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Microphysiological System Global Market Insights 2026, Analysis and Forecast to 2031

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Abstracts

The global Microphysiological System (MPS) market represents a cutting-edge frontier in biotechnology, offering high-fidelity in vitro models that replicate the structural and functional characteristics of human organs and tissues. Often referred to as organ-on-a-chip (OOC) technology, these systems integrate microfluidics, cell biology, and engineering to provide a more predictive environment for drug testing, disease modeling, and toxicological assessment than traditional animal models. As of 2026, the global microphysiological system market is estimated to be valued between 0.9 billion USD and 1.6 billion USD. Driven by the increasing demand for human-relevant data in preclinical trials and the legislative push toward reducing animal testing, the market is projected to expand at a Compound Annual Growth Rate (CAGR) ranging from 3.3 percent to 5.8 percent through 2031.

The landscape of the MPS market is currently being reshaped by significant technological launches and cross-sector collaborations. In May 2025, at ITF World, the research hub imec and the science and technology giant Merck announced a strategic partnership to develop an advanced MPS platform aimed at increasing the predictive validity of next-generation preclinical models. This was followed in October 2025 by CN Bio’s launch of the PhysioMimix Core, a breakthrough solution that delivers validated performance across single-organ, multi-organ, and high-throughput configurations within a single microphysiological system. Furthermore, early 2026 saw MEPSGEN joining the newly established Centre for Intestinal Systems (CIS) at Imperial College London as a technology partner, focusing on human-microbiome interactions and gut-on-a-chip research. These milestones indicate a clear shift toward integrated, multi-functional platforms that can support the entire drug discovery pipeline from initial screening to complex safety evaluations.

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Regional Market Analysis

The regional adoption of microphysiological systems is closely tied to the density of pharmaceutical research hubs and the local regulatory environment regarding animal welfare and drug safety protocols.

North America: This region remains a primary driver of the MPS market, benefiting from substantial government funding through the National Institutes of Health (NIH) and early regulatory support for non-animal testing methods. The U.S. market is characterized by a high concentration of leading technology developers such as Emulate and Hesperos. The implementation of the FDA Modernization Act 2.0 has provided a powerful catalyst for the adoption of MPS, as it officially recognizes the potential for alternative models to replace animal studies in drug approval processes. The estimated growth range for North America between 2026 and 2031 is 3.5 percent to 5.5 percent.

Europe: The European market is anchored by a strong academic and research foundation, with countries like the UK, Netherlands, and Germany leading the way in organ-on-a-chip innovation. The establishment of the Centre for Intestinal Systems at Imperial College London in 2026 exemplifies the region's focus on collaborative, human-based research. European growth is also supported by the European Medicines Agency (EMA) and initiatives like Horizon Europe, which prioritize the development of New Approach Methodologies (NAMs). The market in Europe is expected to grow at a rate of 3.2 percent to 5.4 percent during the forecast period.

Asia-Pacific: The Asia-Pacific region is the fastest-growing market for microphysiological systems. Rapid expansion in the pharmaceutical sectors of China, Japan, and South Korea, combined with increasing investments in regenerative medicine, fuels this demand. Companies like Beijing Daxiang Biotech are emerging as key regional players. The region is also becoming a hub for contract research organizations (CROs) that are increasingly integrating MPS into their service offerings to attract global biotech clients. Growth in Asia-Pacific is projected to be between 4.0 percent and 6.5 percent.

South America and MEA: While these regions currently hold smaller market shares, there is growing interest in MPS for infectious disease research and personalized medicine. Growth is expected to be steady, ranging from 2.5 percent to 4.2 percent, as local research institutes begin to adopt these systems

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for endemic disease modeling and toxicological screenings.

Application and Segmentation Analysis

The microphysiological system market is segmented by end-user and the complexity of the tissue models provided.

Pharmaceutical and Biotechnology Companies: This is the largest application segment, where MPS are used to bridge the 'valley of death' between preclinical research and clinical trials. Companies utilize these systems for ADME (Absorption, Distribution, Metabolism, and Excretion) studies and safety pharmacology. The launch of high-throughput systems like CN Bio's PhysioMimix Core is specifically designed to meet the industrial needs of these companies by allowing for the testing of hundreds of drug candidates in a human-relevant context.

