RE-IMAGINING AGRICULTURE: Engineering as the strategic enabler

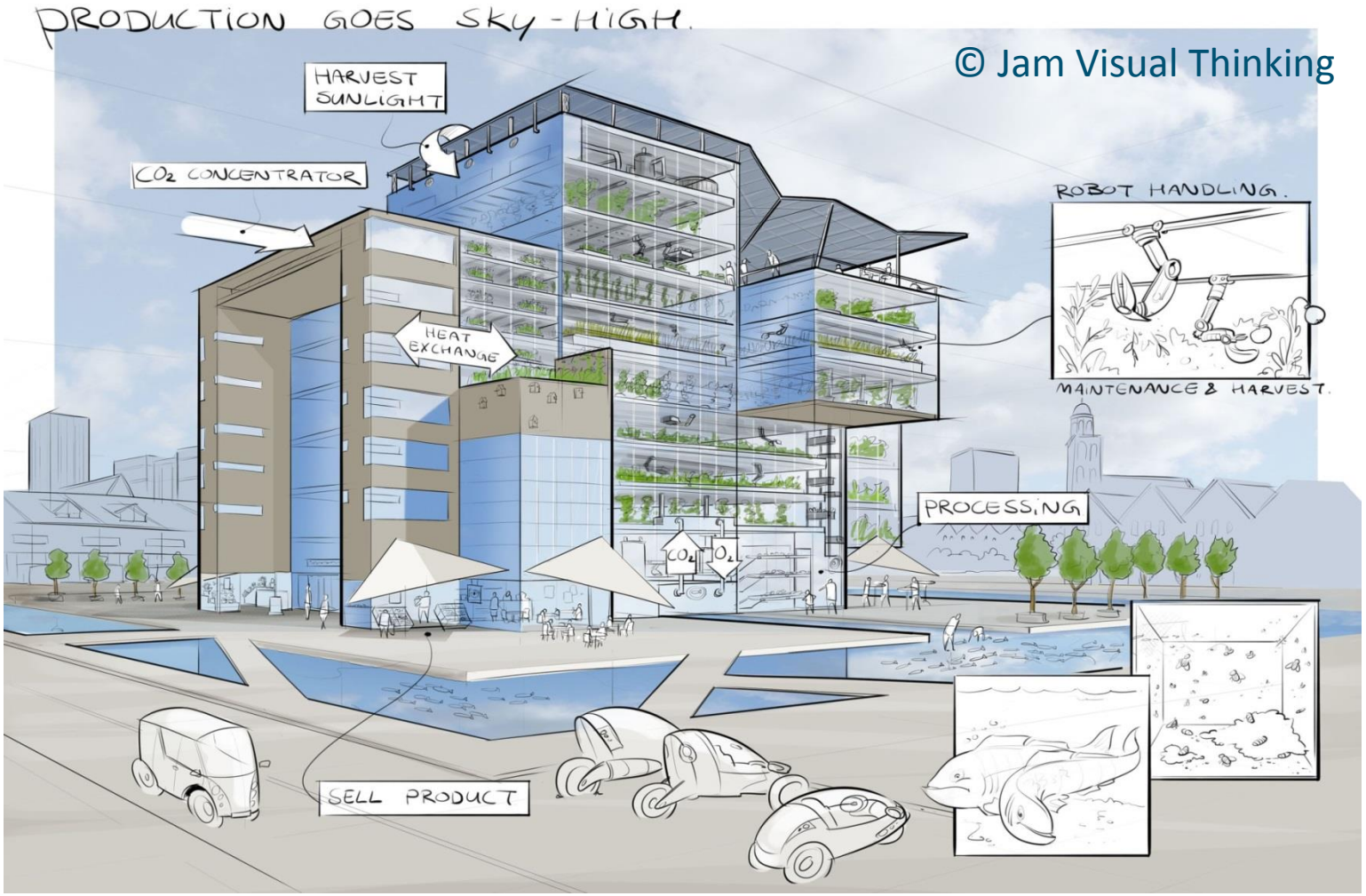
Defining the Engineering Challenges

21 May 2014, Prof.dr. Eldert van Henten, Wageningen University



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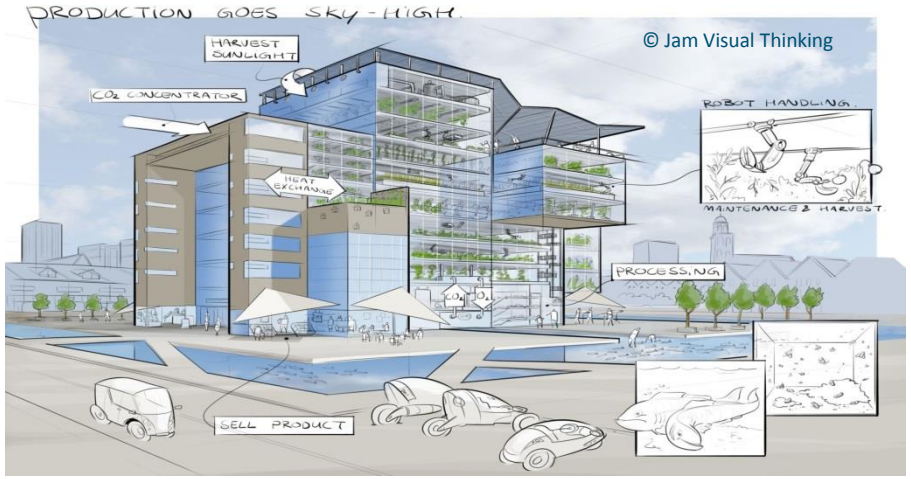
Engineering as the strategic enabler



Contents

Three blocks:

- ‘Crisis’ in the agricultural engineering world?
- The technical focus of WU Farm Technology Group
- Some observations related to a way out...



The global challenge



- Growing world population
  - food, fuel, feed, fibres, ...
- Declining availability of resources
  - labour, fertilizers, fossil energy, water, ...
- Increasing impact on environment
  - greenhouse gasses, chemicals, waste, ...

Sustainable agricultural production!!!

Foresight report 2011



- Some statistics of this text:
  - Technology – 100
    - Nanotechnology – 10
    - Biotechnology - 10

New science and technology to raise the limits of sustainable production and address new threats.
Strategic conclusions on research and development set out in detail in Chapter 4 highlight:

- The importance of animal and plant breeding using conventional and new techniques to improve yields but also to increase water, nutrient and other input efficiencies.
- The need for research in agronomy, agro-ecology, soil science and other areas that have been comparatively neglected in recent years and are critical for sustainable intensification.
- Prioritising research on climate change adaptation and mitigation in the food system.
- The need for research in engineering, information and communication technology, and social science in support of sustainable food production.

