

The Years After the Sale

about

57

operational hours worked,
observed, per robot-month

520

hours assumed,
two ten-hour shifts

126

point spread on one
rental contract form

The years after a robot is sold are a business of their own.
Whether it pays depends on how hard the machine is worked and how it is sold.



The Years After the Sale

The years after a robot is sold are a business of their own. Whether that business pays for itself is decided by how hard the machine is worked and how it is sold, and the audited filings of companies that already run such businesses straddle the line.

-54.7%

Knightscope service margin,
FY2025, second negative year

57 / 520

observed hours a month against
the deck assumption

126

point spread on one rental
contract form

7,500

words of research behind each
word here

CAPABILITY DEMONSTRATED

evidence collection and adjudication across independent
sources

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A showcase of the Quorum evidence pipeline. This report summarises a small part of a much larger body of research; the scale of that work, and how to commission it, are set out on the closing page.

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Every section header states the number of separately sourced claims that section rests on. Superscript numerals throughout resolve to the reference list, and every value in every figure and table resolves to a source in the same way.

EXECUTIVE SUMMARY

A durable aftermarket annuity is the story everyone tells about robots: sell the body once, then earn on spares, service and software for the machine's life. This report tests that story against the audited filings of companies that already run such businesses. The record does not support it as the default.

The dominant sale instrument is an outright capital sale on a public procurement register. It carries a lot value (the awarded price of that tender package), a delivery month and no term, and no recurring fee⁷². The largest disclosed order book records no lessor income at all, and the largest shippers keep rental below half of one per cent of revenue⁷². The razor-and-blades prior is named and rejected on the record. It is not what the modal sale looks like [C-76;C-100].

The parameter that decides whether the years pay is utilisation. The best publicised humanoid pilot logged 1,250-plus fleet hours over eleven months, which divides to about 57 operational hours per robot-month on the two-robot reading, with the denominator disputed one against two and never reconciled^{41,42,46}. A vendor's SEC-furnished investor deck assumes 520 productive hours per robot-month on page 41, under two ten-hour shifts⁴³. Observed and assumed sit strictly apart. The 520-hour assumption is about 4.2 times the best observed per-robot reading, about 125 hours a month on the one-robot customer-side reading^{41,45}; against the two-robot reading of about 57 hours^{41,42,46} it is roughly nine times, the report's own default.

The recurring line is genuinely straddled by resolved businesses, and the counterweight must be taken seriously. AITX's device-rental line is 89.3 per cent of revenue at a group gross margin of 71.4 per cent, though that is one consolidated group number, not an isolated rental margin [C-04;C-05]. Ocado's recurring capacity fees carry a 25.0 per cent segment adjusted EBITDA (operating profit before one-off items), and ABB's service margin beats its product margin by 5.91 points [C-07;C-09]. Intuitive Surgical's lease wraps a consumables annuity above four-fifths of revenue⁴².

The counter-case is equally audited. Knightscope's service gross margin is negative 54.7 per cent for a second consecutive filed year, which means its service revenue covers only about two-thirds of its direct service cost, and its service wrapper is explicitly labour-inclusive [C-02;C-03]. Serve Robotics posts a company gross loss of about 580 per cent of revenue during fleet buildout, a company-level loss rather than a service-line margin, large because direct cost runs several times the revenue earned while the fleet is still being built⁴⁰. Guardforce's robotics line has decayed to 0.68 per cent of revenue, and Geek+ deliberately scaled its rental line from 14.1 per cent to 0.08 per cent while raising group margin [C-27;C-21;C-22].

The verdict is a location, not a value. The machine's years land on a bench of resolved service businesses. The line the bench is built on is a break-even for the service business itself: a resolved issuer sits on the positive side if its service or recurring line covers its own direct cost, and on the negative side if it does not. It is not one universal gross-margin level. In year one, sold outright and still under warranty, there is no service line to have a margin; where a line is forced at these economics, the audited bench places it on Knightscope's side of zero [C-02;C-93]. In a later year, worked harder and sold on recurring terms, the position sits between ABB, whose services-and-other margin beats its product margin, and CYBERDYNE, whose rental-first model still loses at the operating line [C-09;C-20]. Rockwell, at 44.68 per cent, sits below ABB, and Teradyne, at 62.88 per cent, above CYBERDYNE, as context rather than as the bracket [C-11;C-13]. The margin percentage falls out of that position.

A reader finishes able to make two calls. First, whether to build, buy or contract for a humanoid field-service estate. Second, whether to spend now on branches and technicians, or to negotiate parts, diagnostics, firmware and calibration access as a condition of the component design-in, that is, before the part is locked into the machine's design [C-52;C-99]. The second call is the one this record prices most clearly.

THREE KEY NUMBERS

About 57 hours worked, 520 assumed. The observed reading divides 1,250-plus fleet hours over eleven months at a named automotive deployment by the disputed two-unit count, to reach about 57 operational hours per robot-month^{41,42,46}. The assumed reading is 520 hours per robot-month, derived from two ten-hour shifts on page 41 of a vendor's SEC-furnished investor deck⁴³. One is measured arithmetic on published inputs, the other is a model's assumption. The 520-hour assumption is about 4.2 times the best observed per-robot reading, about 125 hours a month on the one-robot customer-side reading^{41,45}; against the two-robot reading of about 57 hours^{41,42,46} it is roughly nine times, the report's own default. The gap is the report's central parameter.

A 126-point spread, and two different cost bases. Service and recurring-line gross-margin outcomes across the bench run from negative 54.7 per cent at Knightscope, an isolated managed-service line whose cost base includes on-site security staff, to positive 71.4 per cent at AITX, a consolidated group figure that is not an isolated rental margin¹⁹. The two endpoints are not on the same labour base, so the spread is a warning about margins and populations rather than a range of expected returns.

16.45 per cent of sales, and no margin printed. FANUC's cross-product Service division is JPY 141.143bn, 16.45 per cent of consolidated sales, covering a large installed base¹⁷. Because FANUC reports a single segment, meaning it does not split parts from service, it publishes no service cost, profit or margin at all [C-26;C-42]. The clearest installed-base evidence in the sample is also the clearest non-disclosure.

