From Chemical Plant Protection to Digital Plant Protection

The future of farming will be bee-friendly!"

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Structural change in agriculture

Anzahl der landwirtschaftlichen Betriebe pro 100 Hektar. (Grafik: Leo Koppelkamm) Quelle: Statistisches Bundesamt

- Bad for family farmers.
- Bad for socio-economic structure of rural areas and towns.
- Bad for biodiversity.
- Bad for solitary bees, bumble bees and honey bees

What is driving this change? Laws of physics?

Expensive farm equipment needs to be fast to earn it‘s money back

SM 911 TL | SM 911 TL-KC | SM 911 TL-RC | SM 911 TL-KCB

SCHLAGKRAFT OHNE KOMPROMISSE

Diese Mähwerkskombination besetzt das Premiumsegment der Mähtechnik und hat eine Arbeitsbreite von 8,30 m. Die robuste Gesamtkonstruktion ist kompromisslos auf höchste Mähleistung, Einsatzsicherheit und Langlebigkeit ausgelegt. Sie vereint die Vorzüge des FELLA-Kompaktwinkel-Mähbalkens, des innovativen TurboLift-Systems und der patentierten

LINKBOX

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Agricultural industry has found one optimum:

Expensive agricultural technology needs optimal conditions to earn it‘s money back:

- Monocultures
- Large fields – as homogeneous as possible
- Application of chemicals to achieve optimal crop conditions for large machinery.
- Large farms able to make big investments
- No other users have to be taken into consideration in the agricultural landscape (humans, wildlife, bees)
- No regulations should stand in the way of good utilization of the machines. (Foraging times of honey bees, wind speeds etc.)

This model has reached it‘s limits.