Success factors agricultural production

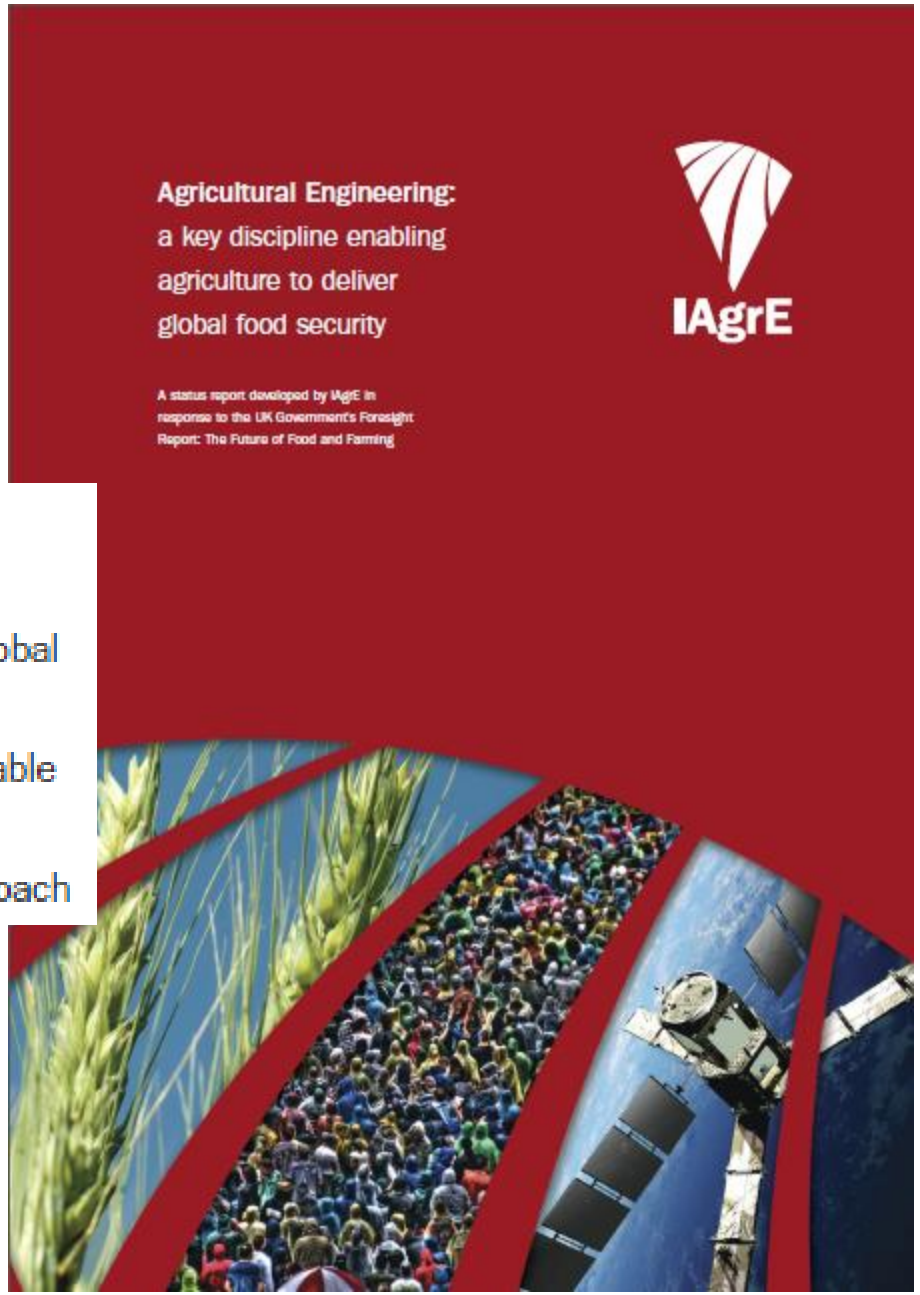
- Breeding (plants, animals)
- Knowledge of plant and animal nutrition
- Chemical fertilizers
- Water management and irrigation
- Agronomy
- Chemical protection and medicines
- Technology







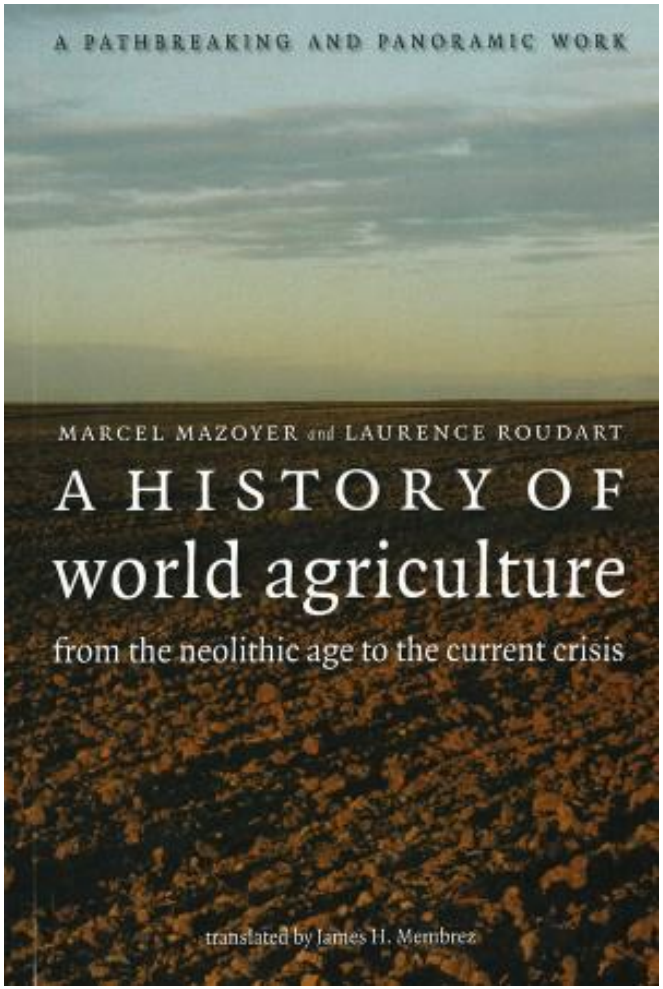
Response of IAgrE



Taken from the foreword:

Engineering has a major contribution to make to the required advances in sustainable farming and food, in sympathy with the environment. The UK response to global food security will be much stronger if agricultural engineering is recognised as a critical component, capable of breaking down traditional barriers and enhancing multidisciplinary approaches to challenges. A new approach

Historical trends no guarantee for future...