01

The razor-and-blades story is not what the sale register shows

RESTS ON 27 SEPARATELY SOURCED CLAIMS

The standard pitch is a razor-and-blades sale: give away the handle, then bill for blades for a decade. That prior fails on the first row of the public record. The modal, dominant disclosed instrument is an outright capital sale on a government procurement register, a goods-purchase award with a lot value and a delivery month, with no term and no recurring fee⁷². Razor-and-blades is the wrong prior, and this report says so on the record rather than hedging it.

The register rows are concrete. One university tender bought ten units at a published CNY 700,000 each, near list, with no visible volume discount at ten units and no recurring obligation^{56,57}. The same buyer took a single education flagship at CNY 367,800 against a contact-sales list that offers no public denominator^{56,57}. The four largest documented awards to one listed vendor are outright goods purchases worth CNY 90.51m, 159m, 264m and 59.62m, with unit counts mostly unpublished and no term attached^{56,59}. A shipping catalogue sells a base humanoid from USD 13,500 per unit, hardware delivered outright⁶⁰. A national-carrier framework of CNY 124.05m splits between two winners with no unit count. Draw-downs, calls on the pre-agreed order value, against it surface as internal orders rather than repeat notices⁷³. The acceptance chain on the one fully documented project gates 95 per cent of payment on signed acceptance, which is how an outright line item is actually paid^{56,58}.

TABLE 1 The sale instruments the public record actually shows

Instrument class	What the record shows	Price and terms	Claims
Outright goods purchase, university body line	Ten units at CNY 700,000 each	No term, no recurring fee	C-77
Outright, single flagship	One unit at CNY 367,800	List is contact-sales; no public denominator	C-78
Outright, four largest awards to one vendor	CNY 90.51m, 159m, 264m, 59.62m	Unit counts unpublished; no term	C-79
Catalogue outright sale	From USD 13,500 per unit	Hardware delivered outright	C-80
Framework order, national carrier	CNY 124.05m, two winners	No unit count; repeat partly unobservable	C-81
Outright plus one-year SaaS	3 x CNY 580,000 hardware plus CNY 590,000 SaaS	Hardware outright; software one year	C-89
Outright or monthly subscription	USD 20,000 outright or USD 499 a month	USD 200 refundable deposit; no verified delivery	C-83
Illustrative deck rate, not shown charged	USD 8,500 a robot-month	About USD 25,000 deployment; never shown billed	C-84
Signed multi-year RaaS (robot-as-a-service), terms undisclosed	Multi-year, in force	No price, unit count, residual or term	C-85
Indicative European wait-list lease	36 months, EUR 3,499 a month plus EUR 5,500 setup	About EUR 48,000 machine; indicative offer	C-88
Day-rental platform	From CNY 1,499 a day, 30-day minimum	Operator, logistics and insurance bundled	C-87
Third-party teleoperation rate card	USD 50 a robot-month software plus USD 12 an operator-hour	50 hours included, USD 0.90 overage	C-90

Sources:^{56,57, 56,59, 60, 73, 56,58, 62, 43, 61, 65,69, 66, 56,64, 67, 16,69.}

Recurring instruments exist, but they are the minority and mostly adjacent. One public order page offers USD 20,000 outright or USD 499 per month behind a USD 200 refundable deposit, with no verified customer delivery⁶². The only itemised award splits hardware from software outright: three units at CNY 580,000 each plus a CNY 590,000 one-year software line, with renewal scope unpublished^{56,64}. A vendor deck places USD 8,500 per robot-month in an illustrative economics block next to a USD 25,000 deployment fee, and nothing shows that rate ever billed to a customer⁴³. A signed multi-year rental agreement exists in force but publishes no price, unit count, residual or usage term⁶¹. A European wait-list operator quotes a 36-month build-up at EUR 3,499 a month plus EUR 5,500 setup against an about EUR 48,000 machine, an indicative offer rather than an executed lease⁶⁶. Across the enumerated instrument set, no humanoid agreement publishes an automatic renewal, a stated residual, or an uptime credit^{16,69}.

Recurring service reaches customers outside procurement registers too, but thinly. A named Chinese bank branch took a two-year humanoid rental award reported at a seven-figure CNY total, with ownership, maintenance, operator, insurance and residual all unpublished, resting on a single trade summary rather than an opened register⁶³. It confirms that a recurring

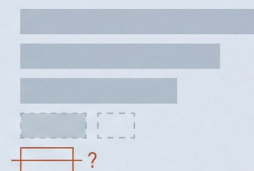
humanoid service contract exists outside the tender record. It does not disclose the economics that would make that contract a margin case⁶³.

EXHIBIT 1

THE SALE INSTRUMENT

The machine changes hands once, with no term attached.

INSTRUMENT	PRICE	RECURRING TERM
Outright goods purchase	Ten units, 700,000 yuan each	No term, no fee
Outright, four largest lots	59.62m to 264m yuan	Unit counts unpublished
Catalogue outright sale	From 13,500 dollars each	Hardware delivered outright
Optional subscription	20,000 dollars or 499 a month	No verified delivery
Illustrative deck rate	8,500 dollars a robot-month	Never shown charged



The modal sale is a value, a month, and no recurring fee.

Serinyx Quorum evidence ledger; every plotted value resolves to a verified source.

Standalone robot-rental service lines lose money at more than one issuer. Knightscope's managed security service runs a service gross margin of negative 54.7 per cent in the 2025 financial year, a second consecutive filed year of gross-negative results, and the 10-K describes the wrapper as an integrated managed service that includes on-premise licensed security personnel [C-02;C-03]. Serve Robotics posts a company gross loss of USD 15.382m, about 580 per cent of its revenue, during active fleet buildout¹⁰. Guardforce's AI and robotics line has decayed from 2.3 per cent of revenue in 2023 to 0.68 per cent in 2025 inside a cash-logistics parent¹⁸. Geek+ deliberately scaled its robot-rental line from 14.1 per cent of revenue in 2022 to 0.08 per cent in 2025, and its own prospectus says it moved to the higher-margin sale of machines [C-21;C-22]. That is four issuers, across security, sidewalk delivery, cash logistics and warehouse AMRs (autonomous mobile robots), where the standalone recurring line did not hold [C-02;C-16;C-27;C-22].

The risk transfer is the point. When a machine changes hands outright, the buyer owns the years after the sale, and the vendor's incentive to price a service line fades with the invoice [C-76;C-100]. That is why the contestable half runs through distributors rather than through the OEM. A buyer can source a battery or a whole module from an independent reseller, but the most valuable service unit stays with the maker [C-55;C-99]. The razor-and-blades model assumes the maker keeps the machine. The register shows the buyer taking it⁷².

