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Published August 5, 2026 35 min read

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Executive Summary

Organ-on-a-chip technology, also called microphysiological systems (MPS), has moved from federally funded research infrastructure into an active line item in the U.S. Food and Drug Administration's drug development tool (DDT) qualification pipeline, but "FDA qualification" remains a narrow, still largely unfinished process rather than a blanket regulatory endorsement. As of January 1, 2026, FDA's own metrics show zero organ-chip or other tools fully qualified through the Innovative Science and Technology Approaches for New Drugs (**ISTAND**) pathway, against 16 projects in development within that pathway and 151 across all Drug Development Tool Qualification Programs combined, of which 20 have reached full qualification (Source: www.fda.gov). The clearest data point for organ-on-a-chip specifically is Emulate, Inc.'s **Liver-Chip**, whose Letter of Intent (LOI) for a drug-induced liver injury (DILI) assessment tool was accepted into ISTAND on September 24, 2024, the first organ-chip technology admitted to the pathway (Source: www.fda.gov) (Source: www.the-scientist.com). LOI acceptance is only step one of a three-step statutory process, so the Liver-Chip is a candidate under review, not a qualified tool (Source: www.fda.gov).

FDA's engagement with this technology predates ISTAND by nearly a decade. The agency joined the National Institutes of Health (NIH) and the Defense Advanced Research Projects Agency (DARPA) in a Microphysiological Systems research initiative that began issuing funding announcements in 2011 (Source: commonfund.nih.gov), and by 2017 that joint program had produced "more than ten individual human organs and tissue chips" according to a peer-reviewed review of the effort (Source: pmc.ncbi.nlm.nih.gov). FDA scientists separately entered a formal Cooperative Research and Development Agreement (CRADA) with Emulate in 2017 to test whether Liver-Chip data meets regulatory evaluation criteria, a collaboration that eventually spanned five FDA laboratories (Source: www.biopharmadive.com (Source: www.selectscience.net).

Formal DDT qualification is not the only route organ-chip data has reached FDA reviewers. Multiple sponsors have already submitted MPS data inside individual Investigational New Drug (IND) applications without waiting for a qualified label. NCATS-funded work using Hesperos's Human-on-a-Chip platform supported an IND that Sanofi used to begin a Phase 2 trial in April 2021, which NCATS itself called "an important milestone in the evolution of

the use of tissue chips" (Source: ncats.nih.gov). Hesperos separately reported that its chip data supported Dianthus Therapeutics' IND for a Phase II trial in generalized myasthenia gravis (Source: www.biospace.com), and MIMETAS reported that data from its OrganoPlate platform contributed to an IND filed by argenx in July 2024 (Source: mimetas.com. A Nature Communications perspective describes the underlying dynamic plainly: adoption depends on whether regulators "ultimately make the decision to qualify them as a drug discovery tool" for a given context of use (Source: www.nature.com).

The legislative tailwind is direct. The **FDA Modernization Act 2.0**, enacted when the President signed it on December 29, 2022, defines a "nonclinical test" to explicitly include "cell-based assays, microphysiological systems, or bioprinted or computer models" as alternatives to animal testing (Source: www.govtrack.us) (Source: www.govinfo.gov). On April 10, 2025, FDA announced a roadmap to phase out animal testing requirements for monoclonal antibodies, promoting lab-grown organoids and organ-on-a-chip systems that mimic human organs as replacements (Source: www.fda.gov), and FDA Commissioner Marty Makary has told reporters the agency is now discouraging sponsors from relying on legacy animal data at all, saying "we don't want you to do this animal testing" (Source: www.pharmavoice.com). FDA reported in April 2026 that it had achieved "Year 1" roadmap goals, and in March 2026 released draft guidance naming organ-chips directly and setting validation expectations around material safety, including "leaching of materials from an organ-on-a-chip, which could cause toxicity or alter cells" (Source: www.fda.gov). Congress has continued to consider FDA Modernization Act 3.0 legislation. The Senate passed S. 355, as amended, by unanimous consent on December 16, 2025; H.R. 2821 remains introduced and referred to the House Committee on Energy and Commerce (Congress.gov: S. 355 (Congress.gov: H.R. 2821.

Commercially, the organ-on-a-chip market remains small relative to the broader life sciences tools industry but is growing quickly, though estimates vary sharply by methodology: Precedence Research put the global market at **$227.40 million in 2025**, forecasting **$4,191.15 million by 2035** (Source: www.precedenceresearch.com), while MarketsandMarkets valued the narrower "organs-on-chips" category at **$123.285 million in 2024**, rising to **$631.073 million by 2029** (Source: www.marketsandmarkets.com). One industry estimate published by SelectScience suggests organ-chip adoption could save large pharmaceutical companies meaningful sums annually by enabling better early-stage attrition decisions (Source: www.selectscience.net). For life-science organizations tracking this space, including consultancies such as **intuitionlabs.ai** that advise pharmaceutical clients on regulatory technology strategy built to FDA and EMA standards (Source: intuitionlabs.ai), the practical takeaway as of August 2026 is that organ-on-a-chip qualification is real but early: a decade of federal research infrastructure, a handful of named sponsor IND cases, one accepted ISTAND LOI, and FDA's latest cited ISTAND metrics—dated January 1, 2026—reporting zero qualified tools, alongside a rapidly shifting legislative and guidance landscape that sponsors need to track meeting by meeting rather than assume is settled.

