Organ on Chip

Putting Science into Standards (PSIS)

April 28-29 2021

CEN CENELEC

European Commission

Putting Science into Standards Workshop Organ-on-Chip 28-29 April 2021 (online)

The European Commission's Joint Research Centre (JRC) and CEN-CENELEC carry out an annual 'foresight on standardisation' action with the aim of Putting Science into Standards (PSIS).

The topic for the 2021 PSIS Workshop will be "Organ-on-Chip".

The development of Organ-on-Chip (OoC) technologies and tools has been extensive in recent years, with the expectation that OoC will lead to:

- More human-relevant approaches in biomedical research;
- Faster, cheaper and more effective pre-clinical evaluation of new drugs;
- Better ways to assess the potential health effects and toxicity of drugs, chemicals, food products and cosmetics;
- Acceleration of drug repurposing;
- Reduction and replacement of animal testing.

The PSIS initiative is a unique opportunity to gather together stakeholders from different fields to identify application areas and related priorities, to share views on future developments and stakeholder needs, and to provide recommendations to CEN-CENELEC on possible next steps.

We invite you to participate in the PSIS 2021 "Organ-on-Chip" Workshop to be held online on 28-29 April 2021.

Putting Science into Standards (PSIS)

The PSIS initiative identifies emerging science and technology areas that could benefit from standardisation activities to enable innovation and enhance industrial competitiveness. Each year CEN-CENELEC and JRC select a topic for a PSIS workshop from a variety of proposals made by JRC scientists.

What is an Organ-on-Chip?

Organ-on-Chip (OoC) refers to a group of innovative technologies able to maintain and monitor living engineered human or animal tissues in a controlled microenvironment. The purpose of OoCs is to mimic specific aspects of organ physiology and function, including interactions between different organs in the body.

Relevance of OoC standardisation

Pre-normative work performed by European and international consortia indicates that standardisation should be a cornerstone for the advancement of OoC technology and its efficient transfer into promising areas of application. It is expected that standardisation activities will:

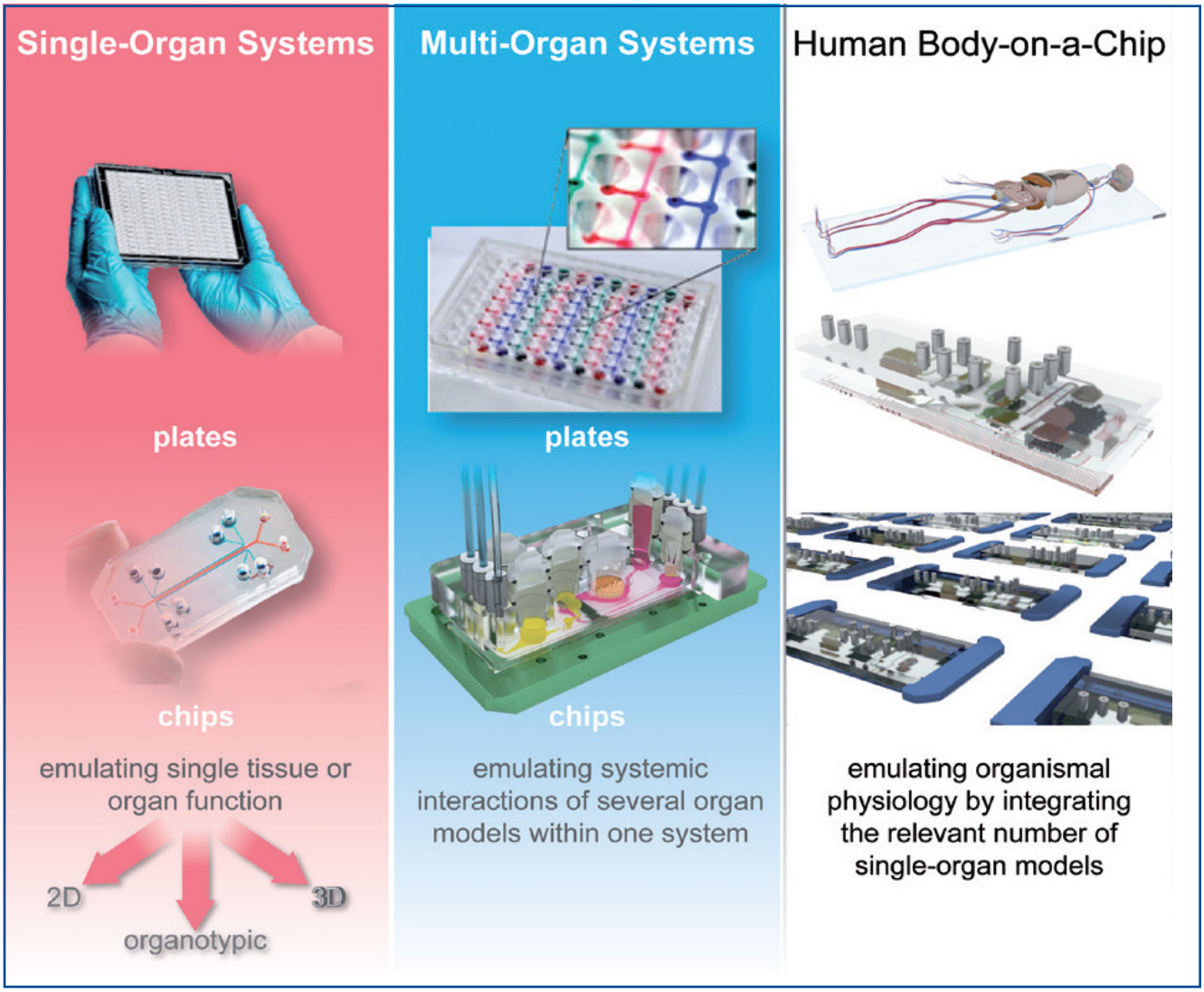
- Increase implementation of OoC in current and future regulatory frameworks.
- Allow OoC to be used in emergency situations for rapid development and testing of drugs and vaccines.
- Strengthen Europe's position as the leader in finding better alternatives to the use of animals for scientific purposes.
- Support European OoC start-ups to bridge the 'valley of death' in shorter timeframes and with lower costs, reaching commercialisation and increasing their market share.