Technology will be needed!

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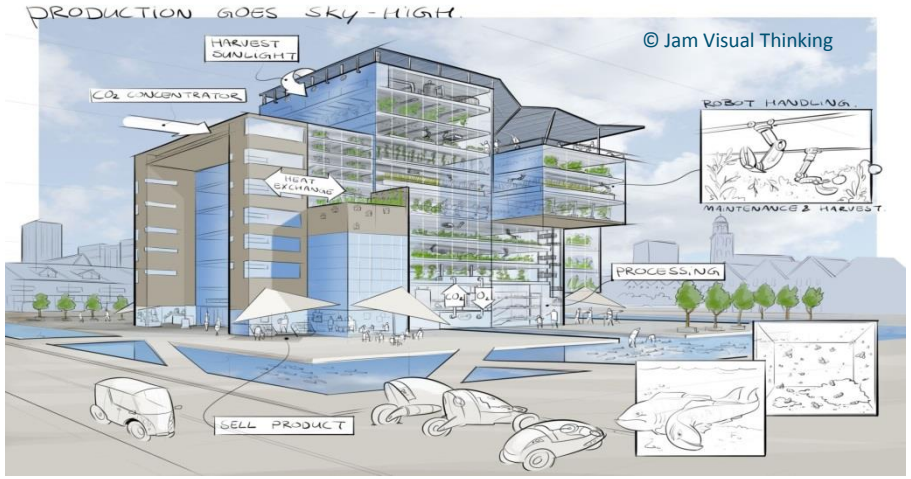
Some engineering challenges

- Communication, because people might think:
  - 'Technology has caused a lot of problems...'
  - 'Technical gadgets'
  - 'Technology is difficult'
  - 'Technology will be available when needed'
- Adopt a true multi-disciplinary approach:
  - Across technical domains
  - Technology, life sciences, economy, sociology, ...
- Develop a research agenda:
  - Vision and mission answering future challenges
  - Government, consumers, manufactures, research,..

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WU Farm Technology group: 2 focus points

- Smart system design
  - Examples: novel production systems

'Greenhouse of the future'



Roundel



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Sources: WUR Greenhouse horticulture and Animal Sciences Group

WU Farm Technology group: 2 focus points

- Smart sensing & operation
  - Example: robotic harvesting





Smart systems design

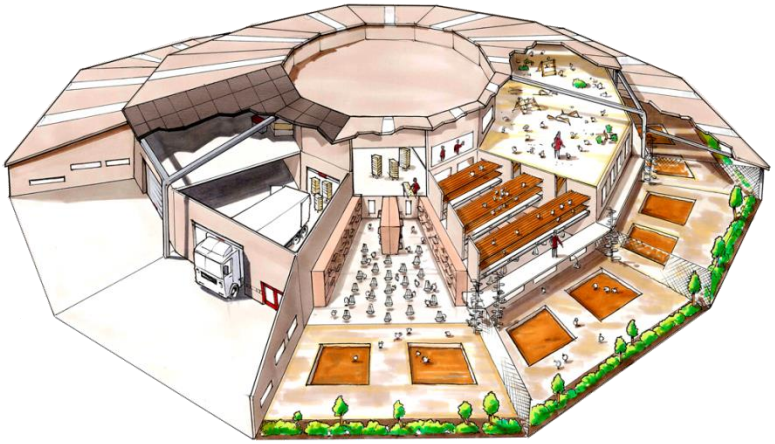


- NL: Rondeel -> UK: Roundel
- Multi-disciplinary approach
- Strong involvement stakeholders:
  - Farmers
  - Consumers
  - Research
  - Ahold
  - ‘Wakker dier’





