirement Identification and Priority Report (D1.3) and stakeholder meeting reports.

Besides the project deliverables the following documents were used as a main source of information:



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- Statement of Work. GALILEO Research and Development Activities, 2nd Call, Area 1A, GNSS for Special User Community. Ref.: GJU/04/2412-SOW/MM/fk, Issue 1, 26/05/2004
- FieldFact Proposal. Financial, management and Administrative Tender. Version 1.0.1. 20/07/2006. FieldFact consortium.
- COUNCIL REGULATION (EC) No 1782/2003 of 29 September 2003
- COMMISSION REGULATION (EC) No 796/2004 of 21 April 2004 (and amendments)
- COMMISSION REGULATION (EC) No 972/2007 of 20 August 2007
- COMMISSION REGULATION (EC) No 1973/2004 of 29 October 2004
- European Patent: EP 0660660 B1, 10/09/1997 (DE 4342171 A1; US 5,754,137) "Process for taking action on productive lands"
- European Patent: EP 1811268 A1 „Methode zur Erzeugung von Referenzfahrspuren fuer landwirtschaftliche Arbeitsmaschinen“
- International Standard ISO 5725 "Accuracy (trueness and precision) of measurement methods and results"

Other references are indicated directly in the text.

1.4 Abbreviations and Acronyms

Acronyms and abbreviation used in this document are listed below.

CAP	Common Agricultural Policy
CAR	Critical Analysis Report
CC	Candidate Countries
EU	European Union
GAEC	Good Agricultural and Environmental Conditions
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	European GNSS Supervisory Authority
IACS	Integrated Administration and Control System
INSPIRE	Infrastructure for Spatial Information in the European Union
ISO	International Standards Organisation
IT	Information Technology
LPIS	Land Parcel Identification System
MS	Member State
OEM	Original Equipment Manufacturer



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- OGC** Open Geospatial Consortium
- OSS** Open Source Software
- PA** Precision Agriculture
- SIS** Signal in Space
- SMR** Statutory Management Requirements
- WP** Work Package



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2 DESCRIPTION OF WORK CARRIED OUT

As the main objective of the FieldFact project is to promote and introduce Global Navigation Satellite System (GNSS) services into the agricultural sector, it is important first to identify what kind of services GNSS technology can offer to the agricultural business and what are the main potentials. The same deliberation needs to be done also for the major potential barriers of GNSS usage in agriculture.

In general, GNSS technology deals with location-based services and all related value added services. In the context of agriculture, GNSS services can be used along the whole chain of food production. Livestock farming as well as arable farming also has great potential of GNSS applications, since spatial issues and managing geo-data form part of their daily work practices.

In order to distinguish the main potentials and barriers of GNSS use in agriculture, the main agricultural applications have been mapped against the examined following aspects:

- Technology;
- Market;
- Regulation;
- Standards and Certification;
- Awareness and Training

To achieve the objectives of this document, a first search has been made on EU CAP regulations which explicitly or implicitly hold a geo-location component that can be obtained through GNSS measurements. Second, a brief review of other legal documents, such as patents and property rights for some agricultural applications in reference to GNSS services has been undertaken.

Stakeholders involved in agriculture business were also offered a communication platform to express their views and perceptions on GNSS services. They articulated their views, where they see benefits in GNSS usage and what the constraints and barriers are in their eyes.

The subsequent sections examine the major potentials and barriers as identified in the frame of this project and report also the constraints and potentials as seen by the agriculture user community.



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3 POTENTIAL AND BARRIERS TO USE GNSS IN AGRICULTURE

3.1 Major GNSS applications and barriers in agriculture from the technological point of view

No specific technological barriers for GNSS application have been identified during this FieldFact project within the agriculture sector. However the precision aspect plays an important role within the agricultural applications. Precision farming is especially dependant on high precision data and reliable provision of these data.

The current GPS-based GNSS services need additional support of auxiliary data in order to satisfy the precision farming requirements. Here a strong improvement by Galileo services is expected by the stakeholders of the agricultural business domain.

3.2 Major GNSS applications and barriers in agriculture as seen by the market

Consumer expectations, involving both potential uses and perceived barriers, are probably the most important driver for the development of the GNSS market in the agricultural community. Although stakeholder considerations are identified and detailed in a separate FieldFact document (DEL 1.3), it is relevant to summarize the key potentials and barriers here.

Potential clients of Galileo devices and services identify three major opportunities resulting from its introduction: Firstly, Galileo would facilitate quality improvement of their products not only in the traditional product quality scope, but also extended to traceability and food safety that are expected to contribute to higher product prices in line with current marketing developments; Secondly they anticipate a cost reduction from an increased efficiency of production processes by savings on fuel, labour, fertilizer and pesticides. And finally, Galileo (and GNSS in general) is expected to enable farming practices in compliance with environmental measures such as environmental protection and soil conservation.