Introduction and Background

Organ-on-a-chip devices, also called microphysiological systems (MPS) or tissue chips, are microfluidic platforms that culture living human cells in a three-dimensional, mechanically and biochemically active environment designed to reproduce the physiology of a specific human organ, most commonly liver, kidney, heart, gut, or the blood-brain barrier. The National Toxicology Program's Interagency Center for the Evaluation of Alternative Toxicological Methods (NICEATM) defines an MPS as "an in vitro platform composed of cells; explants derived from tissues/organs" engineered to reproduce organ-level function outside the body (Source: ntp.niehs.nih.gov). The technology's regulatory relevance stems from a well-documented problem in drug development: animal models frequently fail to predict how a compound will behave in human tissue, particularly with respect to hepatotoxicity, one of the leading causes of preclinical and clinical drug failure.

A decade of federal infrastructure preceded ISTAND. In 2011, NIH issued two funding opportunity announcements creating what became known as the Microphysiological Systems program, run jointly with DARPA and with FDA involved from the start "to improve the process for predicting" human drug response (Source: commonfund.nih.gov) (Source: commonfund.nih.gov). DARPA's own program description states its Microphysiological Systems effort aimed "to rapidly assess medical countermeasures in a way that is relevant to human health," targeting a "reconfigurable platform that permits simultaneous study of ten or more interlinked in vitro physiological systems," and confirms "DARPA involved the FDA from the beginning of the MPS program" specifically to address anticipated regulatory review challenges (Source: www.darpa.mil) (Source: www.darpa.mil). The Wyss Institute at Harvard was a lead performer on that program, entering a DARPA cooperative agreement "worth up to $37 million" to integrate multiple organ-chip systems, with FDA's then-Chief Scientist Jesse Goodman stating the resulting instrument "has the potential to be a better model for determining human adverse responses" than existing animal methods (Source: wyss.harvard.edu) (Source: wyss.harvard.edu). FDA itself began funding organ-chip work directly around the same period: in 2013, "the Wyss Institute received a research award from the FDA" to develop in vitro models for radiation medical countermeasures, an early instance of the agency directly commissioning organ-chip research rather than only reviewing it (Source: wyss.harvard.edu). By the time this joint NIH-DARPA-FDA push wound down, a peer-reviewed retrospective reports it had "resulted in more than ten individual human organs and tissue chips being developed" and that "FDA has been intensively involved in the US tissue chip program since 2011" (Source: pmc.ncbi.nlm.nih.gov) (Source: pmc.ncbi.nlm.nih.gov). Federal coordination continued well beyond the initial funding push: the National Institute of Environmental Health Sciences' NICEATM program later led a working group that "coordinated the use of MPS to reduce animal use in studies of COVID-19," extending the same infrastructure into pandemic-response research (Source: ntp.niehs.nih.gov).

From research infrastructure to a qualification pathway. Since 2020, FDA has run its Innovative Science and Technology Approaches for New Drugs (ISTAND) pilot, launched jointly by the Center for Drug Evaluation and Research (CDER) and the Center for Biologics Evaluation and Research (CBER), specifically to qualify novel drug development tools, including tissue chips, that fall outside the agency's established biomarker and clinical outcome assessment (COA) pathways (Source: www.fda.gov. "FDA qualification" is a specific legal term, not a general endorsement: under Section 507 of the Federal Food, Drug, and Cosmetic Act, a qualified DDT can be relied upon across any drug development program for its defined context of use, without a sponsor re-proving the tool's validity each time (Source: www.fda.gov). A peer-reviewed review of FDA's toxicology framework puts it similarly: "within the stated context of use, qualification is a conclusion that the results" of an assay can be relied upon for a specific regulatory interpretation (Source: pmc.ncbi.nlm.nih.gov). That is a high bar; FDA's latest cited ISTAND metrics, dated January 1, 2026, report zero qualified DDTs in that pathway.

This report examines both tracks that have resulted: the formal qualification mechanics (ISTAND, the broader DDT program, and the three-step Letter of Intent, Qualification Plan, Full Qualification Package process), the legislative backdrop (the FDA Modernization Act 2.0 of 2022 and the FDA Modernization Act 3.0 legislation moving through Congress in 2025 and 2026), the quantitative state of the pipeline and market, and named sponsor cases illustrating how organ-on-a-chip data is actually being used today, distinct from how it will eventually be used once a platform achieves full qualification.

The FDA Regulatory Pathways for Organ-on-a-Chip Qualification

FDA maintains multiple, legally distinct qualification programs under the DDT umbrella, and understanding which one applies to organ-on-a-chip technology is central to interpreting any claim that a chip has been "FDA qualified." Guidance separates DDTs into three formally defined categories, biomarkers, clinical outcome assessments (COAs), and animal models used to satisfy the Animal Rule, plus a catch-all fourth pathway for everything that does not fit those categories. That fourth pathway is ISTAND, and its program page explicitly lists **tissue chips (i.e., microphysiological systems)** as an eligible submission type, alongside artificial intelligence tools and other novel methodologies, when used "to assess safety or efficacy questions" (Source: www.fda.gov. There is no separate "organ-chip qualification program."

The three-step statutory process. Every DDT qualification, ISTAND included, proceeds through the same three formal stages defined under Section 507: the **Letter of Intent (LOI)**, a **Qualification Plan (QP)**, and a **Full Qualification Package (FQP)** (Source: www.fda.gov. The underlying "Qualification Process for Drug Development Tools" guidance, finalized November 25, 2020, implements the 21st Century Cures Act mandate under Section 507 and establishes the formal taxonomy that governs all DDT submissions, while explicitly declining to set the evidentiary bar for what counts as sufficient proof and explicitly excluding medical-device DDTs from its scope (Source: www.federalregister.gov) (Source: www.federalregister.gov).

