Growing Together:

Opening the Way for Comprehensive Public-Private Knowledge Management

KES 2011
15th Annual Conference on
Knowledge-Based and Intelligent
Information & Engineering Systems

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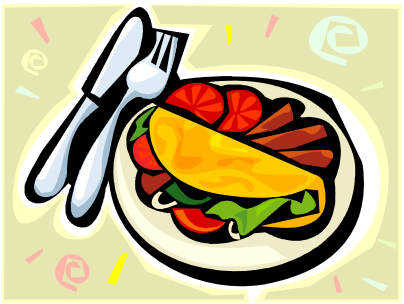
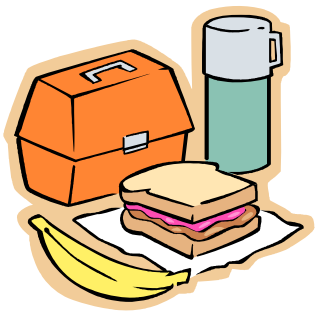
Did you enjoy your Lunch?





Let‘s talk about

FOOD

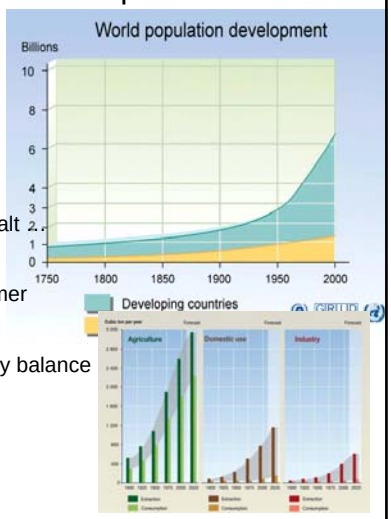
Plant Production

Focus of the R&D project

- Most of the following stems from this project -

Need for increased efficiency in agricultural production

- Increasing demands for food quantity and quality
- Resources are limited
  - Arable soil
    - Limited & in danger: Building, erosion, salt ...
  - Water
    - Agriculture is the most important consumer
  - Energy
    - Nitrogen fertilizer biggest factor in energy balance
- Tight competition
  - Tank or table?
- Sufficient & sustainable agricultural production asks for smart solutions: Produce more & better, using less!



Source: Sir John Beddington, Manchester 2011

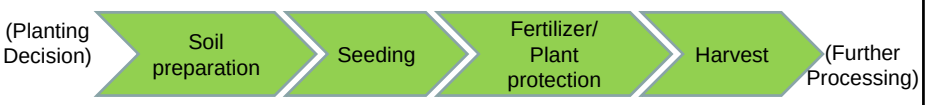
What can

IT / AI / Knowledge-Based Systems

do about that?

Let‘s have a closer look…

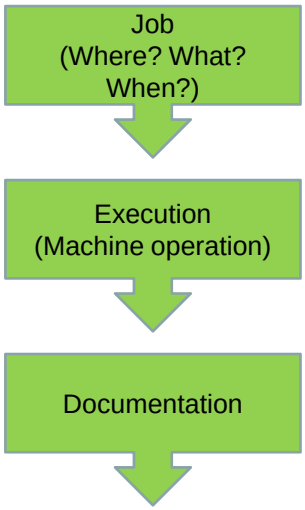
The plant production process comprises numerous decisions



- Decisions: Where? When? What? Require knowledge about many influencing factors
- How can we collect and use the information generated in the field & over the year?
- How can the decisions of the farmer / operator be supported in the field?

The information generated during the year must grow together!

