Face Biometric Quality Measures: Need and Use in EU IT Systems

(what we have learned developing FaceQnet)

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eu-LISA Industry Round Table

DG JRC

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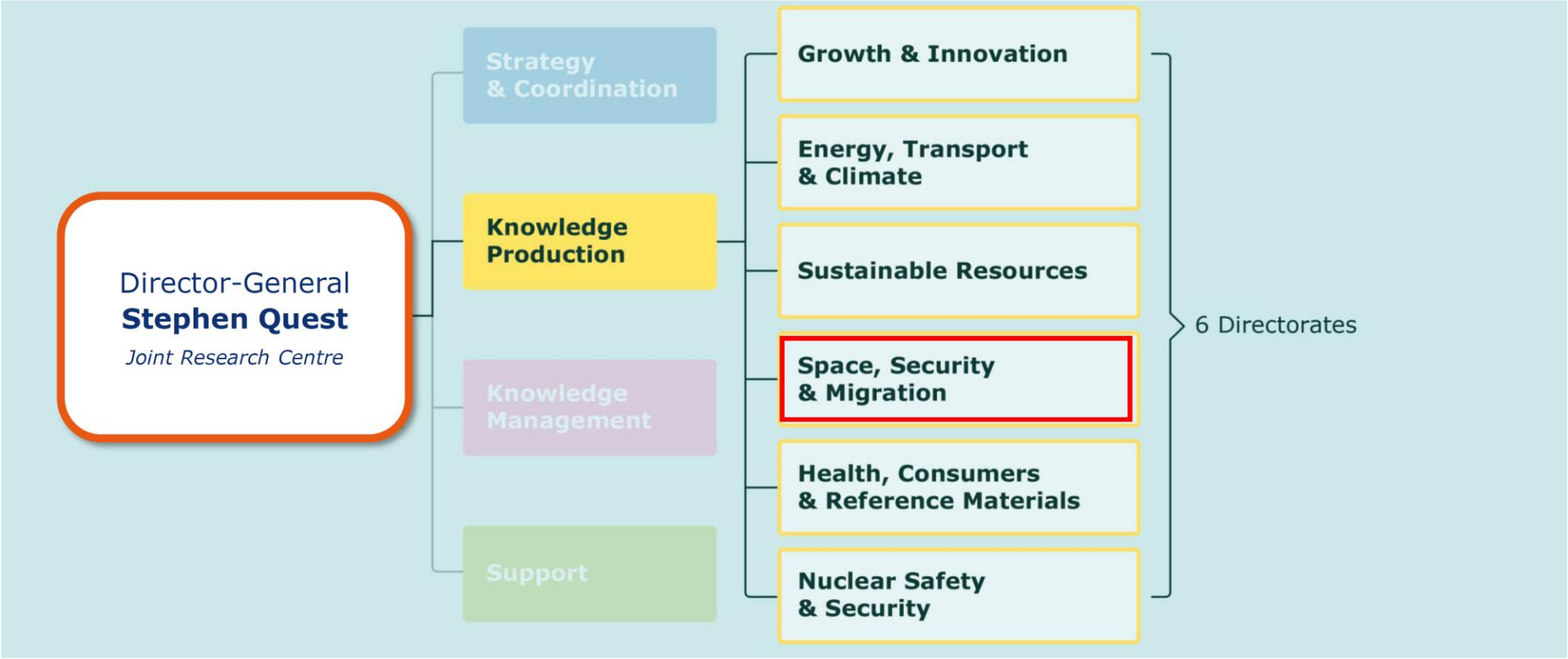

