

40 YEARS ANNIVERSARY

# Industry 4.0 solution for fish farming

Tom Heintjes

November 8, 2017



# CONFERENCE AGENDA

PENKO Engineering B.V. - Schutterweg 35 - 6718 XC EDE



12:30 Registration

13:15 Welcome and Introductions

SMART Industry

Prof. Dr. Ir. Egbert-Jan Sol  
*Chief Technical Officer*  
TNO

Industry 4.0 – a practical example  
Tom Heintjes  
*Development Manager*  
PENKO Engineering B.V.

Mega Trends in Society

Ralph Wessels  
*Investment Strategist*  
ABN Amro Bank

Special Tribute

15:30 Mini Exhibition - Discussion Forums - Networking





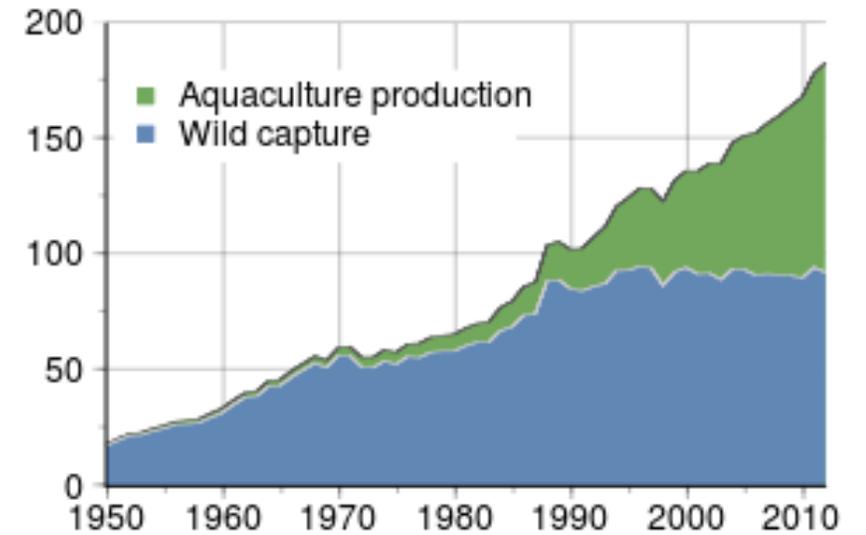
# Agenda



1. Fish farming
2. The opportunity
3. Available, in-house technologies
4. A complete solution:
  - a) *Phase 1 – a system for measuring DO*
  - b) *An even more complete system*
  - c) *(Future) phase 2 – a system for feeding*
  - d) *(Future) phase 3 – a system for harvesting*
  - e) *The ideal, total solution*
5. Conclusion
6. Questions?



# Fish farming



Fish farming is increasingly important to protect wild fish stocks, and to feed a growing global population





# Fish farming – the importance of DO

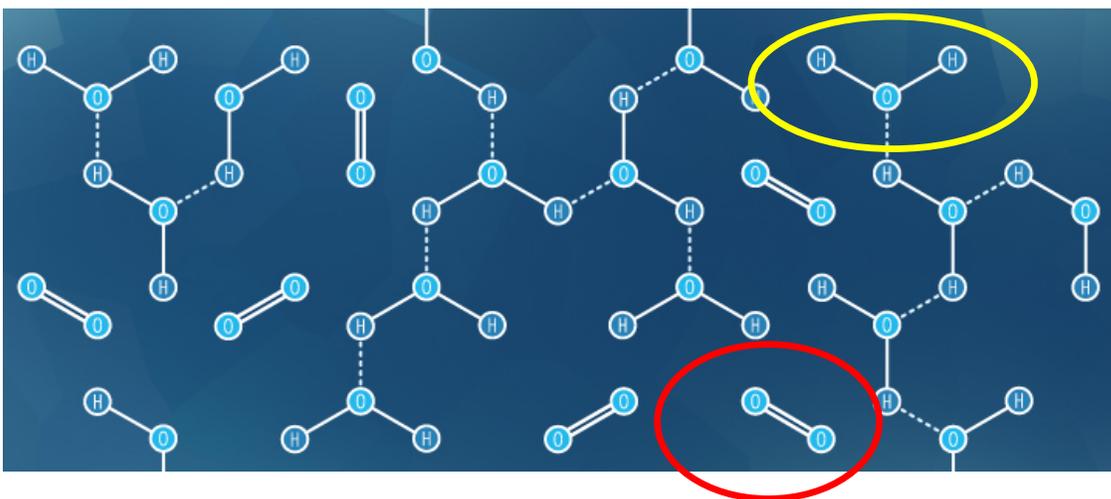


Dissolved Oxygen (DO) is essential for the fish to live!



