Food Authenticity & Integrity - Management Day 2

Assuring Food Authenticity & Integrity - Protecting the Food Sector from Threats & Vulnerabilities

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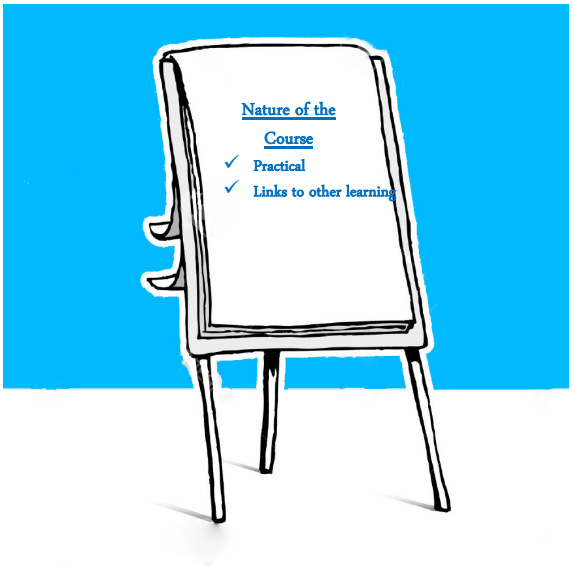
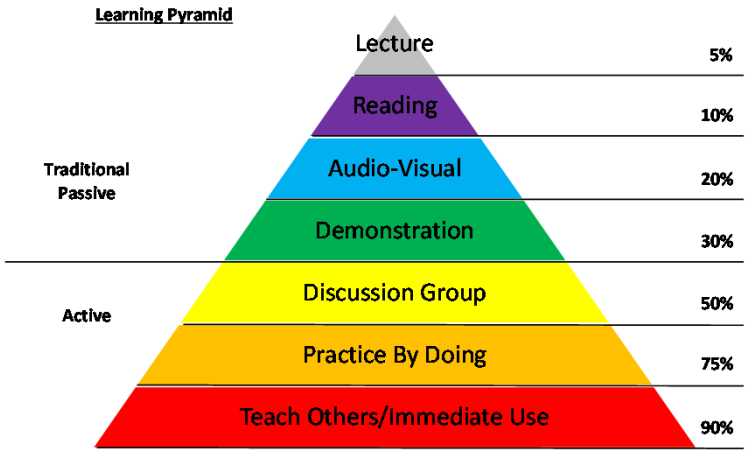
BSc (hons) BSc. Pg Dip (Food Safety) CSci (Food Sci & Tech) FIFST FS Prin (IFST)

seafish

Summary Overview



The Learning Pyramid



Course Relationships

Perspectives

Perspectives Overview

Dying for a Sweet? –The *'Bradford & 'Punjabi' Sweet Incidents*

THE GREAT LOZENGE-MAKER.
A Hint to Paterfamilias.

Pak. J. Biochem. Mol. Biol. 2016; 49(1): 29-35

Review

SUDAN DYES AND THEIR POTENTIAL HEALTH EFFECTS

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Abstract: Sudan dyes are synthetic, oil-soluble, red coloured azo dyes which are not permitted by the authorities in Switzerland, Japan, Europe, and the United States for the purpose of food colouring. Sudan dyes I, II, III, IV, and their degradation products are considered harmful to human health due to their teratogenicity, genotoxicity, and carcinogenicity which leads to cancer. Many experimental studies on animal specimen have confirmed the formation of tumour due to the presence of different Sudan dyes in food products. Sudan dyes are described to have sensitising characteristics; they easily get absorbed through dermal route and airways and causes health problems. This paper discusses the harmful effects of Sudan dyes on human health which is now greatly used in foodstuffs.

Keywords: Sudan dyes, Illegal, Health effects
Received: January 11, 2016 Accepted: February 15, 2016
***Author for Correspondence**: nisaalim64@yahoo.com

Sudan Dye Incidents

Melamine in Milk

Operation Tacannna & Scallop Fraud

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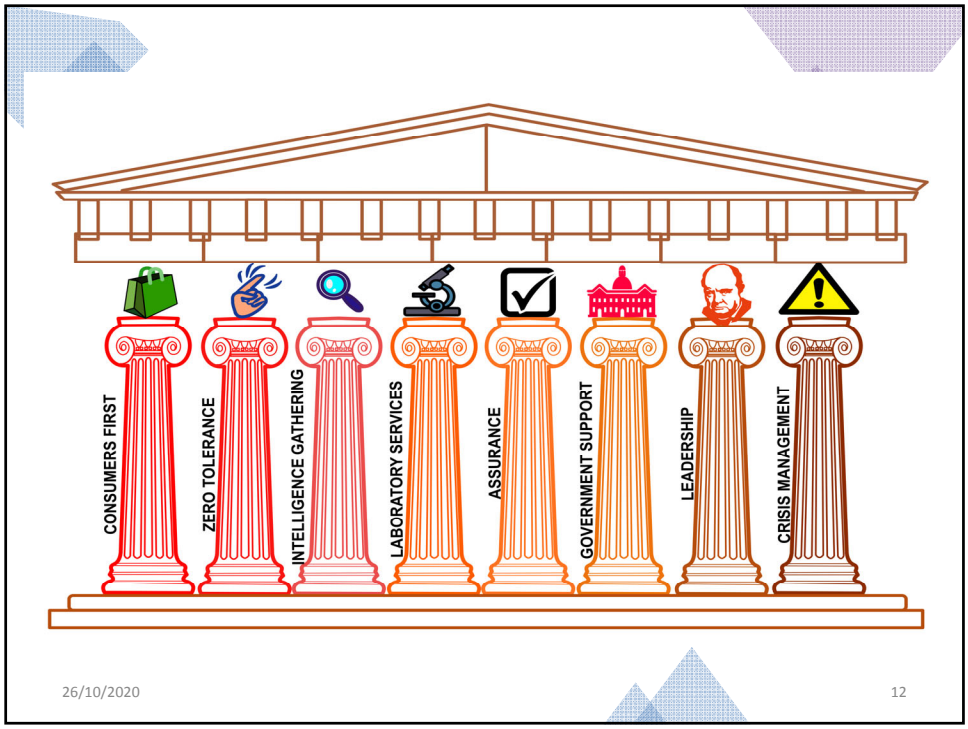

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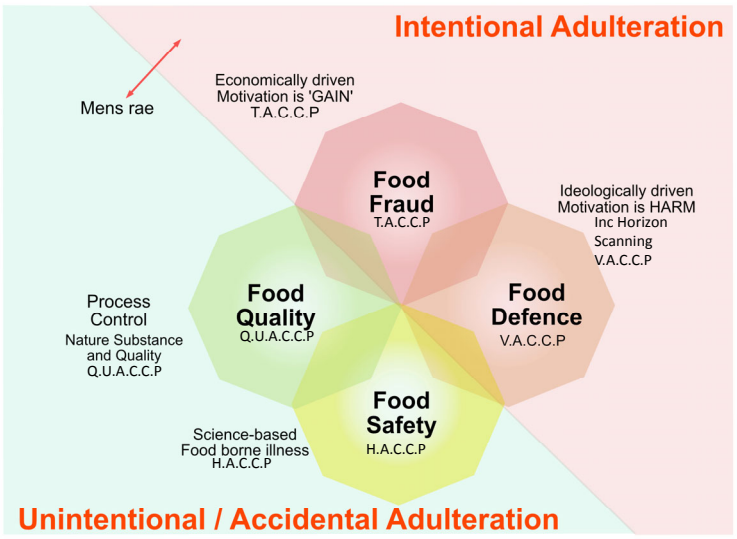
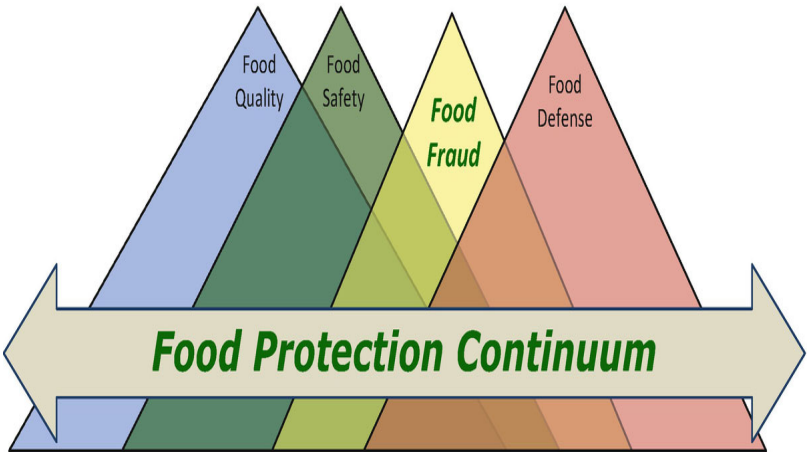
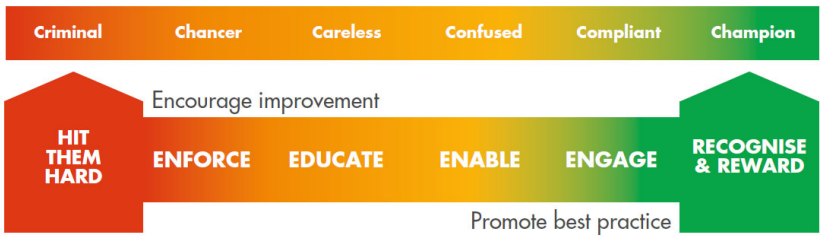
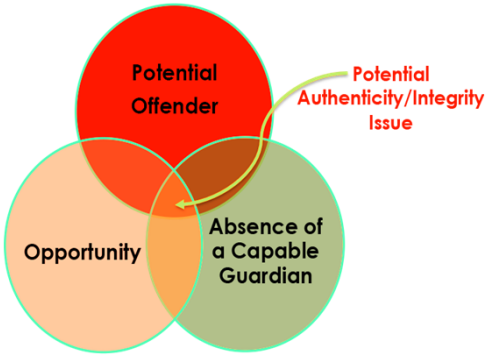

Intentional Adulteration
Mens rae
Economically driven
Motivation is 'GAIN'
T.A.C.C.P
Food
Fraud
T.A.C.C.P
Ideologically driven
Motivation is HARM
Inc Horizon
Scanning
V.A.C.C.P
Process
Control
Nature Substance
and Quality
Q.U.A.C.C.P
Food
Quality
Q.U.A.C.C.P
Food
Defence
V.A.C.C.P
Food
Safety
H.A.C.C.P
Science-based
Food borne illness
H.A.C.C.P
Unintentional / Accidental Adulteration