DG JRC facilities

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The Quality Concept

Quality in Science

Only nonsense conclusions can be expected from flawed premises

Quality in Computer Science

The soundness of the data given as input

to a computerised system

plays a pivotal role on the soundness of its output

Biometric Quality

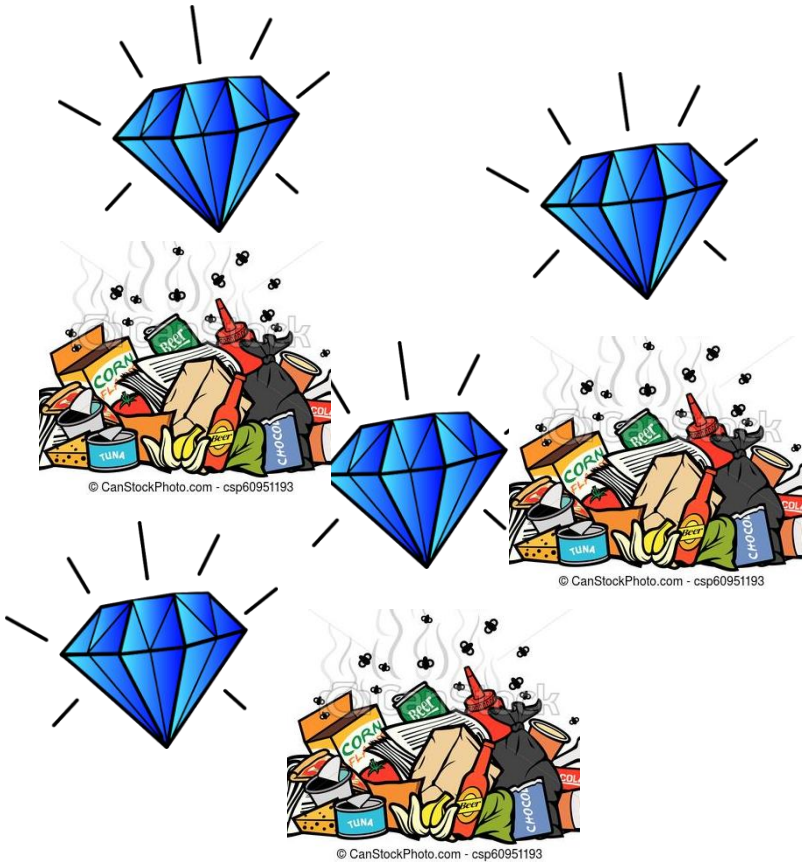
Quality in Biometrics

The GIGO Principle:
Garbage In, Garbage Out

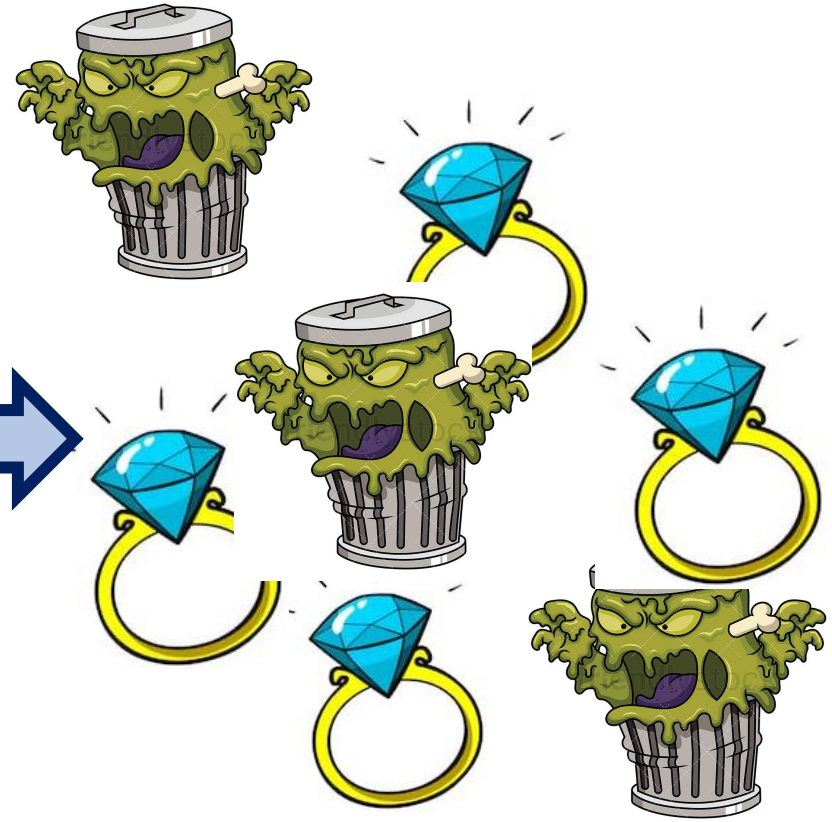
Quality in Biometrics

Biometric System

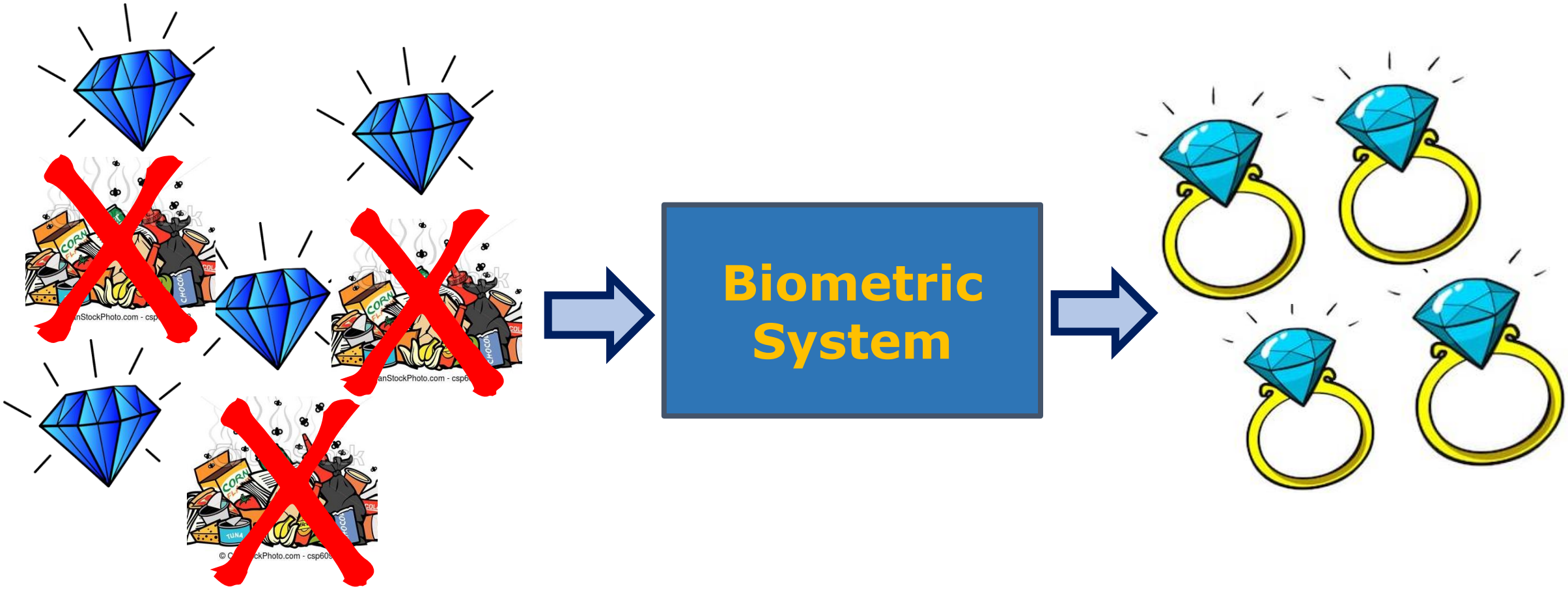
Quality in Biometrics



Biometric System



Quality in Biometrics



Quality in Biometrics

High-quality samples are preferable to low-quality samples... BUT:

- **How can we automatically differentiate between high-quality and low-quality samples?**
- **Who establishes what a high/low quality sample is?**
- **How can biometric quality be measured?**

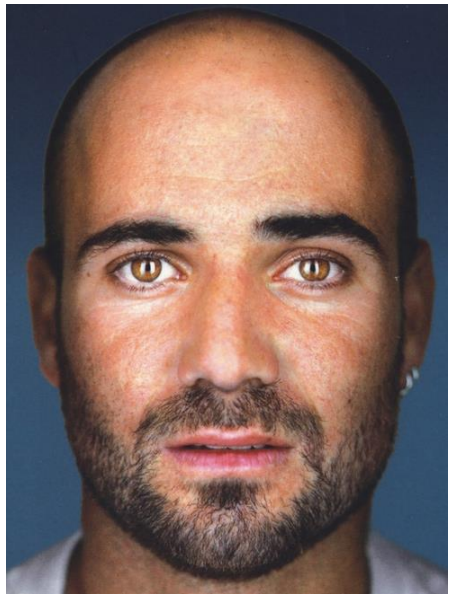
Quality in Biometrics

In summary…

WHAT IS BIOMETRIC QUALITY?