H<sub>2</sub>O molecule

DO molecule



Higher water temperature leads to higher fish body temperatures

Higher fish body temperatures lead to increased metabolism, and higher food intake

During food intake, fish use more DO

The required amount of DO varies significantly in a 24-hour period

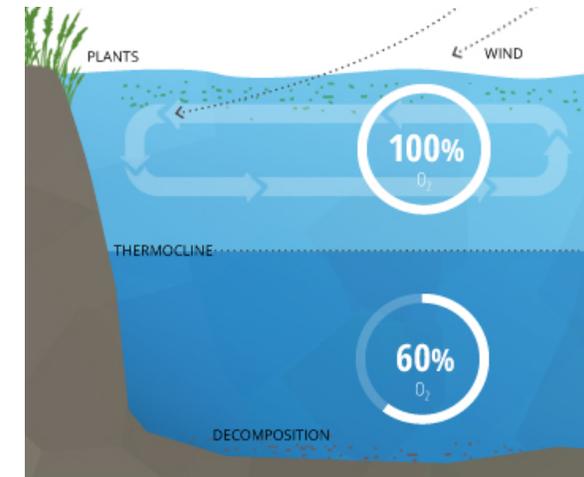
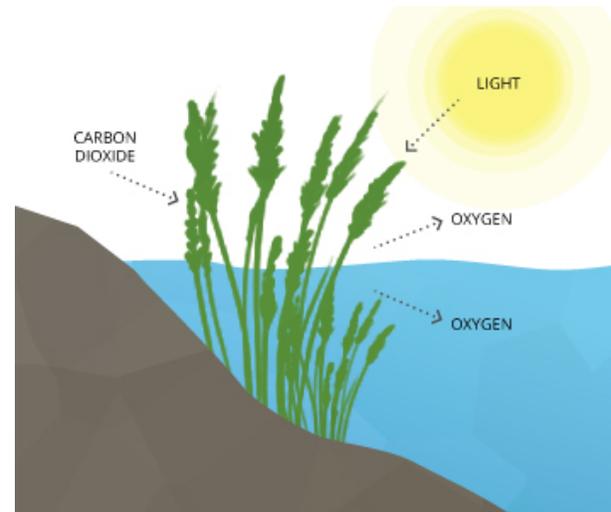
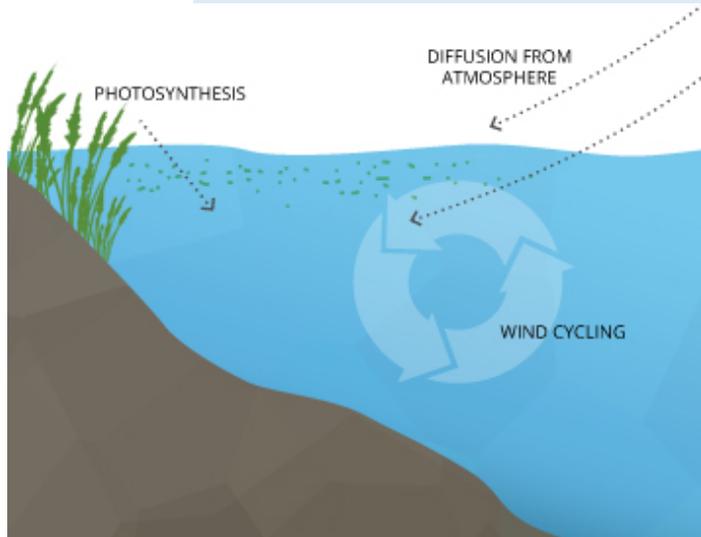
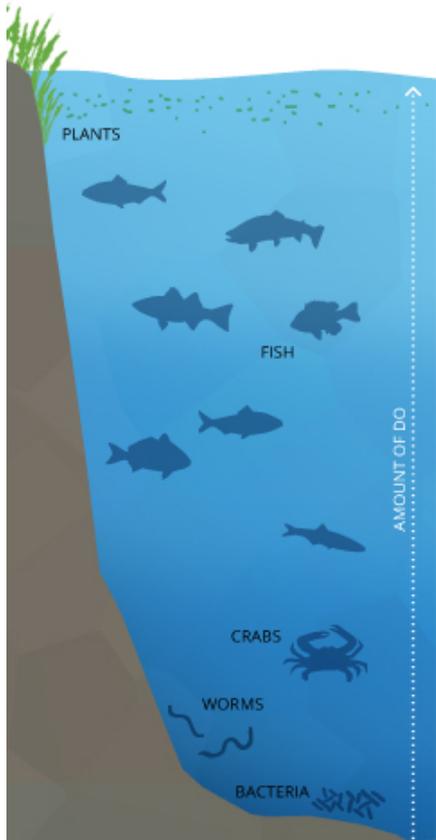
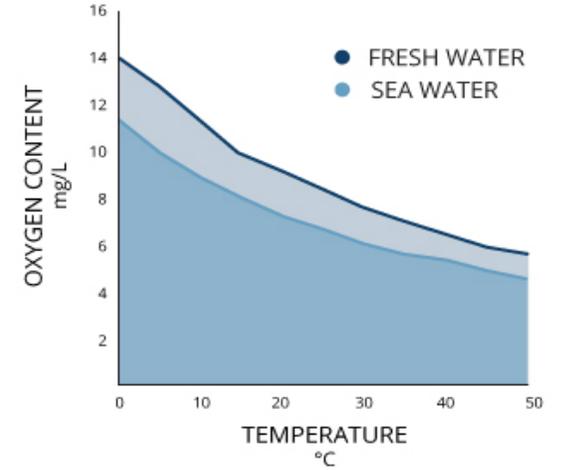


