Technology in the Mango Industry

Enabling quality controlled logistics

November 22nd 2019, Eelke Westra

Content

- Introduction
- Quality controlled logistics
- Summary
- Questions

Wageningen University & Research

This Tiny Country Feeds the World

The Netherlands has become an agricultural giant by showing what the future of farming could look like.

NATIONAL GEOGRAPHIC

www.nationalgeographic.com/magazine/2017/09/holland-agriculture-sustainable-farming/

- Global # 1 in AgroFood

- "A university for the world, and not simply for the Dutch"

- 45% of graduate students from abroad, representing > 100 nations.

WAGENINGEN
UNIVERSITY & RESEARCH
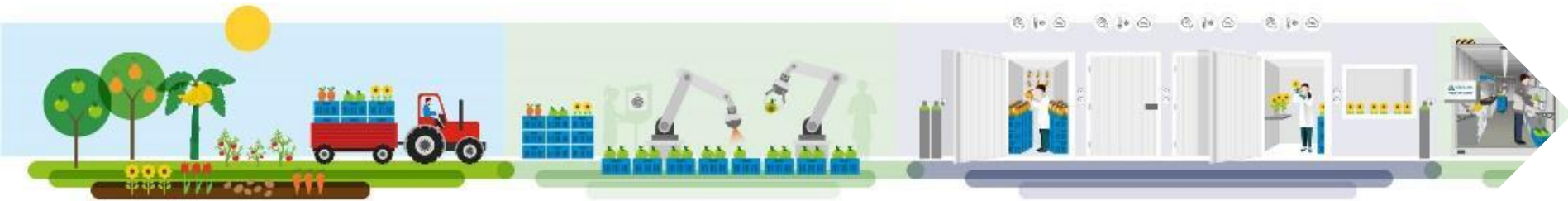
100years
1918 — 2018

Who am I

Eelke Westra

Programm Manager
Postharvest Quality @

Wageningen UR

Postharvest Scientist, 17
years experience in the field
of fruit, vegetables and cut-
flowers

Postharvest Technology @ Wageningen UR

Our results enables our clients to increase their efficiency, reduce their food waste and increase their ability to provide more high quality produce to the market

We understand fresh products

We understand the cold chain

80 Years of Postharvest Research

1936

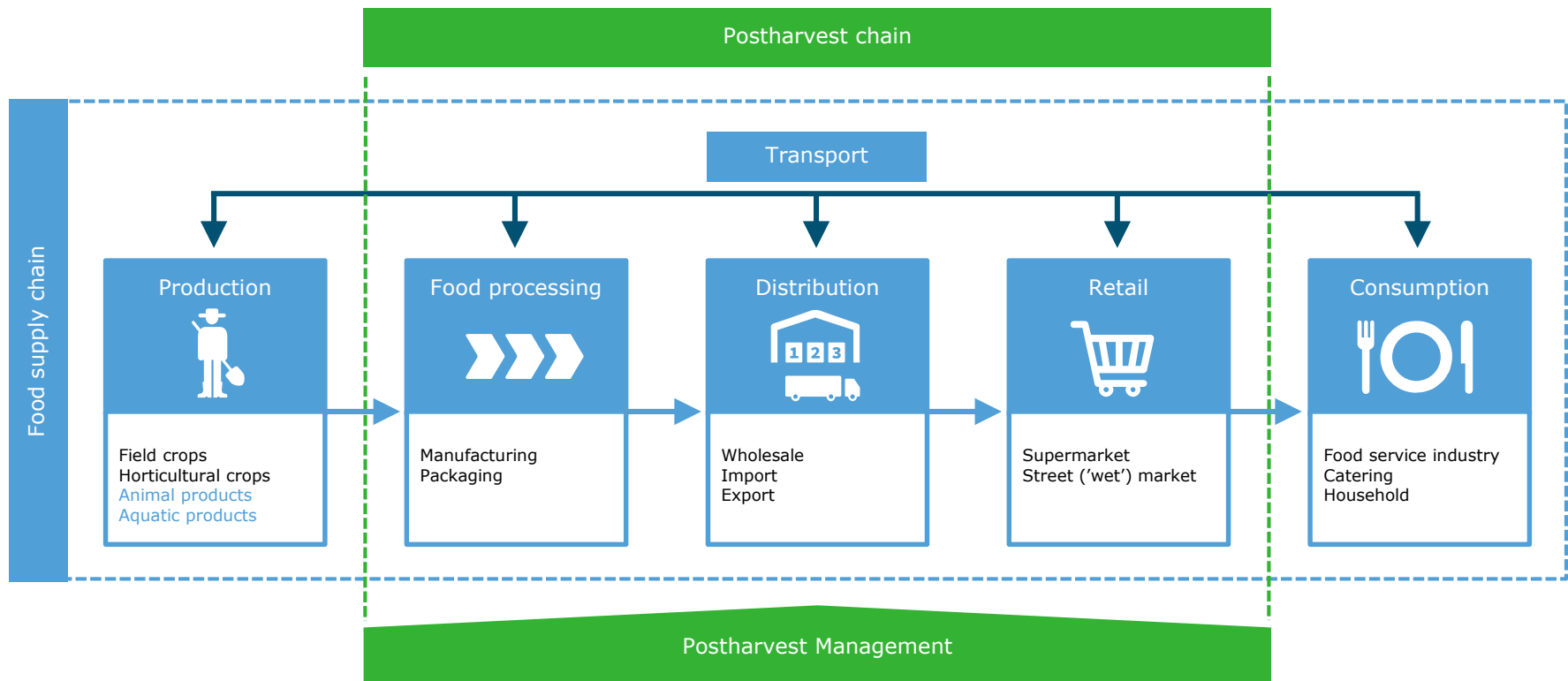Sprenger Institute
by prof. A.M. Sprenger