The aftermarket itself splits in two. The contestable half already runs through ordinary industrial distributors and multi-brand independent repair firms in the US, Europe and China, with batteries and whole modules priced openly [C-55;C-98]. The captive half is not priced publicly at all. The most valuable service unit, a calibrated joint or limb assembly, has no published part number, price or procedure, and FANUC, the clearest installed-base evidence, runs a closed repair regime that withholds engineering updates from third parties [C-52;C-53;C-99]. Consequence: the aftermarket annuity everyone prices is the contestable half. The half with the margin is the half nobody quotes.

02

The machine's years are decided in the first hundred hours a month

RESTS ON 20 SEPARATELY SOURCED CLAIMS

The gap is the report's central parameter.

If the sale does not decide the margin, something else does. It is how hard the machine is worked. Utilisation is the parameter, and the record holds two very different answers to it, which this report keeps strictly apart.

The observed reading comes from Figure 02 at BMW's Spartanburg plant. The fleet logged 1,250-plus runtime hours over an eleven-month pilot, loading 90,000-plus parts for 30,000-plus X3 vehicles on ten-hour weekday shifts^{41,42}. Divided by the two-unit count favoured by the vendor and its trade correspondent, that is about 57 operational hours per robot-month^{41,42,46}. The denominator is disputed. A BMW spokesperson, reported by Fortune in April 2025, described one robot at a time working off-hours, which yields about 113.6 to 125 hours on the same 1,250 hours over a ten-to-eleven month window^{41,45}. The two readings are never averaged and never reconciled. A reader should read the 57 as the lower, conservative of the two: it is the vendor-favoured two-unit figure, and if one robot worked the monthly number is about twice it. The report defaults to that lower figure and never splits the difference. The site is named because the figure is publicly sourced, and the arithmetic is derived rather than directly published [C-56;C-57].

The assumed reading comes from the other direction. Agility Robotics' SEC-furnished investor deck models USD 8,500 of monthly SaaS per Digit under its own assumption of two ten-hour shifts, 120 hours a week over 52 weeks⁴³. That multiplies out to 520 productive hours per robot-month⁴³. A cross-check inside the same deck, about 31,000 service-life hours over a five-year life, lands at 516.7 hours a month, agreeing to within 0.64 per cent⁴³. This is an assumption on page 41 of a deck, not a measurement of any fleet. The assumption exceeds the best observed per-unit reading by about 4.2 times⁴³.

TABLE 2 The utilisation ledger: observed and assumed kept strictly apart

Reading	Hours per robot-month	Observer and basis	Status
Two-robot reading, BMW Spartanburg	about 57	1,250+ hours over 11 months divided by 2	Observed, derived; denominator disputed 1 vs 2
One-robot reading, same site	about 113.6 to 125	1,250 hours over 10 to 11 months on one robot	Observed, spokesperson quote via Fortune
Vendor assumption, Agility deck page 41	520	Two 10-hour shifts, 120 h/week x 52 / 12	Assumed, not observed
Same deck cross-check	about 516.7	31,000 hours over 60 months	Assumed, agrees within 0.64 per cent
Schaeffler Digit, full attendance	about 168	8 h/day times about 21 workdays	Observed, single trade-press origin
AgiBot cohort, peak sprint	about 62.5	1,500+ hours over 8 units and 3 months	Observed, peak not steady state
Chinese day-rental, in season	56 to 80	7 to 10 bookings at about 8 billable hours	Operator-stated
Chinese day-rental, off season	at most 24	Off-season idle above 70 per cent	Operator-stated, single origin
Tesla Optimus internal fleet	about 0	Chief executive states no material factory use	Against-interest statement
Bain class estimate	about 44	About 2 hours under load times 22 workdays	Assumed
Analyst effective-hours range	176 to 264	8 to 12 productive hours times 22 workdays	Assumed
Controlled enterprise pilot	per-unit hours not published	A controlled enterprise pilot exists on the record	Existence confirmed; no hour figure in the release
Design ceiling, hot-swap battery	about 660	22 hours a day design capability	Design claim, no site rate
Industrial-arm one-shift reference	134 to 147	1,600 to 1,760 hours a year divided by 12	Industrial benchmark, not humanoid
Industrial-arm two-shift reference	268 to 294	3,200 to 3,520 hours a year divided by 12	Industrial benchmark, not humanoid
Actual industrial-fleet average	about 44	26 per cent utilisation on one shift	Industrial survey, not humanoid

Sources:^{41,42,46, 41,45, 41,42, 44, 47, 48,49, 50,51, 51, 54, 55, 83, 84, 43, 70, 85, 52,53, 52,53, 52,}

EXHIBIT 2

— UTILISATION, OBSERVED AND ASSUMED

Observed under 170 hours a month.
The business case assumes 520.

about 57

operational hours per
robot-month, observed

170

upper edge of the
observed cluster

520

hours per robot-month,
vendor deck assumption

One is measured arithmetic on published inputs, the other a model's assumption.
The gap between them is this report's central parameter.

Serinyx Quorum evidence ledger; every plotted value resolves to a verified source.

The rest of the observed record clusters with the low numbers. A single Digit at Schaeffler ran eight-hour shifts caged with an on-site contractor, and trade reporting says it could not finish a full shift without recharging, so actual uptime sits below the scheduled 168 hours a month⁴⁷. An eight-unit AgiBot cohort logged 1,500-plus hours over three months, about 62.5 hours a robot-month at a peak sprint that is not steady state^{48,49}. A Chinese day-rental market bills 56 to 80 hours a month in season and sees off-season idle above 70 per cent, which floors it at about 24 hours a month [C-62;C-63]. Tesla's chief executive places its Optimus fleet at about zero productive utilisation, a statement against its own interest⁵⁴. Analyst estimates bracket the middle: about 44 hours a month on a two-hour-per-day view, and 176 to 264 from an eight-to-twelve-hour view [C-65;C-67]. A tightly controlled enterprise pilot is confirmed on the record, and design claims with hot-swappable batteries reach about 660 hours a month [C-68;C-71;C-72].

