Information and communication technologies in agriculture and agribusiness

Past development, current status, perspectives and development needs

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• Why we are dealing with this subject?

• What lies behind us?

• Where are we?

• What awaits us in the future?

• What consequences can we expect?
General Challenges for agriculture

Habitats & Biodiversity

Culture & Landscape

Food and Nutrition

Climate

Biomass

Competitiveness

Rural Areas

Ressource-Management

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Challenges for Agriculture

Task:
Agriculture, including its upstream and downstream areas, is required to explore and immediately implement all optimisation potential and this is increasingly prompted by the integration of information and communication technologies.

Challenges
~ Food Security
~ Food Safety
~ Resource Conservation
~ Satisfaction of social demands

IT – Implications and obstacles:
~ Growing demands for data diversity and quality.
~ Information management through innovative services' products.
~ Integration of value chains and regional clusters by means of digital communication media.

- Extended small business structures.
- Increasing multi-functionality.
- Operational structural asymmetries.
- Changes in organisation and governance.
- Isolated Software applications.
- Limited broadband connection in rural areas.
Outline

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<table>
<thead>
<tr>
<th>Period</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1620 – 1680</td>
<td>&quot;Calculating Clock&quot; by Wilhelm Schickard, mechanical adding machines of Blaise Pascal and Gottfried Wilhelm Leibniz</td>
</tr>
<tr>
<td>1800 - 1840</td>
<td>Punch cards to control looms by Joseph-Marie Jacquard, universally applicable calculating engine of Charles Babbage</td>
</tr>
<tr>
<td>1870 - 1900</td>
<td>Invention of the telephone (Philipp Reis, Alexander Graham Bell), Herman Hollerith founds the Tabulating Machine Company Ltd. (later IBM)</td>
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<tr>
<td>1930 - 1950</td>
<td>Freely programmable computer of Konrad Zuse (Z1), Howard Aiken and IBM (Mark 1) and John von Neumann (ENIAC)</td>
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<tr>
<td>1958</td>
<td>Development of the &quot;modem&quot; by engineers at Bell Telephone Laboratories</td>
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<tr>
<td>1969</td>
<td>Commissioning of the first computer network &quot;ARPANET&quot;</td>
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<tr>
<td>1978</td>
<td>First 16-bit processor (8086) from INTEL</td>
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<tr>
<td>1979 - 1981</td>
<td>First application programs (e.g. WordStar), operating system MS-DOS 1 of Microsoft, mass production and standard personal computer (PC) by IBM</td>
</tr>
<tr>
<td>Since 2000</td>
<td>UMTS, “New Economy”, Web 2.0, Agriculture 4.0, ……</td>
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</tbody>
</table>

Source: Team Informatikjahr 2006
Doubling of complexity of integrated circuits every 18–24 months
Information systems for agriculture in development

Until about 1975
Manual systems (chronological)

Until about 1985
Manual systems (systematic)

Until about 1995
IT-supported individual applications

Since about 1995
Integrated systems
Precision Farming – Past and Present

Structural change and technical progress
Why we are dealing with this subject?

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Bi- and multi-lateral business relations along the value chain

Stage-spanning integrating key factors:

- Quality
- Logistics
- Technology
- Regulatory framework
## Availability of information and information systems

<table>
<thead>
<tr>
<th>Level</th>
<th>Information systems/technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>• Part or fully automatic control and regulation systems</td>
</tr>
<tr>
<td></td>
<td>• Global Positioning Systems (GPS)</td>
</tr>
<tr>
<td></td>
<td>• Precision Agriculture</td>
</tr>
<tr>
<td>Operating branches</td>
<td>• Branch Software Solutions</td>
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<tr>
<td></td>
<td>• Standard Software Solutions</td>
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<tr>
<td></td>
<td>• Remote Sensing Systems</td>
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<td></td>
<td>• Geographic Information Systems (GIS)</td>
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<tr>
<td>Enterprises</td>
<td>• Branch Software Solutions</td>
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<tr>
<td></td>
<td>• Standard Software Solutions</td>
</tr>
<tr>
<td></td>
<td>• Local Networks</td>
</tr>
<tr>
<td>Spatial/temporal extension</td>
<td>• Global Positioning Systems (GPS)</td>
</tr>
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<td></td>
<td>• Geographic Information Systems (GIS)</td>
</tr>
<tr>
<td></td>
<td>• Complex network systems</td>
</tr>
<tr>
<td></td>
<td>• E-Business</td>
</tr>
<tr>
<td>Sector</td>
<td>• Open web-based platforms</td>
</tr>
<tr>
<td></td>
<td>• National and international information systems</td>
</tr>
<tr>
<td></td>
<td>• Global Network Systems</td>
</tr>
</tbody>
</table>
Development and status quo

1. Product
2. Intelligent Product
3. Intelligent Integrated Product
4. Intelligent Product System
5. System of Systems

Quelle: Eigene Darstellung nach Porter und Heppelmann (2014)

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Development and status quo

1. Animal

2. Technology

3. Intelligent Technology

4. Integrated Intelligent Technology (System)

5. System of Systems
   - Datenerfassung
   - Produktionsdaten
   - Umweltdaten
   - Tieridentifikation
   - Einzeltierspezifische
     - Datenaufbereitung
     - Prozesssteuerung
   - Qualitätssicherung
   - Herdenmanagement
   - Vernetzung mit Precision Crop Farming

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Why we are dealing with this subject?