2017

Modern research
facility PHENOMEA

QUEST™

Rose Biomarker

ROBOTICS

Challenges

Postharvest chain

Transport

Food supply chain

Production	Food processing	Distribution	Retail	Consumption
Field crops Horticultural crops Animal products Aquatic products	Manufacturing Packaging	Wholesale Import Export	Supermarket Street ('wet') market	Food service industry Catering Household

Postharvest Management

Challenges

How to get transparent, adaptive supply chains?

How do carbon neutral supply chains look like?
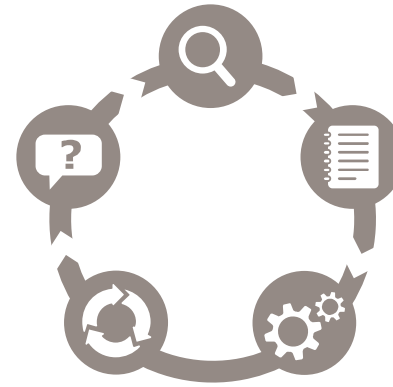
How to create circularity in the supply chain?

Always tasty, high nutritive, long-lasting fruit and vegetables and flowers: how to achieve that?

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Key technology development & application

- **Sensing** technology for food quality and customer specifications and demand

- **Data and tracking** technology to link measurement data to individual products and customers

- **Transport and storage** technology that is able to deliver products to customers, control quality and have a minimal carbon footprint

- **Predictive** algorithms that is able to forecast quality development and customer preferences

Content

- Introduction
- Quality controlled logistics
- Summary
- Questions

Goal

Tasty Mangoes for anyone

Mango supply chain

When to Harvest?

Is it delicious?

How long to store?

How to ripen?

