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An On-Farm Communication System for Precision Farming with Nitrogen Real-Time Application

by

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Introduction

Electronics systems become more and more important in agricultural engineering.

With Precision Farming enormous research activities were developed world-wide.

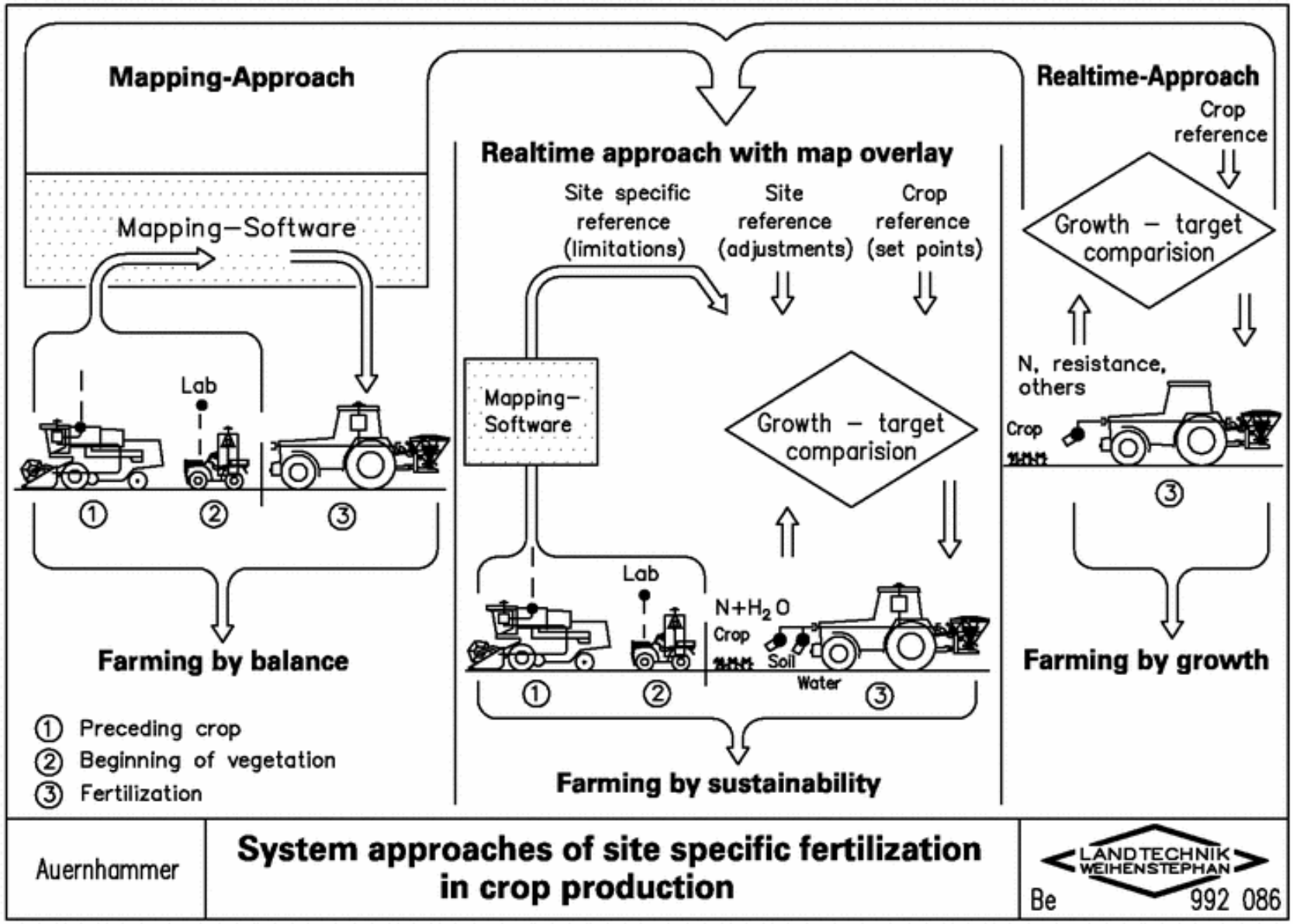
New international conferences in Europe and in the United States turn exclusively to this range of topics.

