



Biopharma **insights** others miss

EXECUTIVE SUMMARY

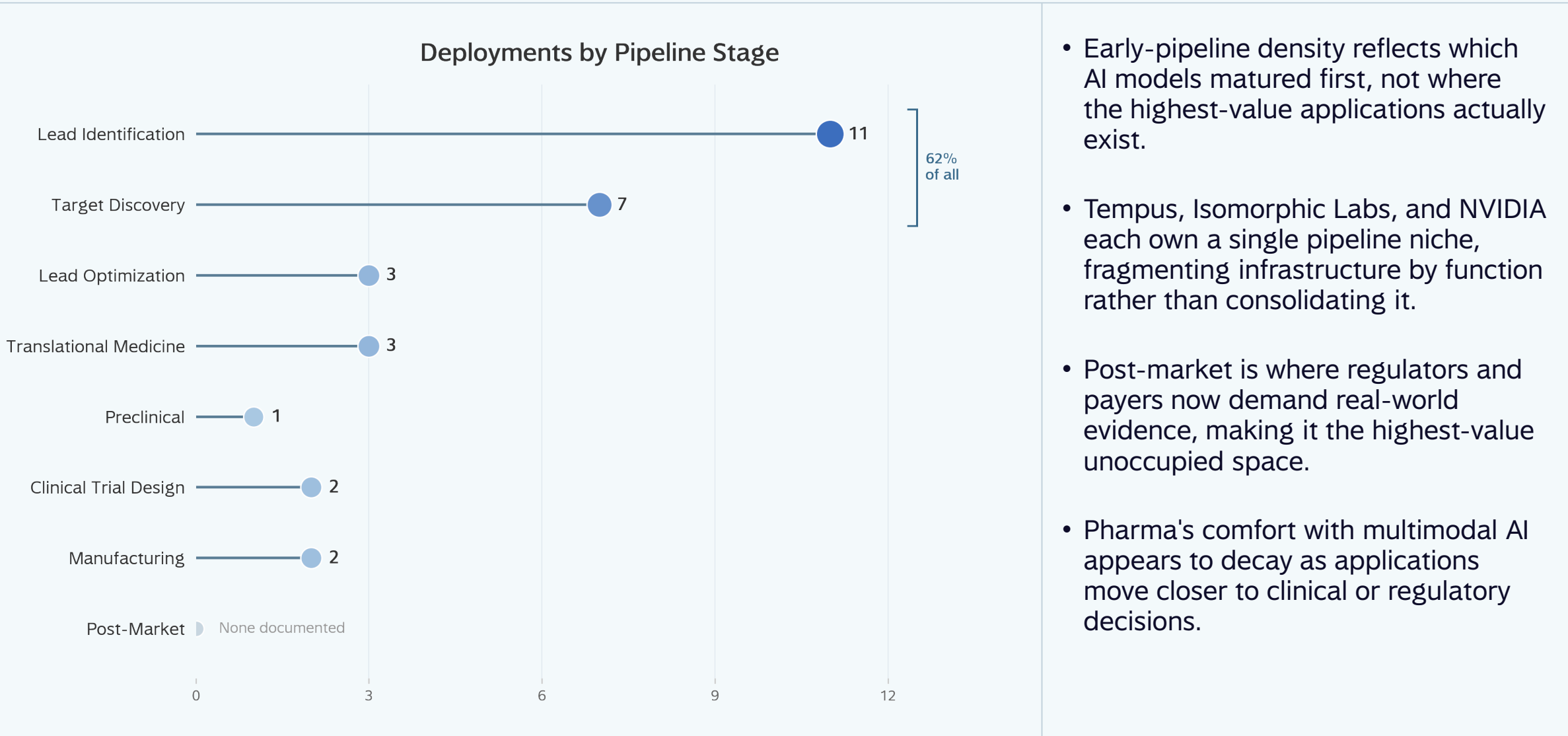
Multimodal Foundation Models and World Models in Biopharma