TECHNISCHE UNIVERSITÄT DRESDEN

Progressive Aufwandssteigerung erzeugt Lücke zwischen Wunsch und Wirklichkeit

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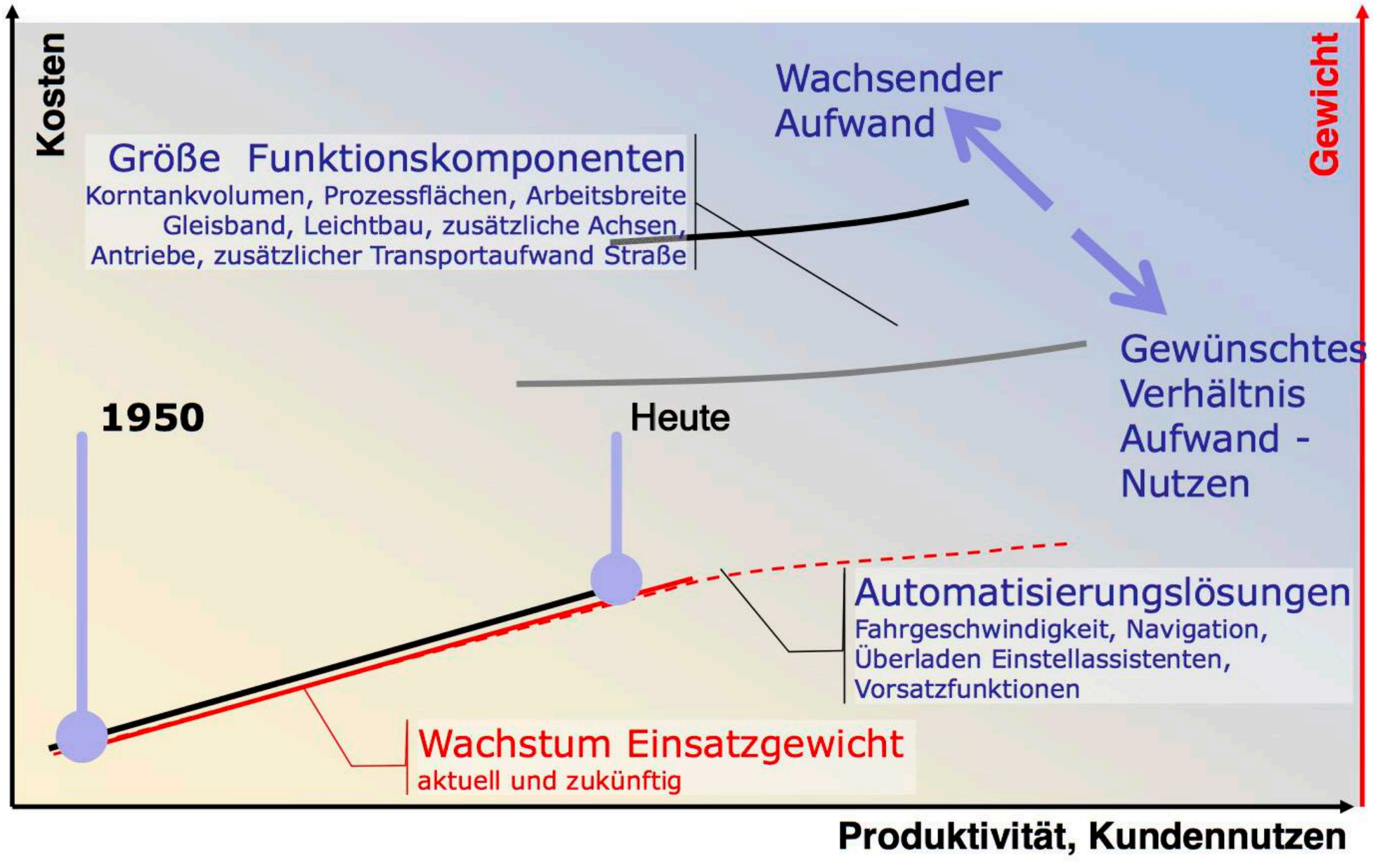
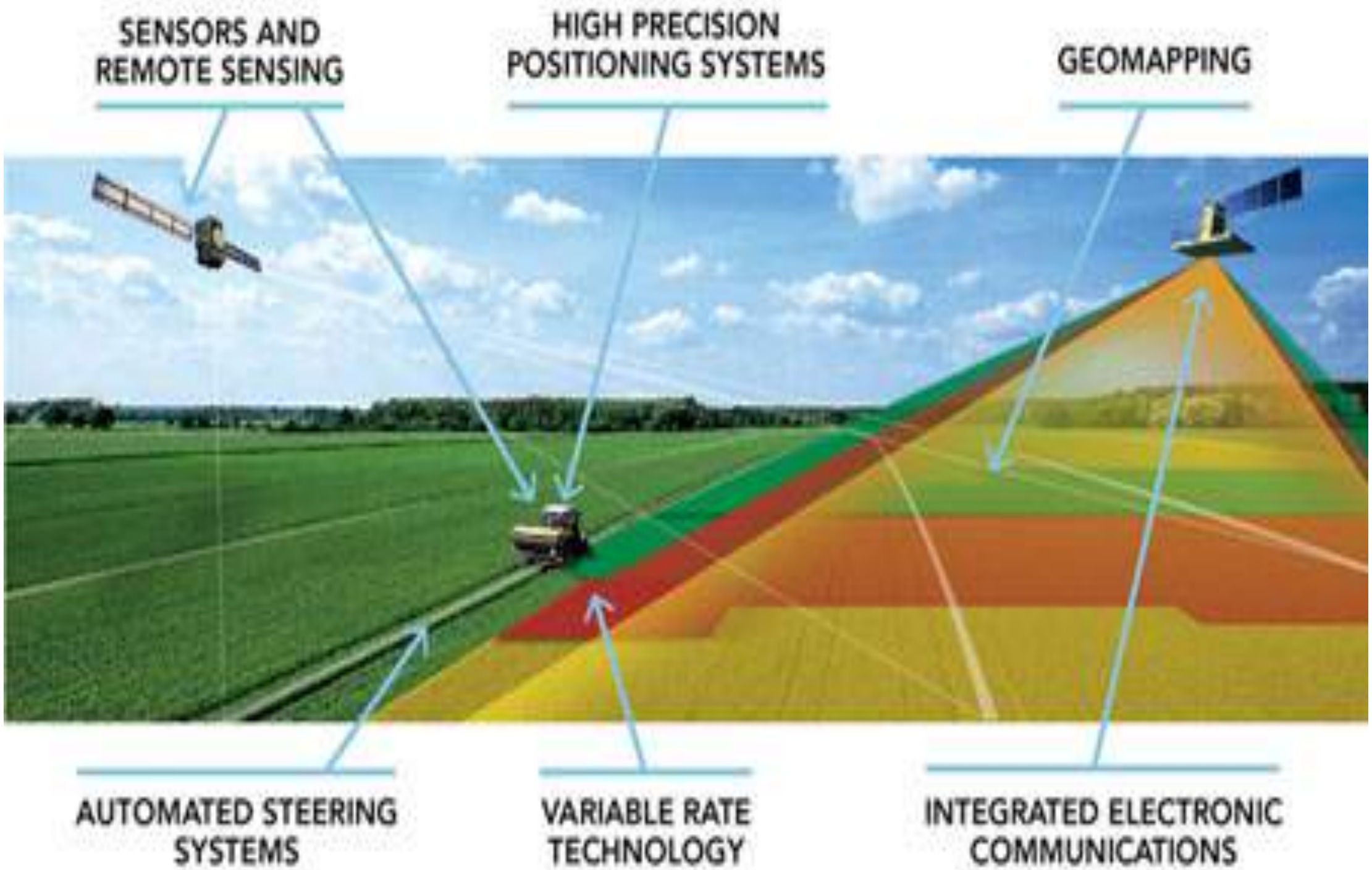


Digitalization of the old model:



The is at least one more optimum!

