ORGANS-ON-CHIPS MARKET AND TECHNOLOGY LANDSCAPE 2019

Market & Technology Report - October 2019

Market growth is pushing changes in materials and technologies.

WHAT'S NEW

- What has happened in the last two years
- What we got right, what we got wrong
- Updated and refined market forecasts and assumptions
- Market-share evolution
- Identification of new entrants
- Analysis of the role of various players, including contract research organizations
- Evolution of the materials mix, and future projections

KEY FEATURES

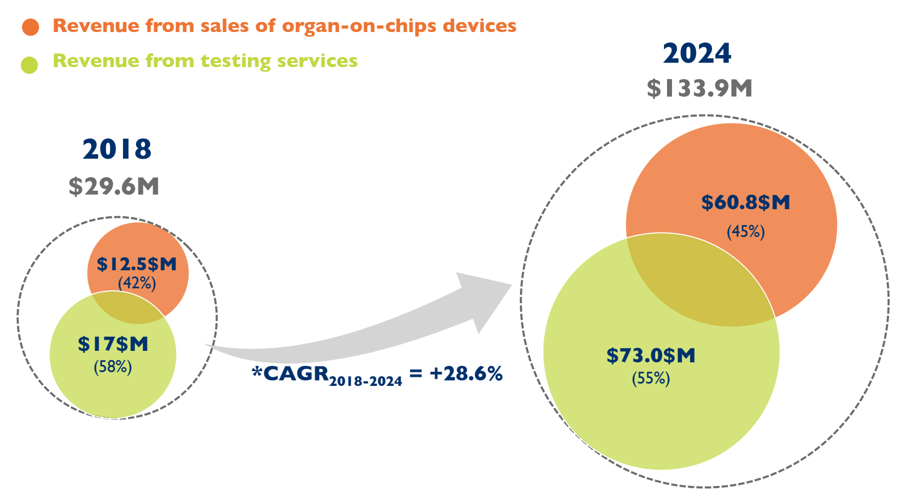
- Major trends and evolutions in the organs-on-chips industry, feedback from end-users, evolution of business models, evolution of "the hype"
- Analysis of the requirements to boost the technology's adoption and make organs-on-chips a success story
- Updated market data and forecast up to 2024, in value and units for organ-on-chip device sales and services
- Comparison with Yole Développement 2017 report's data and analysis
- Supply chain and ecosystem description and analysis, with projections for future evolution
- Technical analysis: type of organ models, device types, importance of flow control, importance of cell sources, materials mix, etc.

A RAPID PACE FOR A HIGH-POTENTIAL MARKET

Organs-on-chips (OOC) has the potential to enable better predictive, physiologically-relevant in-vitro drug testing. This could save hundreds of millions of dollars in development costs, reduce drug development time, and avoid failures due to lack of predictiveness from alternative models like 2D cell cultures and animals. Burgeoned by these promises, the OOC market increased 4-fold from 2016 - 2018 (from $7.5M to $29.6M), and will grow at a $CAGR_{2018\text{-}2024}$ of 28,6%.

Many new players are entering this market with new organ models, and most players that were present two years ago have made noticeable progress. Top players like Mimetas and TissUse now have recurring sales and a consistent revenue stream, and many players are leveraging their OOC devices to provide testing services to their partners in the pharmaceutical, cosmetics, and consumer goods industries - for testing the efficacy and safety of new drugs and products. Evolving regulations in certain countries and industries have spurred a push towards the use of in-vitro models instead of animal models. In the pharmaceutical industry, the real potential of the technology conclusively lies in the promise it holds for personalized medicine. Indeed, it could be possible to create individually-tailored OOC with a patient's own cells, allowing a substance's effects to be predicted on an individual basis. In this report, Yole Développement's (Yole) analysts explain how reaching such milestones could create a real inflexion point, causing the OOC market to skyrocket. However, this is a long-term vision that will not materialize over the next five years.