Quality Controlled Logistics
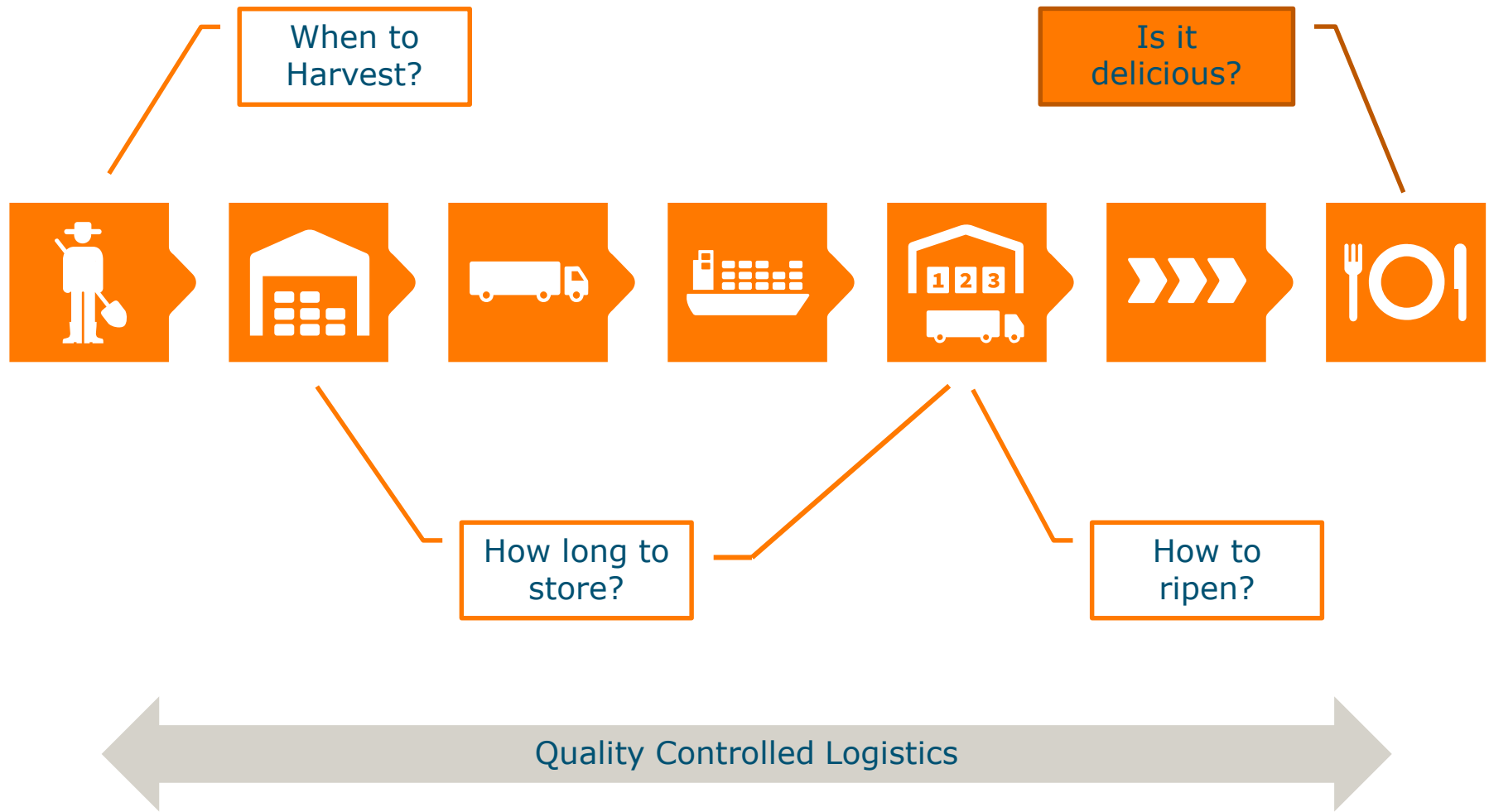
Quality controlled Logistics

- What are the **key quality attributes**
  - From a consumers perspective!

- How to **measure** this in a supply chain
  - Starting in the orchard

- How to create **optimal conditions to preserve** quality

Objective Phenotyping

Objective phenotyping (Sensors):

- ✓ Consistent standardized methods
- ✓ Repeatable, at different locations
- ✓ Non-destructive
- ✓ Ability to follow and compare over time
- ✓ Quantification of subtle differences
- ✓ Early detection of invisible differences
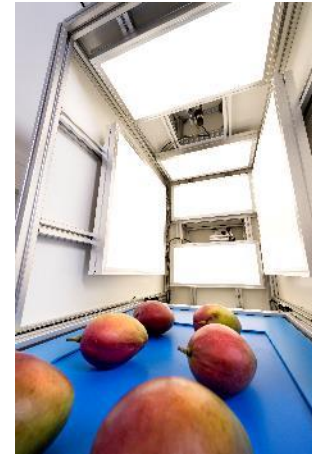
Predict ripening with Firmness

Is it delicious?

