

Humanoid Robot Hands State of the Art

The ultimate guide to dexterous robot hands



Humanoid.guide

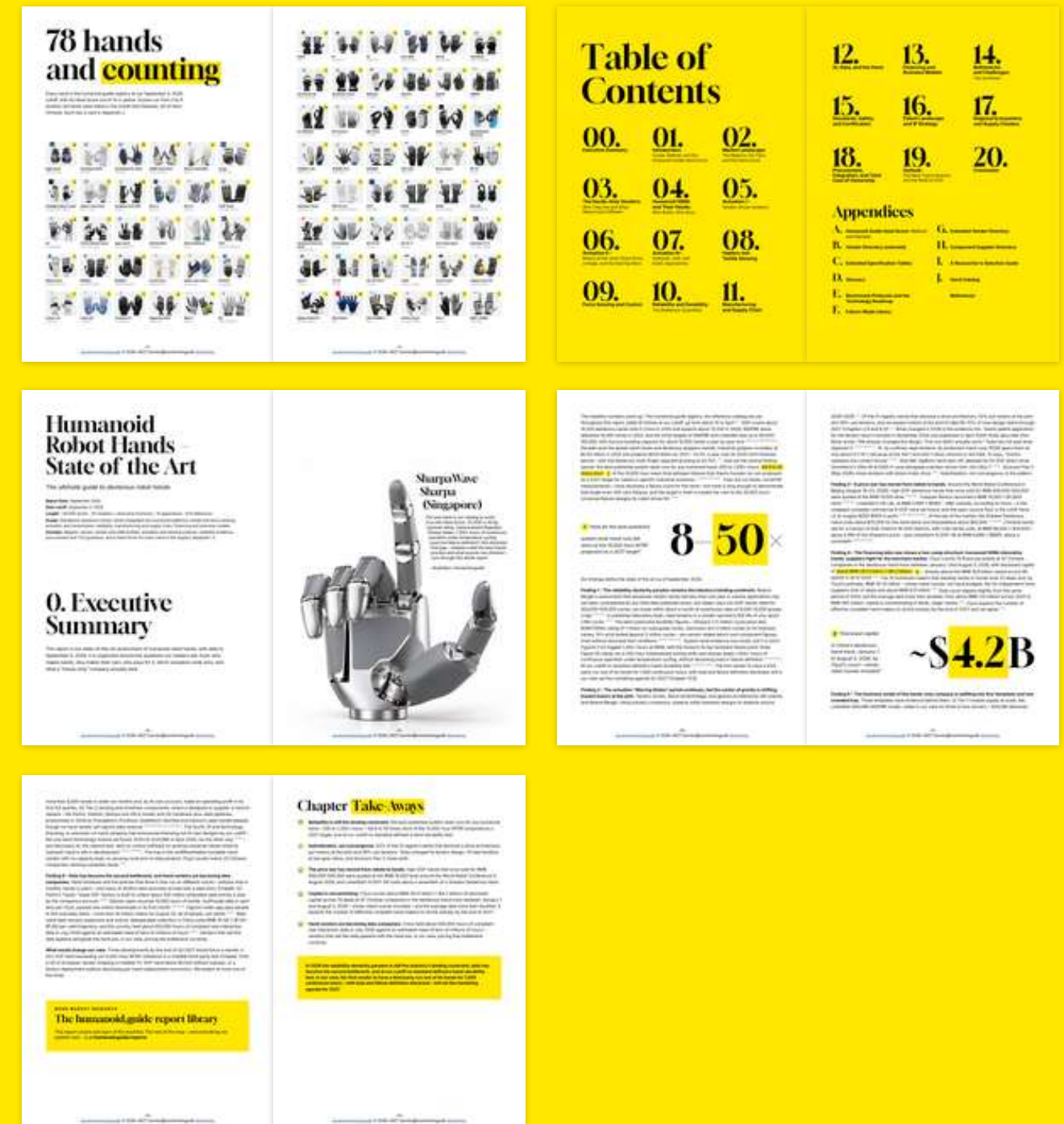
Free Preview – What Each Chapter Covers

Report Date: September 2026
Data cutoff: September 5, 2026
Total Length: ~81,000 words · 325 pages · Executive Summary + 20 chapters + 10 appendices
Scope: Standalone dexterous hands, hands integrated into humanoid platforms, tactile and force sensing, actuation and transmission, reliability, manufacturing and supply chain, financing and business models
Includes: 45 tables · 8 figures · 574 references · a Hand Score card for each of the 78 hands in the registry

0. Executive Summary

The headline numbers all point up: registry listings, hand shipments, financing, market forecasts. The Executive Summary sets that momentum against the one measurement that hasn't kept pace – how long a humanoid hand actually runs. It lays the best published system-level runs beside the reliability target a leading Chinese tech founder has proposed for industrial robots by 2027, and beside the design life a cobot maker already builds its drives for, then asks what those runs can and can't prove. That gap is the report's central argument.

Six findings define the state of the art. The first asks whether any field data has yet contradicted a leading consultancy's verdict on how long advanced hands last. The second follows the contest between tendons, direct-drive and linkage designs, and geared drives through a year in which the best-known hand program, days after its patent application was published, said it had already changed the design – and says where the center of gravity is moving. The third tracks a price war that jumped from robots to hands around Beijing's World Robot Conference. The fourth reads this year's Chinese financing data as two camps, humanoid makers that build their own hands and independent suppliers fighting for the merchant market, and asks how many complete-hand makers will come through. The fifth sorts hands-only business models into a handful of templates and one crowded trap. The sixth looks at what has become the industry's second bottleneck, and what that is turning hand vendors into. Includes a closing note on the developments that would force the authors to change their view – and how many of them they expect to see.



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Shadow Dexterous Hand · Shadow Robot (UK)

1. Introduction: Scope, Method, and the Humanoid Guide Hand Score

A legged robot without useful hands is a surveillance platform. Give it reliable hands and it becomes a labor substitute. This opening chapter argues that the hand decides nearly all of a humanoid’s task-level value and shows where it sits in a bank’s teardown of Tesla’s Optimus. It also introduces the Humanoid Guide Hand Score used throughout the report. The authors call it useful as a screen and misleading as a ranking, then prove the point with a pair of hands whose scores turn the obvious order upside down.

Terminology and Anatomy fixes the vocabulary – why a hand sold as “20 DOF” may have fewer active axes, and why one product can quote grip-force numbers that look nothing alike. How to Read a Vendor Datasheet Critically turns that into the questions that expose most datasheet inflation. A Compressed History runs from the tendon hands of the early 1980s to the humanoid pull, and draws a lesson from how earlier demand shocks ended. The Grasp Taxonomy names the most avoidable way to buy the wrong hand. The Biological Benchmark measures robot hands against the human original and argues that the human hand’s real advantage is none of the things vendors compete on. Sources and Confidence and A Note on Evidence Standards set the rules the report holds itself to – and ask readers to apply them to every document in the field, vendor replies included. Includes the Hand Score’s scoring bands, an eight-question datasheet checklist and the grasp vocabulary the rest of the report relies on.



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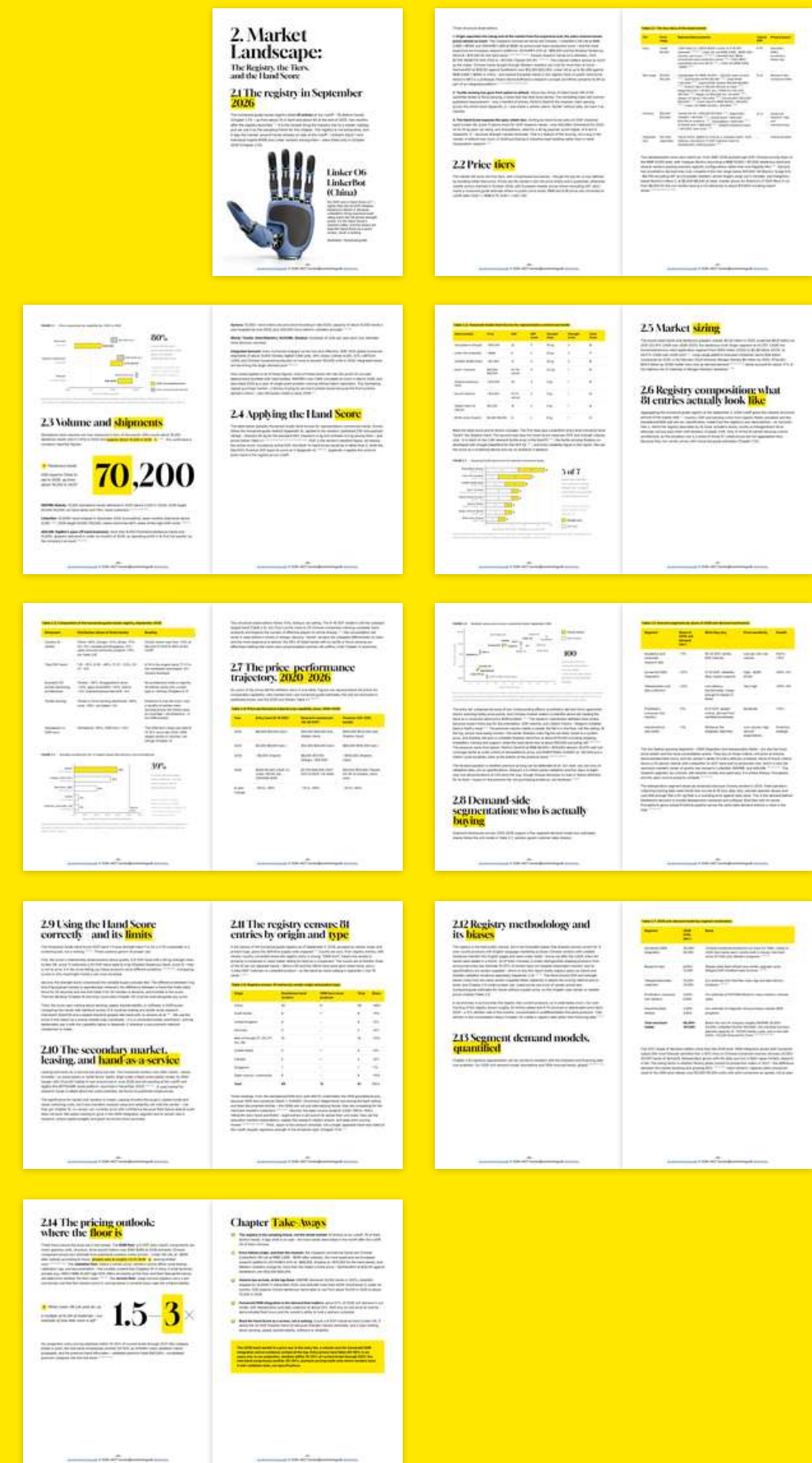


Linker O6 · LinkerBot (China)

2. Market Landscape: The Registry, the Tiers, and the Hand Score

Listing is not selling. This chapter builds the supply side of the market from the humanoid.guide registry – 81 entries at the September cutoff – and then tests that catalog against what is actually shipping, who is buying and what they pay. A hand's country of origin, it finds, separates the cheap end of the market from the expensive end. Something far less glamorous moves the price almost as much. And the premium tier turns out to be selling something other than hardware.

