Digitalization and Single-Use, an end –user's perspective

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GSK

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AGENDA

- Introduction
- How can AI & digitalization support use of Single Use in pharma process
- Case study of process improvement with input of material
- Case study in the context of Single Use (SUT)
- Take away

Charlotte Masy, Christine De Herde, Youness Issaf, Patrick Seow, Marine Lepoutre, Etienne Michel, Amalia Trevisan, Carole Garnir are employees of the GSK group of companies.
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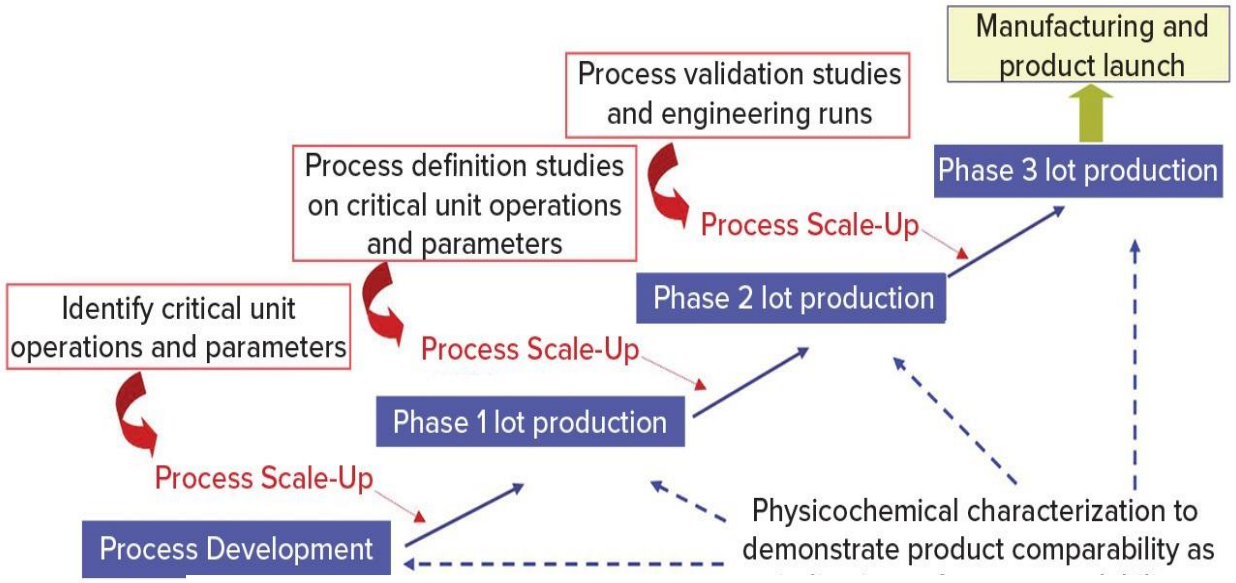
EVOLUTION OF VACCINES DEVELOPMENT