For a reference frame only, industrial-arm benchmarks sit higher: one shift is 134 to 147 hours a month, two shifts 268 to 294, while an actual surveyed fleet averages about 26 per cent utilisation, near 44 hours a month [C-73;C-74;C-75]. These are industrial arms, not humanoids, and the cited explainer does not itself print the annual-hour figures, so they mark a reference frame rather than a humanoid observation [C-73;C-74]. The 65,000-hour Agility aggregate across nine facilities has no robot denominator attached, which is why it cannot be converted into per-unit hours⁴⁴.

Consequence follows directly. The recurring fee covers the cost of serving a machine only when the machine earns enough billable hours to absorb the fixed cost of the field team. At the assumed 520 hours the annuity case closes. At the observed 57 to 168 hours it does not, and the cost of a field estate built for the assumption sits idle.

This is the hinge for the reader's first call. A builder who designs a field-service estate around 520 billable hours a month per robot will staff branches and order spares for a fleet that, on the observed record, runs at a fifth of that rate [C-69;C-56]. A buyer who contracts for the years instead of owning them pays a recurring price that was itself set on the 520-hour assumption⁴⁵. The observed 57 to 168 hours is therefore not a footnote. It is the denominator every service budget in this market is currently mis-stated against [C-56;C-60].

03

The cost of serving is a chain with one locked door

RESTS ON 31 SEPARATELY SOURCED CLAIMS

The most valuable service unit stays under OEM control in practice.

Cost follows hours through a chain. Machine hours drive wear. Wear drives the failure rate. Failure drives parts consumption and technician hours, and those two are the cost of serving. The machine ages, the warranty expires and parts wear on the calendar whether or not anyone touches a control.

The wear-bearing items are known by design, but no operator, insurer or regulator publishes a humanoid maintenance ledger, a failure distribution or parts consumed per operating hour⁸⁶. The component lives come from adjacent industrial gear sets. A strain-wave reducer is rated L10 at 7,000 hours on the CSF series and 10,000 hours on the CSG, with a wave-generator bearing L50 at 35,000 hours. An L10 rating is the hour by which 90 per cent of a batch of bearings is expected to survive, and L50 the hour by which half of it does; these are survival estimates, not a guaranteed life. At the observed 57 hours a month, 7,000 hours is about 123 months of running and 35,000 hours is about 614 months. These are lower bounds on a humanoid that runs far below rated torque²¹. A cycloidal gearbox needs its grease changed at 20,000 hours, earlier if the gear surface runs above 40 degrees, a real constraint in a densely packed limb²². Some clocks do not wait for use at all: an industrial controller battery is replaced at 36 months calendar, and high-flex cable carries a four-year calendar guarantee^{71,80}. A humanoid battery has no published cycle life, and consumer reporting puts a typical replacement at about two years of age^{24,39}.

The calendar point matters as much as the hour point. A controller battery and a cable warranty both fire on time rather than on use, so a robot worked at 57 hours a month still ages on the wall clock^{71,80}. The cost of serving therefore arrives in two currents at once: a slow, steady trickle of calendar parts whether the machine earns anything, and a surge of wear parts only when utilisation is high [C-33;C-34]. At low utilisation the calendar current dominates, and there is little revenue to absorb it.

TABLE 3 What wears on a deployed machine, and what it costs today

Wear-bearing item	Life or interval on the record	Public price where it is priced
Strain-wave reducer (industrial class)	CSF L10 7,000 h; CSG L10 10,000 h; CPL-2A L50 35,000 h	No humanoid joint maps to these lives
Cycloidal gearbox lubricant	Grease change 20,000 h, earlier above 40 C	Cannot be converted to a robot-year rate
Controller battery and cable (industrial arm)	36-month calendar battery; 4-year cable guarantee	Calendar triggers that do not wait for use
Humanoid battery	No cycle life published; G1 runtime about 2 h	G1 pack EUR 839.99 / USD 800-850; H1 USD 1,580
Humanoid joint actuator	Not listed as a spare for G1 or H1	Arm and quadruped actuators USD 319 to 3,000
Factory repair event	Journalistic range, not an OEM tariff	CNY 10,000 to 20,000; head bracket CNY 1,800
Independent repairer turn-around	7 to 14 business days vs OEM 30 to 45	90-day warranty; quote-only
Maintenance order of magnitude	5 to 15 per cent of price a year; technician EUR 80 to 150 an hour	Preventive visit USD 500 to 2,200 per robot
Buyer engineer obligation, Tongji	10 engineer-days a month, about 120 a year	Bundled in a CNY 195,000 unit price

Sources:^{21, 22, 86, 71,80, 24,39, 39, 81, 38,39, 36,37, 30, 79, 82, 76,}

What is priced today is mostly whole-module replacement through distributors. A G1 battery pack sells at EUR 839.99, USD 800 to 850, and an H1 pack at USD 1,580, stocked by at least three independent resellers³⁹. The wear discipline carries down to the gripper. On a commercial parallel gripper, preventive maintenance is scheduled every two million cycles, with a named maintenance kit. A three-finger hand's drive gear is replaced at about two million cycles or one year, a cycle-or-calendar trigger with an official-parts rule²³. A humanoid inherits that discipline only where it buys a commercial gripper, and no humanoid hand publishes the equivalent interval²³. Repair events circulate journalistically at CNY 10,000 to 20,000 each, with a deformed head bracket at CNY 1,800 and a wait of about a week. An independent Shenzhen depot turns G1 hardware around in 7 to 14 business days against 30 to 45 for OEM warranty processing^{38,39}. An order of magnitude for the whole class puts maintenance at 5 to 15 per cent of purchase price a year, a Western European technician at EUR 80 to 150 an hour, and a preventive visit at USD 500 to 2,200 per robot^{36,37}.

The labour half is thinner than the parts half. The only matched humanoid support figure is a buyer obligation: a Tongji University one-unit tender obliges the supplier to station certified engineers on site for no fewer than ten working days a month, about 120 engineer-days a robot-year, bundled inside a CNY 195,000 price³⁰. An adjacent floor-cleaning robot schedules three preventive visits a robot a year and monitors remotely, escalating unresolved faults to the customer's own staff⁷⁹. An adjacent AMR operator runs about 184 robots per service engineer, an upper bound because the denominator is cumulative delivered volume⁸². As of August 2026, no source pairs a technician headcount with a live productive humanoid fleet, publishes corrective visits per robot-year, or measures the share of faults fixed remotely⁷⁶.

