

## **ORCHID (Organ-on-Chip In Development): Achievements and Future Perspectives Final Meeting Leiden (The Netherlands), 23 September 2019.**

*Johannes Vermeer room (5<sup>th</sup> floor), Fletcher Hotel Leiden - Bargelaan 180 - 2333 CW LEIDEN – NL  
The hotel is located in the Level Building next to Leiden Central Station and Leiden University Medical Center (LUMC).*

8.30-9.00	<i>Arrival and registration</i>
9.00-9.15	<b>Welcome and introduction</b> Chair: Christine Mummery (LUMC, the Netherlands)
9.15-9.45	<b>Organ-on-Chip Technology: State-of-the-Art</b> <u>Christine Mummery</u> (LUMC, the Netherlands)
9.45-10.15	<b>Building Blocks of the Organ-on-Chip Roadmap</b> <i>Role of the European Organ-on-Chip Society (EUROoCS)</i> Janny van den Eijnden-van Raaij (hDMT, the Netherlands)
10.15-10.45	<i>Coffee break</i>
10.45-11.15	<b>Unmet Needs, Key Challenges and Market Perspectives</b> <u>Massimo Mastrangeli</u> (TU Delft, the Netherlands) Sylvie Millet (CEA, France)
11.15-11.45	<b>Standardization, Regulation and Ethics</b> <u>Dries Braeken</u> /Wolfgang Eberle (imec, Belgium)
11.45-12.45	<i>Lunch</i>
12.45-13.15	<b>Economic Impact and Training</b> <u>Madalena Cipriano</u> /Peter Loskill (Fraunhofer IGB, Germany)
13.15-13.45	<b>Digital Platform and Community Building</b> <u>Nathalie Picollet-d'Hahan</u> /Xavier Gidrol (CEA, France)
13.45-14.15	<b>Awareness and Communication</b> <u>Luis Fernandez</u> /Ignacio Ochoa (Univ of Zaragoza, Spain)
14.15-15.15	<b>Future Perspectives</b> Discussion about opportunities to bridge the Valley of Death <u>Mart Graef</u> (TU Delft, the Netherlands)
15.15	<i>Closure and drinks</i>

## List of Participants

### **ORCHID Partners**

1. Dries Braeken (imec, Belgium)
2. Madalena Cipriano (Fraunhofer IGB, Germany)
3. Remco den Dulk (CEA, France)
4. Janny van den Eijnden-van Raaij (hDMT, the Netherlands)
5. Luis Fernandez (Univ. Zaragoza, Spain)
6. Astrid van de Graaf (hDMT, the Netherlands)
7. Mart Graef (TUD, the Netherlands)
8. Massimo Mastrangeli (TUD, the Netherlands)
9. Christine Mummery (LUMC, the Netherlands)
10. Nathalie Picollet-d'Hahan (CEA, France)
11. Mieke Schutte (hDMT, the Netherlands)
12. Ellen Thomassen (LUMC, the Netherlands)

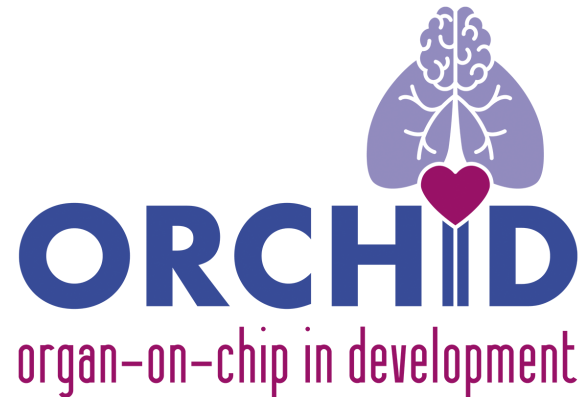
### **ORCHID Advisory Board**

13. Tony Bahinski (GSK, USA)
14. Jacqueline van Engelen (RIVM, the Netherlands)
15. Lorna Ewart (United Kingdom)
16. Torsten Mayr (Univ. of Graz, Austria)
17. Jens Schwamborn (Univ. Luxembourg, Luxembourg)
18. Pietro Siciliano (IMM-CNR, Italy)
19. Ioanna Zergioti (Nat. Tech. Univ of Athens, Greece)

### **Other Stakeholders**

20. Sonja Beken (Federal agency for medicines and health products, Belgium)
21. Ngoc Berris-Pham (Transition Animal-free Innovation, the Netherlands)
22. Peter-Paul van Benthem (Federation Medical Specialists, the Netherlands)
23. Patrick Boisseau (MedTech, CEA, France)
24. Milton Bonelli (EMA, the Netherlands)
25. Lissa Boxy (Innovation Quarter the Hague, the Netherlands)
26. Sandra Coecke (ECVAM, Italy)
27. Patrick Courtney (Association Consortium Standardization in Lab Automation, SiLA, Switzerland)
28. Reyk Horland (Tissuse Berlin, Germany)
29. Stefan Krauss (Institute of Basic Medical Sciences, Univ of Oslo, Norway)
30. Niels van Leeuwen (Dutch Enterprise Agency, the Netherlands)
31. Andreas Lymberis (DG Connect, European Commission, Belgium)
32. Terry McCann (TJM Consultancy, United Kingdom)
33. Amélie Moreau (Servier/EFPIA, France)
34. Debby Weijers (Dutch Society for the Replacement of Animal Testing (dsRAT), the Netherlands)
35. Rosário Zincke Dos Reis (Alzheimer Portugal, Portugal)

# WELCOME AND INTRODUCTION



## Emerging successes and showcases

*Christine Mummary*



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884".*

## Introduction OoC technology

### THE PROBLEM

- No drugs for many chronic diseases
- Existing drugs do not work in all patients
- Drug side effects are the 4<sup>th</sup> leading cause of death
- Health risks of environmental factors, food, cosmetics rely on animal models

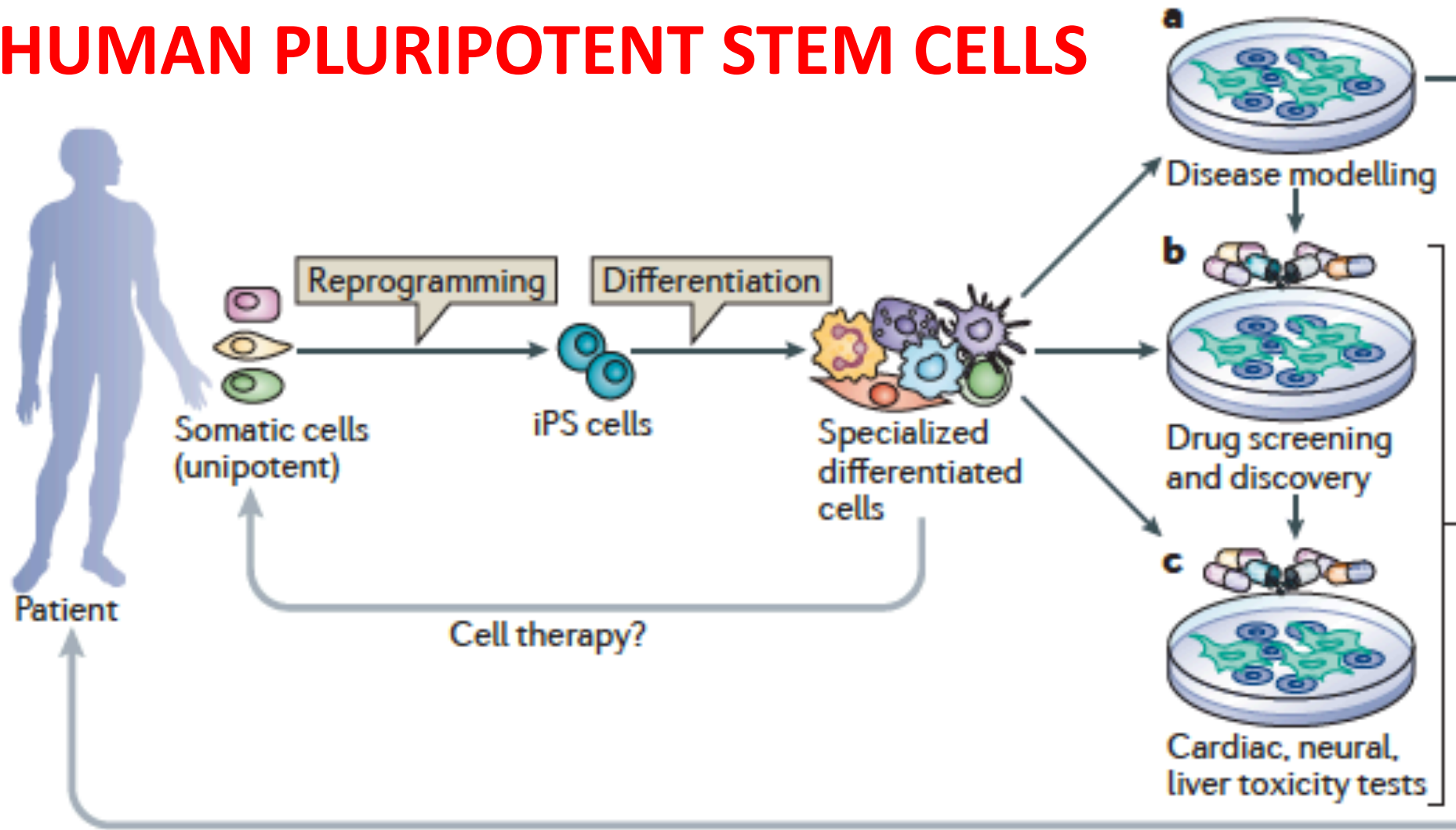
### WHY?

- There are few validated models for the human body or tissues
- Poor insight into *human* disease mechanisms
- Lack of personalized treatment prediction
- Animals are poorly predictive for *humans*

heart, immune system, brain, reproductive system, stomach....

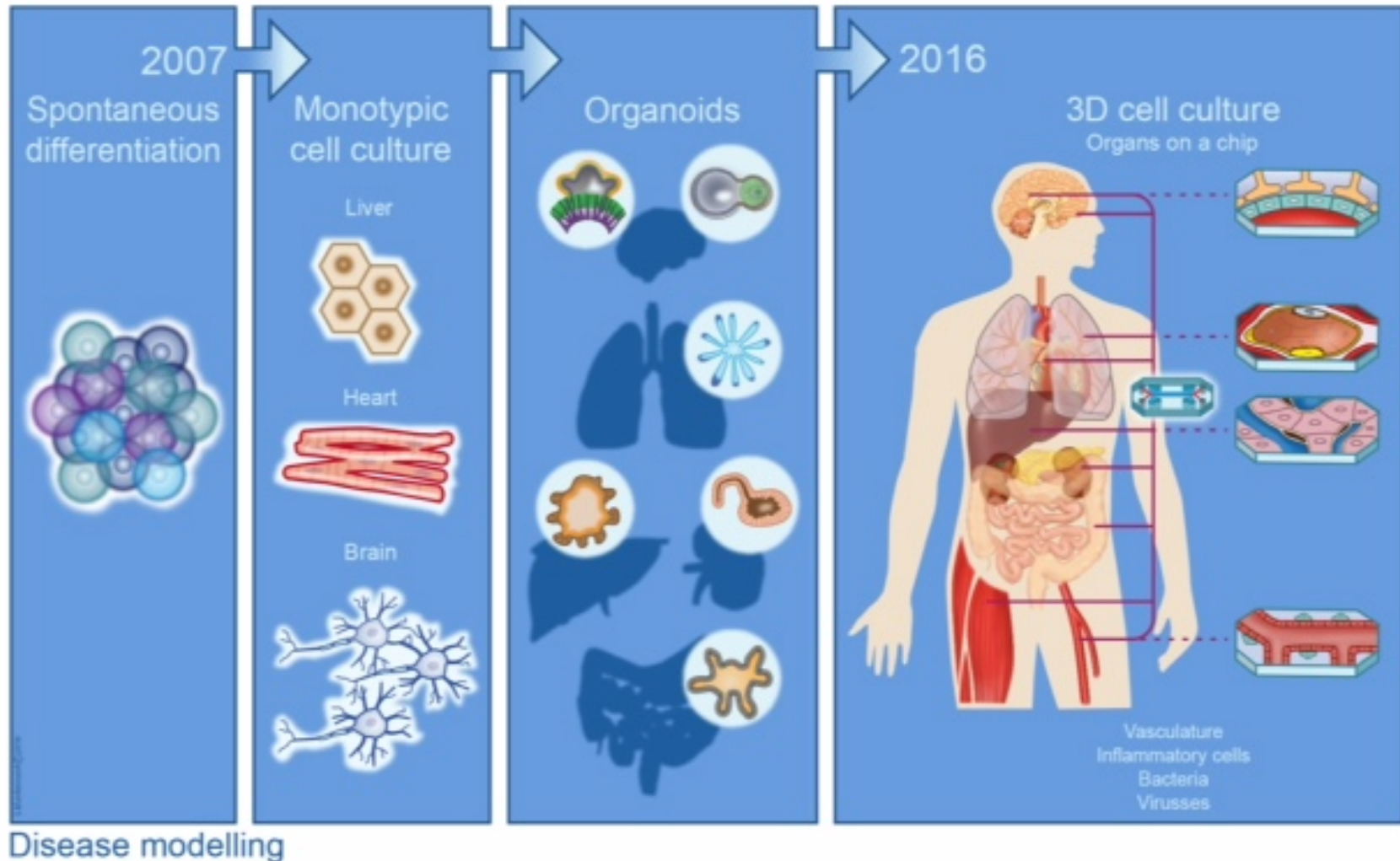


# HUMAN PLURIPOTENT STEM CELLS



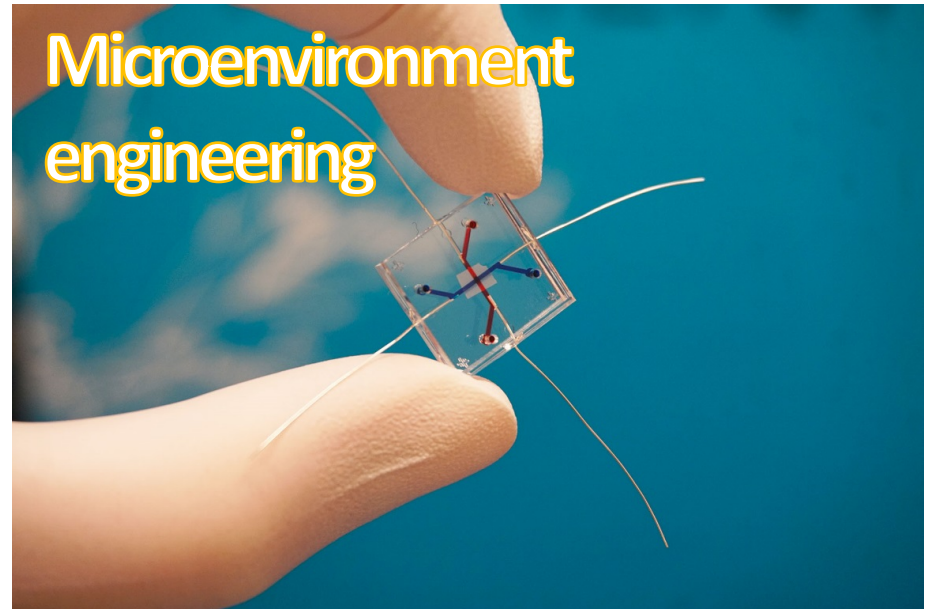
## Introduction OoC technology

# EVOLUTION OF hiPSC IN DISEASE MODELLING



# Organs-on-Chips : microphysiological systems

- Microfluidic devices
- Human- cells and tissues
- Physiological realism
- Design by 'microenvironment engineering'

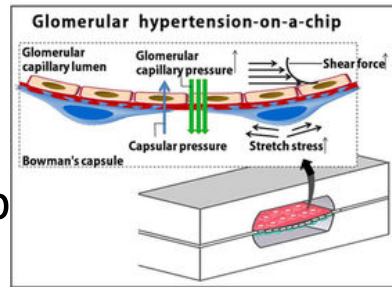


## SHORTCOMINGS OF hiPSC MODELS

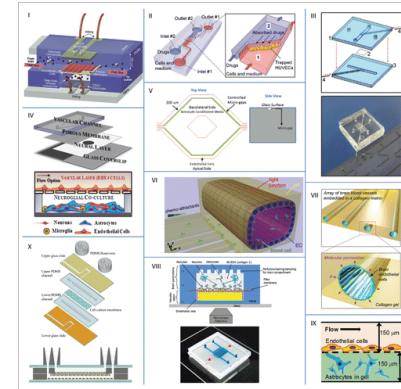
- Differentiated cells are immature so adult tissues, organs and diseases are difficult to model
- Most high throughput screens are in 2D, not 3D
- Most models lack vascular flow, physiological tissue elasticity and mechanical constraints or stimuli

# ORGANS-ON-CHIP UNDER DEVELOPMENT

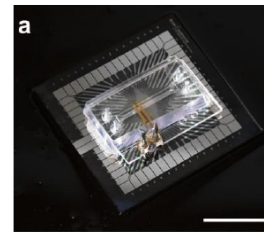
- Lung-on-chip
  - Alveolus
  - Small airway
- Gut-on-chip
  - Small intestine
  - Colon
- Blood-brain-barrier-on-chip
- Kidney-on-chip
  - Proximal tubule
  - Glomerulus
- Heart-on-chip
- Liver-on-chip
- Skin-on-chip
- Eye-on-chip
  - Cornea
  - Retina
- Bone marrow-on-chip
- Pancreas-on-chip
- Cancer-on-chip



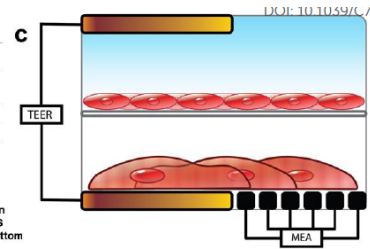
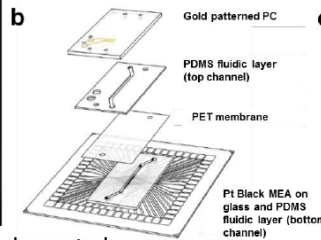
Zhou, Lin, et al.  
Also: Musah, Ingber, et al.



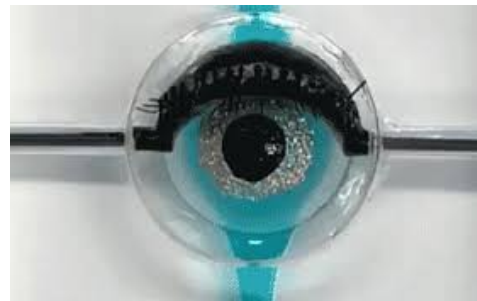
Van der Helm, Van der Meer, Segerink, et al.



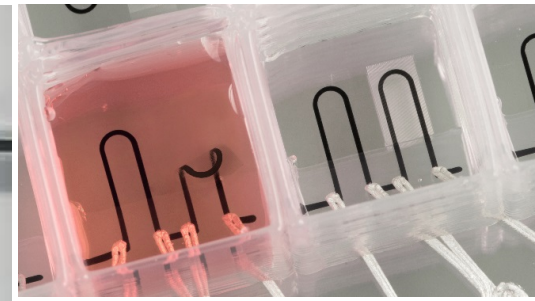
Maoz, Henry, Parker, Ingber, et al.



**SOLUTIONS  
REQUIRE  
MULTIDISCIPLINARY  
NETWORKS**



Huh, et al. UPenn.



Lewis, Parker, Ingber, et al.



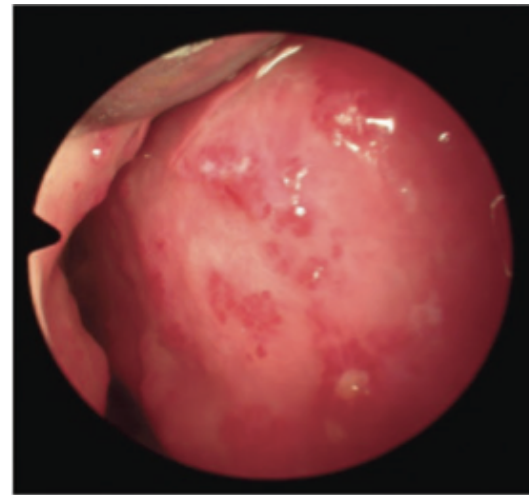
# Example of why OoC are essential for modelling some diseases

## MODELLING VASCULAR DISEASE USING hiPSC IN ORGAN-ON-CHIP

- Hereditary hemorrhagic telangiectasia (HHT): weak blood vessels
- autosomal dominant mutation in TGF $\beta$ - signal transduction genes affecting 1 in 5,000 individuals



Brouillard, P., & Vikkula, M.  
*Human molecular genetics*, 2007



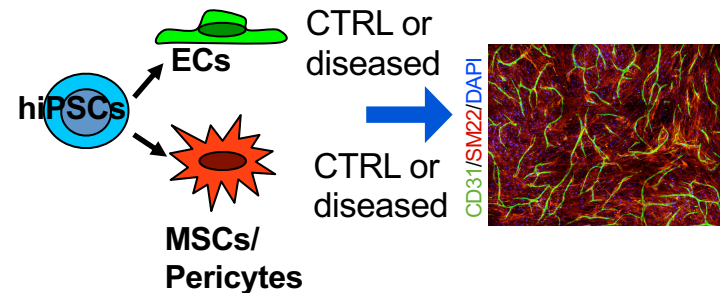
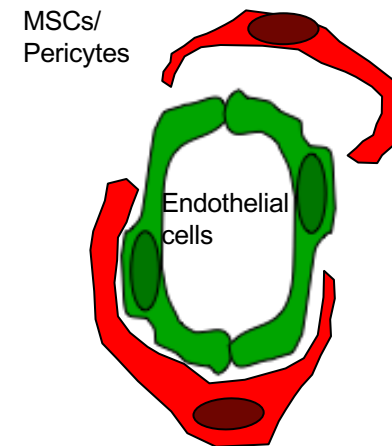
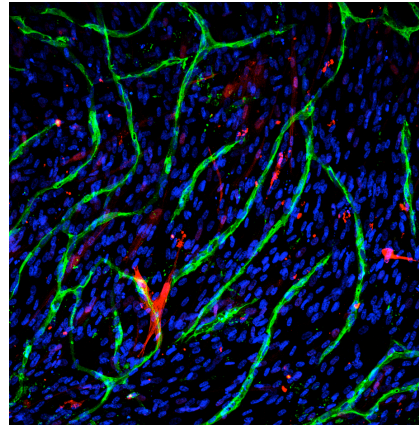
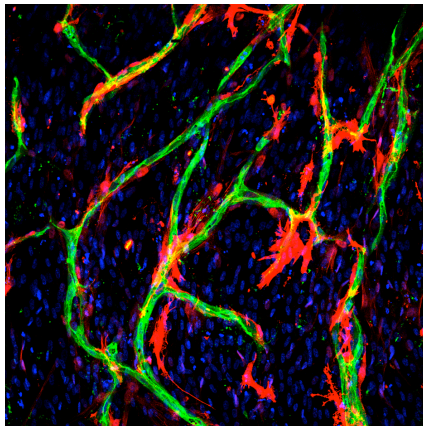
Goumans, M.-J. & Dijke, ten, P.  
*Cell Research*, 2009  
nasal telangiectases (courtesy of Dr U Geithoff)

# CO-CULTURES OF hPSC ENDOTHELIAL CELLS AND PERICYTES

day 7

DAPT

PECAM1/SM22/DAPI



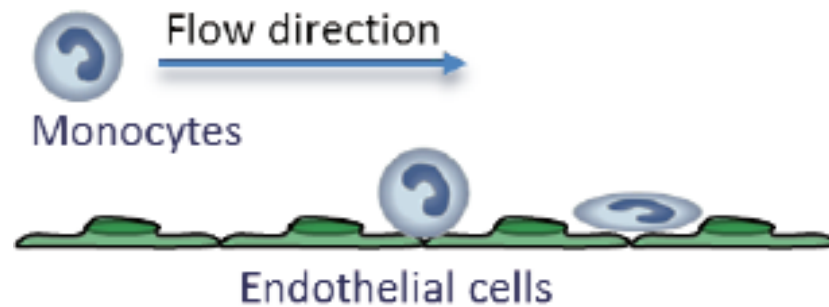
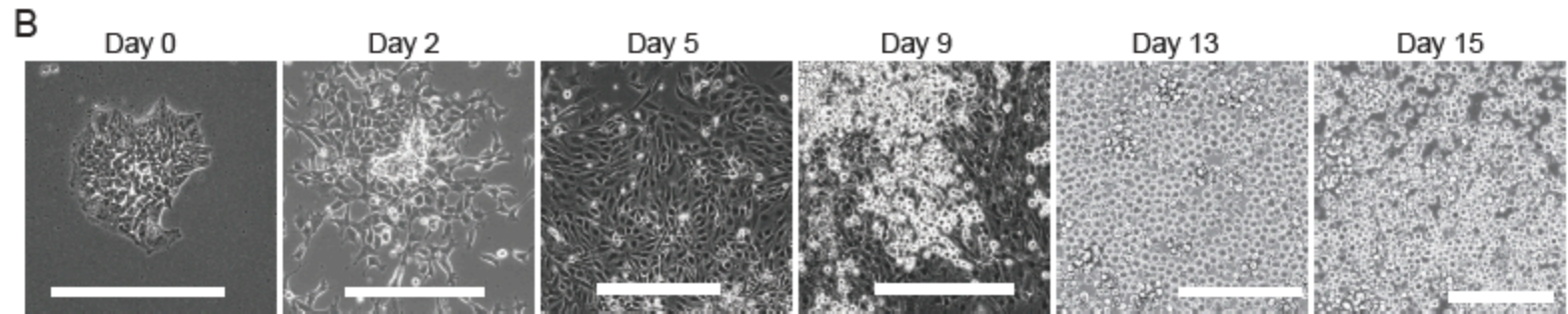
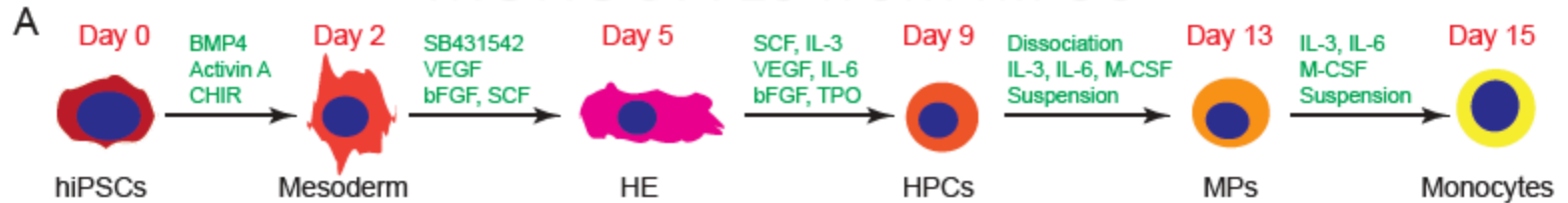
DAPT  
( $\gamma$ -secretase inhibitor)

NOTCH

CADASIL: genetic disease caused by defective Notch signalling

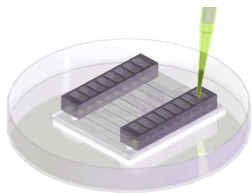
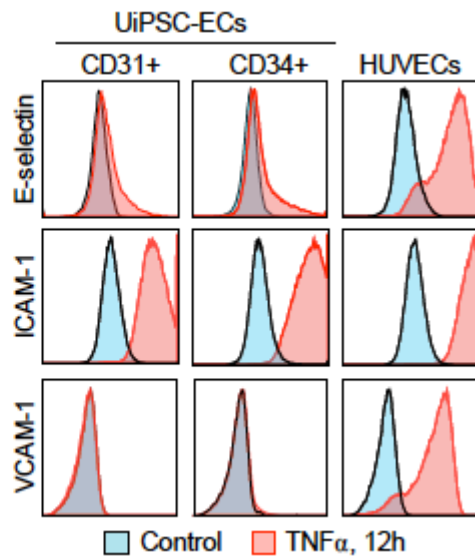
Orlova et al., ATVB, 2013, Nat Protocols 2014

# MONOCYTES from hiPSC

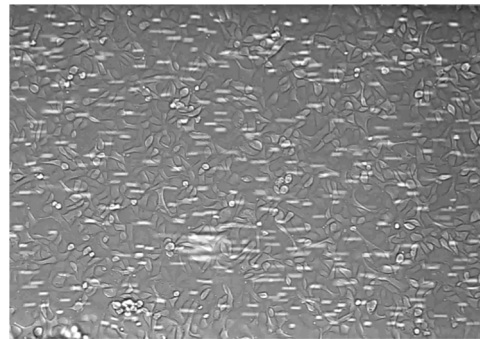




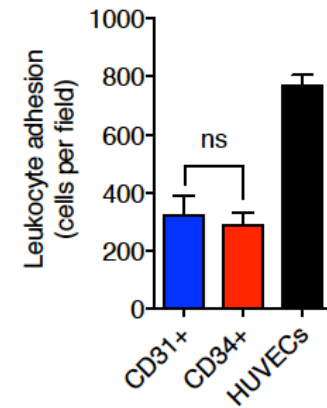
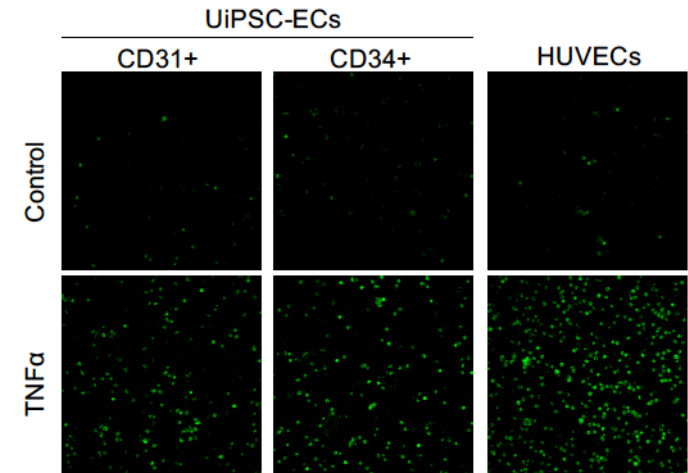
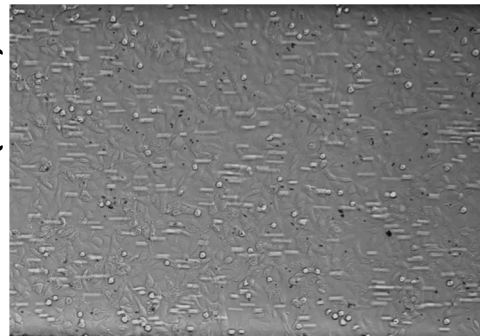
# INFLAMMATORY CYTOKINES: LEUKOCYTE ADHESION UNDER FLUID FLOW



untreated

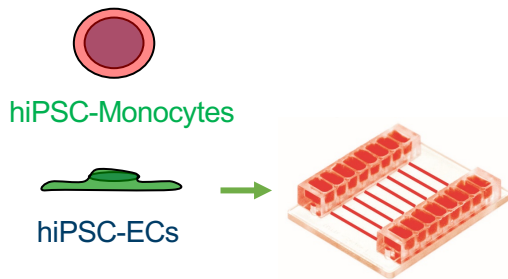


TNF $\alpha$  (12h)