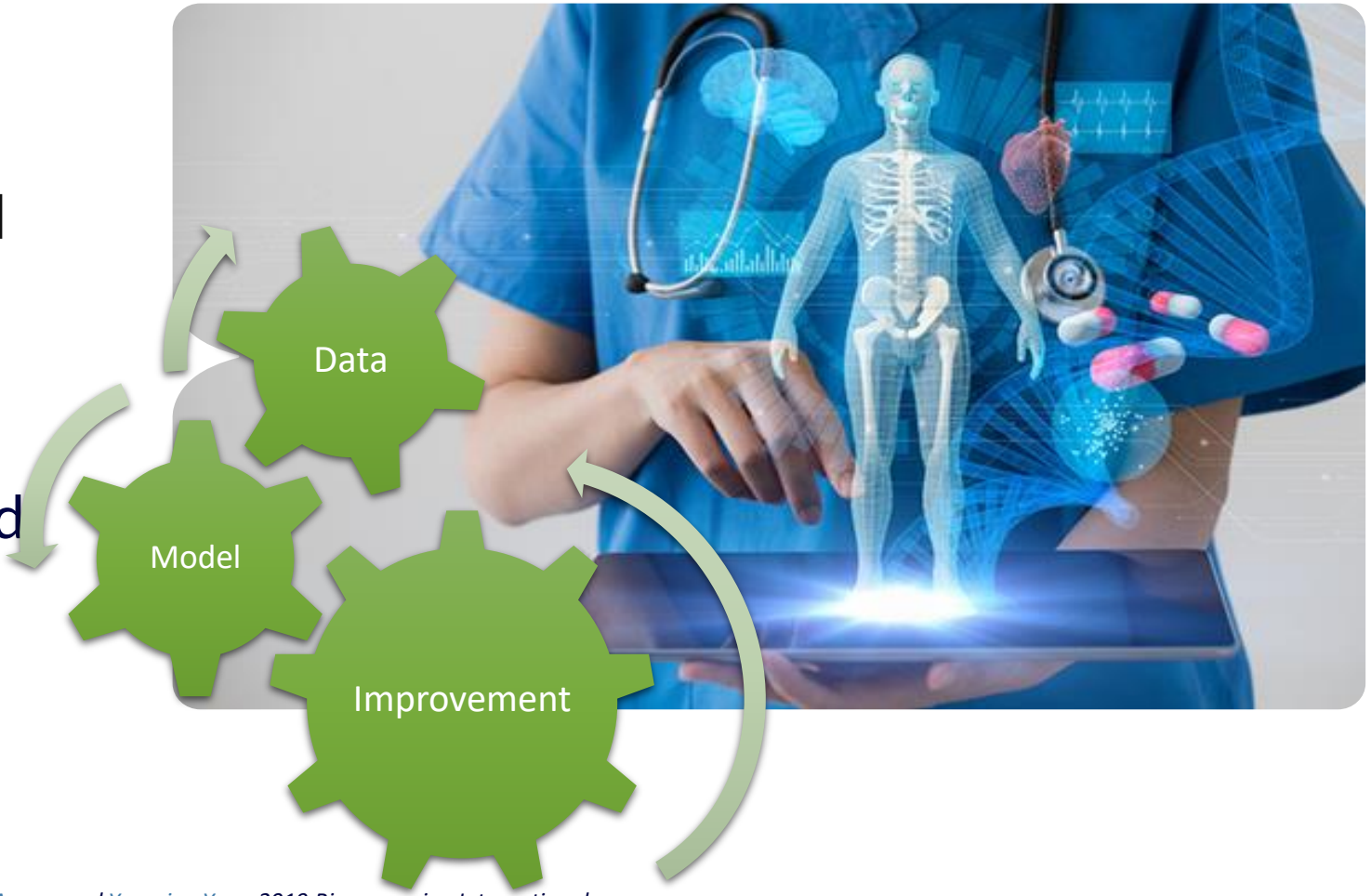
+ immunological characterization

- These timelines does not fit with pandemy → acceleration needed

- ***Advances and Challenges in Vaccine Development and Manufacture*** *by Tony D'Amore and Yan-ping Yang 2019 Bioprocessing International*

Introduction - What is Digitalization & Artificial Intelligence?

- **What is Digitalization?**
- Adaptation of a system, process, etc. to be operated with the use of computers and the internet [1]
- **What is AI?**
- Collection of multiple technologies that allow machines to detect, understand act and learn either on their own or to augment human activities. [2]