Firmness of more then 3000 mangoes measured at:

- Harvest (Brazil) – Arrival - After ripening

(Ready-to-Eat stage)

Brazil   **NL arrival**   **NL RTE**

R^2 89% R^2 87%

High predictive value

R^2 83%

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018

Internal colour to determine maturity

AVERAGE COLOR				
INTERIOR FLESH SAMPLES				
MATURITY/ RIPENESS	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5

Subjective score
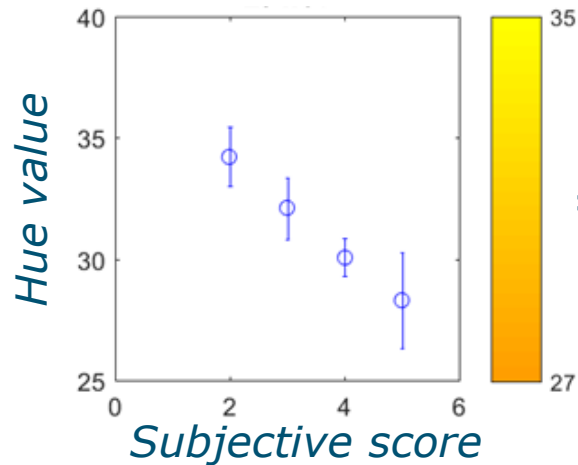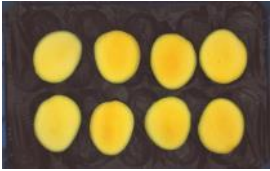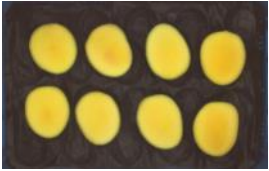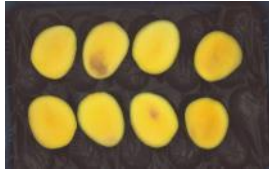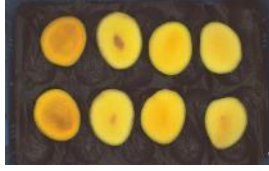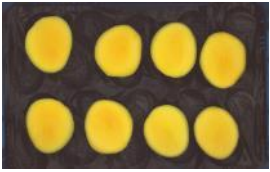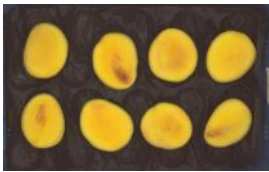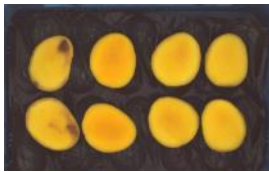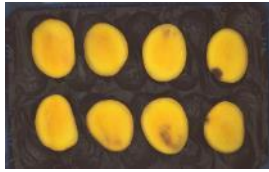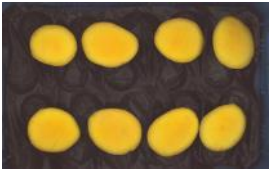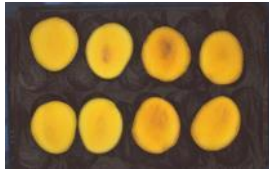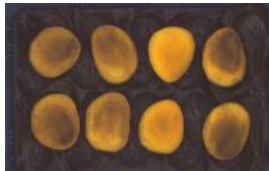
= Objective score

Subjective score
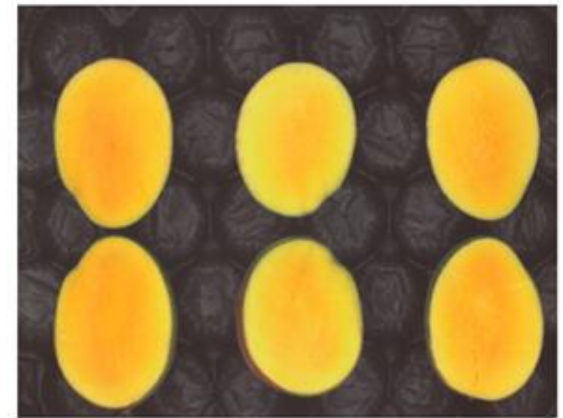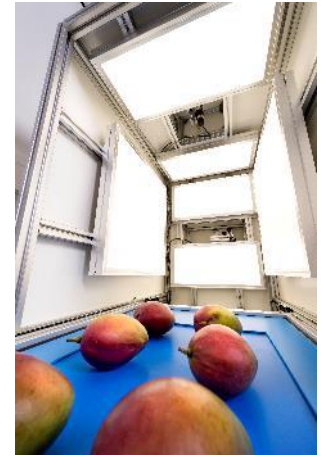
Internal flesh browning