Quality in Biometrics

We all have an **«instinctive feeling»** of what a good/bad quality sample is:



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Quality in Biometrics

THE CHALLENGE:

How can we translate this SUBJECTIVE concept into an OBJECTIVE measure?

Quality in Biometrics

In essence, biometric quality establishes a direct link between the reliability of the input and the output of a system.

INPUT: good-quality samples → OUTPUT: good accuracy

INPUT: bad-quality samples → OUTPUT: bad accuracy

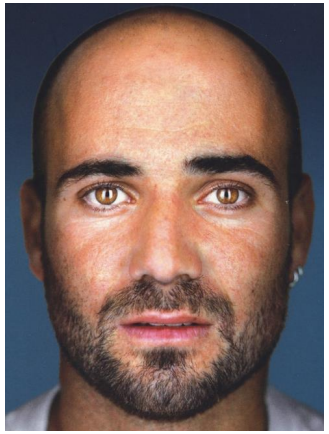
Quality in Biometrics

UTILITY DEFINITION:

Biometric quality
is a **PREDICTOR** of
biometric accuracy

Biometric Quality Measures: General Concept

Biometric quality measures



Biometric Quality Measure

10

Biometric Quality Measure

3

Biometric quality measures

A **biometric quality measure** is:

a function that receives as input a biometric sample and returns as output an estimation of its quality

(i.e., a prediction of its suitability for recognition)