Qualification is optional, not gatekeeping. A frequently misunderstood point is that DDT qualification is not a prerequisite for using an organ-chip in a submission. FDA's own process page states that "a DDT can be used in a drug development program without it going through the qualification programs," with each use then evaluated case by case within the specific IND, NDA, or BLA review (Source: www.fda.gov). This explains why sponsors such as Sanofi, Dianthus Therapeutics, and argenx have already used organ-chip data inside individual IND filings years before any organ-chip platform completes the ISTAND process. The upside of full qualification is standing, not permission: once qualified, "DDTs will be publicly available to be used in any drug development program" for the defined context of use (Source: www.fda.gov).

Industry consortium engagement precedes and reinforces individual submissions. FDA does not evaluate organ-chip technology only through individual company filings. A peer-reviewed report documents a formal workshop between FDA and the Innovation and Quality Consortium's Microphysiological Systems (IQ MPS) Affiliate, an industry group that by October 2019 counted 22 member pharmaceutical companies, including co-authors affiliated with Genentech's Safety Assessment group and Bristol-Myers Squibb's drug candidate optimization group (Source: pubmed.ncbi.nlm.nih.gov (Source: pmc.ncbi.nlm.nih.gov). Separately, the Critical Path Institute (C-Path), a nonprofit that runs FDA-facing consortia, reports that "in 2023 C-Path, with funding from the US FDA, launched a public, collaborative project" through its Predictive Safety Testing Consortium aimed at building qualification pathways for "micro physiological systems (MPS), spheroids, organoids, or organ/tissue on a chip" (Source: c-path.org) (Source: c-path.org. These consortium efforts function as a slower, pre-competitive complement to any single company's ISTAND submission, building shared evidentiary standards that individual qualification packages will eventually draw on.

ISTAND's transition from pilot to permanent program. ISTAND launched as a pilot in 2020 and, per FDA's own retrospective, accepted eight submissions during its pilot phase, three AI-based tools and two tools assessing preclinical safety among others, before the agency established it as a permanent qualification program (Source: www.fda.gov). CDER official Jeffrey Siegel, discussing the Liver-Chip LOI, noted that "emerging technologies like MPS show promise in assessing risks of hepatotoxicity in preclinical phases," language that signals institutional interest without asserting the tool has been validated (Source: www.fda.gov).

The FDA Modernization Act 2.0/3.0 and the Push Beyond Animal Testing

The legislative context changed substantially with the **FDA Modernization Act 2.0**, enacted when it was "signed by the President on Dec. 29, 2022," according to the official congressional tracking record, with a stated purpose "to allow for alternatives to animal testing for purposes of drug and biological" product development (Source: www.govtrack.us) (Source: www.govtrack.us). The enacted statutory text is unusually specific for a definitions section: it defines a "nonclinical test" as one "conducted in vitro, in silico, or in chemico" or as a non-human in vivo test, and it names organ-chip technology by category, "such as cell-based assays, microphysiological systems, or bioprinted or computer models" (Source: www.govinfo.gov) (Source: www.govinfo.gov). FDA's own roadmap paraphrases this as a law that "explicitly authorized the use of non-animal alternatives" to support IND applications and separately removed a requirement to use animal studies for biosimilar biologics license applications (Source: www.fda.gov). Crucially, the law authorized non-animal alternatives; it did not mandate their use or automatically qualify any specific platform, which is why organ-chip sponsors still route submissions through ISTAND or submit data case by case rather than citing the statute alone.

Industry has already tied its adoption plans to the statute. A peer-reviewed Nature Communications perspective on Organ Chip adoption describes "the pathway to adoption by the pharmaceutical industry, especially given the FDA Modernization Act 2.0," as now running directly through the regulatory qualification question rather than around it (Source: www.nature.com). MIMETAS made the same connection explicitly when announcing its argenx IND collaboration, stating the work "seamlessly aligns with the goals set forth by the 2022 FDA Modernization Act" (Source: mimetas.com). A separate 2026 peer-reviewed review of skin microphysiological systems similarly frames the 2022 law, alongside the cosmetics-focused Modernization of Cosmetics Regulation Act (MoCRA), as marking "a pivotal shift in preclinical testing" strategy across the industry, evidence the legislative effect extends beyond drugs into adjacent regulated categories (Source: www.nature.com.

FDA's own roadmap and April 2025 announcement. FDA translated the statutory authorization into an agency initiative on April 10, 2025, announcing a plan to phase out the animal testing requirement for monoclonal antibodies and, over time, other drug classes. The announcement commits FDA to act "by leveraging AI-based computational modeling, human organ model-based lab testing, and real-world human data," and confirms that inclusion of New Approach Methodology (NAM) data, the umbrella term FDA uses for organ-chips, organoids, and computational models, is encouraged and outlined in an accompanying roadmap that promotes lab-grown human organoids and organ-on-a-chip systems mimicking organs such as liver, heart, and immune tissue as replacements for animal safety testing (Source: www.fda.gov). Trade coverage of the roadmap quotes its long-run ambition directly: FDA "will aim to make animal studies the exception rather than the norm for pre-clinical safety/toxicity testing" (Source: www.the-scientist.com). By December 2025, Commissioner Makary was describing the policy in blunter terms to a national news program, stating of legacy animal testing, "we don't want you to do this animal testing" (Source: www.pharmavoice.com).

A note on federal funding volatility. The push toward organ-chip adoption has not been uniformly smooth at the federal research level. Trade press reported that Donald Ingber, the Wyss Institute scientist widely credited as a founder of organ-chip technology and an Emulate scientific founder, "received stop-work orders on two major organ-on-a-chip projects in late April 2025," a reminder that federal research funding for the underlying science can move independently of, and sometimes in tension with, FDA's own regulatory-acceptance timeline (Source: www.the-scientist.com).