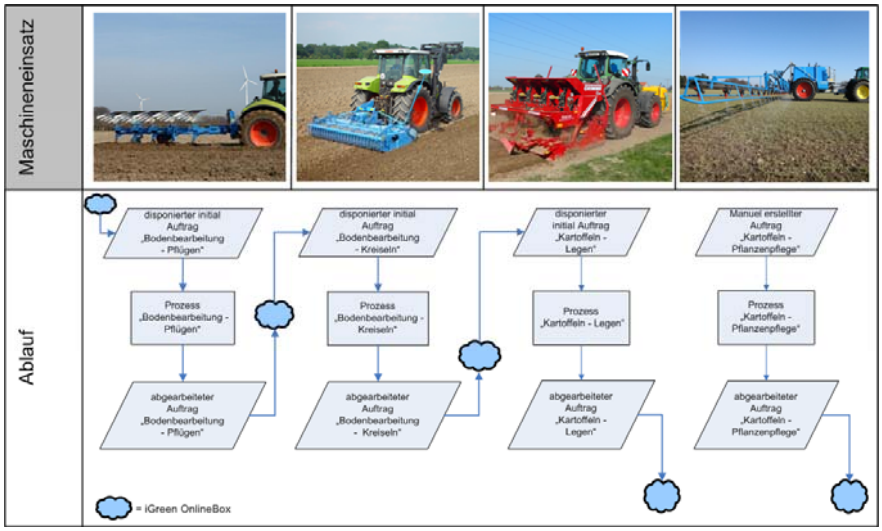
Agricultural work processes pose IT challenges



Challenges:

- How can a farmer specify location data for a job?
  - Field location and job definition via internet-based GeoForms
  - Using and integrating public geo data
- How to transmit the relevant data to the machines?
  - Communication in unreliable situations
- How to use sensor data and mobile user input effectively?
  - Documentation support, knowledge creation

Information flow over time: Potato production



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„Integration of location-based data is the key to Knowledge Management in agriculture“

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Key participants: Many islands must grow together!

- Farmer
  - Responsible decision maker
- Contractor
  - Execution of selected operations
- Consulting services
  - Location- & situation-specific know-how
  - Private or public institutions
- Suppliers
  - Materials & their application characteristics
- Consumers
  - Ask for traceable, well-produced, well-tasting, healthy, and cheap products
- Public & Governmental institutions
  - Regional, national and international level
  - Mandatory data collections
  - Rules & regulations
  - Subsidies



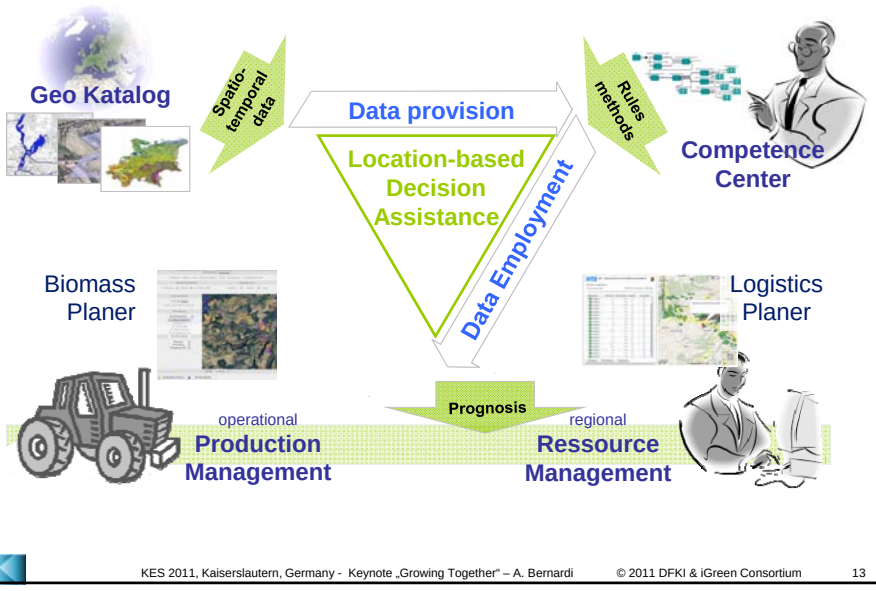




Multiple participants will profit from efficient knowledge exchange

- Public geo data
  are a valuable basis
  for location-specific services
- Mobile access to data, knowledge sources, and services enable effective support on site
- The combination of public and private actors facilitates comprising and efficient services
  - e.g. improved consulting combining public data and private services
  - e.g. better data by exploiting individual sensor data