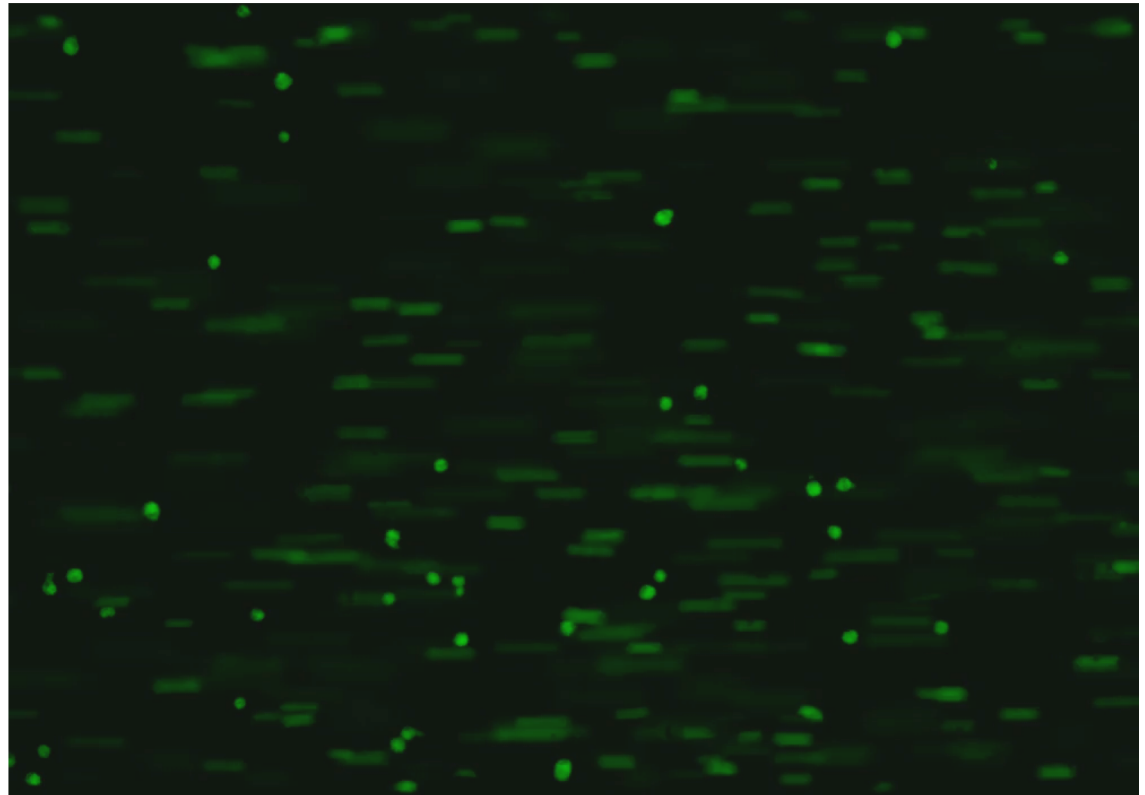


O. Halaidych, V. Orlova et al, Stem Cell Reports 2019

# MODELLING INFLAMMATION WITH HHT1-iPSCs ECs AND MONOCYTES



TNF $\alpha$  (12h)



hPSC-ECs + hiPSC-Monocytes  
0.5dynes/cm<sup>2</sup>

V. Orlova, X. Cao

# ORGAN-ON-CHIP SHOWCASE

## HHT phenotype recapitulated in 3D in organ-on-chip

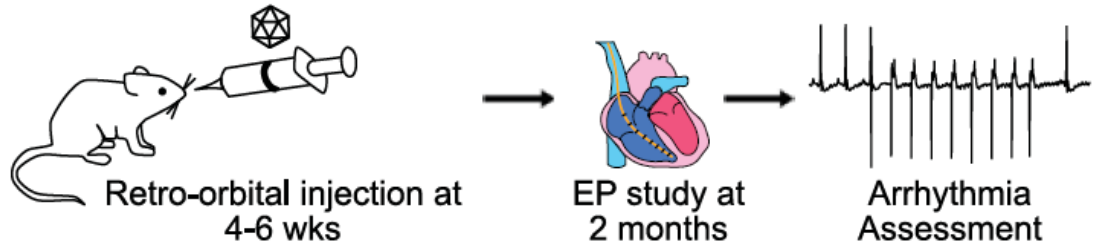
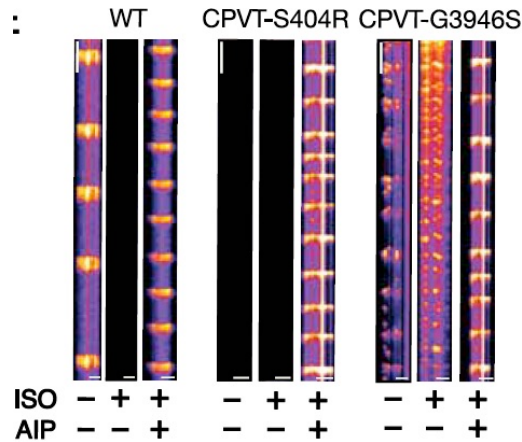
- Abnormal proliferation of mutant hiPSC endothelial cells
- Abnormal interaction between ECs and pericytes/smooth muscle cells
- Abnormal behaviour of macrophages
- Only evident in 3D Organ-on-chip formats

# ORGAN-ON-CHIP SHOWCASE

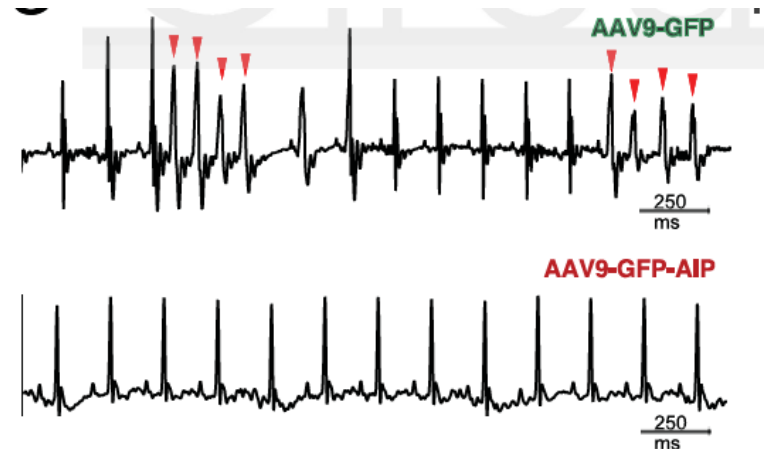
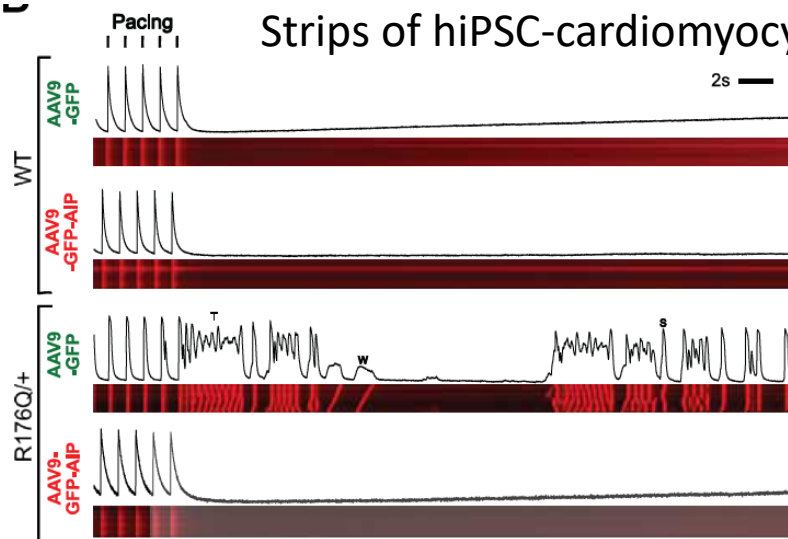
Gene Therapy for Catecholaminergic Polymorphic Ventricular Tachycardia by Inhibition of  $\text{Ca}^{2+}$ /Calmodulin-Dependent Kinase II Lab: W. Pu, Harvard

<https://doi.org/10.1161/CIRCULATIONAHA.118.038514>

Heart-on-Chip : calcium waves



Strips of hiPSC-cardiomyocytes



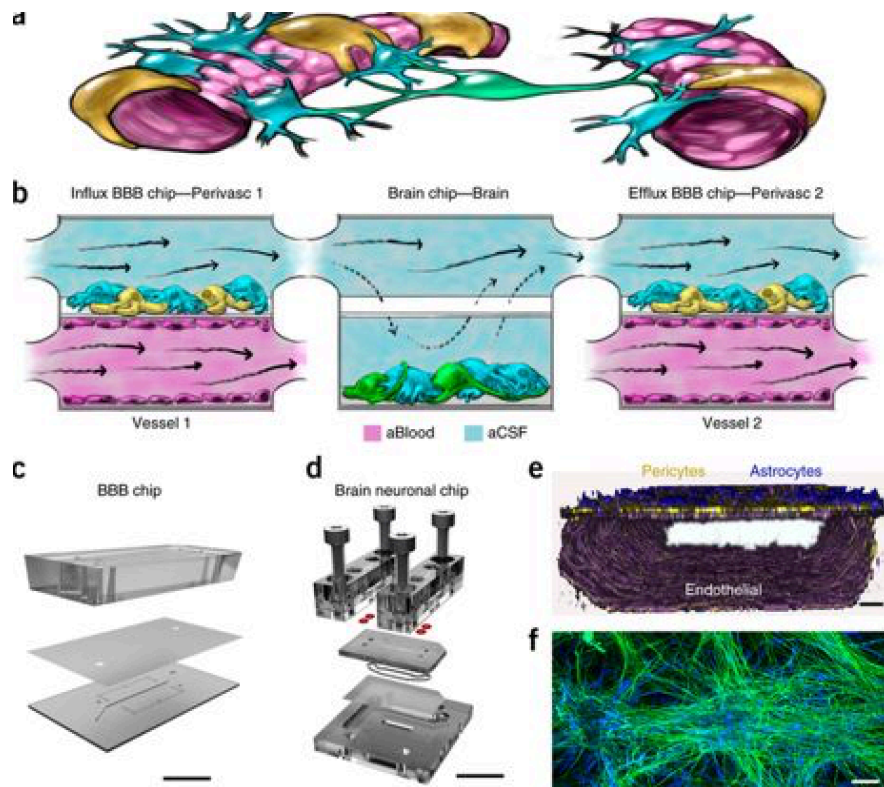
# ORGAN-ON-CHIP SHOWCASE

**A linked organ-on-chip model of the human neurovascular unit reveals the metabolic coupling of endothelial and neuronal cells.**

Maoz BM, Herland A....Ingber DE, Parker KK Nat Biotechnol. 2018; 36(9):865-874

**Increased synapse elimination in schizophrenia patient-derived models of synaptic pruning**

Sellgren CM, Gracias J...Sheridan SD, Perlis RH Nat Neurosci. 2019 22(3):374-385.



...microglia in the cell models were “treated” with an antibiotic, minocycline, which proved to inhibit the synaptic pruning. By then using electronic data records from more than 20,000 individuals who had received either minocycline or another antibiotic during adolescence, for treatment of acne, they were able to demonstrate a clear protective effect from minocycline treatment in relation to schizophrenia onset.

# OTHER ORGAN-ON-CHIP SHOWCASES

[Translational Assessment of Drug-Induced Proximal Tubule Injury Using a Kidney Microphysiological System.](#) Maass C, Sorensen NB, Himmelfarb J, Kelly EJ, Stokes CL, Cirit M. CPT Pharmacometrics Syst Pharmacol. 2019;8(5):316-325.

[Interconnected Microphysiological Systems for Quantitative Biology and Pharmacology Studies.](#) Edington CD, Chen WLK, ... Cirit M, Griffith LG. Sci Rep. 2018 14;8(1):4530

[Integrated Assessment of Diclofenac Biotransformation, Pharmacokinetics, and Omics-Based Toxicity in a Three-Dimensional Human Liver-Immunocompetent Coculture System.](#) Sarkar U, Ravindra KC, Large E, Young CL, Rivera-Burgos D, Yu J, Cirit M, Hughes DJ, Wishnok JS, Lauffenburger DA, Griffith LG, Tannenbaum SR. Drug Metab Dispos. 2017;45(7):855-866.

# IS IT POSSIBLE TO MEASURE PK/PD RELATIONSHIPS?

[Physiologically Based Pharmacokinetic and Pharmacodynamic Analysis Enabled by Microfluidically Linked Organs-on-Chips.](#) Prantil-Baun R, Novak R, Das D, Somayaji MR, Przekwas A, Ingber DE. Annu Rev Pharmacol Toxicol. 2018 58:37-64.

[A microfluidic device for a pharmacokinetic-pharmacodynamic \(PK-PD\) model on a chip.](#) Sung JH, Kam C, Shuler ML. Lab Chip. 2010 10(4):446-55.

[Multi-functional scaling methodology for translational pharmacokinetic and pharmacodynamic applications using integrated microphysiological systems \(MPS\).](#) Maass C, Stokes CL, Griffith LG, Cirit M. Integr Biol (Camb). 2017 Apr 18;9(4):290-302.

[A pumpless multi-organ-on-a-chip \(MOC\) combined with a pharmacokinetic-pharmacodynamic \(PK-PD\) model.](#) Lee H, Kim DS, Ha SK, Choi I, Lee JM, Sung JH. Biotechnol Bioeng. 2017;114(2):432-443.

[On the potential of in vitro organ-chip models to define temporal pharmacokinetic-pharmacodynamic relationships.](#) McAleer CW, Pointon A, ..., Williams D, Schnepfer MT, Roles JL, Shuler ML, Hickman JJ, Ewart L. Sci Rep. 2019 ;9(1):9619.

[Integrated Gut and Liver Microphysiological Systems for Quantitative In Vitro Pharmacokinetic Studies.](#) Tsamandouras N, Chen WLK, Edington CD, Stokes CL, Griffith LG, Cirit M. AAPS J. 2017;19(5):1499



# Organ-on-Chip

## Roadmap Building blocks

*Role of the European Organ-on-Chip Society (EUROoCS)*

*Janny van den Eijnden-van Raaij*  
*Managing Director **h**DMT*

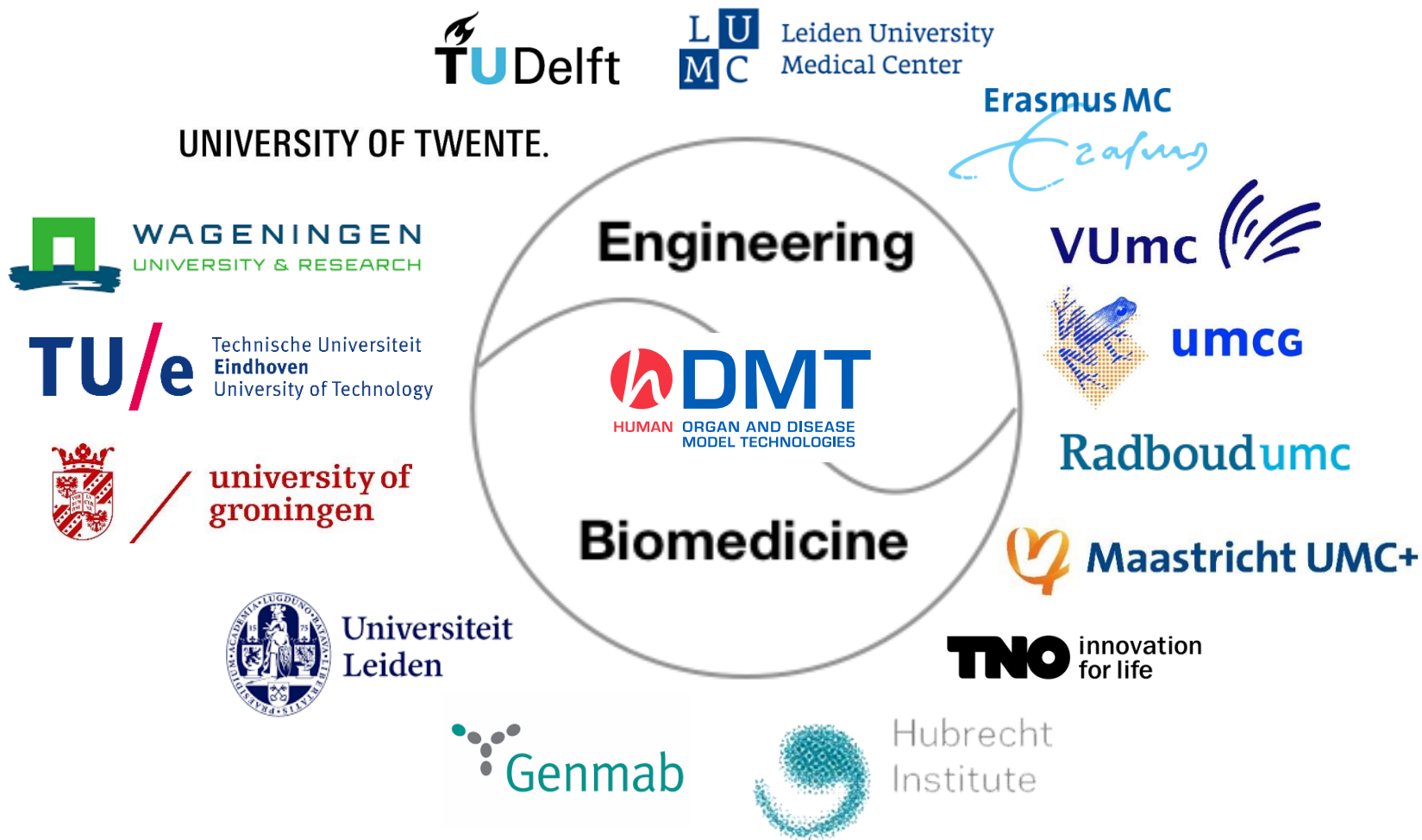
*ORCHID final meeting*  
*Leiden, 23 September 2019*



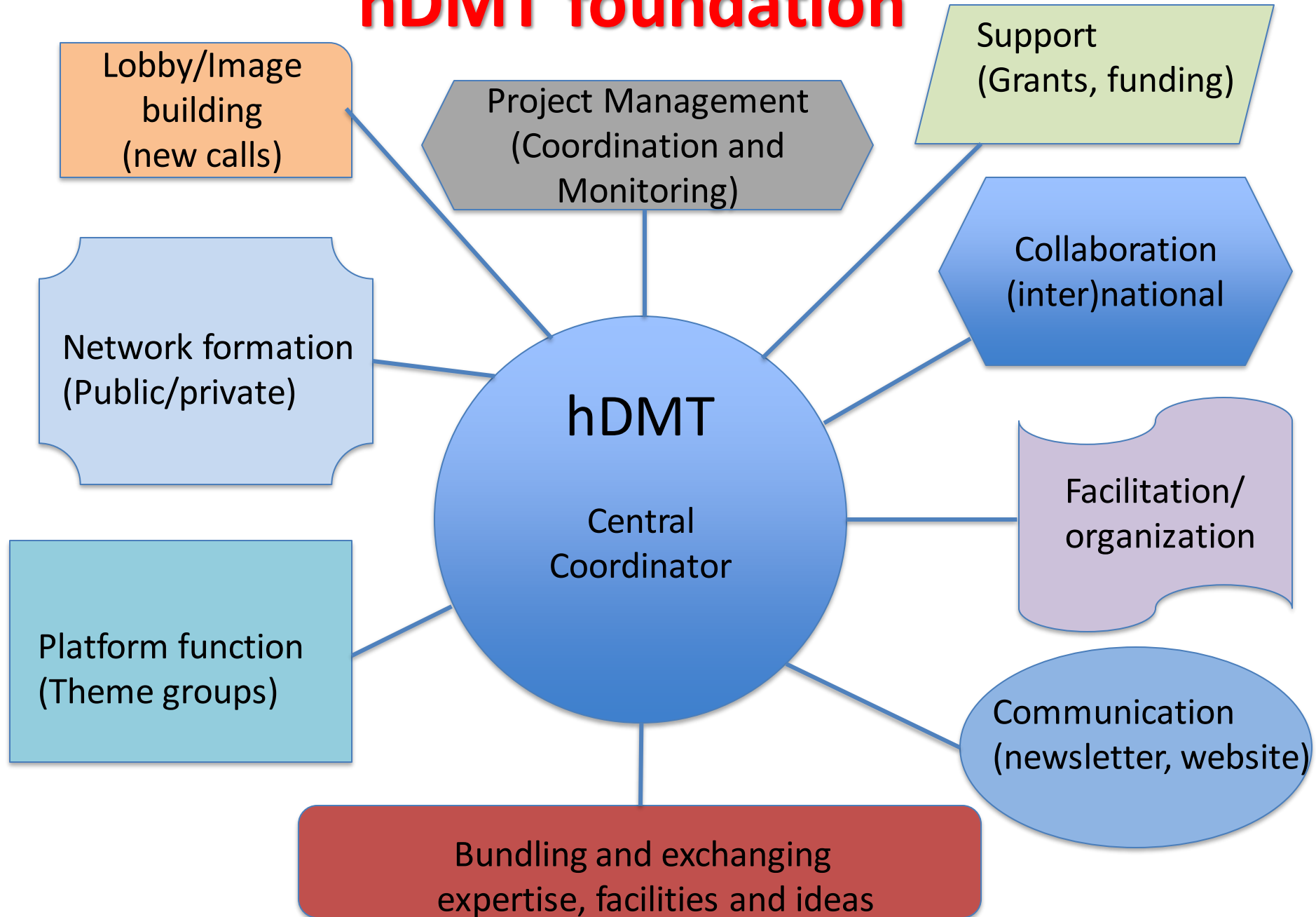


# Organ-on-chip Consortium

*Bottom-up initiative since 2015*



# hDMT foundation



# NOCI - NETHERLANDS ORGAN-ON-CHIP INITIATIVE



Mummyery



Clevers



Wijmenga



Ferrari



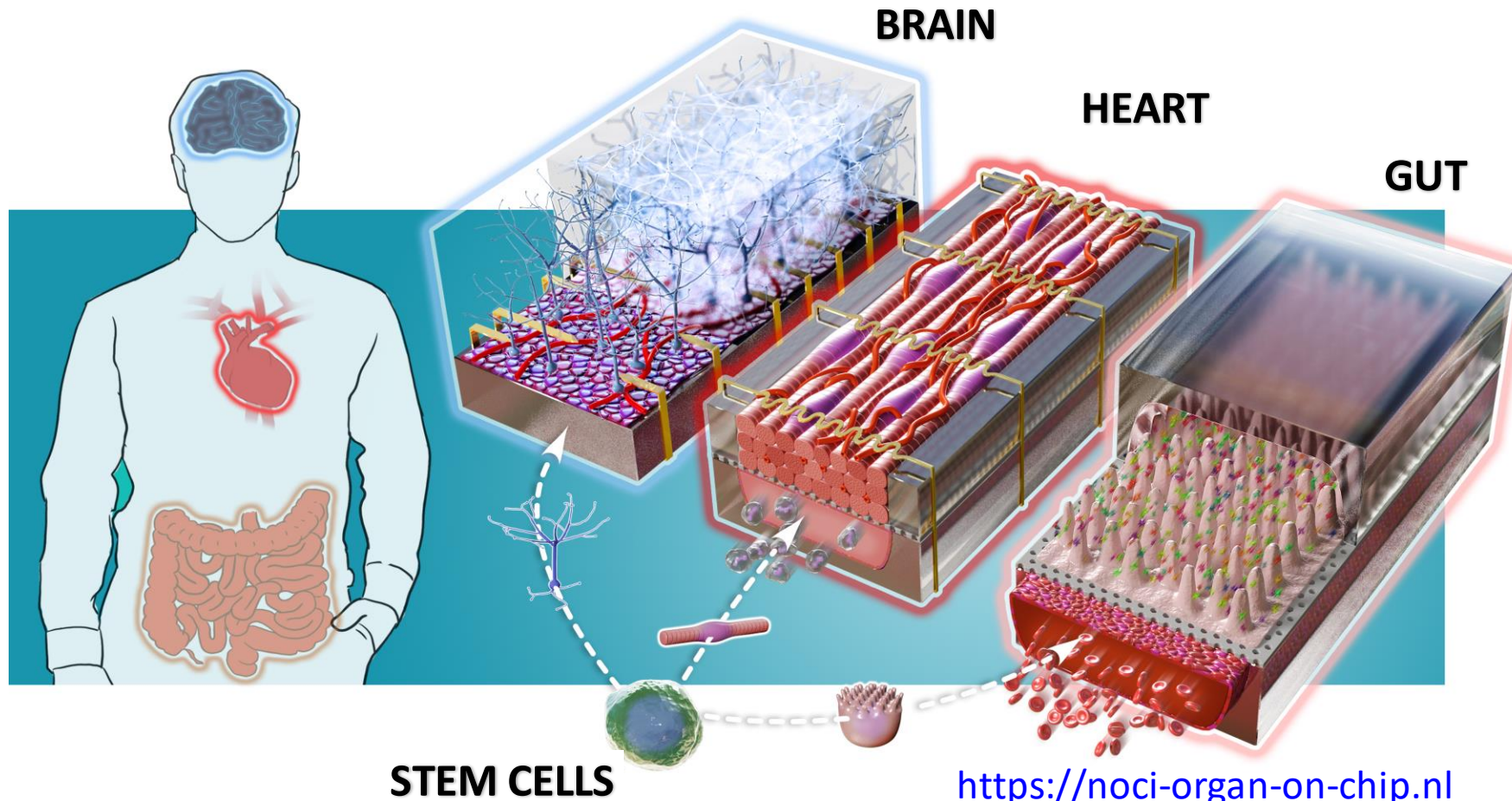
Sarro



vd Berg



Kushner



# ORCHID - ORgan-on-CHip In Development

H2020 Future and Emerging Technologies (FET-open-03) program  
CSA Coordination and Support Action (2 yr, 0.52M, start 1 October 2017)



## Goal:

1. Build a network/community of academia, research institutes, industry, regulatory bodies, patient organizations, .....
2. Create a roadmap for Organ-on-Chip technology
3. Raise awareness by dissemination and communication



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884.*

[www.H2020-orchid.eu](http://www.H2020-orchid.eu)





# Community Building

## European Organ-on-Chip network



### Partners

Austria (Univ of Technology Graz, Vienna)  
Belgium (IMEC)  
Denmark (Univ. Kopenhagen)  
Finland (Biomeditech Tampere)  
France (CEA-LETI, CNRS)  
Germany (Fraunhofer, UMC Hamburg, Tissuse, Jena Univ Hosp, TU Berlin, NMI, U Tübingen)  
Greece (Nat. Techn Univ of Athens)  
Italy (IMM-CNR, IPN-CNR, IFN-CNR)  
Luxembourg (Univ)  
Norway (Univ of Oslo)  
Portugal (Univ of Coimbra)  
Spain (Univ of Zaragoza)  
Sweden (Uppsala Univ, Karolinska)  
Switzerland (EPFL, Univ of Bern, ETH Zürich)  
The Netherlands (hDMT)  
United Kingdom (UK Organ-on-a-chip Network)  
and more partners to come.....

*Towards a European Center of Excellence on human **Organs-on-Chips**  
By creating strong research collaborations throughout Europe and beyond*



# EUROOCS

EUROPEAN ORGAN-ON-CHIP SOCIETY

[www.euroocs.eu](http://www.euroocs.eu)





EUROPEAN ORGAN-ON-CHIP SOCIETY

## Member benefits

- enjoy discounted registration fee for the Annual Conference
- have exclusive access to the digital platform and forum
- share latest results and news
- find and connect with experts in the field
- receive regular updates on latest developments through our newsletter
- profit from the upcoming EUROOCS Journal

[www.euroocs.eu](http://www.euroocs.eu)