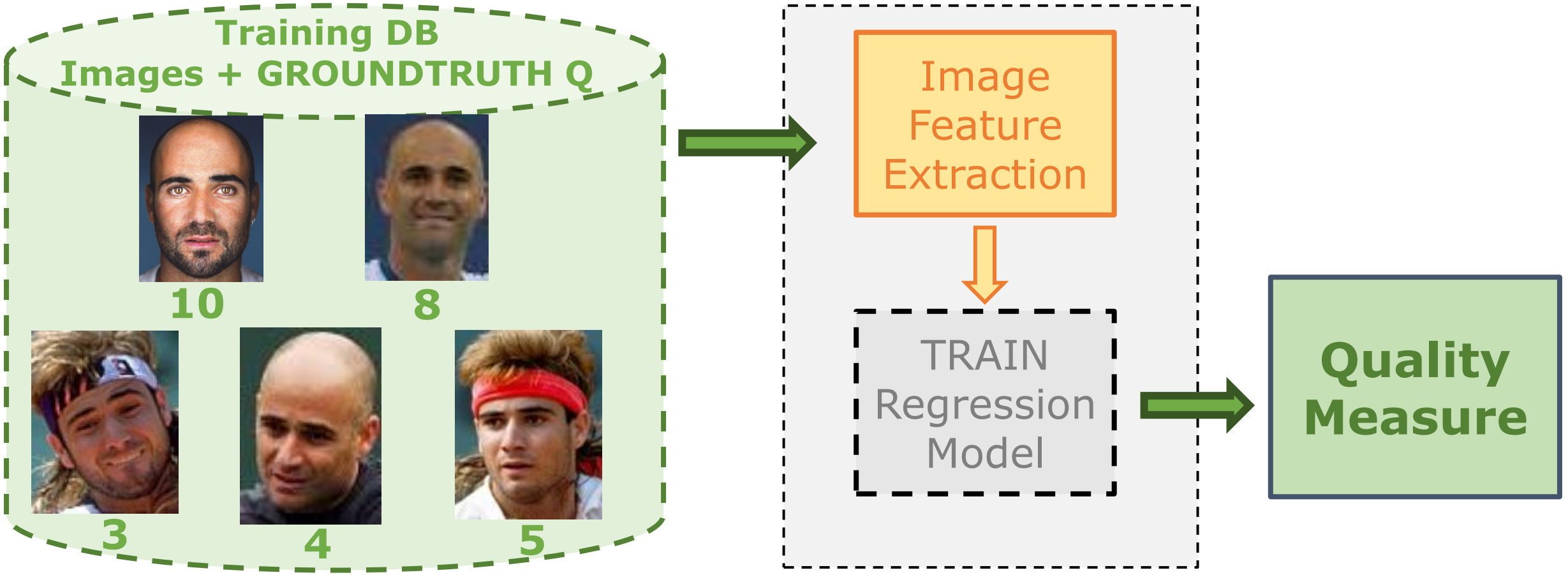
(i.e., a prediction of accuracy)

Biometric quality measures

How can we develop a quality measure?

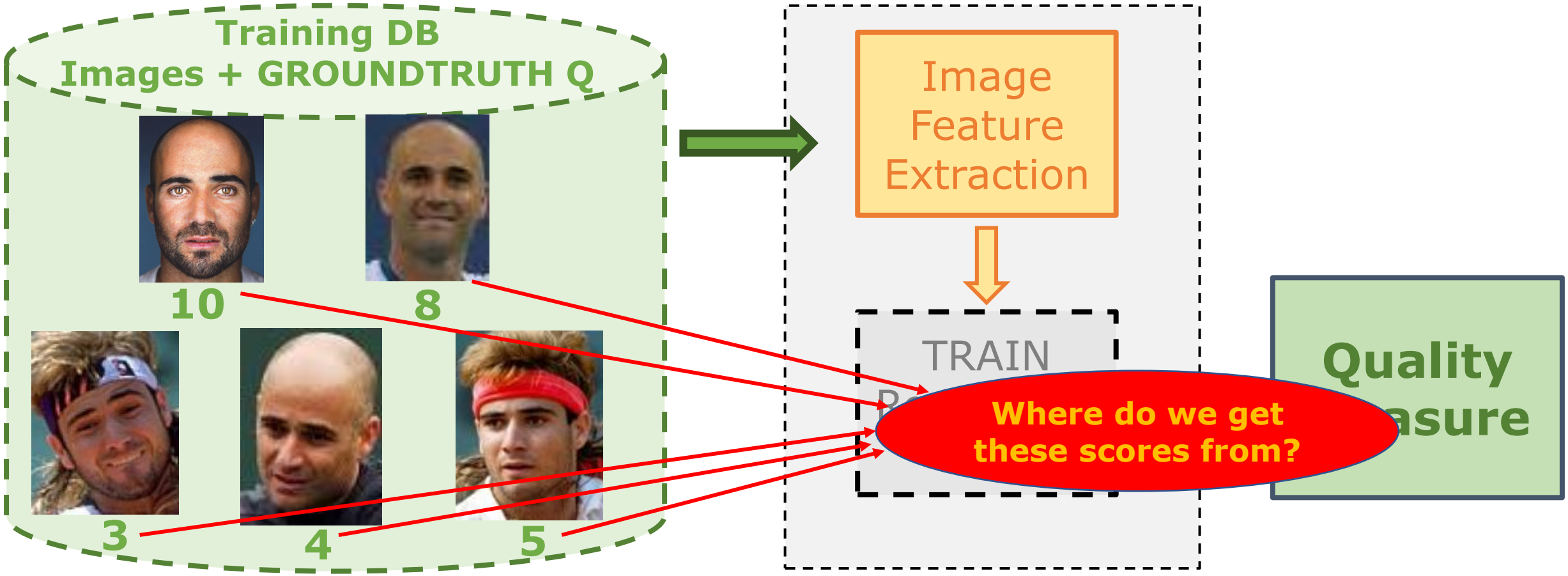
Prediction problem → REGRESSION

Biometric quality measures



Development of FaceQnet: Challenges and solutions

CHALLENGE 1: Groundtruth scores



CHALLENGE 1: Groundtruth scores

CHALLENGE 1

Definition of the GROUNDTRUTH quality scores

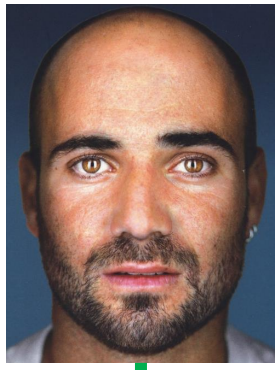
(Quality is a SUBJECTIVE concept,
how then can we define
the OBJECTIVE groundtruth quality scores?)