# Fish farming – a complex process



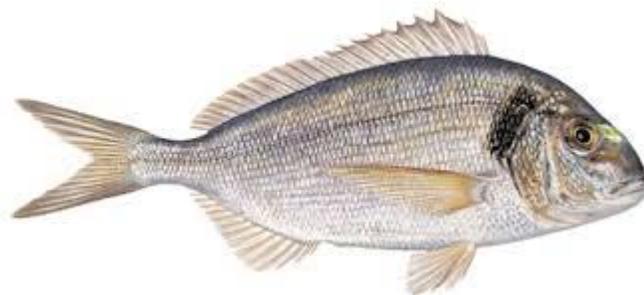
The DO-level in water depends on:

- *Water temperature*
- *Photosynthesis*
- *Depth, currents*
- *Presence of fish and other species*
- *Water salinity*
- *Interaction with air at the water surface*





# Fish farming – a complex process



Fish feed pellets are the most expensive cost item

Juveniles: feeding 6 – 8 times per day \* Mature fish: feeding 1 – 4 times per day \*



During feeding, fish use a lot of DO



(Daily) variable market demands

\* During growth season (May – October), less frequent in winter period



# The opportunity



- Knowing the **real-time DO-levels** in the fish farm\* allows for an optimal feeding schedule
- An optimized feeding schedule will **save on expensive fish feed**, and lead to **optimized operator capacity**
- Fine-tuning the daily market demand with the kg's of captured fish allows for **less give-away**

So...

- Fish farms can benefit from an overall data management system!

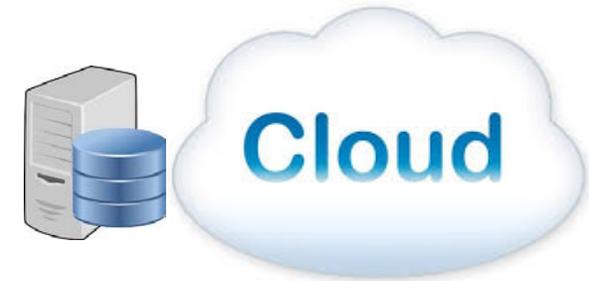
\* The natural level at open sea, in between the fish cages and inside the fish cages



# Available, in-house technologies

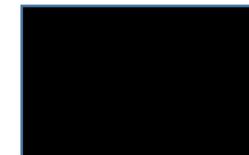


- Penko controlling solutions
- Penko cloud solutions
- Echoflex sensor technology