Smart systems design



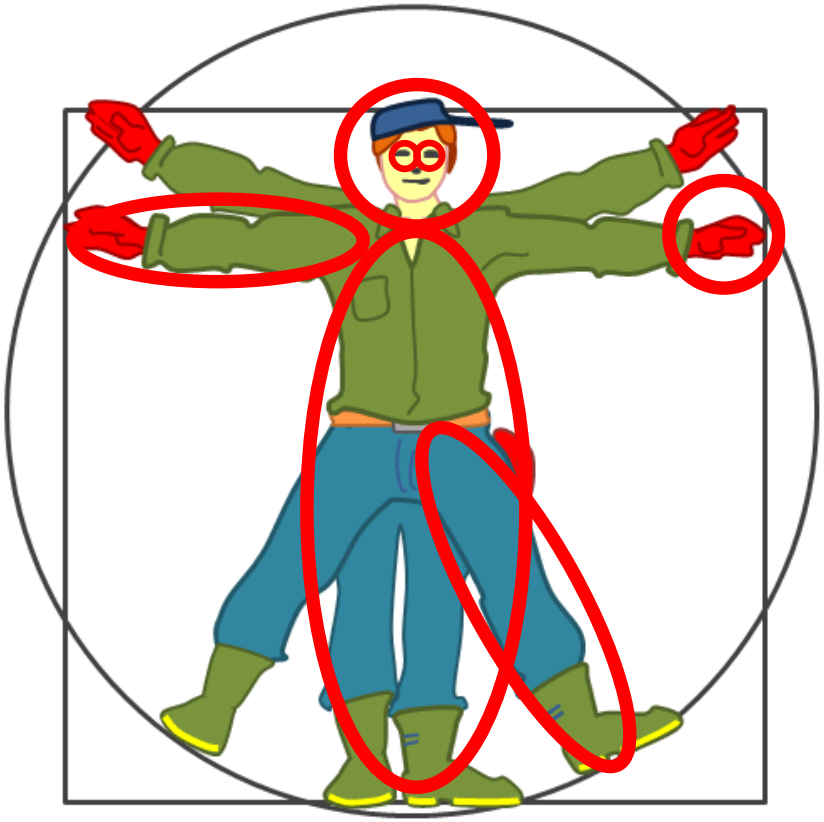






Smart sensing & operation

- Functionality embedded in the human body



Van Tuijl (2013) based on Da Vinci (ca. 1490)

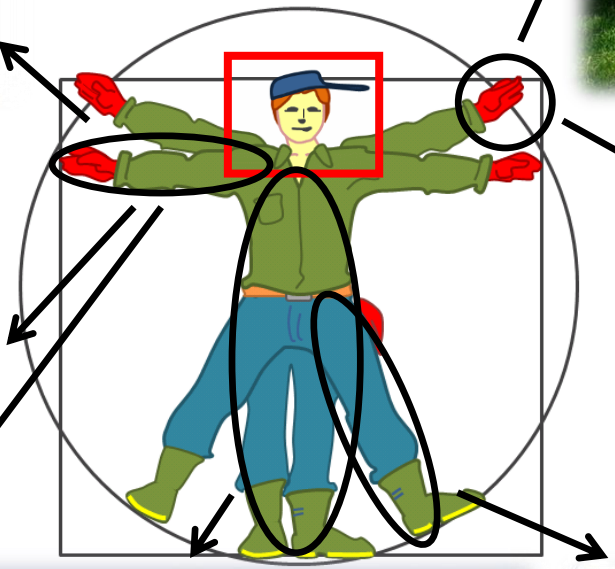
Smart sensing & operation

- Availa ogy

















Scientific challenges





- Variation in shape, size, colour and (non-linear) response of natural objects
- Unstructured environment
- Weather (uncertainty, variation)