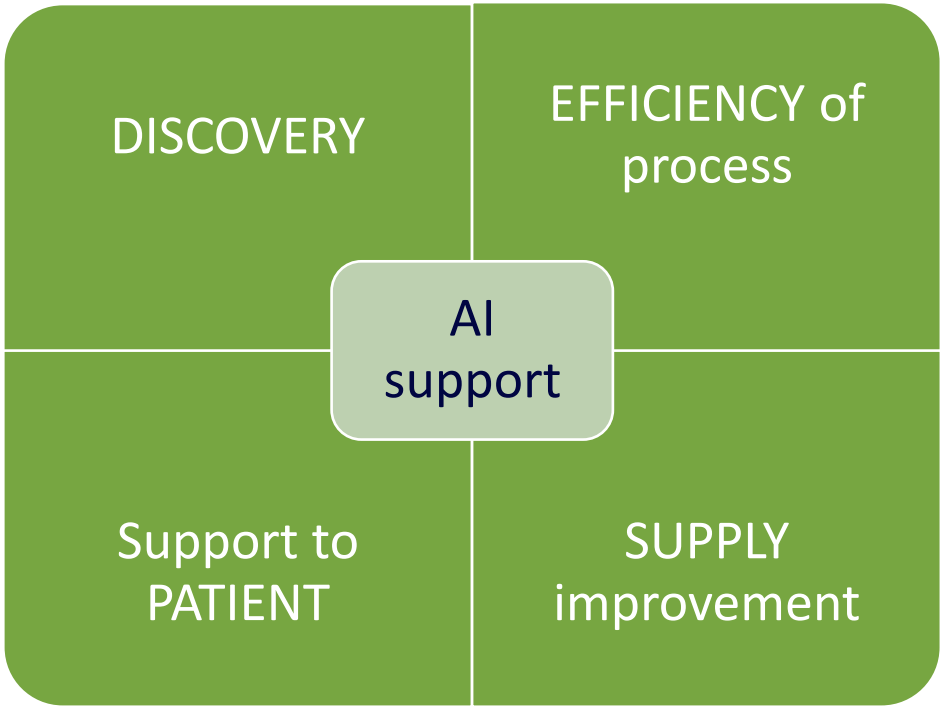


- 1 Oxford Languages website 2 Accenture Research website

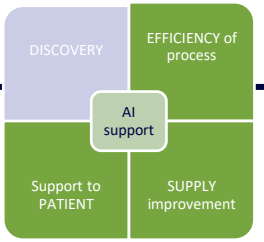
- ***Advances and Challenges in Vaccine Development and Manufacture*** *by Tony D'Amore and Yan-ping Yang 2019 Bioprocessing International*

Introduction - How can AI &Digitalization support pharma process?

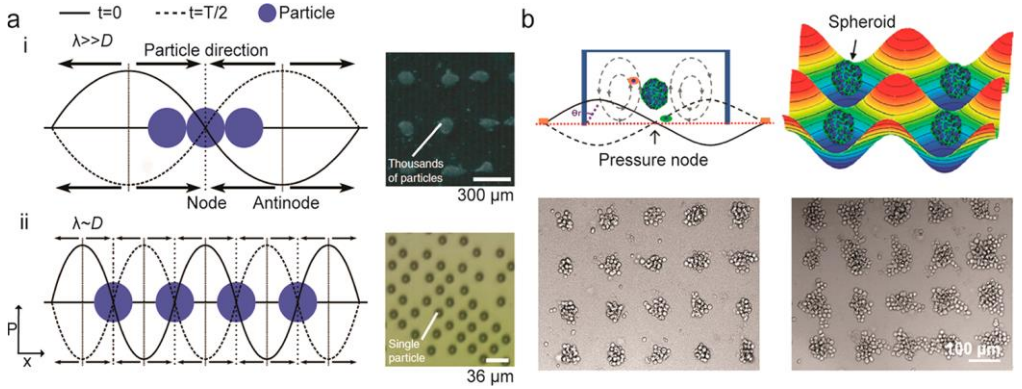
- There are several area in which AI can be a support: Discovery, Efficiency, Patient and Supply
- In this presentation :
  - Focus on Discovery and efficiency of process



How can AI & Digitalization support pharma process? – Discovery



- Technology that can support:
  - Help analyze disease patterns → best treatments
  - Digital Twin including historical data on process → designing and optimization of process
  - **Single Use** : development of technologies allowing online monitoring (e.g. cell growth in bioreactor -Ultrasonic sensor Ovizio)



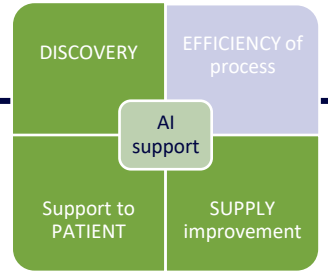
- *Smart Cell Culture Systems: Integration of Sensors and Actuators into Microphysiological Systems by Mario M. Modena,Ketki Chawla, Patrick M. Misun, and Andreas Hierlemann 2018 ACS Chem Biol -13-1767-1784*