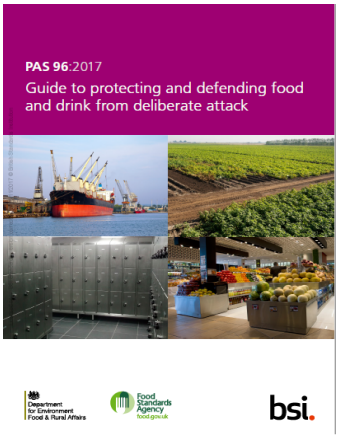

Food
Quality
Food
Safety
Food
Fraud
Food
Defense
Food Protection Continuum

An Enforcement Spectrum



Routine Activity Theory

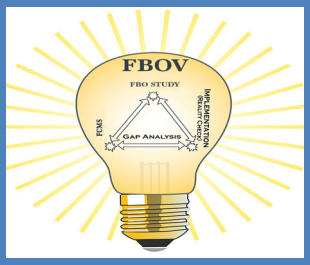




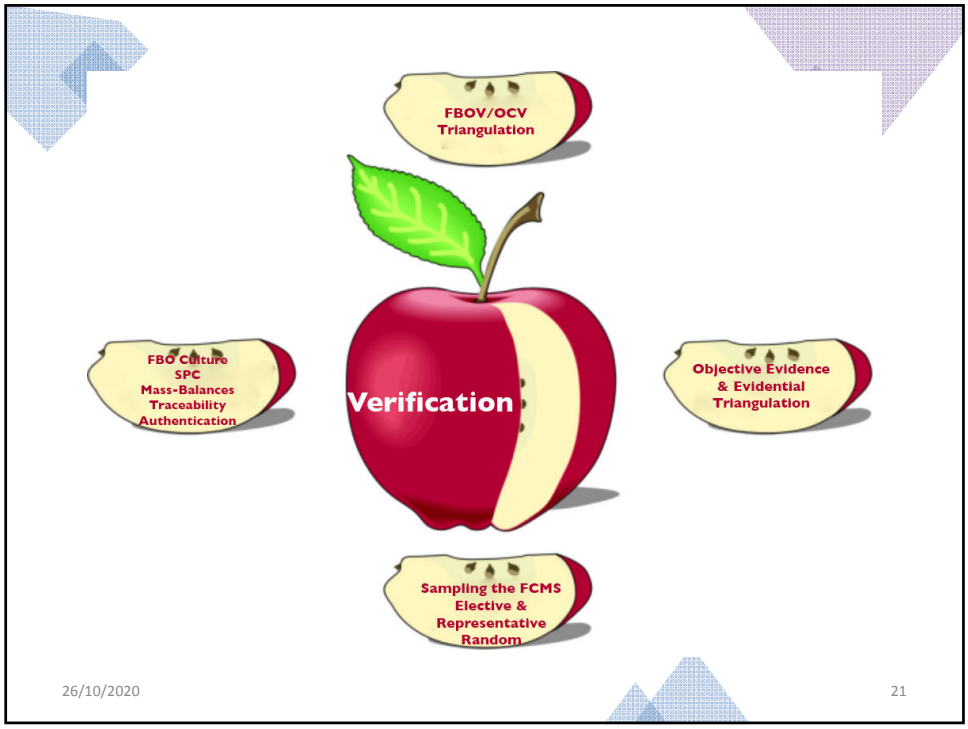
Capable Guardians

Perspectives Summary

Verification



Verification FBOV & OCV Overview


FBOV/OCV
Triangulation
FBO Culture
SPC
Mass-Balances
Traceability
Authentication
Verification
Objective Evidence
& Evidential
Triangulation
Sampling the FCMS
Elective &
Representative
Random


EFFECTIVENESS CHALLENGE
...FBOVS AND OCVS MUST BE 'EFFECTIVE' (FROM FOOD LAW)– AND THE PURPOSE OF FOOD LAW (AND THEREFORE FBOVS AND OCVS) IS TO ENSURE THE FBO PROTECTS THE CONSUMER IN FOOD AUTHENTICITY, INTEGRITY AND IN SAFETY TERMS...
Sharpie

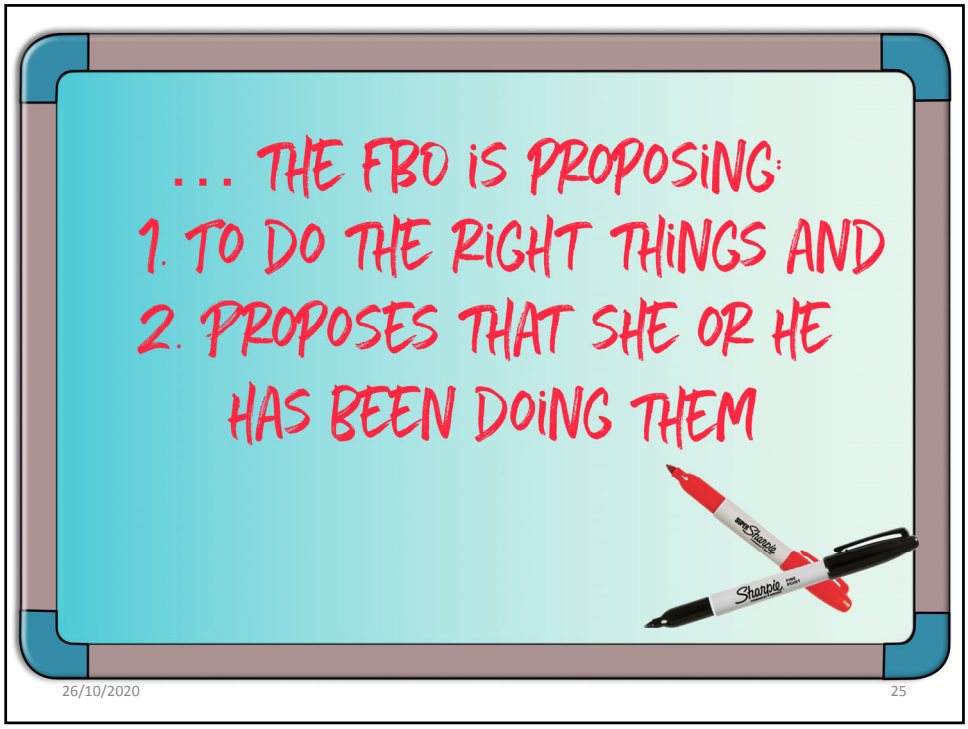
SCIENCE CHALLENGES

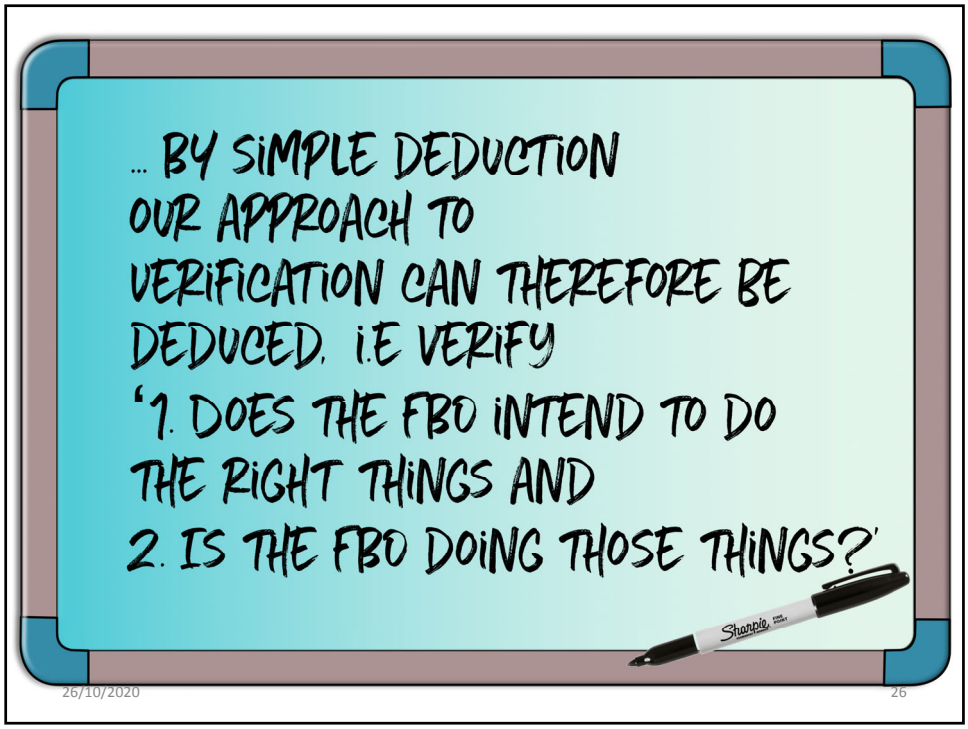
REG 178 ESTABLISHED THE SCIENTIFIC BASIS OF FOOD LAW

THEREFORE –EMPIRICISM – OBJECTIVE EVIDENCE AND MEASUREMENT

PROPOSITIONS CHALLENGE

... BY PLACING FOOD ON THE MARKET – WE CAN DEDUCE THAT THE FBO PROPOSES THAT IT IS AUTHENTIC AND IT IS SAFE


. . . THE FBO IS PROPOSING:
1. TO DO THE RIGHT THINGS AND
2. PROPOSES THAT SHE OR HE
HAS BEEN DOING THEM
Sharpie


... BY SIMPLE DEDUCTION
OUR APPROACH TO
VERIFICATION CAN THEREFORE BE
DEDUCED. I.E VERIFY
'1. DOES THE FBO INTEND TO DO
THE RIGHT THINGS AND
2. IS THE FBO DOING THOSE THINGS?'
Sharpie

STRUCTURING A VERIFIER'S SOLUTION

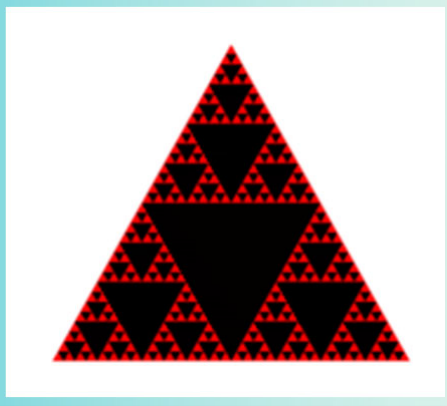
... FROM FBD PROPOSITIONS AS A PRIORITY WE CAN DEDUCE 3 CARDINAL POINTS OF REFERENCE ...