Price Tiers sorts the market into four tiers, the top one now defined by bundling rather than price. Volume and Shipments gathers the deliveries vendors have reported, then adds the caveat one vendor's own CMO conceded about where most of those hands end up. Registry Composition and The Registry Census break the catalog down by origin, degrees of freedom, actuation and sensing – and find one major robotics nation missing entirely. The Price-Performance Trajectory follows prices back to 2020 – estimates for the early years, published prices since – and shows where the deflation really happened, and where it didn't. Demand-Side Segmentation and Segment Demand Models, Quantified build a unit model of who is buying, including a segment that barely existed in 2024, and name the swing factor for 2027. Using the Hand Score Correctly marks the limits of the rating, Registry Methodology and Its Biases those of the registry, and The Pricing Outlook closes on the floors that bound the next phase of the price war. Includes seven tables, among them the full registry census and a 2026 unit-demand model by segment, and four figures.



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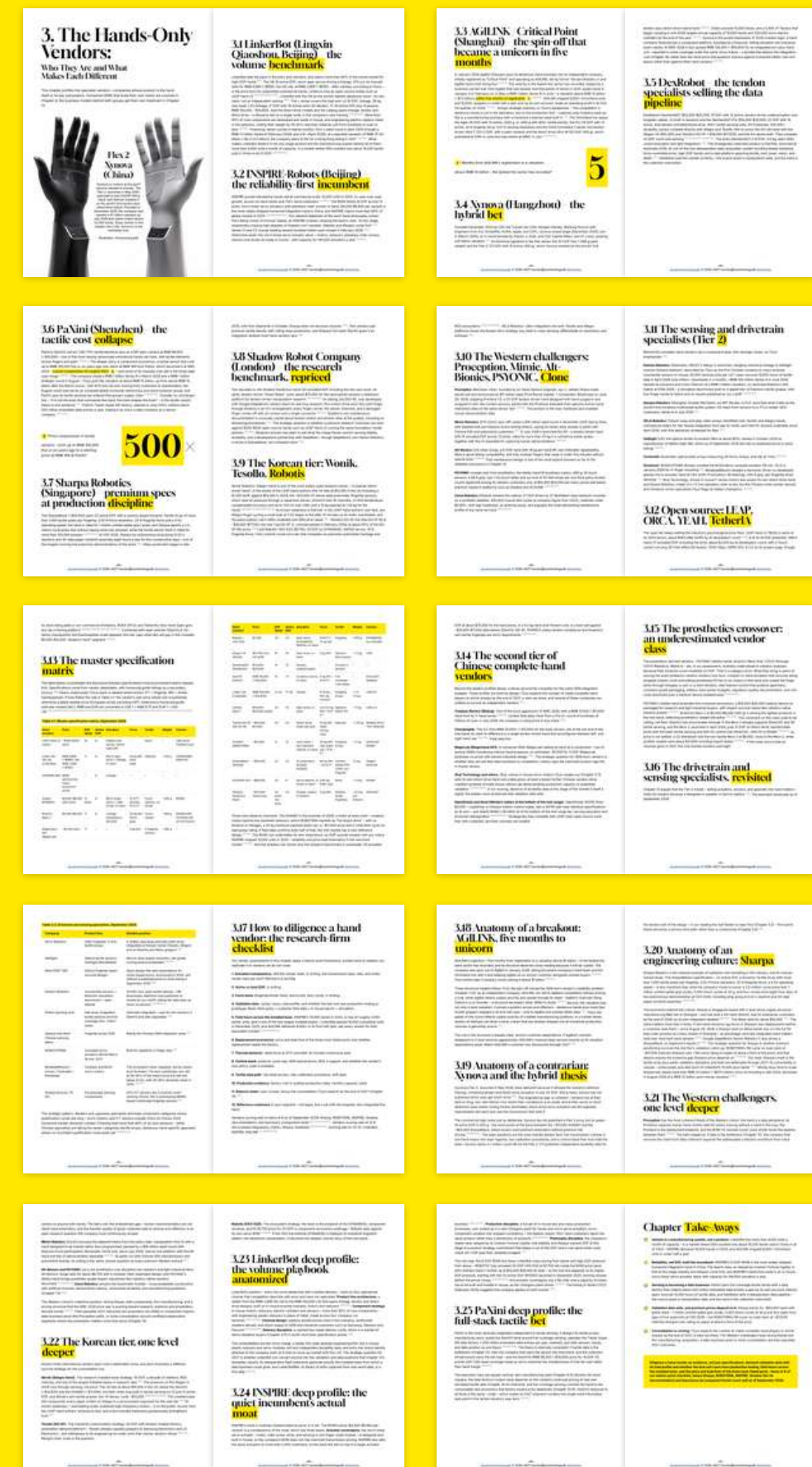


Flex 2 · Xynova (China)

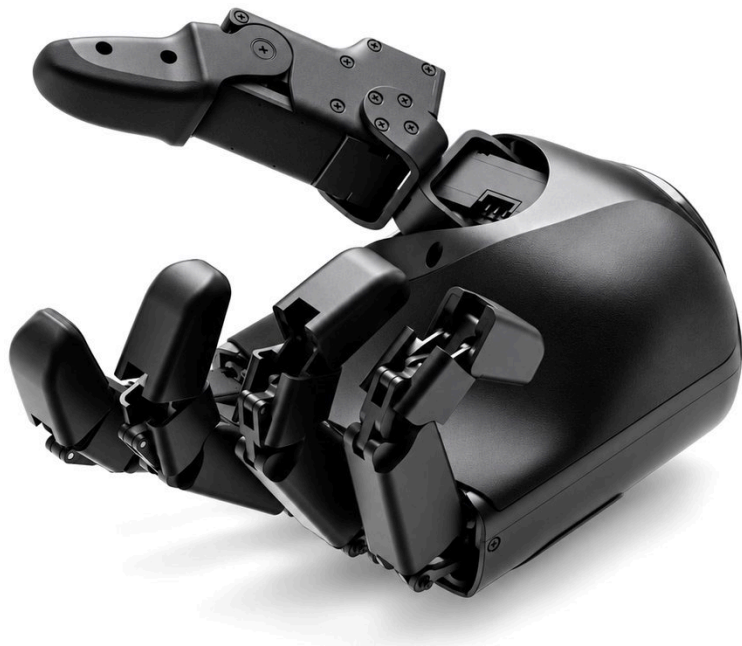
3. The Hands-Only Vendors: Who They Are and What Makes Each Different

Dozens of startups can draw a dexterous hand. Far fewer can ship one at humanoid-production volume, and several of the companies in this chapter are unlikely to survive as independent vendors. The chapter profiles the specialists whose product is the hand itself or one of its key subsystems, and asks what actually sets each one apart. The answer rarely matches the spec sheet. More than once, the obvious explanation for a leader's position is the wrong one.

The profiles run from LinkerBot, the volume benchmark, and INSPIRE, the reliability-first incumbent, through AGILINK's sprint from spin-off to unicorn, Xynova's hybrid bet, PaXini's tactile cost collapse, Sharpa and a repriced Shadow, then out to the Korean tier, the Western challengers and open source. The Master Specification Matrix lines the leading hands up on the numbers procurement teams ask for first, and singles out the row the authors call the anomaly of 2026. The Prosthetics Crossover argues that a whole vendor class is undervalued because of a category error. The Drivetrain and Sensing Specialists maps the component layer behind the hand makers, and why ITjuzi rates its moats above theirs. How to Diligence a Hand Vendor gives readers the authors' own framework for companies the report doesn't cover. The closing deep profiles show why INSPIRE's moat is routinely misdescribed, and name the single data point that will tell the tactile industry most in the near term. Includes the master specification matrix, a table of drivetrain and sensing specialists and a twelve-point vendor diligence checklist.