Main starting points are situated in closed cycles with yield detection, soil sampling and prediction into fertilization.

Approaches for site specific plant protection are in scientific handling (Second European Precision Farming Conference 1999).

First attempts refer the different planting densities also into a total system.

Two systematically different approaches with emphasis in the USAandin Europe are pursued with fertilization.


Mapping-Approach
Mapping–Software
Lab
①
②
③
Farming by balance
Realtime approach with map overlay
Site specific reference (limitations)
Site reference (adjustments)
Crop reference (set points)
Mapping–Software
Growth – target comparision
Lab
N+H2O
Crop
Soil
Water
①
②
③
Farming by sustainability
Realtime-Approach
Crop reference
Growth – target comparision
N, resistance, others
Crop
③
Farming by growth
① Preceding crop
② Beginning of vegetation
③ Fertilization
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System approaches of site specific fertilization in crop production
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Real-time approach with map overlay

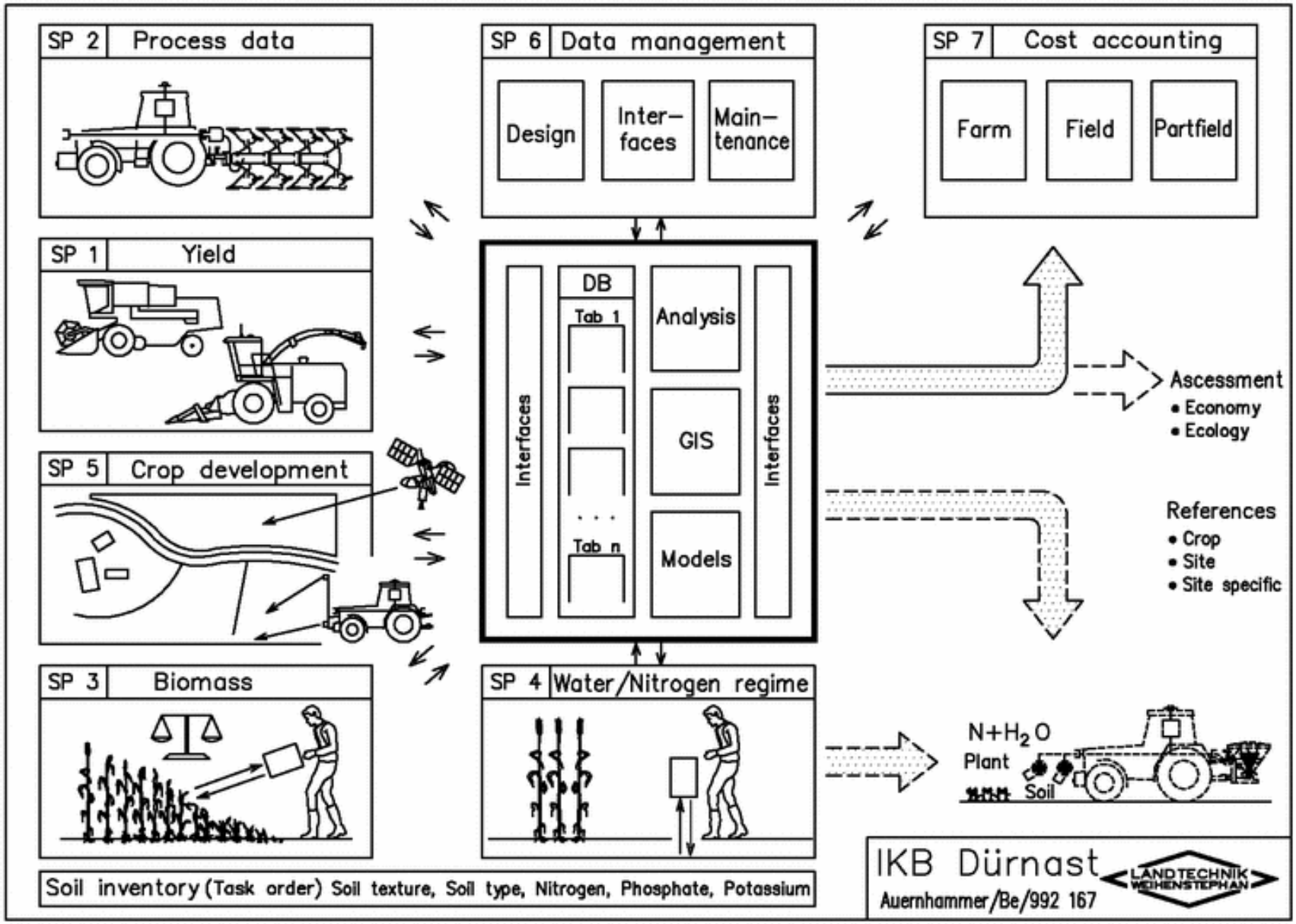
The first control input is again a crop reference function. Additional sensors complete the control loop:

A first adjustment of the crop reference to the real growth situation is done by a site reference. Reflection measurements are used over near and remote sensing methods.

A second adjustment is done by site-specific limitations from the mapping approach, which includes the local soil fertility into the control loop.

Apart from the online-data recording of plant growth the plant stress is included into the automatic control loop.

Further the data recording of the available subsoil water and the up-to-date available nitrogen of the soil takes place in the control.


SP 2 Process data
SP 6 Data management
Design
Inter–faces
Main–tenance
SP 7 Cost accounting
Farm
Field
Partfield
SP 1 Yield
DB
Tab 1
Tab n
Analysis
GIS
Models
Interfaces
Interfaces
Ascessment
• Economy
• Ecology
References
• Crop
• Site
• Site specific
SP 5 Crop development
SP 3 Biomass
SP 4 Water/Nitrogen regime
N+H2O
Plant
Soil
Soil inventory (Task order) Soil texture, Soil type, Nitrogen, Phosphate, Potassium
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Why LBS

"Mobile Agricultural BUS-System (LBS)" is characterized by the following features:

- The definition took place in a time interval lasting over 11 years from representatives of science and industry

- LBS is available as a standard since January 1997

- There are real products available on the market

- For use of checking of the standard conformity global test and reference systems exist

- Increasingly low-priced solutions were developed by competitive suppliers

Intelligence of farm machinery today and tomorrow

A standard family farm in Germany has

- at least 3 tractors

- more than three trailers

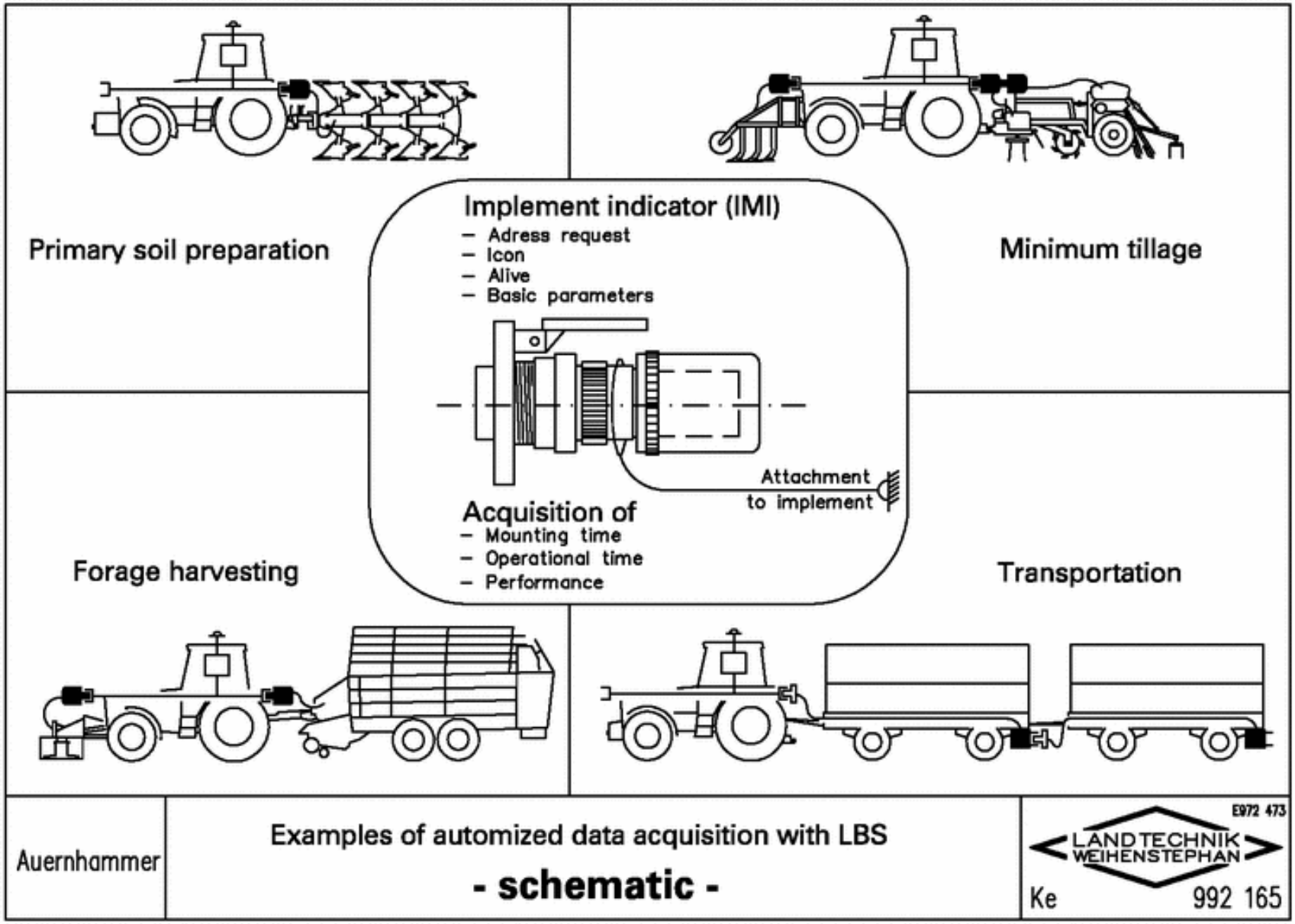
- twenty and more different implements
  (on our experimental farm there are 28 different once)

- only three different application units

---> if tractors and application units get more and more electronics

===> the majority of implements works without electronics

is and will be "stubid" !