Progress reported one year in. FDA reported in an April 20, 2026 update that it had achieved "Year 1" goals under the roadmap, including qualifying its first artificial intelligence-based drug development tool and establishing "a permanent pathway for qualifying innovative drug development tools" (Source: www.fda.gov). On March 18, 2026, FDA released draft guidance titled "General Considerations for the Use of New Approach Methodologies in Drug Development," which names "three-dimensional models such as organoids, spheroids and organs on chips" as an example NAM category, and establishes four validation principles: **Context of Use**, **Human Biological Relevance**, **Technical Characterization**, and **Fit-for-Purpose** (Source: www.fda.gov). The guidance text itself warns specifically about "leaching of materials from an organ-on-a-chip, which could cause toxicity or alter cells," a technical characterization concern sponsors will need to address in any future qualification package (Source: www.fda.gov).

FDA Modernization Act 3.0 in Congress. Separately from FDA's own administrative action, Congress has continued to legislate. The Senate passed its version, S. 355, on December 16, 2025, with the vote taken by unanimous consent (Source: www.govtrack.us), and the House passed its companion, H.R. 2821, by voice vote on July 20, 2026, directing FDA to publish a rule that would "replace any references to ``animal'' tests, data, studies, models, and research with a reference to nonclinical tests, data, studies, models, and research" across specified sections of Title 21 of the Code of Federal Regulations (Source: www.govinfo.gov). As of August 2026 the bill had not yet been reconciled and signed, so the terminology change is prospective, not current law.

Current State of Organ-on-a-Chip FDA Submissions

The single most important fact for anyone evaluating vendor or trade-press claims about "FDA-qualified" organ-chips is the agency's own pipeline data. As of January 1, 2026, ISTAND-specific figures show 16 projects in development and zero qualified DDTs to date within ISTAND, including 14 Letters of Intent accepted and 2 Qualification Plans accepted, with no newly qualified DDTs added in the prior 12 months; across all DDT Qualification Programs combined, FDA reports 151 total projects in development and 20 qualified DDTs to date (Source: www.fda.gov). Organ-on-a-chip technology occupies one of the 14 accepted-but-unqualified Letters of Intent inside a program that has qualified zero tools since becoming permanent.

Why qualification is slow across the board, not just for organ-chips. Peer-reviewed analysis of FDA's Clinical Outcome Assessment (COA) Qualification Program, a comparable DDT subtype, found qualification review takes an average of six years once a submission is accepted, with only 8.1% of submitted tools ultimately achieving full qualification (Source: pmc.ncbi.nlm.nih.gov). While that data covers COAs rather than ISTAND submissions specifically, it establishes a useful base rate: DDT qualification generally is a multi-year, low-completion-rate process, and organ-on-a-chip technology, roughly 16 months into its first LOI as of this writing, sits well within the range where zero completed qualifications would be expected rather than anomalous. A separate peer-reviewed analysis in Frontiers in Toxicology observes that "the majority of reported [organ-on-chip] models are still at a low technology readiness level," a structural gap between academic and early commercial development on one side and the technical characterization rigor FDA's qualification process demands on the other (Source: www.ncbi.nlm.nih.gov).

Two accepted organ-chip and organ-chip-adjacent LOIs. FDA has publicly announced LOI acceptance for two related technologies. The first, accepted September 24, 2024, is Emulate's Liver-Chip, intended "to assess the risk of DILI in adults to create relevant data for a drug's investigational new drug (IND) submission" (Source: www.fda.gov. The second, accepted around June 3, 2026, is "an artificial intelligence (AI)-Driven Digital Liver Model for Prediction of Drug-Induced Liver Injury (DILI)" (Source: www.fda.gov. The latter is computational rather than chip-based, but its acceptance alongside the Liver-Chip signals that FDA treats DILI prediction as a priority context of use regardless of the underlying NAM technology.

Existing acceptance of adjacent NAM categories. FDA has already accepted at least one related cell-based NAM into routine regulatory use outside formal qualification: human induced pluripotent stem cell-derived cardiomyocyte (hiPSC-CM) assays, described by CDER as "a new approach methodology used in regulatory submissions to FDA" for cardiac safety assessment (Source: www.fda.gov). This precedent, a cell-based in vitro NAM accepted into submissions without full DDT qualification, is the closest existing analog for how organ-on-a-chip data is likely to be used in the near term: case-by-case acceptance inside individual submissions, ahead of and separate from any eventual formal qualification.

Table 1 below summarizes how organ-on-a-chip technology fits within FDA's overall DDT qualification architecture.

DDT PATHWAY	ESTABLISHED	SCOPE	ORGAN-ON-A-CHIP / MPS FIT	STATUS AS OF JAN. 1, 2026
Biomarker Qualification Program	Pre-2016, formalized under Cures Act	Biological measures indicating disease state or drug response	Not applicable; organ-chips are assay platforms, not biomarkers themselves	Part of 151 total DDT projects in development
Clinical Outcome Assessment (COA) Program	Pre-2016, formalized under Cures Act	Patient-reported, clinician-reported, or performance outcomes	Not applicable	Average 6-year review, 8.1% qualification rate for COAs specifically (Source: pmc.ncbi.nlm.nih.gov)
Animal Rule Model Qualification	Pre-2016, formalized under Cures Act	Animal models used when human efficacy trials are infeasible (e.g., certain biothreats)	Not applicable; organ-chips are explicitly framed as animal-testing alternatives	Not organ-chip relevant
ISTAND Program	2020 (pilot); made permanent 2025 (Source: www.fda.gov)	Any novel DDT not fitting the above, explicitly including "use of tissue chips (i.e., microphysiological systems)"	Direct fit; the sole applicable qualification pathway for organ-chips	16 projects in development, 14 LOIs, 2 QPs accepted, 0 qualified to date

The table underscores a point easy to miss in vendor marketing: organ-on-a-chip technology has exactly one formal qualification door, ISTAND, and that door, while open, has not yet produced a single completed qualification for any tool of any type since the pathway became permanent. Sponsors evaluating whether to build a regulatory strategy around a "qualified" organ-chip assay should treat that outcome as a multi-year prospective goal, not a present-tense fact, while recognizing that unqualified use inside individual submissions remains fully available today.