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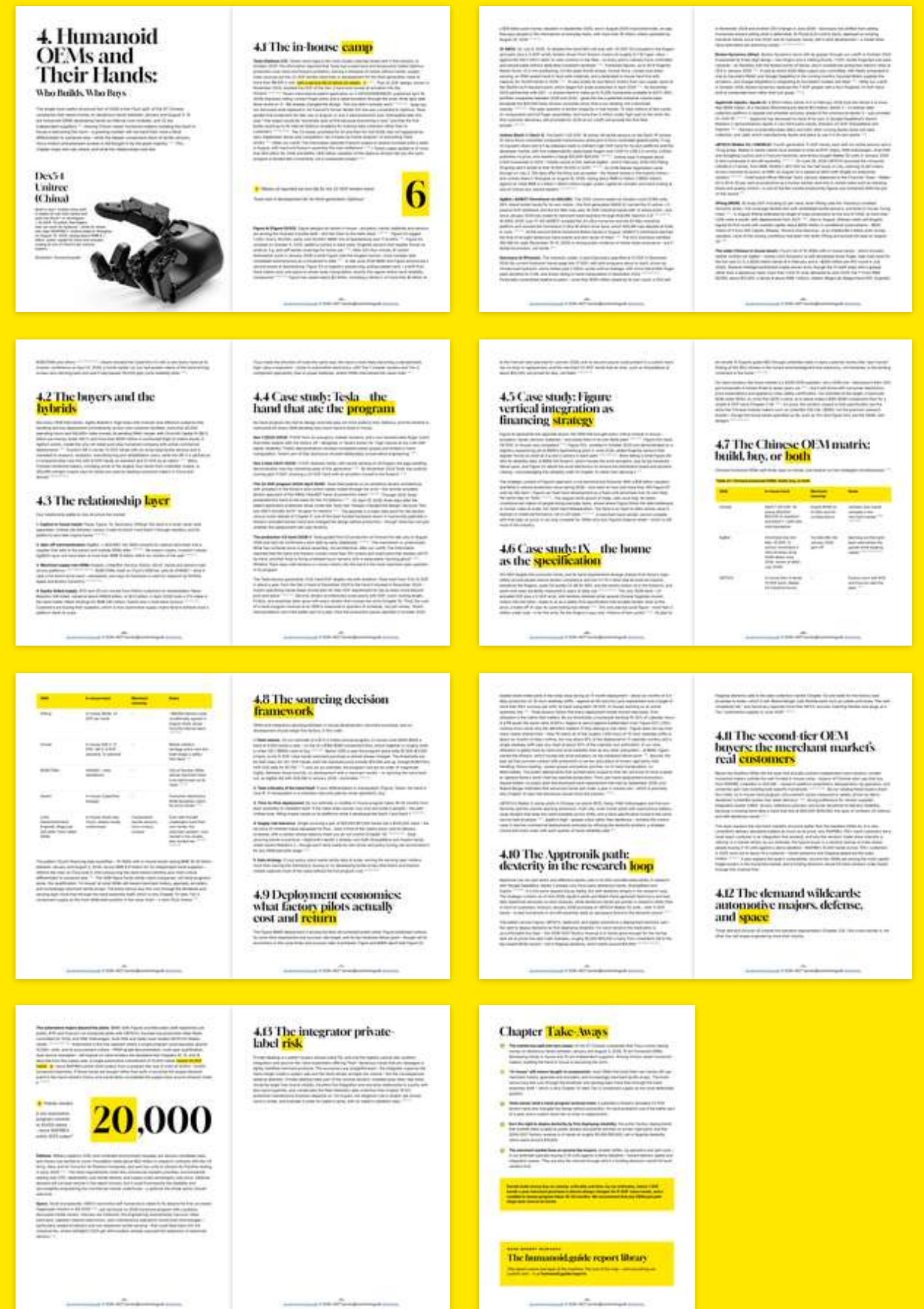


Dex5-1 • Unitree (China)

4. Humanoid OEMs and Their Hands: Who Builds, Who Buys

Build the hand or buy it? Few decisions carry more risk for a humanoid maker, and no hand program has had its reversals play out more publicly than Tesla's. This chapter maps how the major OEMs have answered, and reads this year's Chinese financing data for where the industry is heading. Its conclusion about where the real build-or-buy line runs isn't the one most people would draw. And it finds the merchant vendors' real customers somewhere other than the headline names.

The In-House Camp works through Tesla, Figure, 1X, Unitree, AgiBot, Sanctuary AI, Boston Dynamics, Apptronik, UBTECH, XPeng and the wider Chinese bench, and The Relationship Layer shows why customers have started buying their suppliers. The case studies go deeper: Tesla as the hand that ate the program, Figure's vertical integration as a financing strategy, and 1X, where the home writes the specification. The Sourcing Decision Framework ranks what an OEM should weigh, and puts numbers on the fleet volume at which building stops losing to buying. Deployment Economics reads one of the best-documented factory pilots for what its runtime hours do and don't prove, and names the metric that matters. The Second-Tier OEM Buyers profiles the customers that actually keep independent hand vendors alive – and the channel through which a funding downturn would hit them first. The Demand Wildcards weighs automotive, defense and space, one of which could reorder the demand picture. Includes a build-or-buy matrix of the Chinese OEMs, three OEM case studies and a ranked sourcing framework.



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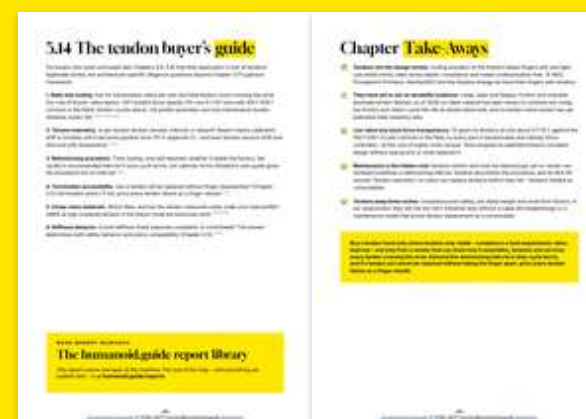
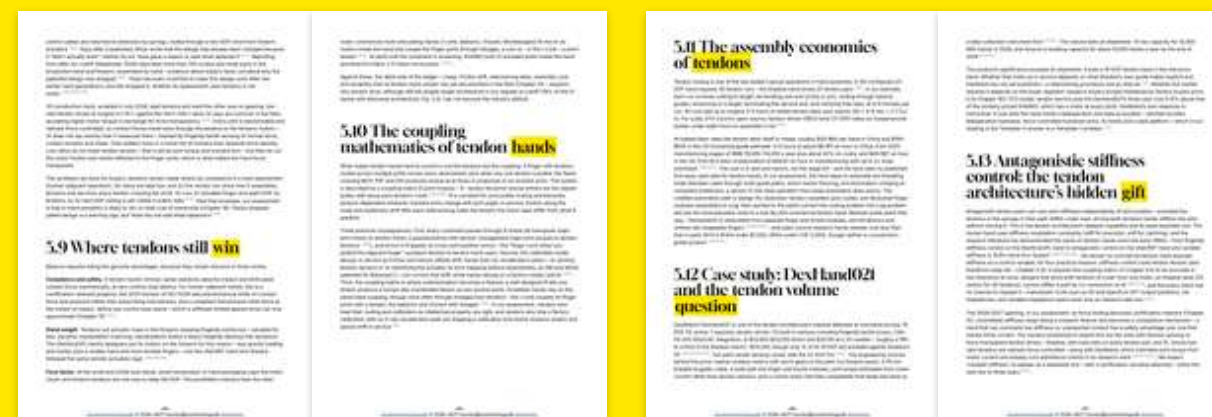
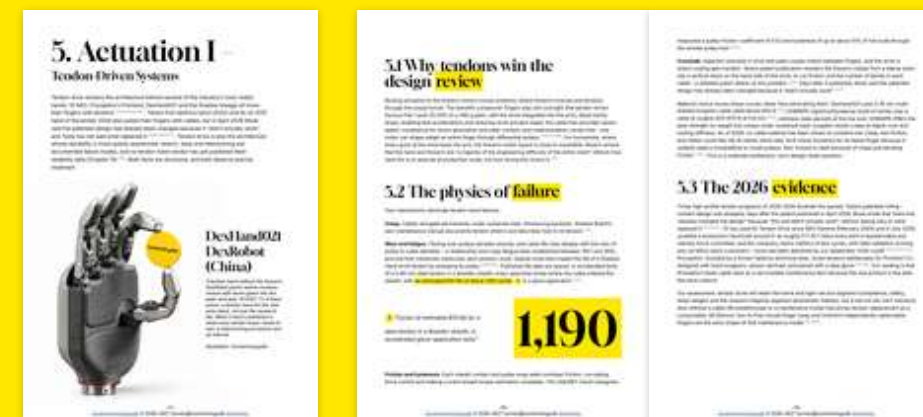


DexHand021 · DexRobot (China)

5. Actuation I – Tendon-Driven Systems

Tendons win the design review. Slim fingers, light fingertips, motors tucked into the forearm the way human muscles are – for a humanoid, where every gram at the wrist taxes the arm, the layout is close to irresistible. Tendons also carry the most openly questioned durability record in the field. This chapter treats both facts as structural, and argues that the cost that matters most in a tendon hand has little to do with efficiency.

The Physics of Failure works through creep, wear, friction and crosstalk, and calls the result a materials bottleneck rather than a matter of design taste; Tendon Materials and the Physics of the Weak Link shows why no fiber or cable escapes the compromise. Routing, Actuation Layouts, and the N+1 Problem shows how routing decides what a hand can do and how fast it wears. Sensing and Control exposes the operating cost that never appears in a brochure. The case studies read the Shadow Dexterous Hand as an engineering document, set Tesla’s dropped patent design beside 1X’s low-ratio production hand, and test DexHand021’s bid for the mid-price band. The Coupling Mathematics of Tendon Hands explains why a factory calibration with no way to recalibrate in place is a time bomb. The Assembly Economics of Tendons finds the most plausible route to a much cheaper tendon hand, and Antagonistic Stiffness Control digs out the architecture’s least exploited capability – one that certification could soon turn into a datasheet line. Includes three case studies, a worked estimate of tendon assembly labor and a six-question tendon buyer’s guide.