First Board



JOIN  
**EUROOCS**  
TODAY

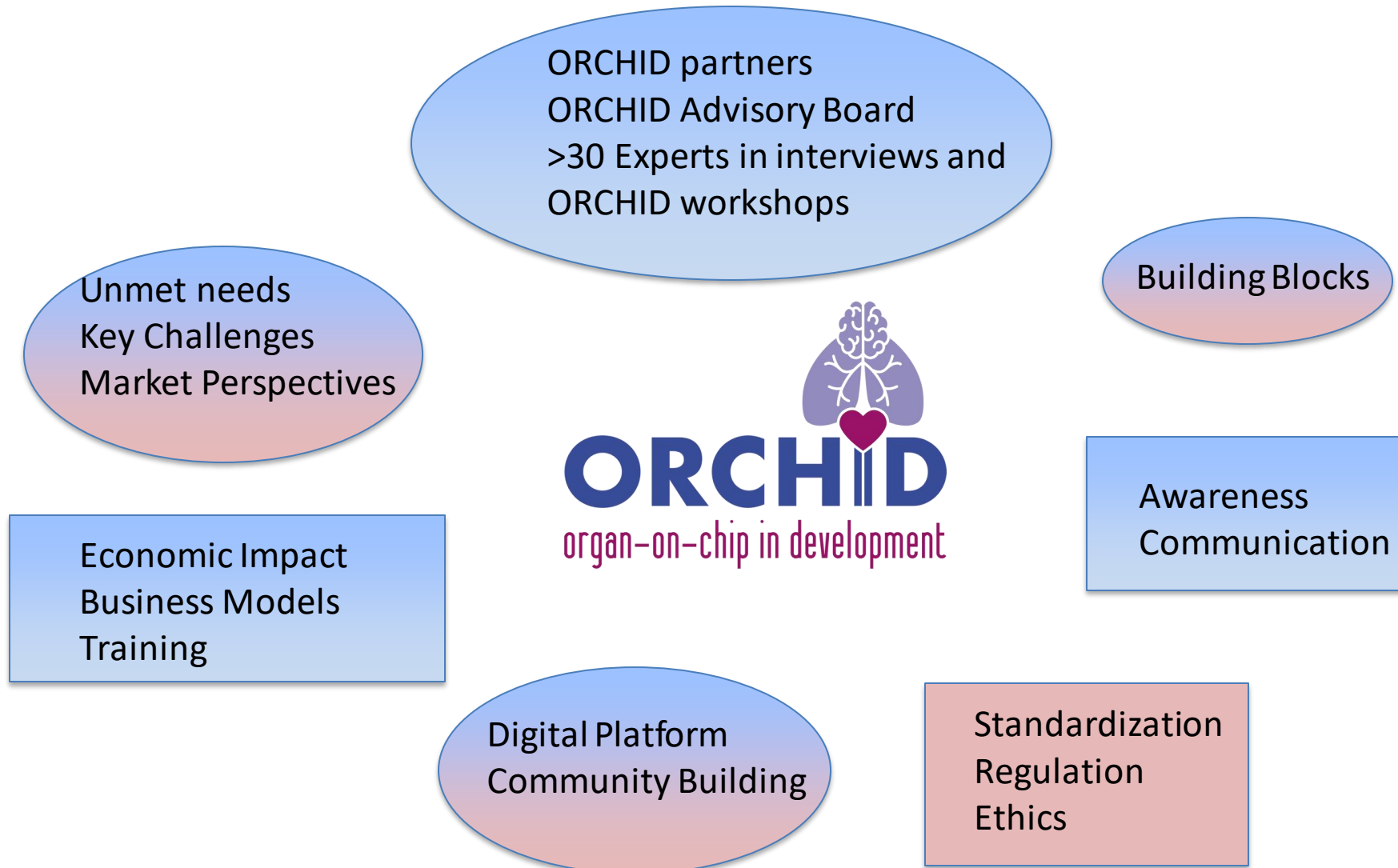
Since 5 November 2018

# Stay tuned and join Organ-on-Chip Society



# Developing the roadmap

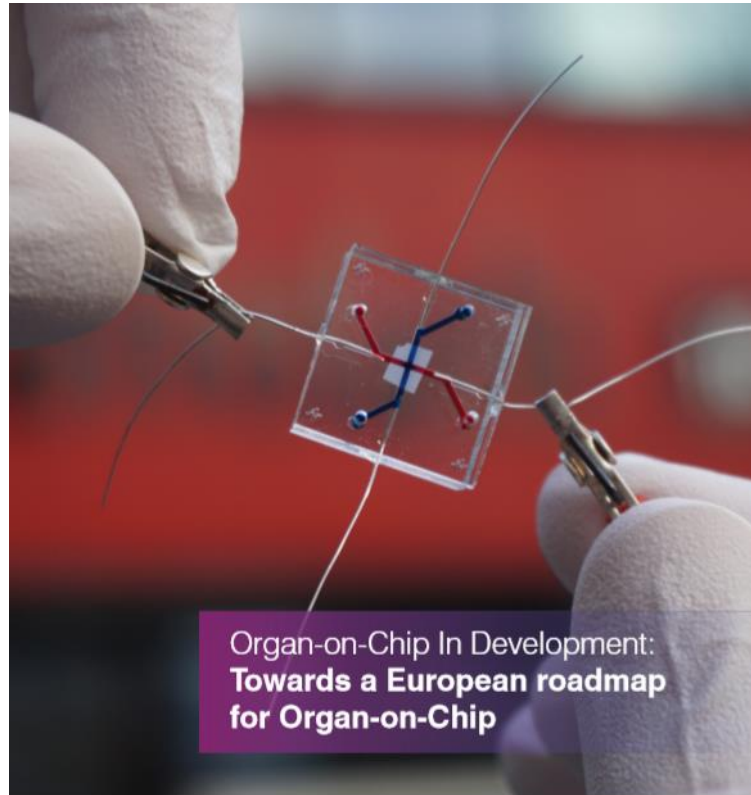
## A joint effort





# ORCHID brochures

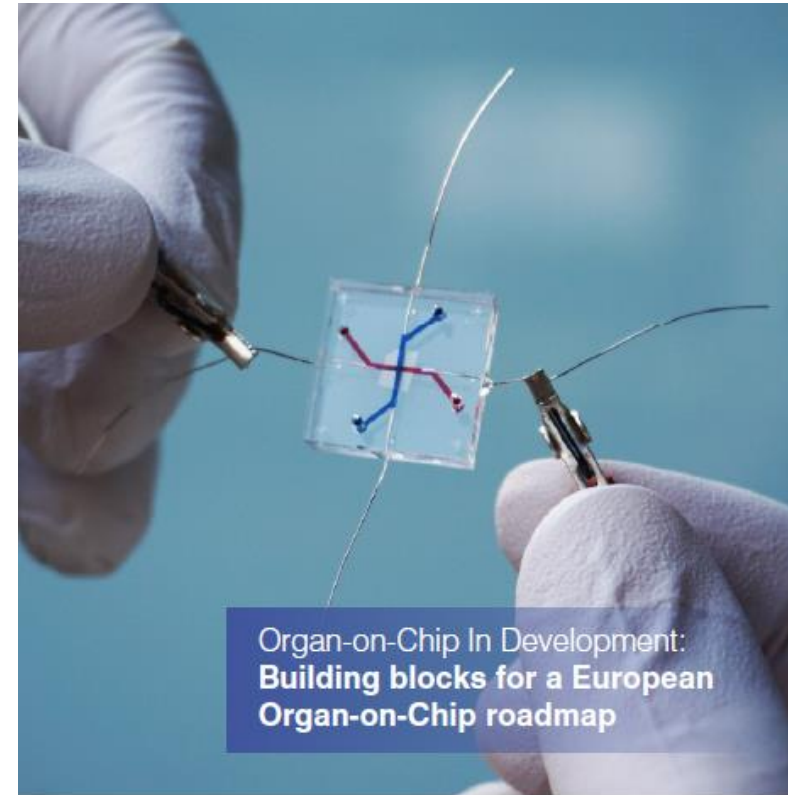
## *Vision workshop*



DOI: 10.14573/altex.1908271



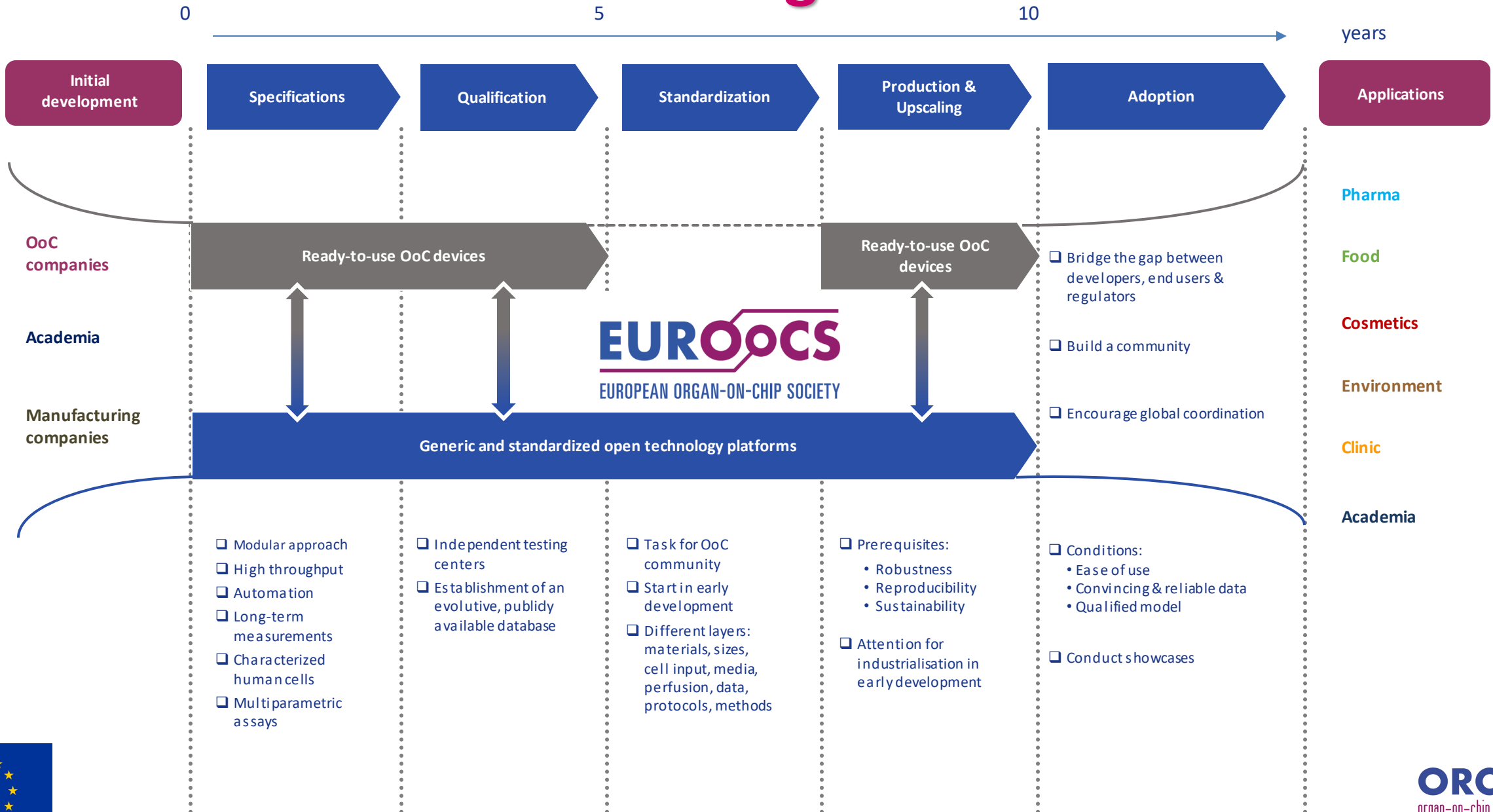
## *Strategy workshop*



DOI: 10.14573/altex.1905221



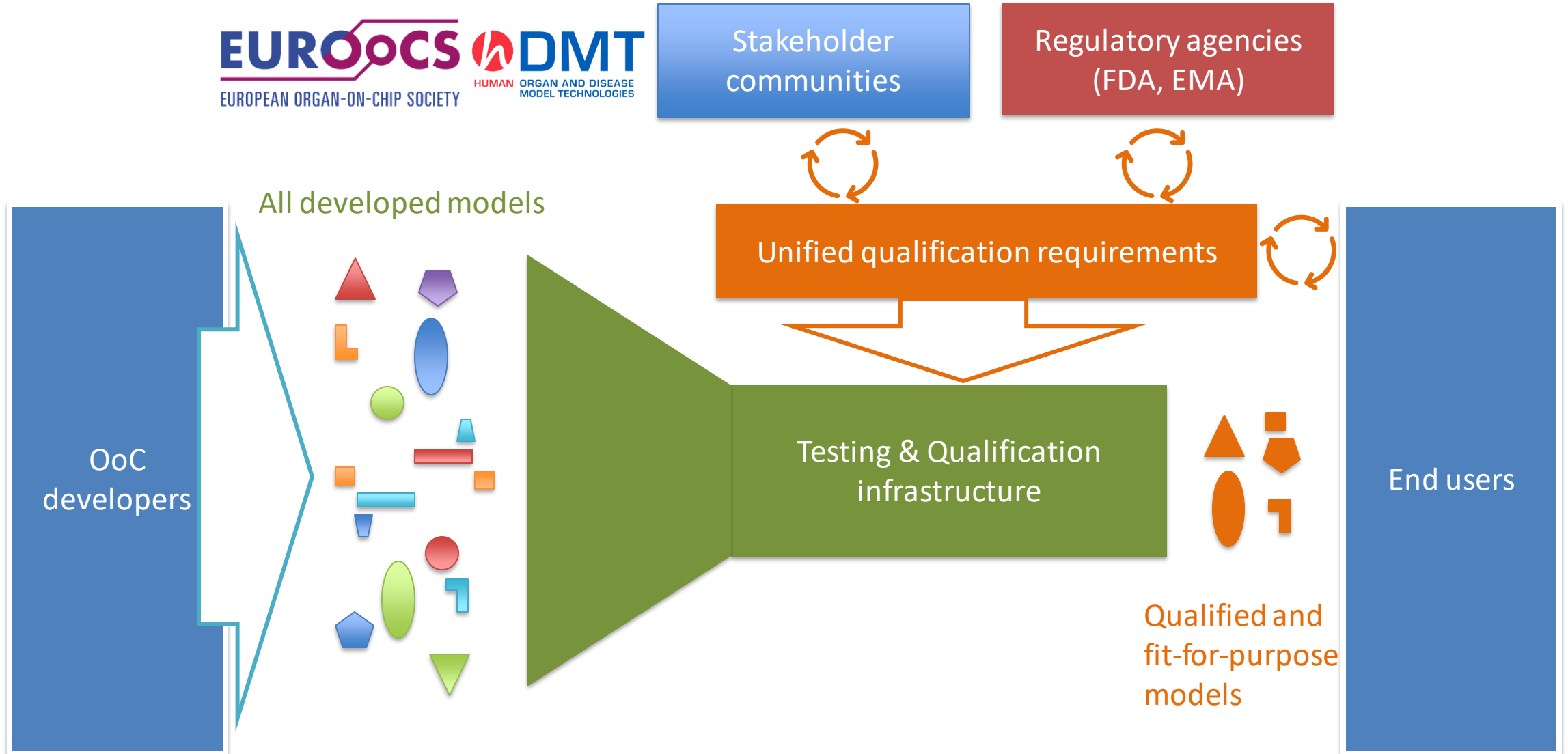
# The Building Blocks





# Qualification

*Bridging the gap between developers and end users*





Input

Standardized  
Qualification  
/ Testing  
Methodology

**CENTER 1**  
Upgrade from iPSC Hotel

# EOCI

Activities:

- Protocol development
- Standard methodology development
- Training

**CENTER 2**  
Upgrade to OoC Models

Activities:

- Standardized testing
- Model analysis
- Qualification

**CENTER 3**  
Virtual



Wide variety of protocols, devices, etc.

Portal

Standardized technology transfer:  
Protocols (& devices)

Reproducible testing

Standardized technology transfer:  
Data

End users/Industry

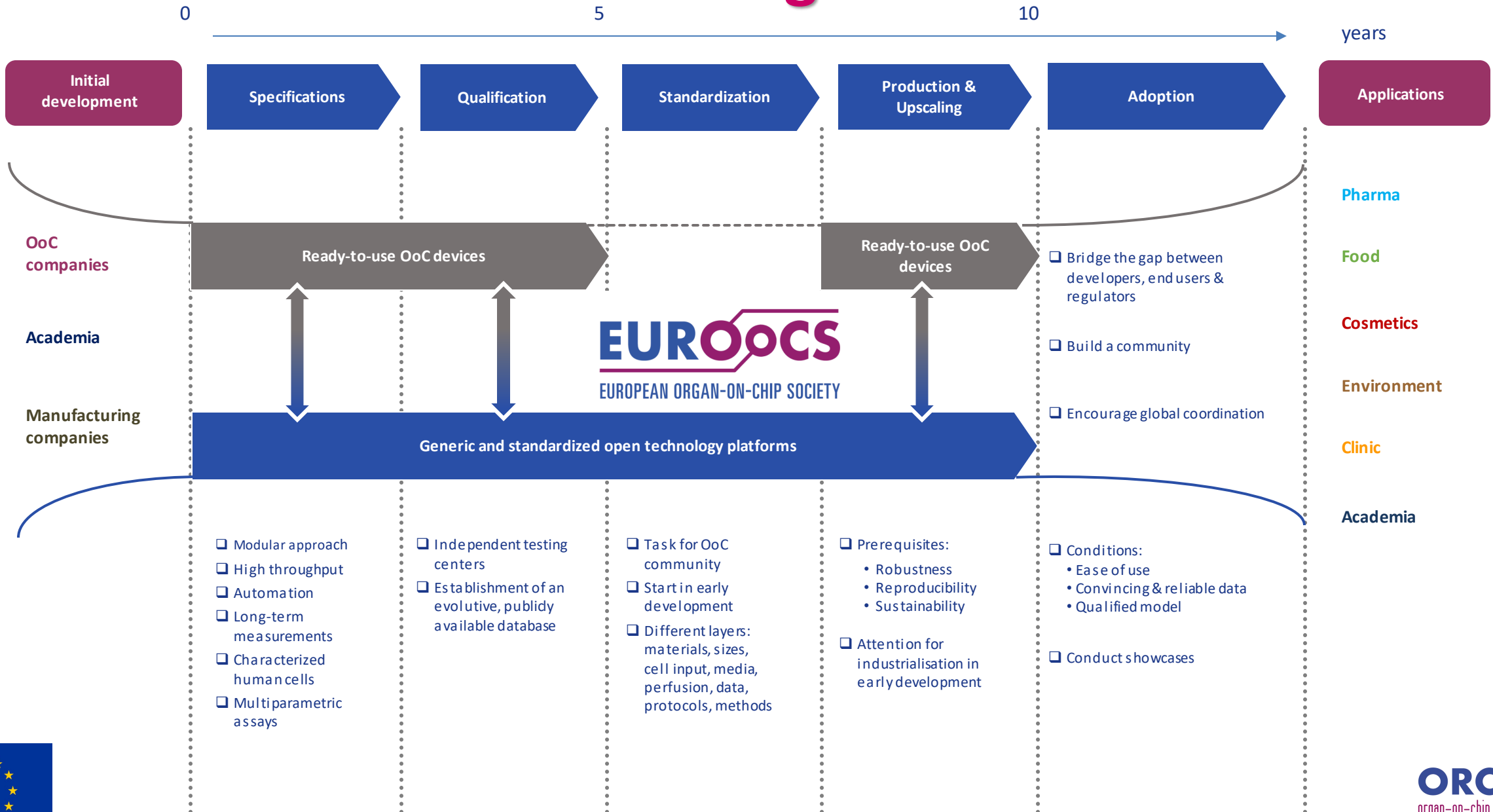
Autonomous  
center

Autonomous  
center



EU infrastructure

# The Building Blocks



# Beyond ORCHID

## Role of EUROoCS





# Future Events



<https://www.micronanoconference.org>



**EUROOCS**  
**CONFERENCE 2020** **UPPSALA, SWEDEN**  
**Early July 2020**

Transition Animal-free Innovation



Pioneer-2-Policymaker  
Conference 27-29 Nov 2019  
Utrecht, the Netherlands



# Thank you!

THANKS TO ALL WHO CONTRIBUTED TO



AND TO ALL WHO WILL CONTRIBUTE TO



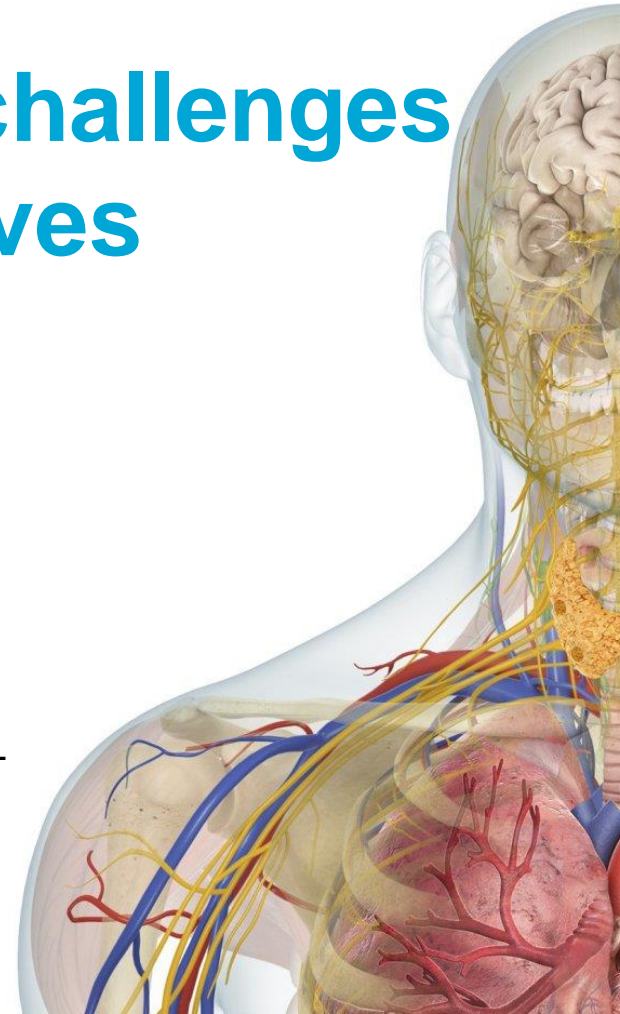


# Unmet needs, key challenges & market perspectives in organs-on-chip

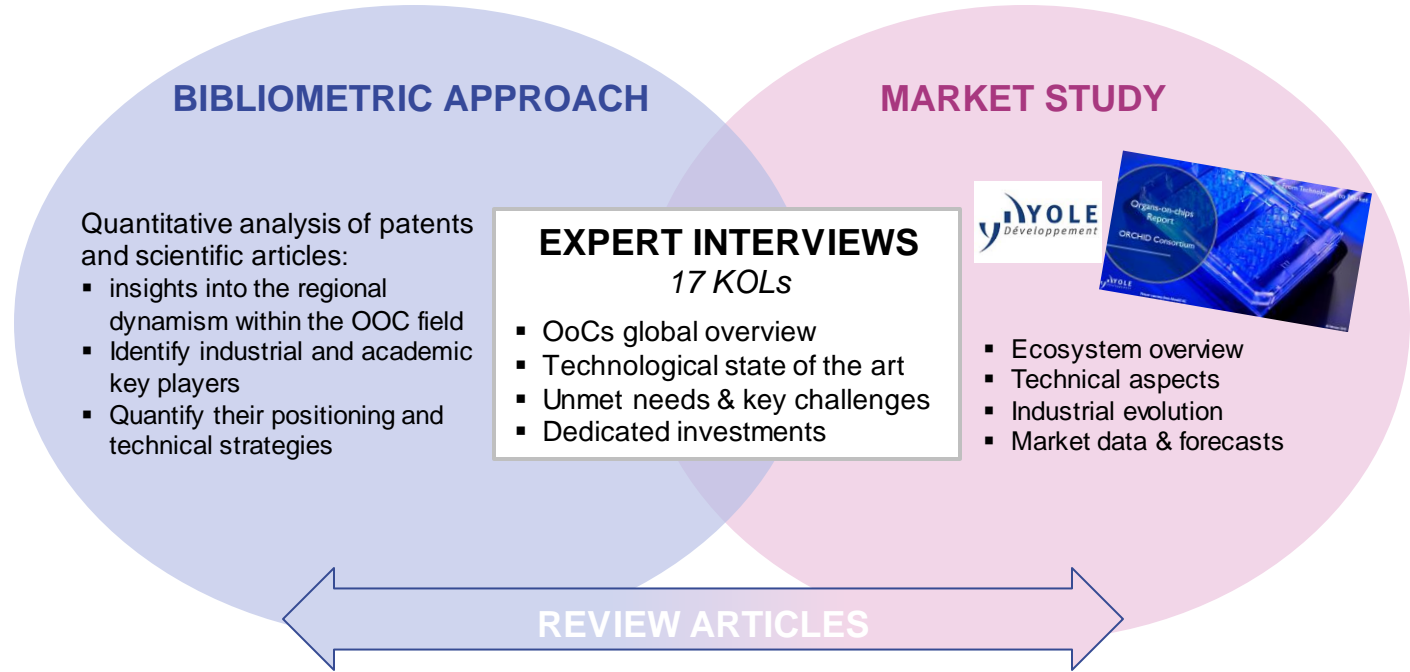
Massimo Mastrangeli  
Delft University of Technology, NL

Sylvie Millet, CEA, FR  
Janny van den Eijnden-van Raaij, hDMT, NL

M. Mastrangeli *et al.*, *ALTEX* 36 (4), 2019 (in press)

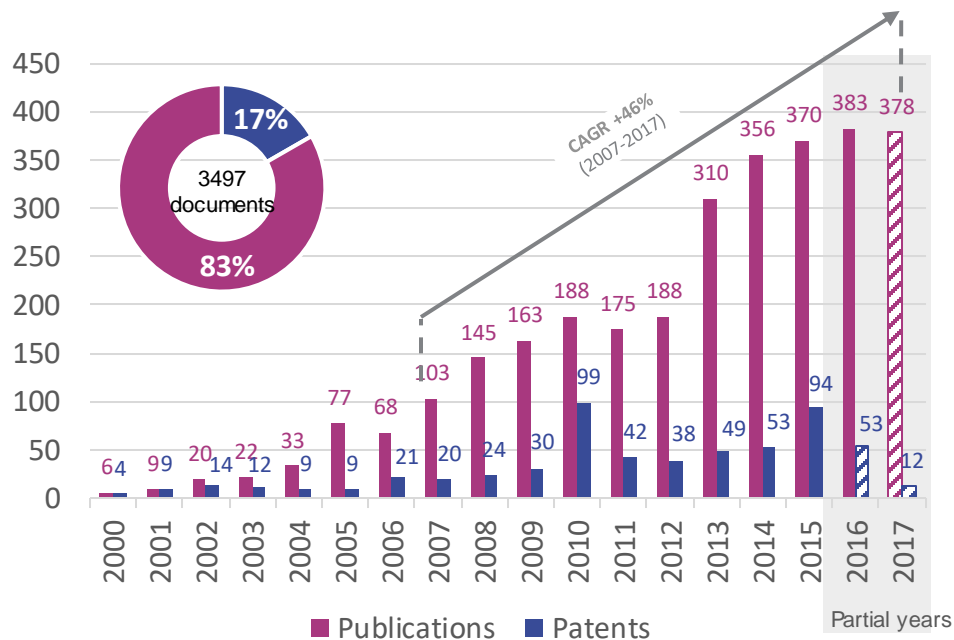


# WP 2: Methodology





# WP 2: Methodology



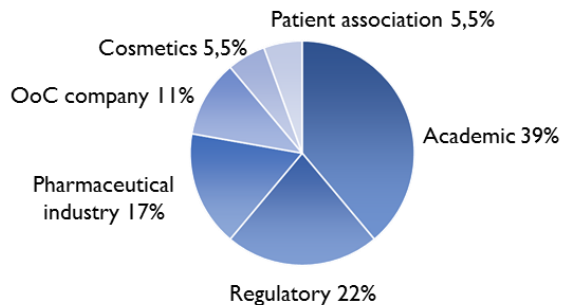
Year 2015 : latest complete year for patents (18 months are needed to publish the patent application).

Year 2016 : latest complete year for publications (documents were imported in November 2017).

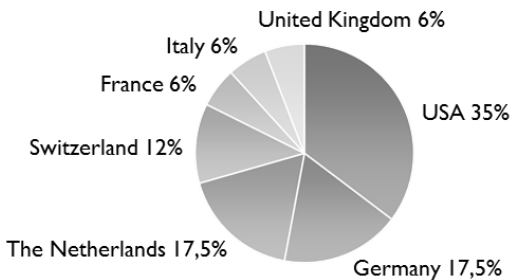
CAGR : Compound Annual Growth Rate.

# Interviewed experts

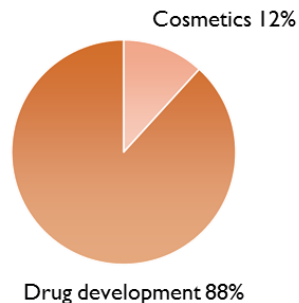
## EXPERTS' PROFILES



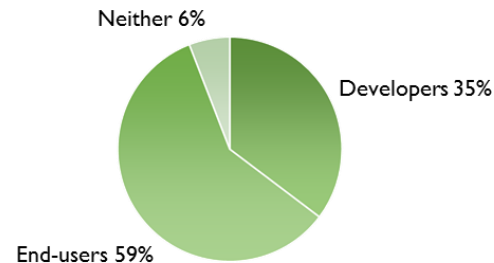
## COUNTRIES



## TARGETED APPLICATIONS

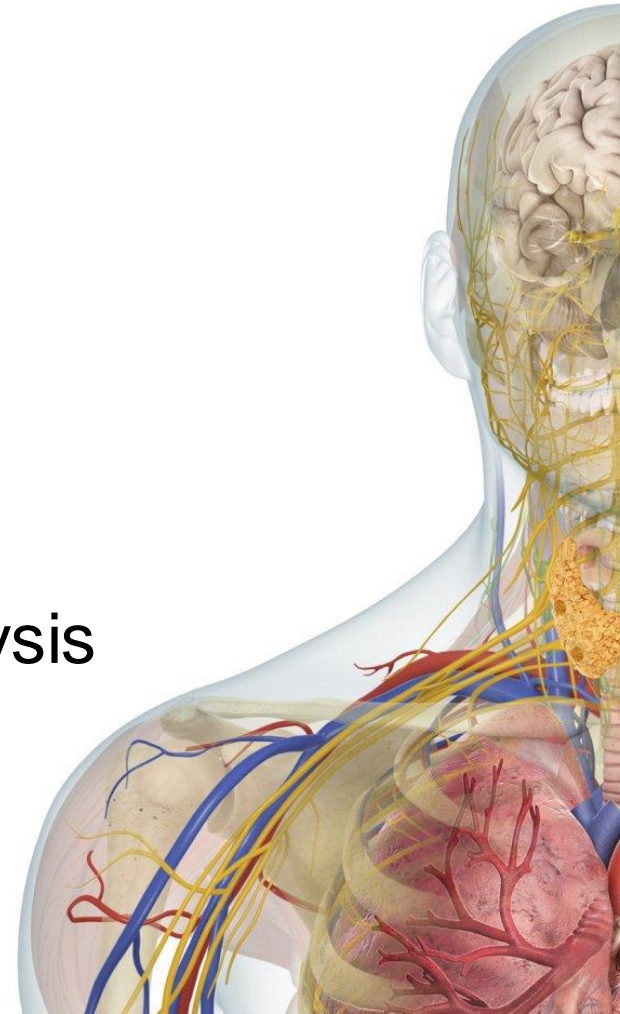


## OoC DEVELOPERS/USERS



# Outline

- Definition
- Unmet needs
- Technological challenges
- Key players
- Ethics
- Investments & market analysis
- Public awareness
- Conclusions

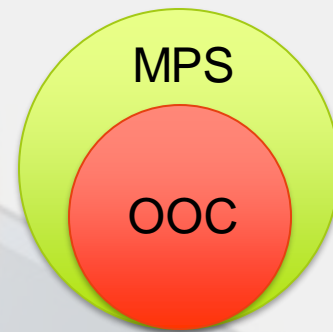


### Definition

Unmet needs  
Tech challenges  
Key players  
Ethics  
Investments  
Awareness  
Conclusions

# What is an OOC?

- A subclass of MPS
- Features:
  - Recapitulation of (patho)physiology
  - Cell engineering
  - Controlled microenvironment
  - Dynamics
    - Perfusion, stimuli
  - Real-time monitoring





# What is an OoC?

*“a fit-for-purpose microfluidic device, containing living engineered organ substructures in a controlled microenvironment, that recapitulates one or more aspects of the organ’s dynamics, functionality and (patho) physiological response in vivo under real-time monitoring”*

# Unmet needs

- Cells
- Monitoring
- Ease of use
- Qualification
- Standardization
- Drug development
- Accessibility for citizens
- Community
- New science



# Unmet needs

## Cells

- Abundant source
- Optimal type
  - Primary cells
  - Cell lines
  - stem cells
    - Foetal
    - Embryonic
    - Induced pluripotent



# Unmet needs Monitoring

- Real-time
- Multiple sensor data
- Unsupervised

Unmet needs

# Ease of use

- Easy to set up
- Compatibility with laboratory facilities
- Automation
- Easy to interface
- Limited training

# Unmet needs Qualification

- Reproducibility & robustness
  - Quality control
- Regulatory guidelines
  - Context of use
- Specific to end users
  - Reference compounds
  - Comparison with prior data



# Unmet needs

## Standardisation

- Translation across labs
  - Robustness, reproducibility
- Cross-platform compatibility
  - Plug-and-play
- Guidelines
  - Data formats
  - Device performance

# Unmet needs

## Drug development

- Toxicology
- Efficacy
- High-throughput screening
- Clinical-trials-on-chip

## Unmet needs

# Accessibility for citizens

- Legislative regulation
- Therapeutic acknowledgment
- Cost reimbursement by health system



# Unmet needs Community

- Joint international development
  - Projects & actions
  - Programs & initiatives
  - Consortia & institutes
  - Non-specialist education
- Dialogue among players
  - Multiple disciplines
  - Early involvement of regulators

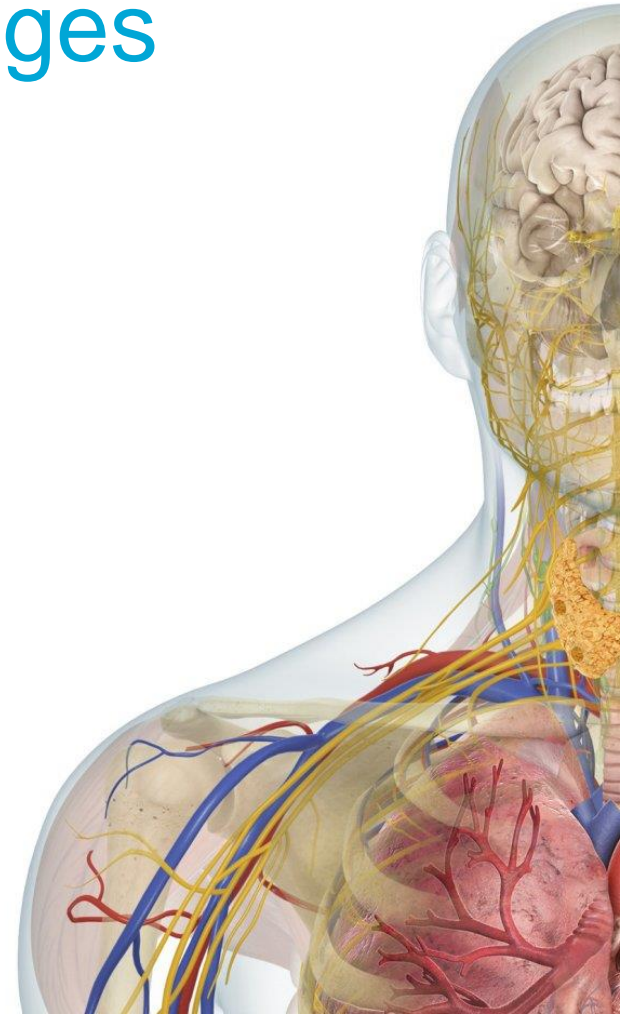
# Unmet needs

## New science

- From reductionism to organism
- Tools for discovery
  - Physiological mechanisms
    - Non-modelled diseases
    - Rare diseases
  - Scaling laws
- Major long-term societal benefits

# Technological challenges

- Devices
- Cells
- Model complexity
- Drug development
- Qualification
- Personalized medicine





# Technological challenges

## Devices

- Beyond PDMS
- Integrated sensors and actuators
- Simple, customized, flexible
- Compatibility with lab equipment
- Multiplexing, simplification of connections
- Upscaling & manufacturability