Academic and Research Institutes: Universities and specialized research hubs use MPS for fundamental biological research, disease pathogenesis studies, and the development of new tissue-engineering techniques. The collaboration between MEPSGEN and Imperial College London highlights the critical role of academic centers in validating new MPS technologies and exploring niche areas like human-microbiome interactions.

Segmentation by System Complexity: The market is evolving from single-organ chips (e.g., Liver-on-a-chip) toward multi-organ systems (Human-on-a-chip). Multi-organ systems allow researchers to study the interaction between different physiological compartments, such as the gut-liver axis or the blood-brain barrier, which is essential for understanding systemic drug effects and complex inflammatory diseases.

Value Chain and Industry Structure

The value chain of the microphysiological system market is highly interdisciplinary, involving specialized suppliers of microfluidic components, cellular materials, and data analysis software.

The upstream begins with cell sourcing, where Induced Pluripotent Stem Cells (iPSCs)

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and primary human cells are critical inputs. Companies specializing in cell engineering and bio-banking are essential partners for MPS developers. The midstream involves the design and fabrication of the microfluidic chips, which requires precision engineering and biocompatible materials like PDMS or specialized plastics. A significant portion of value is added through the integration of sensors and imaging interfaces that allow for real-time monitoring of tissue health.

The downstream includes the end-users—pharmaceutical giants and academic labs—who utilize the systems for drug development. The industry structure is currently characterized by a mix of specialized OOC startups and large technology companies like Merck and imec that provide the necessary infrastructure and global reach. As the market matures, there is an increasing trend toward 'MPS-as-a-Service,' where companies like Emulate and CN Bio offer both the hardware and the specialized testing services to clients who lack in-house expertise.

Macroeconomic Analysis and Geopolitical Impacts

The MPS market is influenced by the global R&D funding environment. In 2025 and 2026, despite some global economic volatility, investment in biotechnology has remained a priority for major economies seeking to improve drug success rates and reduce healthcare costs. However, high interest rates can impact the capital-intensive nature of OOC startups that require significant R&D cycles.

Geopolitically, the market is affected by the competition for technological leadership in the 'bio-economy.' The U.S. and China are both investing heavily in organ-on-a-chip technology as a strategic asset for drug sovereignty. Trade regulations on high-tech microfluidic components and specialized cell lines can impact global supply chains. Furthermore, international standardization efforts, such as those led by the International Organization for Standardization (ISO), are critical for ensuring that data generated in one region can be recognized by regulatory bodies in another. Geopolitical stability in the Asia-Pacific region is particularly important, as much of the high-end electronic and sensor manufacturing essential for MPS hardware is concentrated there.

Key Market Players and Company Developments

- Emulate: Emulate is a pioneer in the microphysiological system space, known for its Human Emulation System that utilizes flexible, translucent chips. The company's technology is used extensively for modeling the lung, liver, and brain. Emulate has established significant collaborations with the U.S. FDA to evaluate

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the performance of OOC in drug safety testing. Their platform is designed for openness, allowing researchers to incorporate their own cell types while benefiting from Emulate’s standardized microfluidic environment. With a strong intellectual property portfolio and a focus on high-fidelity human-to-chip translation, Emulate remains a cornerstone of the North American market, consistently driving the transition toward animal-free preclinical research.

Mimetas: Based in the Netherlands, Mimetas is the creator of the OrganoPlate, a high-throughput organ-on-a-chip platform that is uniquely compatible with standard laboratory equipment. Unlike traditional OOC systems that require complex tubing, the OrganoPlate utilizes 384-well plate formats, allowing for hundreds of simultaneous experiments. This high-throughput capability has made Mimetas a preferred partner for large pharmaceutical companies looking to integrate MPS into the early stages of drug screening. The company focuses on a wide range of tissue models, including the kidney and vasculature, and emphasizes ease of use and scalability in industrial research environments.

InSphero: InSphero is a global leader in 3D spheroid and organoid technology, providing specialized platforms like the Akura plate system. While often classified under 3D cell culture, their advanced microphysiological solutions bridge the gap between simple spheroids and complex OOC systems. InSphero focuses on providing 'assay-ready' models of the liver and pancreas for toxicology and metabolic disease research. Their technology is valued for its robustness and reproducibility, which are essential for industrial drug discovery pipelines. By offering both high-quality biological models and specialized imaging services, InSphero has built a diverse client base across Europe and North America.