VERIFIER PROPOSITION

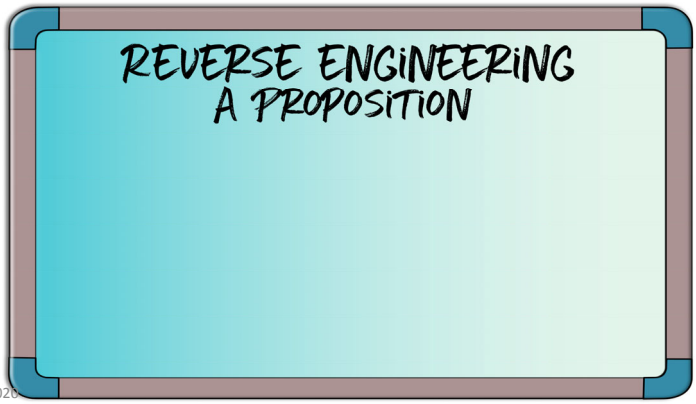
FBD PROPOSITION

FBD IMPLEMENTATION (REALITY CHECK)

REVERSE ENGINEERING A PROPOSITION



Exercise – Reverse Engineering the FBO's Proposition



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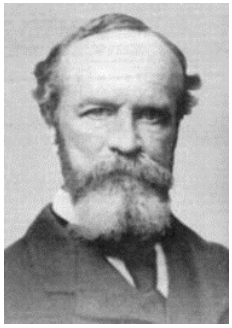
"***Objective evidence and certitude are doubtless very fine ideals to play with, but where on this moonlit and dream-visited planet are they found?"***

- William James 1842 –1910 (considered to be one of the greatest philosophers of the pragmatic school)



"Information that can be proved true, based upon facts obtained through observation, measurement test or other means"

- First defined BS EN 8402/1995
- Referred Regulation (EC) 178/2004 - but not defined

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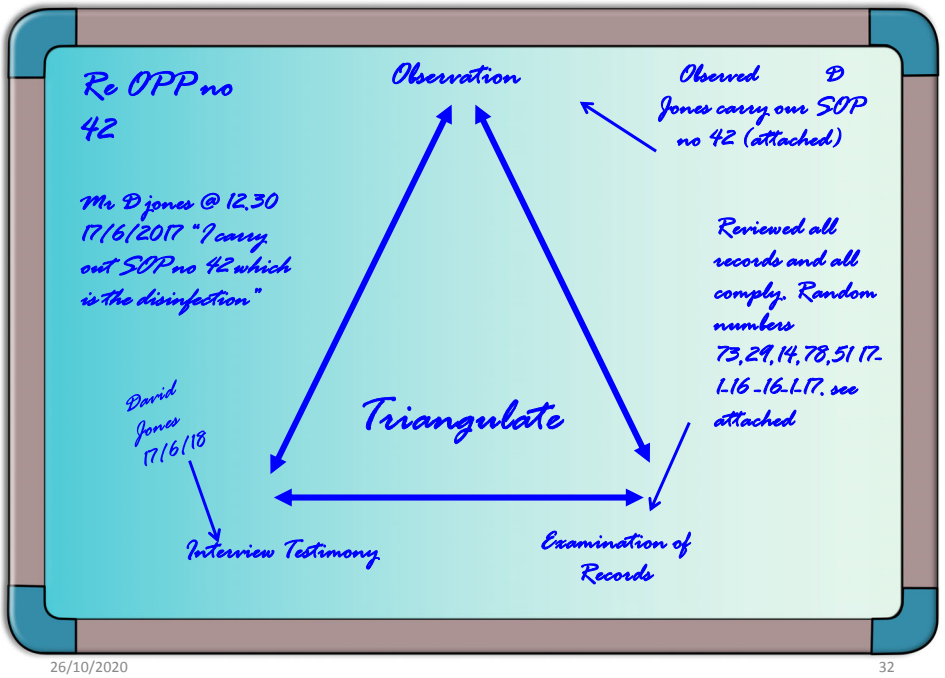
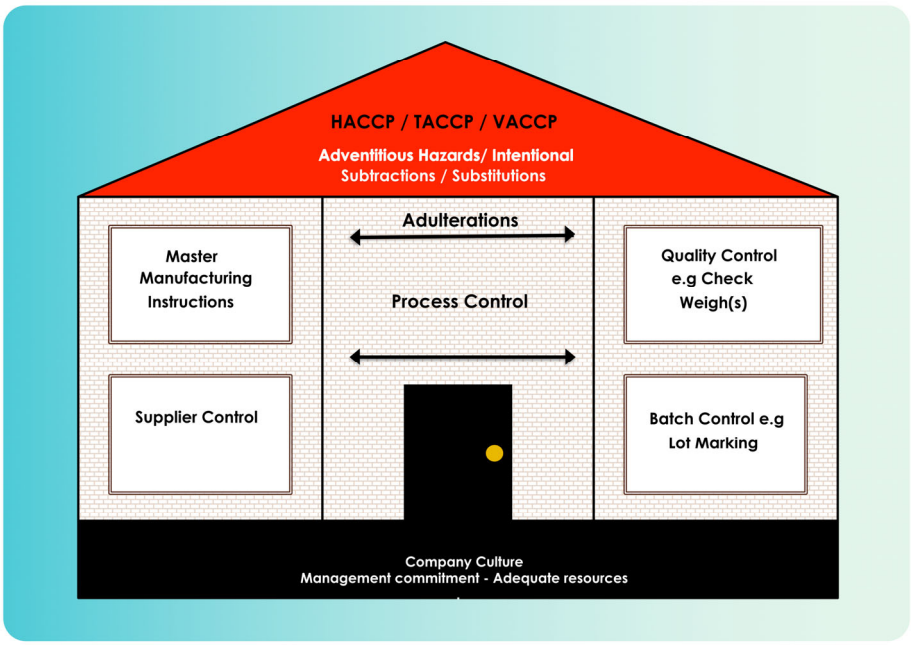
Attributes of Objective Evidence

- ✓Scientific — Can the data be evaluated by independent observers to reach the same conclusions?
- ✓Scientific — Are the data documented in a manner to allow re-creation of the data or the events described?
- ✓Scientific — Does the documented evidence provide sufficient data to prove what happened, when, by whom, how, and why?
- ✓Legal — Was the documentation completed concurrent with the tasks?
- ✓Legal — Is the documentation attributable?

Denise Dion
USA FDA Office of Regulatory Affairs
Primary Editor of the FDA Investigations Operations manual





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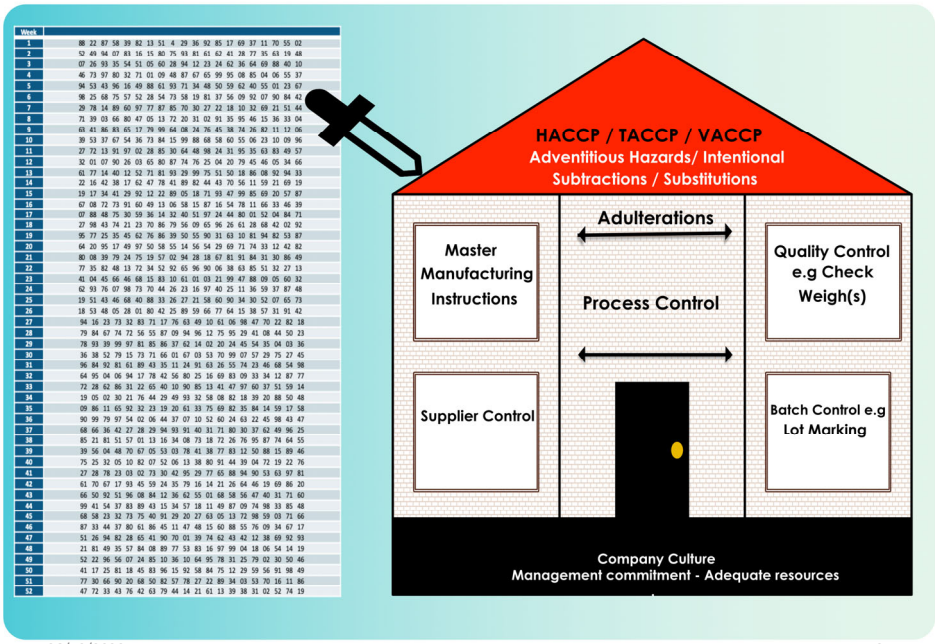

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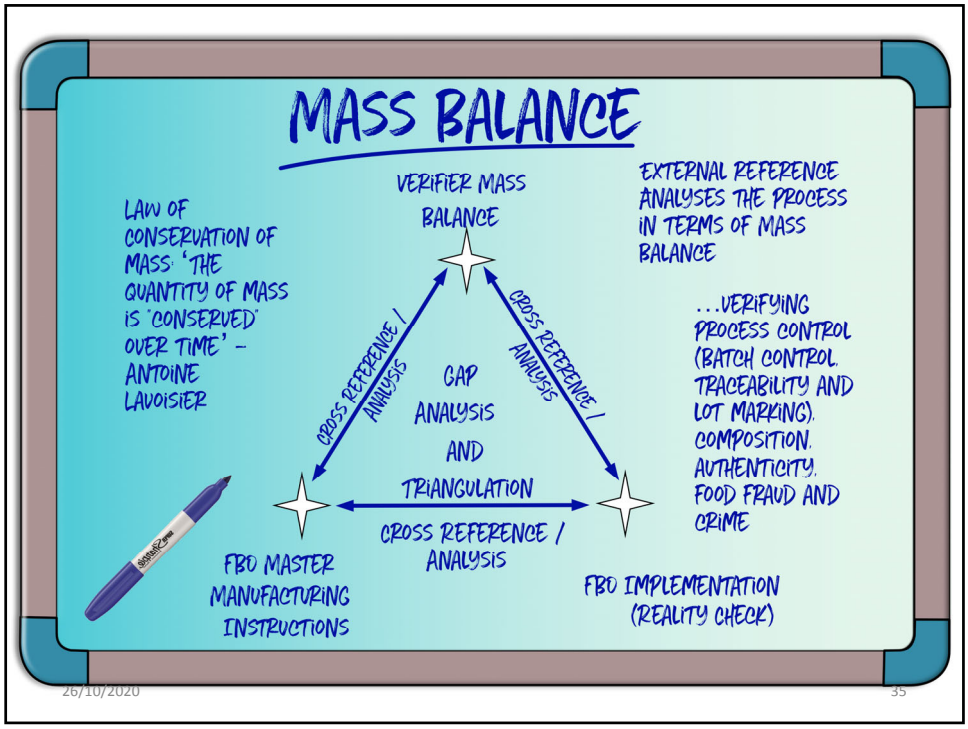


EQUATIONS OF MASS BALANCE

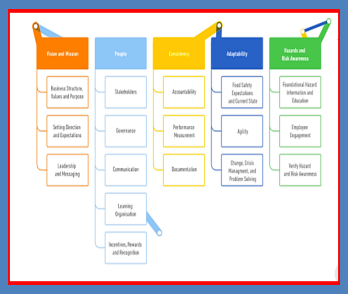
$m_{in} = m_{out}$	*Steady State Situation'* – The most common situation e.g. batch process Where M_{in} and M_{out} are the total mass flow rates entering and leaving the system respectively
$\dot{m}_{in} - \dot{m}_{out} = \frac{dm_{sys}}{dt}$	*Continuous Flow Situation'* e.g. Milk pasteurisation with *'Just in Time'* Distribution. Where dm_{sys}/dt is the rate of mass accumulation (or mass depletion) within a system at a specific point in Kg/s.
$\sum_{i=1}^{K} \dot{m}_{i\,in} = \sum_{j=1}^{n} \dot{m}_{j\,out}$	Multi Stream Situation. Where $M_{\,i\,in}$ and $M_{\,j\,out}$ are the flow rates of streams 'i' and 'j' entering and leaving the system respectively.
$\sum_{i=1}^{K} X_i \dot{m}_{i\,in} = \sum_{j=1}^{n} X_j \dot{m}_{j\,out}$	Chemical Reaction Situation:- Where X_i is the mass fraction of a specific component in the 'entering stream' 'i', and X_j is the mass fraction of the same component in the 'exiting stream' 'j'.