Smart sensing & operation

Knowledge representation

Cognition

Learning

Modelling

Decision making

Multi-objective decision making

Data analysis



Sensor fusion

Planning

Sensing

Action

Sensor technology

Active sensing

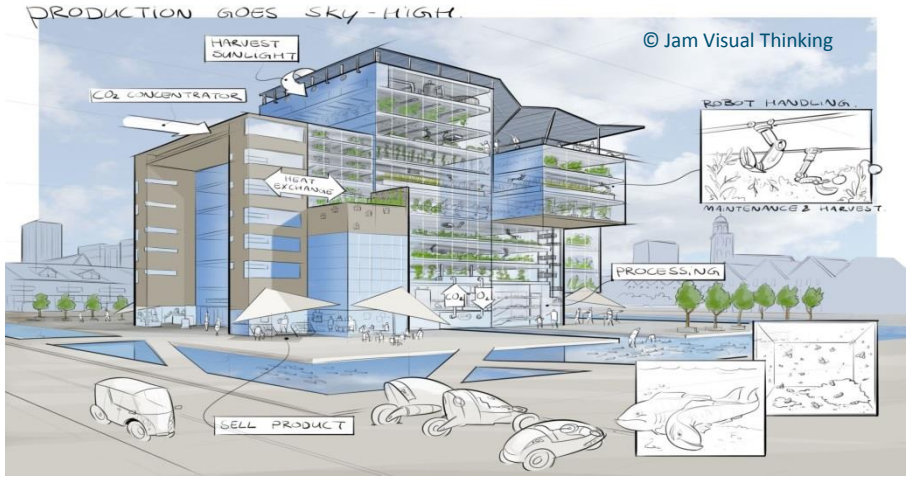
Actuators, grippers

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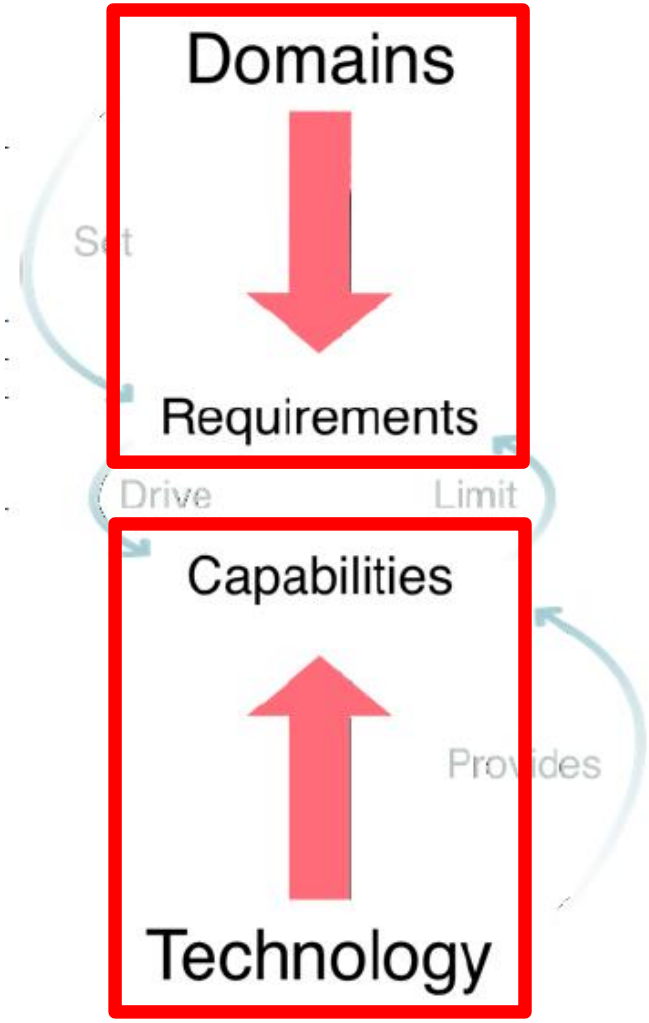
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Developing research agenda, an example?

- SRA developed by euRobotics aisbl (www.eu-robotics.net)