TissUse: TissUse, based in Germany, is renowned for its HUMIMIC multi-organ chips, which can simulate the interaction of two, three, or four organs on a single platform. This 'Multi-Organ-Chip' (MOC) technology is critical for studying systemic drug effects and complex physiological processes like the immune response. TissUse provides both the microfluidic hardware and specialized control units that regulate the flow of media across the organ compartments. Their focus on multi-organ integration positions them as a key player in the development of 'Human-on-a-chip' systems, serving clients who require a holistic view of human physiology during preclinical testing.

CN Bio: CN Bio is a leading provider of benchtop Organ-on-a-chip solutions,

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headquartered in the UK. The company’s PhysioMimix platform is highly regarded for its ability to model human liver and gut functions. The October 2025 launch of PhysioMimix Core represents a major milestone, as it offers a unified system for single-organ, multi-organ, and higher-throughput experiments. CN Bio has a strong track record of regulatory collaboration, having its technology used in landmark studies with the FDA. Their focus is on providing user-friendly, validated systems that can be easily adopted by researchers in both biotech and academic settings to accelerate drug discovery.

Hesperos: Hesperos is an innovative U.S.-based company that focuses on 'Human-on-a-Chip' systems using serum-free media. Their platform is designed to maintain the functional viability of multiple tissue types for extended periods, allowing for the study of chronic drug exposure and rare diseases. Hesperos emphasizes the measurement of functional readouts, such as electrical activity in neurons or contractile force in cardiac tissue, rather than just metabolic markers. This functional focus provides deep insights into drug efficacy and safety. The company operates as a contract research organization, helping clients design complex physiological experiments that cannot be performed in animal models.

Valo Health: Valo Health is a technology company that integrates human-centric data with machine learning and advanced biological models. While broader than just MPS, they utilize microphysiological systems as a key part of their 'Opal Computational Platform' to generate high-quality data for drug discovery. Valo focuses on accelerating the timeline from target identification to clinical trials by using AI to interpret the complex data generated by MPS. Their approach represents the next generation of drug development, where biological engineering and digital intelligence work in tandem to reduce the cost and risk of bringing new therapies to market.

TNO: TNO (Netherlands Organisation for Applied Scientific Research) is a leading research institute that has been a long-time contributor to the development of microphysiological systems. They focus on the practical application of MPS in the food and chemical safety sectors, as well as in pharmaceuticals. TNO is known for its 'InTESTine' model, a gut-on-a-chip system used to study drug absorption and nutrition. Their work often bridges the gap between academic innovation and industrial application, providing validated models that help companies meet regulatory requirements. TNO’s collaborative projects across Europe have been instrumental in standardizing OOC

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technologies.

AxoSim: AxoSim is a specialized MPS company focused on the nervous system, with flagship products like Nerve-on-a-Chip and Brain-on-a-Chip. Based in the U.S., AxoSim addresses the critical need for better preclinical models for neurodegenerative diseases and peripheral neuropathy. Their platforms replicate the complex architecture of the human nervous system, allowing for the measurement of nerve conduction velocity and other electrophysiological parameters. By providing a more accurate model of human neuro-pharmacology, AxoSim helps pharmaceutical companies avoid the high failure rates associated with neurological drug candidates in clinical trials.

Newcells Biotech: Newcells Biotech, based in the UK, specializes in building complex in vitro models of the eye, kidney, and lung. Their focus is on high-fidelity models that use primary human cells to replicate the specific barriers and transport mechanisms of these organs. Newcells provides both specialized assay services and the underlying MPS technology to global pharmaceutical and chemical companies. Their 'Eye-on-a-chip' models are particularly valued for studying drug toxicity and disease mechanisms in the retina and cornea, providing an alternative to traditional animal-based ocular testing.

Nortis: Nortis is a Seattle-based company that provides the ParVivo system, a versatile microfluidic platform for creating 3D tissue models. Their technology allows for the growth of tubular structures, such as kidney tubules and blood vessels, which are critical for studying transport and inflammatory processes. Nortis emphasizes the importance of the 3D microenvironment, including the extracellular matrix and physiological shear stress, in maintaining cell function. Their systems are designed for high-resolution imaging and real-time monitoring, making them a valuable tool for researchers studying vascular biology and nephrotoxicity.