Primary soil preparation
Minimum tillage
Implement indicator (IMI)
– Adress request
– Icon
– Alive
– Basic parameters
Attachment
to implement
Acquisition of
– Mounting time
– Operational time
– Performance
Forage harvesting
Transportation
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Examples of automized data acquisition with LBS
- schematic -
E972 473
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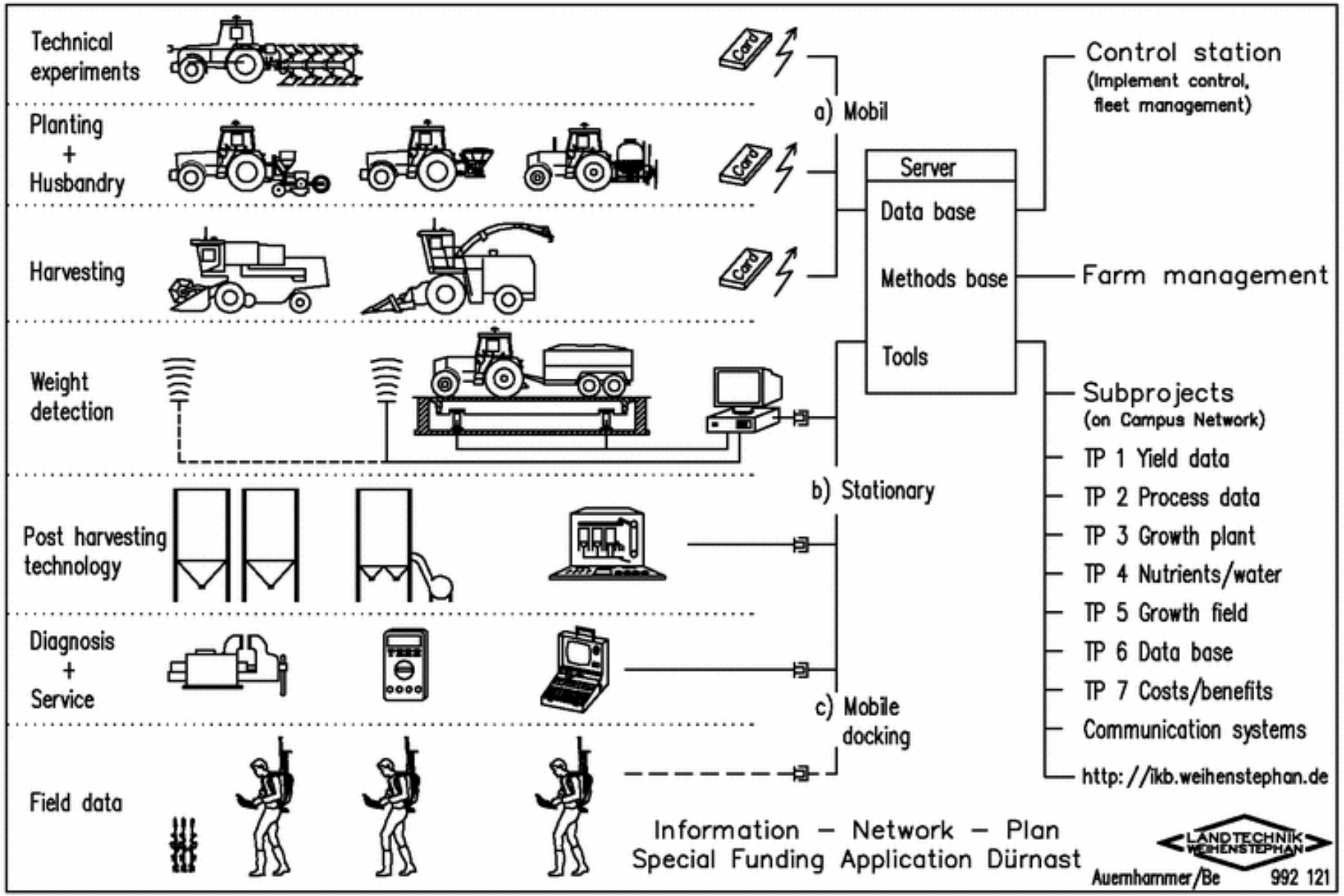
Investment of automated data acquisition with LBS and GPS

Terminal (field-operator 200)	*1.888 €*	
Terminal adapter cable	*47 €*	
LBS cable loop	*106 €*	
LBS (add-on solution)		**2.041 €**
DGPS		**1.500 €**
IMI (without sensors), a 50 €; 8 implements per farm		**400 €**
Total		**3.941 €**


Technical experiments
Planting + Husbandry
Harvesting
Weight detection
Post harvesting technology
Diagnosis + Service
Field data
Card
a) Mobil
b) Stationary
c) Mobile docking
Server
Data base
Methods base
Tools
Control station
(Implement control, fleet management)
Farm management
Subprojects
(on Campus Network)
TP 1 Yield data
TP 2 Process data
TP 3 Growth plant
TP 4 Nutrients/water
TP 5 Growth field
TP 6 Data base
TP 7 Costs/benefits
Communication systems
http://ikb.weihenstephan.de
Information – Network – Plan
Special Funding Application Dürnast
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Conclusions

Under European production conditions high yields with low environmental impact only can be achieved with time specific and site specific nitrogen fertilization.

The following problems must be solved:

- Development of reference values (functions) of crop specific nitrogen requirement
- On-line sensing of the nitrogen and water conditions in plant and soil
- Integration of remote sensing for crop development sensing
- Derivation and use of standardized evaluation algorithms of site specific yield data
- Site specific process data acquisition with standardized data transmission for the use of farm, field and part-field cost accounting
- Establishment of an efficient operational data base for the universal use of site-specific nitrogen fertilization and economic and ecological evaluation

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