Example: Geodata and consulting know-how support operative activities



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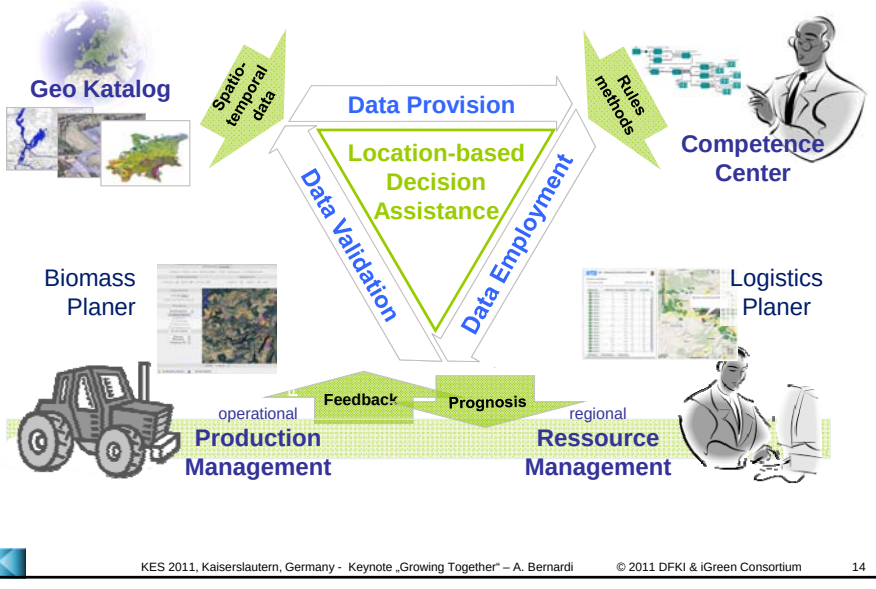
Example: Feedback improves the data & knowledge



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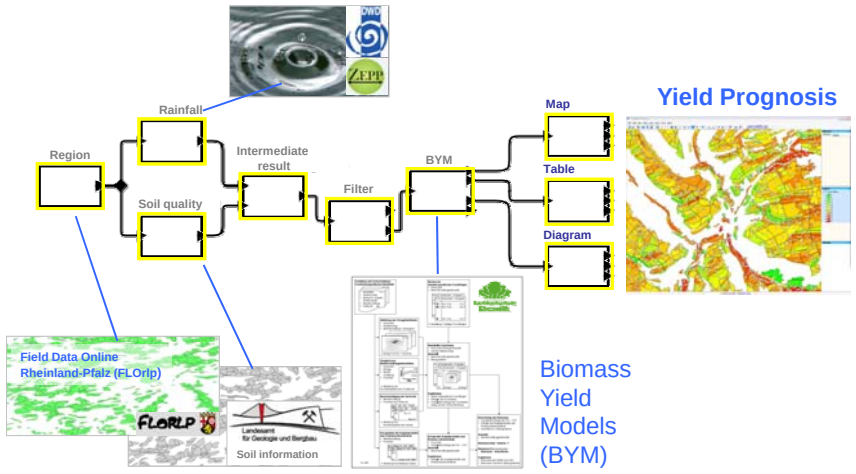
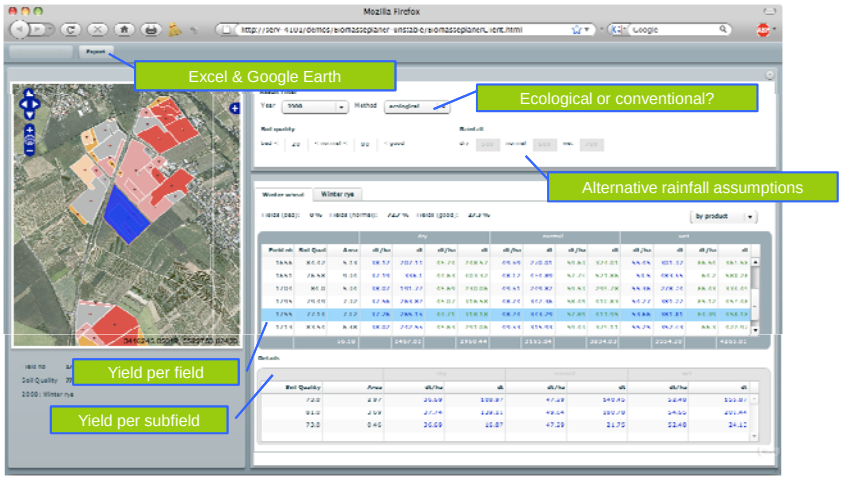
Example: Yield prognosis based on combination of data