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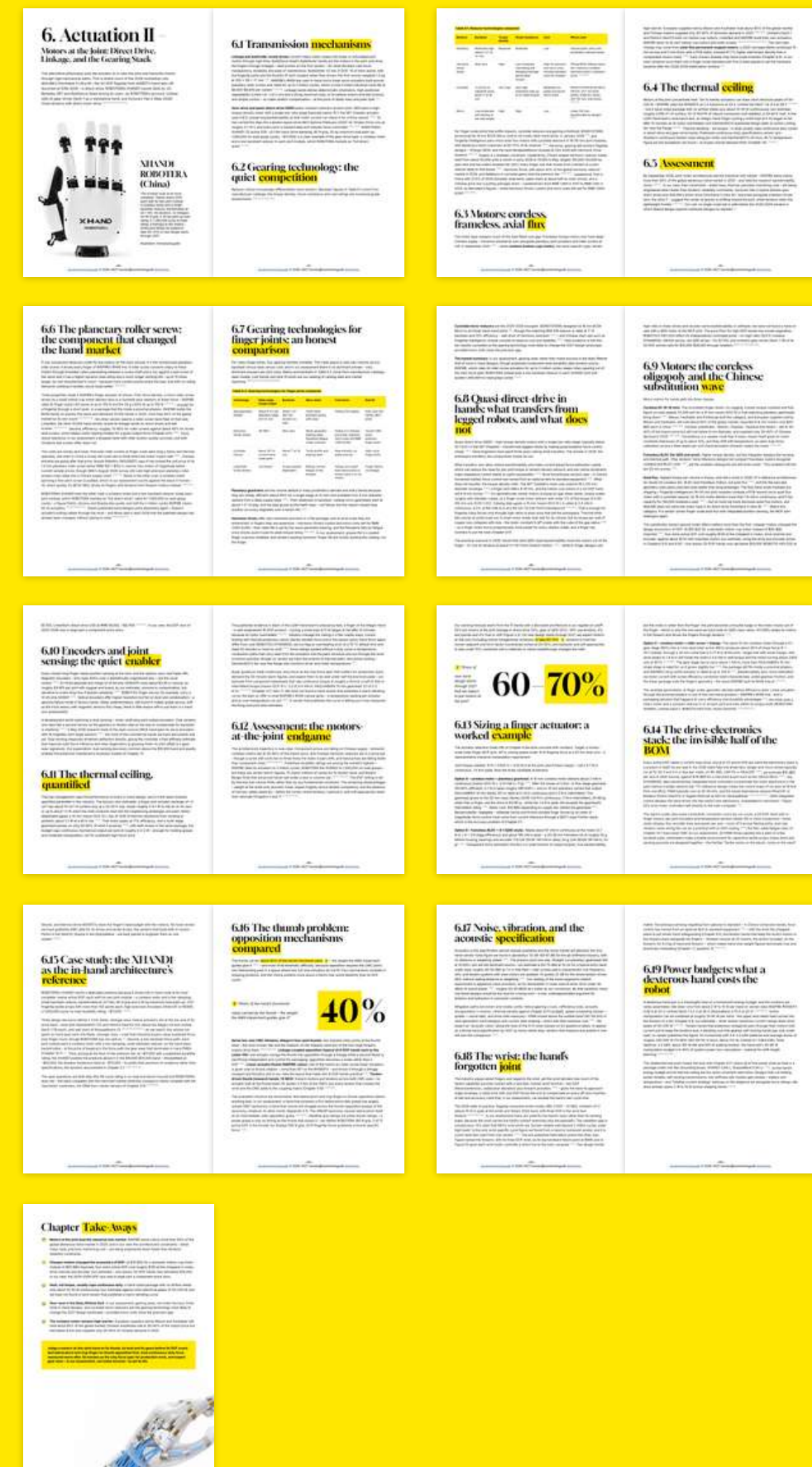


XHAND1 · ROBOTERA (China)

6. Actuation II – Motors at the Joint: Direct Drive, Linkage, and the Gearing Stack

Much of 2026's momentum sits here: motors at or near the joint, with motion carried through linkages, screws and compact gearing instead of cables. This chapter takes the architecture apart layer by layer and forecasts which route new hand designs will take through 2027. It also argues that the race for degrees of freedom was largely a story about something more mundane than engineering ambition – and that the force figure on the brochure is the wrong number to buy on.

Gearing Technology: The Quiet Competition compares the reducer families and shows why reducer supply has become a strategic constraint. **The Planetary Roller Screw** explains how one small part changed the hand market. **Quasi-Direct-Drive in Hands** asks what transfers from legged robots and what doesn't, and **The Coreless Oligopoly** and **the Chinese Substitution Wave** traces how cheaper motors changed the economics of every extra axis. **The Thermal Ceiling, Quantified** works out how much heat a finger joint can shed – the least honestly specified parameter in the industry. **Sizing a Finger Actuator** runs one joint requirement through three candidate drivetrains to show what decides at finger scale. It isn't efficiency. The XHAND1 case study reads ROBOTERA's hand as the in-hand route's reference design, and **The Thumb Problem** compares opposition mechanisms, a choice that predicts more about real dexterity than the DOF count. Further sections cover drive electronics, acoustics, the wrist and the power a hand pair costs the robot. Includes two comparison tables, on reducer technologies and on gearing for finger joints, plus a worked actuator-sizing example.



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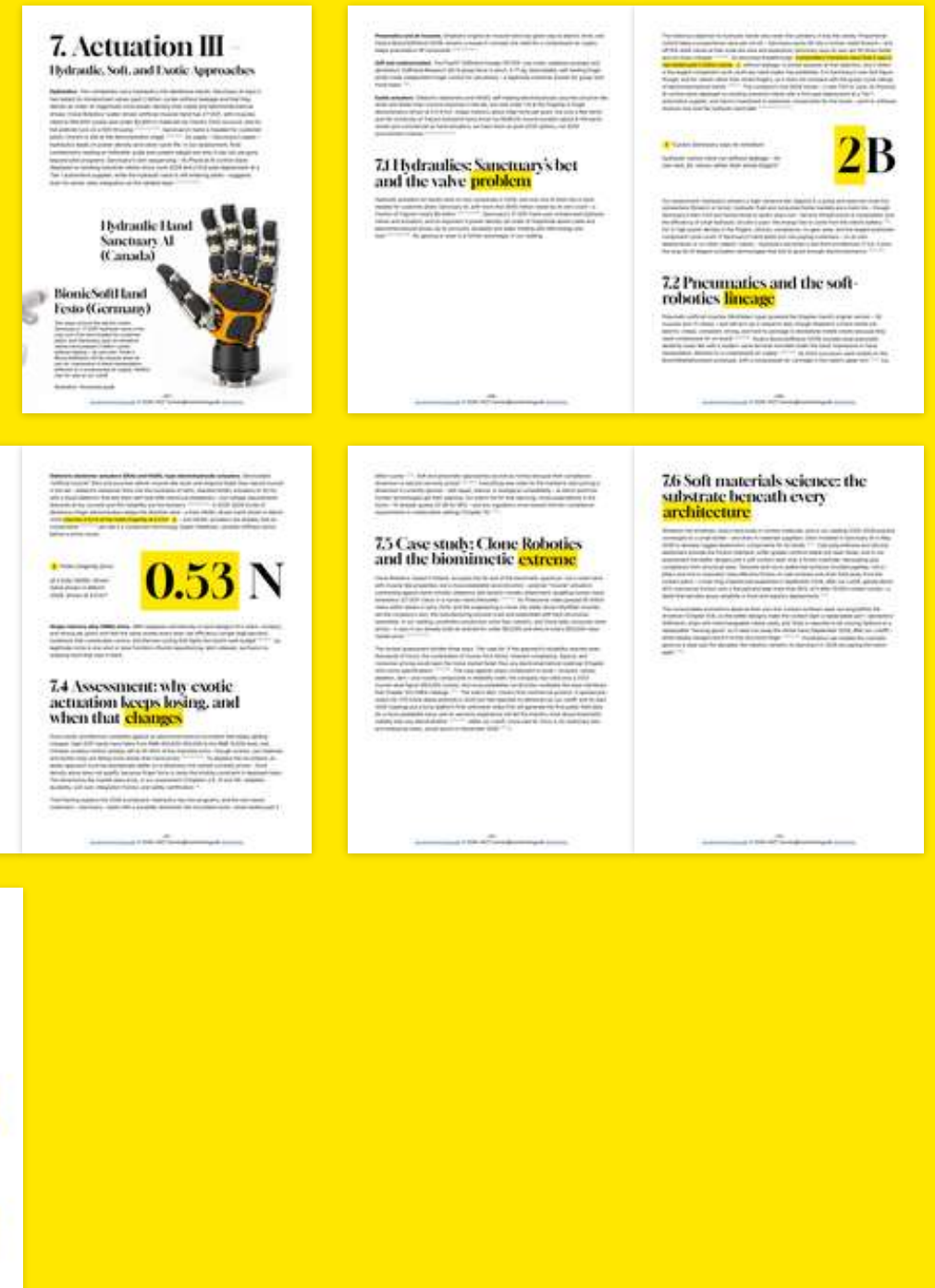


Hydraulic Hand · Sanctuary AI (Canada)

7. Actuation III – Hydraulic, Soft, and Exotic Approaches

Every few years a new way to move a finger turns up – pressurized fluid, compressed air, electrostatic film, even lab-grown muscle – and every few years good-enough electromechanics wins again. This chapter takes the challengers seriously. It asks what each one would have to beat, shows why the advantage most of them lead with is one the market barely pays for, and names the shifts that could reopen the contest. One of these losing traditions has quietly won anyway. Just not as a product.

Hydraulics: Sanctuary's Bet and the Valve Problem explains why the old objection to fluid-driven hands was never the cylinders, what Sanctuary says it has solved, and why its eye-catching cycle figure can't be set against the grasp-cycle ratings of other hands. Pneumatics and the Soft-Robotics Lineage runs from the original Shadow Hand's air muscles to the Pisa/IIT SoftHand, separating the architecture that stalled from the ideas now built into most hands on sale. The Biohybrid and Novel-Materials Frontier puts a sober clock on lab-grown muscle, HASEL actuators and shape-memory wire. The assessment sets out the dimensions buyers actually price. A case study weighs Clone Robotics – human-hand form, water-driven muscle, consumer-level price talk – against the reliability math that novelty compounds. The last section turns to the contact material every hand ends in, which wears out long before the drivetrain, and the prosthetics lesson robot vendors are paying to learn again. Includes a Clone Robotics case study and a watch list of the signals that would reopen the contest.