TABLE 4 Warranty and after-sales terms on the public record

Vendor or buyer	Warranty term	Post-warranty structure
Unitree	8 months standard, 18 months on the EDU line	Per-case quote; customer pays outbound freight

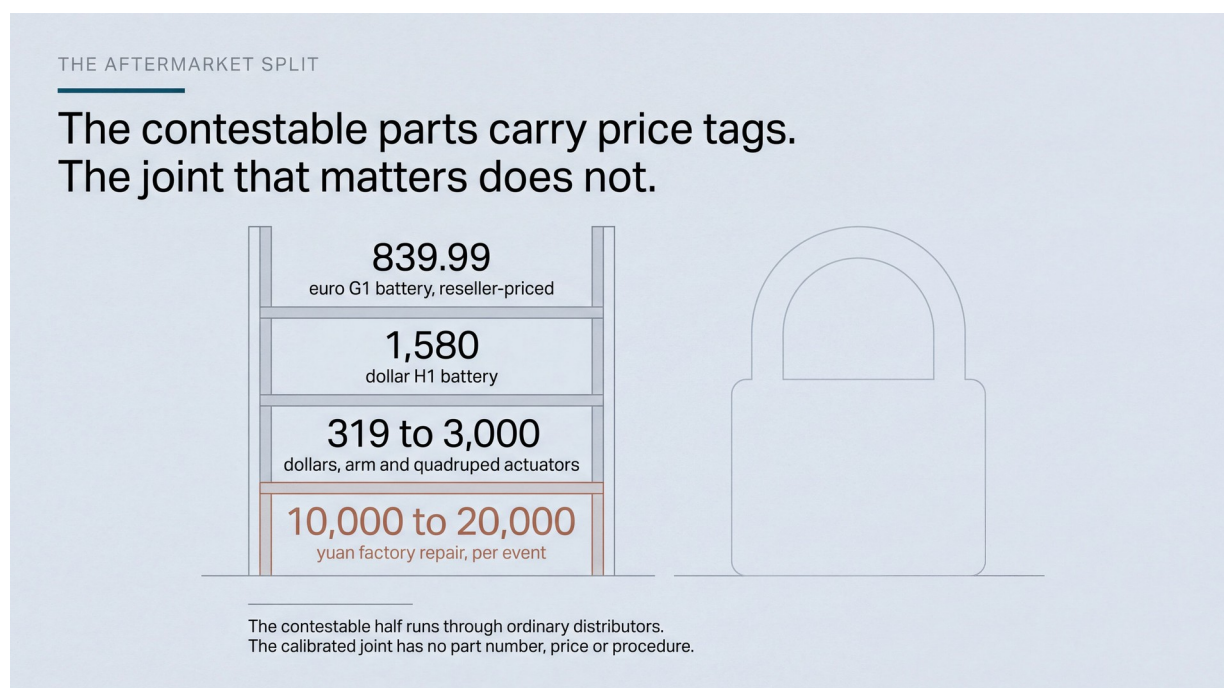
Vendor or buyer	Warranty term	Post-warranty structure
AgiBot	6 to 18 months by model, 12 months across most	Out-of-warranty time-and-materials; extension unpriced; 30-minute first response
Dominant structure, record-wide	Warranty bundled inside the equipment price	Per-incident time-and-materials; no fixed-price annual contract
Response clocks, university tenders	1-hour to 48-hour response	No uptime percentage paired with a service credit
Spot Care (legged robot)	10 business days with cover; batteries excluded	About 20 days without cover is an operational estimate
Jiangsu University demand	Post-warranty repair at 10 per cent of original price	A buyer's demand, ambiguous denominator and period

Sources:^{24, 25, 29, 25-29, 33, 25, 60, 25, 28,}

The after-sales contract that survives in public is a warranty in the box, then a bill for time and materials. Unitree holds 8 months on the standard unit and 18 months on the education line, with out-of-warranty work quoted per case [C-47;C-95]. AgiBot publishes 6 to 18 months by model, a purchasable extension with no public price, and a 30-minute first-response commitment [C-48;C-96]. Across the whole record there is no standard annual maintenance contract priced as a fixed fee or a percentage of asset value, and no document pairs an uptime percentage with an automatic service credit, liquidated damages or a termination right [C-49;C-94]. The closest priced extended-service object is a buyer's demand, not a tariff: a university tender asks post-warranty repair at 10 per cent of original price, with an ambiguous denominator and period [C-49;C-97]. The fullest legged-robot contract, Spot Care, sells a turnaround of 10 business days with cover and explicitly excludes batteries, while the about-20-day figure without cover is an operational estimate rather than a vendor number³³.

The warranty clock is short against the machine's expected life. After that clock, service reverts to per-incident time and materials, billed for the hours worked plus parts, with no published rate²⁹. The buyer's own engineering team steps into the gap the warranty leaves, which is where the engineer-day obligations on a research tender and the independent repairer turn-arounds come from [C-43;C-40].

EXHIBIT 3



Serinyx Quorum evidence ledger; every plotted value resolves to a verified source.

The locked door is the choke point. A catalogue reducer is not a usable replacement until joint dimensions, interfaces, firmware and calibration are known, so the most valuable service unit stays under OEM control in practice⁷. The access poles bracket it: FANUC is the sole authorised repairer in the Americas and withholds engineering updates, KUKA runs an open web shop with 20,000-plus priced parts and a ten-year spare guarantee, and Boston Dynamics conditions any repair on prior authorisation^{31,32}. No right-to-repair rule reaches industrial robots anywhere reviewed. The EU right-to-repair law covers consumer goods, the Machinery Regulation obliges no parts supply, and the Data Act, from 12 September 2025, confers operational data rather than parts, firmware or diagnostics^{34,35}.