- What if agricultural technology is cheap and intelligent
- Devices that are not expensive, do not have to be fast.
- Devices that are so cheap that they can constantly remain on the field, do not have to be powerful:
- Problems are detected at an early stage.
- In early stages weeds and pests can be dealt with applying minimal effort.
- Pesticide use is at least partially no longer necessary.
- Slow machines do not need large homogeneous areas.
- Technical challenges for image processing and actors are dramtically lower for slow machines.
- Low cost machines do not need large farms.
- Low cost and intelligent machines fit the cultural landscape and the needs of people in rural areas.
- Some machines can be built in the community (Digital Blacksmith)

Digitalization actually enables a whole new model:

Paradigm shift in lawn mowers

Robot „BoniRob“ by Amazone and Bosch

Farm robot competition in corn crop

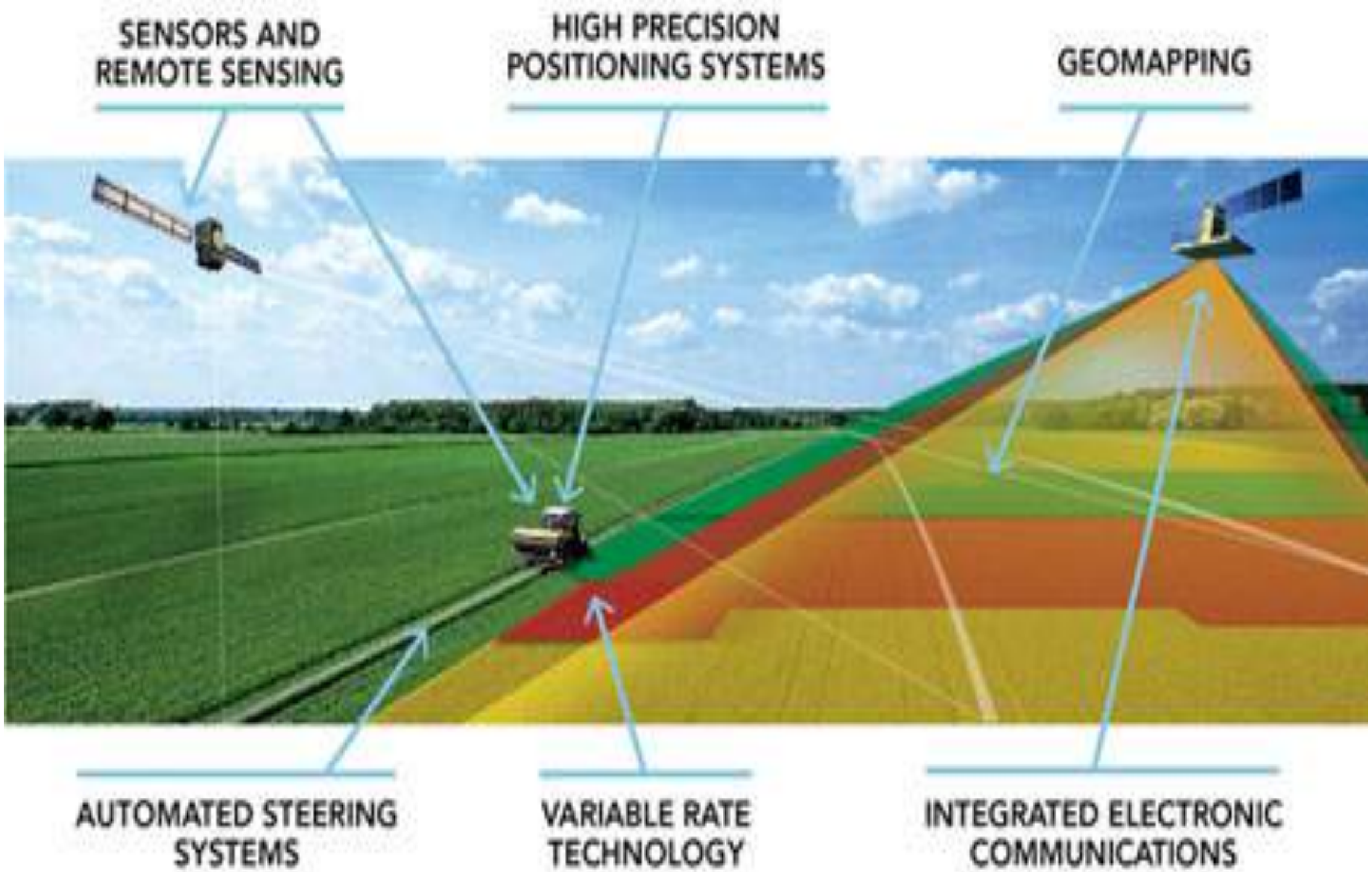
Achieving low cost by using mass produced components