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DexH13 · PaXini (China)

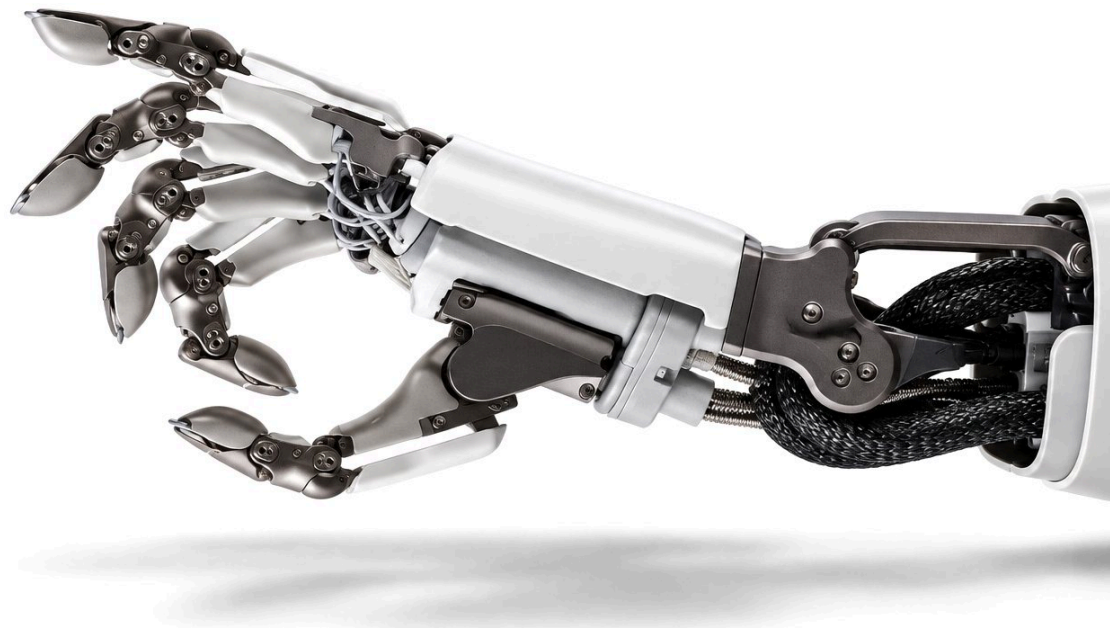
8. Haptics and Tactile Sensing

A human hand carries thousands of touch receptors. Commercial robot hands carry anywhere from a handful of tactile sensors to more than a thousand, and fingertip sensor prices have collapsed. So why does so much real work still run without touch? Part of the answer is that much factory work doesn't need it yet. The rest has less to do with taxel counts than with everything around them – the bus the data has to squeeze through, the software that turns it into something a policy can use, and the elastomer quietly wearing out underneath. The chapter also shows why wiring touch into a policy naively can make it worse.

Transduction Technologies and The Transduction Zoo, Mapped Honestly sort six competing families by what each really measures and how close it is to a hand you can buy. The Bandwidth Wall does the arithmetic the brochures skip and rewrites the question buyers should be asking. Coverage Strategy splits 2026 practice into three doctrines and shows which buyers end up with which. From Taxels to Representations asks whether value is migrating from the sensor to the model trained on its data. The Skin Is a Consumable converts press-cycle ratings into operating hours. Later sections cover haptic feedback for teleoperators, the RobOmni benchmark and what touch is actually worth, sensor fusion, skin manufacturing and optical sensing in close-up, before a capacitive-versus-magnetic head-to-head that ends on the question no vendor answers yet. Includes a comparison table of tactile transduction families and a head-to-head table of capacitive versus magnetic arrays.



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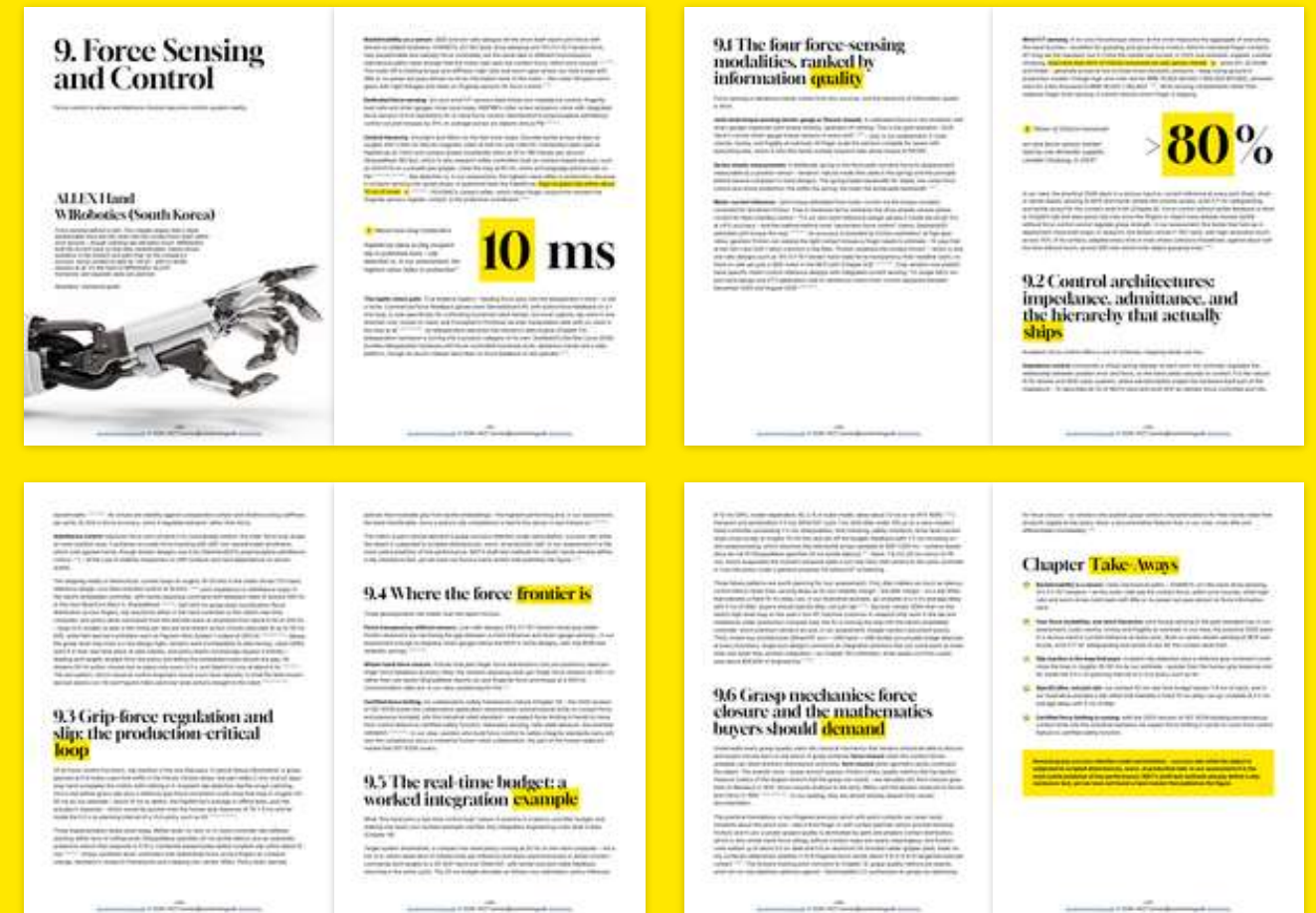


ALLEX Hand · WIRobotics (South Korea)

9. Force Sensing and Control

Force control is where a hand's architecture stops being a slide and becomes a loop that either holds the part or drops it. This chapter ranks the ways a hand can know how hard it's pushing, then follows that signal up the control stack, from motor drives to learned policies. Along the way it singles out the one reflex that pays for itself in production. And the metric buyers should demand for it. You won't find it on a datasheet.

The Four Force-Sensing Modalities, Ranked by Information Quality weighs motor-current inference, wrist force/torque sensing, joint torque sensors and series-elastic springs against each other, and sketches the stack a serious hand should carry. Control Architectures explains why shipping hands settle on impedance or admittance control, and how the grasp-level loop became a turf fight between hand vendors, robot makers and policy teams – and which side the best-known learned stacks took. Grip-Force Regulation and Slip follows a part sliding out of a grasp and works out how fast a hand could catch it, against human reflexes and a VLA's re-planning interval. Where the Force Frontier Is looks ahead to sensorless force transparency and certified force limiting. The Real-Time Budget works through latency and jitter for a hand on EtherCAT and shows how fast the slack disappears. Grasp Mechanics closes on the decades-old force-closure mathematics vendors almost never document, and why publishing it would make a hand easier for learned policies to use. Includes a worked real-time integration budget and the failure patterns integrators should plan for.



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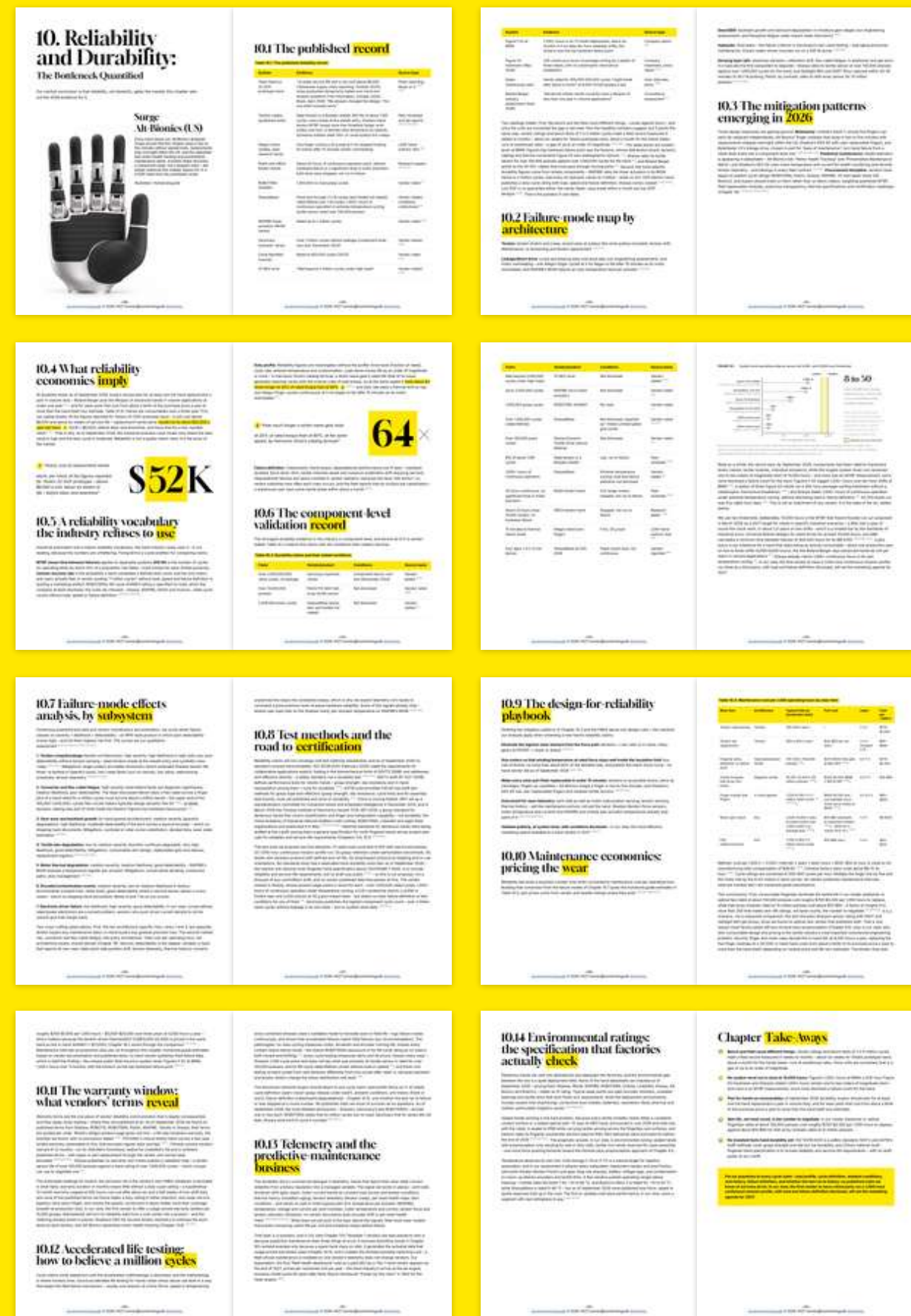


