



**E-Growing: Data-Driven Horticulture and Potential Use Cases**  
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**AVAG**  
ADVANCED VERTICAL AGRICULTURE GROUP

**HORTIVATION**  
TECHNICAL GREEN INNOVATION HOLLAND

**GreenTech**  
HORTICULTURES FOREFRONT

**TOPSECTOR**  
TUINBOUW & BUITENRUIMTELIJK

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UNIVERSITY & RESEARCH

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**TRENDS  
&  
OPPORTUNITIES**

## TRENDS IN GREENHOUSES

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- Customer of greenhouse builder shifts from grower to investor
- Investors demand guarantees on production in a greenhouse build with certain construction concepts
- Greenhouse builders need to shift from providing a turnkey greenhouse builder to a service provider that supports the grower in its activities.



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## TRENDS IN GROWING

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- Local extensive agroparks ask for different growing systems and higher investments
- Knowledge of local growers needs to be enhanced to get “green fingers”.
- Data from different greenhouse components becomes available and new ICT analysis techniques can be applied.
- Efficient and sustainable use of materials.

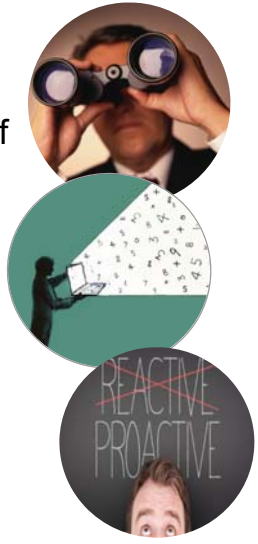


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## WHAT DOES THE SECTOR WANT?






- **Remote monitoring** of the greenhouse and its connected devices and equipment
- **Insight in the performance** of the greenhouse in terms of yield related to growing strategies and greenhouse configuration.
- **Deal with anomalies** in the climate or crop in the greenhouse by combining data about growing strategies and greenhouse configuration.
- **Optimize greenhouse construction** concepts by using intelligence from available data with new ICT analysis techniques, like deep learning.




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## DATA OPPORTUNITIES ARE THERE!

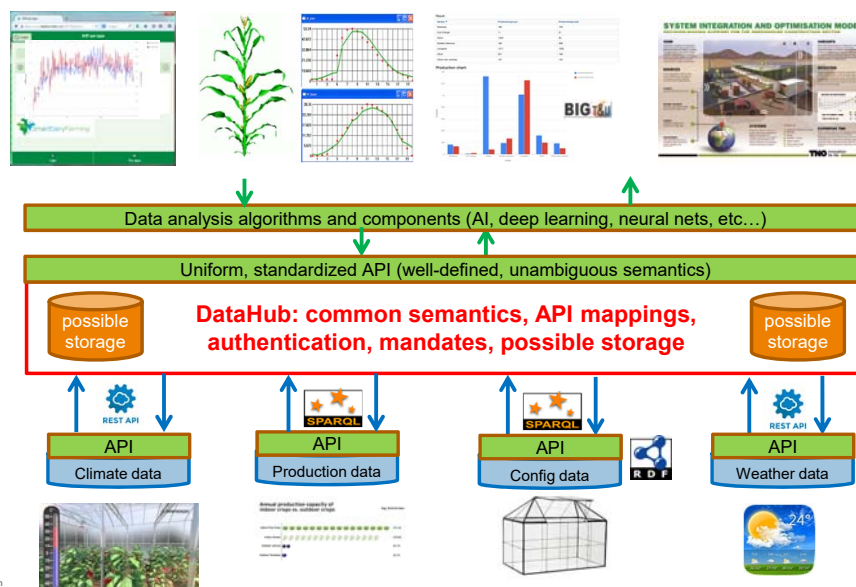
- › Greenhouse climate
  - › Temperature, CO2 dosing, light control (LED/...), humidity control, window guidance, shading screens, energy screens, pesticide control, whitewash,...
- › Labour management
  - › Hours, costs, activities, ....
- › Greenhouse construction
  - › Configuration of equipment,....
- › Plant growth
  - › Stem thickness, number and size of leaves, ...
- › Production
  - › Yield, revenue, ...
- › External factors affecting production
  - › Weather, satellite images, exchange rates, energy prices



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# SOLUTION DIRECTION

## SO, LET'S COMBINE THE DATA!



## WHY A DATAHUB?...BECAUSE IT:

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1. Saves development time/money by connecting data source **once** and reuse for **multiple** applications.
2. Aligns **semantics** of different data sources to get unambiguous meaning of information.
3. Provides a **standardized** interface to speed up application development on top of it.
4. Offers **storage** capabilities for long-term historic data capturing and comparison.
5. Enables **data analysis** over historic and real-time data of multiple combined data sources.