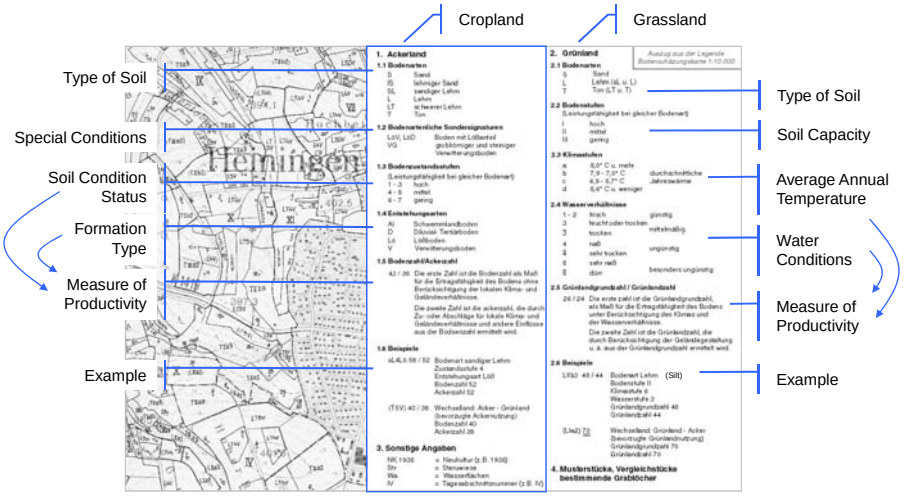


* Zentralstelle der Länder für EDV-gestützte Entscheidungshilfen und Programme im Pflanzenschutz

Interactive Presentation of the calculated predictions



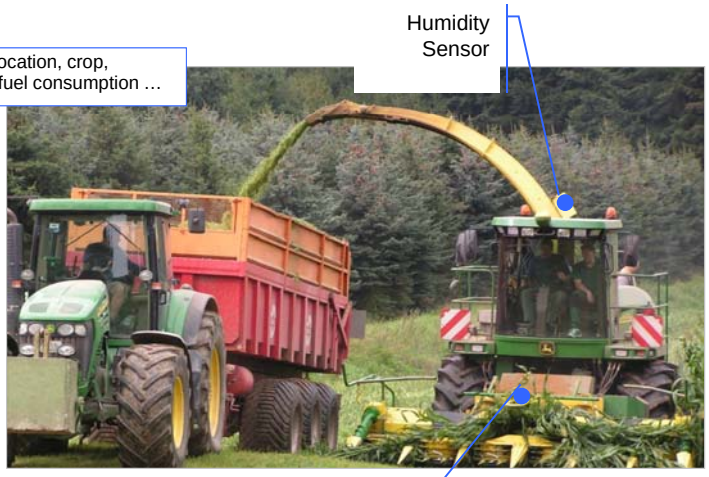
Soil quality maps provided by state government and available to farmers describe various aspects of farm land



Digital soil quality maps provided by state government allow farmers to get an overview about the quality of their fields