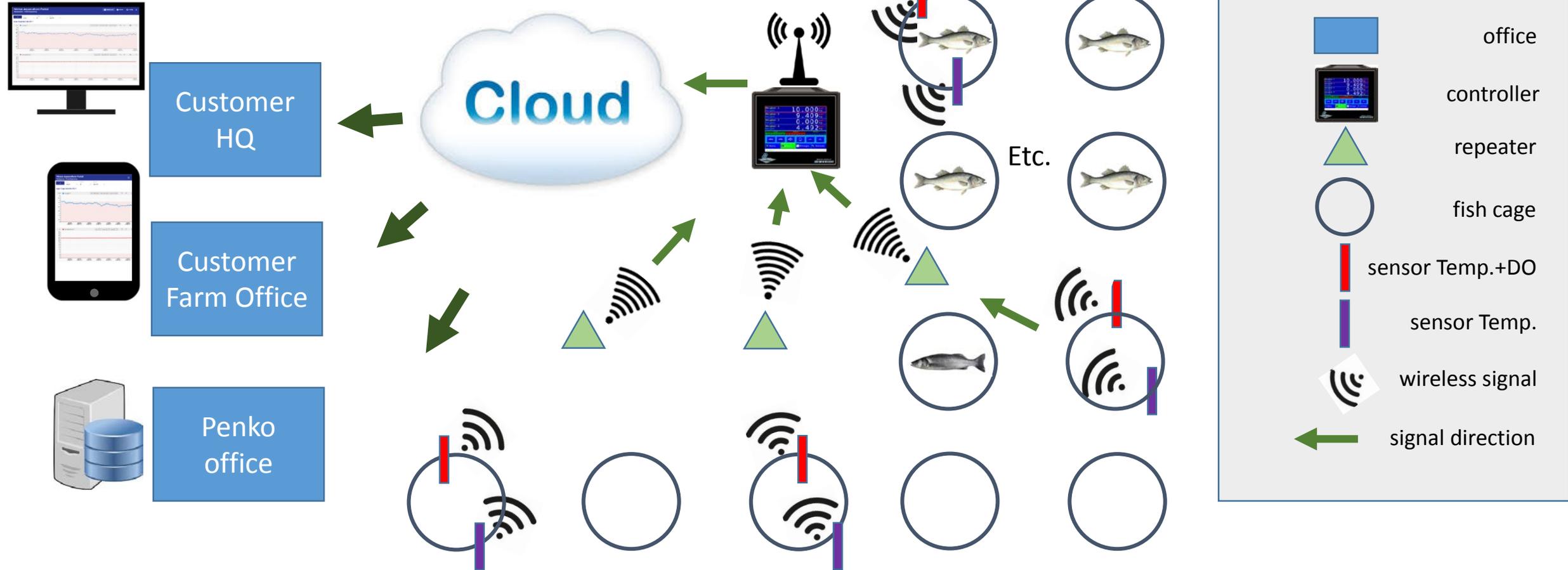
- Echoflex low-energy harvesting technology

Mini-solar panel 2 x 3 cm





# Phase 1 – solution for measuring DO





# Phase 1 – results



**Aquaculture Portal**  
Headquarters - Tom Heintjes

chart - all - custom - 13 Oct 2017 10:41 - 18 Oct 2017 14:41

view: table - all - custom

**cage: Inside farm A1 (Sensor 7)**

oxygen Inside farm

timestamp	unit	value	raw value
18-10-2017 14:40:58	mg/l	6.64	7447
18-10-2017 14:39:12	mg/l	6.61	7419
18-10-2017 14:37:25	mg/l	6.64	7445
18-10-2017 14:35:38	mg/l	6.47	7261
18-10-2017 14:33:52	mg/l	6.46	7248
18-10-2017 14:31:59	mg/l	6.36	7137
18-10-2017 14:30:12	mg/l	6.46	7250
18-10-2017 14:28:25	mg/l	6.34	7117
18-10-2017 14:26:29	mg/l	6.35	7122
18-10-2017 14:24:52	mg/l	6.58	7382
18-10-2017 14:23:06	mg/l	6.52	7309
18-10-2017 14:21:13	mg/l	6.24	7005
18-10-2017 14:19:26	mg/l	5.81	6521
18-10-2017 14:17:40	mg/l	6.04	6774
18-10-2017 14:15:53	mg/l	5.69	6384
18-10-2017 14:14:07	mg/l	6.08	6823
18-10-2017 14:12:20	mg/l	6.13	6876
18-10-2017 14:10:25	mg/l	6.27	7031
18-10-2017 14:08:40	mg/l	6.70	7810
18-10-2017 14:06:53	mg/l	6.97	7821
18-10-2017 14:05:07	mg/l	7.09	7951
18-10-2017 14:03:20	mg/l	6.88	7713
18-10-2017 14:01:34	mg/l	7.19	8062
18-10-2017 13:59:40	mg/l	6.59	7292
18-10-2017 13:57:54	mg/l	6.44	7224
18-10-2017 13:56:07	mg/l	6.34	7116
18-10-2017 13:54:21	mg/l	6.27	7031

oxygen Inside farm  
min: 4 mg/l | max: 9.14 mg/l | avg: 6.74 mg/l

temperature Inside farm  
min: 21.7 °C | max: 22.6 °C | avg: 21.9 °C

**Inside cage (4)**

oxygen Inside cage

live value	3.01 mg/l
last update	15:37:40
yesterday	2.45 mg/l
today	2.99 mg/l
last hour average	2.35 mg/l
day average	2.59 mg/l
day minimum	1.89 mg/l
day maximum	3.30 mg/l