How can AI support pharma process- Supply improvement

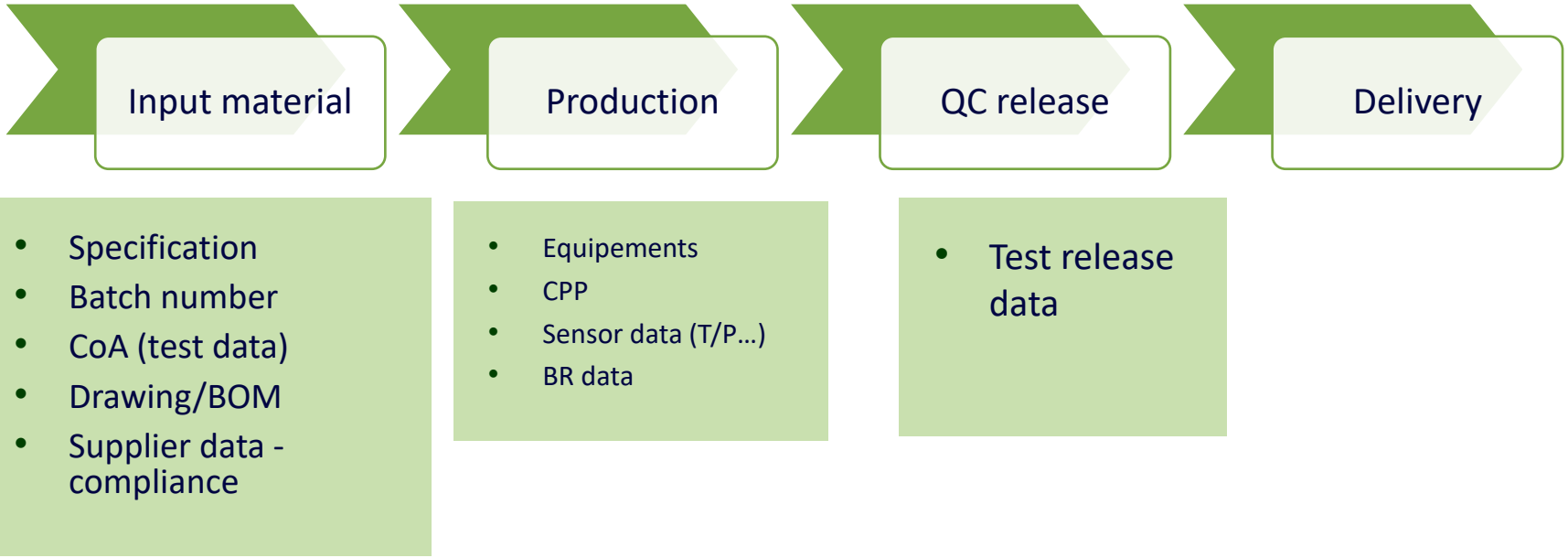
- What can AI do:
  - Personnalize Diagnostic
  - Predic epidemic outbreak
  - …
  - →importance of SU supply

- *Smart Cell Culture Systems: Integration of Sensors and Actuators into Microphysiological Systems by Mario M. Modena,Ketki Chawla, Patrick M. Misun, and Andreas Hierlemann 2018 ACS Chem Biol -13-1767-1784*

How can AI/Digitalization support use of SUT in process? - efficiency of process



- A standard process has a lot of data associated but not always available !
- Traditionally, improvement of process based on human/SME experience