# Technological challenges

## Cells

- Identification
- Differentiation & maturation
- Co-culture conditions
- Viability
- Isogenic lines
- Genetic representativity

# Technological challenges

## Model complexity

- Cellular microenvironment
  - Multiple cell types & ECM
  - Immune & endocrine system
  - Microbiome
- Vascularization & barriers
- Innervation
- Multi-organ interactions & scaling
  - From single- to multi-OOC to human-on-chip



# Technological challenges

## Drug development

- Priority diseases
  - Efficacy
- Priority organs
  - Toxicity
- High throughput

# Technological challenges

## Qualification

- Availability of reference compounds
- Availability of *in vivo* data

# Technological challenges

## Personalized medicine

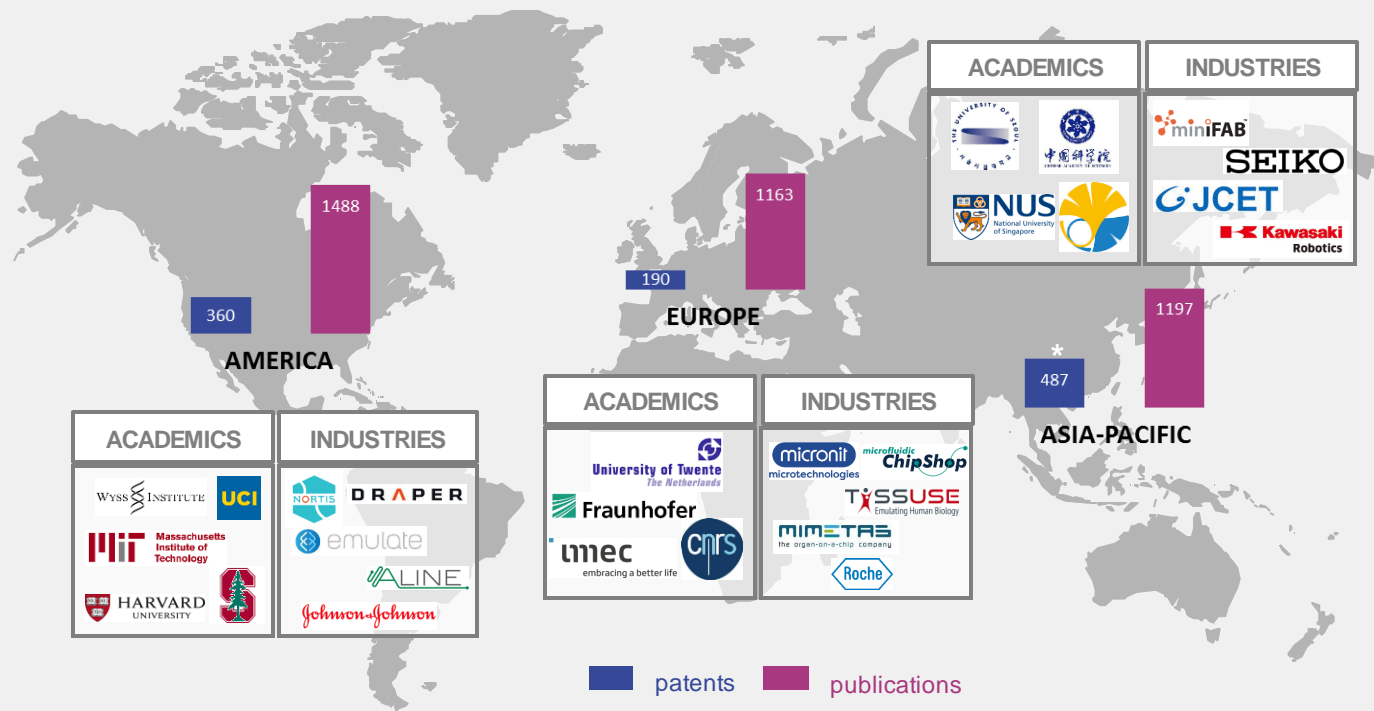
- Patient-specific assay development





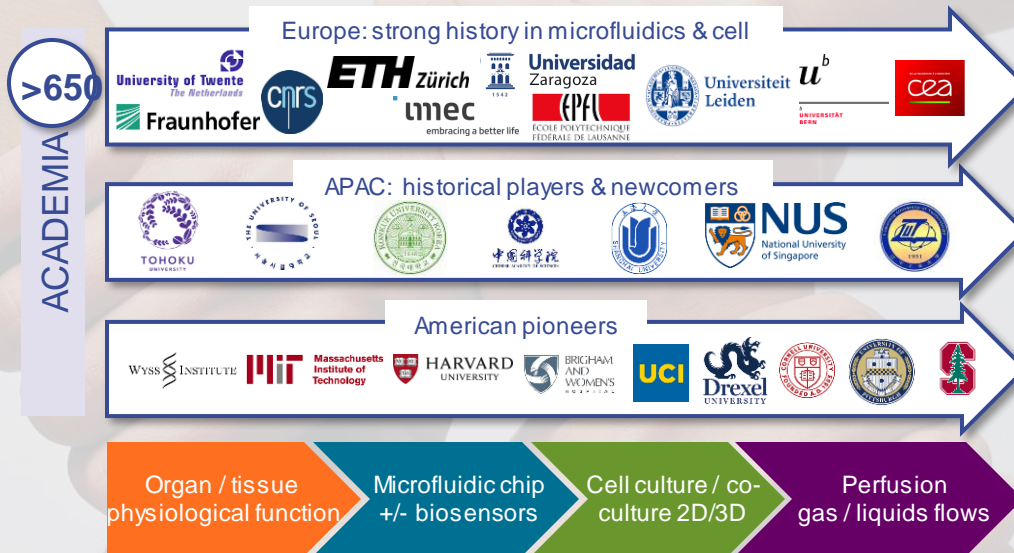
Definition  
Unmet needs  
Tech challenges  
**Key players**  
Ethics  
Investments  
Awareness  
Conclusions

# Key players



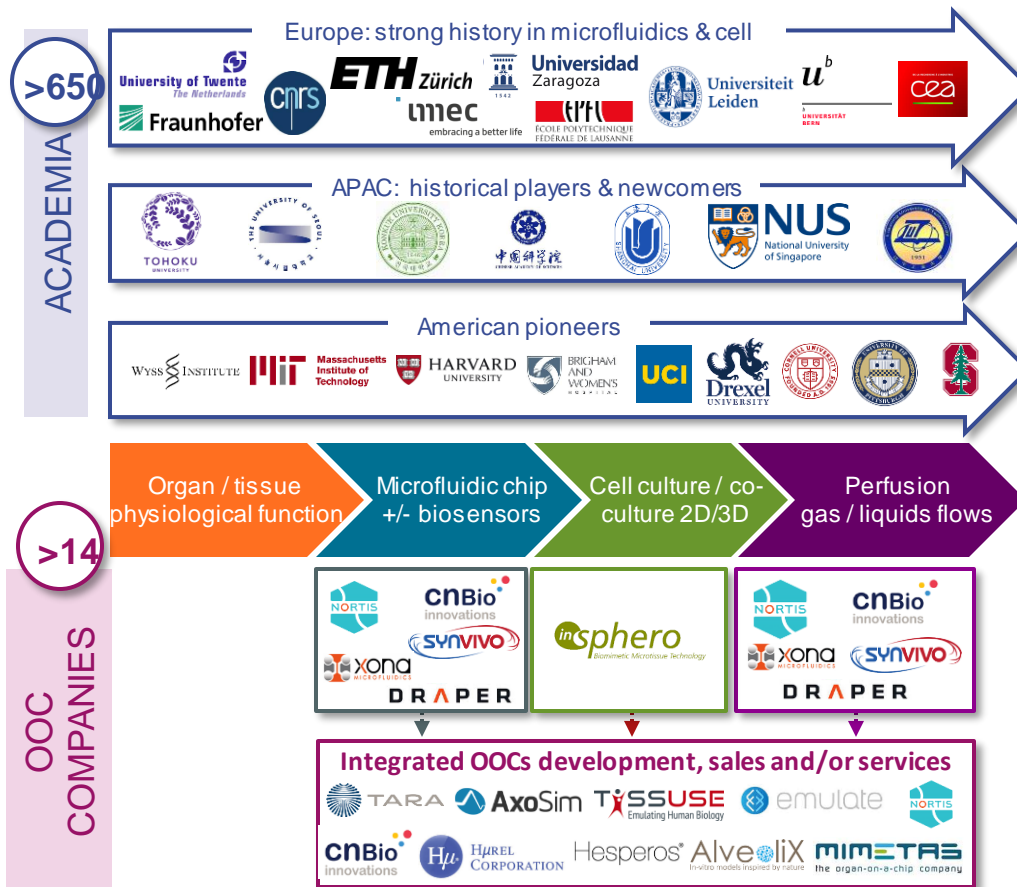


# Key players

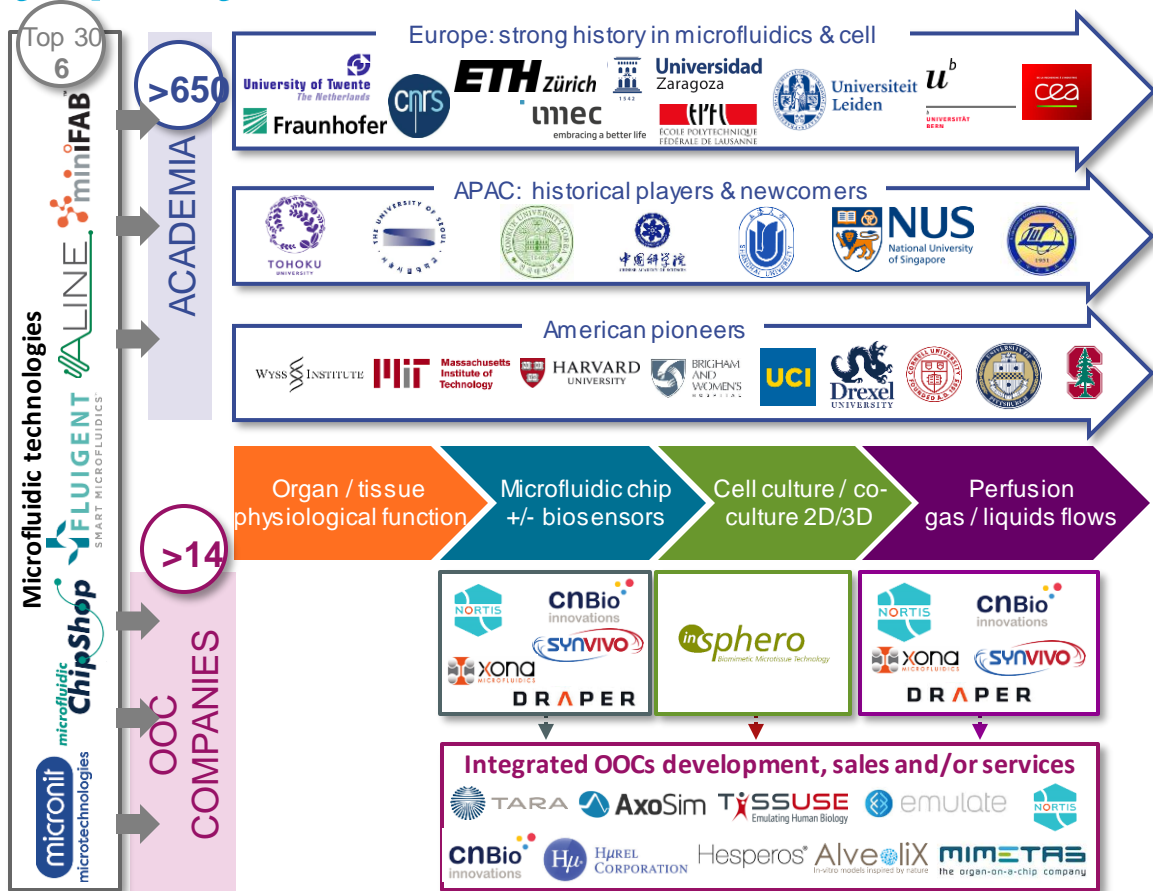




# Key players

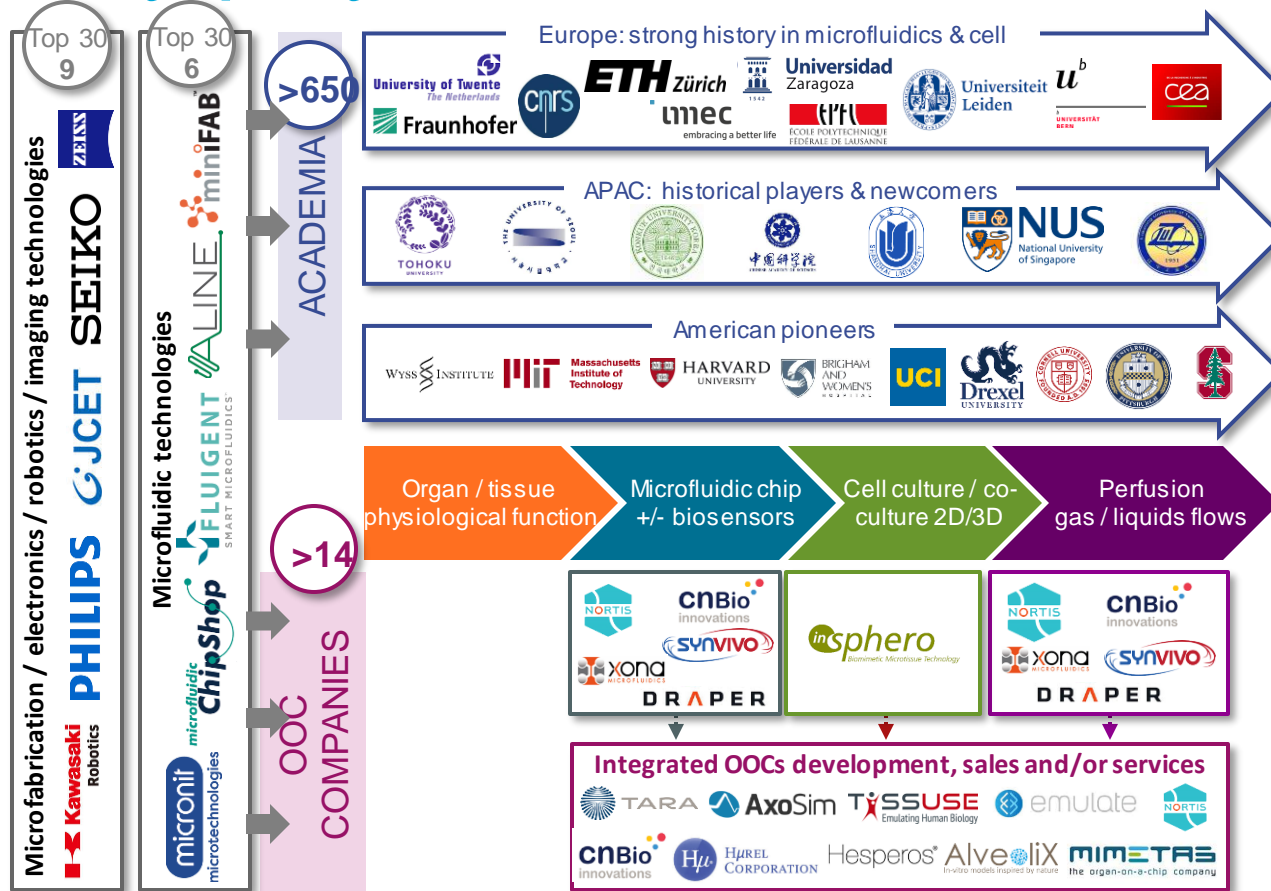


# Key players



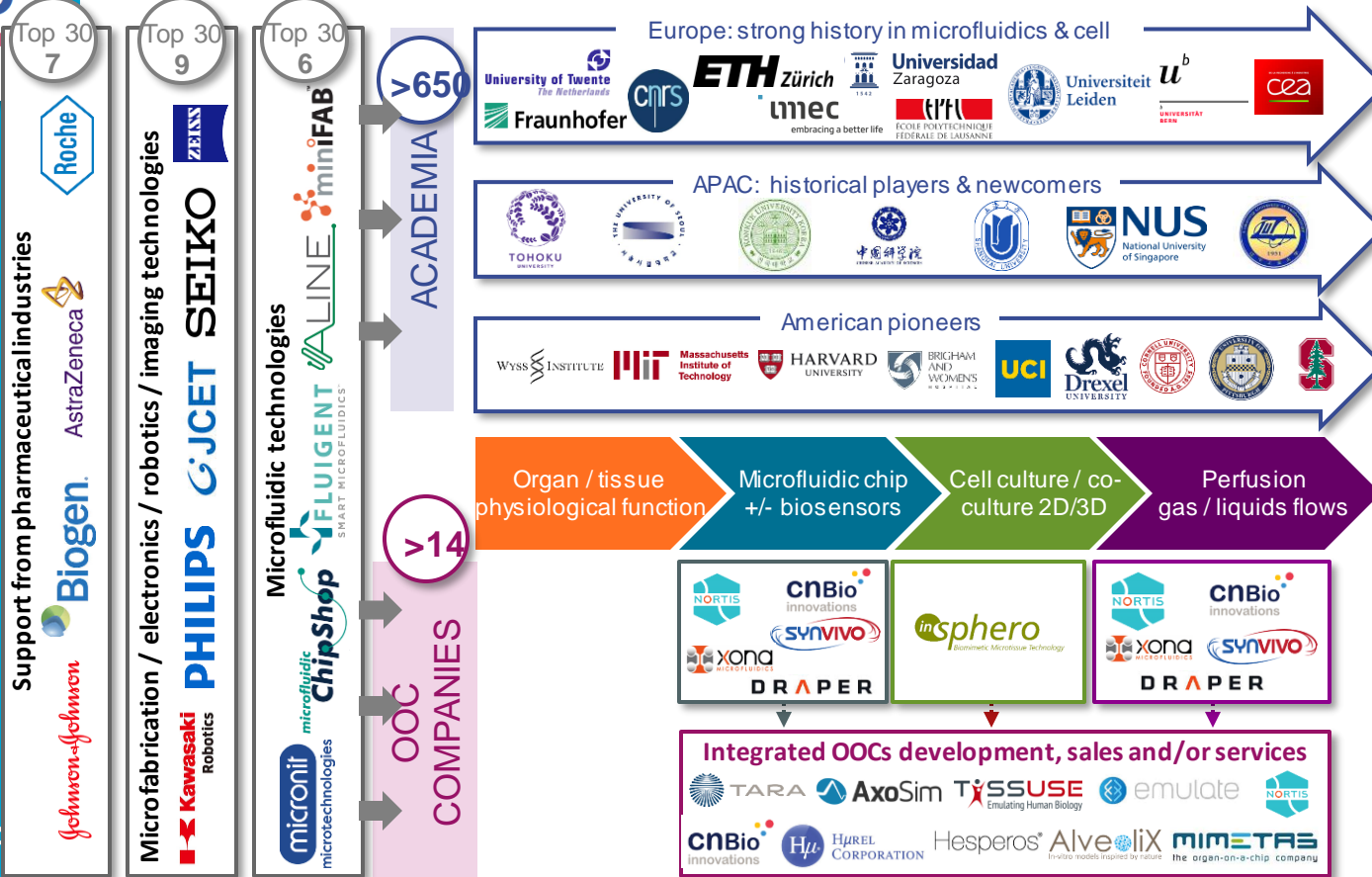


# Key players





# Key players





# Key players

- Dialogue between categories
  - Academics: *invention*
  - Industry: *upscaling*
  - Regulators: *rules & standards*
  - Clinicians: *diagnostics*
  - Patients: *ease of access*

# Ethics

- OoCs solve rather than rise issues
  - 3R's of animal testing
  - Clinical trials
- Use of human cells well addressed
- International coordination

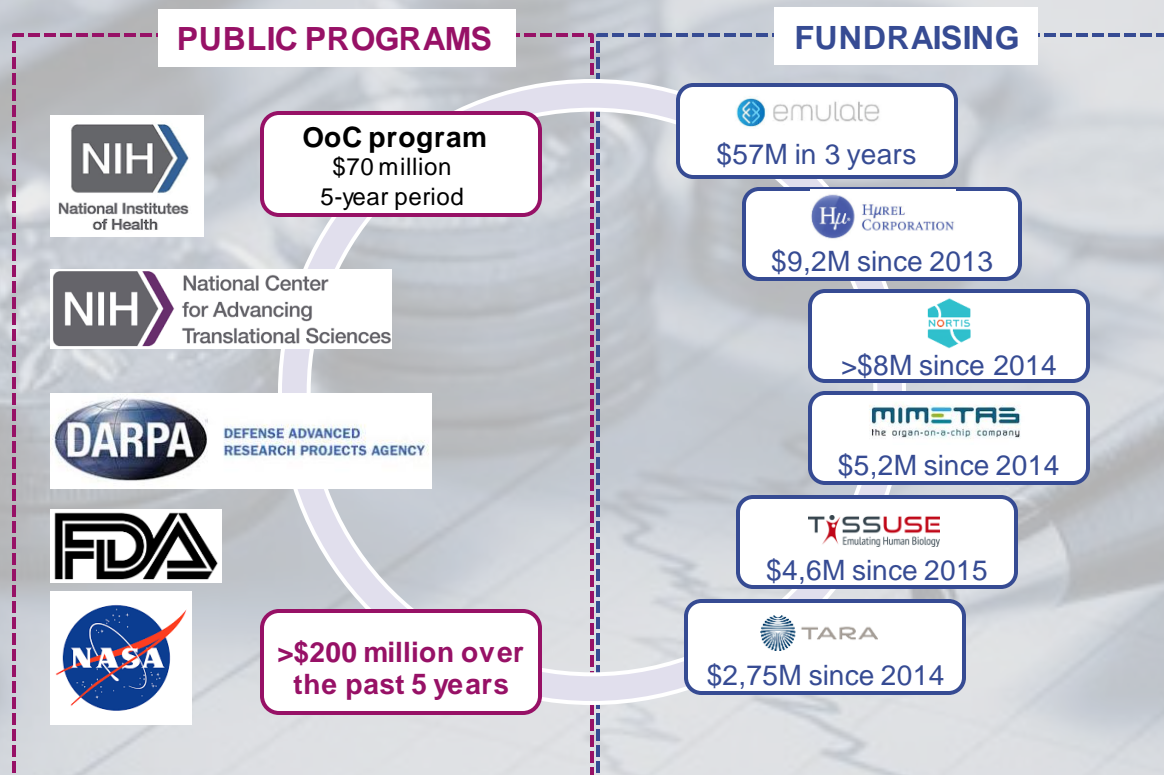
# Investments

- Global: ~Human Genome Project (~1B\$)
  - DARPA+NIH funding: ~225M\$ (2012-2022)
  - NOCI: ~19M€ (2017-2027)
- From prototype to commercialisation
  - Academia needs investors' money to convince investors that their prototypes deserve investments
  - Lack of standards may inhibit industry
  - IP: freedom to operate study
  - Fit for purpose: better and/or cheaper



Definition  
Unmet needs  
Tech challenges  
Key players  
Ethics  
**Investments**  
Awareness  
Conclusions

# Investments





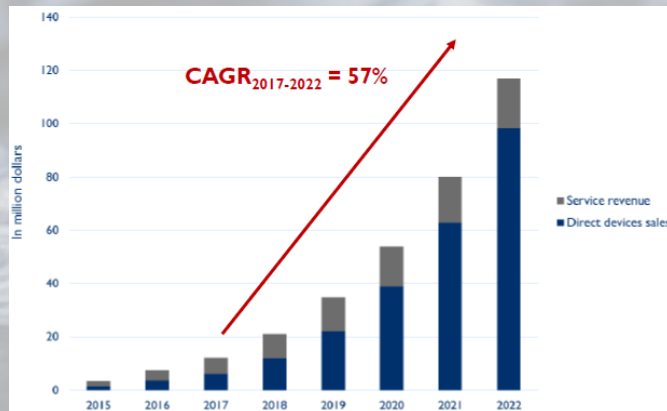


Definition  
Unmet needs  
Tech challenges  
Key players  
Ethics  
**Investments**  
Awareness  
Conclusions

# Market analysis

## Forecasts

### OPTIMISTIC SCENARIO

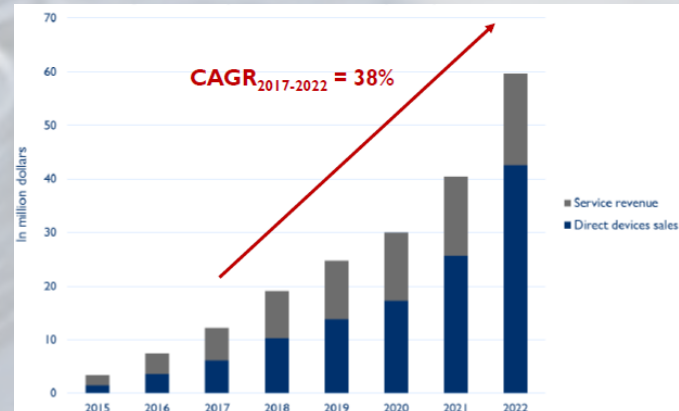


- ✓ industrial adoption speed up
- ✓ technical challenges overcome
- ✓ production upscaling



production of 858k units in  
2022  
**overall market of \$117M**

### REALISTIC SCENARIO



- ↓ technical challenges not overcome
- ↓ Scaling issues unsolved
- ↓ Industrial adoption slowdown



production of 310k units in  
2022  
**overall market of \$59,7M**



# Public awareness

- Public mostly unaware, but **easy to excite**
  - Animal testing has *emotional & political* appeal
- Media coverage small, but rising
  - Oversimplification
  - Scientific outlets
- Need to **avoid hype**
  - Cautious communication
  - Keep realistic

# Conclusions

- A most promising technology
- General excitement
- Multi-disciplinary
- Keep realistic
- Challenging
- High hopes

# Acknowledgements

The interviewees

The ORCHID partners



**Universidad**  
Zaragoza

Thank you  
for your attention!

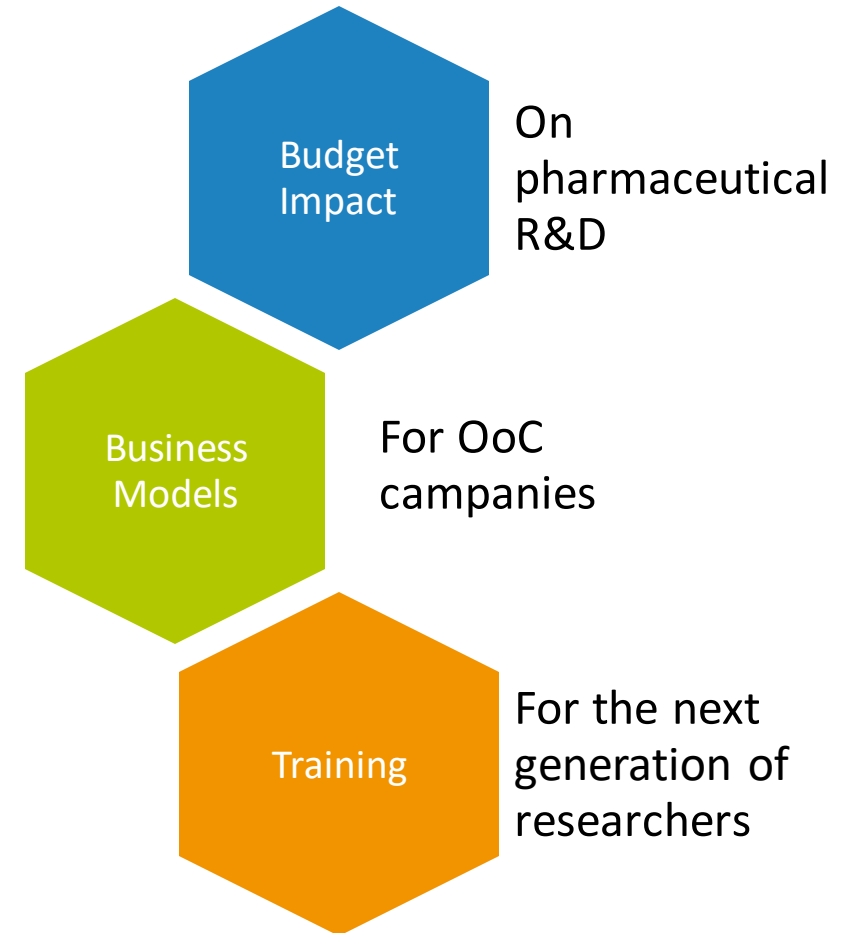
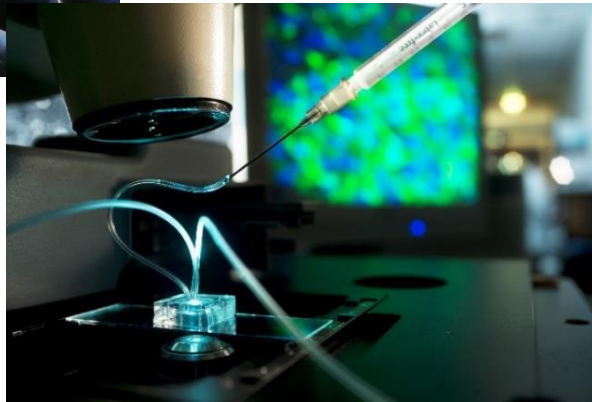
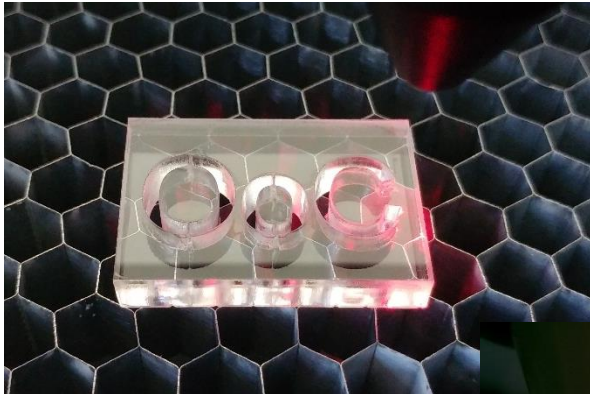
ANY  
QUESTIONS?