**Inside cage (7)**

temperature Inside cage

live value	21.5 °C
last update	15:37:40
yesterday	21.8 °C
today	21.5 °C
last hour average	21.8 °C
day average	21.5 °C
day minimum	21.6 °C
day maximum	21.4 °C

Summary statistics for oxygen and temperature:

Parameter	Yesterday	Today
Temperature	21.9 °C	21.6 °C
Oxygen	3.03 mg/l	3.56 mg/l
Temperature	21.8 °C	21.5 °C
Oxygen	3.99 mg/l	4.60 mg/l
Temperature	21.6 °C	21.3 °C
Oxygen	3.79 mg/l	4.52 mg/l



# An even more complete solution



(example)

Scientific research, analysis of historical data

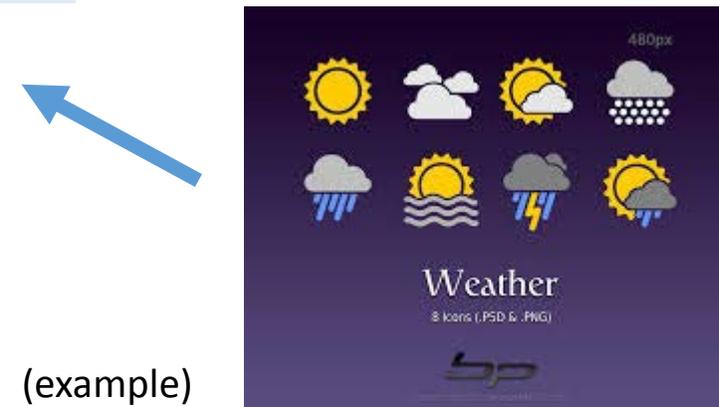
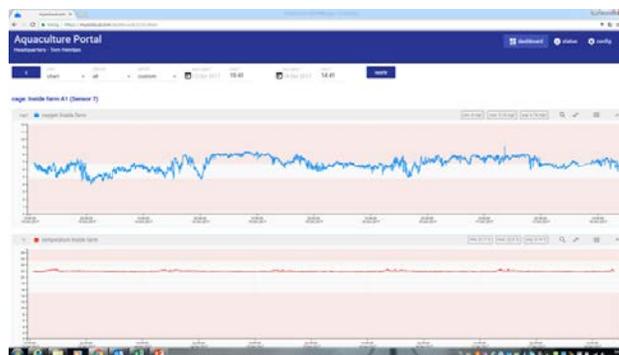
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(example)