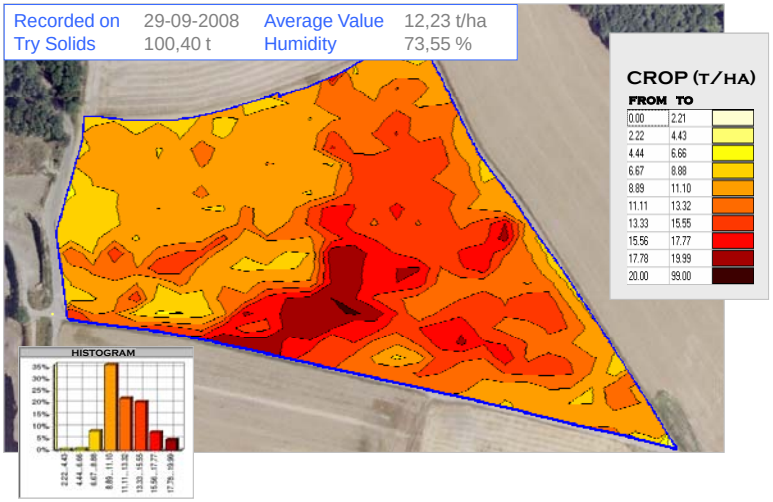
Agricultural engineering provides relevant location-based data

Recording of location, crop, humidity, and fuel consumption …



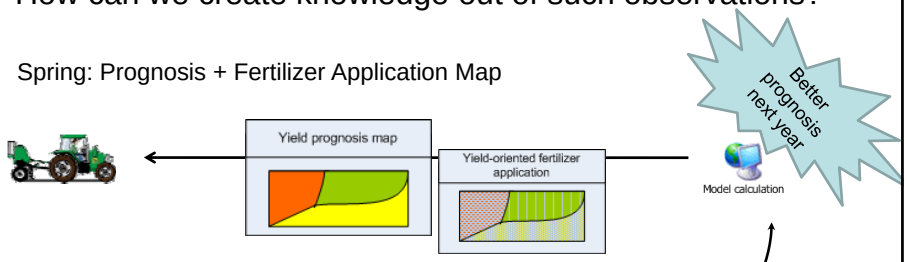
Location-based recording of crop data leads to an up-date of soil quality maps

Recorded on	29-09-2008	Average Value	12,23 t/ha
Try Solids	100,40 t	Humidity	73,55 %

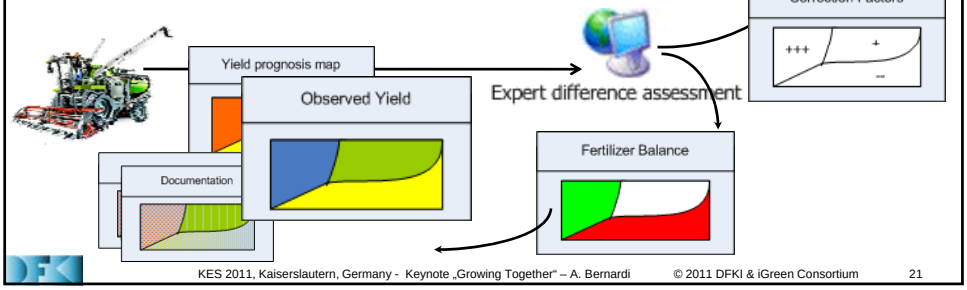


How can we create knowledge out of such observations?

Spring: Prognosis + Fertilizer Application Map



Fall: Harvest + Observed Yield Map



How can a contractor locate the fields?