CHALLENGE 1: Groundtruth scores

We want to predict accuracy (i.e., mated comparison scores) so…

Let’s use mated comparison scores as groundtruth quality scores

CHALLENGE 1: Groundtruth scores



Biometric System

Biometric Q-measure

Comparison Score: 3

(Prediction of…)

Quality Score: 10

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CHALLENGE 1: Groundtruth scores

The quality paradox

This is an ill-defined problem:

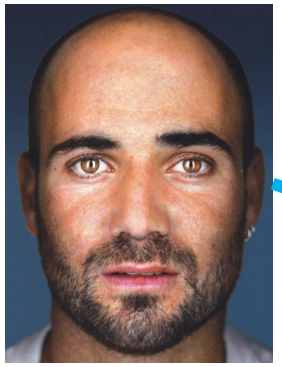
With only **ONE input**

we have to **predict** the output

of a system with **TWO inputs**

CHALLENGE 1: Groundtruth → Our solution

Sample A: **PERFECT** quality **(10/10)**



Sample B: Other quality **(3/10)**

Use multiple training systems to minimise system dependency!

Biometric System

Comparison Score: 3

QUALITY Groundtruth for…

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CHALLENGE 1: Groundtruth → Our solution

SOLUTION: MACHINE-PERCEIVED QUALITY

ASSUMPTION/HYPOTHESIS:

given a sample A of perfect quality and a sample B of any quality,
the comparison score will reflect the quality of sample B

- It predicts machine accuracy
- Machines do not get tired
- Fully scalable

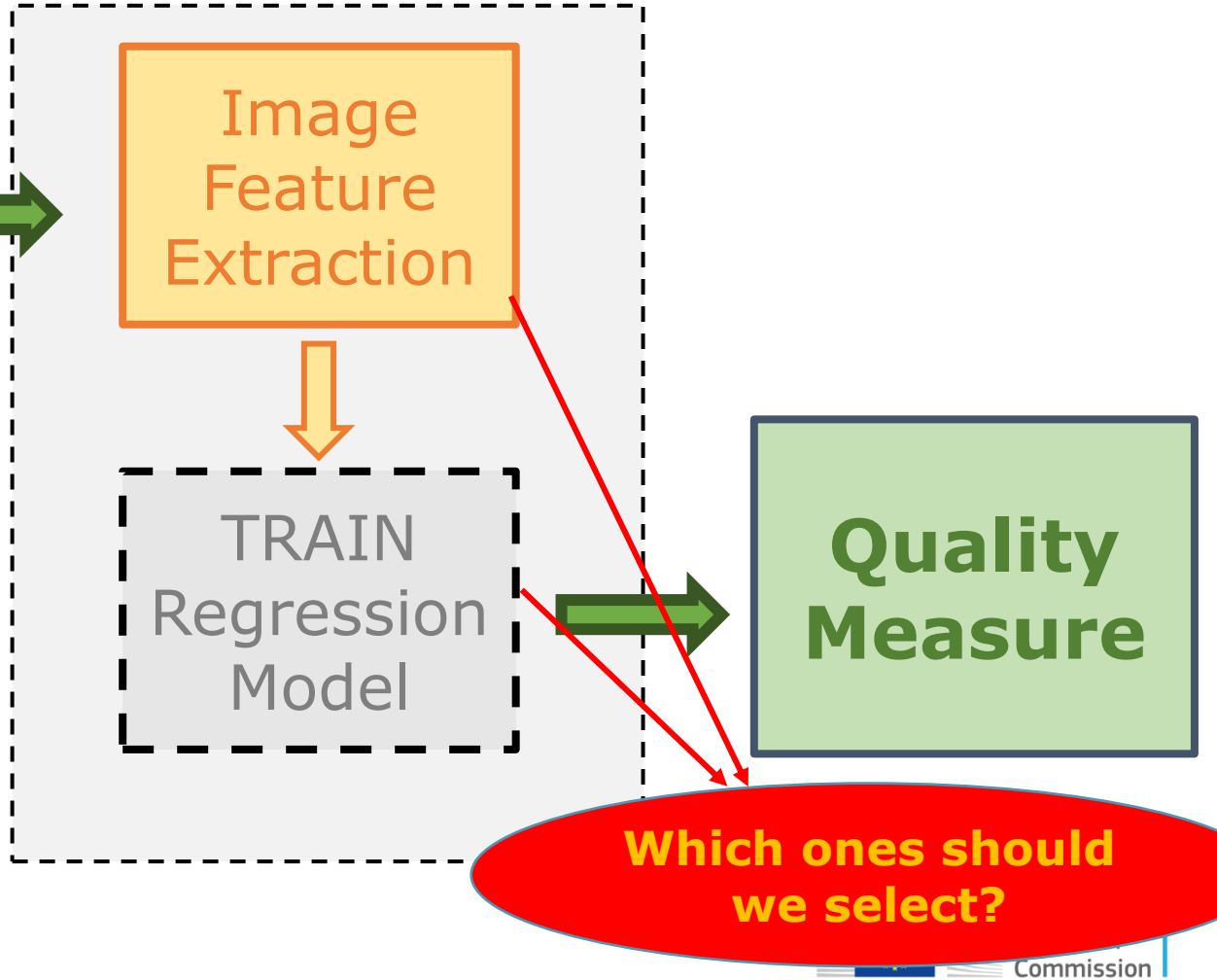
Who defines "PERFECT" quality?