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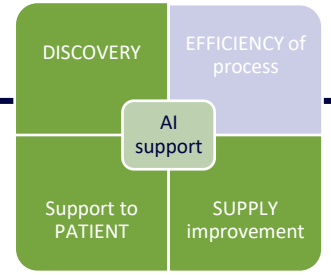
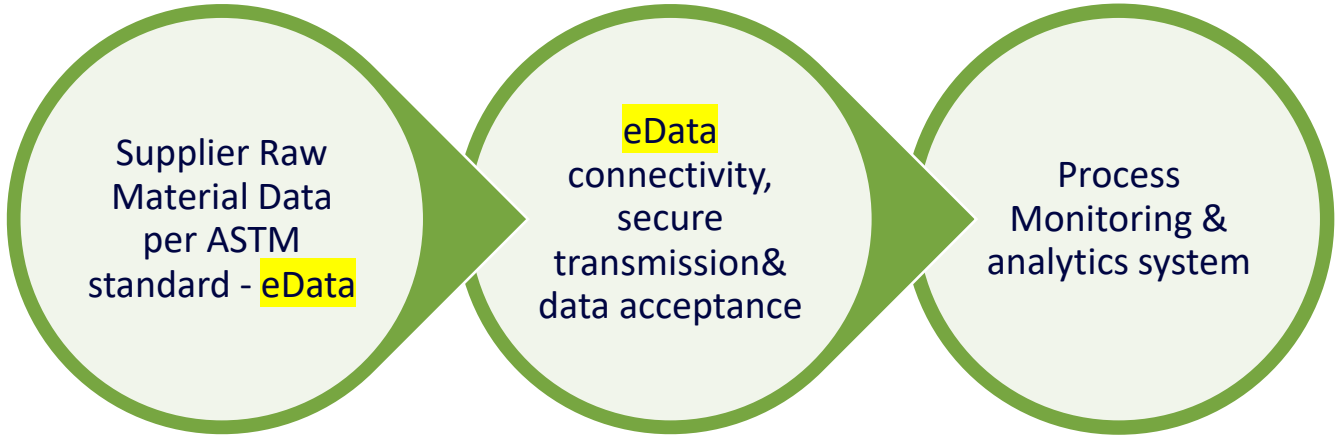
Digitalization and Continued Process Verification (CPV)

- Input material case study – Team:C. De Herde, Y. Issaf, P. Seow



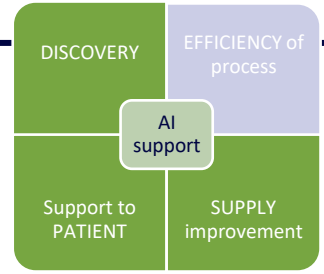
- Electronic Data Exchange: collect data automatically from supplier (CoA)
- Data are merged with process data and used for data analytics
- Monitor raw material performance to control our process performance / variability and prediction
- Two Proof Of Concepts successfully developed with two suppliers

- **Batch number**
- **CoA (test data)**



- From Christine De Herde, Youness Issaf, Patrick Seow

Digitalization and Continued Process Verification (CPV)
New way to extract data; Optical Character Recognition (OCR)



- The data can be extracted automatically from the PDF copy of the CoA into a structured data format e.g. Excel to be analyzed

Certificate of Analysis

PRODUCT :HYDROCHLORIC ACID 35% ERBApharm - According to pharmacopoeia : Ph.Eur.-USP-JP
CODE :P1010521GSV
LOT N° :Q4I118134M
EXPIRING DATE :2020/11 EDITION 2
PACKAGING DATE :16/11/2020

TEST	U.M.	SPECIFICATION	RESULT
Clear,colourless solution	-	Conform	Conform
Hydrochloric acid content	%	35 - 39	37.6
Residue on evaporation	% m/m	<= 0.01	<= 0.0100
Residue on ignition	mg/Kg	<= 80	< 80
Bromide or iodide (USP-NF)	-	Conform	Conform
free bromine or chlorine (USP-NF)	-	Conform	Conform
Sulphite (USP-NF)	-	Conform	Conform
Sulphate (SO4--)	mg/Kg	<= 20	<= 20
Free chlorine	mg/Kg	<= 4	<= 4.0
Heavy metals (as Pb)	mg/Kg	<= 2	<= 2
Arsenic (As)	mg/Kg	<= 1	<= 1
Mercury (Hg)	mg/Kg	<= 0.04	< 0.04

Our products should be used in compliance with the current legislation, raw material for pharmaceutical uses included.