Internet-based GeoForms allow the farmer to define location-specific job orders

… using public geo data (from field subsidy procedures)

An open communication infrastructure is basis for all participants

Open, manufacturer-independent solutions are crucial

- Farmers & contractors use machines from multiple suppliers
- Existing proprietary approaches suffer from missing user acceptance

- Today‘s possibilities for data collection far outreach established procedures for data usage
- Data, collected today, must be usable for yet unknown services tomorrow!

iGreen develops a communication platform for the exchange of data, knowledge,and services

- Semantic Technology:
  - Easy understanding of shared data, due to explicit information about meaning and data format
  - Easily extensible at any time
- Service Orientation:
  - Flexible orchestration of multiple components
- Manufacturer-independent exchange
- Combination of public and private sources for data and knowledge

The Challenge: Flexible Data Handling

- „*Before talking about sensor data, provide me with a flexible solution for storing and managing such data*“LU Marx
- Goal: Universal data management for individual participants
  - Flexible storage, including new attributes/values
  - Allows to easily publish data
  - Open for extensions (as data might become valuable in the future)
  - Browsing in collected information
  - Interfaces to sources and users
- Requirement: Individual ownership & control of data
  - Local storage with controlled exchange in P2P networks

iGreen relies on Semantic Technology

- Approach: Semantics of data is made accessible for the computer

Attribute	Value
Formally defined vocabulary „Concept“, „Relation“ Can be extended at any time	Formally specified value ranges Can be extended at any time

„Ontology“

- Applications (Programms) can „look up“ Character and semantics of data at runtime

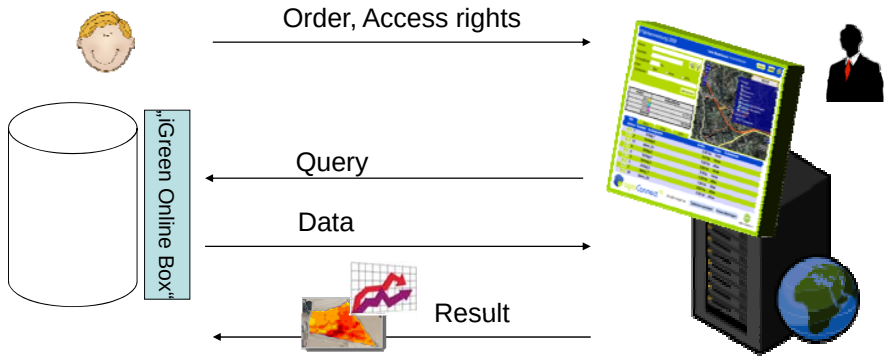
Don‘t try to standardize the data, but enable flexible sharing & uptake!

- Standards are useful and efficient, but standard creation is cumbersome
- Look at the flexibility & power of Web 2.0 and „Linked Data“!
- Approach: Enable to handle diversity!
  - Not one standard data model
  - but specify which data model YOU use
- Promise: Easy „Mashup“ of data and web services

Separation of concerns results in Win-Win-situation

- Data owner:
  - Make data available! (Electronically, with easy-to-use tools)
  - Acess control, privacy, trust
- Service provider:
  - Care for understanding available data
  - Possible due to the semantic technology basis

iGreen-Vision: Services initiate the Data transfer



- Data owners make data available online
- Services issue queries and obtain the necessary data
- Crucial: Shared vocabulary / Ontology!

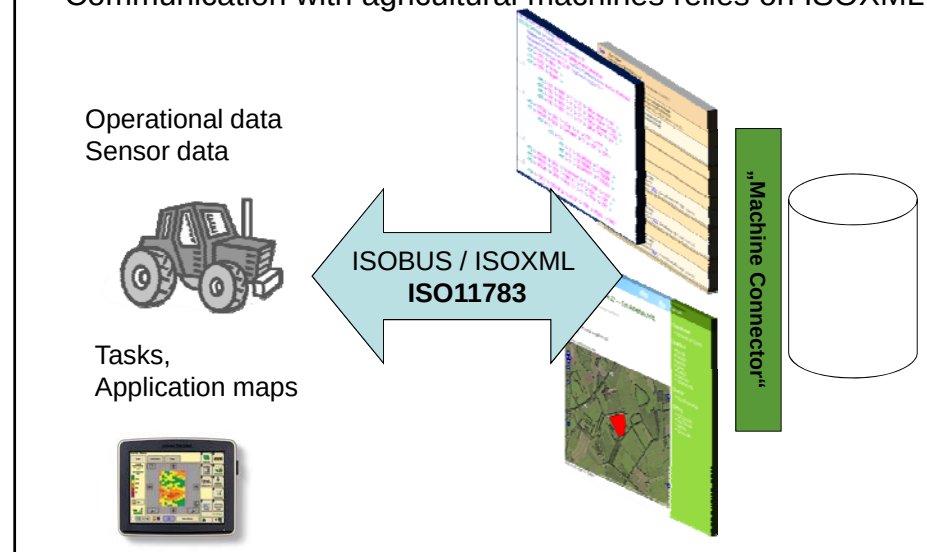
An „Ontology Universe“ is the basis for understanding

