Digital Horticulture

A Few Considerations

Data as an asset

It is said that “data is fuel for AI.” The more sophisticated the AI (rocket ship), the greater the need for large amounts of high-quality, clean data (jet fuel). But amid the rush to jump on the AI bandwagon, companies (and even data scientists and machine learning specialists themselves) **overlook the critical need to build a solid foundation for how data is captured, consumed, and shared within the organization**. This includes both technical infrastructure as well as operational processes to ensure data quality.

A related problem: I have worked at places where product management wanted to collect “as much data as possible”, with the idea that someone (else) will sift through the data and discover valuable insights at some later point in time. Of course, this basically never happens, even though the engineering work incurs substantial time costs, in terms of both upfront work and maintenance work, in addition to opportunity costs. **Messy data ends up being a liability, not an asset.**

Data platform as infrastructure

Just as governments build roads and bridges but neglect to plan and budget for the necessary maintenance over time, companies make the mistake of treating new technology adoption as a simple matter of acquisition. In evaluating data platforms, **maintainability needs to be a key consideration,** in addition to obvious functionality and upfront costs. Specifically:

- What will it take to support a data platform on an ongoing basis?
- Is it better to develop a custom system or go with an off-the-shelf solution?
- What will the market look like in a few years?
- Who inside the company should own the infrastructure?
- Who inside the company should own the data?

Another key consideration is **openness.** How easy is it to get data in and out of the system? For growers, it is critical to own your data, so that it is not “held hostage” by some third-party. To enable more data analysis and AI applications, it is also important that the data platform supports **different kinds of data** (climate, nutrition, pest, harvest, labor, costs, etc) and integrates with **different kinds of equipment from different manufacturers**, so that data can be centralized instead of being trapped in “data silos”. The ability to import and export data in standard formats such as CSV, therefore, should be considered a must-have.

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Beyond basic CSV exports, having well-designed **application programming interfaces (APIs)**, which allow developers to write code to send and receive data, should also be considered essential for anything to call itself a data platform.

Data-driven as a mindset

The biggest problem in data science is not technical: it's the failure to integrate data science with existing business processes and goals. Almost every company I've personally worked at has struggled with this. Indeed, studies have found that an overwhelming majority of data science projects never make it into production or otherwise deliver poor results. Companies embark on promising data science initiatives only to find that they turn into expensive vanity projects.

Two examples of actually successful responses to large-scale technological change come to mind. One is Microsoft's belated reaction to the Internet in the 1990s. After helplessly watching new competitors like Netscape appear, Bill Gates penned a famous memo that compared the Internet to a "tidal wave". He gave a speech in which he declared: "You'll hear from us that **we're not forming an Internet division**… To us that's like having an electricity division or a software division. The Internet is pervasive in everything we're doing." Microsoft proceeded to realign existing business lines as well as create new ones, all with the goal of "embracing and extending" the Internet.

Another successful response to technological change is IKEA's adoption of 3D computer graphics (CG). Already in 2014, IKEA revealed that as much as 75% of product imagery in the catalog were fully computer-generated. To effect this change, **they implemented cross-training**: all the computer graphic artists had to learn traditional photography, and all the photographers had to learn 3D computer graphics. The cross-training broke down cultural barriers and boosted the quality of work on both sides.

Like the Internet to Microsoft and 3D computer graphics to IKEA, Digital Horticulture is a technological shift, made possible by low-cost miniaturized processors, networks and sensors, all brought about by the Internet and smartphone revolutions. As Microsoft realized, such a large-scale technological shift needs to be made pervasive across the entire organization. But first and foremost, Digital Horticulture is a shift in mindset. As IKEA realized, establishing a culture that supports interdisciplinary learning is a prerequisite for success.

A Comparison of Horticulture Data Platforms

There are only a handful of true (i.e. vendor-agnostic) data platforms commercially available for the horticulture sector. More than half of them appeared only in the past few years, indicating accelerating demand in this space:

- **LetsGrow.com** (2000)
- **30MHz** (2014)
- **Grownetics** (2015)

- **e-Gro** (2019)
- **PYLOT** (2019)
- **FarmRoad** (2019)
- **Koidra** (2020)

Minimally, all of the above ingest data from climate computers (most commonly Priva, Hoogendoorn, and Ridder) and provide data monitoring and analysis functionality. Some allow for manual entry of non-sensor data, such as pests and disease, plant growth, actual harvest, and labor productivity. About half of the platforms offer a yield prediction feature based on AI.

Additionally, **Autogrow** and **Bosch** are horticultural automation companies which offer data analytics solutions that work primarily only with their own hardware, though at least Autogrow offers an API for reading sensor data.