Organ-on-Chip applications

The development of OoC, bringing technology and biology together, started in universities about 15 years ago, but in the past few years their use has rapidly expanded, thanks to increasing use in pharma companies. OoC includes a wide range of different technologies of varying complexity and their range of applicability typically varies based on the organ function that is mimicked.

OoC can be used for applications in many scientific fields, the most common being toxicity testing, drug discovery and development (including biokinetics), disease modelling and personalised medicine.

The use of these technologies is also relevant for biomedical research where it could replace the use of animal models in the study of specific pathologies such as cancer and neurodegenerative disorders.



OoC types with focus on single organs, multiple organs with relevant interaction and full body emulation. © U. Marx et al., "Biology-inspired microphysiological system approaches to solve the prediction dilemma of substance testing", ALTEX, vol. 33, no. 3, pp. 272-321, Aug. 2016. Under CC BY 4.0.

Possible standardisation priorities

Considerable international interest and funding in OoC has resulted in some companies being already able to offer products at high Technological Readiness Level (TRL 7/8) for specific applications. However, the majority of the devices are still being developed and tested in research laboratories and start-ups (TRL 3/4).

Standards are powerful tools that can be used to support the process of OoC qualification, thus demonstrating biological relevance, increasing implementation by end-users, and facilitating regulatory acceptance. Standards can support the qualification and assessment of these new technologies, by enabling appropriate characterisation of OoC devices, including a systematic description of expected performance. Standards can facilitate the interoperability of different OoC components thereby facilitating innovation and product development. Moreover, standards can be used to benchmark OoC performance to allow comparisons to be made between similar devices and to determine fitness-for-purpose. Standards can also improve communication through harmonised reporting of system characteristics using agreed formats and terms.

Opportunities for standardisation

1. Terminology. A clear and common definition and classification of OoC devices is fundamental to facilitate communication among developers, end-users and regulators. Many new terms related to OoC are being used by different communities and thus there is a need to define and agree on a common lexicon.

2. Methodology to assess the technological performance of the device. Although the technology is quite advanced, developers typically use their own internal procedures for technical validation. A consensus is needed on relevant parameters to be controlled, the acceptability ranges and the measurement methods and units that should be used.

3. Methodology for the biological assessment. Due to the many applications of OoC, this assessment has to be conducted considering specific purpose or context of use. It is important to identify relevant biomarkers for each organ function and reference compounds (e.g. positive and negative controls) that can be used for characterisation of the biological performance.