TABLE 5 The two halves of the aftermarket, contestable and captive

Half	What is priced publicly	What is not priced publicly
Contestable: batteries	OEM-branded packs stocked by three independent resellers	Internal EUR versus USD ladder inconsistency, not averaged
Contestable: whole modules	Battery packs and modules move through independent resellers ³⁹	The humanoid actuator is not listed as a spare ⁴¹
Contestable: independent repairers	Shenzhen G1 depot 7 to 14 days; named firms in US, EU, China	No like-for-like independent-versus-OEM price pair
Channel structure	Three channels reach the buyer: OEM, distributors, independents	No humanoid distributor channel-share percentage
Captive: calibrated joint or limb	No part number, price or procedure published	Needs dimensions, interfaces, firmware and calibration
Captive: access poles	FANUC closed, updates withheld; KUKA open, 20,000-plus parts	No humanoid-specific access policy is published
Captive: legal access	EU Data Act confers operational data from 12 Sep 2025	Not parts, firmware or diagnostics
Captive: installed-base margin	FANUC Service 16.45 per cent of sales, JPY 141.143bn	No service cost, profit or margin published

Sources:^{17, 39, 81, 38, 39, 40, 77, 31, 32, 34, 35, 78, 74, 75}

Consequence for the buyer. Spending now on branches and technicians assumes the contestable half: batteries, modules, visits and wrench work. Negotiating parts, diagnostics, firmware and calibration access as a condition of the component design-in buys the captive half before it is priced, which is the edge that disappears once the machine is on the floor [C-52;C-99].

04

Where the years land is a position on a bench of resolved businesses

RESTS ON 34 SEPARATELY SOURCED CLAIMS

The honest question is which side of the bench the utilisation and the instrument will place the machine on, and the margin follows.

The machine's life profit and loss does not land at a single number. It lands on a bench of about fifteen named service businesses that have already filed an outcome. Two hands hold the position: utilisation, and the commercial instrument. The margin percentage is read off the position, never predicted from a story.

TABLE 6 The comparator bench: resolved service businesses and the side of the line they end on

Issuer	Instrument or line	Margin outcome	The base that matters
Knightscope	Security-robot managed service	Service GM -54.7 per cent FY2025, ~-55.6 per cent FY2024	Isolated service line, second year negative
AITX / RAD	Device rental, 89.3 per cent of revenue	Group GM +71.4 per cent	Consolidated group, not rental-isolated
Ocado	Recurring capacity fees, 79.1 per cent of segment	Segment adjusted EBITDA 25.0 per cent	Grocery segment, throughput-indexed
ABB	Services and other, 16.71 per cent of group	Service GM 45.98 vs product 40.07, +5.91 points	Group-wide "and other", Robotics discontinued
Rockwell	Services and Lifecycle Services	Service GM 44.68 vs products 48.60, -3.92 points	Consolidated cut; lowest-margin segment
Teradyne	Service (semiconductor test)	-2.13 / +1.85 / +5.58 points across 2023-25	No service line in the robotics segment
Serve Robotics	Fleet services, 61.2 per cent of revenue	Company gross loss about -580 per cent of revenue	Company-level buildout, not line margin
Geek+	RaaS scaled down	14.1 per cent (2022) to 0.08 per cent (2025)	Prospectus series; FY2025 residual
CYBERDYNE	Rental and maintenance, 49.9 per cent over time	Group GM 58.9 per cent but operating loss JPY 601m	Group margin, chronic operating loss
Guardforce	AI and robotics solutions, 0.68 per cent	Segment operating loss -USD 1.6m	Cash-logistics parent

Issuer	Instrument or line	Margin outcome	The base that matters
Intuitive Surgical	Lease wrapping consumables	Recurring revenue above four-fifths of total	Closed regulated ecosystem
FANUC	Installed-base Service division	16.45 per cent of sales; margin not disclosed	Single-segment election
Yunji	Hotel service robots	Rental 1.04 per cent; rental GM 41.0 vs sale 38.1 per cent	One of two isolated line margins
Richtech	Sale and rental side by side	Rental 28.3 per cent; blended GM 65.2 per cent, unsplit	Blended margin, no line split

Sources:^{1, 3, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 10, 11, 10, 12, 12, 13, 13, 14, 14, 15, 15, 16, 17, 18, 19, 40, 68}

Key to the table. "Group" means the whole consolidated company, "segment" a business line inside one, "company" the whole issuer during buildout, and "isolated line" one named revenue line on its own. "Gross margin" is revenue less direct cost, "adjusted EBITDA" is profit before one-off items and financing, and an "operating loss" is after fixed costs. The bench mixes these populations, so a position on it is a location, not a like-for-like margin quote.

The bench runs the full width. At one edge, Knightscope's managed service posts a service gross margin of negative 54.7 per cent, second year running, with service revenue covering about two-thirds of direct service cost [C-02;C-93]. Serve Robotics loses about 580 per cent of revenue at company level during buildout, and Guardforce's robotics line has decayed to 0.68 per cent of revenue inside its parent [C-16;C-27]. Geek+ exited the bottom deliberately, scaling rental down to 0.08 per cent while lifting group margin to 35.5 per cent [C-21;C-22].

In the middle, CYBERDYNE runs a 58.9 per cent group gross margin on a rental-first model for more than a decade and still posts an operating loss, because the gross line does not absorb fixed costs¹³. Yunji's hotel robots keep rental at about 1 per cent of revenue, and its one isolated rental margin of 41.0 per cent sits modestly above its 38.1 per cent sale margin [C-23;C-24]. Richtech runs sale and rental side by side at 28.3 per cent rental, but its blended 65.2 per cent margin is never split by line¹⁶.

EXHIBIT 4

THE COMPARATOR BENCH

The verdict is a point on the bench

SIDE OF THE LINE	ISSUER AND LINE	WHAT FILED
Year one	Outright	No service line yet
Negative	Knightscope	Margin negative 54.7 per cent
Negative	Serve	Loss about negative 580 per cent
Negative	Guardforce	0.68 per cent, a loss
Bracket	ABB services, other	Beats product by 5.91
Bracket	CYBERDYNE	58.9 per cent, loss
Context	Rockwell	44.68 per cent, below ABB
Context	Teradyne	62.88 per cent, sign-unstable
Middle	Geek+	0.08 per cent exited
Middle	Yunji	Rental 41.0, sale 38.1
Unpriced	FANUC	16.45 per cent, no margin
Captive	Intuitive	Recurring above four-fifths

Serinyx Quorum evidence ledger; every plotted value resolves to a verified source.