Certificate of Analysis

PRODUCT :HYDROCHLORIC ACID ERBApharm - According to pharmacopoeia : Ph.Eur.-USP-JP
CODE :P1010521GSV
LOT N° :P8I110038L
EXPIRING DATE :09/2024 EDITION 2

TEST	U.M.	SPECIFICATION	RESULT
Clear,colourless solution	-	Conform	Conform
Hydrochloric acid content	%	36.5 - 38.0	37.3
Residue on evaporation	% m/m	<= 0.01	<= 0.01
Residue on ignition	mg/Kg	<= 80	<= 80
Bromide or iodide (USP-NF)	-	Conform	Conform
free bromine or chlorine (USP-NF)	-	Conform	Conform
Sulphite (USP-NF)	-	Conform	Conform
Sulphate (SO4--)	mg/Kg	<= 20	<= 20
Free chlorine	mg/Kg	<= 4	<= 4.0
Heavy metals (as Pb)	mg/Kg	<= 2	<= 2
Arsenic (As)	mg/Kg	<= 1	<= 1
Mercury (Hg)	mg/Kg	<= 0.04	<= 0.04

Our products should be used in compliance with the current legislation, raw material for pharmaceutical uses included.

Certificate of Analysis

PRODUCT :HYDROCHLORIC ACID ERBApharm - According to pharmacopoeia : Ph.Eur.-USP-JP
CODE :P1010521GSV
LOT N° :Q7I015187I
EXPIRING DATE :09/2023 EDITION 2

TEST	U.M.	SPECIFICATION	RESULT
Clear,colourless solution	-	Conform	Conform
Hydrochloric acid content	%	36.5 - 38.0	37.5
Residue on evaporation	% m/m	<= 0.01	<= 0.01
Residue on ignition	mg/Kg	<= 80	<= 80
Bromide or iodide (USP-NF)	-	Conform	Conform
free bromine or chlorine (USP-NF)	-	Conform	Conform
Sulphite (USP-NF)	-	Conform	Conform
Sulphate (SO4--)	mg/Kg	<= 20	<= 20
Free chlorine	mg/Kg	<= 4	<= 4.0
Heavy metals (as Pb)	mg/Kg	<= 2	<= 2
Arsenic (As)	mg/Kg	<= 1	<= 1
Mercury (Hg)	mg/Kg	<= 0.04	<= 0.04

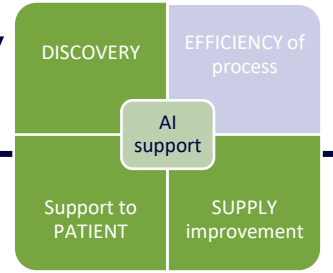
Our products should be used in compliance with the current legislation, raw material for pharmaceutical uses included.