Exercise – A mass Balance

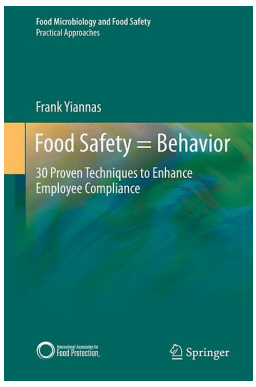
Lucid Chart

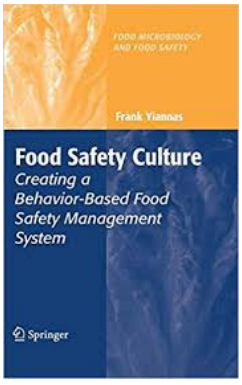
Verification FBOV & OCV Summary

Company Culture



Company Culture Overview



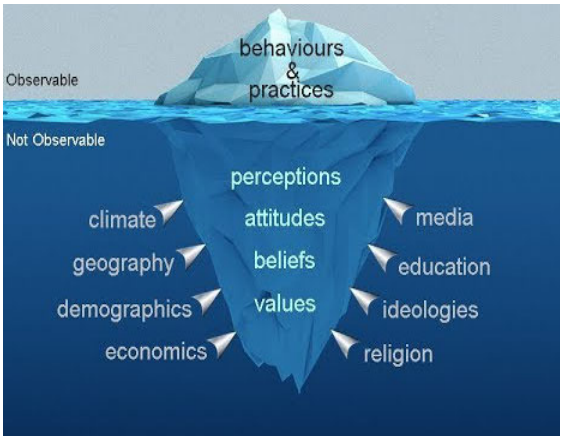


Sources

FBO Culture

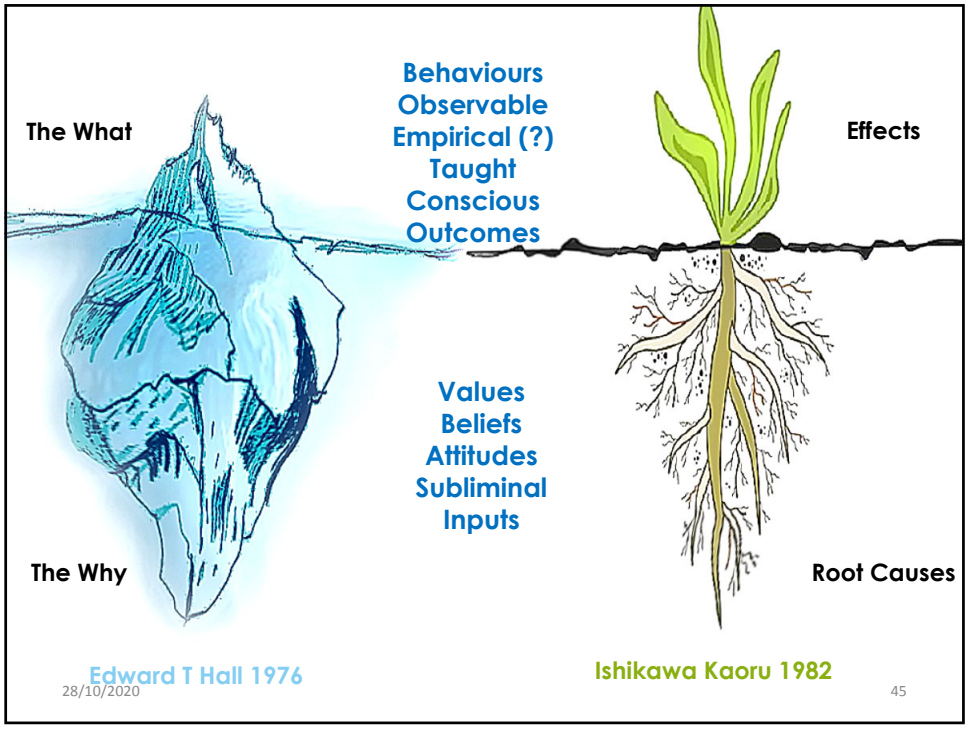
"Creating a culture in which all staff are both able and confident to report suspicions of wrongdoing is vital. Businesses can do this by ensuring they provide an environment in which staff are able to see the moral as well as the commercial benefits of identifying wrongdoing, whether within or outside of their business. Working with the National Food Crime Unit, whether by sharing fraud concerns or by finding new ways to design out fraud, will make the UK food sector both a safer and a more economically prosperous place, benefitting both businesses and consumers alike"

- Andy Morling Head of FSA Food Crime Unit 2016

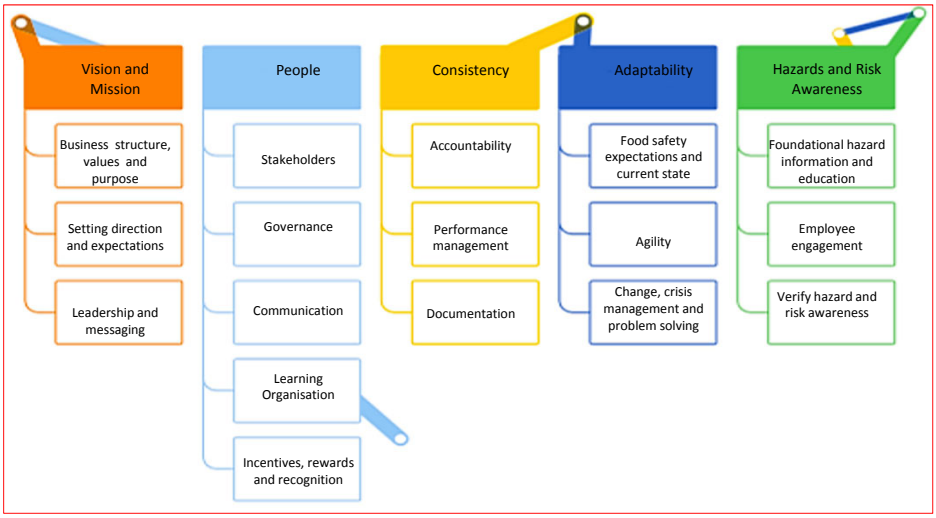


The Iceberg Model

- ***"Shared values, beliefs & norms that effect mind-set & behaviour toward Food Safety in, across & throughout an organisation" GFSI 2018***



Five Dimensions of Food Culture



Verifying FBO Culture

Food safety culture diagnostic toolkit for inspectors

This is a draft toolkit developed as part of an ongoing research project. The views expressed in this document are those of Greenstreet Berman Ltd and its contractors and not necessarily those of the Food Standards Agency.

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Authors: Michael S Wright, Paul Leach and Gill Palmer.

 July2012

Exercise - Promoting & Verifying FBO Food Culture

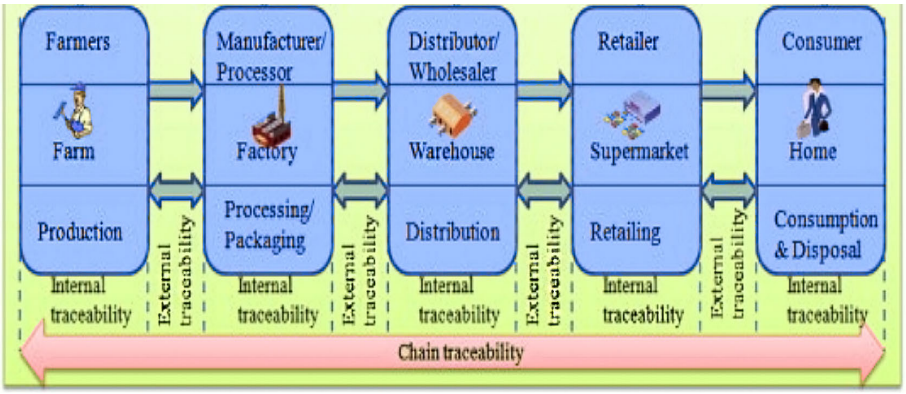
Company Culture Summary

Traceability & Provenance

Traceability & Provenance Overview

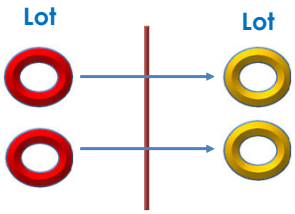
Sources

Traceability



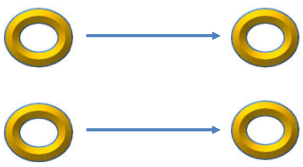
Transactions

(a) Receiving Lots



- Verify the incoming shipment & its information (labels/invoice etc)
- Cross ref to supplier date & time
- Record info
- Where one step back FBO has not implemented traceability verify ID on incoming lot – Follow G (see below)

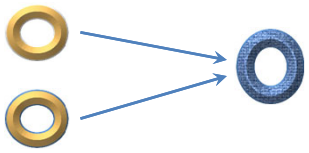
(b) In establishment movement where there is no processing



- Cross ref the lot with label & invoice
- Record date & time

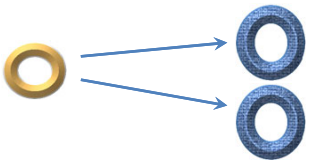
Transactions

(c) Combination of a lot



- Verify data re pre-combined lots, refer SOP & record
- Assign new ID to combined lot
- Link data before & after combination & record
- Record info re combination work needed for ID if any (eg date, quantity before & after combination)
- Prepare label & invoice with the new ID & attach.