Surge · Alt-Bionics (US)

10. Reliability and Durability: The Bottleneck Quantified

Ask a hand vendor how long its product lasts and you'll get a cycle count. Ask a warehouse that runs those hands all day and you'll get a very different answer. This chapter measures the distance between the two and argues that this gap, not dexterity, is what gates the market. It converts cycles into hours and lands on a paradox about where the industry's best durability data comes from.

The Published Record sets vendor ratings, lab tests and the few field accounts side by side – Tesla's prototype hand, Figure at BMW, a warehouse operator – and shows where the weak points really sit. The FMEA scores seven failure classes, including the one almost nobody talks about, and explains why detectability is the sleeper variable. A Reliability Vocabulary the Industry Refuses to Use checks which vendors state the load, speed and failure definition behind their cycle claims. Test Methods and the Road to Certification reviews what today's standards cover and proposes a test suite no vendor's published data yet passes. Maintenance Economics turns wear into cost per operating hour and finds the rating buyers should negotiate hardest. The Warranty Window reads vendors' terms as their own failure analysis; Accelerated Life Testing gives buyers a disclosure checklist for any cycle claim; Telemetry sketches the predictive-maintenance business nobody has built yet; and Environmental Ratings holds the specification factories actually check against what the datasheets say. Includes three tables – the published reliability record, durability claims and their conditions, and a maintenance-cost model – and one figure.



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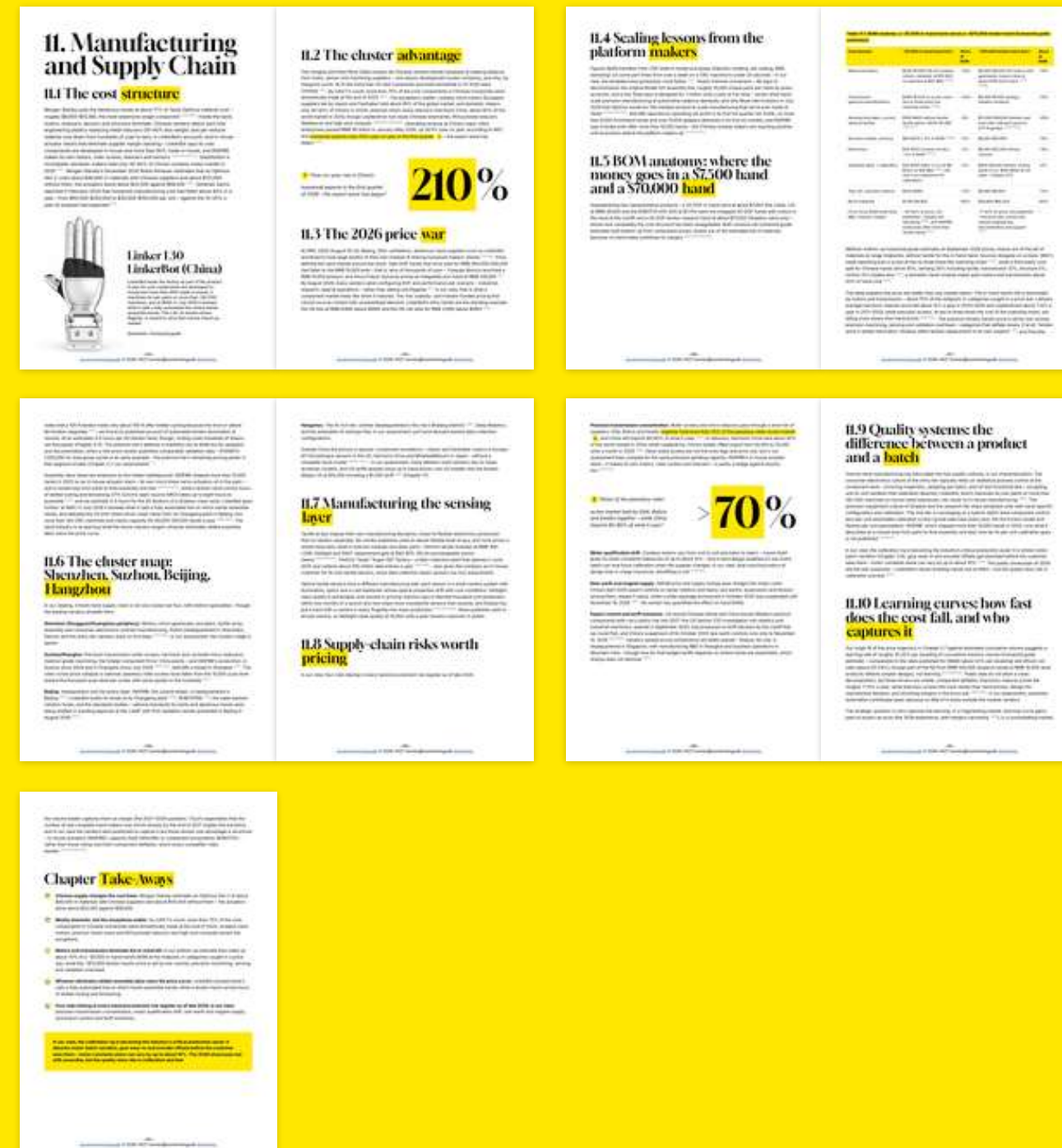


Linker L30 · LinkerBot (China)

11. Manufacturing and Supply Chain

The dexterous hand has gone from a hand-built research instrument to a component sold in an open price war. This chapter takes two hands apart on paper to see where the money goes, and finds a cost structure renegotiated almost line by line – with one category stubbornly refusing to keep pace. Then it asks the question that decides what comes next. As costs keep falling, who gets to keep the savings?

The Cost Structure sets out what Morgan Stanley estimates the hands cost inside Tesla's Optimus, and what Chinese suppliers do to the whole robot's bill. The Cluster Advantage and the cluster map of Shenzhen, Suzhou, Beijing and Hangzhou explain why Chinese vendors iterate at walking distance from suppliers, and which components still come mostly from abroad. The 2026 Price War asks whether today's entry prices can survive unsubsidized demand. Scaling Lessons from the Platform Makers sets Figure's BotQ and Tesla's Fremont conversion against the Chinese module makers and asks who reaches positive unit economics first. BOM Anatomy dissects a budget 20-DOF in-hand hand against a premium tendon hand and finds the real battleground hiding in one of the smallest lines. Quality Systems identifies the production asset that matters more than any showcase assembly line. Supply-Chain Risks Worth Pricing covers concentration in screws and reducers, rare earths and tariffs, and Learning Curves estimates how fast costs fall with each doubling of volume – and who is built to capture the gain. Includes a bottom-up bill-of-materials table comparing the two hands line by line.



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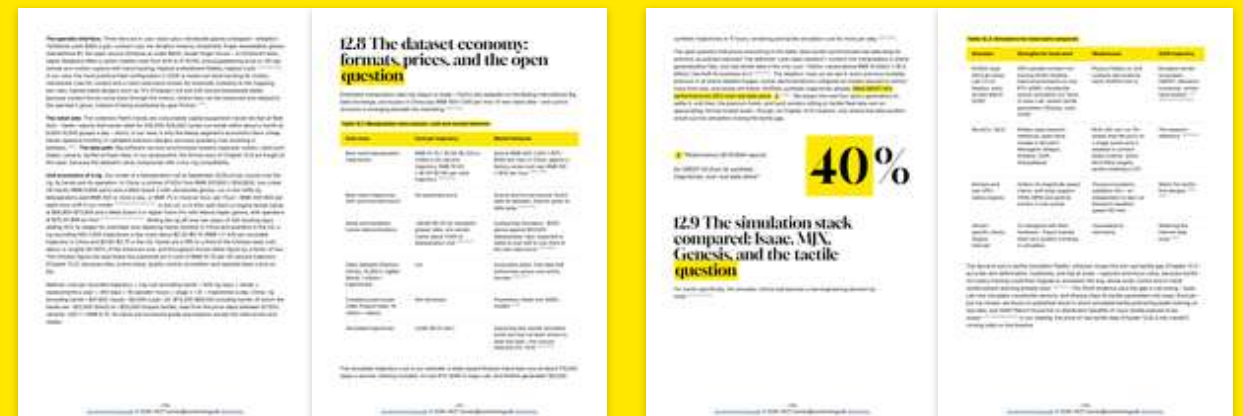


LEAP Hand · Carnegie Mellon (US)

12. AI, Data, and the Hand

Policies ship in months. Hands ship in years. This chapter follows what happens when the software outruns the hardware it drives, and goes straight at the deepest strategic question a hand vendor faces: does better autonomy make the hand more valuable, or less? It lays out the evidence for both readings, then gives its own answer – one that tells a vendor which part of the market to stand in and which part to leave.