LetsGrow.com

LetsGrow.com (a "sister company" to Hoogendoorn) is the most established player in the field, having been around for over 20 years. They claim to be "the data platform for the horticultural sector, both nationally and internationally." They are an implementation partner of Plant Empowerment, a Dutch methodology that heavily emphasizes "data-driven growing (DDG)".

I signed up for a free account. The user experience feels clunky. The page for managing device locations appears with no controls and the help text appears in Dutch, even though my user interface is set to English. Indeed, of all of the data platforms evaluated, LetsGrow.com got the lowest rating in AwesomeTechStack's analysis of technology choice, performance, and security.

According to email correspondence, **LetsGrow.com does have a data API**. Strangely, they do not mention this anywhere on their product website.

Confusingly, on Hoogendoorn's own website, they refer to two different software services:

- a data analysis platform with modules for climate monitoring, yield forecasting, etc.
- a management information system for tracking pests and disease as well as **production costs and employee performance**. This latter functionality seems to be unique for the data platforms evaluated.

Nowhere there does it refer to Letsgrow.com, but a sales manager confirmed that "the platform that is discussed on the Hoogendoorn webpage is actually the LetsGrow.com platform."

- *2020-08-20 I created a free account.*
- *2020-08-26 I sent an inquiry about APIs and pricing model.*

- *2020-09-01 No direct response to the above, but a Sales Manager replied via the inquiry that I sent to Hoogendoorn.*
- *2020-09-02 I replied with questions. No response.*
- *2020-09-09 I sent a follow-up email.*
- *2020-09-23 The Sales Manager finally replied, clarifying the relationship to Hoogendoorn and providing credentials to a demo account, but neglecting to answer my other questions about technical issues and pricing.*

30MHz

30MHz calls itself "the data platform for horticulture." It is a company founded by hardware and software specialists to develop cloud-based industry-agnostic automation solutions, eventually focusing on the horticulture sector. Consequently:

- The product looks and feels modern. 30MHz got the second highest rating in AwesomeTechStack's analysis of technology choice, performance, and security.
- There are **social collaboration features**, namely a news feed that supports comments with image attachments.
- 30MHz is "API-friendly".
- It leans heavily on external partners for horticultural expertise (Delphy) and artificial intelligence expertise (Fresh4Cast).

30MHz itself develops and sells SRD860 (Z-Wave?) wireless sensors, but their data platform has a data ingestion API for adding data from other sources.

Grownetics

Grownetics is a small company based in Colorado that develops "smart farm" software and hardware. A year ago they moved to open source their core software, so-called "Grownetics OS", which "links any sensor or control system to every plant grown powering the next generation of smart farms with no hardware lock in."

TBD

e-Gro

e-Gro was launched in 2019 by Grodan, a Dutch manufacturer of stone wool substrates (part of the ROCKWOOL group). It is an "open software platform that connects available data from the greenhouse and presents it in a user-friendly way in a dashboard."

- *2020-08-20 I sent an inquiry with questions about hardware integration, data export, and APIs.*
- *2020-08-26 I sent another inquiry.*
- *Waiting for response…*

PYLOT

PYLOT comes from a Dutch greenhouse manufacturer, KUBO. PYLOT is a tool which "analyzes and interprets" different types of growing data and "presents it in a user-friendly dashboard."

They mentioned that they are working on "developing more and more intelligence in the platform to make harvest forecasts and climate incident 'tracking'."

PYLOT does not seem to offer any open data API.

- *2020-08-27 I sent an inquiry.*
- *2020-08-28 They responded, clarifying that* ***PYLOT "only connects with Priva, Ridder, Hoogendoorn, Argus and Fito."***

FarmRoad

FarmRoad is a subsidiary of Autogrow, launched in 2019 in partnership with Ridder. Both are leading suppliers of horticultural automation solutions. Its stated purpose is "to bring all farming data together in one powerful, unified, easy-to-use platform."

FarmRoad announced that their AI Yield Prediction hits "95% yield accuracy" for tomato growing. They plan to extend to other crops in the future.

According to email correspondence with Autogrow, "**FarmRoad does not control automation equipment**."

I had a call with their Head of Product, Steve Gardner, and two members of his team. I asked about the relationship between Autogrow and FarmRoad. He clarified that Autogrow is repositioning itself to focus on their existing hardware/automation business while putting the bulk of the company's resources on a new "pure" software and AI business called FarmRoad.

FarmRoad is a vendor-agnostic "crop management platform". It is not a "farm management platform" (Finance, Labor Management). The product consists of Farm > Compartments (Greenhouses) > Sectors and Teams > People abstractions, with Dashboards and a social media-like Activity Feed that supports comments and images.