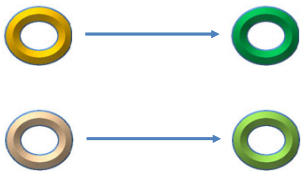
(d) Division of a lot



- Verify pre-divided lot data & record
- Assign new lot ID to divided lots
- Record the ID linkages
- Record division data, e.g quantities before & after division, date & time.
- Prepare label & invoice with the new ID & attach

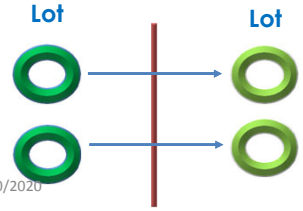
Transactions

(e) Processing Not Involving Combination of Lots e.g Heating, freezing drying etc



- Verify pre-processing lots data & record
- Record info re processing work required fo ID - If any e.g date & time of processing, quantities before & after processing.
- Prepare label & invoice with ID of processed lot and attach.

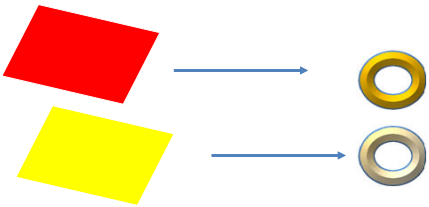
(f) Shipment of a Lot



- Verify lot to be shipped & its data. Record
- Cross ref & link ID of shipped lot to buyer date & time. Record.

Transactions

(g) Formation of a lot (e.g obtaining from the farm (livestock & marine products) or when receiving no Id products not covered by the FCMS



- Decide on the product lot & assign ID
- For each lot record data required for ID e.g (producer, farm date & time).

(h) Disposal of a lot

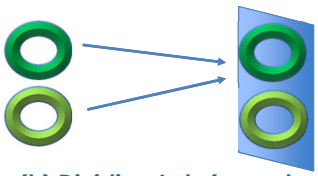
- Verify the product lot & its data prior to disposition. Record
- For each lot record the disposal date, time & place.

Transactions

(i) Requirements for In-House IDs

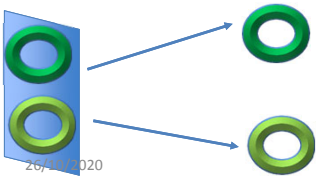
- FBO to set a rule re in-house ID, linked to incoming & out-going lot IDs.

(j) Grouping (Forming) Lots



- Assign a new ID to grouped lot
- Link to product ID before the grouping to after. Record.
- Record info re grouping work if any e.g date, time place.

(k) Dividing Lots (e.g a traceable unit)

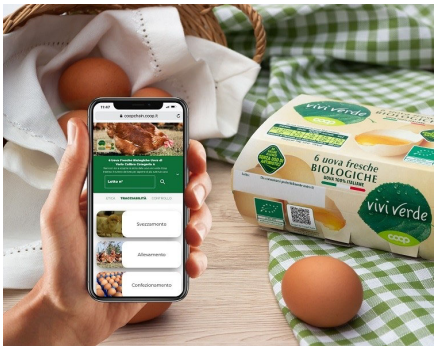


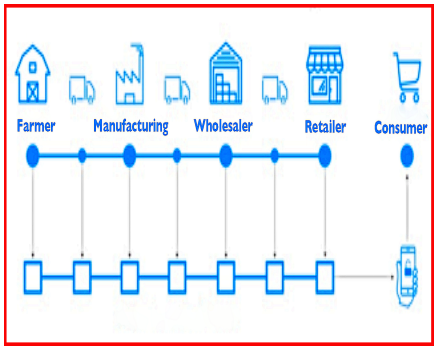
- Link to product ID before the division to after. Record.
- Record info re division work if any e.g date, time place

Traditional vs Forensics

	Traditional	Forensics
Speed	x Can be slow relies on checking data & each point in the supply chain	✓ Fast 1 to 5 days
Accuracy	x Reliant on packaging - Fails when packaging lost or counterfeit	✓ Traces product not packaging ✓ Science & algorithmic methods Can't be counterfeited without detection
Farm to Fork	x Reliant on packaging – Does not reach critical point of consumption	✓ Actual product assayed Trace from consumer to farm
Scientific	x Paper based – Prone to error	✓ Peer reviewed scientific literature ✓ Accepted as evidence in court

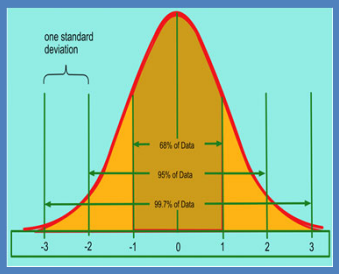
Blockchain



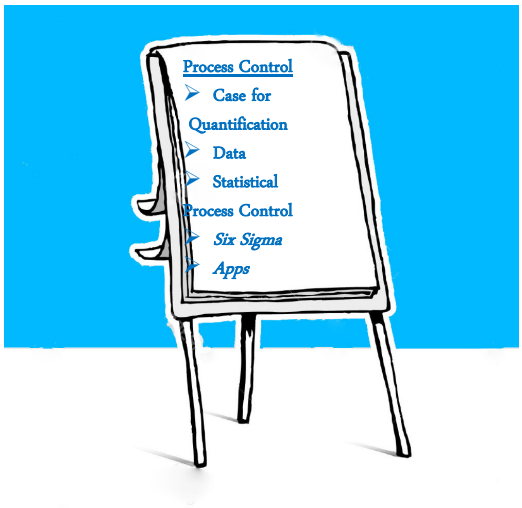


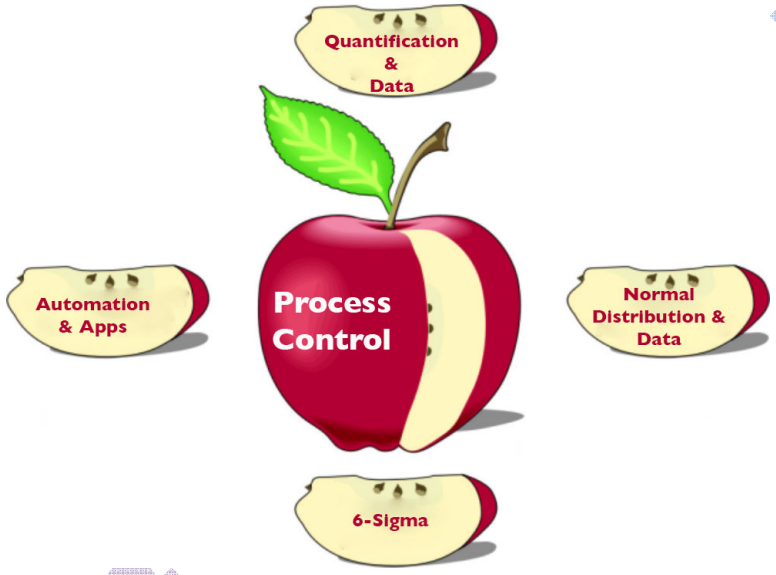
Traceability & Provenance Summary

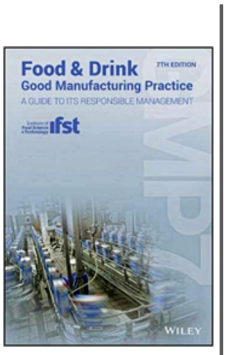
Process Control

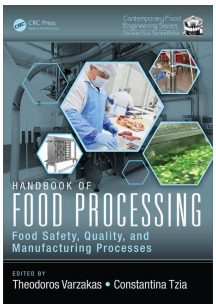


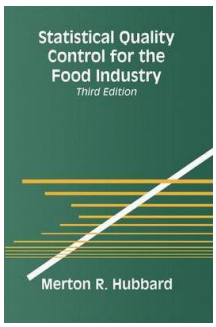
Process Control Summary

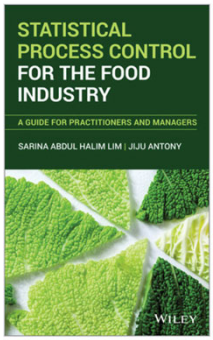








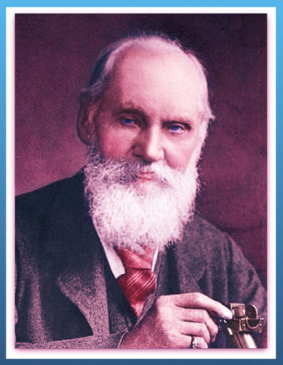




Sources

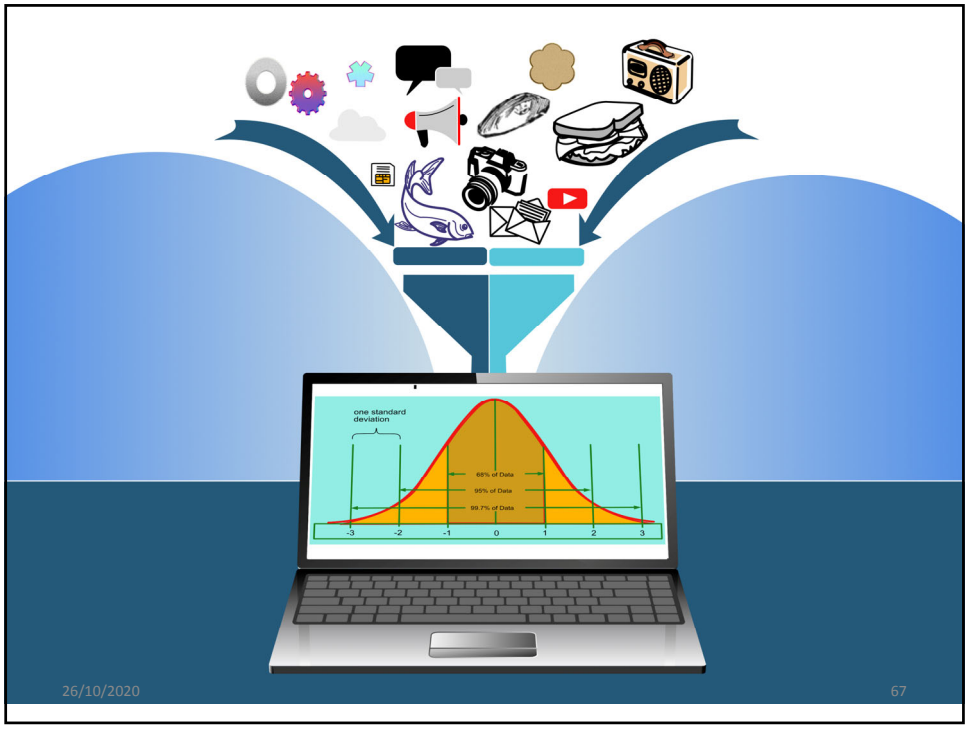
Quantification

Lord Kelvin on quantification and scientific knowledge



I often say when you can measure what you are speaking about, and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be.