# ECONOMIC IMPACT AND TRAINING

## DELIVERIES 3.1, 3.2 AND 3.3

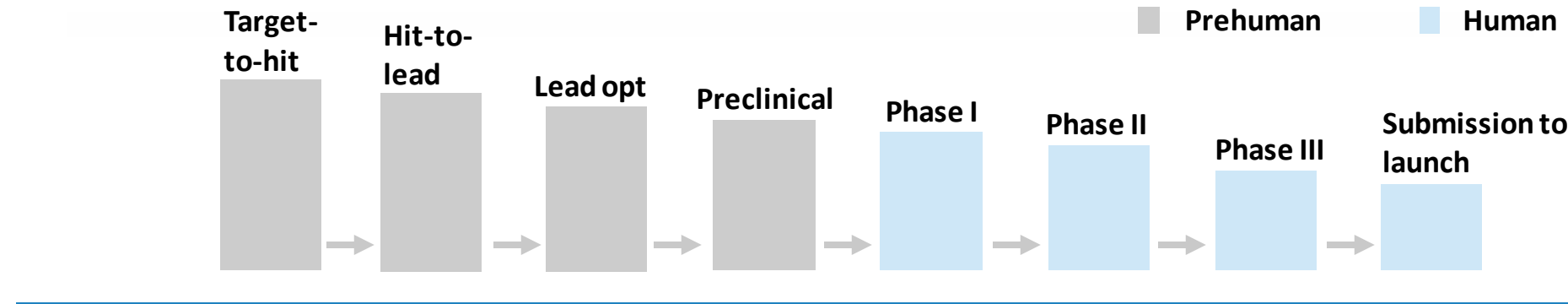
Madalena Cipriano / Peter Loskill





# BUDGET IMPACT ANALYSIS

**Challenge:** Exact R&D cost data is not publicly available; Different estimates from multiple sources

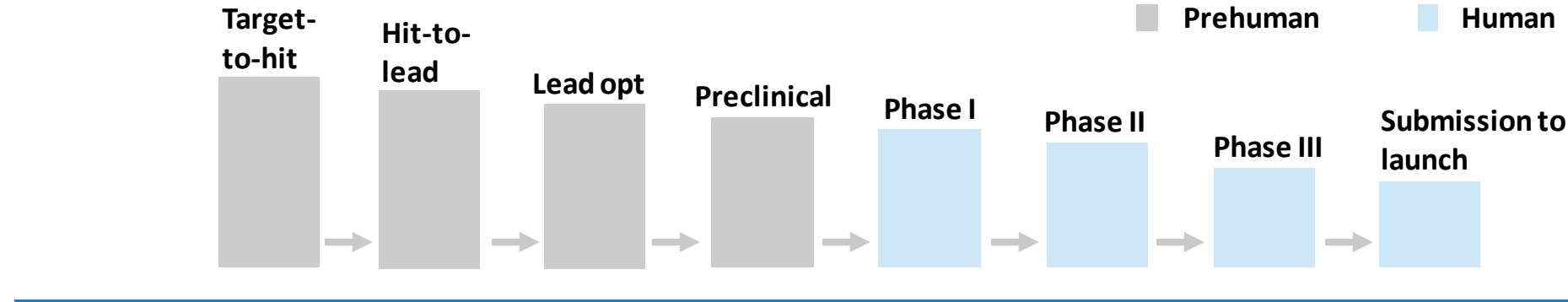


	<u>Public Citizen</u>	<u>Prasad</u>	<u>Paul</u>	<u>DiMasi</u>
<u>Total 2018 in USD Million</u>	327	662	2056	2759

Source: Paul et al, 2010; Prasad et al, 2017; DiMasi et al, 2016

# BUDGET IMPACT ANALYSIS

Costs per project, success rate, and cycle length are the most important cost drivers



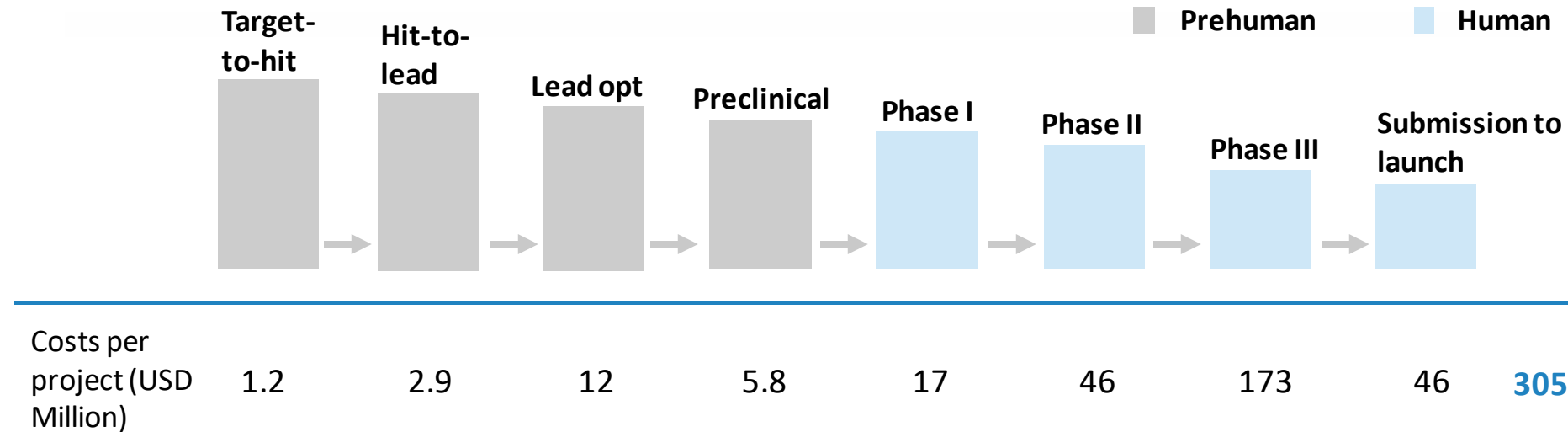
## Cost drivers

- **Cost-per-project** refers to the costs-per-project that occur in each phase.
- **Success rate** calculates the numbers of projects needed for one launch and accounts for the cost of failed projects.
- **Cycle length** is used as a time reference for the duration of each phase, and for the process as a whole. This time reference is used to estimate the additional capitalized costs of the investment.

Source: Paul et al, 2010

# BUDGET IMPACT ANALYSIS

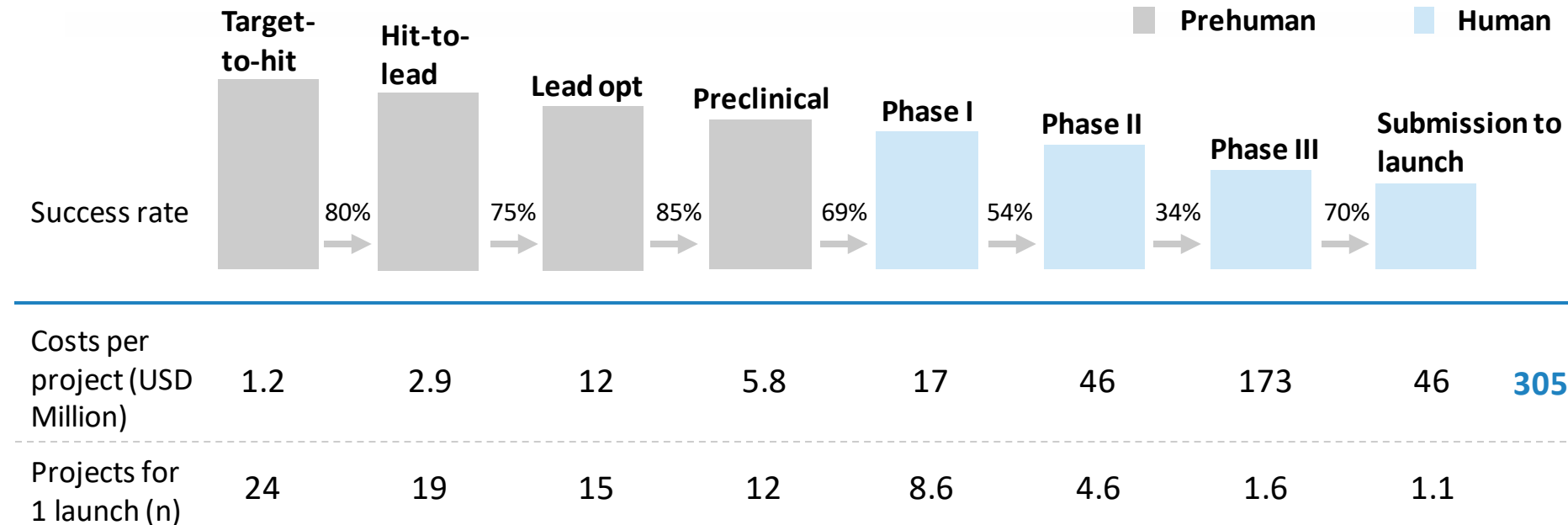
Costs per project describes the **direct costs** which occur for each project per phase



Source: Paul et al, 2010

# BUDGET IMPACT ANALYSIS

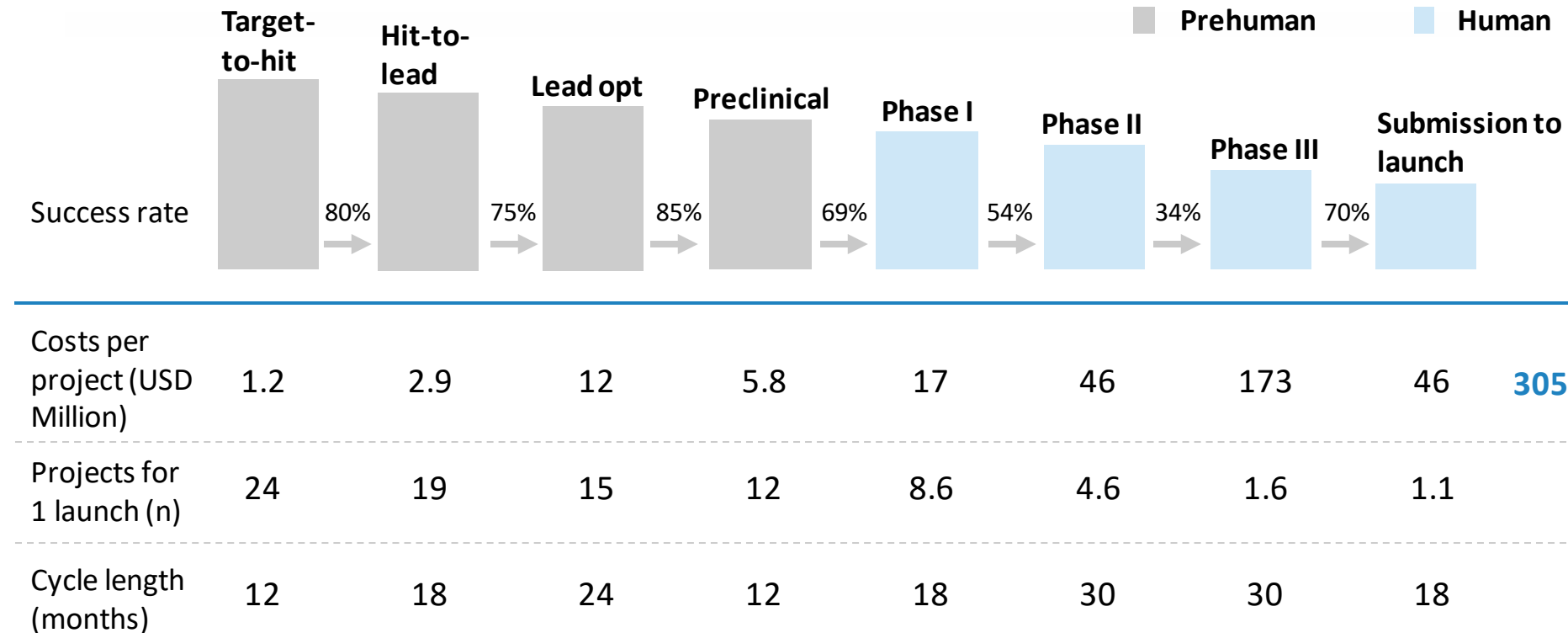
**Success rate** describes a project's likelihood to reach the next phase



Source: Paul et al, 2010

# BUDGET IMPACT ANALYSIS

**Cycle length** describes the time a project takes on average to reach the next phase

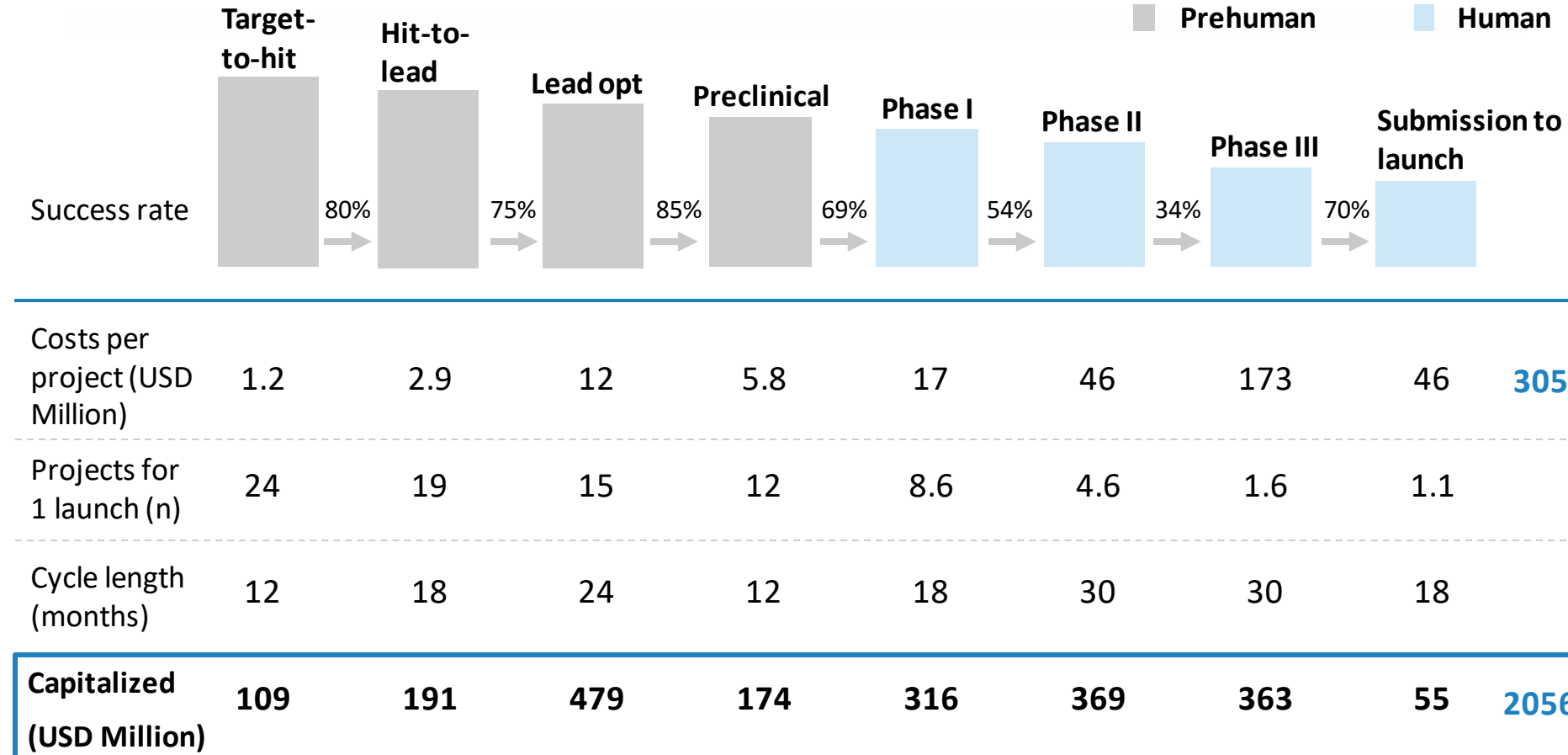


Source: Paul et al, 2010



# BUDGET IMPACT ANALYSIS

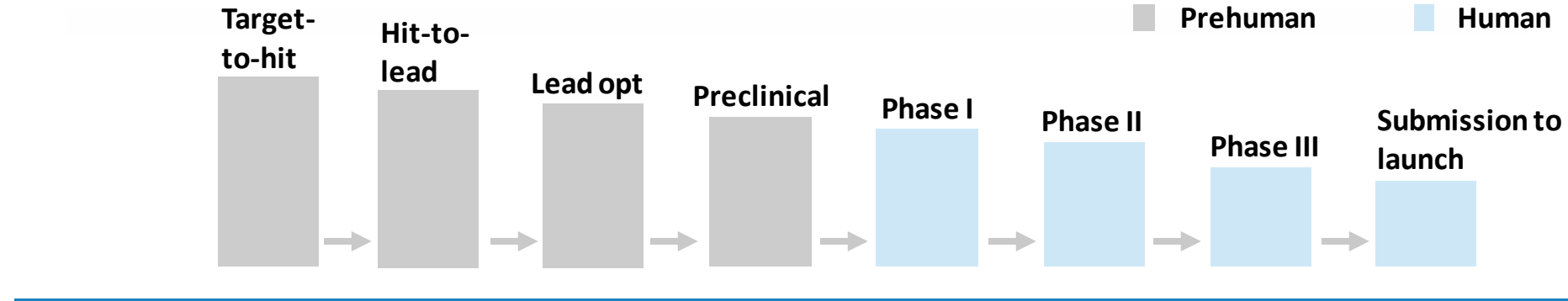
Capitalized costs account for the costs of financing the R&D process over time



Source: Paul et al, 2010

# BUDGET IMPACT ANALYSIS

Challenge: Exact R&D cost data is not publicly available; Different estimates from multiple sources



**Refined hypothesis:** Organ-on-a Chip reduces the costs of the R&D process by

- a) acting upon the cost drivers “cost-per-project”, “success rate” and “cycle length”
- b) acting differently in the various R&D phases

Source: Paul et al, 2010; Prasad et al, 2017; DiMasi et al, 2016

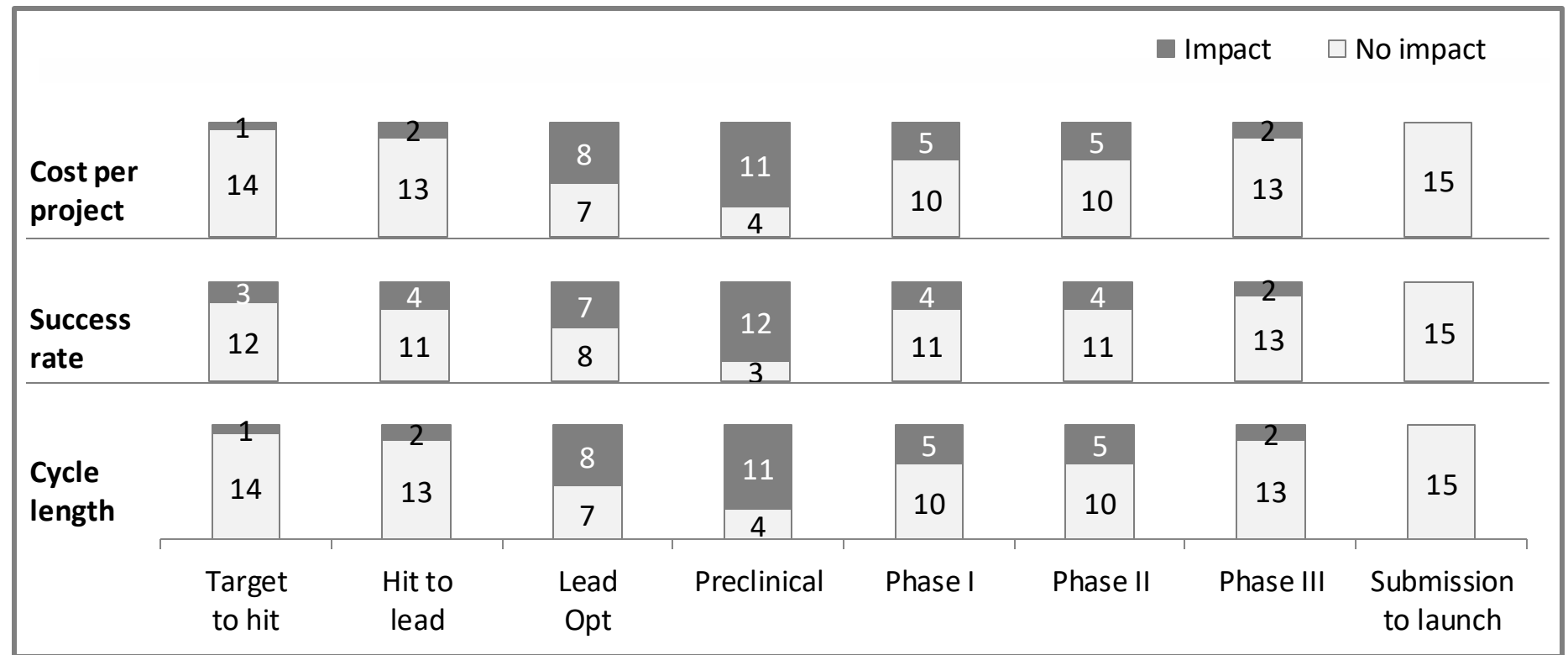
# BUDGET IMPACT ANALYSIS

- Budget impact analysis via expert interviews
- Total of 17 experts: from pharma (n=7), biotechnology (n=3), academia, (n=3), Organ-on-a-Chip developer, (n=1) and regulator (n=3)
- Combined results by linear opinion pooling, weighted for experience

N. Franzen *et al.* *Drug Discover Today* (2019)

# BUDGET IMPACT ANALYSIS

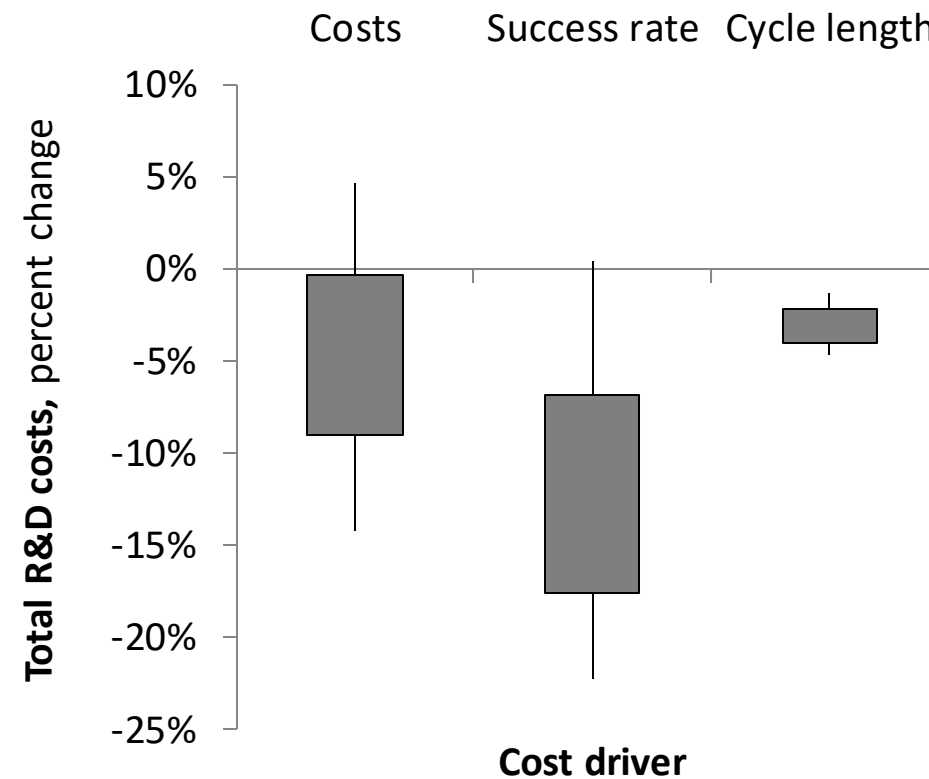
- Budget impact analysis via expert interviews
- Total of 17 experts: from pharma (n=7), biotechnology (n=3), academia, (n=3), Organ-on-a-Chip developer, (n=1) and regulator (n=3)
- Combined results by linear opinion pooling, weighted for experience
- Impacted phases:**



N. Franzen *et al.* Drug Discover Today (2019)

# BUDGET IMPACT ANALYSIS

- Budget impact analysis via expert interviews
- Total of 17 experts: from pharma (n=7), biotechnology (n=3), academia, (n=3), Organ-on-a-Chip developer, (n=1) and regulator (n=3)
- Combined results by linear opinion pooling, weighted for experience
- **Impact on cost drivers:**



N. Franzen *et al.* *Drug Discover Today* (2019)



# BUDGET IMPACT ANALYSIS

- Budget impact analysis via expert interviews
- Total of 17 experts: from pharma (n=7), biotechnology (n=3), academia, (n=3), Organ-on-a-Chip developer, (n=1) and regulator (n=3)
- Combined results by linear opinion pooling, weighted for experience
- **Overall impact:**

	Total R&D
Optimistic	- (26 – 35%)
Average	- (10 – 26)%
Pessimistic	(-10%) – (+5%)

**Average** = (Weighted mean of 75<sup>th</sup> percentile) - (Weighted mean of 25<sup>th</sup> percentile)

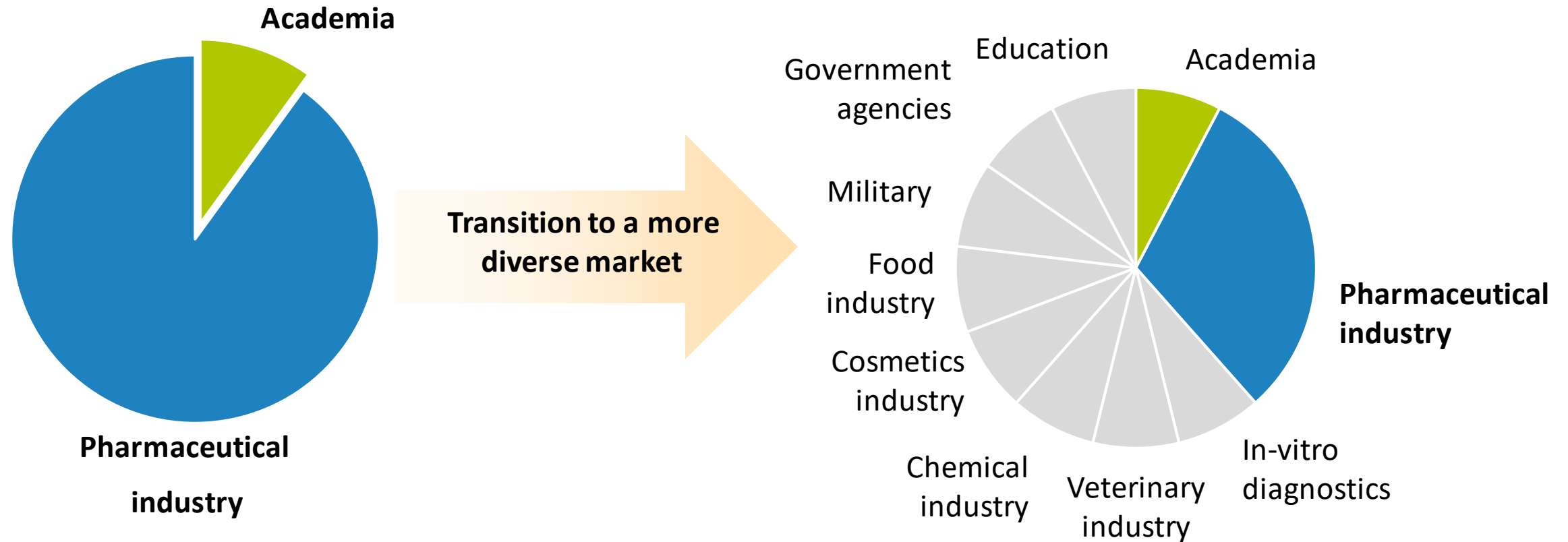
**Optimistic** = (25<sup>th</sup> percentile) - (2 standard errors below lower limit of the distribution)

**Pessimistic** = (75<sup>th</sup> percentile) - (2 standard errors above the upper limit of the distribution)

N. Franzen *et al.* *Drug Discover Today* (2019)

# BUSINESS MODELS

## Customer segments

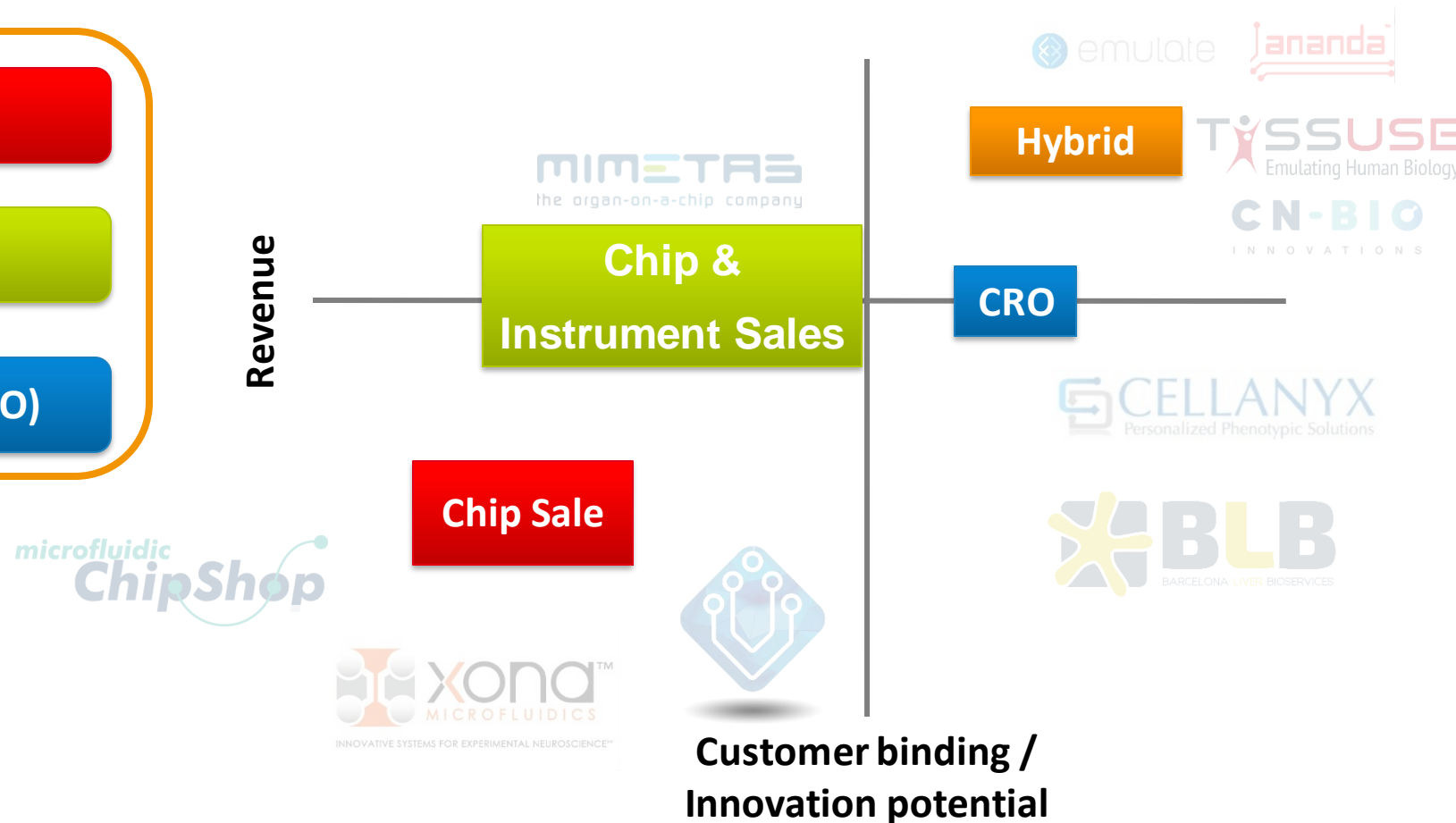


# BUSINESS MODELS

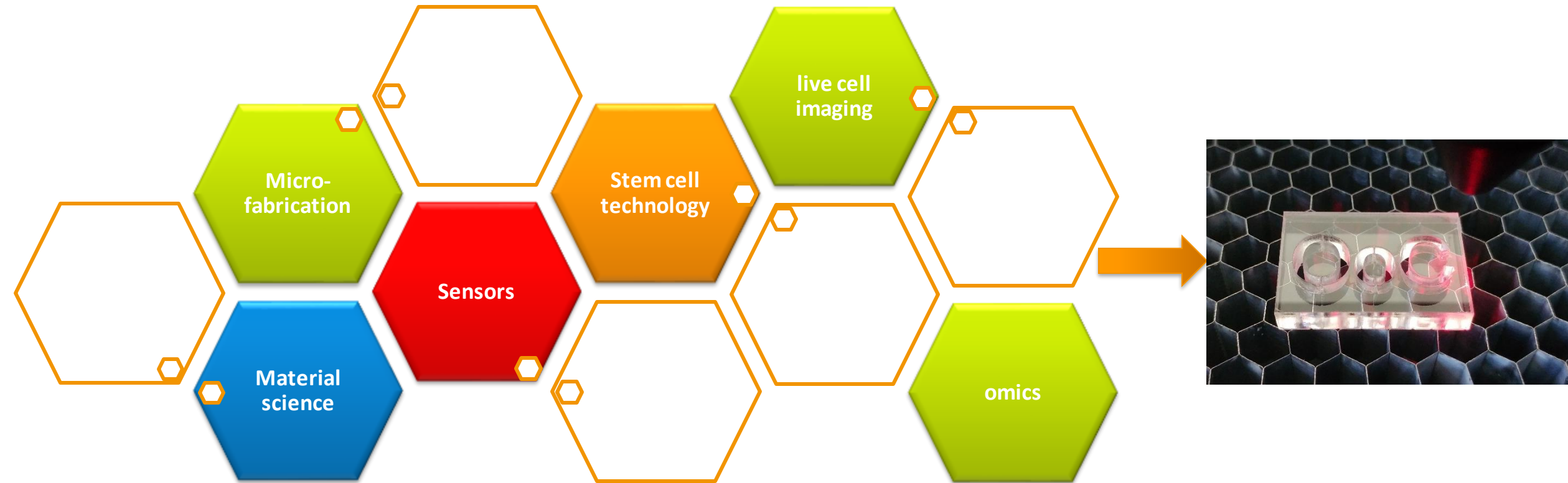
## Business models categories



## Ranking of current business models



# TRAINING AND EDUCATION



Questionnaire for stakeholders

Organ-on-a-chip

Training needs of the next generation of researchers and technicians

# TRAINING AND EDUCATION

Scientists as developers,  
Scientists as end users (Academia),  
Scientists as end users (Industry),  
Scientists as decision-makers (Regulators / Grant Evaluators / Peer Reviewers),  
Technicians,  
Clinicians,  
Postgraduate Students (Doctorate studies),  
Postgraduate Students (Master's studies),  
Undergraduate Students (Bachelor's Studies)



Who?