FarmRoad provides data consolidation primarily via API, but they will do custom integration with legacy systems as part of their onboarding.

The pricing is per hectare and depends on selection of modules, $50–150/hectare/month.

- *2020-09-01 Autogrow passed my contact info to FarmRoad's Head of Product Marketing.*
- *2020-09-03 She replied.*

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- *2020-09-06 I replied with questions about API and pricing.*
- *2020-09-10 She put me in contact with FarmRoad's Head of Product.*
- *2020-09-16 I had a call with 4 members of the FarmRoad product team.*

Koidra

Koidra is an early-stage startup founded by Dr. Kenneth Tran, who worked at Microsoft Research as a machine learning researcher. In that capacity, he led the team that won the first Autonomous Greenhouse Challenge. **His was the only AI team to outperform a team of expert human growers.**

Their Krop Manager product "helps you integrate and unify your data, from heterogeneous sources, under one roof in the cloud". Separately, Koidra also features an autonomous control product, which is a unique offering that reflects the company's origins. Most of the data platforms only support analysis and prediction and do not support even manual control of process computers.

I have emailed and spoken with Dr. Tran. He said that none of the established horticulture data platforms were created with AI applications in mind. He emphasized that Koidra is "**the only AI-first and research-oriented company"** and, coming from the tech industry, it has been able to build both better technology and user experience. Indeed, Koidra got the highest rating in AwesomeTechStack's analysis of technology choice, performance, and security.

Dr. Tran says that pricing is $/m2/month, with the exact figure depending on the farm. He stated that "we can guarantee that it's more cost-competitive than LetsGrow."

- *2020-08-26 I sent an inquiry and subsequently had a call with Dr. Tran.*
- *2020-08-27 Beta testing access requested.*
- *2020-08-28 Account created, though API documentation is still pending.*
- *2020-09-14 I had a call with Dr. Tran and a developer regarding the data API. I am giving feedback and working with them to start testing the API and product.*

Autogrow

Autogrow is a horticultural automation company from New Zealand. After becoming CEO in 2015, Darryn Keiller pushed the company hard toward high-tech, including hiring a new CTO and head of AI.

Corresponding, Autogrow has been a proponent of data APIs. They announced that they were the first company in the industry to launch an open API. This API supports their MultiGrow and Intelli range of hardware. Recently, they launched another API for their Folium wireless sensors.

- *2020-08-29 I submitted an inquiry.*
- *2020-08-30 They responded, clarifying that the purpose of lab.autogrow.com is to **allow customers to access data _from_ Autogrow hardware**. They stated that*

*"**IntelliGrow will not work with other party controllers**" and connected me to FarmRoad's product team (see section on FarmRoad).*

Bosch

Bosch's Greenhouse Guardian was launched by their subsidiary in Japan in 2017 under the name "Plantect." It was built by Bosch.IO using components from the Bosch IoT Suite. It uses LoRa wireless sensors.

Uniquely, Greenhouse Guardian features AI-based disease prediction for tomatoes.

Greenhouse Guardian is currently **available only in Japan and South Korea**, though the webpage says "Please contact our team if you want to learn about availability in your country."

- *2020-08-29 I submitted an inquiry.*
- *Waiting for response…*

Do-It-Yourself

Uber, Airbnb, Netflix, and Skype think of themselves as tech companies—not taxi, hospitality, entertainment, or telecom companies. Similarly, a number of vertical farms and hydroponic greenhouse farms think of themselves as tech companies, not conventional farms. Like tech companies, they are raising staggering amounts of venture capital—and thereby building deep benches of expertise in advanced technology. Examples:

- **Plenty** (San Francisco, vertical farms, $400M total funding, Series C) is "looking for a Staff-level Data Scientist to support analyzing full farm processes and system behavior from the top down in order to help **create the most efficient farms that the world has ever seen**."
- **Bowery** (New York, vertical farms, $167M total funding, Series B) talks proudly of their "**proprietary farm operating system, BoweryOS**," which "uses vision systems, automation technology, and machine learning to monitor plants and all the variables that drive their growth 24/7." They are actively hiring software engineers to develop "software systems that power a modern farm. This includes building out work management systems, data collection, visualization, control systems, and farm automation."
- **Infarm** (Berlin, vertical farms, $305M total funding, Series C) is building **a "smart worldwide" network of remotely controlled Infarms**. Their "cloud-based farming platform" "learns, adjusts and improves itself continuously." They are hiring engineers to build systems to perform the following: "Monitor, automate and control our vertical farms to provide the highest quality crops; Support the logistics of operations along with the crops life cycle; Monitor the quality of our crops to drive operational improvements."
- **Gotham Greens** (New York, hydroponic greenhouses, $38M total funding, Series C) are actively "seeking an experienced Technical Product Manager who can help us **advance the farm of the future**" and "will partner with leadership to drive the

overarching vision and strategy for how we can **use data science, proprietary software tools, hardware, and visualizations to optimize the way we grow produce** (e.g. leafy greens & herbs) and to optimize operations and decision making up and down the business."