The potential clients understand GNSS implementation well, but perceive a number of constraints that could withhold them from embracing the technology. Above all, the financial cost, in terms of return of investments and in term of staff resources for training and use, is still considered the major obstacle that needs to be addressed. Further doubts relate to the operational reliability of GNSS signals and technical issues regarding the integration of the technology in the farming business. Examples of such difficulties are local dependencies of automated applications, inadequate agricultural models underlying these applications and a general low level of software standardisation and interoperability within the farm business cycle.

Producer constraints could not be identified. There are numerous GNSS device manufacturers that offer a wide range of specific products for marked segments as motoring, shipping and outdoor activities. In the domain of agriculture applications, several solutions are already on the marked, starting from the low-cost, e.g. F@rmphone, finishing on the professional ones offered for instance by John Deere. F@rmphone with its Guidomat home developed software can navigate the farmer driving the tractor when spraying whereas the John Deere's solutions can even drive the vehicle and optimize spraying almost without any interaction of the user.

Apart from offering dedicated software functions, these agricultural devices often integrate components from an Original Equipment Manufacturer (OEM components) that lift specific handicaps encountered with off the shelf mass-market devices, e.g. F@rmphone has all the



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functionalities of a mobile phone, an inbuilt camera and other gadgets that are offered by the mass-market devices.

3.3 Major GNSS application in agriculture from the legal point of view

3.3.1 EU CAP legislation

The Common Agricultural Policy (CAP) of the European Union is the policy framework established for direct aid payments to farmers. Implementation of this policy is carried out via the regulations specifying the Integrated Administration and Control System (IACS), which mandates the use of GIS and GNSS. These regulations have been reviewed in detail. However, national agricultural legislation of the Member State (MS) has not been analysed, since the national regulations have to comply with the European rules forming the minimum level of agricultural legislations of each MS.

A regulation is a legislative act of the European Union which becomes immediately enforceable as law in all Member States simultaneously. Several legislative documents relates directly to agricultural applications such as unambiguous position determination, area measurement and similar.

The Council Regulation (EC) No 1782/2003 is the basic regulation that establishes the essential rules for direct support schemes under the common agricultural policy, The Commission regulations (EC) No 796/2004 and (EC) No 795/2004 technically organize these essential rules for the implementation of cross-compliance, modulation and the integrated administration and control system provided and for the implementation of the single payment scheme respectively. The Commission Regulation (EC) No 1973/2004 set up the conditions for eligibility for community aid.

The EU CAP regulations relate directly to four specific spatially related applications:

- unambiguous parcel identification
- parcel boundary mapping for the LPIS creation and update
- correct parcel determination for eligibility validations
- spot location for compliance with GAEC and SMR, and soil/goods sampling

These already existing applications are based of GPS, thus the related accuracy issues and performance integrity are inherited from this system. Accordingly the agricultural user community is interested in optimized performance in terms of high accuracy positioning with cost effective solutions, high level of signal continuity and availability and provable location data and time-stamp using SIS authentication which is expected to be provided by EGNOS/Galileo.

3.4 Barriers to use GNSS in agriculture from the legal point of view

In the scope of this FieldFact project no legislative documents have been identified, neither European nor national which explicitly prevent the GNSS application in agriculture. On the contrary, Reg 796/04 specifically highlights the use of GNSS for the purposes of measurement and control of farmers' fields.

However, intellectual property rights for specific agricultural application have been identified which are protected by patent laws. The following patents, given here as examples, refer to agricultural applications where GNSS service play a key role:



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- European Patent: EP 0660660 B1, 10/09/1997 (DE 4342171 A1; US 5,754,137) “Process for taking action on productive lands”;
- European Patent: EP 1811268 A1 „Method for creation reference lanes for agriculture machinery“ (Methode zur Erzeugung von Referenzfahrspuren fuer landwirtschaftliche Arbeitsmaschinen).

In fact patent right does not represent a barrier to use GNSS in its strict sense, it merely calls for respect of the property rights and licensing. Moreover, patents on specific agricultural applications extend the potentials of GNSS application in the agricultural user community.

3.5 Major GNSS application and barriers in agriculture from the standardisation point of view

Lack of standardisation has been identified by some stakeholders as a major obstacle for GNSS applications in the farming business. The issue is discussed in separate FieldFact deliverables D4.5 and D4.9.