Data Analysis and Evidence

Quantifying the organ-on-a-chip sector requires separating three distinct data types often conflated in press coverage: FDA regulatory pipeline counts (covered above), commercial market sizing, and public research funding and cost impact.

Market size estimates diverge by methodology. Two established market-research firms have published current sizing for this category, and their figures differ by roughly an order of magnitude, illustrating how immature and methodology-dependent organ-chip market sizing still is. Precedence Research puts the global organ-on-a-chip market at **$227.40 million in 2025**, projecting growth to **$4,191.15 million by 2035** at a 33.83% compound annual growth rate (CAGR) (Source: www.precedenceresearch.com). MarketsandMarkets, using a narrower "organs-on-chips" product definition, valued the market at **$89.202 million in 2023** and **$123.285 million in 2024**, forecasting **$631.073 million by 2029** at a 38.6% CAGR (Source: www.marketsandmarkets.com). Both firms agree directionally on rapid growth, and Precedence Research further reports that pharmaceutical and biotechnology companies accounted for **73% of end-user market share in 2025** (Source: www.precedenceresearch.com), with North America holding **more than 52% of global market share** and Asia-Pacific the fastest-growing region (Source: www.precedenceresearch.com). The same report identifies Emulate, Inc. as a leading platform vendor that has raised **$225 million** across multiple funding rounds (Source: www.precedenceresearch.com).

Estimated cost impact. Beyond top-line market sizing, one trade-press estimate published by SelectScience suggests that organ-chips like the Liver-Chip could save large pharmaceutical companies substantial sums annually "by enabling better early-stage decisions" that avoid late-stage clinical failures driven by unpredicted hepatotoxicity (Source: www.selectscience.net). The same reporting states that Emulate's organ-chips have supported "over 30 organ models across more than 130 peer-reviewed publications," an indicator of platform breadth rather than a regulatory metric (Source: www.selectscience.net). These figures originate from vendor-adjacent trade coverage rather than an independent economic analysis and should be read as directional industry estimates, not audited savings.

Public funding for non-animal alternative methods. Federal investment in the underlying science has scaled up sharply in 2026. NIH announced **more than $150 million** in new funding on March 18, 2026 for its Complement-ARIE initiative, aimed at developing and scaling "research methods that better simulate human biology" as alternatives to animal models (Source: www.nih.gov). Within that program, NIH plans roughly **$20 million** in contributions to a Validation and Qualification Network intended to help bridge the technology-readiness gap identified in the peer-reviewed literature above (Source: www.nih.gov), and NIH separately launched a **$7 million** NAMs Reduction to Practice Challenge in coordination with FDA and the Environmental Protection Agency (Source: www.nih.gov). This funding builds on NCATS's longer-running Tissue Chip for Drug Screening program, which draws flexible funding from the Cures Acceleration Network to coordinate FDA-facing chip development work (Source: ncats.nih.gov), and traces back to the original NIH-DARPA-FDA Microphysiological Systems program that issued its first funding announcements in 2011 (Source: commonfund.nih.gov).

Industry-side survey data on regulatory engagement. The Biotechnology Innovation Organization (BIO), through its BioSafe NAMs Task Force, surveyed member companies and presented findings at the BioSafe General Membership Meeting held April 7 to 9, 2025 in Basel, Switzerland (Source: bio.news). The task force found that **81% of survey respondents** proactively seek pre-filing advice from health authorities specifically to reduce regulatory uncertainty before submitting NAM-based data (Source: bio.news, a strong signal that sponsors view early engagement, not retroactive justification, as the operative strategy for getting non-animal methods like organ-chips accepted in a given submission.

Table 2 below places the two published market-size estimates side by side.

SOURCE	BASE YEAR VALUE	FORECAST YEAR	FORECAST VALUE	CAGR
Precedence Research	$227.40 million (2025)	2035	$4,191.15 million	33.83%
MarketsandMarkets	$123.285 million (2024)	2029	$631.073 million	38.6%

Both firms describe the same underlying market, yet their base-year figures differ by nearly $100 million even after accounting for a one-year difference in base year, most likely reflecting different scoping decisions about which product categories (chip hardware alone versus hardware, reagents, and services combined) each firm counts. Readers evaluating organ-on-a-chip investment or procurement decisions should treat both figures as order-of-magnitude estimates rather than precise industry consensus, and should independently confirm current pricing and market position with vendors before making purchasing decisions.