An international standardisation effort

Various consortia have developed position papers that describe the vision of many stakeholders, both at European and international levels, with specific focus on standards development and on the role of standards in advancing the OoC field.

The Organ-on-Chip in development (ORCHID) project was an EU initiative aiming at creating a roadmap for OoC technology and building a network of all relevant stakeholders in this promising innovative field. The ORCHID project delivered a European OoC roadmap, including standardisation and qualification recommendations that cover both technological and biological assessment.[1]

Another welcome outcome of the project was the creation of the European Organ-on-Chip society (EUROoCS) which brings together public institutions; academic research communities; industry groups representing the pharmaceutical, cosmetics, chemicals, and food sectors; hospitals and university medical centres; patient associations; regulatory agencies and policy makers.

The T4 workshop, organised in June 2019 by CAAT- Europe (the Center for Alternative to Animal Testing in Europe), brought together 46 leading international experts from all key stakeholder groups – academia, supplier industry, pharmaceutical and consumer products industries, and leading regulatory agencies. The workshop analysed challenges and hurdles along the life cycle of microphysiological systems (MPS), a group of technologies which also include OoC. In their report "Biology-inspired MPS to Advance Patient Benefit and Animal Welfare in Drug Development"[3], standardisation and harmonisation are being fundamental to advance the qualification and validation of OoC technology.

The IQ Consortium (International Consortium for Innovation and Quality in Pharmaceutical Development) - MPS Affiliate, includes stakeholders from the pharma industry that are already using or are interested in using OoC technologies in their drug development cycle. The consortium works with National Institute of Health (NIH), Food and Drug Administration (FDA) and tissue chip developers towards the implementation and qualification of MPS models as in vitro tools for drug development. Their perspectives are described in a series of papers[4] on specific organs and applications published in early 2020.

The ORCHID project

The ORCHID project[2] (Organ-on-Chip in development) was coordinated by Leiden University Medical Center and the Dutch Organ-on-Chip consortium (hDMT). It started in October 2017 and ran for 2 years and involved 7 leading European research institutions.

1. Drug Discovery Today - 2017 Sep;22(9):1392-1399. doi: 10.1016/j.drudis.2017.03.011

2. ALTEX - Alternatives to animal experimentation, 36(3), pp. 481-492. doi: 10.14573/altex.1905221.

3. ALTEX - Alternatives to animal experimentation, 37(3), pp. 365-394. doi: 10.14573/altex.2001241.

4. Lab Chip, 2020,20, 1049-1057, doi: 10.1039/C9LC01168D

PSIS workshop – Organ on Chip – Agenda

April 28-29 2021

DAY 1 — *PLENARY*

14:00 - 14:10 ***Get settled in***
MODERATOR: Maurice Whelan, EC JRC

14:10 - 14:30 ***Welcome and opening***
Stephen Quest, EC JRC Director General; Ruggero Lensi, CEN Vice President Technical

14:30 - 15:00 ***The present and future of Organ on Chip***
Janny van den Eijnden-van Raaij, EUROoCS

15:00 - 15:30 ***What are standards and what are they good for?***
Lena Morgan, SIS and CEN Advisory Board for Healthcare Standards

15:30 - 15:45 ***BREAK***

15:45 - 16:15 ***Standardisation in the pharmaceutical sector***
Marian Raschke, Bayer

16:15 - 16:45 ***Standardisation opportunities for OoC***
Monica Piergiovanni, EC JRC

16:45 - 17:00 ***Setting up our activities for the Day 2***
MODERATOR: Maurice Whelan

DAY 2 — *PARALLEL SESSIONS*

The parallel sessions will be divided in three themes: life science, engineering, and regulatory and data reporting. Participants have to choose in advance and they cannot go from one room to another.