Motor & Sensor Control: Arduino!

Where can wen get HD camera, GPS, accelerometer, processing power for image processing and high speed mobile data connection highly integrated at extremely low cost?

Smartphones!

Why data acquisition by satellite, if you can do it locally?



Farmer‘s data sold to commodity traders. Why should farmers support a business model used to speculate against them?

Why not Drones?

- **Drones need a lot of energy just to stay in the air.**
- **If a drone detects a problem, it cannot exert mechanical force to deal with it.**
- **No long term autonomous operation.**
- **Noisy.**
- **Better: Bring the intelligence of a drone to a low cost, light weight, stable platform.**

Think outside the box!

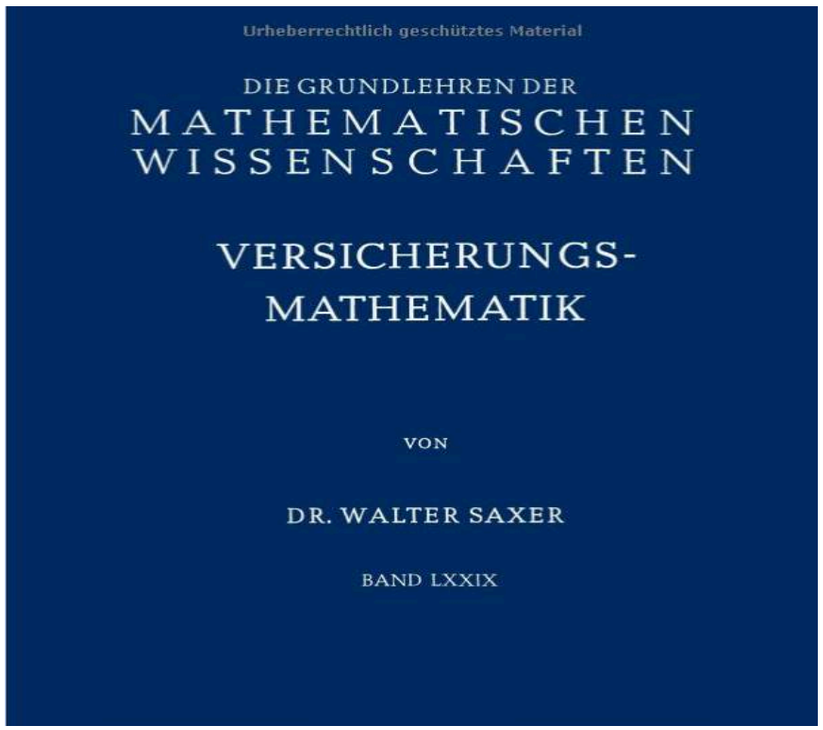
- Digitalization of the old model is just an intermediate stage.
- Digitalization will enable completely new model.
- We will no longer need to tolerate structural change to adapt the landscape and the farming communities to the needs of large but relatively dumb machines.
- Machines will be smart enough to adapt to the needs of the crops, the farmers and the ecosystem.
- Machines will be smart enough to actually discriminate between harmful and beneficial insects.

Plant protection industry unnecessarily harmful to bees?

For somebody who‘s only tool is a hammer
every problem is a nail.

Chemistry: a solution in search of a problem?

Chemistry is not the only science



Chemistry is not the only science

- Biology
- Physics
- Insurance mathematics
- Computer Science

Recent break through in neural networks

Review TRENDS in Cognitive Sciences Vol.11 No.10

Learning multiple layers of representation

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To achieve its impressive performance in tasks such as speech perception or object recognition, the brain extracts multiple levels of representation from the sensory input. Backpropagation was the first computationally efficient model of how neural networks could learn multiple layers of representation, but it required labeled training data and it did not work well in deep networks. The limitations of backpropagation learning can now be overcome by using multilayer neural networks that contain top-down connections and training them to generate sensory data rather than to classify it. Learning multilayer generative models might seem difficult, but a recent discovery makes it easy to learn nonlinear distributed representations one layer at a time.