Case Studies and Real-World Examples

Emulate, Inc.: FDA Collaboration, ISTAND Submission, and Multi-Sponsor Adoption

Emulate's Liver-Chip is the most regulator-facing organ-chip platform in the United States, and its relationship with FDA predates its 2024 ISTAND submission by seven years. In April 2017, FDA entered a formal Cooperative Research and Development Agreement (CRADA) with Emulate, described by trade press as a "multi-year Cooperative Research and Development Agreement (CRADA) [that] will assess whether Emulate's Liver-Chips, instrumentation and software apps meet regulatory evaluation criteria," with the stated possibility that "the collaboration could eventually expand to other Organ-Chips, including Emulate's Intestine-Chip, Lung-Chip, and Cardiac systems" (Source: www.biopharmadive.com (Source: www.biopharmadive.com). FDA's Suzanne Fitzpatrick, of the Center for Food Safety and Applied Nutrition, framed the collaboration's purpose around understanding "how a toxin or combination of toxins affects cells, information that ultimately can be used to help assess risks to human health" (Source: www.biopharmadive.com). By the time the Liver-Chip's ISTAND Letter of Intent was accepted on September 24, 2024, the underlying FDA relationship had grown to span five agency laboratories covering "models for the liver, lung, intestine, brain, and alveolus" (Source: www.selectscience.net).

Trade press coverage of the ISTAND acceptance reports that "Emulate's Liver-Chip was accepted into the US Food and Drug Administration's ISTAND program to assess the potential" for drug-induced liver injury, citing blinded validation results in which "the human Liver-Chip correctly identified 87 percent of small molecule drugs known to cause human DILI, with 100 percent specificity" (Source: www.the-scientist.com) (Source: www.the-scientist.com). This figure differs from an earlier 27-compound validation study Emulate itself has cited, which reported 77% sensitivity and 100% specificity (Source: emulatebio.com), a discrepancy likely reflecting different validation cohorts or blinding protocols across studies; readers should treat any single sensitivity figure as study-specific rather than as a settled performance benchmark for the platform overall.

Beyond the regulatory submission, Emulate has documented use by pharmaceutical sponsors in discovery-stage contexts distinct from regulatory filings. Emulate's Chief Scientific Officer Lorna Ewart states that "scientists at Moderna leveraged the Liver-Chip to screen 35 novel lipid nanoparticles" before advancing candidates into animal studies (Source: emulatebio.com). AstraZeneca's IMED Biotech Unit entered a strategic agreement with Emulate in May 2018 to use the Liver-Chip for safety testing across its pipeline, with executive Mene Pangalos stating the technology "has the potential to enhance and accelerate our ability to translate science into innovative medicines" (Source: pmlive.com). Separately, industry trade press reported that Roche "will use Emulate's Human Emulation System in place of lab animals to run drug safety and efficacy tests," while Takeda "will use the firm's Intestine-Chip to discover and evaluate gastrointestinal disease drugs and biomarkers," two distinct named-sponsor use cases documented independently of Emulate's own communications (Source: cen.acs.org) (Source: cen.acs.org).

Hesperos, Inc. and Sanofi: An IND Built Primarily on Tissue Chip Data

The clearest documented case of organ-chip data underpinning an actual FDA IND filing, as opposed to a discovery-stage screening exercise, comes from Hesperos's Human-on-a-Chip platform. Research funded by True North Therapeutics (later acquired by Sanofi) and an NCATS Small Business Innovation Research (SBIR) grant produced preclinical data on a rare neuromuscular disorder that NCATS describes as "using primarily tissue chip data for an FDA Investigational New Drug application," calling it one of the first cases of its kind (Source: ncats.nih.gov). NCATS confirms funding came from "True North Therapeutics (now Sanofi), NCATS" (Source: ncats.nih.gov, and that "Sanofi started recruiting participants into a Phase 2 clinical trial in April 2021," the trial that followed the tissue-chip preclinical package (Source: ncats.nih.gov). NCATS program manager Lucie Low described this outcome as marking "an important milestone in the evolution of the use of tissue chips" for regulatory purposes (Source: ncats.nih.gov).

Hesperos has since reported a second such case. In a September 2024 announcement, the company stated its Human-on-a-Chip technology was "supporting a client's Investigational New Drug submission with the Food & Drug Administration" for Dianthus Therapeutics' complement-targeting monoclonal antibody DNTH103, described elsewhere in the release as "a potent monoclonal antibody that selectively targets the classical pathway of the complement system," now in a Phase II trial (NCT06282159) for generalized myasthenia gravis (Source: www.biospace.com) (Source: www.biospace.com). Together, these two cases are the strongest available evidence that organ-chip data has already influenced actual IND outcomes, independent of whether the underlying platform ever completes ISTAND qualification.

CN Bio Innovations: The First Commercial-Regulator Co-Publication

CN Bio's PhysioMimix platform produced a distinct kind of regulatory interaction: rather than a submission on behalf of a sponsor, CN Bio scientists co-authored a peer-reviewed paper directly with FDA researchers, which the company describes as "the first co-published, peer-reviewed research paper between a commercial MPS provider and a regulator," published January 11, 2021 (Source: cn-bio.com). Independent trade coverage of the same study reported that "CN Bio and FDA scientists demonstrated that data derived using the PhysioMimix liver-on-a-chip system are appropriate for use in drug safety and metabolism applications" (Source: www.genengnews.com). CN Bio's chairperson at the time framed the collaboration as evidence that it "starts to make the case for inclusion of the data in IND submissions" (Source: cn-bio.com), while CN Bio CEO David Hughes has separately described a structural tradeoff that applies across the organ-chip category generally: "there is an inverse relationship between physiological relevance and throughput," meaning the most biologically realistic chip platforms tend to be the slowest and most expensive to run at scale (Source: www.genengnews.com). This case illustrates a third pathway distinct from ISTAND submission or individual IND use: direct scientific collaboration with FDA's own research laboratories aimed at building the evidence base that future qualification packages, whether from CN Bio or other vendors, will eventually need to cite.