09:00 - 09:10 ***Welcome and orientation***
MODERATOR: Maurice Whelan

09:10 - 10:10 ***Cells and Tissues***
CHAIR/SPEAKER: Christine Mummery, University of Leiden; **RAPPORTEUR:** Sofia B. Leite
ROUNDTABLE MEMBERS: Jochen Kuehnl, Beiersdorf; Oliver Frey, inSphero; Paula Alves, iBET

Sensing and Integration
CHAIR/SPEAKER: Luis Fernández, University of Zaragoza; **RAPPORTEUR:** Ozlem Cangar
ROUNDTABLE MEMBERS: Dries Braecken, IMEC; Christoph Jeschke, MCS; Marco Rasponi, Polytechnic University of Milan

Good experimental practices
CHAIR/SPEAKER: Sandra Coecke, JRC; **RAPPORTEUR:** Monica Piergiovanni
ROUNDTABLE MEMBERS: Pelin Candarlioglu, GSK; Rhiannon David, AstraZeneca; Sonja Beken, Fagg

10:10 - 10:30 ***BREAK***

Agenda

DAY 2 — ***PARALLEL SESSIONS*** *The parallel sessions will be divided in three themes: life science, engineering, and regulatory and data reporting. Participants have to choose in advance and they cannot go from one room to another.*

10:30 - 11:30

Biomaterials and 3D printing
CHAIR/SPEAKER: Peter Loskill, University of Tübingen; **RAPPORTEUR:** Sofia B. Leite
ROUNDTABLE MEMBERS: Bas Trietsch, Mimetas; Lorna Ewart, Emulate; Hector Martinez, CELLINK

Interoperability and control systems
CHAIR/SPEAKER: Andries Van Der Meer (University of Twente) **RAPPORTEUR:** Ozlem Cangar
ROUNDTABLE MEMBERS: Holger Becker, Microfluidic Chip Shop; Serge Renouard, Fluigent; Wolfgang Eberle; IMEC

Data acquisition and management
CHAIR/SPEAKER: Martin Golebiewski (HITS) **RAPPORTEUR:** Monica Piergiovanni
ROUNDTABLE MEMBERS: Christian Maas (ESQlabs); Patrick Courtney (SiLA)

11:30 - 11:50 — ***BREAK***

11:50 - 12:50

Assays and biomarkers
CHAIR/SPEAKER: Adrian Roth, Roche; **RAPPORTEUR:** Sofia B. Leite
ROUNDTABLE MEMBERS: Godfrey Smith, University of Glasgow; Florian Fuchs, Novartis; Ofra Benny, Hebrew University of Jerusalem

Microfluidics
CHAIR/SPEAKER: Mathieu Odijk, University of Twente; **RAPPORTEUR:** Ozlem Cangar
ROUNDTABLE MEMBERS: Nicolas Verplank, CEA; Alexios Tzannis, IMTAG; Marko Blom, Micronit

Characterisation and reporting
CHAIR/SPEAKER: Ilka Maschmeyer, TissUse **RAPPORTEUR:** Monica Piergiovanni
ROUNDTABLE MEMBERS: Albert van den Berg, University of Twente; Peter Ertl, Vienna University of Technology; Thomas Steger-Hartmann, Bayer

12:50 - 14:15 — ***LUNCH BREAK***

PLENARY

14:15 - 15:00 — ***Flash Summaries of parallel sessions***

15:00 - 15:45

Panel discussion on ways forward
MODERATOR: Maurice Whelan, EC JRC; **ROUNDTABLE MEMBERS:** Christine Mummery, President of EUROOCS; Gergely Tardos (tbc), EC RTD; Ivan Rusyn, regulatory toxicology expert Texas A+M, Lena Morgan, CEN CENELEC Healthcare Advisory Board; Karl Gruen, Austrian Standards

15:45 - 16:00

Workshop Closing
Fabio Taucer, EC JRC

Advisory board members

Alexios Tzannis	(IMT)
Andreas Jenet	(European Commission – JRC)
Andries van der Meer	(University of Twente)
Anna Herland	(KTH)
Anne Riu	(L'Oréal)
Ashok Ganesh	(CEN-CENELEC)
Berend van Meer	(Leiden University Medical Center)
Christian Pellevoisin	(Episkin)
Dries Braeken	(Imec)
Fabio Taucer	(European Commission – JRC)
Janny van den Eijnden-van Raaij	(hDMT, EUROoCS)
Lena Morgan	(SIS)
Livia Mian	(CEN-CENELEC)
Luis Fernández	(University of Zaragoza)
Massimo Mastrangeli	(TU Delft)
Maurice Whelan	(European Commission – JRC)
Monica Piergiovanni	(European Commission – JRC)
Nicolas Verplanck	(CEA Leti)
Ozlem Cangar	(European Commission – DG R&I)
Patrick Courtney	(SiLA)
Peter Loskill	(Fraunhofer Institute)
Samira Nik	(CEN-CENELEC)
Wolfgang Eberle	(Imec)