- Partners exchange „documents“
- Form of a document is described in the Information Elements Ontology
  - „Schema in a schema-less data world“
  - Flexible extensions by users
  - Shared ontology development, using wiki support
- Content refers to concepts from domain ontologies
  - International vocabularies (FAO)
  - Procedure & component descriptions („AgroRDF“)
  - Public crop lists
  - Official lists of pesticides & fertilizers
  - …

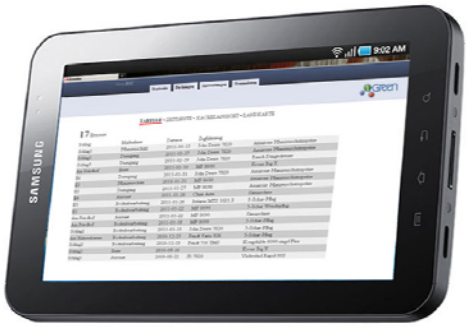
iGreen Infrastructure – make it easy to share data!

- Adressing of data sources & services
  - DNS IP-NameServer, Web service registry
- Transmit requests, results, data
  - http/REST
  - RDF data format
- Make vocabulary explicit
  - FAO AgroVoc, AgroXML -> AgroRDF
  - Vocabulary server
  - Individual extensions possible
  - Translation by individuall converters (supported by generation workbench)
- Authentication
  - Single-Sign-On in dedicated domains
- Make data available
  - „OnlineBox“ as reference implementation
  - Integration with OGC-compliant geo data infrastructure

Communication with agricultural machines relies on ISOXML



Mobile Devices facilitate human-centered information access!



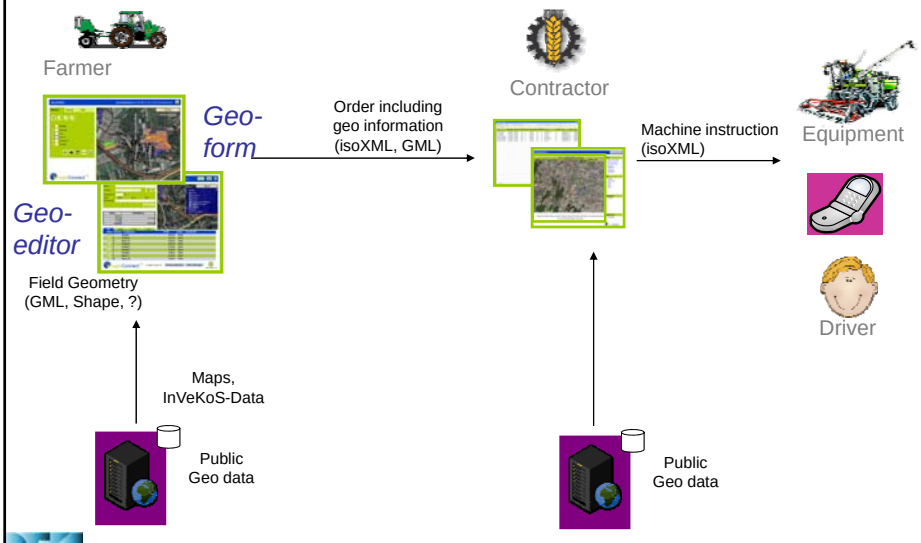
Example: Prototype of a mobile documentation assistant, using Samsung Galaxy

- Personal access to data and services
- Flexible, rapid technological progress, high personal acceptance
- Development is ongoing…

Using Smartphones et al. as universal information assistant in direct connection to machines and sensors seems a promising approach!