At the other edge sit the incumbents that set the later-year position. Rockwell's consolidated service margin is 44.68 per cent against 48.60 per cent for products, a 3.92-point trailing gap, and its Lifecycle Services segment is the lowest-margin of its three segments [C-11;C-12]. Teradyne's service margin changes sign across three disclosed years: minus 2.13 points in 2023, plus 1.85 in 2024, plus 5.58 in 2025, and its service share of revenue is falling while its robotics segment loses money with no service line at all [C-13;C-14]. ABB's service margin beats product by 5.91 points, but that is a group-wide "services and other" line and ABB Robotics itself is held as discontinued⁸. FANUC shows the installed base without the margin: 16.45 per cent of sales, no profit published¹⁷.

The bench direction is not uniform even among the incumbents, and no robot maker anywhere in the sample publishes a robot-aftermarket margin as such²⁰. ABB runs above product, Teradyne flips sign year to year, and Rockwell runs below it, so two firms pulling in opposite directions is not a premium worth claiming. It is a warning that the service line's sign depends on the year and the population it measures²⁰.

The two hands set the bracket. In year one, sold outright and still under warranty, there is no service line to have a margin; where a line is forced at these economics, the audited bench places it on Knightscope's side of zero [C-02;C-93]. In a later year, worked harder and sold on recurring terms that hold the machine on the lessor's book, the position sits between ABB, whose services-and-other margin beats its product margin, and CYBERDYNE, whose rental-first model still loses at the operating line [C-09;C-20]. Rockwell, at 44.68 per cent, sits below ABB, and Teradyne, at 62.88 per cent, above CYBERDYNE, as context rather than as the bracket [C-11;C-13]. Consequence: a buyer should not ask what the service margin will be. The honest question is which side of the bench the utilisation and the instrument will place the machine on, and the margin follows.

The positive side of the bench is reachable only at the corner of 520 hours a month⁴³, the unbilled USD 8,500 deck rate⁴³, and the fifth year out of warranty [C-69;C-70;C-48]; the full grid of that corner lives in the simulator. At the observed 57 hours a month^{41,42,46}, the model computes a flat USD 8,500 fee⁴⁵ at positive 58.32 per cent on the service line, and a throughput-indexed fee after the grocer's mechanic [C-07;C-08] at negative 280.21 per cent, on the same machine and the same hours; the fee basis flips the sign of the verdict at the same utilisation, and the annuity's survival turns on a contract detail nobody negotiates carefully.

The 126-point spread across the bench carries one warning above all. Across different populations and labour bases, gross margins run from negative 54.7 per cent to positive 71.4 per cent, and both the deeply negative and the highly positive cases lose heavily at the operating line¹⁹. Fixed-cost absorption, fleet utilisation and field labour dominate the result¹⁹. A gross margin by itself, of either sign, cannot tell a buyer whether the service business is good. That is why the bench is a location test and not a margin quote.

THE COUNTERWEIGHT: THE ANNUITY IS REAL FOR THE BUSINESS THAT PLACES THE MACHINE, NOT THE ONE THAT OWNS IT

The strongest case against this reading is not a footnote. It is four resolved businesses on audited numbers where the recurring line covers its own direct cost, and this section gives them their due. Throughout this report, "pays for itself" means the line covers its own direct cost, its gross-margin sign; it never means the whole group is profitable, which is why a positive group margin sitting above an operating loss is reported as both.

AITX / Robotic Assistance Devices is the pure rental test. Device rental is 89.3 per cent of revenue in the year ended February 2026, up from 82.4 per cent, and direct goods sales are only USD 825,000³⁴. The group gross margin is 71.4 per cent³. The caveat does the work of honesty. That 71.4 per cent is a single consolidated group figure, not an isolated rental-line margin, and it sits above an operating loss of USD 11.94m and a net loss of USD 14.51m because operating expenses run at about 2.3 times revenue³. Gross margin is not operating profit.

Ocado shows the annuity on recurring capacity fees, not on robot bodies. Recurring capacity fees are 79.1 per cent of the Technology Solutions segment's revenue, and the segment earns a 25.0 per cent adjusted EBITDA [C-06;C-07]. That is roughly four-fifths of segment revenue, the recurring throughput-indexed component the whole annuity case turns on³. The fee survives because it is indexed to throughput the grocer cannot self-supply, and it bundles automated warehouse operation rather than charging a per-robot tariff³. This is adjacent grocery automation, not a humanoid, and the instrument is a capacity commitment, not body rental.

EXHIBIT 5

THE COUNTERWEIGHT

The annuity is real for the issuer that keeps the machine.

89.3	79.1	16.71	8.7
per cent rental, one group number	per cent recurring, grocer throughput	per cent services, group-wide line	per cent lease, wraps consumables

Each base does not transfer to the humanoid sold outright and worked at 57 hours.

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ABB offers the industrial incumbent's version. Sales of services and other are 16.71 per cent of group revenue, and the service gross margin of 45.98 per cent beats the product gross margin of 40.07 per cent by 5.91 points [C-08;C-09]. The caveat is the point: the line is group-wide "services and other", not an ABB Robotics aftermarket margin, and ABB Robotics is held as a discontinued operation, slated for sale, so it discloses no internal service split⁶. The direction is real; the population is not the robot aftermarket.

Intuitive Surgical earns its place as the clearest case of an annuity built on disposables. Its operating-lease revenue, renting the machine to the hospital rather than selling it, is USD 874.3m, 8.7 per cent of total, and 50.7 per cent of systems placed are on operating lease¹². But the lease exists to place proprietary instruments and accessories, which are 59.8 per cent of revenue, and issuer-defined recurring revenue runs above four-fifths of the total [C-17;C-18]. The machine itself is the distribution channel for a disposable annuity inside a closed, regulated ecosystem¹². The lease demonstrates annuity placement, not that body rental alone is profitable, because the durable rent sits in the disposables the lessor alone supplies¹².

Taken fairly, razor-and-blades is true for these issuers on audited numbers [C-05;C-07;C-09;C-18]. What none of them proves is that humanoid body rental alone is profitable. AITX loses money at the operating line. Ocado sells warehouse throughput, not a robot tariff. ABB's number carries the "and other" caveat. Intuitive's lease wraps consumables it alone can make. The annuity case survives in this report as a real, labelled counterweight, and it does not transfer to an outright-sold humanoid worked at 57 hours a month.

The fairest reading of the counterweight is that it describes placement, not ownership. AITX retains the device and bills rental; Ocado holds the throughput contract; Intuitive owns the disposable ecosystem; ABB services a long-fledged installed base [C-04;C-06;C-18;C-26]. Each earns its annuity because it keeps the machine or its consumables. The annuity holder, then, is the issuer that keeps the machine on its own book or keeps the consumables; the outright buyer keeps neither.