MIMETAS and argenx: A 2024 IND Filing Aligned to the Modernization Act 2.0

MIMETAS's OrganoPlate platform contributed data to an IND filed by the Belgium-headquartered biotechnology company argenx, announced July 11, 2024: "announce an Investigational New Drug (IND) filing by argenx, supported by data from MIMETAS" (Source: mimetas.com. MIMETAS CEO Jos Joore framed the case as part of a broader industry shift, noting the value of "embracing advanced human in vitro models over traditional methods like 2D cell culture" and, implicitly, animal models (Source: mimetas.com). Alongside the Hesperos/Dianthus and Hesperos/Sanofi examples, the argenx case brings the total count of publicly documented, named IND filings supported by organ-on-a-chip data to at least three separate sponsors across three separate chip vendors, evidence that unqualified organ-chip use inside individual submissions is now a repeatable pattern rather than a single anecdote.

Table 3 below summarizes the cases documented in this section.

COMPANY / PLATFORM	SPONSOR OR PARTNER	TYPE OF FDA INTERACTION	DOCUMENTED OUTCOME
Emulate (Liver-Chip)	Self-submitted; also AstraZeneca, Moderna, Roche, Takeda	CRADA (2017) plus ISTAND Letter of Intent (Sept. 2024) (Source: www.biopharmadive.com	First organ-chip DDT in FDA qualification pipeline; not yet qualified
Hesperos (Human-on-a-Chip)	True North Therapeutics / Sanofi	IND supported primarily by tissue chip data (Source: ncats.nih.gov)	Phase 2 trial recruitment began April 2021
Hesperos (Human-on-a-Chip)	Dianthus Therapeutics	Chip data cited in IND submission (Source: www.biospace.com)	DNTH103 in Phase II (NCT06282159)
CN Bio (PhysioMimix)	FDA scientists (direct co-publication)	Joint peer-reviewed research paper (Source: cn-bio.com)	Evidence base cited toward future IND use
MIMETAS (OrganoPlate)	argenx	Chip data cited in IND filing (Source: mimetas.com	IND filed July 2024

Read together, the table shows FDA-facing organ-chip activity today is concentrated in hepatotoxicity and neuromuscular/immunology contexts of use, spans at least five distinct chip vendors and named pharmaceutical partners, and has not yet produced a single completed DDT qualification despite multiple IND-level submissions. Sponsors should note that IND acceptance of chip data in these specific cases does not establish a general precedent that any organ-chip data will be accepted in any future submission; each case remains subject to reviewer discretion absent a completed ISTAND qualification.

Implications and Future Directions

Four structural forces will shape organ-on-a-chip regulatory acceptance over the next several years. First, the ISTAND pipeline itself: with 14 Letters of Intent accepted and only 2 Qualification Plans advanced as of January 2026, the Liver-Chip LOI accepted in September 2024 is roughly on pace with, or possibly ahead of, the multi-year timeline comparable DDT categories have historically required (Source: pmc.ncbi.nlm.nih.gov). The timing of any first full organ-chip qualification remains uncertain; sponsors building regulatory strategies around a formally qualified chip assay should plan for a multi-year process rather than assume near-term availability.

Second, the draft NAM guidance released in March 2026 will materially affect how any future organ-chip qualification package is evaluated. Its four stated principles, Context of Use, Human Biological Relevance, Technical Characterization, and Fit-for-Purpose, together with the specific engineering concerns the guidance raises about material leaching from chip devices, signal that reviewers will scrutinize device engineering and manufacturing consistency alongside biological performance, an area some academic organ-chip developers, per the Frontiers in Toxicology technology-readiness finding cited earlier (Source: www.ncbi.nlm.nih.gov), have historically underinvested in relative to biological validation.

Third, consortium infrastructure continues to mature in parallel with individual company submissions. The IQ MPS Affiliate's 22-company membership as of 2019 and the Critical Path Institute's 2023 FDA-funded Complex In Vitro Models project both point toward a pre-competitive push to standardize how organ-chip evidence is generated and evaluated before any individual sponsor files (Source: pmc.ncbi.nlm.nih.gov) (Source: c-path.org). This mirrors how the original NIH-DARPA-FDA Microphysiological Systems program built shared technical foundations before any commercial qualification pathway existed (Source: www.darpa.mil).

Fourth, international alignment. The European Medicines Agency (EMA) offers a comparable but procedurally distinct mechanism: its Committee for Medicinal Products for Human Use (CHMP) can "issue a qualification opinion on the acceptability of a NAM within a specific context of use," and EMA explicitly notes that "the NAM may not necessarily need to be formally qualified in a separate procedure," allowing case-by-case acceptance inside a marketing authorization application, mirroring FDA's own case-by-case IND pathway (Source: www.ema.europa.eu) (Source: www.ema.europa.eu). EMA's Innovation Task Force briefing meetings, an early informal engagement channel, explicitly list "New approach methodologies (NAMs) and implementation of the 3Rs principles" as a covered topic area, giving sponsors a parallel European entry point analogous to a pre-ISTAND FDA meeting (Source: www.ema.europa.eu. A sponsor pursuing organ-chip-supported development for a global asset should expect to engage both agencies separately, since neither a U.S. ISTAND qualification nor an EMA qualification opinion automatically transfers to the other jurisdiction.

Legislative status adds a fifth variable. The Senate passed S. 355, as amended, on December 16, 2025, while H.R. 2821 remains introduced in the House; neither bill has become law. If enacted, the proposed terminology change would be primarily semantic and structural rather than an independent scientific validation trigger, but it would reinforce the direction FDA has already signaled through its own roadmap and draft guidance (Congress.gov: S. 355 (Congress.gov: H.R. 2821. For pharmaceutical and life-science organizations tracking this regulatory trajectory, including advisory firms such as intuitionlabs.ai that help clients build regulatory-compliant data and technology strategies aligned to FDA and EMA expectations (Source: intuitionlabs.ai), the practical implication is to monitor FDA's ISTAND summary metrics page and forthcoming final NAM guidance directly rather than relying on vendor characterizations of qualification status, and to budget regulatory strategy timelines in years, not quarters, for any organ-chip assay intended to reach full DDT qualification.