CHALLENGE 1: Groundtruth → Our solution

PERFECT quality is usually referred to compliance with human-defined features

Illustrative example: PERFECT QUALITY in face is a picture that complies with the requirements for portraits to be used in MRTD documents (VERY HIGH controlled and restricted acquisition conditions).

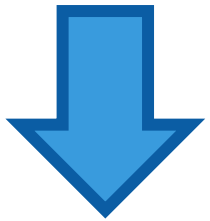
CHALLENGES 2+3: Feature Extraction + Reg. Model



CHALLENGE 2+3: Our solution

DEEP LEARNING

(if you cannot beat the machine, let her do it)

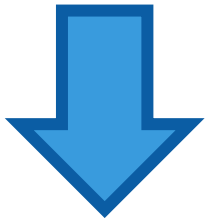


Deep Learning sounds good but, IT NEEDS A GREAT AMOUNT OF TRAINING DATA

CHALLENGE 2+3: Our solution

ASSUMPTION:

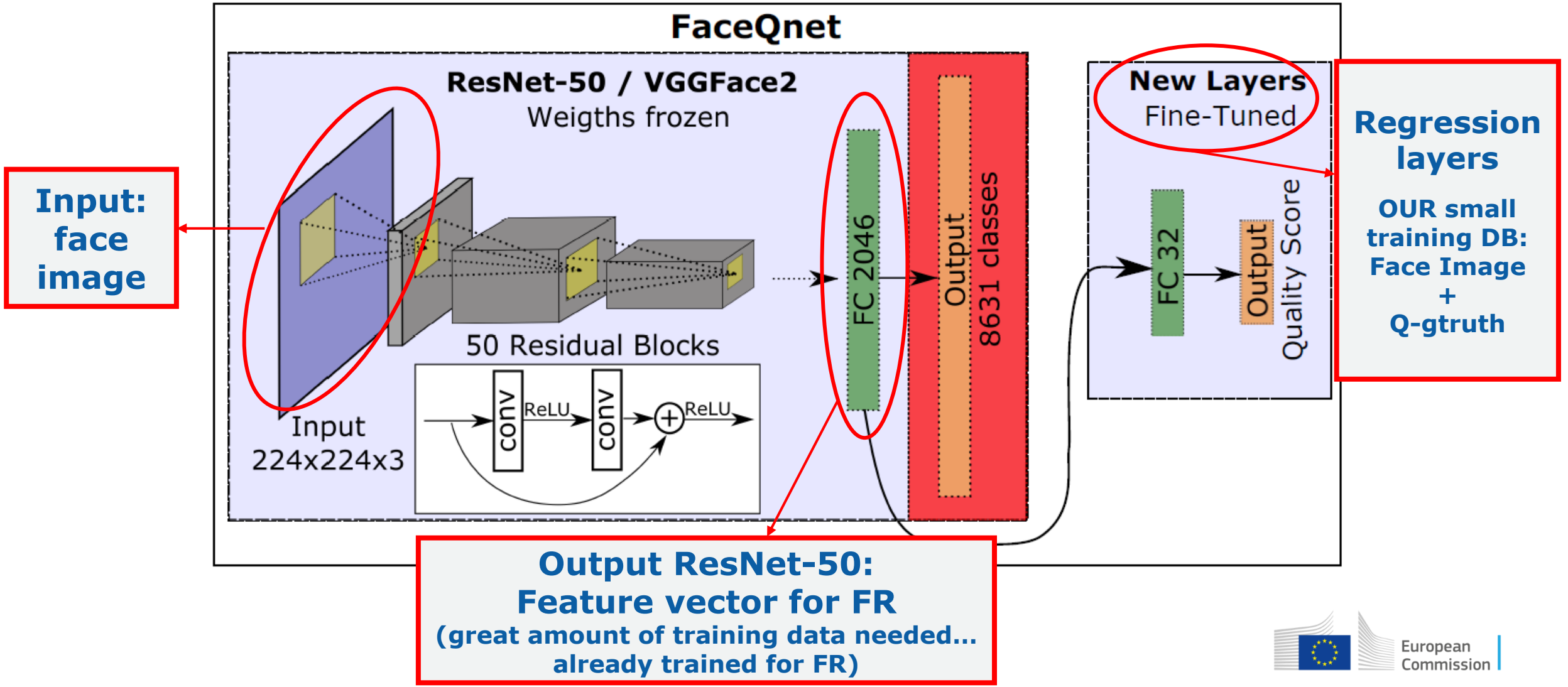
Since QUALITY and ACCURACY are closely related, features that comprise the identity of faces (ACCURACY), is expected to also comprise the information of their QUALITY