How?

When?

How much?  
In what?



# TRAINING AND EDUCATION

Scientists as developers,  
Scientists as end users (Academia),  
Scientists as end users (Industry),  
Scientists as decision-makers (Regulators / Grant Evaluators / Peer Reviewers),  
Technicians,  
Clinicians,  
Postgraduate Students (Doctorate studies),  
Postgraduate Students (Master's studies),  
Undergraduate Students (Bachelor's Studies)



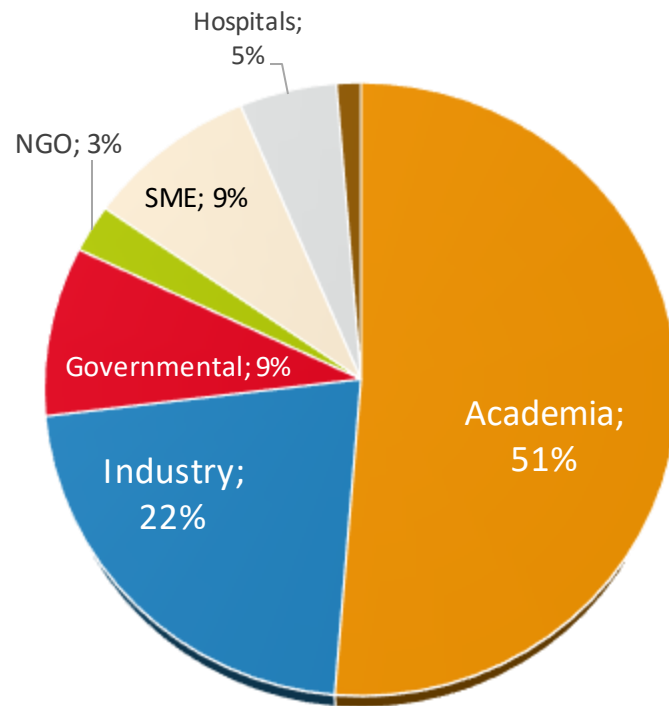
71 experts answered 15 questions

- Professional profile
- Opinion on the state of Organ-on-Chip field development
- Specific training needs

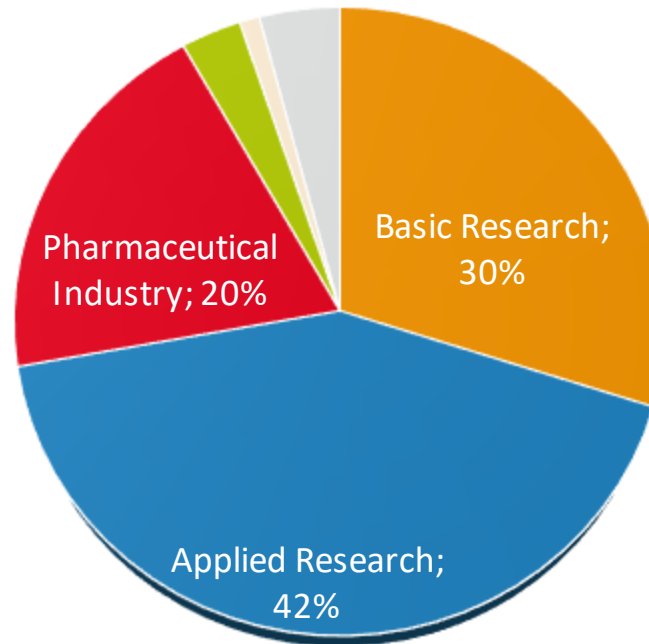
# TRAINING AND EDUCATION

## Professional profile

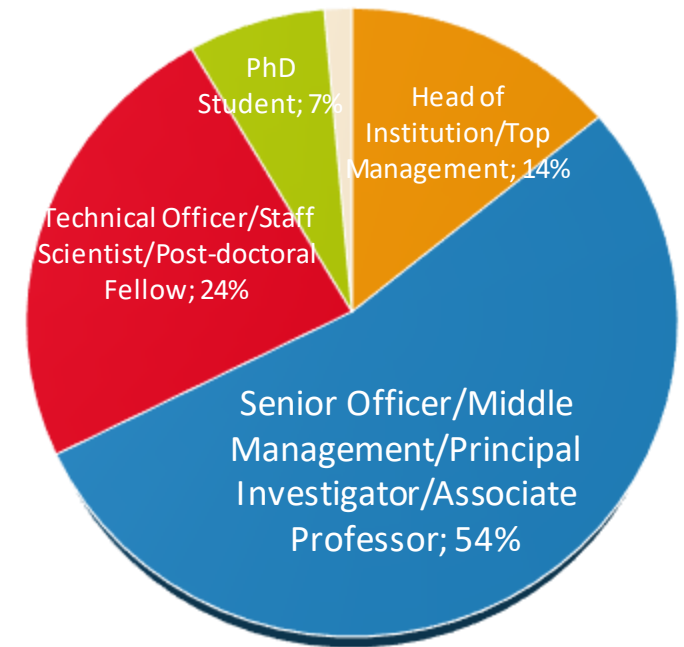
Employer



Field of Work



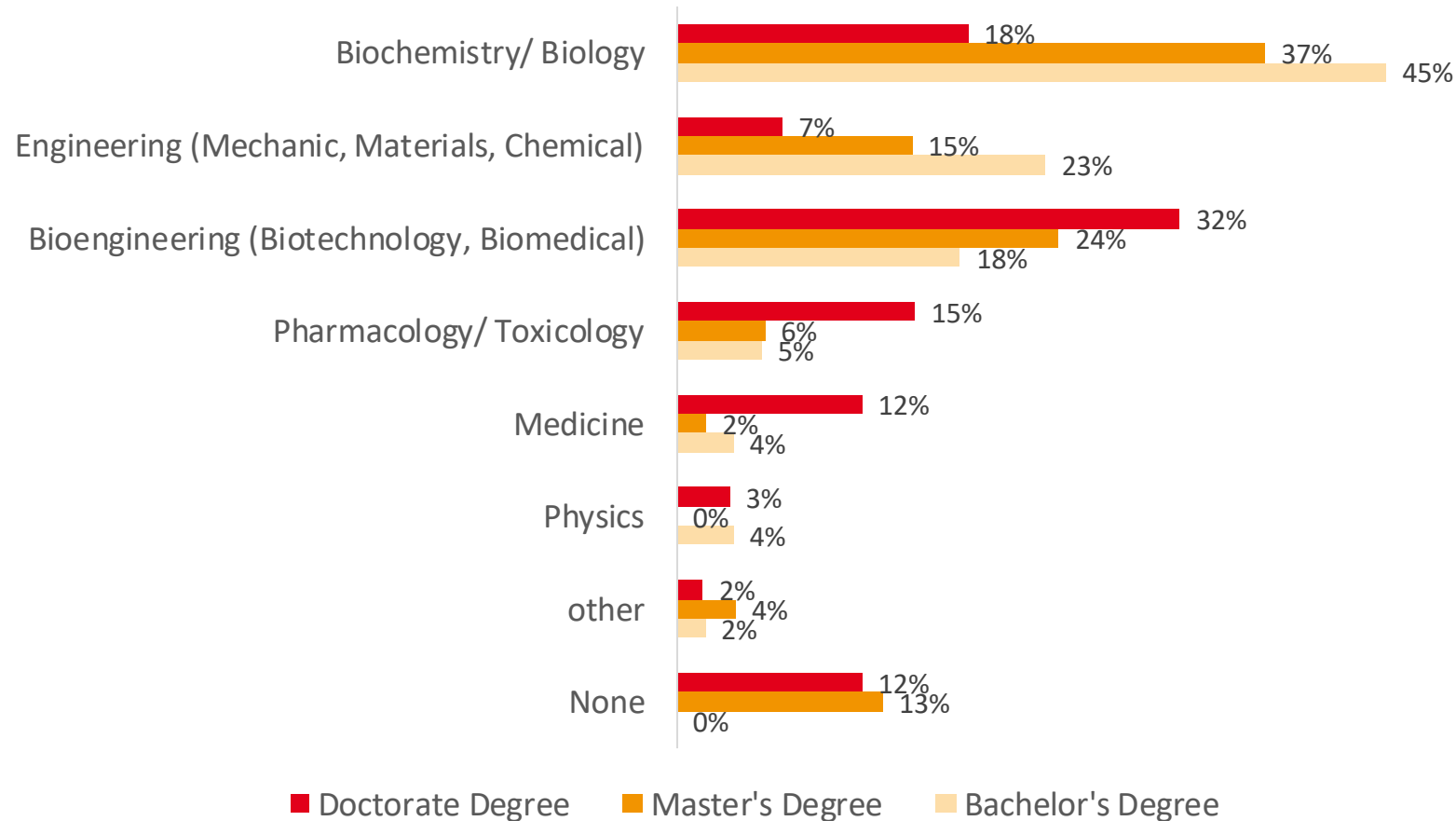
Job Level



# TRAINING AND EDUCATION

## Professional profile

Field of University education



- Initial basic science degree followed by a translational field of PhD
- 44% changed the field of studies from initial Bachelor Degree to Master and/or Doctorate degree
- 88 % hold a Doctorate Degree and all at least a Bachelor's

# TRAINING AND EDUCATION

## Opinion on the state of Organ-on-Chip field development

Aspects contributing for development	Rank of Importance*	Degree of Importance
Definition of specific cell culture standards – function and origin of cells	4,79	Very Important
Usability	4,64	
Qualification of the models	4,51	
<b>Training</b>	<b>4,51</b>	
Sensors integration and real-time monitoring	4,38	
High throughput cultivation and endpoint measurements	4,37	Somewhat Important
Production scale-up of Organ-on-Chip systems	4,28	
Microfabrication techniques	4,25	
Comparison with clinical data	4,06	
Uptake by scientists from other fields	4,00	
Comparison with animal data	3,48	
PKPD modelling	3,35	

\* The answers were ranked considering by points: Very Important = 5; Somewhat Important = 4; Less Important = 3; Not Important = 1; Not Sure = 0

# TRAINING AND EDUCATION

Who?

Key Stakeholders to promote the Organ-on-Chip systems qualification, usability, uptake and/or long-term development	Rank of Importance*	Degree of Importance
Scientists as end users (Industry)	4,77	Very important
Technicians	4,49	
Scientists as end users (Academia)	4,42	
Scientists as developers	4,37	
Scientists as decision-makers (Regulators/Grant Evaluators/Peer Reviewers)	4,29	Somewhat Important
Clinicians	3,63	

\* The answers were ranked considering by points: Very Important = 5; Somewhat Important = 4; Less Important = 3; Not Important = 1; Not Sure = 0



# TRAINING AND EDUCATION

## In what?

		Rank of Importance*					
		Scientists as developers	Scientists as end users (Academia)	Scientists as end users (Industry)	Scientists as decision-makers	Technicians	Clinicians
Engineering aspects	Biomaterials	4,43	3,87	3,76	3,20	3,86	2,90
	Microfabrication techniques and manufacturability	4,32	3,42	3,32	3,11	3,94	2,47
	Microfluidic principles	4,46	3,96	3,72	3,20	3,94	2,90
	Monitoring and analyzing (sensors, imaging)	4,46	4,41	4,44	3,73	4,01	3,89
Biological aspects	<b>Cell culture and stem cell technology</b>	4,66	4,58	4,46	3,70	4,47	3,91
	Bio banking, Data Management and Protection	3,84	4,00	4,21	3,97	3,47	4,34
	Monitoring and analyzing (molecular biology / omics)	4,19	4,42	4,41	3,84	3,99	3,96
	PKPD modelling	3,62	3,75	3,96	3,60	2,79	3,43
	Pharmacology and Toxicology principles	3,99	4,24	4,56	4,06	3,30	4,26
Translational aspects	<b>Quality Assurance</b>	4,41	3,99	4,51	4,47	4,14	4,11
	Science Communication	4,12	4,27	3,85	4,14	2,83	3,86
	Regulatory affairs	3,84	3,73	4,47	4,61	2,70	4,09
	Ethics	3,84	3,97	4,10	4,54	3,07	4,54
	Average of total ranking in all aspects	4,17	4,05	4,14	3,86	3,58	3,74
Data from Table 3 on how important is training		4,37	4,42	4,77	4,29	4,49	3,63

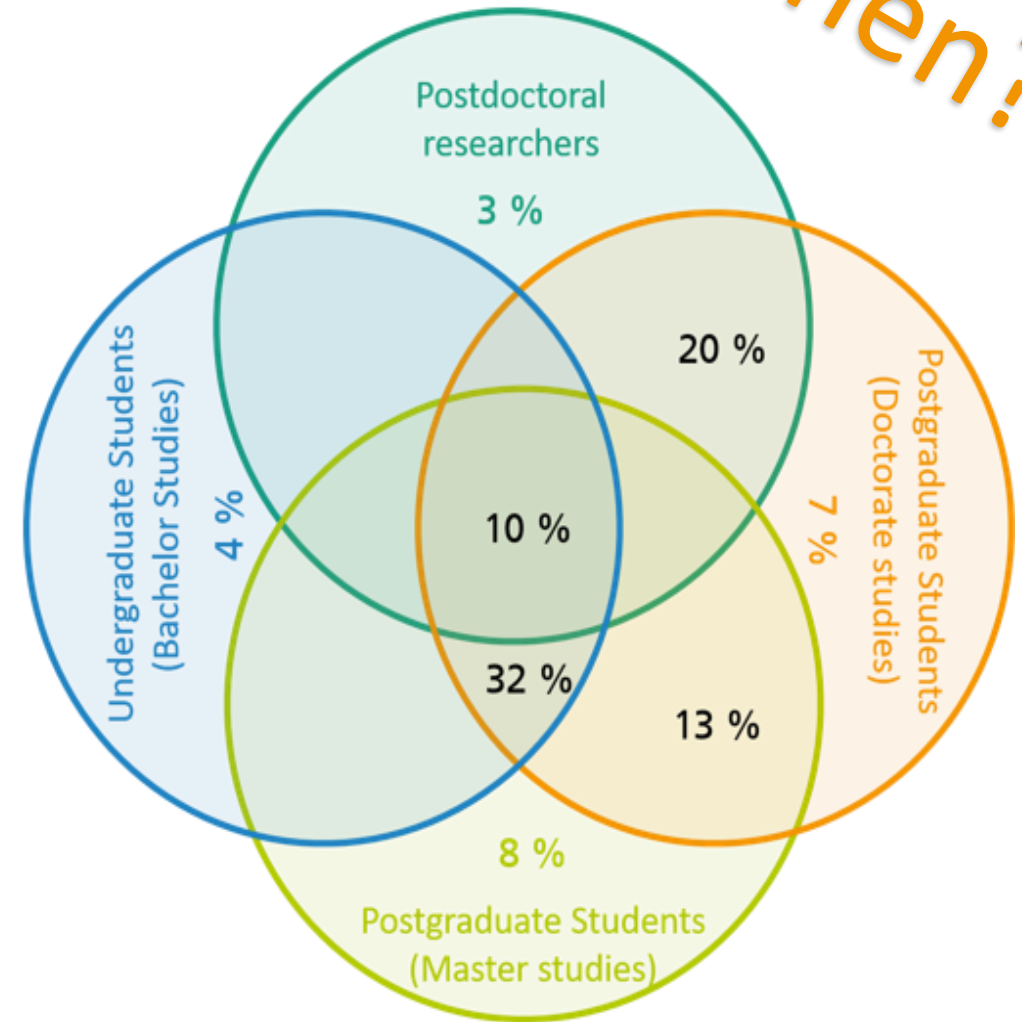
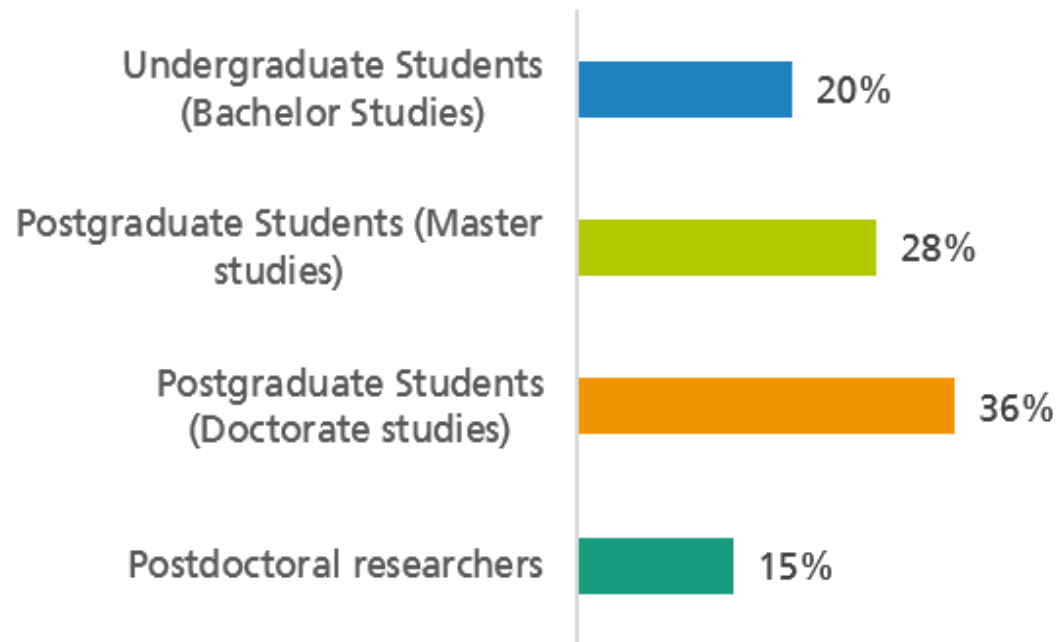
# TRAINING AND EDUCATION

How much?

	Scientists as developers	Scientists as end users (Academia)	Scientists as end users (Industry)	Scientists as decision-makers	Technicians	Clinicians
Deep knowledge/Theoretical and practical skills	96%	46%	33%	13%	13%	10%
Competence/Theoretical skills and Practical skills	0%	12%	10%	7%	9%	12%
Competence/Theoretical skills	4%	22%	26%	54%	7%	25%
Competence/Practical skills	0%	20%	30%	7%	65%	19%
Introductory/Awareness	0%	0%	0%	19%	4%	33%
None	0%	0%	0%	0%	1%	1%

# TRAINING AND EDUCATION

Level in need of specific training to promote the Organ-on-Chip systems qualification, usability, uptake and/or long-term development (% of all answers)



# TRAINING AND EDUCATION

## In which format?

Seminars/courses integrated in a broader training program (1 semester)

Specific postgraduate course (1 to 2 years)

Up to approx. 20 h of non-practical training

Up to approx. 20 h of practical training

None

Scientists as developers	Scientists as end users (Academia)	Scientists as end users (Industry)	Scientists as decision-makers (Regulators / Grant Evaluators / Peer Reviewers)	Technicians	Clinicians	Postgraduate Students (Doctorate studies)	Postgraduate Students (Master's studies)	Undergraduate Students (Bachelor's Studies)
8%	49%	42%	31%	41%	24%	39%	53%	28%
85%	33%	27%	12%	12%	9%	52%	19%	13%
2%	1%	2%	41%	6%	36%	2%	4%	16%
5%	16%	28%	11%	40%	27%	7%	24%	39%
0%	0%	0%	5%	1%	4%	0%	0%	5%

# TRAINING AND EDUCATION

How?

	Rank of Importance*	Degree of Importance
Bioengineering (Biotechnology, Biomedical)	4,81	Very important
Pharmacology/ Toxicology	4,73	
Biochemistry/ Biology	4,49	
Medicine	4,10	
Engineering (Mechanic, Materials, Chemical)	4,09	
Chemistry	3,44	Somewhat Important
Physics	3,29	

Seminars/courses integrated in a broader training program (1 semester)

Specific postgraduate course (1 to 2 years)

Up to approx. 20 h of non-practical training

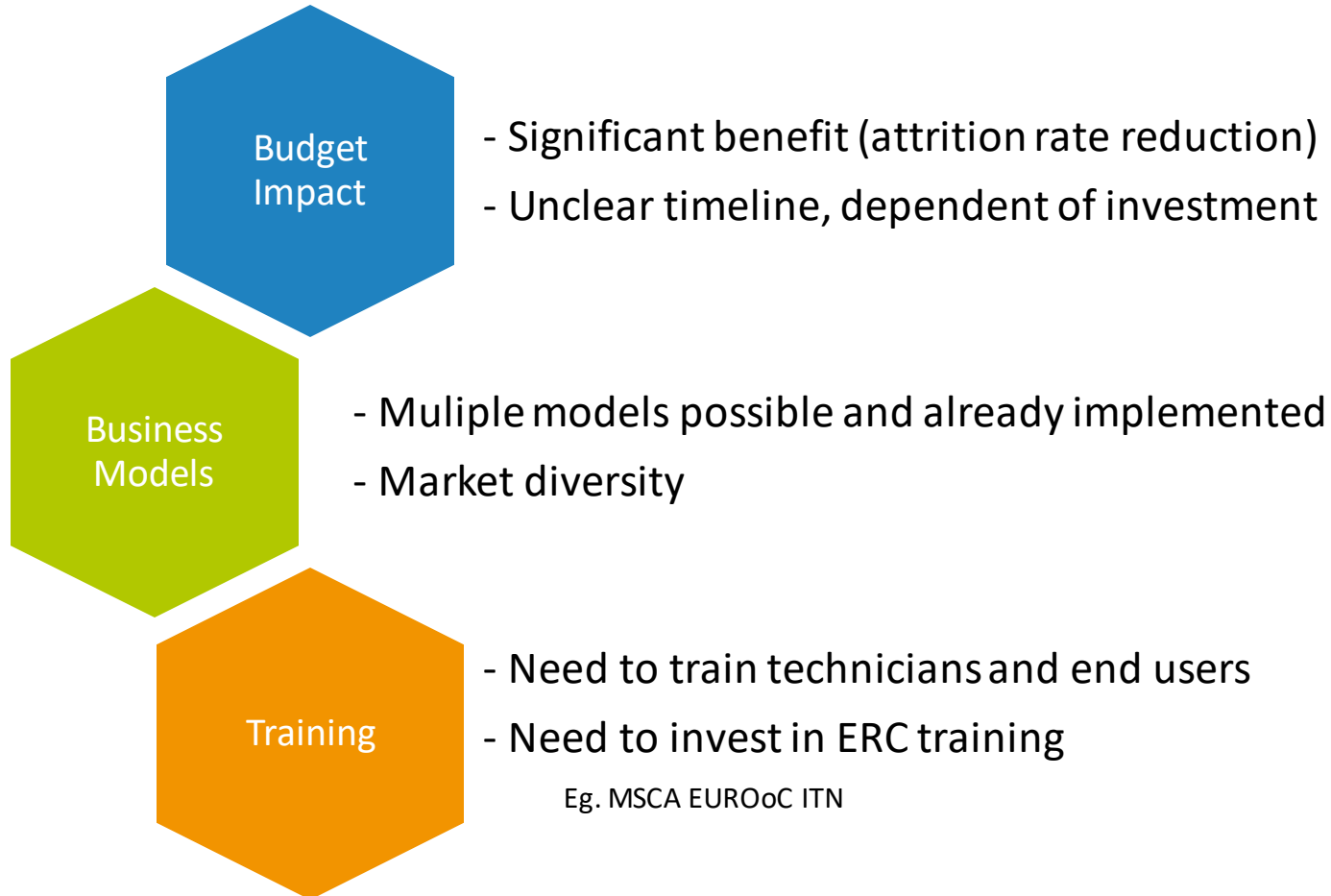
Up to approx. 20 h of practical training

None

Postgraduate Students (Doctorate studies)	Postgraduate Students (Master's studies)	Undergraduate Students (Bachelor's Studies)
39%	53%	28%
52%	19%	13%
2%	4%	16%
7%	24%	39%
0%	0%	5%



# FUTURE PERSPECTIVES



**How to accelerate the adoption of OoC by stakeholders?**

**How can you support us on assuring that?**



COORDINATION AND SUPPORT ACTION

## Achievements & Future Perspectives



23 Septembre 2019, Leiden

# Digital Platform & Community Building

*N. Picollet-D'hahan, CEA, France*



Universidad  
Zaragoza



- broadcast and share **information** about OoC
- be established as **Europe's expert platform** in this field of research.

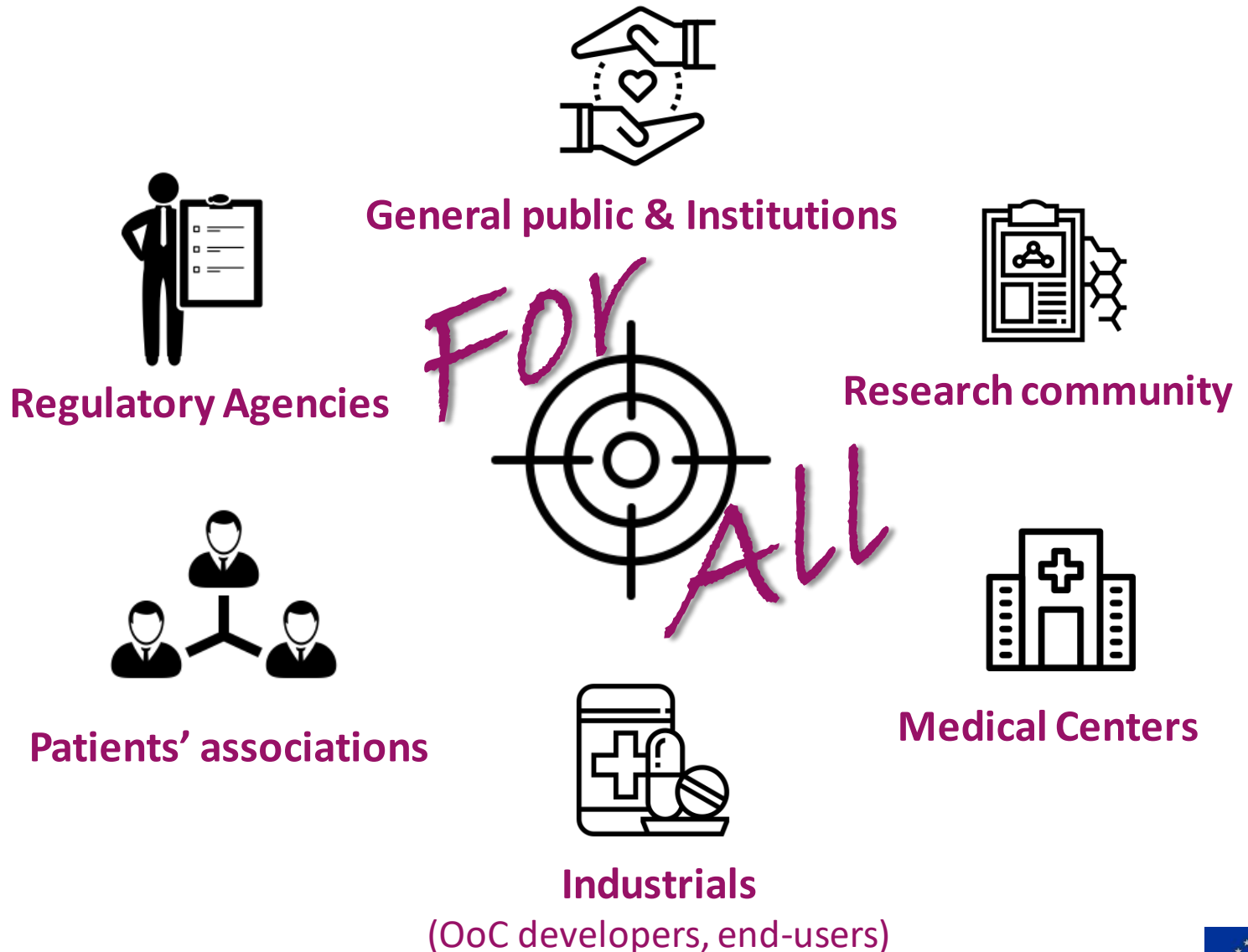


- become a **worldwide reference** for OoC technology.
- encourage **collaborative** projects
- create a **community** of experts
- target a **large audience** (*FOR ALL*)

# Building a broad Community

2

## Target Audience





# Phasing

Oct. 2017

Nov. 2018

March 2019

Specifications

Mapping

Graphic design

Development

Testing & final

**Integration & launching**



- Benchmarking
- Requirements



Pilot group



- Content integration



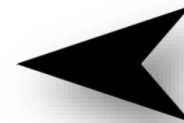
Pilot group

- Pilot version ☒
- **162 Members**



- Architecture
- Functional design
- Ergonomics

**EUROOCS**  
EUROPEAN ORGAN-ON-CHIP SOCIETY



Digital Platform



[www.euroocs.eu](http://www.euroocs.eu)



## Connexion to the website (as a non member)

- Global architecture
- About
- Timeline
- News
- Events

+ introduction to a dedicated access



# A dedicated access for members

3

Pilot version

As a main achievement, the **newborn EUROoCS** and its **support website** is now including a **Digital Platform** for **Members**.



## This dedicated access :

- will serve as the **central point** to gather all information & to boost the **OoC dissemination @ EU and international levels**
- offers a '**marketplace**' for interdisciplinary experience sharing and specific working groups.
- ensures higher **visibility** to European research teams
- allows to **position** those as **key leaders** in the field of OoC.

Join us 😊!

 [www.euroocs.eu](http://www.euroocs.eu)



# Becoming a member...

- ✓ Gives you access to **forum of discussion** (updated topics) and to **specific reports**
- ✓ Helps you to find new academic/industrial **partners**
- ✓ Gives you contacts for **participating** in emerging projects (e.g. H2020)
- ✓ Allows you to highlight **your expertise**
- ✓ Gives you **projects details** and **experts profiles**
- ✓ Allows you to post **job offers, Events, News, special announcements** (Website administrator)
- ✓ Offers you **discounts** to conferences (e.g. EUROoCS Graz, 2019)

[www.euroocs.eu](http://www.euroocs.eu)



## Connexion to the website (as a member):

- Members profiles and mapping
- Projects details and mapping
- Forum



## Key challenges for the future of the EUROoCS website ?

- ☐ **A management structure:** EUROoCS proposed as the driver of the DP, supporting its update and maintenance.
- ☐ **A flexible and evolving tool:** EUROoCS website will be enriched with relevant **new content** coming from **new members** (*Events, News, Expertise, job offers, special announcements...*)
- ☐ **A Business model:** evaluated to generate financial resources through membership fees and advertisements.
- ☐ **A dissemination strategy:** how to invite more people to become a member ? *Networking ? Other European Societies ? Newsletter ? Press release ? Conferences mailing list ?? ...others ????*

Any suggestions ???