Service orientation asks for understanding the chain of interconnected, atomic operations

Example: Order transmission support for contractors

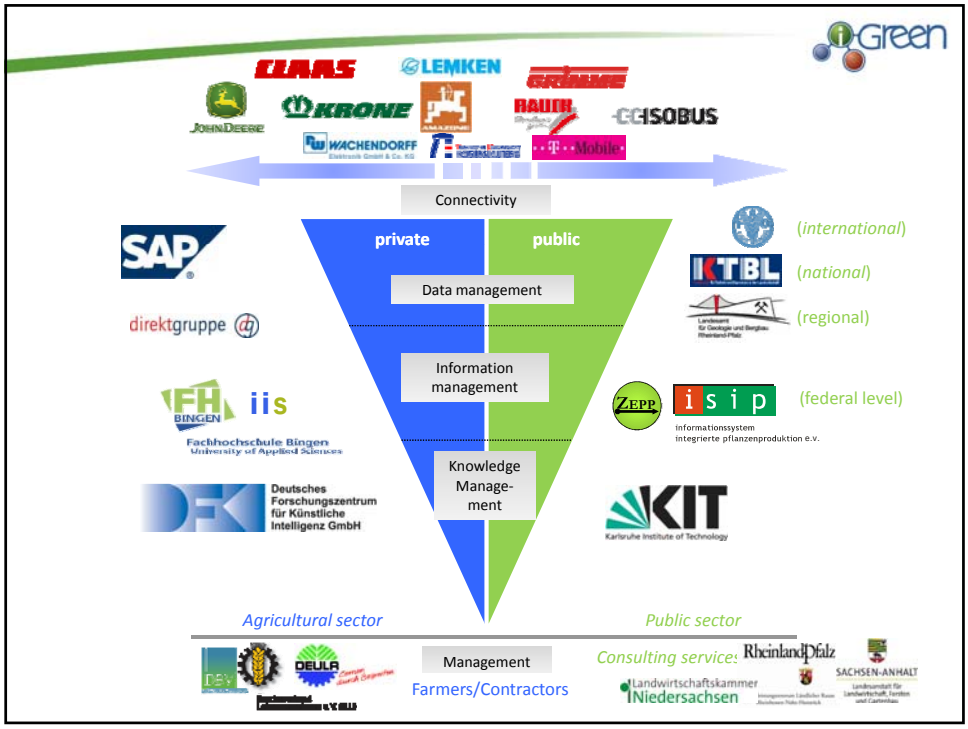


The issues discussed reach well beyond crop production

In general, decision support systems in crop production provide important contributions for recent questions in:

- Food and energy production
- Environment and climate protection
- Optimization respecting the use of fertilizers and fuel

The iGreen project unites a powerful consortium


iGreen
Connectivity
private
public
Data management
Information management
Knowledge Manage-ment
(international)
(national)
(regional)
(federal level)
Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Agricultural sector
Public sector
Management
Farmers/Contractors
Consulting services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Summary (I)

- Agricultural production needs increase in efficiency
- Agriculture profits from inter-organizational, public-private knowledge management
- Integration of location-based data is the key to knowledge management in agriculture
- Mobile applications provide support in the field
- Decentral solutions guard individual data control

Summary (II)

- Semantic Technologies offer flexibility, openess, and mutual understanding of shared data
- Collaborative exchange between public and private partners leads to comprehensive knowledge generation

Agriculture is a promising application area for intelligent technologies in a complex collaborative setting –

Let‘s grow together!