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## DDINGS PROJECT

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### Goals:

1. Develop a pre-competitive datahub with data and knowledge models that provides insight in performance of the greenhouse and its equipment by combining various datasources
2. Develop interfaces for external plug-ins of models in (existing) dashboards.
3. Develop a clear business case for further scaling of the datahub.

### Kassenbouw



- › Dalsem
- › Alcomij
- › Havecon
- › VB Group
- › Certhon
- › Van der Hoeven
- › BOM
- › Prins Group
- › Maurice Kassenbouw
- › Gakon

### ICT

- › Van Dijk Heating
- › Berg Groep BV
- › Letsgrow.com
- › Technolution
- › Bosman v Zaal
- › Hortimax

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## 3 DDINGS USE CASES



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**1. Know-how support:**  
*Goal:* how can we better support decisions of foreign growers with a data-driven system that utilizes Dutch knowledge about horticulture and greenhouse management? How do we enlarge our span of control on foreign customers, e.g. via an automated learning system?  
*Target:* foreign grower (+++), crop-advisor (++) and indirectly greenhouse builder (+).

**2. Yield prediction:**  
*Goal:* how can we automatically measure the yield of a specific plant to predict short-term how much production the plant will give and when? How can we decide on long-term prediction based on historic conditions in the greenhouse, the weather and figures about the production?  
*Target:* grower (++), greenhouse builder (++), investor (+++)

**3. Greenhouse configuration improvement**  
*Goal:* how can we relate anomalies in the greenhouse climate and/or plant growth/condition to the construction and configuration of the greenhouse? How can we explain and resolve an inhomogeneous greenhouse climate, plantgrowth-backlog and plant disease by improving on the greenhouse configuration?  
*Target:* greenhouse builder (+++), grower (++)

## UC – KNOW-HOW SUPPORT: FOR WHOM AND WHY?

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**Pro's for builders:**

- Can sell growing strategies on top of high-tech greenhouses and be able to better guarantee production yields.

**Pro's for equipment suppliers:**

- Can supply more equipment to enable more extensive, automatic greenhouse control

**Pro's for grower:**

- Exploit his knowledge as crop advisor for foreign growers

**Con's**



- Knowledge of Dutch growers is exported to foreign countries. How to ensure the advantage of the Dutch grower?

**Possible solutions:**

- Develop a platform on which Dutch growers can provide their knowledge to foreign growers as part of total package of buying and operating a new greenhouse.

USE CASES

## UC – YIELD PREDICTION: FOR WHOM AND WHY?






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<p><b>Pro's for growers:</b></p> <ol style="list-style-type: none"> <li>1. Short-term prediction to better align supply with demand from supermarkets beforehand.</li> <li>2. Planning of the labour is better feasible.</li> </ol> <p><b>Pro's for builders:</b></p> <ol style="list-style-type: none"> <li>1. Middle-term prediction to sell greenhouses supported by predicted yield on the longer term.</li> </ol> <p><b>Pro's for investors:</b></p> <ol style="list-style-type: none"> <li>1. Longer term prediction of the yield to check whether the grower is still feasible and compare with other growers and crop.</li> </ol>	<p><b>Con's:</b></p> <ul style="list-style-type: none"> <li>• Is yield prediction feasible at a detailed enough level with the desired accuracy of ?</li> <li>• Is enough data and knowledge available to decide on growing strategies and economical aspects ?</li> <li>• Are measurements on plant-growth feasible?</li> </ul>
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USE CASES

## UC – CONFIGURATION IMPROVEMENT: FOR WHOM AND WHY?

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<p><b>Pro's for builders:</b></p> <ol style="list-style-type: none"> <li>1. Determine causes for anomalies in the greenhouse related to building systems or growers behaviour.</li> <li>2. Respond to performance questions based on better insight in the greenhouse operation phase.</li> <li>3. Calibrate their greenhouse building design to make it more effective (e.g. cost, production quality and quantity).</li> <li>4. Develop new technologies targeting to improve the performance of the greenhouse as construction and/or climate control.</li> </ol> <p><b>Pro's for growers:</b></p> <ol style="list-style-type: none"> <li>1. Better understanding on anomalies and can take specific actions to improve their yield amount and quality, energy use, logistics etc.</li> </ol>	<p><b>Con's:</b></p> <ul style="list-style-type: none"> <li>- Correlation between anomalies and the actual problems ?</li> <li>- Data density is too low ?</li> </ul>
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USE CASES





LESSONS ON DATA SHARING IN OTHER SECTORS

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**Innovate by joining forces: as sector or supply chain!**

1. Open innovation for a better position of the sector globally
  - New opportunities by combining data
  - Cost reduction by building once and reusing multiple times
2. It is not always easy
  - Organizations tend to sit on their data
  - Thus, use permissions and mandates for accessing data
3. No central database persé
  - A datahub with broker functionality and storage upon request
4. Datahub not owned by a single stakeholder
  - Form a foundation with stakeholders of all roles in the sector.
5. The grower or investor is key!
  - Added-value applications should drive data-driven e-growing!