ML translate

Use a trained CNN for FR as basis for Q-estimation

CHALLENGE 2+3: Our solution



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FaceQnet

FaceQnet (by UAM and JRC)

FACE QUALITY: Deep-learning based, machine-produced groundtruth

OBJECTIVE: Reach NFIQ2 + Contribute to ISO/IEC 29794-5

INDEPENDENTLY ASSESSED: NIST FRVT Ongoing Quality Evaluation
https://www.nist.gov/programs-projects/face-recognition-vendor-test-frvt-ongoing

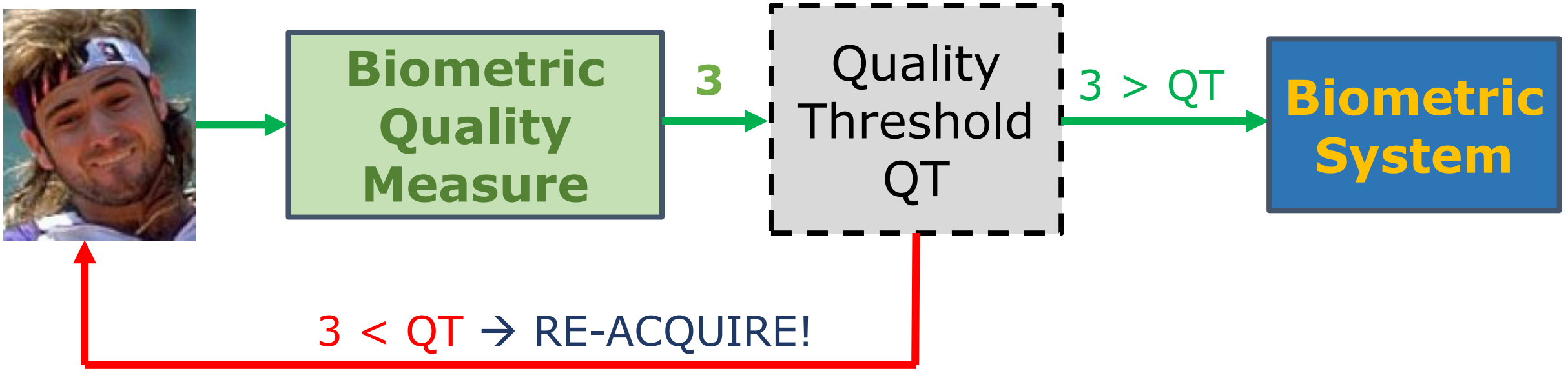
OPEN SOURCE: https://github.com/uam-biometrics/FaceQnet

FURTHER READING: J. Hernandez-Ortega, J. Galbally, J. Fierrez and L. Beslay, "Biometric Quality: Review and Application to Face Recognition with FaceQnet", arXiv:2006.03298, 2020

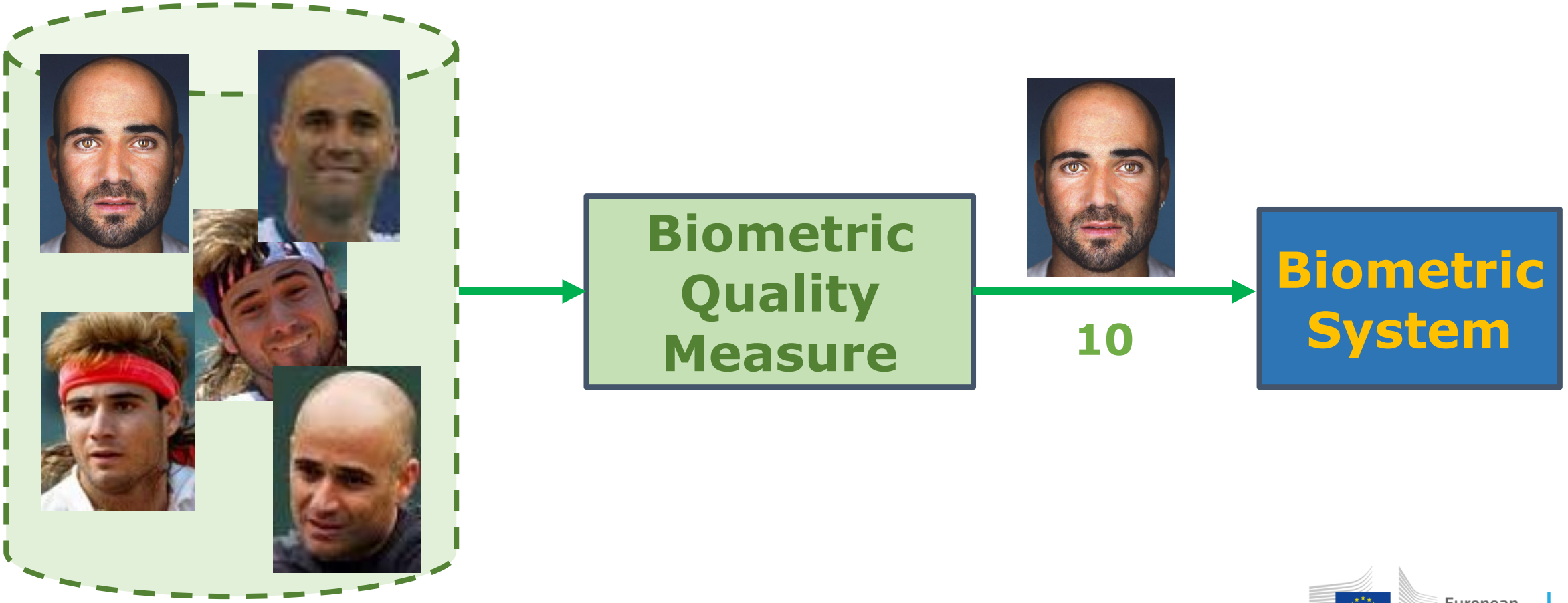
https://arxiv.org/abs/2006.03298

Biometric Quality Measures: Use-cases (large E-IT Systems)