*Xavier*



*Sylvie*



*Ignacio*

(15) ORCHID partners,  
Stakeholders (interviewees) @  
Vision Workshop & Inserm  
Workshop speakers





ORCHID final meeting

*WP5 – Regulation, Standardization and ethics*

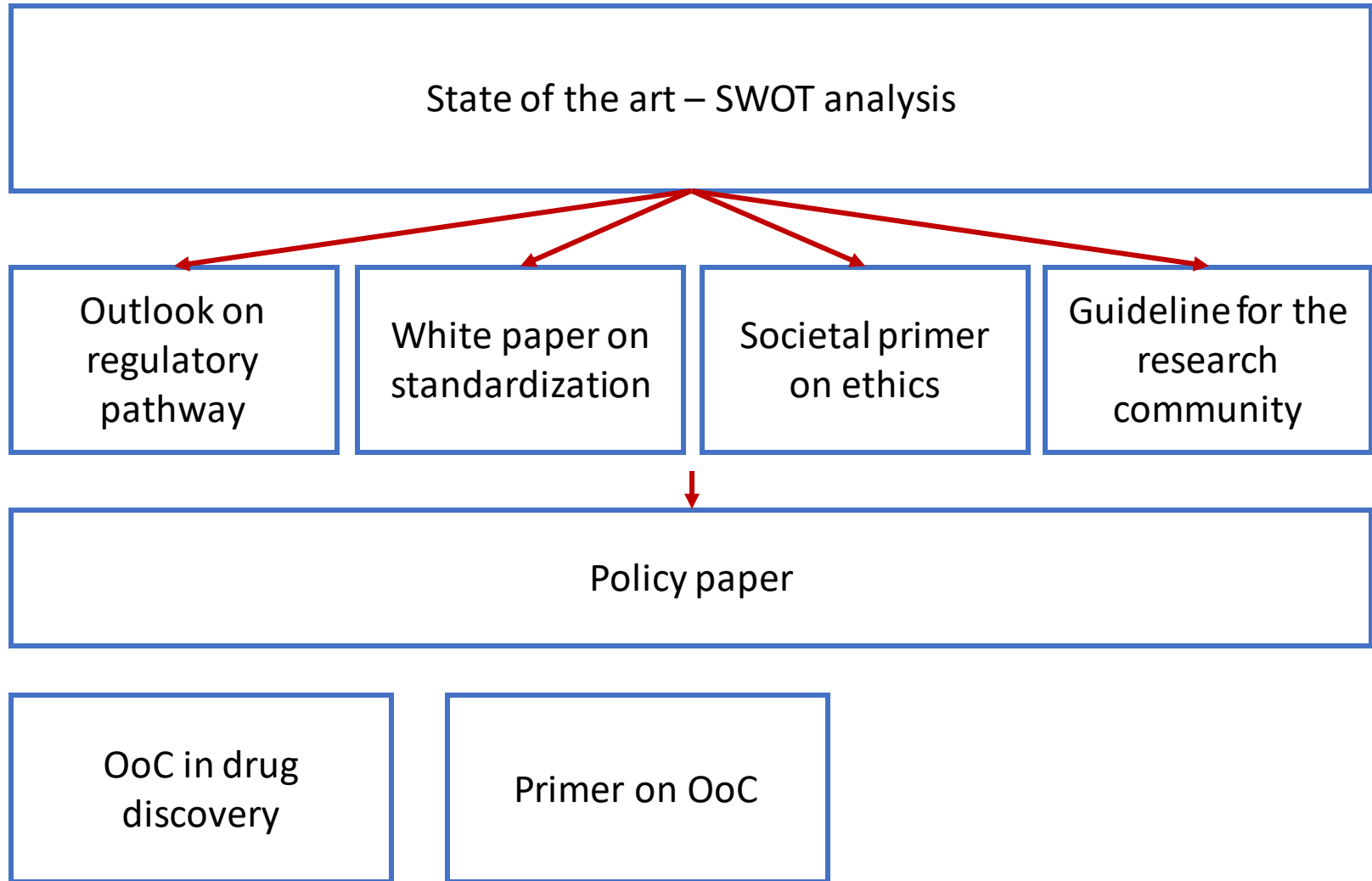
*Dries Braeken/Wolfgang Eberle*

*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884".*





# WP5: standardization, regulation, ethics



# ETHICS/COMMUNICATION

- OoC as an alternative to animal studies – a great opportunity filling the gap on missing test methods
- Ethical debate is more shifted to handling informed consent from the donor
  - Complexity of OoC model poses the challenge of describing all purposes of experimentation upfront
  - Development of a broad and enduring consent
- Connect to other debates
- Largely positive bias today but take caution to overpromising

# ETHICS/COMMUNICATION

- **The window of opportunity for communicating to the public at large is now:** We are only at the beginning of a roadmap for OoC and hence ideally positioned to enter a fruitful dialogue with the public at large with realistic expectations.
- The general public will not value OoC from a technology point of view but will embrace it or reject it **from a personal or societal benefit.**
- **Recommendations:**
  - Explain the impact of OoC with respect to a concrete need. E.g. faster availability of drugs.
  - Use case should be central, not the technology
  - Perspective of impact in time – expectation management
  - Cultural and value difference may influence perspectives
- **The definition**
  - Reduce or translate to understandable concepts
  - Explain!!
- Use the **EUROoCS society** to enable efficient communication

# A reach out to the policy makers...

<b>Policy question: How does OoC technology needs to be communicated in the future to the general public?</b>	<b>Policy choice A: active EU or national programs to disseminate OoC</b>	<b>Policy choice B: leave (academic) community to take the lead</b>	<b>Policy choice C: no communication</b>
<b>Criteria 1: legality</b>	Yes	Yes	Yes
<b>Criteria 2: cost effectiveness</b>	No	Neutral	Yes
<b>Criteria 3: inclusiveness</b>	Yes	Yes, but less probable	Probably not
<b>Criteria 4: impact</b>	Yes	Yes, but less probable	No

# REGULATION

- Regulatory acceptance of 3R's testing approaches:
  1. Availability of the defined test methodology
  2. Relevance – relation of the test to the effect of interest
  3. Context of use: does the new data fill a gap
  4. Reliable/robust
- The validation process (EURL-ECVAM)
  - Evaluation
  - Pre-validation
  - Validation
  - Independent peer review
  - Recommendation for consideration in a regulatory context

# Examples – ongoing efforts - outlook

- NCATS (NIH) testing centers / FDA / DARPA

Human tissue chips program – Tissue Chip testing centers

1. development of in vitro disease models
2. determine disease relevance
3. test effectiveness of candidate drugs

- EU programs (EU-ToxRisk – SEURAT-1, eTox, etc.)

- CIPA initiative

- **EU based testing centers** will be crucial for EU OoC technology adoption
- **Qualification in specific context of use** / EU frameworks
- **Collaboration** with all stakeholders



# A reach out to the policy makers...

**Policy question: How can OoC technology be implemented in the regulatory pathway?**

**Policy choice A: Follow current guidelines for qualification, in concert with original methods (e.g., animal testing)**

**Policy choice B: Policy maker creates an instrument or framework**

**Policy choice C: Policy makes pilot lines for consortia that include relevant stakeholders and is actively involved**

**Criteria 1: legality**

Yes

Not at this moment

Not at this moment

**Criteria 2: cost effectiveness**

Yes

No

Yes

**Criteria 3: inclusiveness**

No

Yes

Yes

**Criteria 4: impact**

Yes, to a lesser extent

Yes

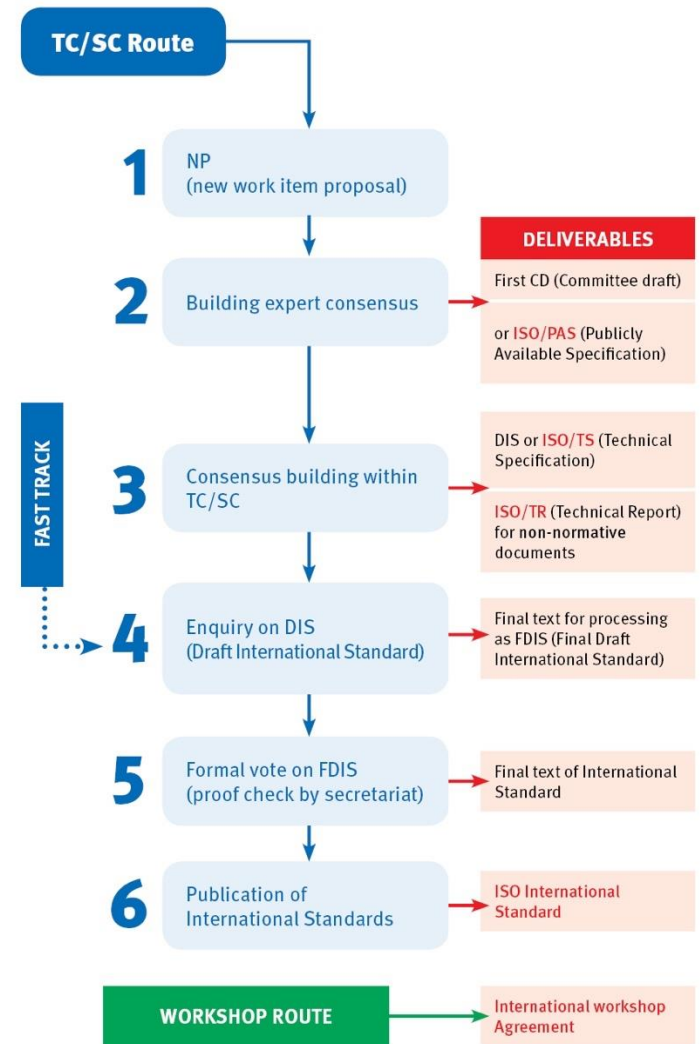
Yes

# STANDARDIZATION

- **Definition:** Standardization is the process of developing and implementing specifications based on the consensus of the views of firms, users, interest groups and governments
- **A technology standard** represents the collective choice resulting from a balance between utility, technical possibilities and the cost structure of manufacturers on the one hand, and constraints of political, social and economic institutions on the other
- **Friend or foe?**
  - Can have a positive impact on innovation, can make industries much more efficient and fuel progress
  - Might constrain innovation by hampering creativity and delaying commercialization of inventions

# Development of standards

- ISO: independent, non-governmental organization with members in 162 countries
- 20,000 standards been set up since 1926
- Others: IEEE, IETF, 3GPP, SEMI, ...



# The key principles in standard development

- **ISO standards respond to a need in the market**

The request to develop a new standard always comes from industry or other stakeholders. In the process, a member of the stakeholder group contacts the national member of ISO, who then contacts ISO.

- **ISO standards are based on global expert opinion**

ISO standards are developed by groups of experts from all over the world, that are part of larger groups called technical committees. These experts negotiate all aspects of the standard, including its scope, key definitions and content.

- **ISO standards are developed through a multi-stakeholder process**

The technical committees are made up of experts from the relevant industry but also from consumer associations, academia, NGOs and government.

- **ISO standards are based on a consensus**

Developing ISO standards is a consensus-based approach and comments from all stakeholders are considered.

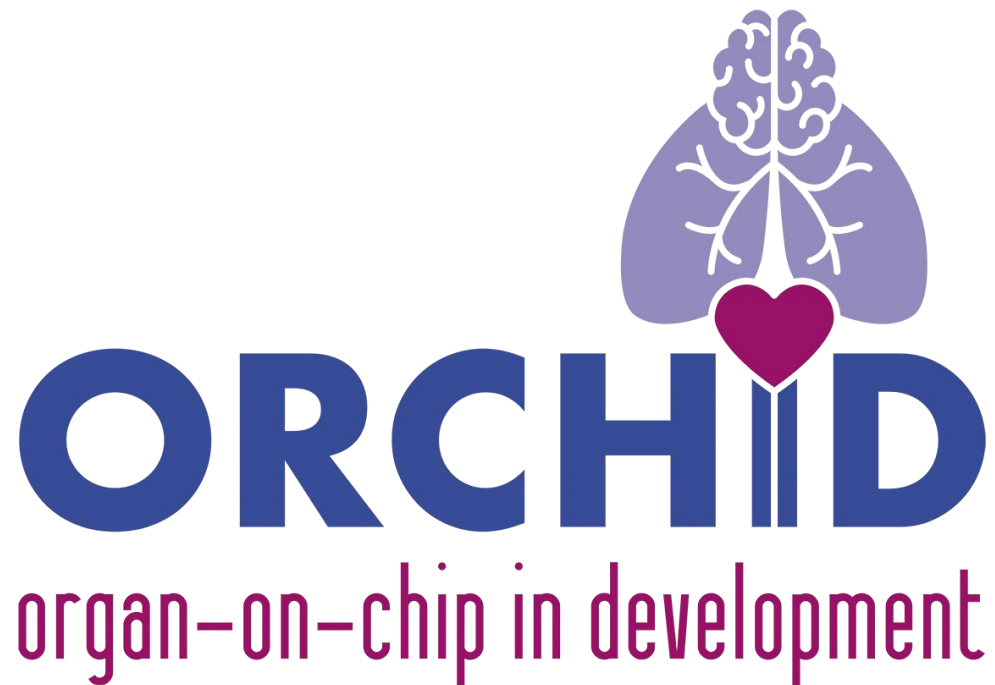
# Standardization for OoC...

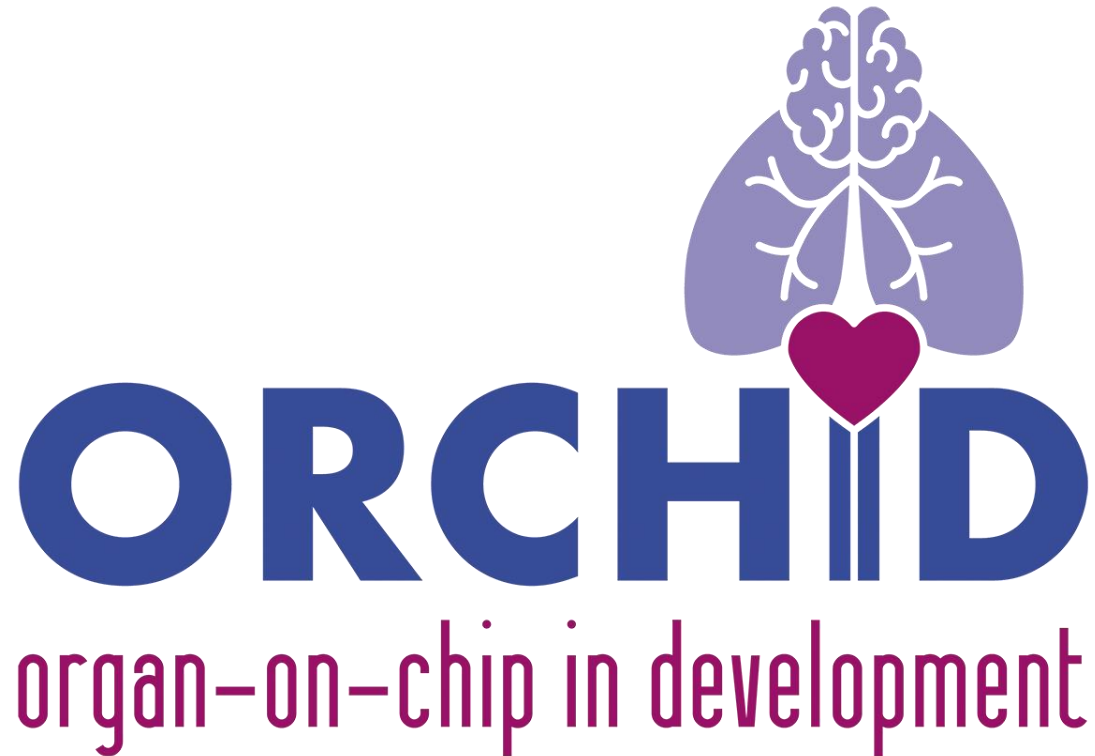
- Lab on chip technology standardization efforts:
  - Working group in ISO, CEN/TC 332 (WG 7 micro process engineering) - *ISO 10991 2009 working document*
  - DIN (Deutsches Institut für Normung) standardization group on characterization for microreactors
  - Microfluidics Consortium and consortium partners of EU **Mfmanufacturing project**
    - Standard pitch spacing dimension
    - Connectors
- Cell culture good practices

# A reach out to policy makers...

<b>Policy question: How can standardization be implemented in OoC technologies?</b>	<b>Policy choice A:</b> Bottom up, i.e., spontaneous and without active role of the policy maker	<b>Policy choice B:</b> Top down approach facilitated by the policy maker	<b>Policy choice C:</b> Top down approach with a strong direction of the policy maker and influenced by regulatory stakeholders
<b>Criteria 1: legality</b>	Yes	No	No
<b>Criteria 2: cost effectiveness</b>	Yes	Yes	Yes
<b>Criteria 3: inclusiveness</b>	No	Yes	Yes
<b>Criteria 4: impact</b>	Uncertain	Yes	Yes







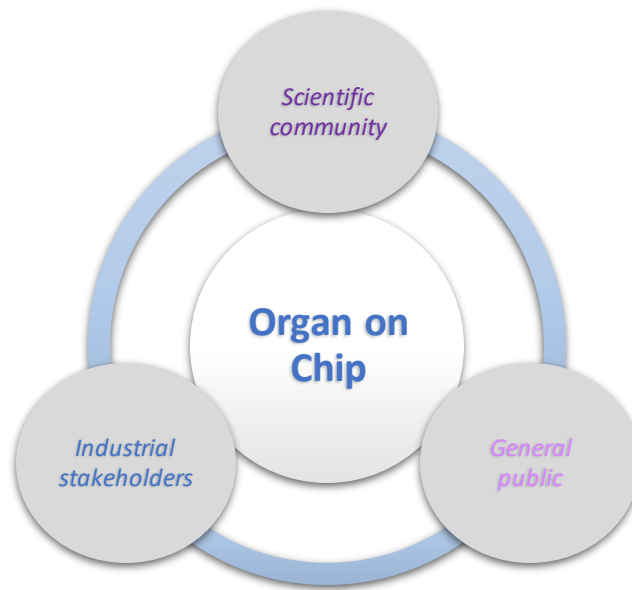
*Awareness and communication*

*Luis J Fernandez / UNIZAR*



*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884".*

# Communication and dissemination strategy



Informing about the project

Project Website  
Press release  
Brochure  
Articles in magazines  
Open days / Guided visits

Informing about results

Project Website  
Brochures  
Social media  
Newsletter  
Conference presentation  
Open days / Guided visits

Provide results for their use

Scientific publications  
Roadmap  
Training / Workshops  
Brochures  
Available repository of public deliverables

# Website and Logo



[HOME](#) [ORCHID PROJECT](#) [MEETINGS](#) [PARTICIPANTS](#) [NEWS](#) [LOGIN](#) [CONTACT](#)

## ORGAN ON CHIP IN DEVELOPMENT

The ORCHID project (Organ-on-Chip development) is an EU initiative, coordinated by Leiden University Medical Center and the Dutch Organ-on-Chip consortium hDMT in The Netherlands. The main goal of ORCHID is to create a roadmap for organ-on-chip technology and to build a network of all relevant stakeholders in this promising innovative field. In the ORCHID project that started on 1 October 2017 in total seven leading European research institutions are involved.

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No 766854





Spring has been a very active period for the Organ-on-Chip community. In May, Stuttgart was the European capital of the organ on chip technology. This city hosted one of the important events of the ORCHID Project, the **ORCHID Vision workshop**. In this workshop, more than 30 experts with different profiles (academia, industry, regulators, etc.) met to define the roadmap for Organ-on-Chip in Europe and address the new challenges it faces. In addition to our workshop, in the same city, the **EUROoC workshop** on Organ-on-Chip took place. This conference brought together leading researchers with the new generations in a very favorable environment for networking.

After a well-deserved holiday period for our Organ on chip community during the summer time, Autumn has arrived plenty of very exciting conferences that we detail in the upcoming events section.

Moreover, it is our great pleasure to highlight the creation of a **European training program for organ-on-a-chip research** coordinated by our colleague Dr. Peter Loskill (Fraunhofer Institute, Germany). With more than 20 partners from different countries and sectors, this European network will focus on the interdisciplinary training of young researchers.

Last but not least, On September 18 the **Health EU flagship** proposal, leaded by Lex Eggermont (Gustave Roussy, France), Adrian Ionescu (EPFL) and Albert van den Berg (UTwente), was successfully submitted. Organ on chip technology was one of the main pillars of the proposal in which the future health based on avatars was purposed.

As you can see, there is a new era in the organ on chip technology,  
Do not miss it!!!

Due to changes in the European data protection legislation we have to ask you to reaffirm your interest in receiving our newsletter. You will receive an email shortly in this regard. We hope to continue having your confidence. In return, we will try to improve our content every day and provide you with the most relevant information related to Organ-on-Chip technology.

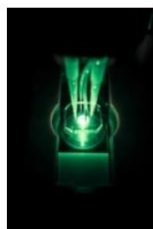
THANKS !!!



## TOP NEW STORIES



Invitational Vision workshop ORCHID in Stuttgart. As part of our ORCHID project roadmap a vision workshop has been organized in Stuttgart to discuss the challenges and unmet needs in the ORGAN-on-Chip field and to determine the ingredients for the European Organ-on-Chip roadmap. [click here](#)



**EUROoC Network** has been funded by the European commission to promote the interdisciplinary training of young scientists in the Organ on chip field. A consortium of 20 top research institutes and companies are going to work in close collaboration to establish a European research network to promote organ-on-a-chip technology. More info: [click here](#)



Health EU has made it into the second round of the selection process to become FET (future and emerging technologies) Flagships. Health EU is a major project, led by a consortium headed by EPFL in collaboration with hDMT and the University of Twente and run by Adrian Ionescu at the Nanoelectronic Devices Laboratory (Nanolab). If it is selected, it will receive one billion euros over ten years as part of the European Commission's ambitious funding program. A total of 33 projects from universities across Europe have applied for the FET program. Only 17 of them - just over half - were selected for the second round, scheduled to end on 18 September 2018. More info: <https://www.health-eu.eu/>

**CEA paper made the cover of the latest issue of Nucleic Acids Research (NAR)**

In this paper, our colleagues from CEA have demonstrated that organoid cultures in 3D matrices inside Organ-on-Chip microdevices are relevant models to mimic the complex *in vivo* environment that supports cell physiological and pathological behaviors. Read the full paper here .

<https://academic.oup.com/nar/article/46/12/e70/4831079>



## UPCOMING EVENTS



ORCHID partners from CEA are organizing a very interesting two phases workshop focused "Organ-on-chip: understanding and mimicking living organisms for better treatment"

**15-17 October 2018: Insem Workshop** "Organ-on-chip: understanding and mimicking living organisms for better treatment"-Bordeaux, France  
([click here](#))

**22-25 October 2018: ORCHID Insem Workshop** "Organ-on-chip: understanding and mimicking living organisms for better treatment", phase II Technical Workshop, Lyon and Grenoble, France  
([click here](#))



**8-9 November 2018: IOOC2018** (International Organ-on-chip Symposium 2018) - Eindhoven, the Netherlands ([click here](#))



**11 - 15 November: MicroTAS 2018** - The Twenty Second International Conference on Miniaturized Systems for Chemistry and Life Sciences (μTAS 2018), Taiwan ([click here](#))



**11-12 December 2018: International MicroNano Conference** (ORCHID partner hDMT is in the program committee. Several Organ-on-Chip sessions and an Organ-on-Chip hands-on workshop will be organized) -Amsterdam, The Netherlands. Keynote speaker Uwe Marx, invited speaker Cecile Legallais both involved in the ORCHID interviews for WP2. ([click here](#))



**Report on the 11th Annual Concertation and Consultation Workshop on Micro-Nano-Bio-Systems: MNBS 2017 has been released.** This report is the result of the Micro-Bio-Nan workshop that has been held in Amsterdam as part of the International MicroNanoConference 2017 on 12 and 13 December. In this report the European Organ-on-Chip network has been mentioned, as well as ORCHID (see reference 31) ([click here](#))

## ORCHID IN THE NEWS

Aragón Medical Magazine: Zaragoza Valley

## JOB OFFER

CDD/Post-doctoral position in microfluidic

Post-doc position in microfluidics and bioengineering for a human « Pancreas-on-a-chip »

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884





# Brochures









ORGAN ON CHIP IN DEVELOPMENT

The ORCHID project (Organ-on-Chip development) is an EU initiative, coordinated by Leiden University Medical Center and the Dutch Organ-on-Chip consortium hDMT in The Netherlands. The main goal of ORCHID is to create a roadmap for organ-on-chip technology and to build a network of all relevant stakeholders in this promising innovative field. In the ORCHID project that started on 1 October 2017 in total seven leading European research institutions are involved.



Organ-on-Chip In Development:  
**Towards a European roadmap  
for Organ-on-Chip**







Organ-on-Chip In Development:  
**Building blocks for a European  
Organ-on-Chip roadmap**







# Social media



**Organonchip**  
@organonchip · Te sigue

Organ on chip Technology. Project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884

📍 España  
🌐 h2020-orchid.eu  
📅 Se unió en diciembre de 2016

[Twittear a](#) [Mensaje](#)

27 Seguidores que conoces

**Tweets** **Tweets y respuestas** **Multimedia**

Organonchip retweeted  
**Organonchip** · 11 nov.  
Hopefully we will live them together !!!!! 🙏

**Organ-on-a-Chip Technologies Network** @OrganOnAChip  
Exciting times! twitter.com/hdmt\_technolog...

Traducir Tweet

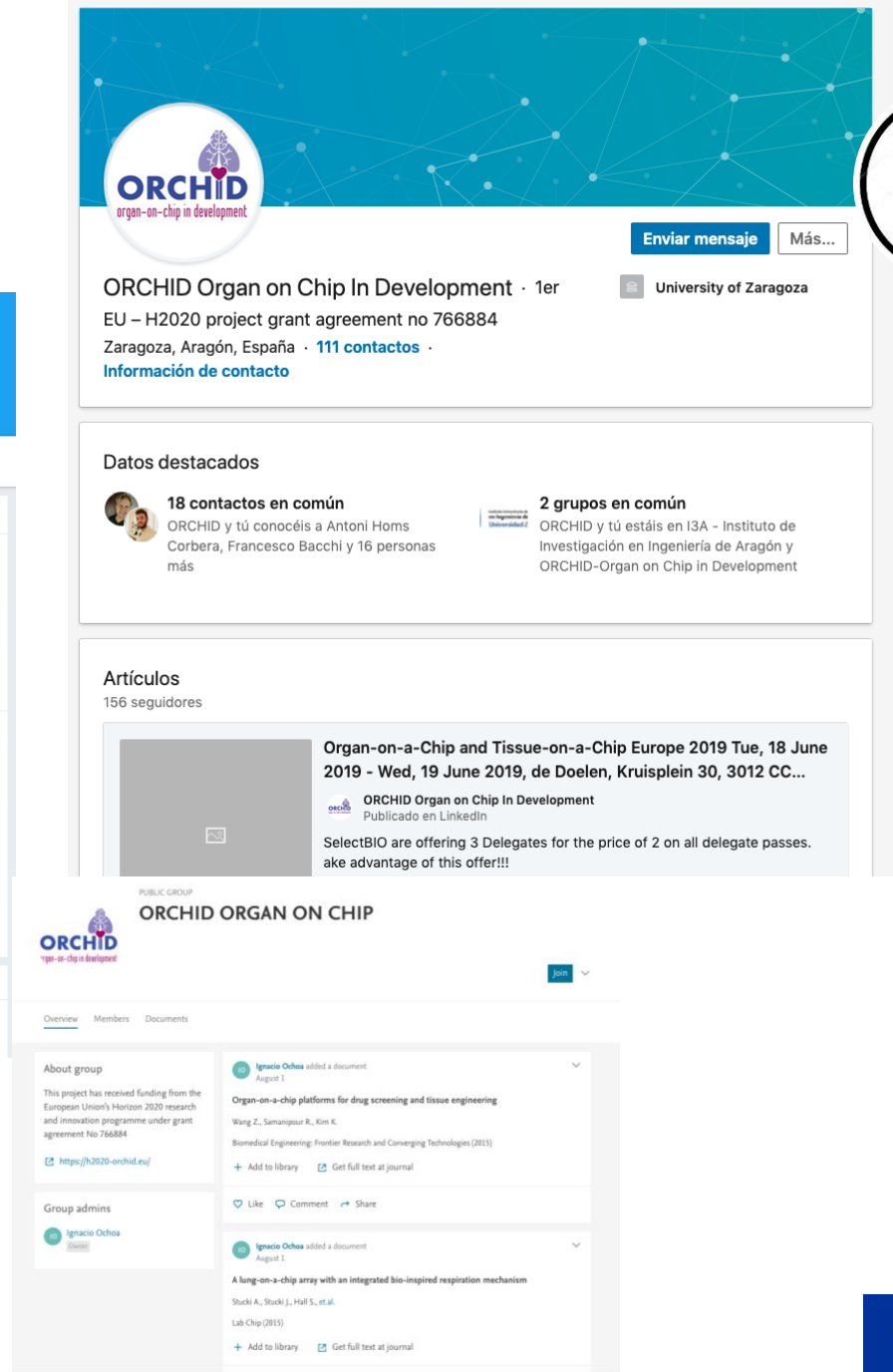
Organonchip retweeted  
**EUROoC 2019** @Eurooc2019 · 9 nov.  
European Orga-on-Chip society has been launched! #organonchip

**Computational Biophysics and Imaging Group** @Hytti...  
Launching of the European Organ on Chip Society in Eindhoven! Looking forward to coming activities and conferences. Great possibilities as novel source of #personalizedmedicine data for #inSilico community ...

Traducir Tweet

**Tweet promocionado**

**BenchSci** @BenchSci · 24 oct.  
A **new** antibody search engine with publication data. **#Free** online platform for academic scientists!

**ORCHID**  
organ-on-chip in development

[Enviar mensaje](#) [Más...](#)

**ORCHID Organ on Chip In Development** · 1er  
EU – H2020 project grant agreement no 766884  
Zaragoza, Aragón, España · [111 contactos](#) · [Información de contacto](#)

**Datos destacados**

**18 contactos en común**  
ORCHID y tú conocéis a Antoni Homs Corbera, Francesco Bacchi y 16 personas más

**2 grupos en común**  
ORCHID y tú estáis en I3A - Instituto de Investigación en Ingeniería de Aragón y ORCHID-Organ on Chip in Development

**Artículos**  
156 seguidores

**Organ-on-a-Chip and Tissue-on-a-Chip Europe 2019 Tue, 18 June 2019 - Wed, 19 June 2019, de Doelen, Kruisplein 30, 3012 CC...**  
ORCHID Organ on Chip In Development  
Publicado en LinkedIn  
SelectBIO are offering 3 Delegates for the price of 2 on all delegate passes. Take advantage of this offer!!!