Netri: Netri is a French industrial start-up that specializes in high-throughput microfluidic devices for the pharmaceutical and cosmetics industries. Their 'Neuro-on-a-chip' platforms are designed for standardized, automated testing of drug candidates on neuronal and skin models. Netri focuses on the industrialization of MPS, providing high-volume chips that can be integrated into existing laboratory automation systems. Their goal is to make OOC technology as routine as standard cell culture, providing a faster and more cost-effective way to generate human-relevant data for safety and efficacy assessments.

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Draper Laboratory: Draper is a non-profit engineering and research organization that has developed advanced microphysiological systems for defense and healthcare applications. Their MPS platforms are known for their ruggedness and integration of advanced sensors for real-time data acquisition. Draper has worked on multi-organ systems that simulate the female reproductive tract and the immune system. Their engineering-first approach ensures that their OOC platforms are highly reliable and capable of long-term tissue maintenance. Draper often collaborates with government agencies and major research hospitals to solve complex biological engineering challenges.

Beijing Daxiang Biotech: Beijing Daxiang Biotech is a leading Chinese player in the organ-on-a-chip market. The company provides a range of OOC products and services, including liver, lung, and heart models. They have successfully established partnerships with domestic and international pharmaceutical companies to support drug screening and toxicological testing. Daxiang Biotech emphasizes the use of primary human cells and iPSCs to create ethnically relevant models, which is an important consideration for global drug developers targeting the Asian market. Their rapid growth reflects the increasing investment in advanced biotech in China.

Altis Biosystems: Altis Biosystems focuses on the development of high-fidelity models of the human intestinal epithelium. Their 'Altis RepliGut' system uses primary stem cells to create a 3D layer of intestinal tissue that replicates the complex crypt-villus architecture. Based in the U.S., Altis provides a more accurate model for studying nutrient absorption, drug permeability, and inflammatory bowel disease (IBD) than traditional cell lines. Their technology is used by pharmaceutical and nutrition companies to generate data that is more predictive of human clinical outcomes, helping to de-risk the development of oral drug candidates.

Cherry Biotech: Cherry Biotech is a French company known for its focus on temperature control and long-term tissue maintenance in microphysiological systems. Their 'Cubix' platform is a multi-functional system that allows for precise control of the cellular microenvironment, including thermal stability and oxygen levels. Cherry Biotech emphasizes the importance of 'Metabolic Modeling,' providing researchers with the tools to study how environmental factors affect cellular metabolism and drug response. Their systems are designed to be user-friendly and highly adaptable, supporting a wide range of

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OOC and organoid applications in both academic and industrial labs.

Obatala Sciences: Obatala Sciences is a New Orleans-based company that specializes in tissue engineering solutions for a diverse range of adipose (fat) tissue models. They provide 'Fat-on-a-Chip' systems that allow for the study of metabolic diseases, obesity, and diabetes in a human-relevant context. Obatala emphasizes the importance of diversity in their cell sourcing, providing models that reflect different ethnicities and age groups. Their products include specialized hydrogels and media that support the 3D growth of adipose-derived stem cells, providing a unique platform for drug discovery in the growing field of metabolic health.

Ananda Devices: Ananda Devices, based in Canada, specializes in high-throughput microfluidic systems for neuroscience and immunology. Their 'Neuro-on-a-chip' platforms allow for the precise alignment of neurons and the study of axonal growth and connectivity. Ananda’s technology is designed to be 50 times faster than traditional methods, significantly accelerating the screening of drug candidates for neurological disorders. Their focus is on providing standardized, scalable solutions that help researchers quantify the effects of drugs on the nervous system with high precision and throughput.

ImmuONE: ImmuONE is a UK-based company that specializes in 3D human lung models and immune system interactions. Their 'ImmuLUNG' platform is a high-fidelity model used to study the inhalation toxicity and efficacy of respiratory drugs. ImmuONE focuses on providing an alternative to animal testing for the development of inhaled therapies, offering models that accurately reflect the human lung's barrier function and immune response. Their services are used by pharmaceutical and chemical companies to assess the safety of new compounds before they enter clinical trials, providing a critical layer of human-relevant data.