Sim-to-Real for Hands argues that a published simulation model now matters as much as the price tag, citing a low-cost research hand that, by its authors' account, outperformed a rival several times its price. Manipulation Foundation Models lists what VLA-class policies demand from hardware, including one requirement a routine firmware update can break, quietly invalidating weeks of collected trajectories. The Data-Collection Economy, Quantified puts real costs on trajectories, hours and throughput, and sets PaXini's data factory, Daimon's open dataset and Figure's Index side by side. Policy-Hardware Co-design follows the lock-in vendors are building around action spaces and sensor formats, and the research that could undo it. Further sections map the benchmark landscape and how to read it, price a teleoperation rig per trajectory in China and the US, ask whether real tactile data keeps its premium, and compare Isaac, MuJoCo/MJX and Genesis on the axis that will decide where tactile training happens. Includes a table of manipulation data classes by cost and market behavior, a simulator comparison table and a worked teleoperation-rig cost model.



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OmniHand 2025 · AGILINK (China)

13. Financing and Business Models

Money poured into the hand sector in 2026, and it didn't land evenly. This chapter takes the question humanoid.guide hears most from clients – can a company that sells only hands build a durable business? – and answers it with the year's financing data and a unit-economics model. The answer isn't yes or no. It's four templates that can work, a trap a crowded field is walking into, and one line in the cost model that swings the whole result.

The 2026 Financing Picture and the segment tables work through ITjuzi's count of Chinese hand-sector deals, split into camps – OEMs building hands in-house and independent suppliers – valued on entirely different logic. Business Models for Hands-Only Companies sets out the templates, from Tier-1 module supply to licensing, and a later section grades each. The unit-economics model builds a mid-tier Chinese vendor line by line to find its scale thresholds. M&A and Exit Landscape ranks the exit routes. An Investor's Diligence Checklist gives ten questions that separate the fundable from the exposed, and the annotated rounds read the year's defining deals. Valuation Frameworks explains why term sheets in this sector diverge so violently, China and the West contrasts how each ecosystem funds hand companies, and The OEM Internalization Math finds the volume at which building your own hands pays – and why the chapter is less generous about in-house programs than ITjuzi is. Includes five tables – among them the two financing camps, a unit-economics model and the annotated 2026 rounds – and two figures.



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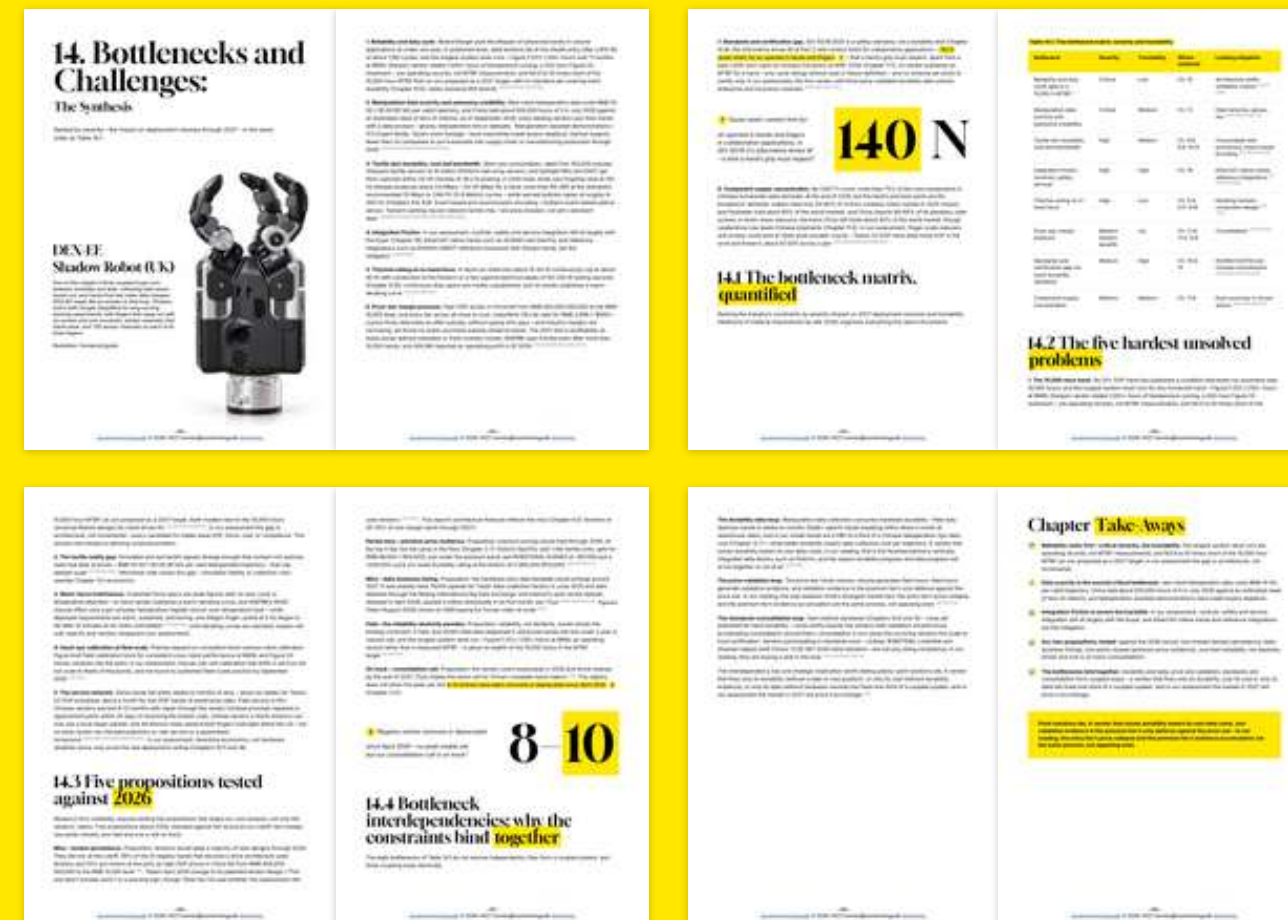


DEX-EE · Shadow Robot (UK)

14. Bottlenecks and Challenges: The Synthesis

The chapters before this one find constraints one at a time. This one puts them all on a single scale. The synthesis ranks the industry's bottlenecks twice – by how hard each will hit deployment volumes through 2027, and by how likely each is to improve materially by late 2028 – and the two rankings don't line up. Reading them together turns a list of problems into a plan. But the chapter's sharpest claim isn't about any single bottleneck. It's about how they're wired together.

The Bottleneck Matrix, Quantified places eight constraints on that grid – supply concentration, thermal limits, manipulation data, price-war margins and duty cycle among them – each paired with its leading mitigation. The Hardest Unsolved Problems narrows the field to what was still open at the cutoff, including questions no datasheet answers: what a hand's force is worth once it's warm, and who fixes it when it breaks. Five Propositions Tested Against 2026 turns the scrutiny back on the calls behind the report's own analysis – among them tendons, premium pricing, data-business timing and consolidation – and grades each against the record. Not every call survives. Bottleneck Interdependencies shows why the constraints bind together rather than one at a time, traces the loops that tie durability to data, price to validation and standards to consolidation, and explains what the chapter calls 2026's strangest market fact. Includes one table: the bottleneck matrix, rating each constraint on severity and tractability.



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SVH · SCHUNK (Germany)

15. Standards, Safety, and Certification

Dexterous hands got by without a standards regime because they were research instruments. Humanoid deployment at scale ends that exemption. This chapter maps the regulatory surface at the September 2026 cutoff and the workstreams most likely to bind hand vendors by 2028 – a picture that matters as much to the integrator signing off a collaborative cell as to the investor judging who can sell into one. It names the obligations arriving that almost no hand maker was set up to meet, then recasts standards work as something other than compliance overhead, with a fuse attached.

The Current Regulatory Surface works through the revised ISO 10218 and what it now asks of an end-effector, the collaborative force limits absorbed from ISO/TS 15066, NIST's long-running draft test methods and the ASTM work carrying them forward, China's fast-moving national and group standards, and the CE and UL pathways. The Certification Gap, Stated Plainly takes three obligations in turn – certified force limiting as a safety function, home-market certification for consumer humanoids, and end-effector cybersecurity – and asks what each demands of a hand maker, and who, if anyone, is ready. What Vendors and Buyers Should Do Now turns that into instructions for both sides of the contract, including a window for shaping the standards that the chapter expects to shut sooner in China. The Standards Landscape at a Glance pulls every relevant instrument into a single reference. Includes one table mapping the standards landscape for dexterous hands at the September 2026 cutoff.



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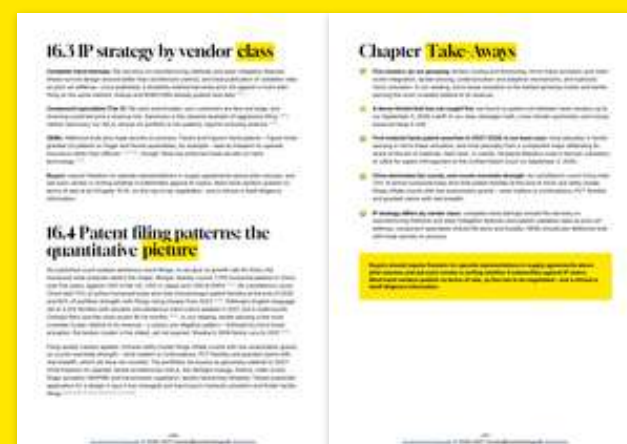


RH56 series · INSPIRE-Robots (China)

16. Patent Landscape and IP Strategy

Hand IP looks like one of the most litigated corners of robotics. It's one of the least. Filings have piled up around tendons, micro actuators and tactile skins, the stakes keep climbing, and still the thicket hasn't caught fire. This chapter explains that calm, says what would end it, and sets out what each kind of company should do with its patents before it does. Along the way it finds a widely covered patent family protecting a design its own owner has publicly set aside.