		Storage time (days)			
		6	**10**	**16**	**22**
Temperature (°C)	**6**				
	10				
	16				
	22				

Conclusion:

* Successful induction of internal browning
* No browning at 6 °C

Application:
QCL:

* Apply lower transport temperatures
* communicate actual temperatures and duration of transport

17

Non-invasive detection

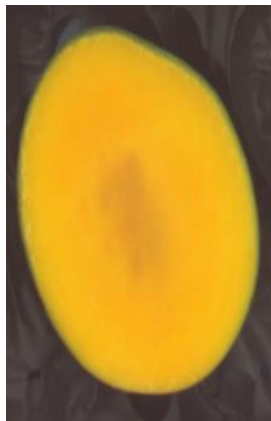## NIR shows ~85% correct prediction of healthy or brown
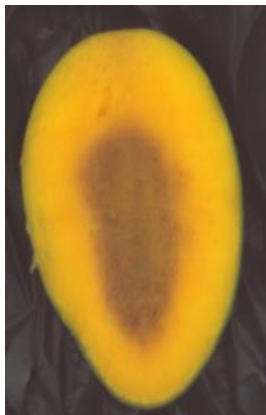
Brown

Healthy

|		Prediction (NIR)	
		Brown	Healthy
Ground truth	Brown	85%	12%
	Healthy	15%	88%

NIR to track on-tree maturity

Preliminary results

- NIR-spectra of 100 mangoes on the tree were measured weekly during 5 weeks until 3 days after harvest