Data is unstructured (PDF file)
1 PDF = 1 raw material batch

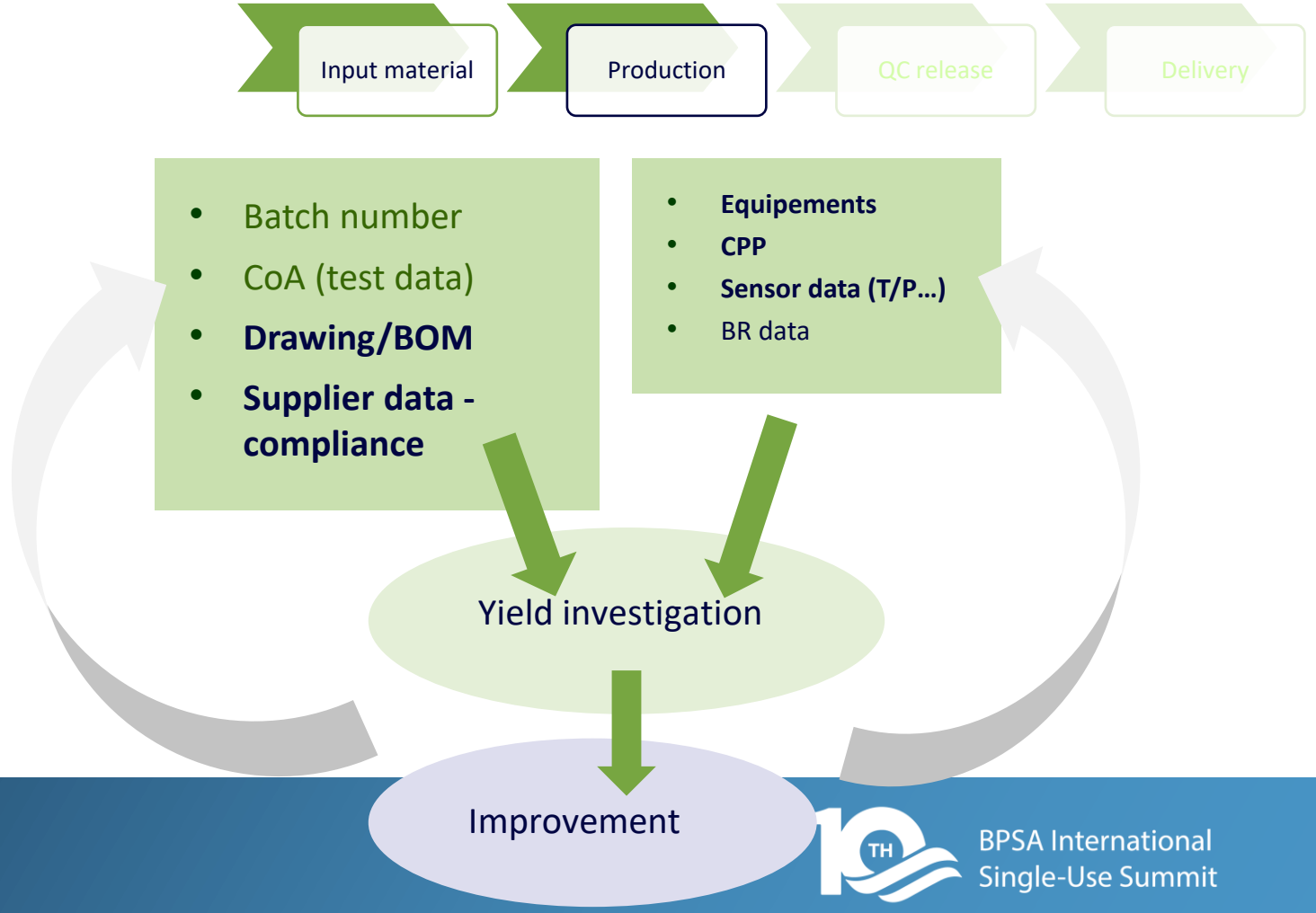
Structured data in Excel

Hydrochloric acid content	Residue on evaporation	Residue on ignition	Bromide or iodide	free bromine or chlorine	Sulphite	Sulphate	Free chlorine	Heavy metals	Arsenic	Mercury	Clear,colourless solution
37.6	<= 0.0100	< 80	Conform	Conform	Conform	<= 20	<= 4.0	<= 2	<= 1	< 0.04	Conform
37.70	<= 0.0100	< 80	Conform	Conform	Conform	<= 20	<= 4.0	<= 2	<= 1	< 0.04	Conforms
37.4	<= 0.01	<= 80	Conform	Conform	Canform	<= 20	<= 4.0	<= 2	< 1	<= 0.04	Conform
37.7	<= 0.01	< 80	Conform	Conform	Conform	<= 20	<= 4.0	<= 2	<= 1	< 0.04	Conform
37.5	<= 0.01	<= 80	Conform	Conform	Conform	<= 20	<= 4.0	<= 2	<= 1	<= 0.04	Conform
37.3	<= 0.01	<= 80	Conform	Conform	Conform	<= 20	<= 4.0	< 2	< 1	<= 0.04	Conform

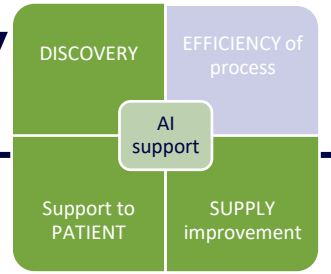
Digitalization and process improvement
Single Use Case study Team: C. Garnir, A. Trevisan, C. Masy