1. **EARLY DISCOVERY CAPTURES ALL:** Biopharma's multimodal deployments cluster in lead identification and target discovery, reflecting which AI matured first rather than where the value is. The later pipeline stages where regulatory and commercial decisions converge remain unoccupied and represent the most significant white space.
2. **WORLD MODELS ALREADY WORK:** Manufacturing digital twins reached production grade because process variables and sensors are directly measurable. Biology simulation is the largest domain but mostly partnered, meaning the competitive window for a defensible human biology platform is still open.
3. **PHARMA BUYS, NOT BUILDS:** Technology vendors and AI-native biotechs define the infrastructure layer for both foundation models and world models. Large pharma appears sparingly and almost never as a primary builder. The partnership terms being set now will determine pharma's long-term leverage.
4. **POSTURE INVERSION IS STRATEGIC:** Companies that partner externally for foundation models shift toward internal builds for world models, treating simulation as proprietary advantage. Their investments cluster in quantitative systems pharmacology and manufacturing because those domains connect directly to regulatory submissions.
5. **BIOLOGY SIMULATION ENTERS VIA ACQUISITION:** No large pharma company is building a broad biology world model comparable to Recursion, Bioptimus, or CytoReason. The most ambitious simulation capabilities are developing outside pharma and will arrive through partnerships or acquisitions.



Multimodal AI clusters in early discovery, then vanishes

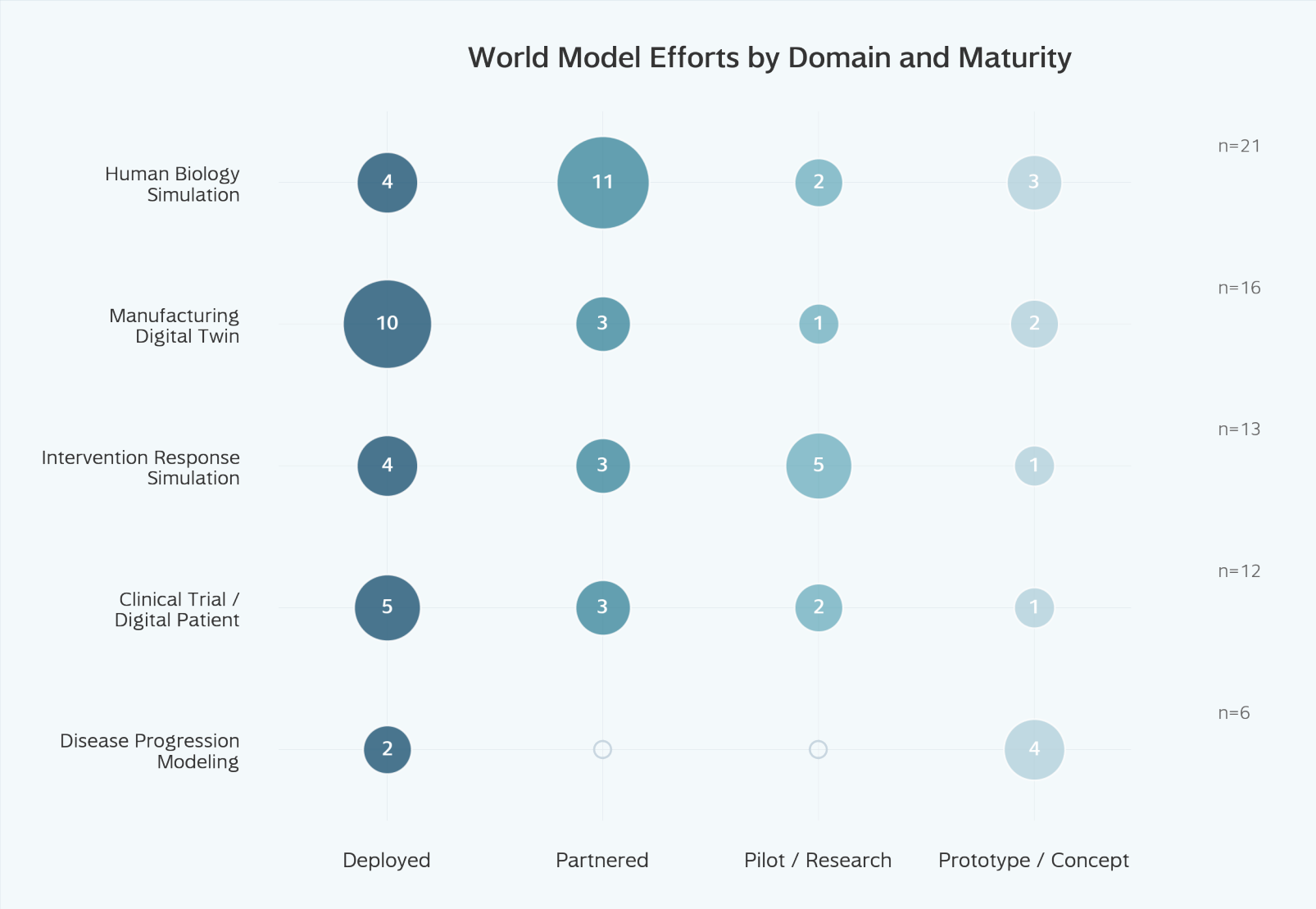
29 documented deployments across the biopharma pipeline