Organs-on-chips market: 2018 - 2024 forecast



(Yole Développement, October 2019)

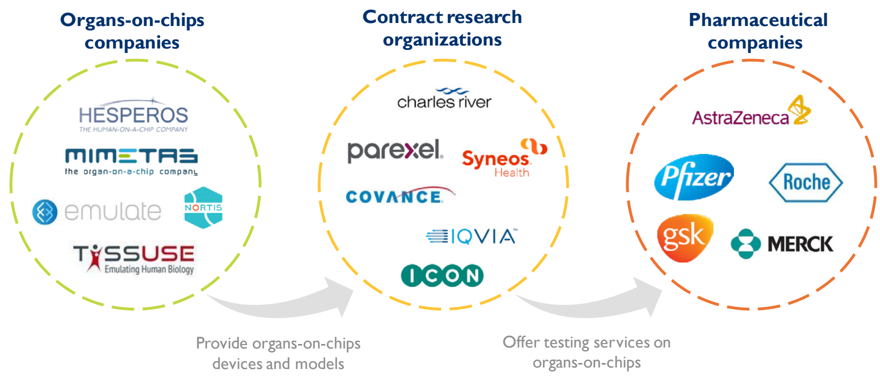
**CAGR: Compound Annual Growth Rate*

TOO MANY EXPECTATIONS, TOO MUCH HYPE?

Since OOC holds great promise, the associated expectations are extremely high. Personalized medicine, fully replacing current in-vitro and in-vivo models, for disease modelling? We have entered a phase where end-users don't expect such results yet - but they do expect reproducibility and automation. Though OOC companies claim to have positive feedback from end-users overall, the comments from end-users are more restrained. The problem is that most OOC models are still "proof-of-concept", whereas end-users prefer industry-grade models with validated processes and outcomes. In this report, Yole's analysts explain the reasons for such negative feedback, and what the end-users' expectations are.

OOC technology is intriguing, but it is struggling to generate a consensus. Consequently, OOC companies strain to find the ideal business model: most end up adopting a hybrid business model combining product sales and services, because even though different users have different demands, OOC firms cannot say "no". Ultimately though, each company must find the right balance inspired by its strengths, instead of trying to please every customer.

Organs-on-chips user chain: Midterm future prediction*



(Yole Développement, October 2019)

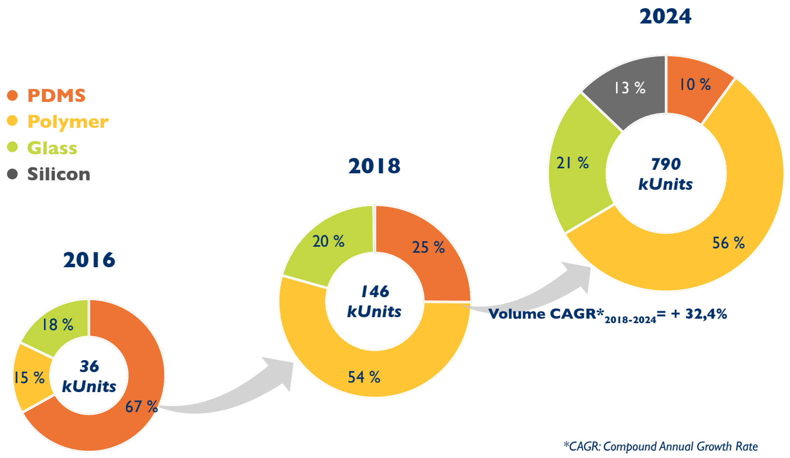
**Non exhaustive list of companies*

The OOC industry's maturation could signal the beginning of contract research organizations' (CROs) involvement. Today, CROs seem minimally involved in the OOC field, and are waiting for more evidence of the technology's potential. However, CROs are usually the privileged subcontractors of the pharmaceutical, cosmetics, and consumer goods industries for safety and efficacy testing - and in a midterm future, they will certainly be the primary users of OOC in order to perform testing services for the pharma industry. Also, they will work closely with OOC companies to learn how to best use their models. That said, it's too early to speculate, and additional data must be generated to prove OOC's relevance over the gold standards CROs have used for decades.

ORGANS-ON-CHIPS IS A MULTIDISCIPLINARY FIELD, AND VARIOUS PARAMETERS WILL SHAPE TOMORROW'S TECHNOLOGY

Organs-on-chips can take various shapes and appearances, depending on their purpose. The drug development process is long and complex, and the needs are not the same at the early drug-screening stages as they are in the late preclinical trial stages. Thus, we see some players specializing in plate formats for automation and high throughput, while others prefer developing single independent chips.