Ongoing developments are currently establishing a standardised legal and regulatory regime framework. For example, the INSPIRE Directive 2007/2/EC deals with harmonisation of coordinate reference systems and spatial and temporal profiles for geospatial data. In these standardisation developments, acknowledgment of existing technologies and existing standards is used to accomplish interoperability of applications on a technological and service level, rather than on an internal component level.

Several standardisation bodies can be identified (e.g. OGC, CEGRAL (<http://www.galileo-in-lbs.com>), certification for Galileo) that can easily cater for the needs of the agricultural market, given the technology, requirements and testing procedures are at hand.

3.6 Major GNSS application and barriers in agriculture from certification point of view

The current situation on using GNSS systems and services, most often GPS and/or DGPS based, envisages certification schemes mostly in safety related GNSS applications, such as aviation navigation. These schemes are designed for two purposes: first to test and qualify the GNSS equipment for a particular application and second to certify the operator of this equipment, saying that he possesses the required qualifications and is able to operate this equipment correctly.

However, the growing demand on high accuracy for an increasing number of agricultural applications requires certification schemes also in this domain. Precision Agriculture (PA) applications but also parcel area measurements and precise location determination in the frame of EU CAP regulations call for reliable navigation and/or positioning instruments fulfilling the minimum accuracy requirements.

From 1 January 2008, the European Commission Regulation 972/2007 requires that measurements are made by means proven to assure quality at least equivalent to that required by applicable technical standard, as drawn up at Community level. These standards include a minimum quality requirements for the instruments used for field inspection work

In order to validate these minimum quality requirements, extensive experiments were conducted and a certification test procedures was developed based on ISO standards (ISO 5725).



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Independent certification bodies, e.g. NavCert GmbH, perform the above certification test procedure on a commercial basis and issue certificates for those GNSS instruments that pass the test criteria.

In addition to the instruments certificates, operator certification schemes are also investigated by the JRC. Such schemas are mostly developed for a special target groups. The core of these schemes consists of lectures on GNSS background information and demonstration elements as well as practical training. These lectures often cover such topics as:

- background of the GNSS systems
- accuracy issues
- relevant agency operating policies
- operation of GNSS equipment, basic troubleshooting
- data collection procedures
- data output I formats appropriate for GIS and relational DB's

The accompanying hand-on exercises comprise following:

- pre-planning, including data quality objectives, equipment and materials needed, logistics of field data collection
- navigation to a given coordinate
- storing and transferring raw positional data
- data processing and outputting to a GIS data format

In the frame of FieldFact WP5 a training schema specially tailored for farmers and field inspectors has been developed aiming in promotion of GNSS in agriculture and also providing some hands-on exercises with GPS devices and FieldFact demonstrators to training participants.

The above mentioned certification schemes are currently based on GPS and were developed more or less independently tailored for specific targets group in absence of common concepts and standards. Therefore the current certification schemes are difficult to compare with each other in terms of basic requirements for GNSS equipment and the level of qualification obtained during trainings such as depth of knowledge and practical issues.

A consolidated set of core requirements for both devices certification and trainings for operators needs to be established. Such a set of requirements might lead to a classification of devices and will allow the end user easily to determine the quality of the device and decide which category suits best his application.

3.7 Major GNSS application and barriers in agriculture from the training and awareness point of view

This topic is dealt with in detail in WP5 by UWM (Poland) and discussed briefly in section 3.6 (certification) above.



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4 CONCLUSIONS & RECOMMENDATIONS

This 'Potential major GNSS application and major barriers to GNSS use' report studies the general drivers and obstacles that relate to the further penetration of GNSS within the agricultural community. It forms the basis for successful promotion of GNSS use in the agricultural sector and in consequence the development of the FieldFact demonstrators that assist this GNSS promotion.

Five aspects have been examined: technology, market; regulation; standards and certification, and awareness and training. A major part of these are specifically addressed in other work packages of the FieldFact project, technology and market enablers are dealt with in WP7, awareness and training are covered by WP5 and WP6. Standards are dealt with under WP4.

The EU Regulation provides for an important driver for location based services as they are explicitly and implicitly specified in the various Regulations of the Common Agricultural Policy. As a common regulation applies to all farmers that apply for EU aid, this also supports the case for the various aspects of standardisation of GNSS use.

As the identified agricultural GNSS applications are not critical in respect of human life or national security there are no legal barriers to its expanded use over Europe. In fact the major barrier for an GNSS application seems to originate from the real or perceived obstacles of the farmer and contractor community.

Since FieldFact is in essence a promotion project, it needs to clearly address all these stakeholder constraints to lift the barriers that stand between further penetration of GNSS use in the agricultural community.