***“Collaboration is the new Competition”***

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KEEP YOUR HEAD START!

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AgroTools: Driving revolution with big

Agricultural data expected to scale to 1,600PB in coming years

By moving to Google Cloud Platform, AgroTools is able to scale to support its ambition to find answers in the world's largest data for tropical agribusiness.

enable conditions for a digital

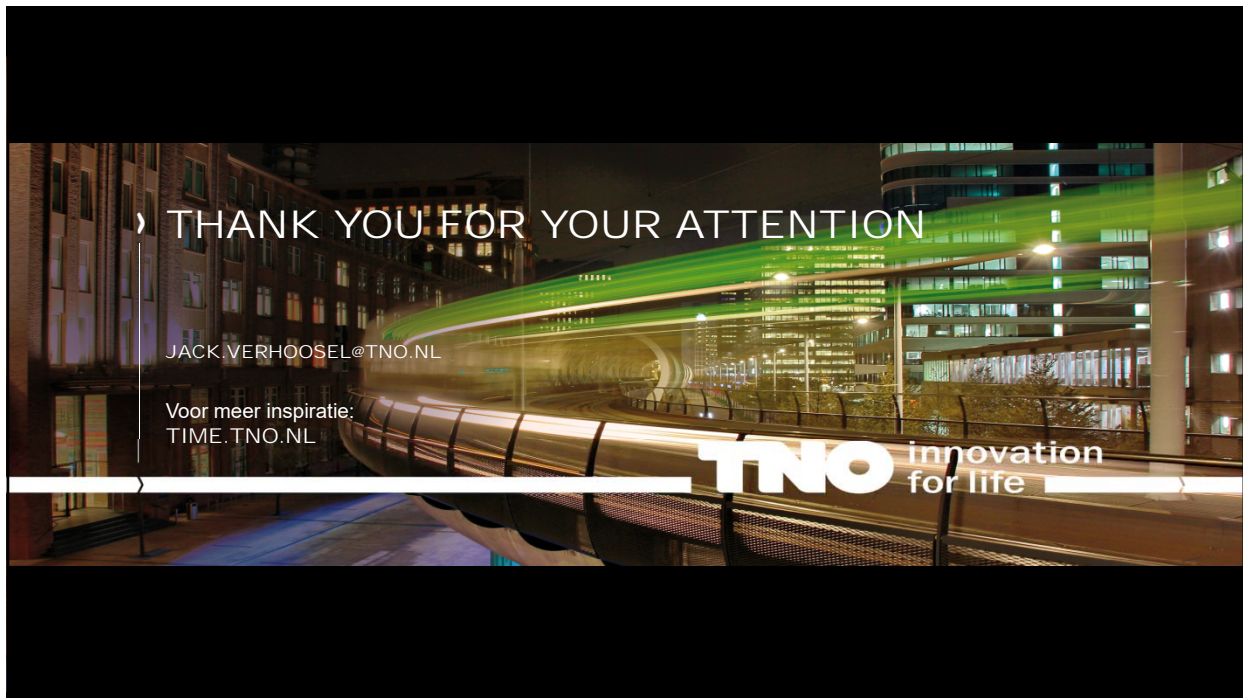
AND PREPARE FOR THE FUTURE!

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HORTIVATION

A cartoon illustration showing two men in an office. One man, standing and holding a large stack of papers, says to the other man, who is sitting at a desk with a computer: "GET ALL THE INFORMATION YOU CAN, WE'LL THINK OF A USE FOR IT LATER." The desk is cluttered with papers and a box labeled "CHRIS".

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## STELLING 1

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Nederland raakt zijn voorsprong  
kwijt als data-driven tuinbouw  
niet snel van de grond komt!

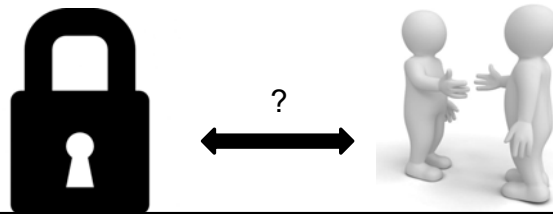


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## STELLING 2

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De veiligheid van mijn data is  
belangrijker dan sterker worden  
door data te delen!

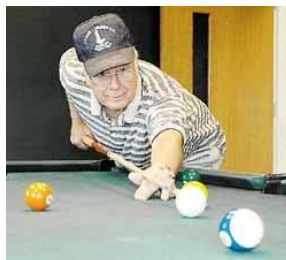


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## STELLING 3

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Over 10 jaar runt een data-  
driven AI systeem de gehele kas  
en de teler kan met pensioen!



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