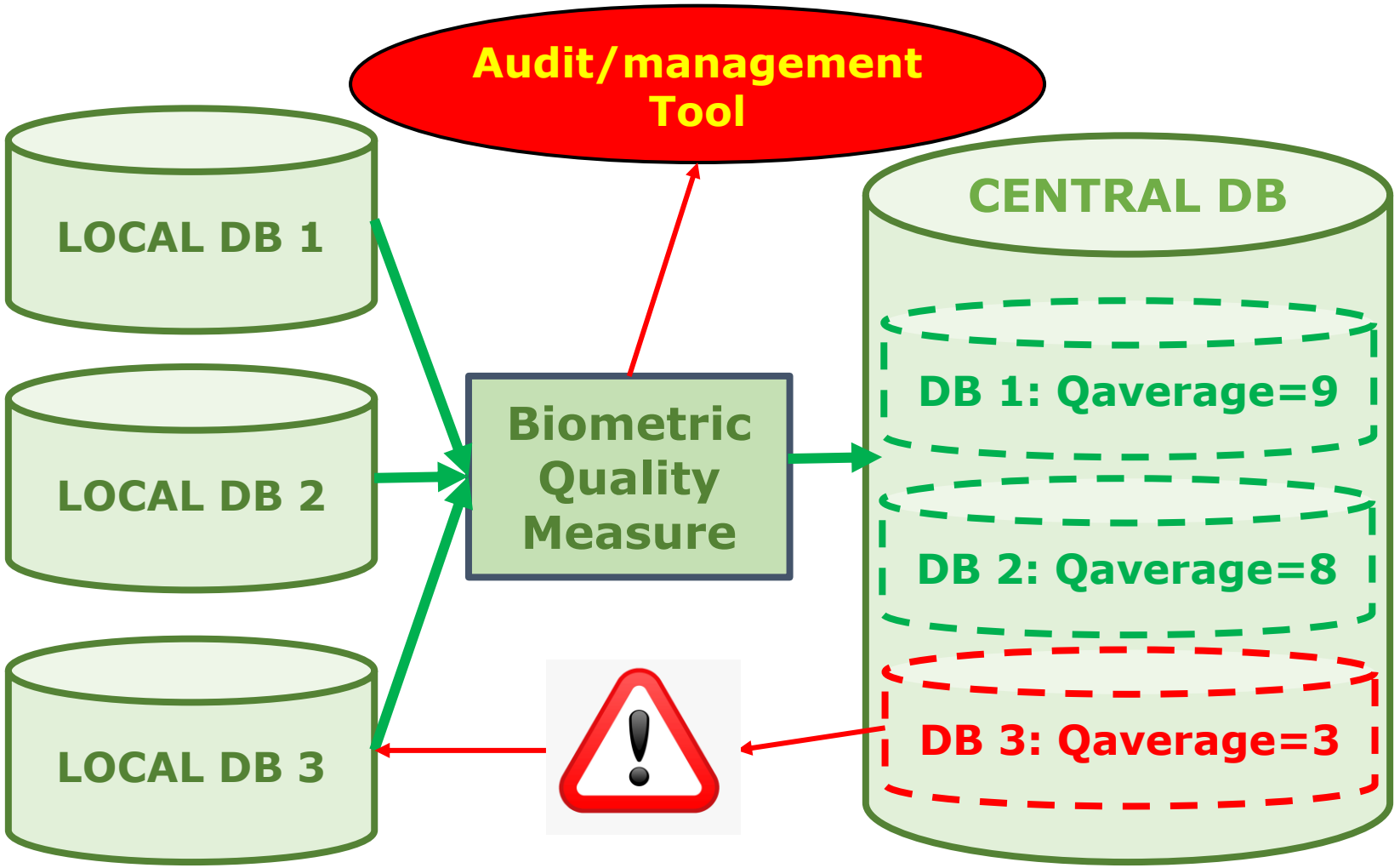
Quality Use-Cases: Sample Acceptance



Quality Use-Cases: Sample Selection



Quality Use-Cases: Quality Summarisation



EUROPE
Large IT Systems:
EES
VIS
SIS
EURODAC
...

Biometric Quality: To Conclude…

“On two occasions I have been asked, ‘Pray, Mr. Babbage, if you put into the machine wrong figures, will the right answers come out?’... I am not able rightly to apprehend the kind of confusion of ideas that could provoke such a question.”

- *Charles Babbage,*
  Passages from the Life of a Philosopher, 1864.

Thank you

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