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Perspectives /
The driving factors

Economic and market factors:
• Optimisation of production processes
• Efficient farm management
• Inter-enterprise information systems
• Electronic business processing
• Value Chains
• Quality assurance and traceability

Examples:
~ Precision Farming
~ E-business in the seed trade
~ Examples of value chains

Technological developments:
• Hardware Development
• Software Development
• Data availability and quality
• Network
• Organizational progress

Examples:
~ Integrated branch software
~ "Nutriweb"
~ Standardised data formats (agroXML)
~ Integrated Value Chains
~ Mobile Technology
~ Robotics

Environmental and sustainability issues:
• Cross compliance
• Indicator Systems for Environmental Monitoring
• Life Cycle Assessment

Example:
~ Enterprise assessment systems for sustainability measuring

Social aspects:
• Progress on Data Protection and Privacy
• Communication and social interaction
• Appreciation of IT benefits

Example:
~ Web 2.0 and developments
# Perspectives / The driving factors

## Economic and market factors:
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Objectives:
(1) Production optimization
(2) Assessment of variability
(3) Site-specific management
(4) Conservation of resources and the environment
Sensor technology (real time)

Measurement → Calculation → Spreading

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Farming of the future

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Precision Agriculture

Precision Farming

Precision Livestock Farming

Differentiated collection of production and environmental data

Satellite tracking

Animal identification

Site-specific
- Data processing
- Process control

Individual animal-specific
- Data processing
- Process control

Quality assurance along the agro–food value chain

IT-supported dairy farming
Farming of the future
Steps to enterprise improvement

1. Internet-präsentation
   - Verbindung zur Adressdatenbank

2. Internet-kommunikation
   - Verbindung zum ERP-System

3. E-Business
   - Verbindung zu Lieferanten, Partnern und Kunden

4. Real-Time Enterprise
   - Gemeinsame Wertschöpfung

- Interaktion in der Kommunikation
- Interaktion in den geschäftlichen Transaktionen
- Interaktion entlang der Wertschöpfungsketten
- Wechselseitiger Informations- bzw. Wissenszuwachs
- Individuelle Datenaufbereitung

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Example:
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✓ For each enterprise.
✓ Extra easy to use.
✓ Never again manage data twice.
✓ One card instead of a thousand lists.
✓ Documentation made easily.
✓ Compatible in all directions.
✓ You know it makes sense.
✓ Be better tomorrow than today.
✓ Data access per server.
✓ Mobility guaranteed.
„Nutriweb“ as practical example:

- Farmer
- Marketing Organisation
- Slaughter house
- Veterinarian
- Animal feed suppliers
Agro–Food–Supply Chain integration

Farmer → Slaughter house → Processing operation → Retail trade

Identity Management
Discovery Service
Master data

Central infrastructure

Decentralised storage of results and production data

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## Smartphone Apps – Examples from the agricultural sector

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrarmarkt</td>
<td>Agricultural market information with price alert</td>
</tr>
<tr>
<td>AgriCours</td>
<td>Exchange rates of the MATIF (French)</td>
</tr>
<tr>
<td>BayDir Wetter</td>
<td>Weather information and forecasts for agriculture</td>
</tr>
<tr>
<td>Herakles Feld Assistent</td>
<td>Acreage index with synchronisation to HELM Multi Plant and myfarm24.de</td>
</tr>
<tr>
<td>iOutbank</td>
<td>Mobile online banking with proven data security</td>
</tr>
<tr>
<td>Landwirt.com</td>
<td>Used machinery exchange with radius search</td>
</tr>
<tr>
<td>Schadbilder</td>
<td>Diagnoses of diseases in crops</td>
</tr>
<tr>
<td>SprayCalc</td>
<td>Computer for determination of pesticides mixtures</td>
</tr>
<tr>
<td>traktorpool</td>
<td>Used machinery exchange with radius search</td>
</tr>
<tr>
<td>Wetter.info</td>
<td>Weather forecast with rain radar</td>
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Source: DLG – Info 11 /2010
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Example:
~ Web 2.0 and developments
Computer-based indicator systems for measuring and evaluating the environmental compatibility, economic efficiency and social situation of an individual farm.

Criteria system for sustainable agriculture (KSNL)

DLG-certification system "Sustainable agriculture"

Response Inducing Sustainability Evaluation (RISE)
Perspectives / The driving factors

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Data Protection and Data Security:

- Sensitive area.
- Importance increasing with increasing integration.

Progress through ...

- Secure user identification.
- Suitable network topologies.
- Systemic registration of modification access.
- Separation of user data and content data.
Content-based Web 1.0 ("networked documents")

+ Social–interactive Web 2.0 ("networked persons", "networked services")

= Web 3.0 ("networked data", "networked (semantic) services")
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Expectable consequences and necessary enterprise competencies

- Productivity improvements, especially increased labour productivity
- Structural changes in work content
- Relaxation of working hours and labour force attachment
- Risk Changes
- Growth Potential
- Improved quality of data and information

Requested farmers skills:
- Information and communication capabilities
- Curiosity and creativity
- Motivational skills
- Organizational skills
- Leadership and social skills
- Willingness to take risks
- Strategic thinking
Summary and Conclusions

- Growing challenges for agriculture.
- Any optimization potential must be exploited.
- Integration of ICT becoming increasingly important (Megatrend “Digitalization”).
- Economic and market factors, environmental and social aspects can be identified as the driving forces to penetrate the industry.
- Connected with this development, business requirements are growing and opening up open spaces.
Thank you for your kind attention!

"This will be the new navigation system that I warned your father about."

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