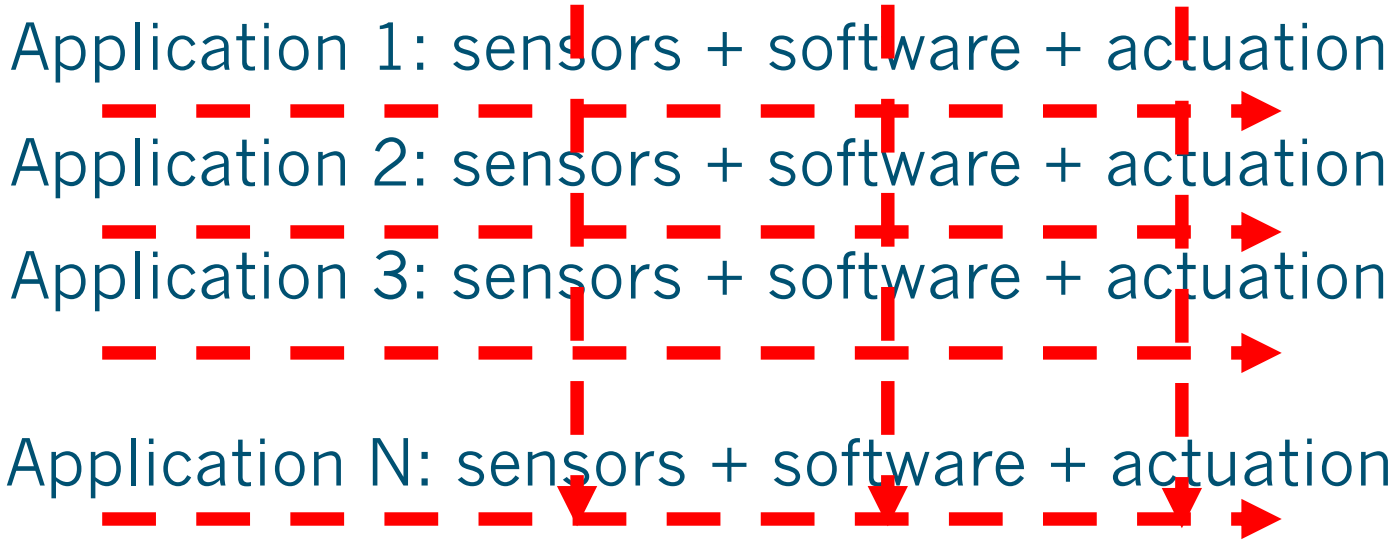


Identify the requirements of stakeholders

Improve sustainability
People
Environment
Social acceptance
Labour
Food safety
Animal welfare and health
Planet
Energy
Climate
Nutrients and fertilization
Water use, irrigation
Crop protection
Biodiversity
Soil quality
Plant health
Fine dust (emissions)
Profit
Income (revenues, costs)
Capital investment
Innovation power
Competition (import/export)

Develop generic capabilities instead of particular solutions

An observation from the field of agro-robotics:



Develop generic technology for detection, localisation of objects and required actuation

Adopt a systems approach

Generic capabilities, systems approach

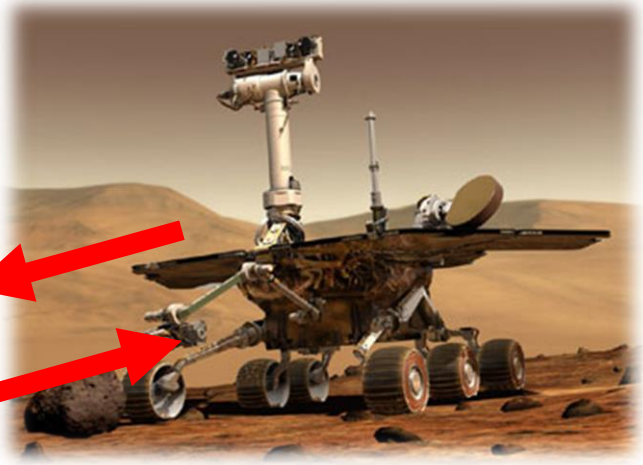


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Systems approach opens the door to other domains...









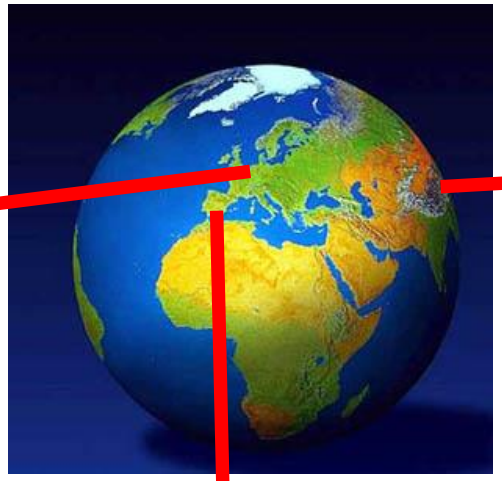


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Adaptive technology

- For example in protected cultivation:









Redefine high-tech...?



- High-tech -> concern: too difficult!



- High-tech inside -> simple outside
  -> human-machine interfacing



- High-tech -> knowledge intensive

Summarizing

- Agricultural engineering needed? Yes!!!
- Attention for:
  - Communication
  - Multi-disciplinarity
  - Proper assessment of stakeholder requirements
  - Generic capabilities instead of specific technical solutions
  - Cross agro-domain, systems approach
  - Adaptive technology
  - Re-define high-tech?
- Focus points: 1) System design, 2) Sensing and operation

Thank you for your attention!



Contact information:

Mail:
eldert.vanhenten@wur.nl

Phone:
+31 (0)317 483328

Website:
www.fte.wur.nl

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