Lecture on "Electrical Units of Measurement" (3rd May 1883) published in Popular Lectures

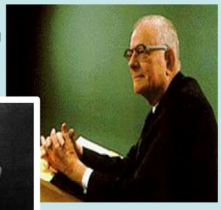


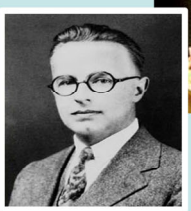
Statistical Process Control

改善

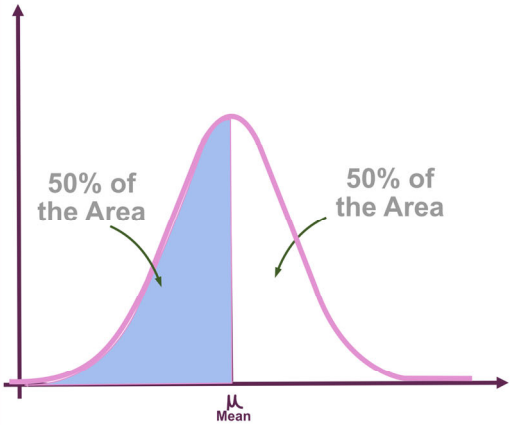
Kai =Change Zen = Good

William E. Denning

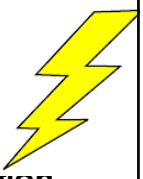




Walter A. Shewhart



Common Cause & Special Cause Variation



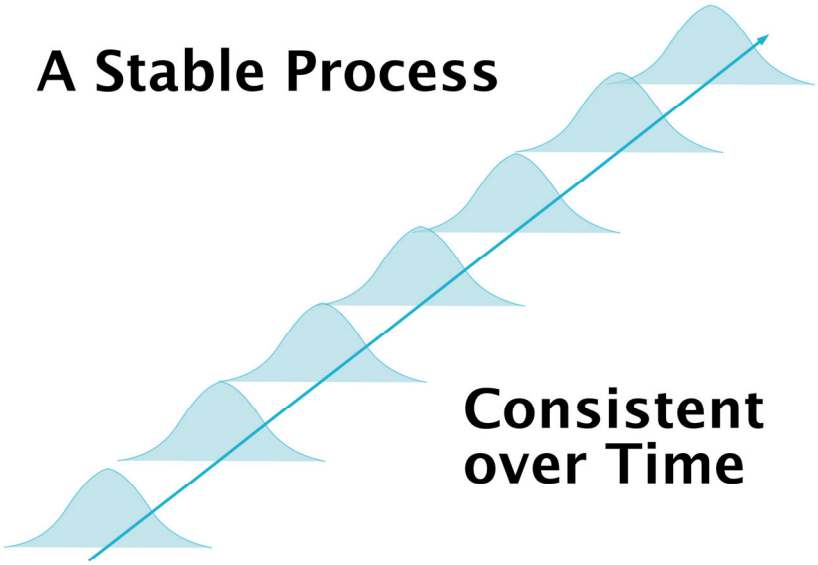
Common Cause Variation

- A source of **variation caused** by unknown factors that result in a steady but random distribution of output around the mean/average of the data. **Common cause variation** is a measure of the process's potential, or how well the process can perform when **special cause variation** is removed.

Special Cause Variation

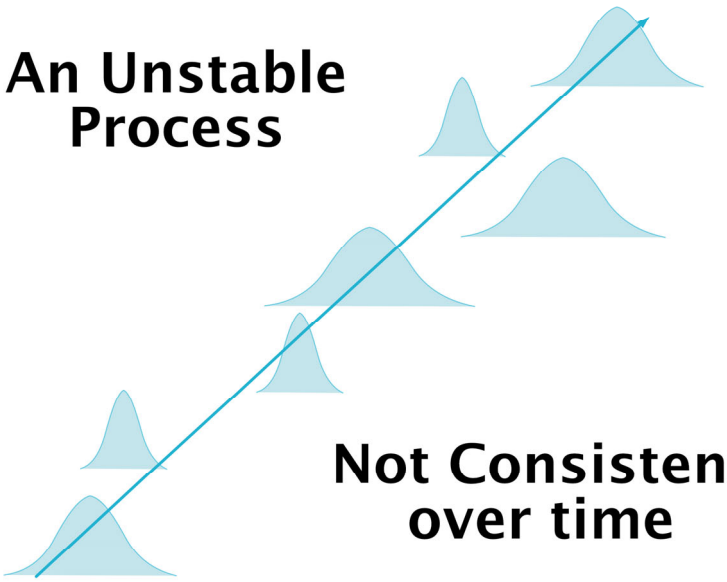
- **Special cause variability** is a shift in output caused by a specific known factors such as environmental conditions or processing errors. It is insidious but can be accounted for directly and potentially removed. It is a **measure of process control.** Also referred to as "**exceptional**" or "**assignable**" variation