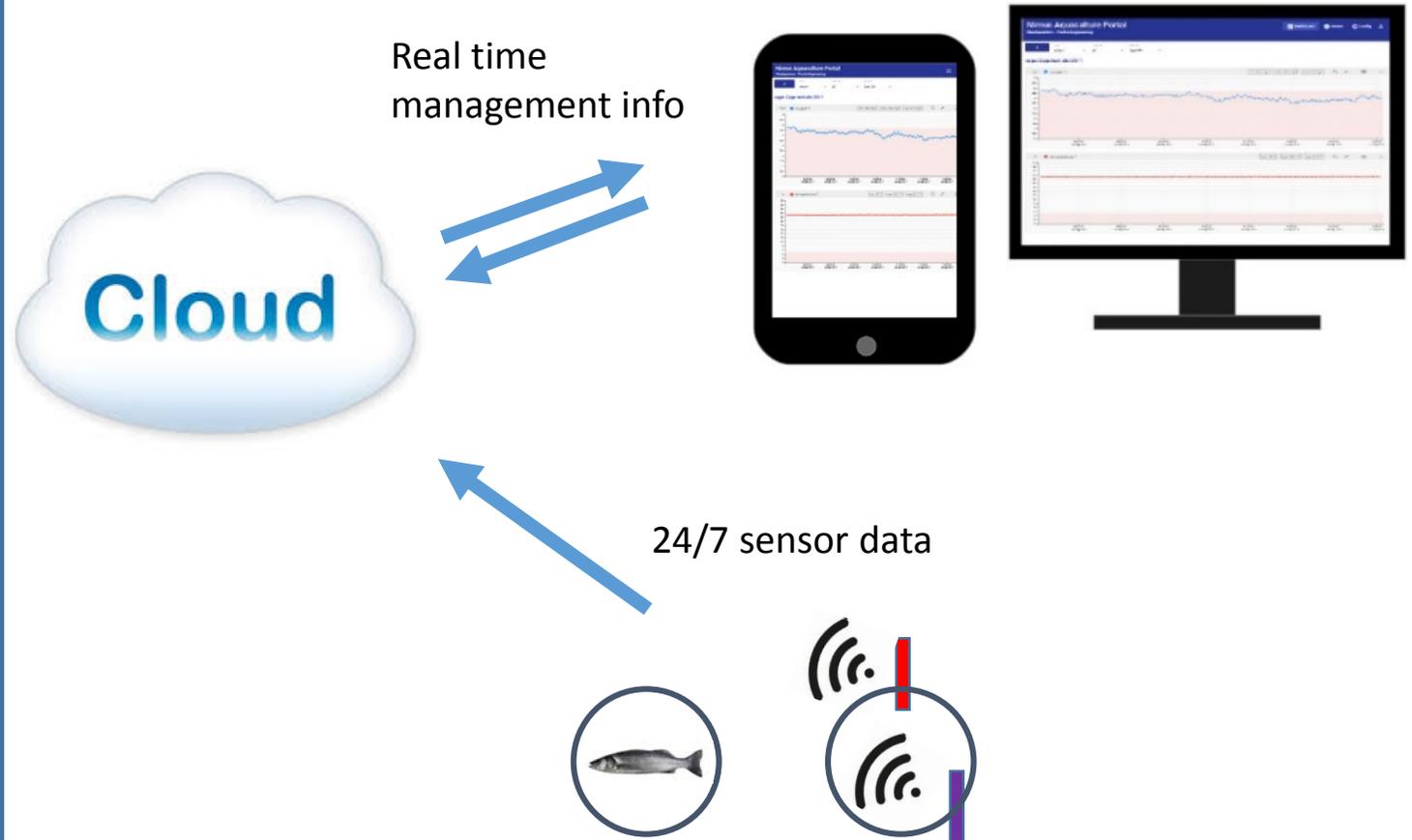
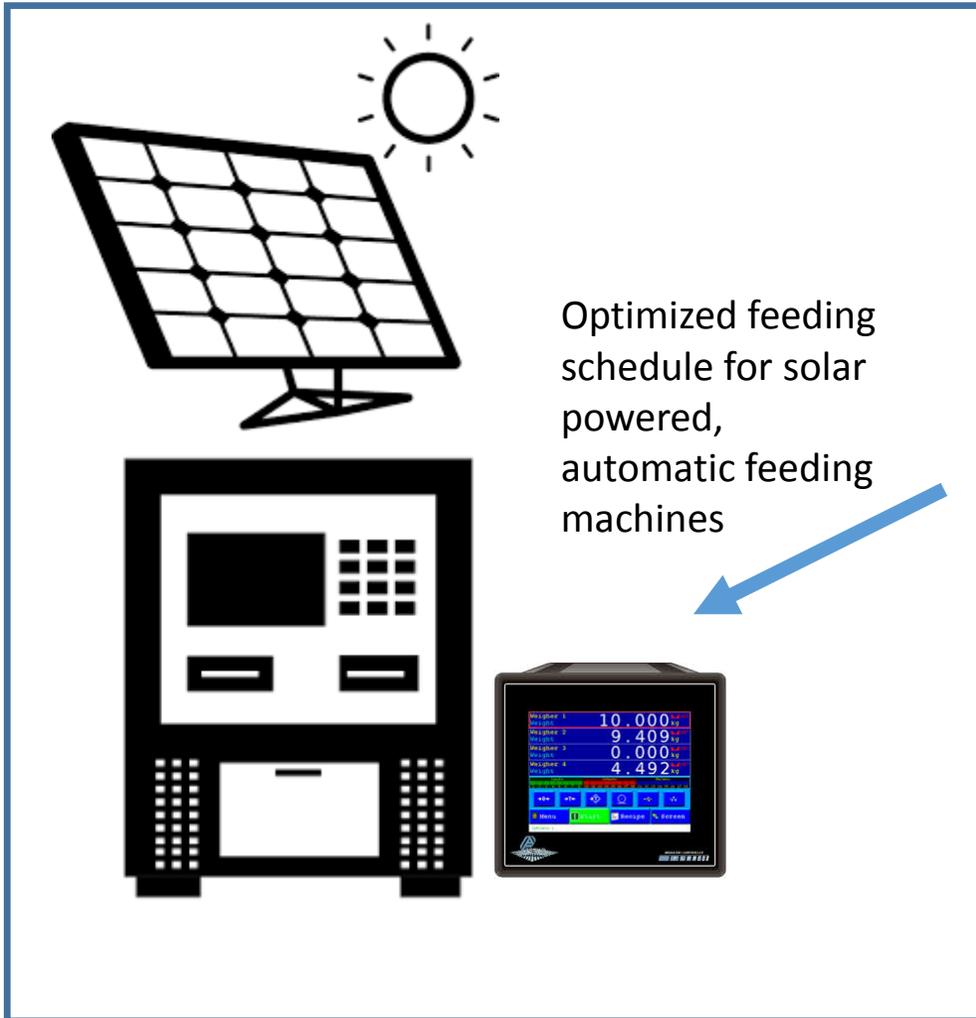
Weather forecasting, real time data