React4life: React4life is an Italian biotech company that has developed the 'Mimetix' and 'Moliere' systems for 3D cell culture and organ-on-a-chip applications. Their platforms are designed to replicate the physiological flow of fluids and nutrients across tissue barriers, making them ideal for studying cancer metastasis and drug delivery. React4life focuses on providing versatile and modular systems that can be easily customized for different tissue types and research objectives. Their commitment to technological innovation is reflected in their focus on creating systems that bridge the gap between static 2D cultures

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and complex in vivo environments.

AlveoliX: AlveoliX, a Swiss company, is specialized in the development of 'Lung-on-a-chip' systems that mimic the respiratory motion of the human lung. Their 'AX Barrier' platform provides cells with a biomimetic microenvironment, including the cyclic mechanical stretching that occurs during breathing. This mechanical stimulation is essential for maintaining the physiological function of lung tissue. AlveoliX's models are used for drug safety and efficacy testing, as well as for studying respiratory diseases like asthma and COPD. Their focus on the 'breath of life' provides a unique and highly relevant platform for respiratory research.

BiomimX: BiomimX is an Italian start-up that focuses on 'Beating-on-a-chip' technology. Their flagship product, the 'uHeart,' is a microphysiological system that replicates the mechanical and electrical activity of the human heart. This allows for the study of drug-induced cardiotoxicity and the development of new therapies for cardiac diseases. BiomimX emphasizes the integration of mechanical stimulation into their tissue models, providing a more accurate representation of the heart's dynamic environment. Their systems are used by pharmaceutical companies to detect cardiac safety issues early in the drug development process, reducing the risk of clinical trial failures.

Market Opportunities

Multi-Organ and Systemic Modeling: There is a significant opportunity in the transition from single-organ to multi-organ systems. As technologies like CN Bio's PhysioMimix Core and TissUse's HUMIMIC mature, the ability to model the 'Human-on-a-chip' will become a standard requirement for complex safety and efficacy evaluations. This allows for the study of drug interactions across different organs, such as the gut-liver-kidney axis, providing a holistic view of human physiology.

Precision and Personalized Medicine: MPS offers a unique opportunity to create 'Patient-on-a-chip' models using iPSCs derived from specific individuals or patient populations. This allows for the testing of drug candidates on models that reflect the genetic diversity and disease characteristics of specific patients, paving the way for truly personalized therapy and more successful clinical trials.

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Integration of AI and Big Data: The high volume of data generated by multi-organ MPS, including real-time imaging and sensor data, presents an opportunity for AI and machine learning integration. Companies like Valo Health are already leading this trend. AI can help identify complex patterns in drug response and toxicity that may be missed by human observation, further increasing the predictive power of these systems.

Replacement of Animal Testing in Regulatory Filings: The legislative momentum to reduce animal testing (e.g., the FDA Modernization Act 2.0 and EU initiatives) creates a massive opening for validated MPS technology. As regulatory bodies gain more confidence in MPS data, these systems will move from being 'supplemental' to being a 'required' part of the drug approval dossier, significantly expanding the market.

Market Challenges

Standardization and Validation: One of the primary challenges is the lack of standardized protocols across different MPS platforms. For these systems to be widely accepted by regulatory bodies, there must be a consensus on validation metrics and manufacturing standards (such as ANSI/SLAS). Without standardization, it is difficult to compare results across different labs and systems.

High Cost and Complexity of Use: Microphysiological systems are currently more expensive and technically demanding than traditional 2D cell cultures. The need for specialized microfluidic hardware, high-quality primary cells, and advanced imaging equipment can be a barrier for smaller research labs and biotech firms. Improving the ease of use and reducing the cost-per-assay is essential for mass-market adoption.

Scalability of Manufacturing: Producing high-fidelity OOC platforms at an industrial scale remains a challenge. The complexity of integrating microfluidics, sensors, and living cells into a single, sterile device requires sophisticated manufacturing processes. Ensuring consistent quality and performance across large batches is critical for pharmaceutical clients who require high reproducibility.

Biological Limitations: While MPS are superior to 2D cultures and animal models

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in many ways, they still have biological limitations. Replicating the full complexity of the human immune system, vascular network, and hormonal regulation on a chip is an ongoing challenge. Furthermore, the use of synthetic materials like PDMS can lead to the unintended absorption of lipophilic drugs, which can skew experimental results. Manufacturers are working on developing new biocompatible materials to address these issues.

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