World models are already operational, not speculative

69 efforts across five domains, from manufacturing to biology simulation

- Manufacturing twins reached production grade because process physics and sensors are observable in ways biology still is not.
- Biology simulation is large but mostly partnered, meaning the race to own a defensible platform in that domain remains open.
- The competitive advantage is not just building a world model but shaping what the category means while definitions remain fluid.
- Disease progression modeling remains academically anchored, creating a potential acquisition pathway into longitudinal patient simulation.



Pharma buys the infrastructure it does not build

AI-native biotechs and tech vendors dominate both landscapes

Entity Type Across Both Landscapes

Builder Category	Foundation Models (n=29)	World Models (n=69)	Strategic Read
AI-Native Biotech	4 of 29 build internally (Owkin, insitro, Xaira, Recursion)	16 of 69 efforts (23%) Recursion, Bioprimus, CytoReason, Aitia	The credible frontier builders in both landscapes are AI-native, not pharma
Technology Vendor or AI Partner	24 of 29 use an external AI partner Isomorphic Labs, Tempus, NVIDIA lead	23 of 69 efforts (33%) Simulations Plus, Siemens, Ansys, Certara	Vendors dominate world models and power most FM deployments as partners
Large Pharma	2 of 29 are internal builds Only GSK operates a hybrid model	7 of 69 efforts (10%) Clustered in manufacturing twins and QSP	Pharma partners for FMs but builds internally for narrow world model bets
Academic / Consortium	Not represented in FM deployment dataset	21 of 69 efforts (30%) VCell, ENISI, OpenQSP, Living Heart	Academic groups anchor biology simulation and open-source intervention models

- The vendor partnership terms pharma negotiates today will define its long-term strategic leverage across the multimodal AI stack.
- GSK is the sole hybrid, making it the reference case for whether internal capability and external partnerships coexist.
- Commercial world models depend on open-source academic simulation tools, a structural dependency invisible in pharma's partnership announcements.



Foundation model landscape (n=29) and world model landscape (n=69). Entity type based on primary organizational role. Deployer posture based on model ownership and partnership structure. The two landscapes use different inclusion criteria and are not directly comparable by count. Two world model efforts (1 academic lab, 1 contract manufacturer) are not shown separately due to small count. Quantitative systems pharmacology abbreviated as QSP throughout.

Pharma licenses foundation models but owns world models

Four crossover companies show a consistent posture inversion

How Pharma Engages Differently by AI Type

	Foundation Model Approach Partner-led, externally accessed	World Model Approach Internally built or internally led
Genentech	Partners with NVIDIA for target discovery platforms	Built internal QSP Simulator for drug-disease programs
Novartis	Partners with Isomorphic Labs and Generate Biomedicines for lead ID	Built internal spinal cord and tissue simulation model
Pfizer	Uses AWS commercial platform for manufacturing analytics	Operates bioreactor digital twin with M-Star CFD internally
Sanofi	Partners with BioMap for protein design via xTrim	Leads internal manufacturing twin and rare-disease QSP digital twins

- Pharma treats foundation models as commodity infrastructure worth licensing and world models as proprietary advantage worth owning.
- Internal bets connect to established regulatory workflows like model-informed drug development, where the return pathway is already legible.
- Recursion, Bioptimus, and CytoReason are building the biology world models no pharma company has attempted, positioning for acquisition.
- Sanofi spans two world model domains but stays within orthodox manufacturing and QSP territory, the most conservative frontier bet.



Large pharma companies appearing in both the foundation model (n=29) and world model (n=69) landscapes. Engagement mode assessed from partnership structure, model ownership, and named platform linkages. Astellas and Takeda appear only in the world model landscape. QSP refers to quantitative systems pharmacology.