- Correlation found between NIR measurements and maturity

Benefit of using NIR-measurements at harvest
Optimize harvest moment based upon non-destructive indication of maturity
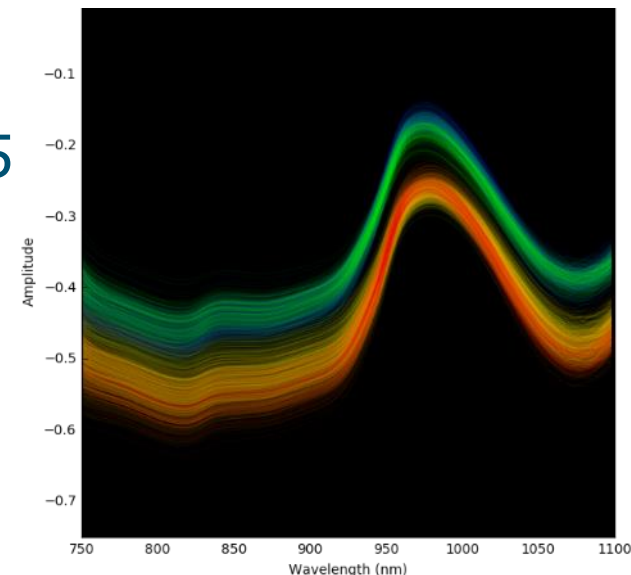
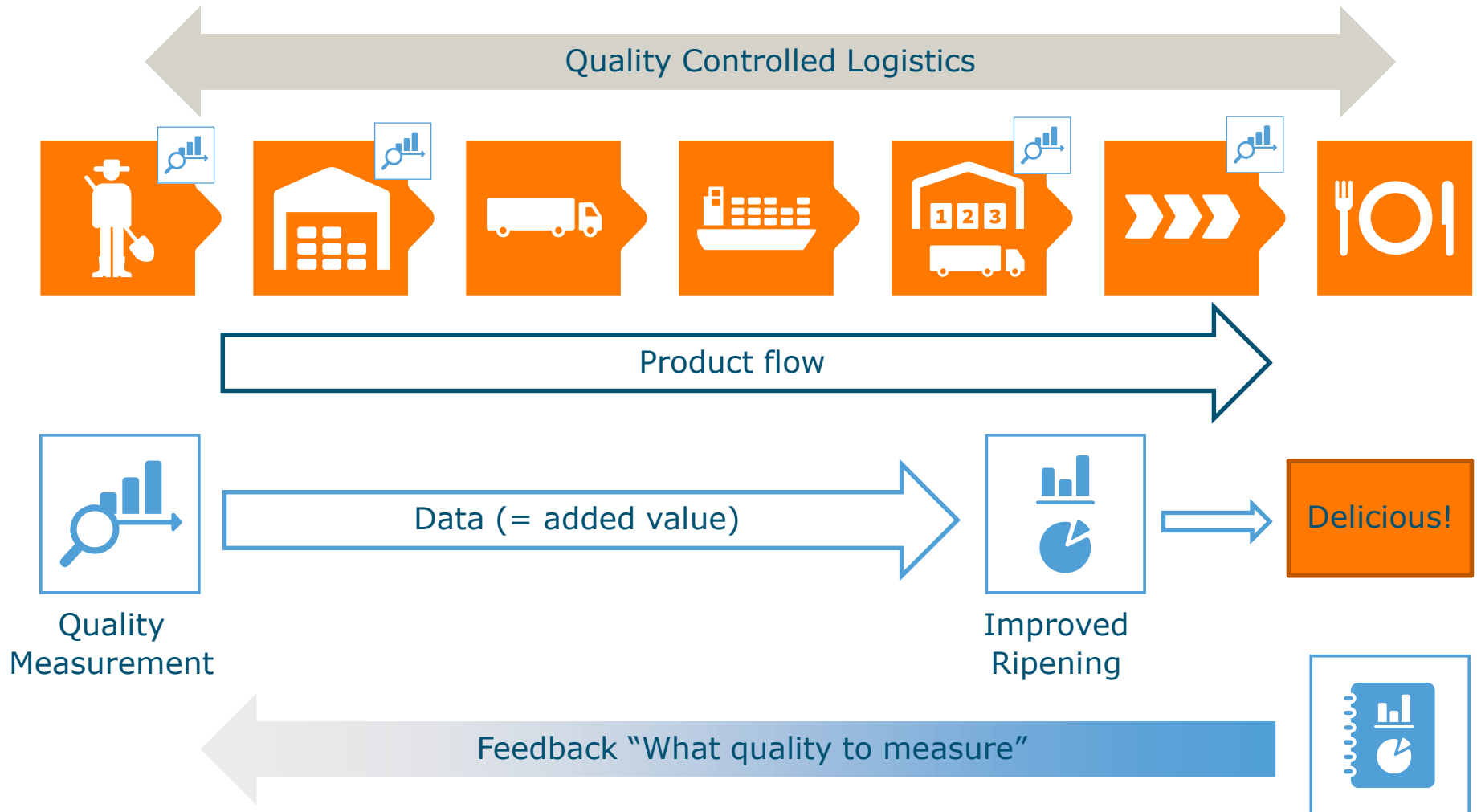*Each colour represents data from a specific week*

Blue: harvest -5 w
Orange: harvest +3 d

Content

- Introduction
- Quality controlled logistics
- Summary
- Questions

Mango supply chain → QCL

Quality Controlled Logistics

Product flow

Quality Measurement

Data (= added value)

Improved Ripening

Delicious!

Feedback "What quality to measure"

Summary

Quality Controlled Logistics enables right quality for the right market

- Need for non-invasive phenotyping systems

- Demonstrated added value in Mango Supply Chain

  - Firmness measurement for Optimal Ripening

  - NIR for Minimising Internal Browning (IB)

  - Temperature and duration for Minimising IB

  - *NIR for picking maturity*

Tasty Mangoes for anyone!

Eelke Westra

Eelke.Westra@wur.nl

+31 651 619 215

Reports downloadable on:
www.wur.nl/greenchainge

Eelke Westra

Programme Manager

Postharvest Quality

WAGENINGEN
UNIVERSITY & RESEARCH

100years
1918 — 2018