Evolution and forecast of the organs-on-chips material mix in volume



**CAGR: Compound Annual Growth Rate*

(Yole Développement, October 2019)

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Some players develop key solutions based on single organ models, while others propose multi-organ models to assess metabolic interactions between organs. Every technology is different and has specific application domains.

On the materials side, important changes are happening. Two years ago, Yole's analysts were concerned about the ability of OOC companies to switch from PDMS devices in order to scale-up production. Today, it appears that most companies have successfully managed this transition, or at least engaged with the right partners early enough to avoid the problems young companies usually face at this stage. At the moment, polymer is the preferred material, but some companies use glass. The next step could be the integration of more silicon pieces: indeed, sensing directly at the cell level is a necessity, but right now only a few companies are moving in this direction. This is why silicon is not commonly used in OOC. Yole's analysts expect this to change by 2024, and in this report they detail the evolution of the materials mix, along with various other technical aspects such as the added-value of flow control and vascularization of organs, the emergence of new materials combining the preferred properties of several existing ones, the importance of cell sources, and more.

REPORT OBJECTIVES

- Detail new major trends and evolutions in the OOC industry
- Evaluate end-users' feedback, and the impact it has on the evolution of business models, hype, etc.
- Discern end-users' key requirements for widespread adoption of the technology, and where the gap is today
- Provide updated market data and forecasts up to 2024, in value and units for OOC device sales and services, and a comparison with our 2017 report's data and analysis
- Describe the supply chain and ecosystem, and discuss future evolutions
- Deliver a comprehensive technical analysis: type of organ models, device types, importance of flow control, importance of cell sources, evolution of the materials mix, etc.

COMPANIES CITED IN THE REPORT (non exhaustive list)

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TABLE OF CONTENTS (complete content on i-Micronews.com)

AUTHORS

Sébastien Clerc works as a Technology & Market Analyst, Microfluidics, Sensing & Actuating at Yole Développement (Yole).
As part of the Photonics & Sensing activities, Sébastien has authored a collection of market and technology reports dedicated to microfluidics and other micro-devices for both market segments: medical (including diagnostics, pharmaceutical, biotechnology, drug delivery, medical devices) and industrial (including environment, agro-food).
In parallel, he is daily involved in custom projects such as strategic marketing, technology scouting and technology evaluation to help academic and industrial players in their innovation processes. Thanks to his technology & market expertise, Sébastien has spoken in more than 20 industry conferences worldwide over the last 4 years.
Sébastien Clerc graduated from Grenoble Institute of Technology (Grenoble INP - Grenoble, France) with a Master's degree in Biomedical Technologies. He then completed his cursus with a Master's degree in Innovation and Technology Management in the same institute.

Marjorie Villien, PhD. is Technology & Market Analyst, Medical & Industrial Imaging at Yole Développement (Yole).
As a member of the Photonics & Sensing activities, Marjorie contributes regularly to the development of imaging projects with a dedicated collection of market & technology reports as well as custom consulting services in the medical and industrial fields. She regularly meets with leading imaging companies to understand technology issues, analyze market evolution and ensure the smart combination of technical innovation and industrial application.
Marjorie Villien graduated from Grenoble INP (France) and holds a PhD. in physics & medical imaging.

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SALES CONTACTS

- **Western US & Canada - Steve Laferriere:** **+ 1 310 600-8267** – laferriere@yole.fr
- **Eastern US & Canada - Chris Youman:** **+1 919 607 9839** – chris.youman@yole.fr
- **Europe & RoW - Lizzie Levenez:** **+ 49 15 123 544 182** – levenez@yole.fr
- **Japan & Rest of Asia - Takashi Onozawa:** **+81-80-4371-4887** – onozawa@yole.fr
- **Greater China - Mavis Wang:** **+886 979 336 809** – wang@yole.fr
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The present document is valid 24 months after its publishing date: October 16, 2019

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The "More than Moore" market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO, KnowMade and Blumorpho, supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

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CONTACTS

For more information about :

- Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
- Reports & Monitors: David Jourdan (jourdan@yole.fr) & Fayçal Khamassi (khamassi@yole.fr)
- Marketing & Communication: Camille Veyrier (veyrier@yole.fr)
- Public Relations: Sandrine Leroy (leroy@yole.fr)

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