**ORCHID ORGAN ON CHIP**

[Overview](#) [Members](#) [Documents](#)

**About group**  
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766884  
<https://h2020-orchid.eu/>

**Group admins**  
Ignacio Ochoa

**Documents**

**Ignacio Ochoa** added a document August 1  
**Organ-on-a-chip platforms for drug screening and tissue engineering**  
Wang Z., Samanpour R., Kim K.  
Biomedical Engineering: Frontier Research and Converging Technologies (2015)  
[Add to library](#) [Get full text at journal](#)  
[Like](#) [Comment](#) [Share](#)

**Ignacio Ochoa** added a document August 1  
**A lung-on-a-chip array with an integrated bio-inspired respiration mechanism**  
Stucki A., Stucki J., Hall S., et al.  
Lab Chip (2015)  
[Add to library](#) [Get full text at journal](#)



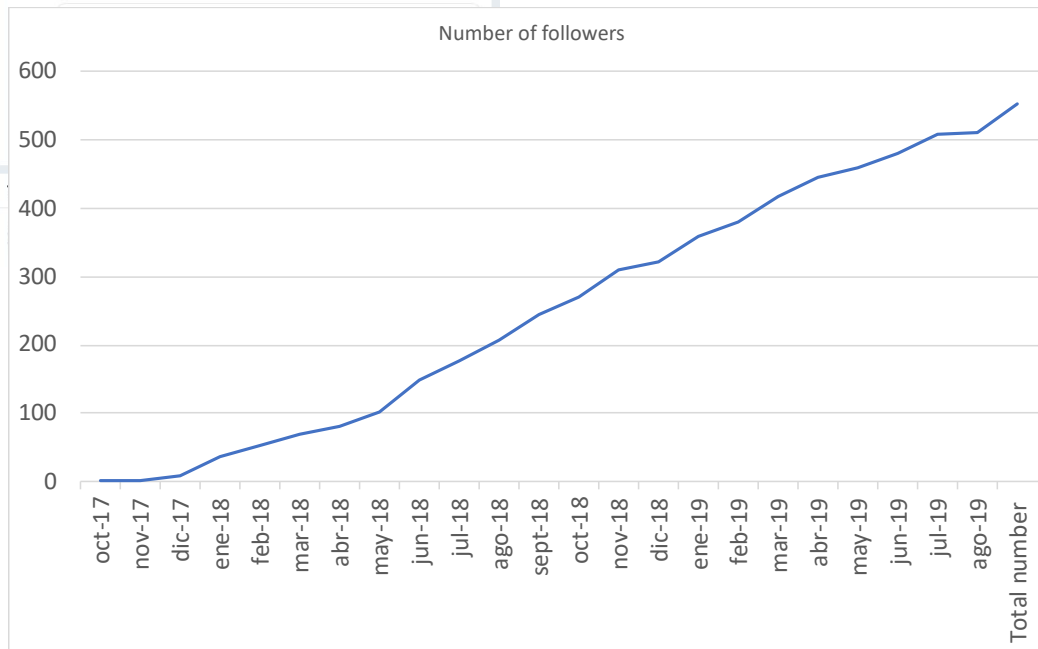
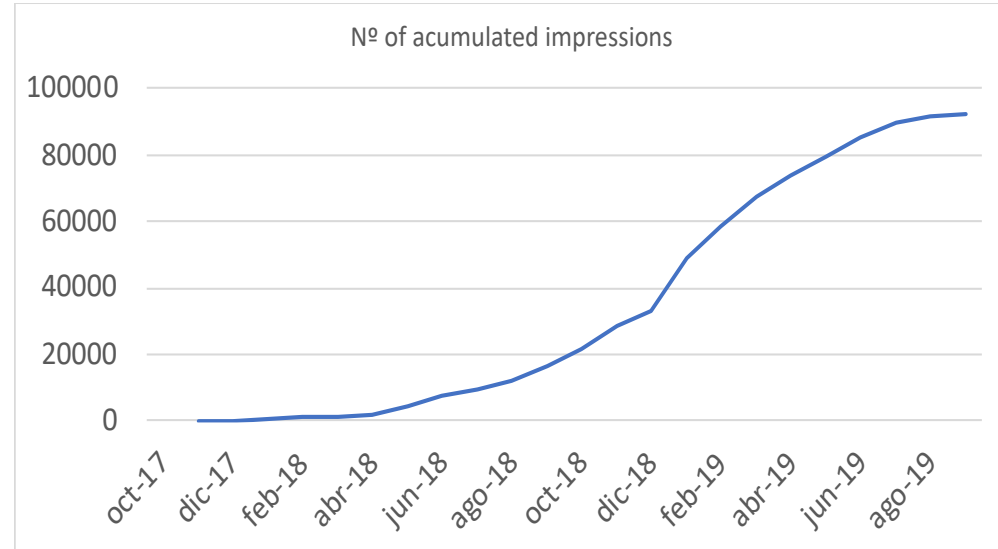
# Social media



## REACHED COUNTRIES IN LINKEDIN



# Social media



# Social media

According to twitter analytics,  
Some of our principal followers during this period



## Seguidor principal Seguido por 1.680

personas



**Don Ingber**

@DonIngber LE SIGUE

Founding Director @wyssinstitute, Judah Folkman Prof. of Vascular Biology @bostonchildrens, @harvardmed, Prof. of Bioengineering @hseas. Tweets are my own.

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 4.936

personas



**Timothy Kassiss**

@TimothyKassiss LE SIGUE

Founder & CEO at Augence Technologies (https://t.co/BBTYdkq032) and instructor @MIT. Ph.D. in Bioengineering. Previously @GeorgiaTech and @UniofNottingham.

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 9.291

personas



**YanThoinet**

@YanThoinet LE SIGUE

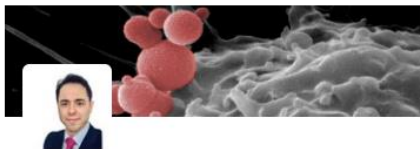
Spect'acteur engagé #impactinvesting #SDGs #Biodiversity @CleantechBA #BusinessAngels #Cleantech #Deeptech #Startups @i4animal #AnimalWelfare @bangels4animal

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 3.640

personas



**Christian Sánchez**

@cristianespinel LE SIGUE

@nanolmmunotech co-founder and CEO. @SEImmunologia ambassador. A lover of #Science, #Immunology, #Nanotechnology, #Biotechnology,...2♀🐶+🐱+🐭 dad.

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 1.020

personas



**PISC**

@PISCLtd LE SIGUE

The PETA International Science Consortium Ltd. promotes & funds animal-free testing approaches. Following ≠ endorsement

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 1.170

personas



**Gordana Vunjak-Novakovic Lab**

@GVNlab LE SIGUE

Laboratory for Stem Cells and Tissue Engineering at @Columbia University, directed by Dr. Gordana Vunjak-Novakovic - @ColumbiaBME @CSCiColumbia @ColumbiaMed

[Ver perfil](#)

[Ver el panel de seguidores](#)

## Seguidor principal Seguido por 1.602

personas



**Rui L. Reis**

@RLGReis LE SIGUE

Vice-Rector for R&D and Innovation of University of Minho, Director of 3Bs Research Group, Director ICVS/3Bs, Prof. Biomaterials, Tissue Engineering, Stem Cells

[Ver perfil](#)

[Ver el panel de seguidores](#)

# ORCHID vision workshop

Stuttgart 23-5-2018

## Aims

*Establish the **roadmap vision**, including definition of the **concrete desired and feasible short-term, mid-term and long-term goals** for growth and deployment of the Organ-on-Chip technology.*

## Most relevant goals achieved

- *Organ-on-Chip (OoC) consensual definition*
- *Kick off meeting of the future European Organ on Chip Society*
- *Identification of the most relevant aspects related with:*
  - ✓ *Unmet needs*
  - ✓ *Technological challenges*
  - ✓ *Qualification and validation*





# ORCHID strategy workshop

Leiden 17-1-2019

## Aims

- Establish a European OoC *roadmap* through *expert* discussions, conclusions and recommendations.
- Six specific *building blocks* were identified:
  - (1) Application
  - (2) Specification
  - (3) Qualification
  - (4) Standardization
  - (5) Production/upscaling
  - (6) Adoption.

## Most relevant goals achieved

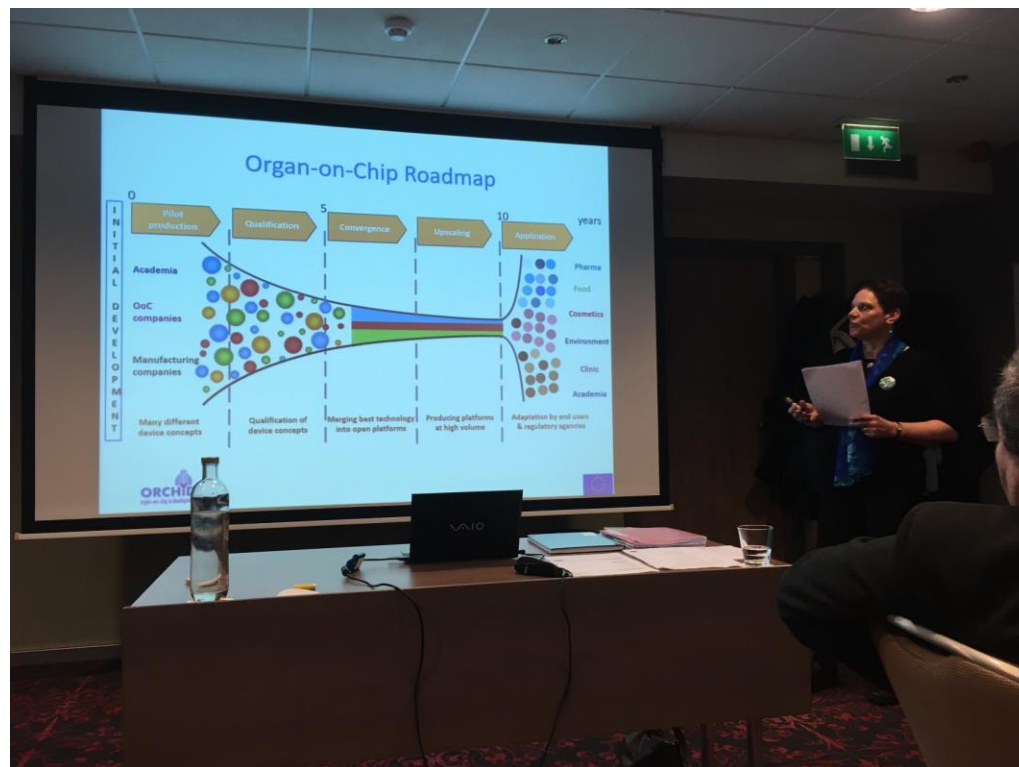
- General consensus on the potential *contribution* of the European Organ-on-Chip Society (*EUROoCS*)
- EUROoCS will initiate and *catalyze dialogue* between OoC developers, end users and regulators





# ORCHID strategy workshop

## Leiden 17-1-2019



# Participation in conferences

## Aims

- *Attract the attention of the scientific community about the benefits of the Organ-on-Chip technology*
- *Increase the interest of young researcher in order to incorporate this technology into their laboratories.*

## Some numbers

- 36 conferences with a total of 8.000 attendees
- Different topics: Organ on Chip and others (toxicology, cancer, etc.)
- Partners involved in the organization of EurOoC 2018



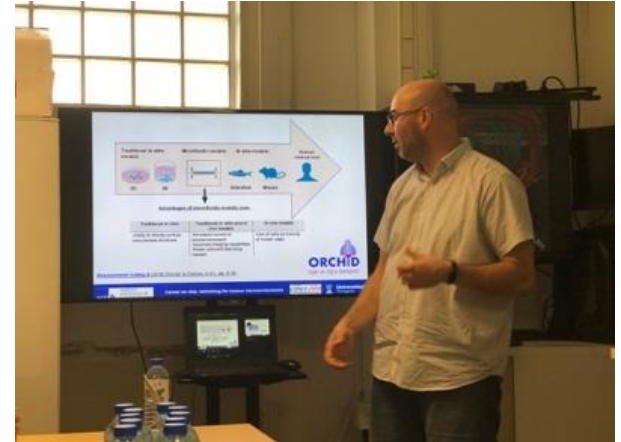
# Industrial Stakeholders

## Aims

*Mobilize the European industrial stakeholders to promote the development and innovation of this technology*

## Most relevant goals achieved

- Experts interviews to define unmet needs, technological challenges and commercial and cost issues
- Bilateral meetings to promote collaboration between the academic and industrial sector.
- Establishment of a European research network to promote organ-on-a-chip technology. H2020 Innovative Training Networks (EurOoC)



# General Public

## Aim

*Communicate to the European citizens the main goals of the ORCHID project and also disseminate the results obtained in the frame of this project*

## Highlighted activities

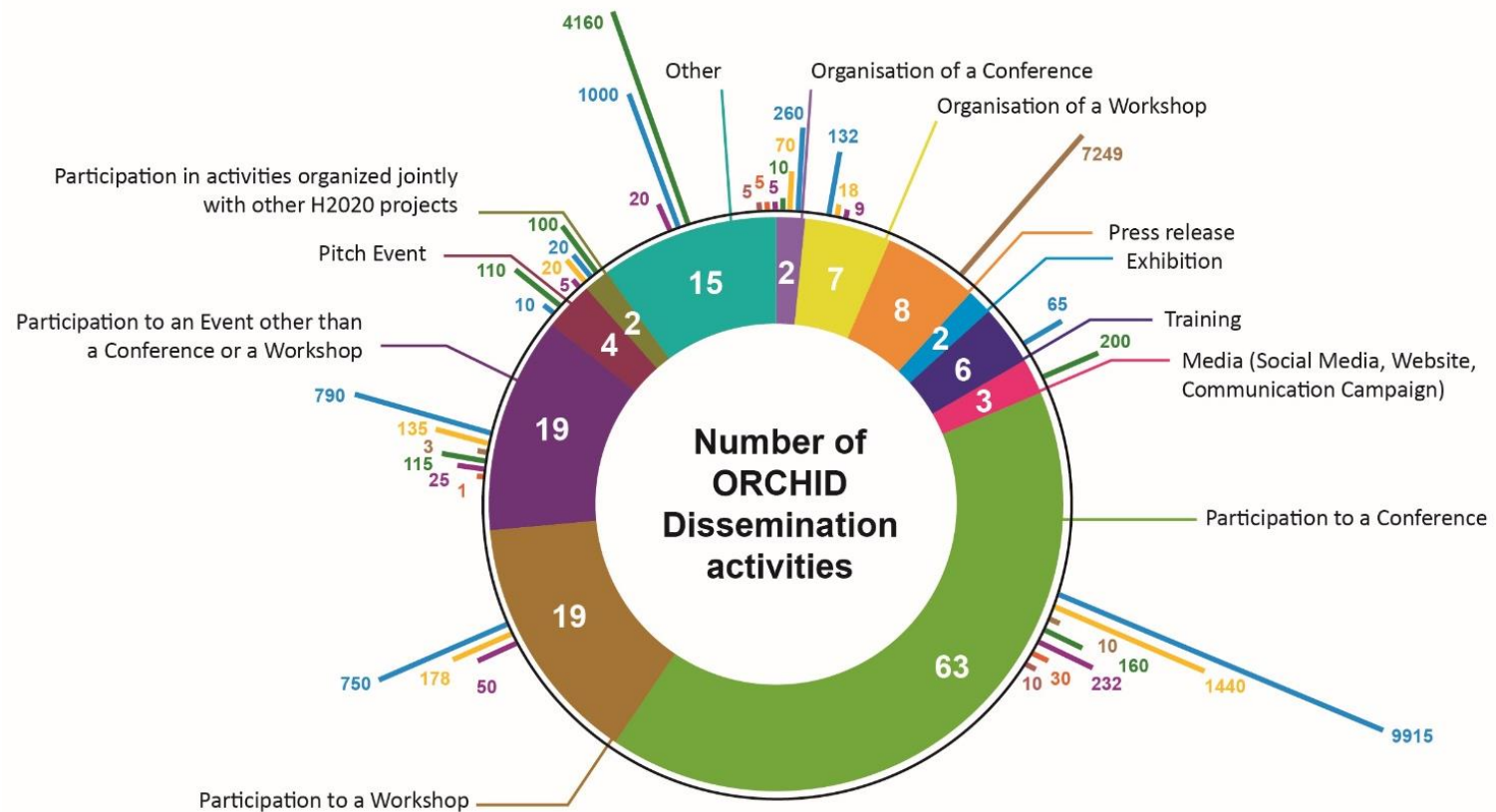
- *European researchers night*
- *Pint of Science*
- *Open doors and visits to Primary schools, High-Schools*
- *TV shows, radio, etc....*





# Summary:

## Dissemination activities

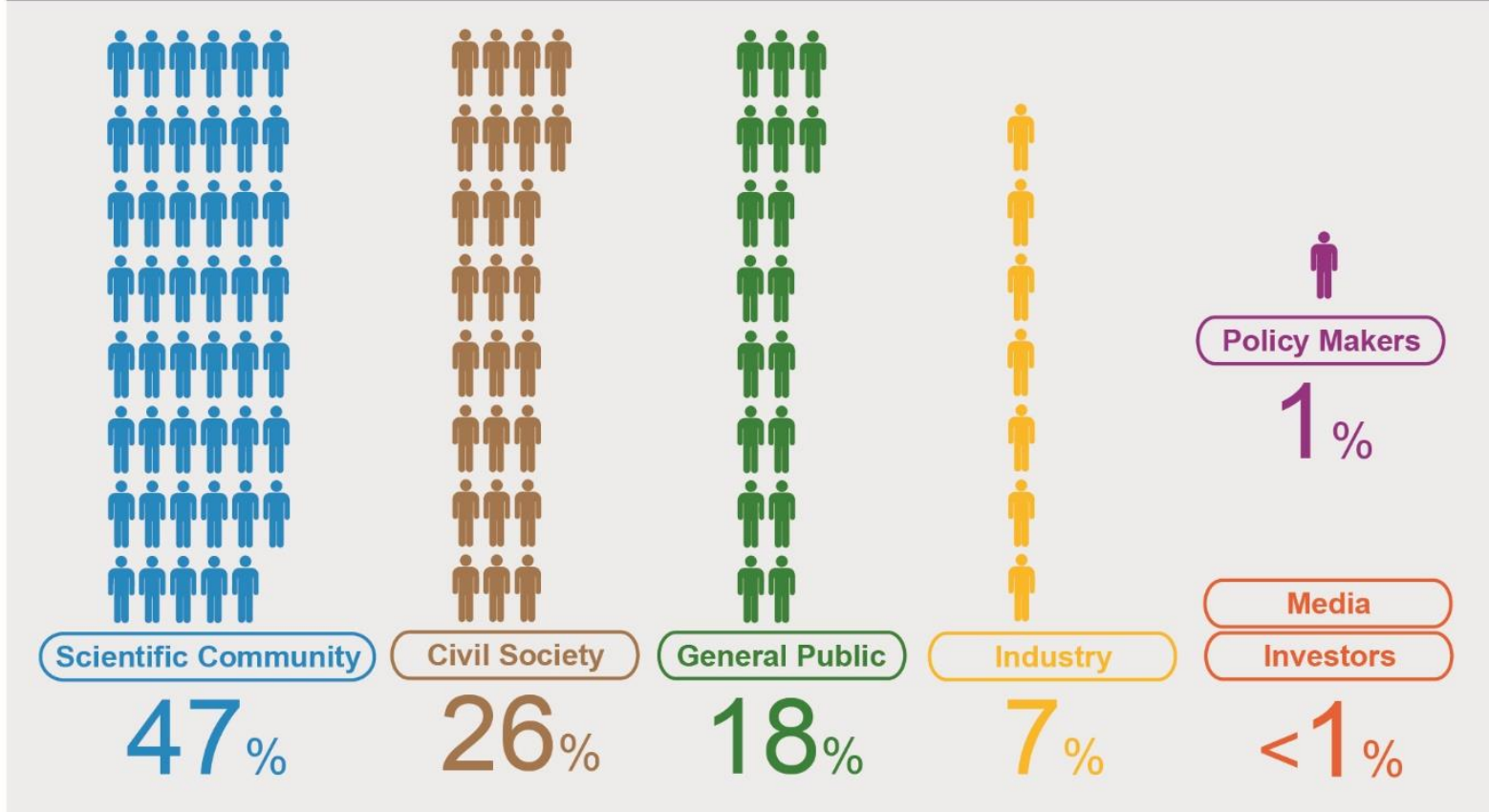


### Estimated numbers of persons reached



## Summary

# +27,000 persons reached





## Most Remarkable Future Actions

# Targets

 POLITICIANS


 SCIENTISTS

 PATIENTS

 REGULATORY AGENTS

 CLINICIANS

 END USERS

 GENERAL PUBLIC

## Most Remarkable Future Actions

# Targets

02

■ POLITICIANS

■ SCIENTISTS

■ GENERAL PUBLIC

■ **PATIENTS**

■ REGULATORY AGENTS

■ **CLINICIANS**

■ END USERS

# Patients

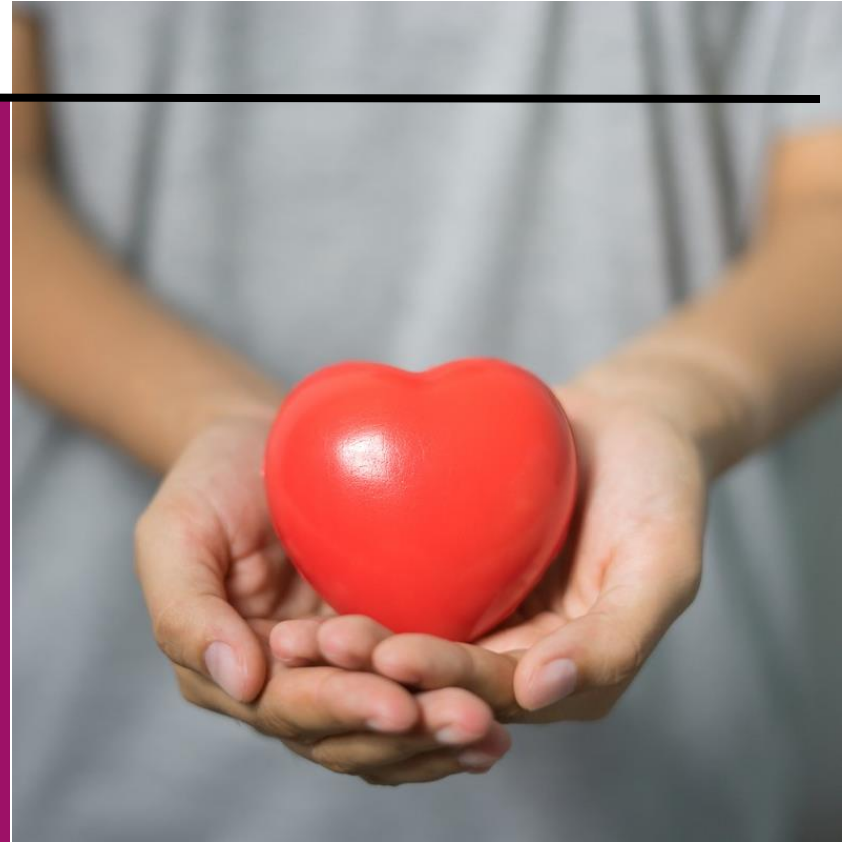
---

Who are they?

*Associations of patients of different pathologies at European level.*

What is the message?

*Let the patient see the benefits and possibilities of OoC technology to improve the quality of life.  
Tiny technology helping bring safe new drugs to patients faster.*



# Patients

---

## HOW TO REACH THEM

- *An explanatory, illustrative document should be prepared, with specific information for the patient association.*
- *Draw up a list of 20 most important patient associations in Europe. (see annex 1).*
- *Contact the president of the patient association for an interview.*
- *Give a presentation about the technology (personally) and the roadmap of ORCHID focusing on their needs.*

# Patients

---

## FOLLOW UP INITIATIVES

- *Invite a patients' association each year to take part in a round table at the EUROOCS congress to explain their problems and / or needs.*
- *Maintain regular contact through newsletters or events.*
- *Each year select new patient associations to contact with in order to obtain feedback on OoC's application priorities.*

# Clinicians

---

Who are they?

*Medical staff.*

What is the message?

*Let them know the concept and what is the possibility they have to imply it in the clinic and at the same time get information from them.*





# Clinicians

---

## HOW TO REACH THEM

- *Try to reach them in medical conference, setting up a stand.*
- *Draw up a list with the most relevant Health Research Institutes in Europe (annex 1).*
- *Select the 10 most relevant and try to make a personal interview with the responsible.*
- *An explanatory, illustrative document should be prepared, such as a brochure (specific for clinicians), explaining OoC technology and its benefits and disseminate it among the next 20 Institutes.*
- *Invite medical associations to the EUROoCS round table and request space in their congresses to demonstrate our technology.*
- *Organize outreach sessions in hospitals for resident doctors and medical students (3 per year).*

# Clinicians

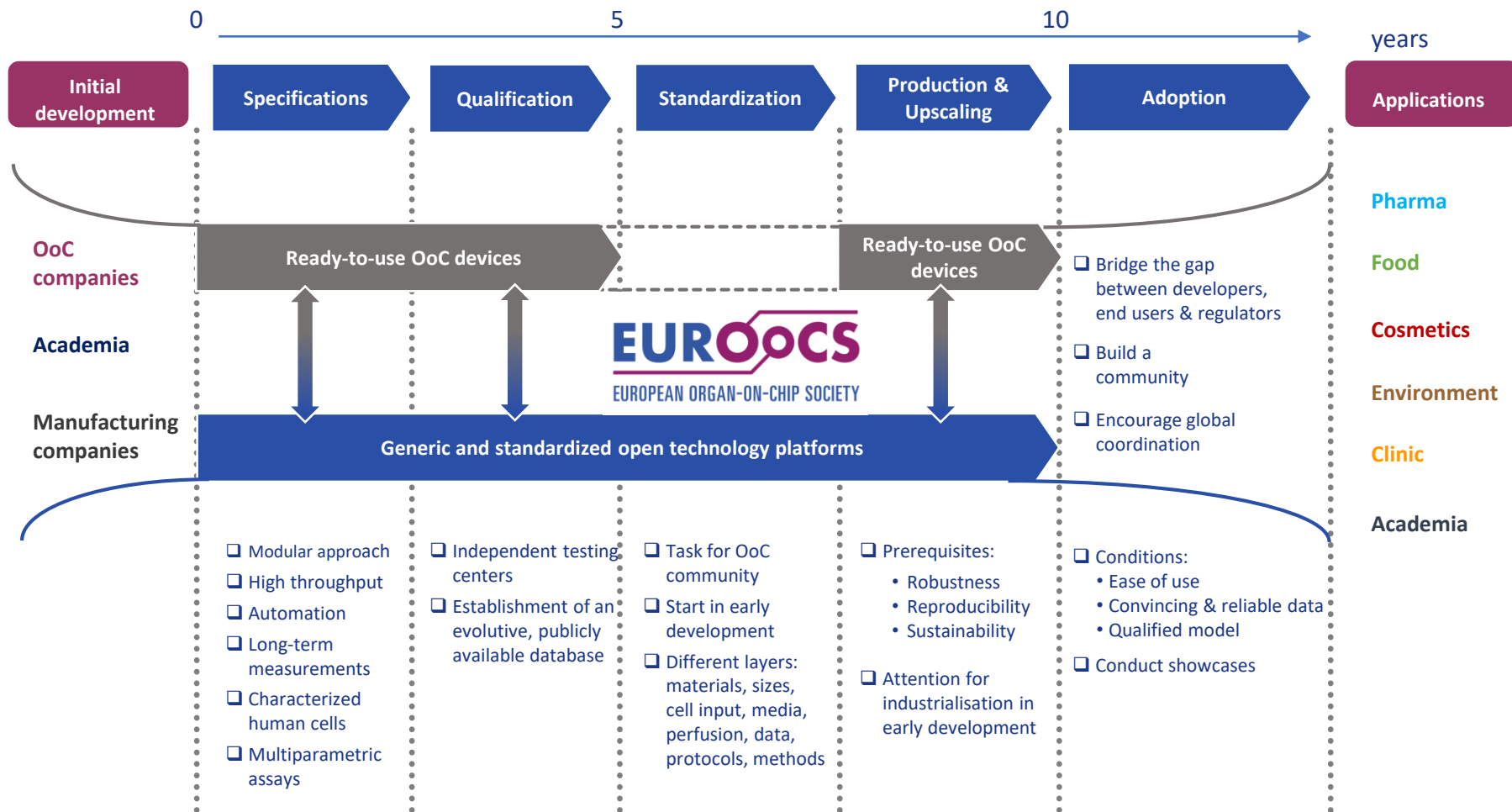
---

## FOLLOW UP INITIATIVES

- *Invite a research organization to the EUROOCS round table*
- *Co-organize satellite sessions in their annual meetings with similar organizations to identify their needs and to define ways of increasing collaboration*
- *Each year select new clinical societies, Aligned with the patient associations, to contact with in order to obtain feedback on OoC's application priorities and needs*

# Organ-on-Chip Roadmap

## The building blocks



# Dissemination

Policy makers



General public



Regulatory agencies



Research community



Patient associations

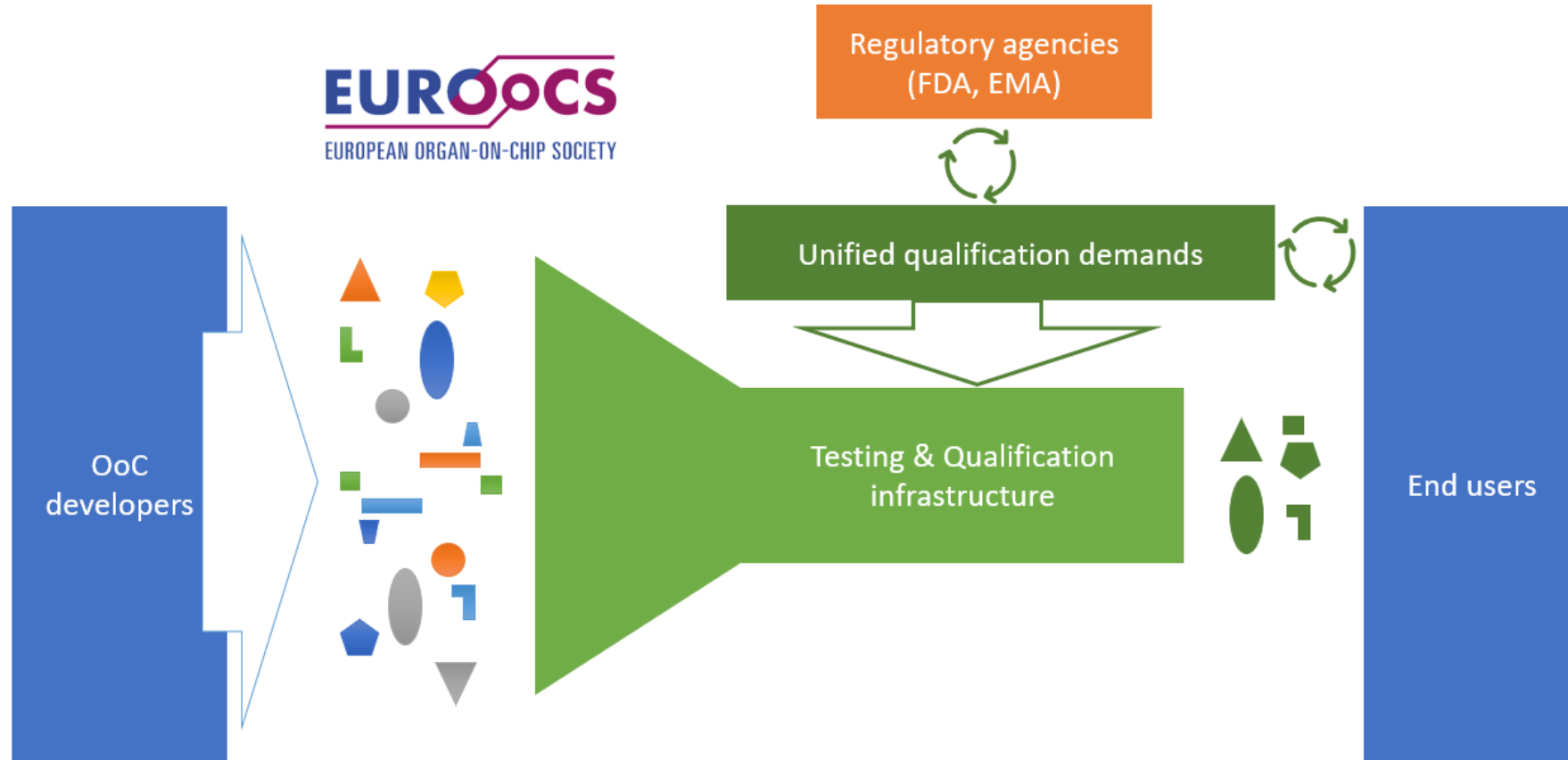


Industry



Medical centers

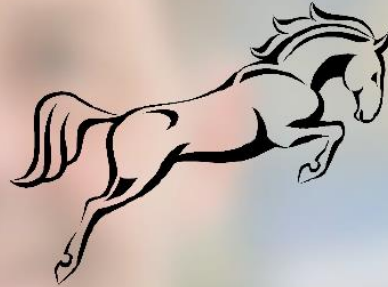
# Qualification



# Standardization

UNIVERSITY OF TWENTE.

**TOP.**



**TWENTE ORGAN-ON-CHIP PLATFORM**

*“ADVANCING ORGANS-ON-CHIPS TOGETHER.”*



# Valorization



*The Valley of Death*