A Stable Process



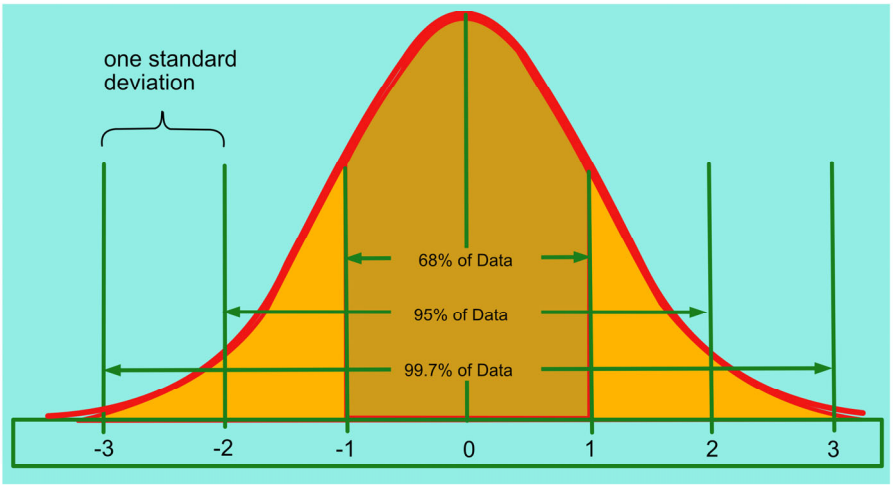
Consistent over Time

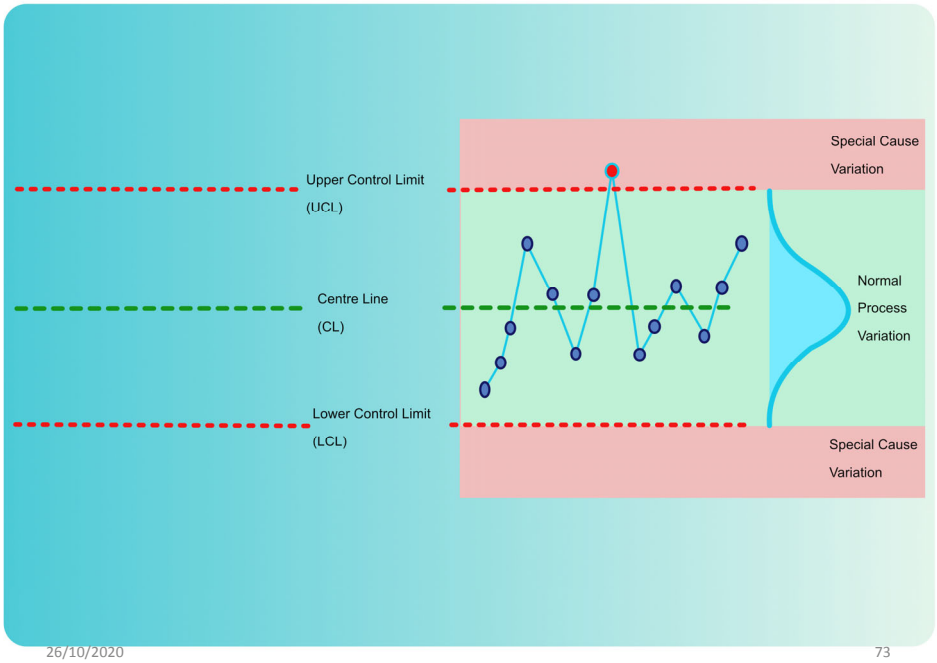
An Unstable Process

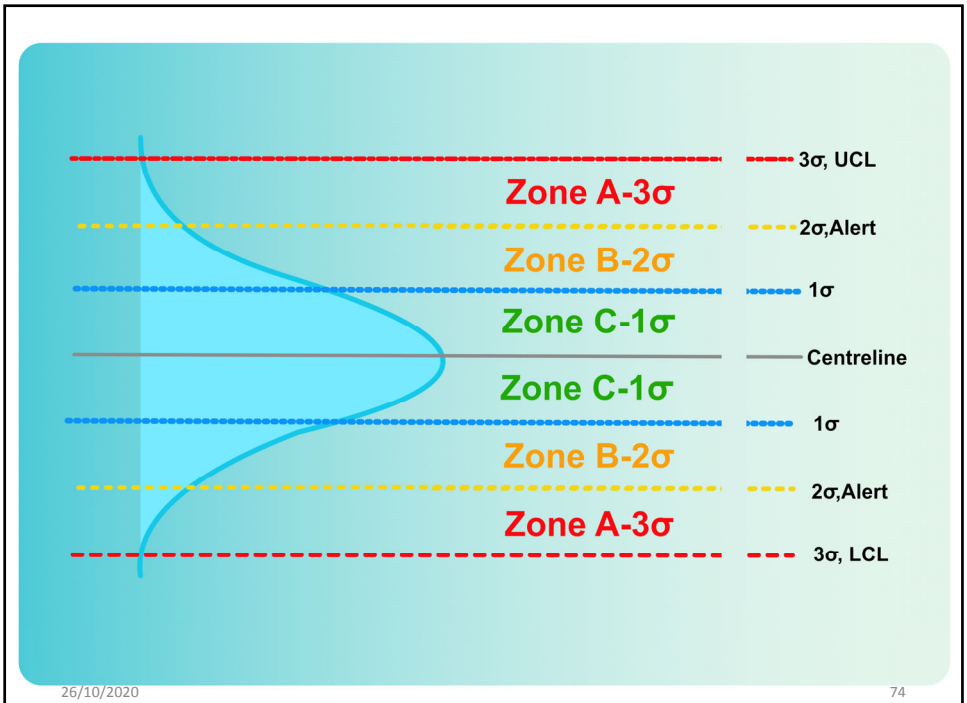


Not Consistent over time

The Empirical Rule



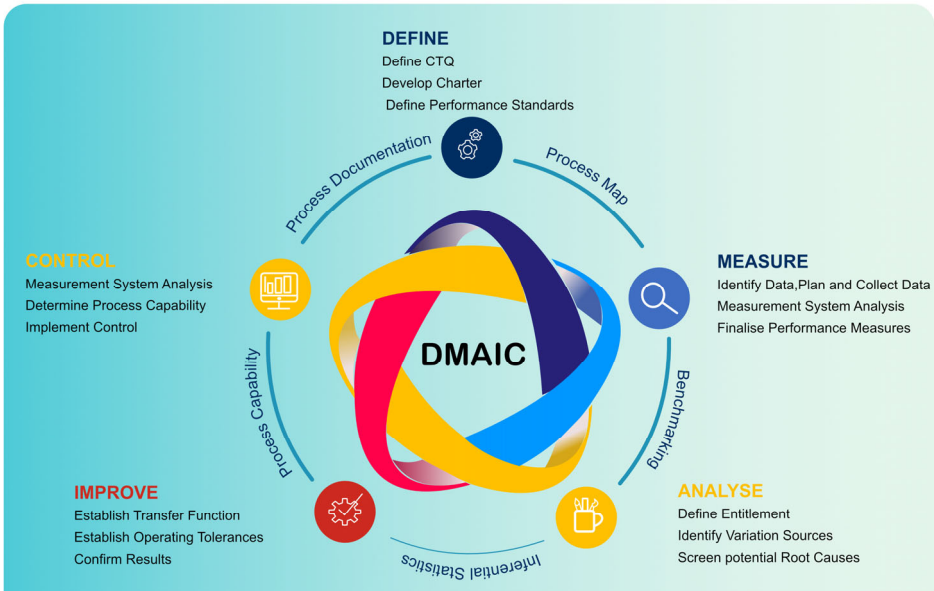

Special Cause
Variation
Upper Control Limit
(UCL)
Centre Line
(CL)
Lower Control Limit
(LCL)
Normal
Process
Variation
Special Cause
Variation

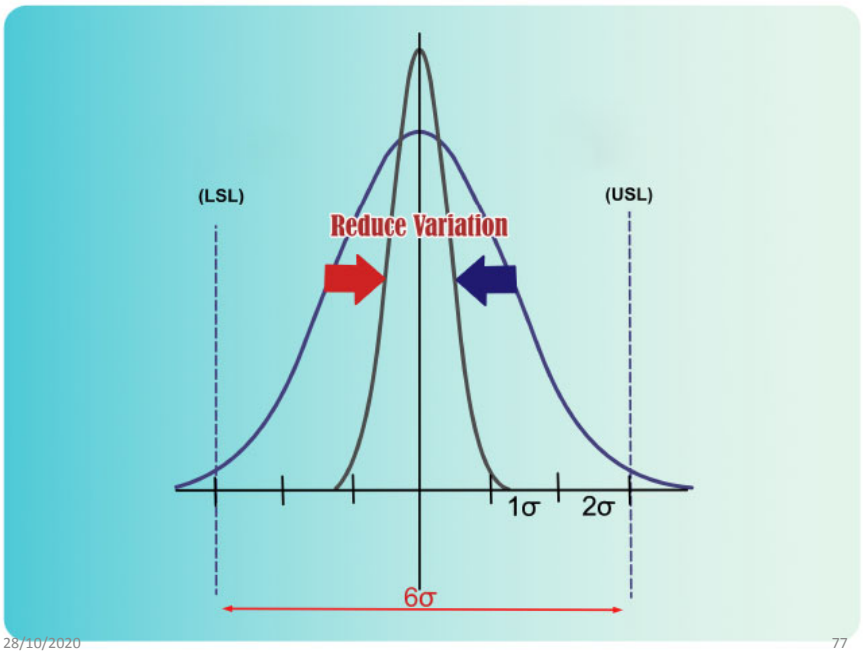

3σ, UCL
Zone A-3σ
2σ,Alert
Zone B-2σ
1σ
Zone C-1σ
Centreline
Zone C-1σ
1σ
Zone B-2σ
2σ,Alert
Zone A-3σ
3σ, LCL

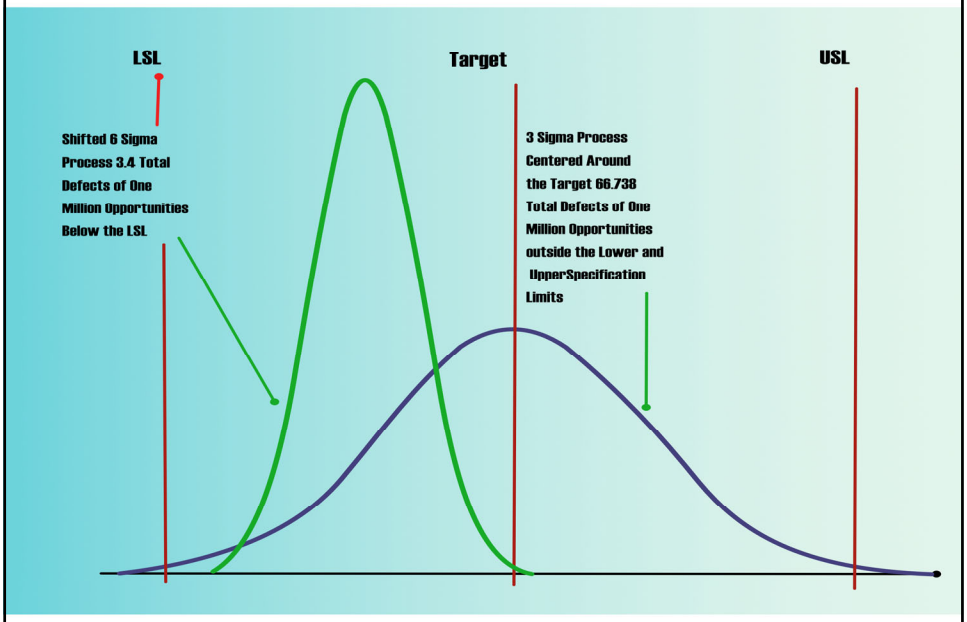
Bill Smith

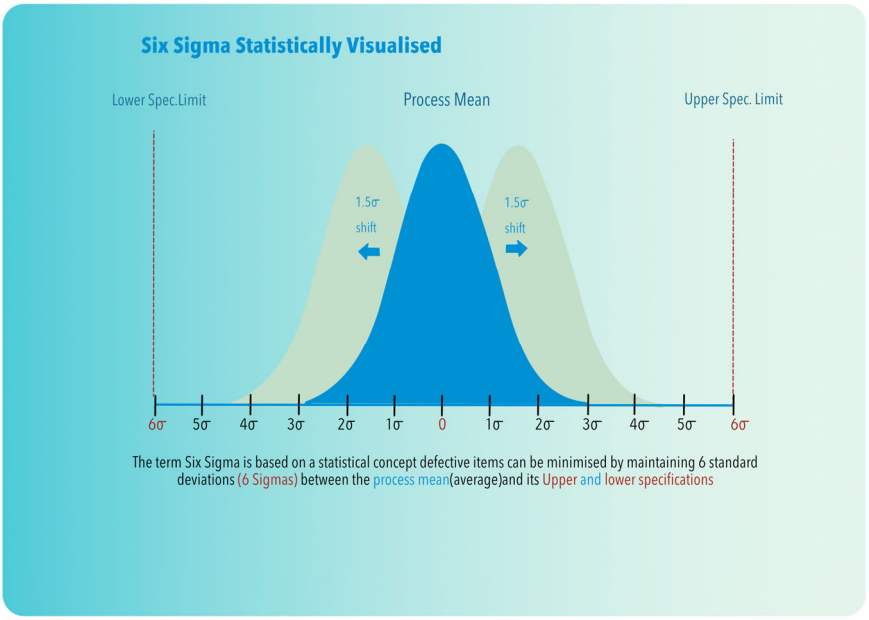
Jack Welch

SIX SIGMA




(LSL)
(USL)
Reduce Variation
1σ
2σ
6σ

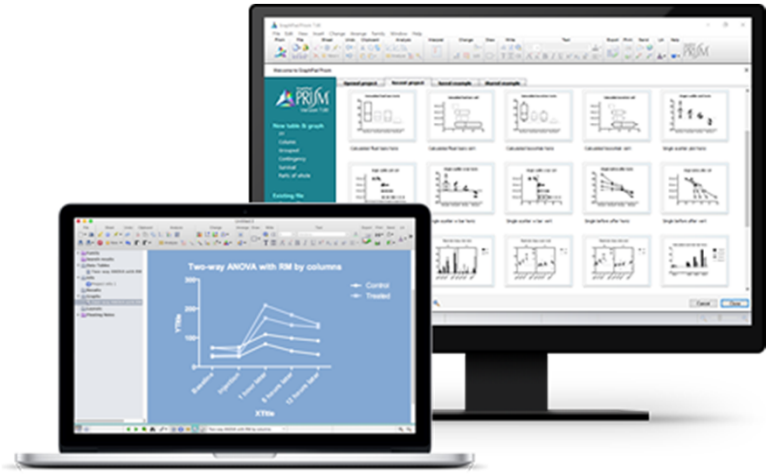

LSL
Target
USL
Shifted 6 Sigma Process 3.4 Total Defects of One Million Opportunities Below the LSL
3 Sigma Process Centered Around the Target 66.738 Total Defects of One Million Opportunities outside the Lower and UpperSpecification Limits