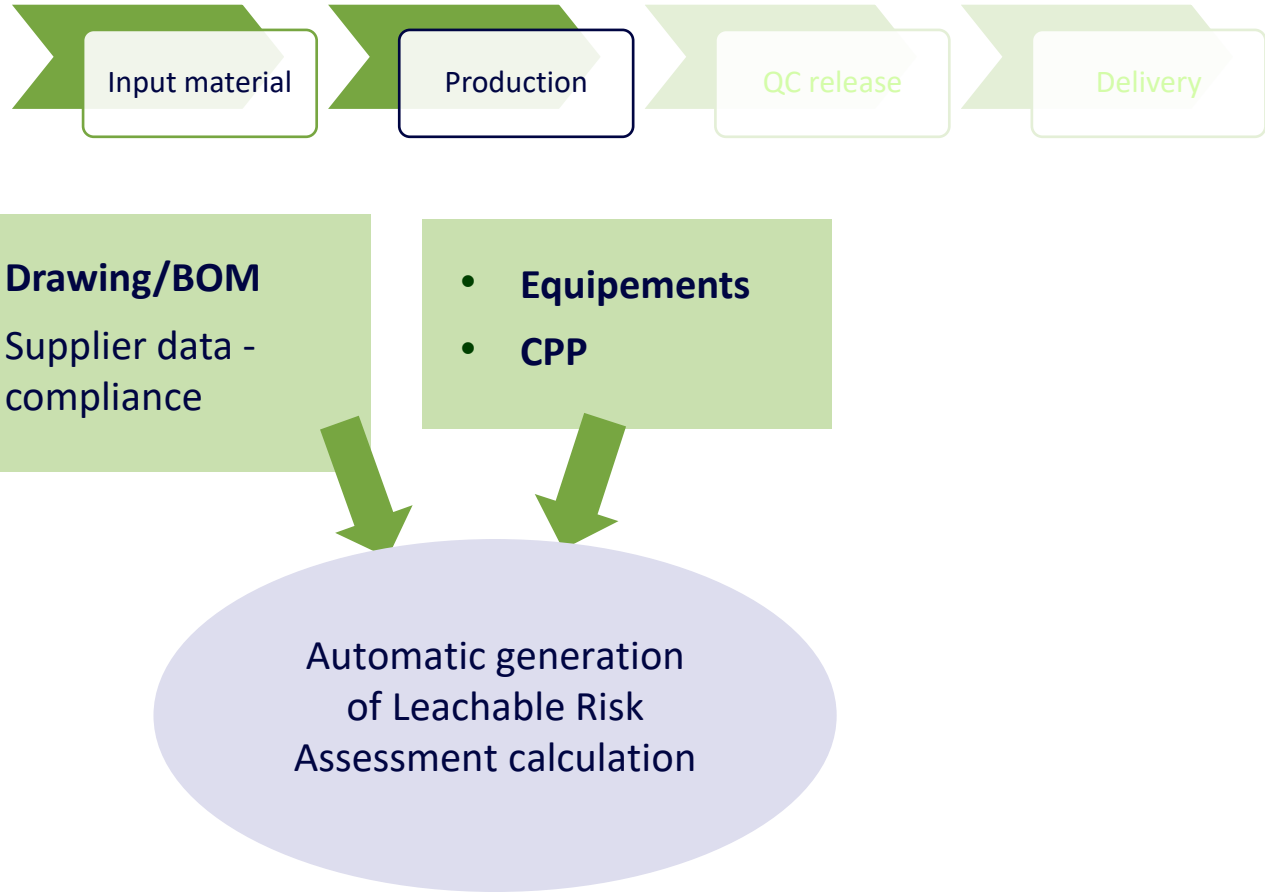
- Current work : exchange on Single Use drawing and Buid of Material (BOM) with supplier
- Supplier data exchange (compliance, e-questionnaire..)
- Future investigation: Machine Learning on based on SUS BOM/genealogy versus process yield?



Digitalization and validation process
Single Use Case study Team M. Lepoutre, E. Michel & C. Masy



- E&L heavy work in validation of Single Use
- Work : Automatization of E&L calculation
- <USP 665> per component →base on drawing, BOM, E&L data from supplier
- Automatic calculation based on process and BOM → speed up validation and change



TAKE AWAY

- Digitalization/AI does not necessarily require complex tools/software
- Digitalization/AI is key for Pharma process (optimization,…)
- SUT Availability of data is a limiting factor – need standards, tools, exchange
- Future is integration of processes