Frequently Asked Questions (FAQs)

Has any organ-on-a-chip technology been fully qualified by the FDA? No. As of January 1, 2026, FDA's own summary metrics show zero DDTs qualified to date through the ISTAND pathway, the only pathway applicable to organ-chip technology, against 16 projects in development (Source: www.fda.gov). Emulate's Liver-Chip has advanced only to the first of three required steps, LOI acceptance, as of September 2024.

What is the ISTAND program, and how does it apply to organ-on-a-chip devices? ISTAND (Innovative Science and Technology Approaches for New Drugs) is FDA's catch-all Drug Development Tool qualification pathway for novel tools that do not fit the biomarker, COA, or Animal Rule categories, and it explicitly lists "use of tissue chips (i.e., microphysiological systems)" as an eligible submission type (Source: www.fda.gov.

Can sponsors use organ-on-a-chip data in an IND submission before the technology is formally qualified? Yes. FDA guidance permits use of a drug development tool in a development program even without completing the formal qualification programs, and at least three sponsors, Sanofi, Dianthus Therapeutics, and argenx, have already done so (Source: www.fda.gov).

How does the FDA Modernization Act 2.0 relate to organ-on-a-chip qualification? Enacted December 29, 2022, the law defined “nonclinical test” to include microphysiological systems among permissible approaches (Source: www.govinfo.gov). It authorized non-animal alternatives for IND support and removed an animal-study requirement for biosimilar biologics license applications; it did not eliminate animal studies generally or qualify any specific platform.

What is FDA's draft guidance on New Approach Methodologies (NAMs), and when does it take effect? FDA released draft guidance titled General Considerations for the Use of New Approach Methodologies in Drug Development on March 18, 2026, naming organ-chips directly and establishing four validation principles: Context of Use, Human Biological Relevance, Technical Characterization, and Fit-for-Purpose. As draft guidance, it does not yet carry binding force and remains subject to revision before finalization.

How large is the organ-on-a-chip market? Estimates vary by research firm. Precedence Research sizes it at $227.40 million in 2025, growing to $4,191.15 million by 2035 (Source: www.precedenceresearch.com), while MarketsandMarkets sizes the narrower "organs-on-chips" category at $123.285 million in 2024, growing to $631.073 million by 2029 (Source: www.marketsandmarkets.com).

When did FDA start working on organ-on-a-chip technology? Well before ISTAND existed. FDA joined NIH and DARPA in a joint Microphysiological Systems research program that began issuing funding announcements in 2011 (Source: commonfund.nih.gov), and FDA scientists entered a direct Cooperative Research and Development Agreement with Emulate in 2017 (Source: www.biopharmadive.com.

Conclusion

Organ-on-a-chip FDA qualification is best understood as an active regulatory process built on more than a decade of federal research infrastructure, rather than a completed status. FDA's latest cited ISTAND metrics, dated January 1, 2026, report zero qualified tools in the pathway; the pathway has accepted Emulate's organ-chip Letter of Intent and a related AI-based liver-model LOI. Qualification timelines elsewhere in the DDT system are measured in years rather than months (FDA summary metrics. Separately, and more immediately relevant to sponsors working today, organ-chip data has already reached FDA reviewers inside individual IND applications from Sanofi, Dianthus Therapeutics, and argenx, built on platforms from Hesperos, MIMETAS, and, in direct research-collaboration capacities dating to 2017 (Source: www.biopharmadive.com and 2021 (Source: cn-bio.com) respectively, Emulate and CN Bio. That distinction, between a technology being formally qualified and a technology's data being accepted within a specific submission, is the single most important fact sponsors, investors, and policymakers need to hold onto when evaluating claims in this space.

The legislative and administrative backdrop favors continued expansion of this activity: the FDA Modernization Act 2.0's 2022 statutory authorization, which names microphysiological systems directly, FDA's own April 2025 roadmap to phase out animal testing for monoclonal antibodies, the agency's reported Year 1 progress in April 2026, and the March 2026 draft NAM guidance collectively indicate an agency actively building the infrastructure for organ-chip acceptance, even as the pending FDA Modernization Act 3.0 legislation works through Congress and federal research funding for the underlying science remains, as the 2025 stop-work orders on Wyss Institute projects illustrate, subject to its own separate volatility. Market growth estimates, while divergent between research firms, agree directionally on a rapidly expanding sector serving an end-user base already 73% dominated by pharmaceutical and biotechnology companies (Source: www.precedenceresearch.com), alongside an active pre-competitive consortium ecosystem spanning the IQ MPS Affiliate (Source: pmc.ncbi.nlm.nih.gov) and the Critical Path Institute (Source: c-path.org). For any organization building a regulatory or investment strategy around microphysiological systems, the evidence assembled here supports one central planning assumption: engage FDA early through consortium channels or direct meetings, budget for a multi-year qualification timeline if pursuing formal DDT status, and, in the meantime, follow the precedent already set by Sanofi, Dianthus, and argenx of submitting well-characterized organ-chip data directly within individual applications rather than waiting for a qualification that, as of this writing, no organ-chip platform has yet achieved.

Tags: organ-on-a-chip, fda qualification, microphysiological systems, istand program, drug development tool, fda modernization act 2.0, ind submission, new approach methodologies, alternative to animal testing, mps

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