(example)

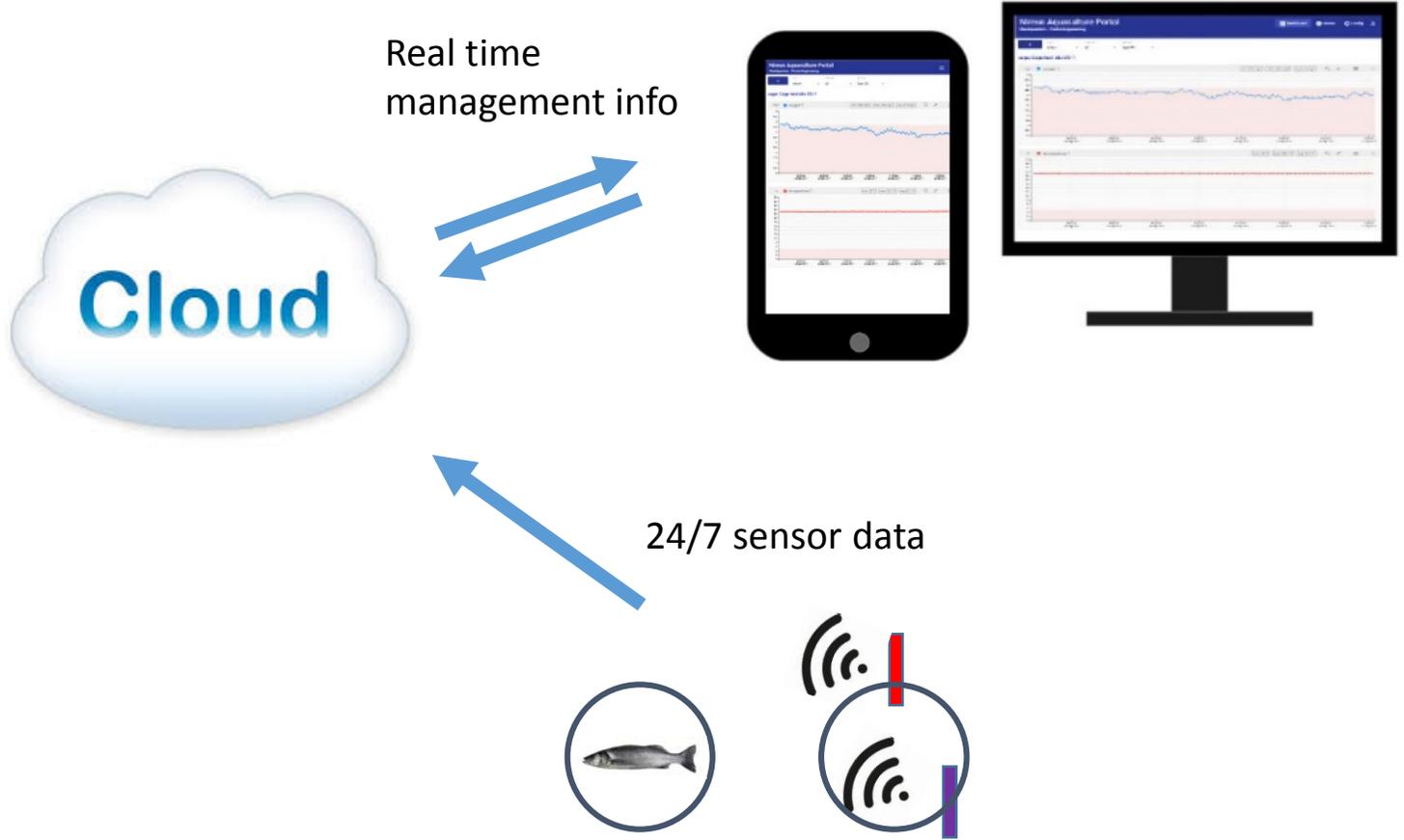
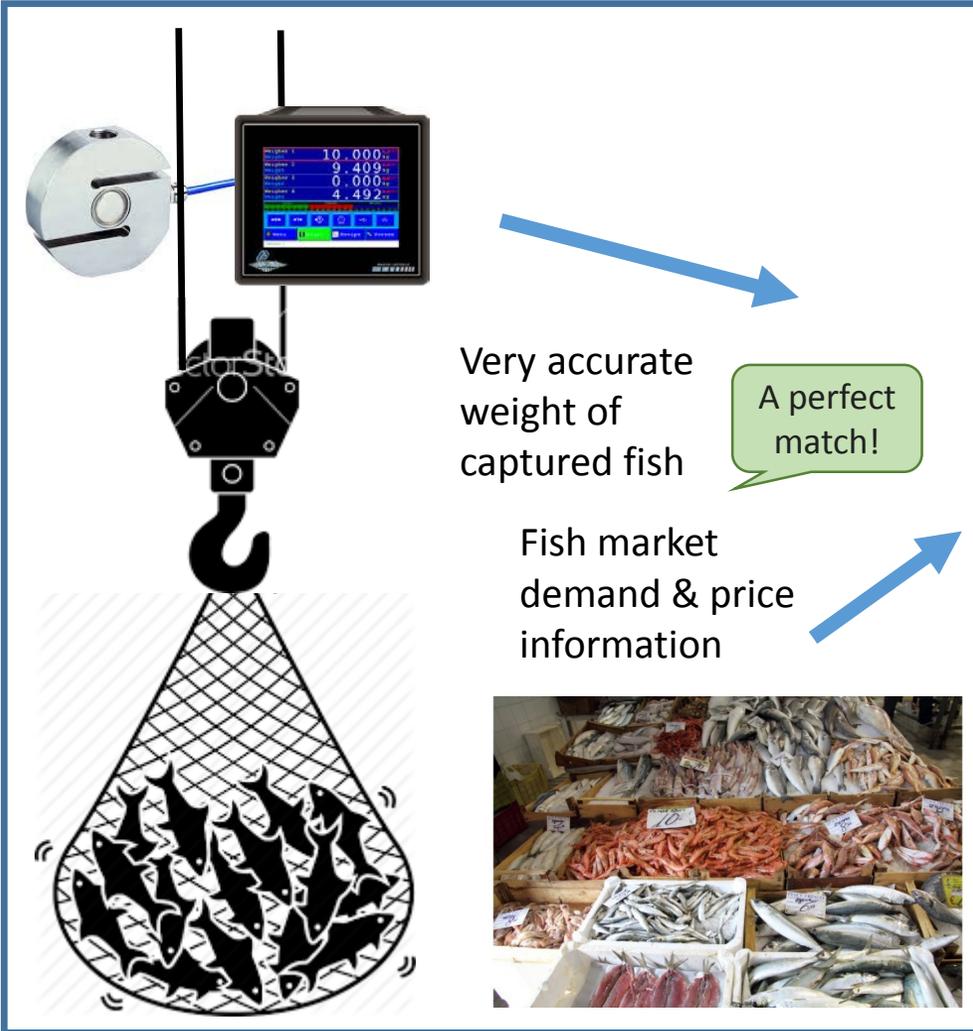


# Phase 2 – a system for feeding





# Phase 3 – a system for harvesting





# The ideal, total solution



Solar powered, lean, optimized feeding solution



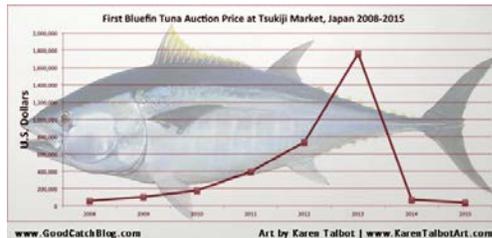
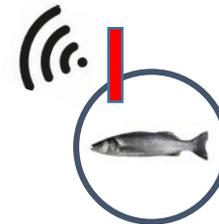
Real time management information



Fish demand market information, capture management



24/7 sensor information





# Conclusion



- Industry 4.0 applications provide countless opportunities
- Each customer can benefit from intelligent, (highly) customized solutions
- Penko is available to consult and help you to capture the benefits of:





Thank you for your attention!





**PENKO**

*an ETC Company*