- **Spread** (Japan, vertical farms, funding unknown) is possibly the most established vertical farm company in the world. **Spread became profitable already in 2014** with a non-automated vertical farm—one of the few ever to do so. Heavily investing in automation and scale, it is estimated that their production costs will "come close to parity with outdoor farms" within years. They partnered with NTT to develop IoT and AI technologies but do their core R&D in-house, "from crop research and development to technology development, trialling and implementation."

Netscape co-founder and venture capitalist Marc Andreessen predicted that "the battles between incumbents and software-powered insurgents will be epic". We see this at play right here. These insurgent "farms" clearly believe that taking on the challenge of developing proprietary software and hardware will be well worth it down the road. Doing this requires a combination of deep pockets, a stubborn willingness to sustain in-house R&D staffing, and a tech-oriented culture ("Culture eats strategy for breakfast").

Digital Horticulture - Data Platforms

	LetsGrow.com (Hoogendoorn)	30MHz	Grownetics	e-Gro (Grodan)	PYLOT (KUBO)	FarmRoad (Autogrow)	Koidra
Launched	2000, 🇳🇱NL	2014, 🇳🇱NL	2015, 🇺🇸US	2/2019, 🇳🇱NL	6/2019, 🇳🇱NL	6/2019, 🇳🇿NZ	2020, 🇺🇸US
Availability	Free trial (Started 2020-08-20)	Paid		Free trial *(Requested 2020-08-20, 2020-08-26)*	Only tomato, bell pepper, cucumber, aubergine, lettuce*	Only tomato? *	"Contact Us" *(Requested beta access 2020-08-27)*
Pricing	?	€329/month (∞ devices)		?		*(Inquiry sent 2020-09-06)*	"$/m2/month" **
Data Portability							
Data Export	TSV, CSV, Excel, XML, HTML, PDF *** + REST API	CSV * + REST API		"Excel" * *(Inquiry sent 2020-08-26)*		?	CSV (future) **
Data API	REST API **	REST API *		?		Yes (?) *	REST API **
Technology							
AwesomeTechStack Rating	10/100	78/100		34/100	74/100	51/100	85/100
Web Tech Stack	ASP.NET, Angular, C#, .Net Core, Azure, SQL, Xamarin	AngularJS, AWS		AngularJS, Laravel, PHP, Nginx	Express, Node.js, Nginx	Semantic, AWS	Vue.js, CloudFlare
Autonomous Greenhouse Challenge	Sponsor; Hoogendoorn part of 2020 winning team	Partnered with Delphy		Sponsor	—	—	CTO led 2018 winning team

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Data Supported							
Climate (Data ingest from sensors)	*(Inquiry sent 2020-08-26)*	30MHz sensors + Priva, Hoog., Sercom, Ridder + other + ingest API		"most common climate computers" *(Inquiry sent 2020-08-26)*	Only Priva, Hoog, Hortimax, Fito (Russia), Argus (America) ***	Any via "API or some form of connector" * (Inquiry sent 2020-09-06)	Argus, Ridder, Priva, Hoog. + custom adaptors **
Crop planning		✔ (?)			✔ **		✔ **
Growth/harvest	✔ *	✔ (?)		✔ (?)	✔ **		✔ ***
Energy usage	✔ (?)	template (?)			✔ Manual **		✔ **
Pest/disease	✔ Work-IT *	✔ Manual *			—		
Labor/costs	✔ Work-IT *	template (?)			—		✔ ***
Images	✔ ***	✔ *			—		✔ ***
Features							
Heatmaps	—	✔ *		—	—	—	—
Social	—	✔ *		—	—	—	—
Mobile	iOS, Android (data entry) *	Web app *		iOS, Android (view, mgmt) *	—	—	—
AI yield pred.	✔	Via partner *		✔ Module *	Forthcoming **	✔	✔
AI climate pred.	—	—		—	Forthcoming **	—	✔
AI comp. vision	Via partner *	—		—	—	Forthcoming *	—
AI auto control	—	—		—	—	—	✔

* From website ** From email/phone correspondence *** From personal experience

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