Learning feature detectors

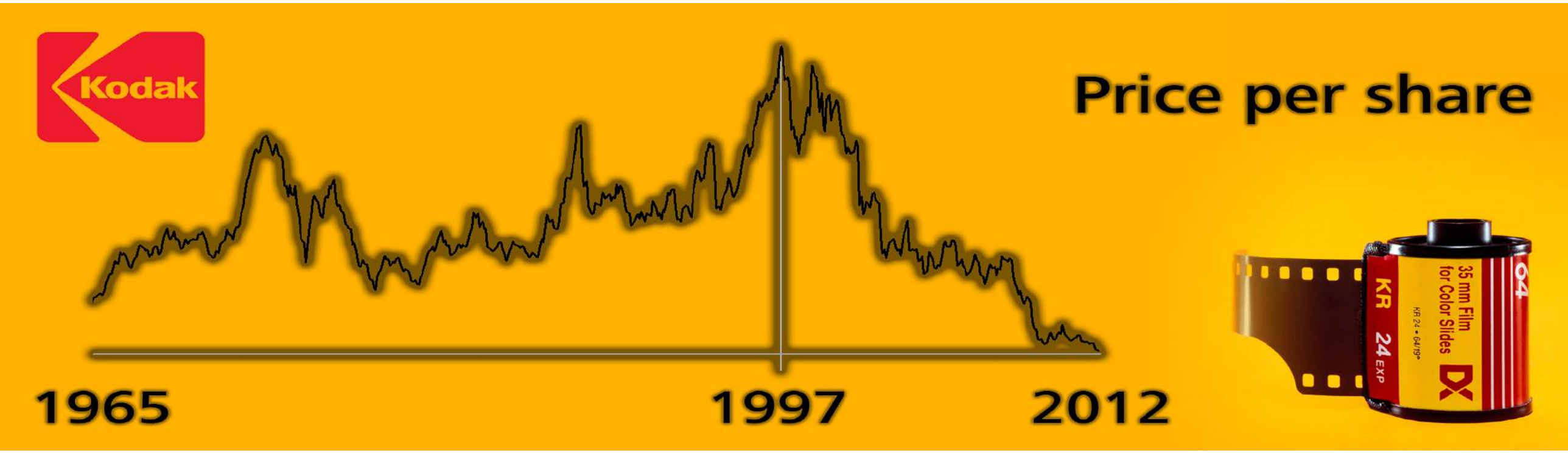
To enable the perceptual system to make the fine distinctions that are required to control behavior, sensory cortex needs an efficient way of adapting the synaptic weights of multiple layers of feature-detecting neurons. The backpropagation learning procedure [1] iteratively adjusts all of the weights to optimize some measure of the classification performance of the network, but this requires labeled training data. To learn multiple layers of feature detectors when labeled data are scarce or non-

digits, the complicated nonlinear features in the top layer enable excellent recognition of poorly written digits like those in Figure 1b [2].

There are several reasons for believing that our visual systems contain multilayer generative models in which top-down connections can be used to generate low-level features of images from high-level representations, and bottom-up connections can be used to infer the high-level representations that would have generated an observed set of low-level features. Single cell recordings [3] and the reciprocal connectivity between cortical areas [4] both suggest a hierarchy of progressively more complex features in which each layer can influence the layer below. Vivid visual imagery, dreaming, and the disambiguating effect of context on the interpretation of local image regions [5] also suggest that the visual system can perform top-down generation.

The aim of this review is to complement the neural and psychological evidence for generative models by reviewing recent computational advances that make it easier to learn generative models than their feed-forward counterparts. The advances are illustrated in the domain of handwritten digits where a learned generative model outperforms discriminative learning methods at classification.

Just a few years ago photography was wet chemistry!



Bee-friendly agriculture needs innovation

PRESS RELEASE

CEMA and EPBA launch joint effort to aid bee-friendly farming practices through training and innovation

Brussels, 7 April 2014 – CEMA and EPBA have decided to explore opportunities for co-operation in training and innovation, with the aim of promoting the deployment and development of technical innovations that support bee-friendly farming practices.

The European Professional Beekeepers Association (EPBA) welcomes the chance to explore with the European Agricultural Machinery Association (CEMA) ways to share best practices and leverage new technologies that enable farmers to minimize the impact of farming operations on honeybees and other pollinators.

Thank you for your kind attention!

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