The surviving counterweight is narrower than the annuity itself. The contestable, billed-by-the-hour humanoid body rental fails at observed hours, but the captive sole-service tail, the calibrated joint no competitor can quote, is unpriced in every register checked and may be the durable pool that mature incumbents actually earn. This report does not dispose of that tail by silence. It records that its margin is unobservable, not thin. What it rejects on the record is razor-and-blades as the default for the sale actually made: the modal humanoid award is an outright capital sale with no term and no recurring fee [C-76;C-100].

A humanoid sold outright on a procurement register, with no term and no fee, sits outside that set⁷². The counterweight is real. It is simply about a different deal.

HOW WE KNOW

This report showcases evidence collection and adjudication across independent sources: every recurring claim below was put to a competing reading before it was kept, and the record decided which side survived. The work behind it rests on 100 individually sourced claims drawn from a corpus of 29,111 files, about 3.6 GB and roughly 50.1 million words of working research text, organised into ten chapter drafts that rest on 78 separate evidence syntheses. About 7,500 words of that working text stand behind each word of this report. The record passed independent editorial, factual, adversarial and layman review, plus a thirty-row grounding audit, before this draft was written.

Every recurring claim in this report carries a grade from a fixed vocabulary, and a strand inherits the weakest grade it rests on. Corroboration counts independent origins, never articles, so a vendor and its customer count as one origin, which is why the BMW 57-hour reading carries its denominator dispute on its face rather than quietly [C-56;C-57]. Observed and assumed readings are never averaged. The 57-hour and 520-hour figures sit in separate columns in this report, each with its observer and basis, because splitting the difference would manufacture a number nobody measured [C-56;C-69]. Disagreement is filed rather than smoothed. Where a claim rests on a single spokesperson quote, a stale filing or an indicative wait-list price, the sentence itself says so: the 113.6 to 125 hour reading is a BMW spokesperson as reported by Fortune, not a deployment disclosure^{41,45}; the Geek+ 2022 to 2024 series comes from the offering prospectus, not the latest annual report⁴⁴; the European lease is a wait-list quote, not a page-listed price⁶⁶.

The verification mechanics are plain. The comparator numbers were read from issuer income statements, segment notes and revenue disaggregations, and the service margins are reproduced exactly as filed, with their bases named in the sentence [C-02;C-05;C-07;C-09;C-11;C-13]. Where a line mixes populations, the mix is printed: ABB's 5.91 points is group-wide "services and other", Knightscope's loss includes on-premise human labour, and Serve's loss is company-level during buildout [C-09;C-03;C-16]. The benchmark hours for industrial arms are flagged as reference frames because the cited explainer does not itself print the annual-hour figures, so they are not presented as humanoid measurements [C-73;C-74].

Evidence cut-off is 11 September 2026. What could not be established is stated as a result, not a gap. No humanoid OEM publishes a field-maintenance ledger, a mean time between failures, or parts consumed per operating hour [C-33;C-46]. No listed robot maker publishes a robot-aftermarket margin as such⁴⁰. No source pairs a technician headcount with a live productive humanoid fleet⁷⁶. The captive calibrated-joint aftermarket is unpriced in every register checked⁷⁵. A completed arm's-length humanoid lease with named customer, asset, financier and consideration has not been published^{16,69}. These are confirmed absences over the reviewed set, and they set the price the reader pays for certainty.

WHAT WOULD CHANGE OUR MIND

1. **A humanoid service line that covers its direct cost at observed hours.** If a filed issuer showed a humanoid or humanoid-class service gross margin at or above its product margin while running the machine at 57 to 168 hours a month, the year-one negative-side bracket weakens [C-02;C-11]. Watch the next Knightscope-style 10-K that isolates a rental line, and the first humanoid OEM to itemise a service segment²⁰.
2. **A measured per-robot hour that meets the business case.** If a deployed cohort publishes a reconciled per-robot hour that approaches the 520-hour assumption, with a named denominator and an independent source, the utilisation gap closes [C-56;C-69]. Watch the Agility fleet for per-unit hours to pair with its 65,000-hour aggregate, and the Figure successor deployment at Spartanburg [C-59;C-58].
3. **A printed captive tariff or a forced access right.** If an OEM publishes a priced parts, diagnostics, firmware or calibration schedule, or a regulator extends a right-to-repair duty to industrial robots, the locked door opens and the captive half becomes contestable [C-52;C-54;C-99]. Watch EU implementation of the Data Act beyond operational data, and the first humanoid parts catalogue with intervals and prices^{34,35}.

EXHIBIT 6

THIS IS A SHOWCASE

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words of research behind each word here

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AI disclosure. Researched, adjudicated and composed by an AI evidence pipeline under human sign-off. Every factual sentence carries a source resolving to the audited evidence record; interpretive sentences carry none. Figures, tables and exhibits compute only from sourced claims. **Currency.** Euro and dollar figures are stated as printed; yuan figures are the register's own prices. Figures are not converted and are not like-for-like across currencies, so a yuan price and a dollar price are read against their own sources. **Corrections.** Errors are corrected in place and logged in the web rendition's correction log. The four claims carried as fixed rather than freshly re-verified this cycle are stated on their true basis in the text: Knightscope's FY2025 service margin rests on the filed 10-K, whose external link could not be re-fetched this cycle, the Geek+ series rests on the offering prospectus, Spot Care's without-cover turnaround is an operational estimate, and the BMW one-robot reading is a spokesperson quote; the 2024 multi-year rental agreement is named without any public price or term [C-02;C-21;C-51;C-57;C-85]. Named companies are public-record subjects; none commissioned or endorsed this report.

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ABOUT THE RESEARCH CORPUS

This report is a summary of a much larger evidence base. The figures below state the size of the research corpus synthesised here, measured on the working corpus at build time.

Full study corpus	29,111 files · 3.6 GB · approximately 50.1 million words of working research text
Synthesis base	10 chapter drafts resting on 78 separate evidence syntheses

Corpus word counts cover machine-readable text files; total sizes include datasets and rendered assets. Sources marked adjudicated were independently verified in the source study before this report used them.

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For a full piece of research or advisory work, contact Lorenz at lorenz@serinyx.com.

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