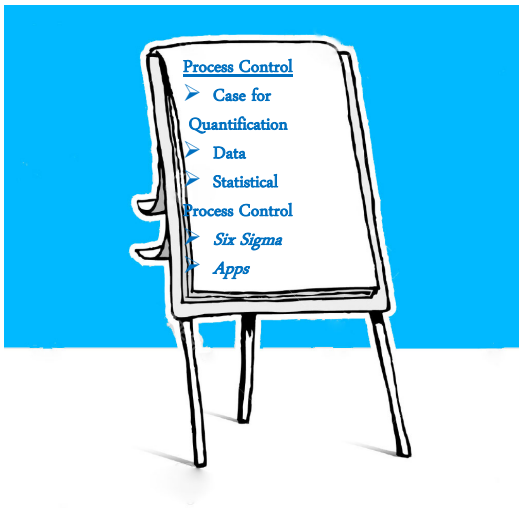
Graph Pad

PA(97

www.graphpad.com

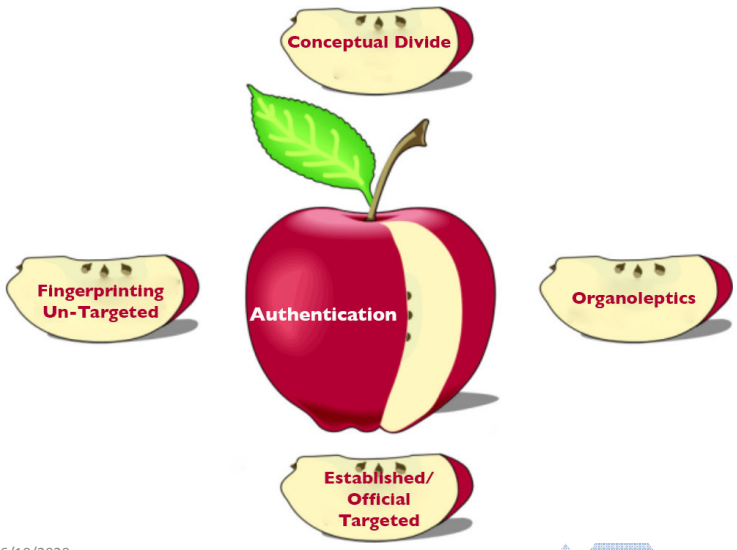


Process Control Summary



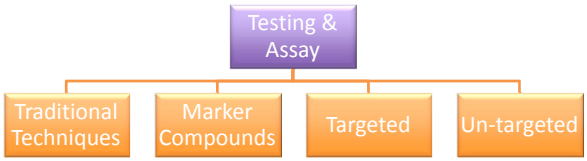
Authentication

Authentication Overview

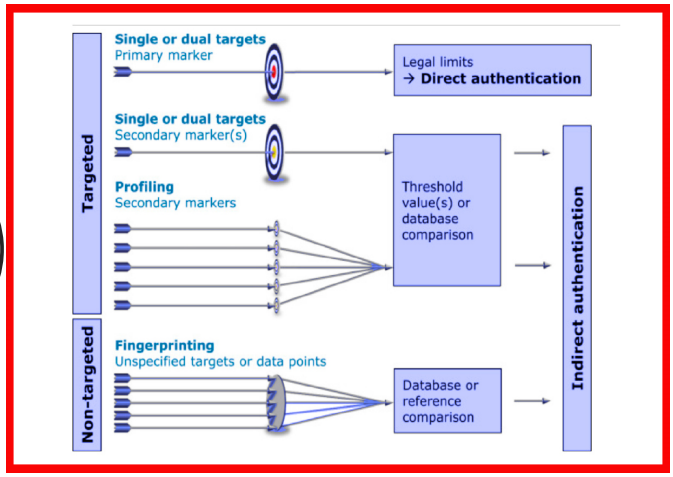


Sources

Conceptual Divide

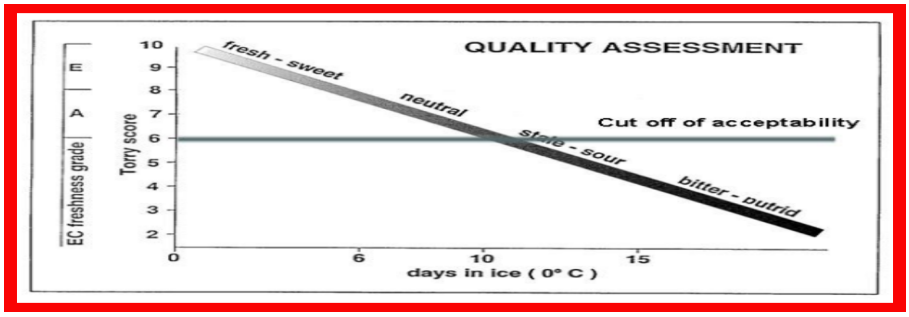


Forensics - Targeted vs Un-targeted Analysis



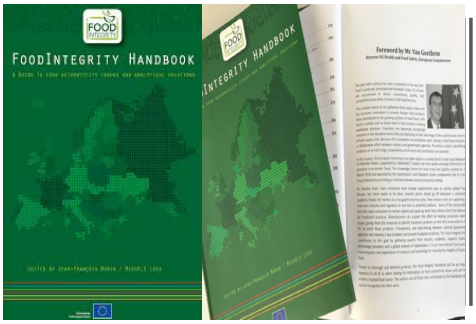
Simple Quantification

Organoleptics



Organoleptics

Targeted Authentication



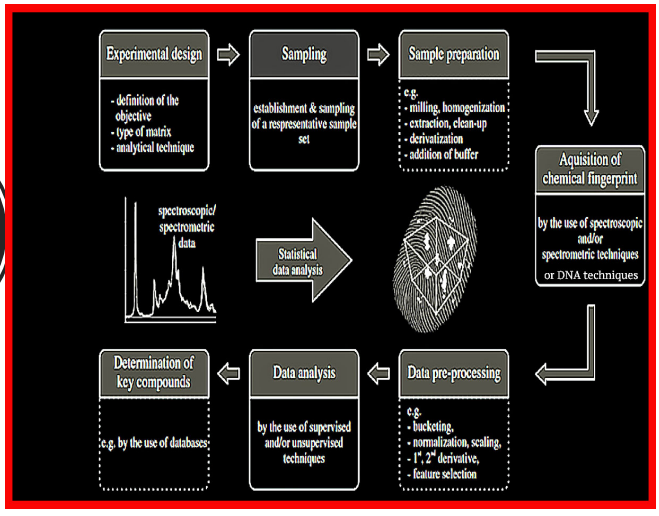
4. Overview of methods for authenticity testing

The following tables provide a summary of the official and commonly used methods respectively and the authenticity issues they address.

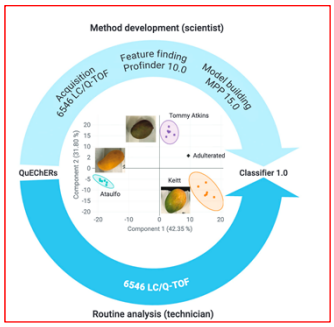
Table 3: Official methods for authenticity testing of meat and meat products

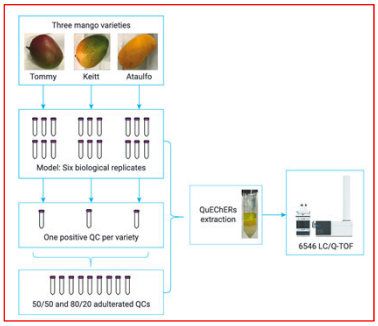
Analytical technique	Indicative data or analyte	Authenticity issue / information
Multiplex PCR	Molecular biomarker	Species substitution
ORBIT (overnight rapid bovine identification test)	Antibodies and antigens	Species substitution
PROFIT (poultry rapid overnight field identification test)	Antibodies and antigens	Species substitution
Kjeldahl	Nitrogen content	Protein substitution
Automated dye binding	Protein content	Protein substitution
Combustion method	Crude protein	Protein substitution
ELISA	Soy proteins	Protein substitution
Gravimetric method	Total fat content	Fat substitution
Colorimetric method	Nitrites and nitrates	Addition of nitrites and nitrates
Spectroscopic method	Nitrites and nitrates	Addition of nitrites and nitrates
Fluorimetric method	Total vitamin C	Addition of ascorbic acid
Spectrometric method	Total phosphorus content	Addition of phosphorus and polyphosphates
Thin layer chromatographic separation	Linear condensed phosphates	Addition of phosphorus and polyphosphates
Gravimetric method	Total phosphorus content	Addition of phosphorus and polyphosphates
Spectroscopic method	Total phosphorus content	Addition of phosphorus and polyphosphates
Thin layer chromatographic method	Synthetic, water-soluble colouring agents	Addition of colouring agents
Titrimetric method	Sulphurous acid (free form)	Addition of sulphur dioxide
Spectroscopic method	Sorbates, ascorbates, benzoates, sulphites	Addition of preservatives
Gravimetric method	Water	Addition of water
Nuclear magnetic resonance	Water	Addition of colouring agents, aromas and preservatives

Fingerprinting

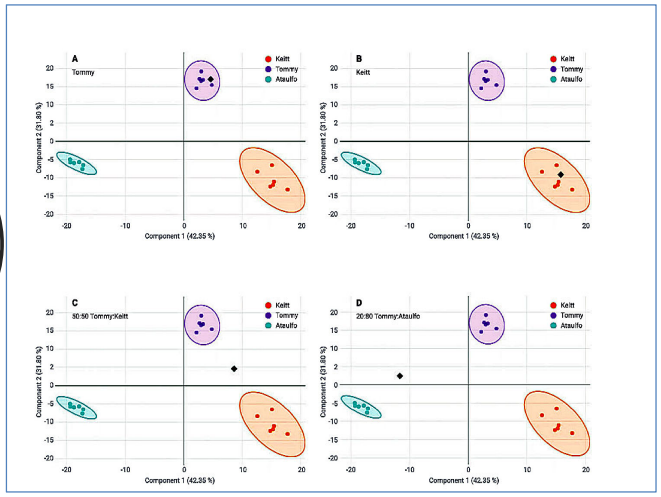


Mass Spectrometry



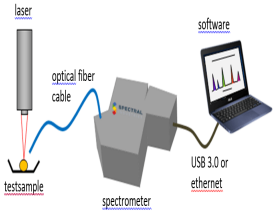


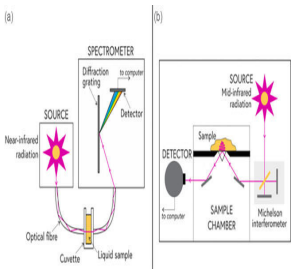
MS Profile for the Mango Case Study



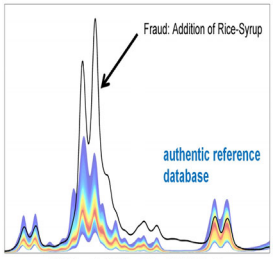


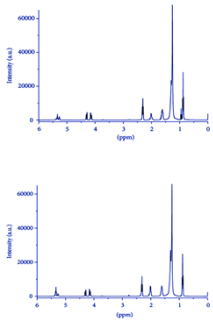
Isotope-ratio **mass spectrometry** (IRMS)





Spectroscopy





Nuclear Magnetic Resonance

DNA Analysis

Authentication Summary

Food Authenticity & Integrity - Management Day 2

Assuring Food Authenticity & Integrity - Protecting the Food Sector from Threats & Vulnerabilities

Andrew MacLeod
BSc (hons) BSc. Pg Dip (Food Safety) CSci (Food Sci & Tech) FIFST FS Prin (IFST)

seafish