Where the Filings Concentrate sorts hand-relevant patents into five clusters – the report's own grouping, since no published count isolates dexterous hands – and asks which is growing fastest, which has settled most of its freedom-to-operate questions, and who holds what it rates China's most underappreciated IP position. Litigation Temperature sets out why the thicket has stayed cold, points to a case next door where such a standoff has already broken, and commits to a base case for when, where and from whom the first material assertion comes. IP Strategy by Vendor Class gives separate playbooks for complete-hand startups, component specialists, OEMs and buyers – including a question every buyer should put to a vendor in writing, where even a refusal tells you something. Patent Filing Patterns sets the humanoid-wide counts side by side, explains why raw counts overstate strength, and names the portfolios the report judges material to freedom-to-operate in 2027–2028. Includes a cluster-by-cluster map of hand-relevant filings, IP playbooks by vendor class and a dated base case for the first hand-patent assertion.



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Allegro Hand V4 · Wonik Robotics (South Korea)

17. Regional Ecosystems and Supply Clusters

Hands sell everywhere. They're made in very few places. This chapter maps the five ecosystems that matter – China, the United States, Europe, Korea and Japan – and the policy forces moving them, reading each one layer by layer. The result is lopsided in ways that count for anyone sourcing hands or backing a hand company, because the layer a region leads in is not always the layer its own hand programs depend on. And one region's profile turns on a paradox the chapter spells out.

China: The Complete-Stack Ecosystem weighs the country's lead against the precision parts it still doesn't lead on, the national and city programs aimed squarely at hands, and the vulnerabilities that could strand an entire tier at once. The United States: Integration-Led, Component-Poor asks what happens to programs that lean on suppliers they don't control – and what one Morgan Stanley estimate says about the cost of doing without them. Europe: Research Aristocracy, Thin Middle explains why the continent's strengths sit in layers being commoditized or bypassed, and where its one structural opening lies. Korea and Japan: The Precision Periphery covers Korea's outsized showing in complete hands, and the paradox in Japan's. Cross-Ecosystem Exposures names the tariff, standards and talent exposures that deserve board attention. Policy Instruments Compared lines up the levers market by market, and the asymmetry to watch into 2027. Includes one table comparing policy instruments by market and their effect on the hand sector.



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HX5-D20 · ROBOTIS (South Korea)

18. Procurement, Integration, and Total Cost of Ownership

This is where the report stops describing the market and starts telling you how to buy from it. It's written for humanoid OEM integration teams, who take the bulk of 2026 hand demand, and for enterprise pilot operators, a small segment whose results decide whether pilots turn into production orders in 2027. Its opening move will unsettle anyone who compares hands on list price. What a hand really costs to own, and which line of the bill dominates, is the chapter's business – worked through in dollars, not adjectives.

The Real Cost Stack breaks ownership into purchase, integration engineering, replacements and wear parts, downtime and firmware upkeep, and shows why good documentation behaves like a hidden discount. A Worked TCO Comparison runs four hands – a servo-driven mid-range hand, a tendon hand, ROBOTERA's XHAND1 and the premium SharpaWave – through one packaging pilot and lets the arithmetic settle when a premium hand pays its way. The RFP Checklist condenses the report's diligence and standards work into questions to print straight into a tender. The Pilot-to-Scale Playbook lists the practices that separate pilots that scale from pilots that stall. A composite case study takes a 14-week pilot apart phase by phase, showing where integration time goes and which phases a better vendor could compress. The Service-Network Question closes on the layer least developed relative to its importance and asks what a technically superior hand is worth when the nearest repair is weeks away. Includes a cost-of-ownership breakdown by cost element and a worked cost comparison of the four hands.



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OrcaHand · ORCA Dexterity (Switzerland)

19. Outlook: The Next Twelve Months and the Road to 2031

Forecasts are cheap. This one comes with the means to check it. The outlook runs on a short clock and a long one – the twelve months to Q3 2027, with a watch list of the events most likely to move the market, and the longer road to 2031, where the plausible paths for the hand market fan out after 2028. The chapter puts numbers on the long view, says what has to happen for each path to play out, and then does the uncomfortable thing: it lists what would prove the whole outlook wrong.

What to Watch picks those events – the Tesla hand disclosure the market was still waiting for at the cutoff, consumer deliveries that would be the first large field test of tendon hands in uncontrolled homes, the first hand-vendor stock listings, Chinese consolidation, design stabilization and a reliability milestone that would reset the market. Scenarios to 2031 anchors a base case on a published third-party forecast and builds the report’s own bull and bear cases around it, each with the conditions it depends on. Recommendations speaks in turn to hand vendors, humanoid OEMs, buyers, investors and policymakers, including where the report sees better risk-adjusted economics than in yet another complete-hand startup. Wildcards That Would Invalidate This Outlook names the low-probability, high-impact events that would force a rewrite. Scenario Triggers and Signposts turns all of it into a monitoring list to hold up against the news. Includes a table of scenario signposts and one figure charting market scenarios from 2025 to 2031.



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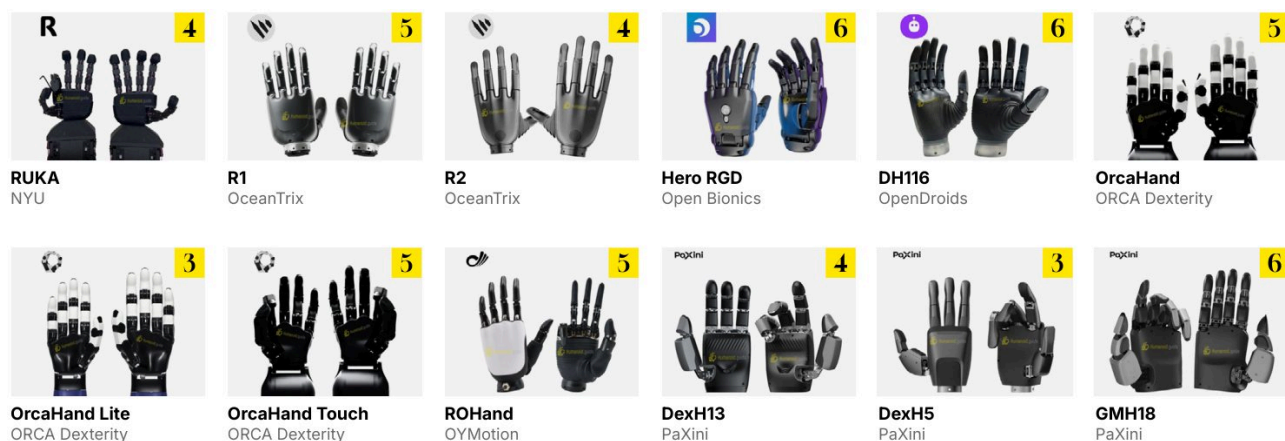
Ability Hand · PSYONIC (US)

20. Conclusion

The closing chapter is short, and it doesn't hedge. It sets out the state of the art at the September 2026 cutoff in two columns – what the industry has genuinely achieved, and what it still hasn't – and argues that the gap between them isn't what it looks like. The Concluding Synthesis explains why the hand, alone in the humanoid stack, has not crossed into the regime where progress is measured in benchmark points, and reads a run of 2026 events, from a wave of capital to an admission from Tesla, as a single phenomenon. Then it commits to a core judgment about which vendors will own the twelve months to September 2027. What We Will Track lists the developments the report will be checked against, and tells readers holding procurement or investment decisions which chapters are most likely to be overtaken by events. Includes the watch list against which this report's forecasts will be tested.



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From Appendix J, the Hand Catalog

Appendices A–J

The appendices are where the report becomes a working tool. The centerpiece is Appendix J, the Hand Catalog: one card for every hand in the humanoid.guide registry at the September 2026 cutoff – 78 of them, from Chinese volume hands and long-serving research platforms to open-source builds, prosthetics crossovers and prototypes not yet for sale. Each card gives the hand's Hand Score with its DOF and strength sub-scores, its DOF, load rating, price, drive and touch, a product image, and a short note on what sets it apart. Specifications were checked against the vendor's own documentation first, and anything resting only on the registry listing is flagged. Appendix A sets out the scoring bands the online listings don't show.

Around the catalog sit the directories. Appendix B sorts vendors by category; Appendix G extends that to 64 vendors and organizations, with headquarters, hand-relevant products and where each is analyzed; Appendix H maps the component supply base – motors and drive electronics, transmission parts, sensing, materials and consumables. Appendix C consolidates extended specification tables by price tier and adds a validation evidence index that separates vendor ratings from field and independent evidence. Appendix F is a failure-mode library written for maintenance teams, each mode with its signature, detection and mitigation. Appendix E collects the grasp taxonomy, the benchmark protocols the report cites and a technology roadmap to 2031 with confidence grades on its forecasts. Appendix D's glossary and Appendix I's selection guide, matching hand platforms to research programs from sim-to-real to prosthetics, complete the set. Includes fourteen reference tables and the full 78-card Hand Catalog.



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Suggested citation

humanoid.guide, Humanoid Robot Hands – State of the Art, September 2026. Industry research report.

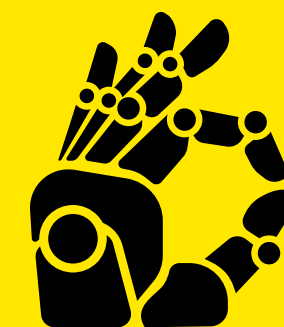
Methodological note and disclaimer

This report compiles manufacturer disclosures, patent filings, market research, financial reporting, academic literature, product registries, and press coverage. Where claims originate from vendors and could not be independently verified, the text says so, and our own estimates and assessments are marked as ours. Prices follow the rule set out with Table 2.1: the vendor's own price where one is published, otherwise a reseller price checked in October 2026 (European reseller prices excluding VAT), and "(est.)" where the figure is our estimate; prices reported after a subsidy are marked as such, prices exclude integration costs, and a tariff is included only where the text says so. Figures in Chinese yuan and euros are converted at cutoff rates (USD 1 ≈ RMB 6.75; EUR 1 ≈ USD 1.16) and marked as approximate, and historical prices are dated in the text. The few developments after the cutoff that we mention are dated and marked as such. Nothing in this report constitutes investment advice.

About this preview

This preview describes what each chapter of the report covers and which questions it answers. The page images are shown at low resolution and are not meant to be read. The findings, figures and prices are in the full report.

Thank you!



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