

MachenIt

Alpha Facility
Operations Strategy

1. Standardized Cell Concept

MachenIt deploys identical, standardized manufacturing cells designed for predictable, scalable throughput. Each cell is a self-contained production unit with identical machine configuration, tooling, fixturing, and control systems. This standardization is the foundation that enables end-to-end automation: from AI-CAM generation through machining to automated inspection, every step operates against known, fixed parameters. Adding capacity means deploying additional machines into the cell or replicating the cell at a new facility.

1.1 Cell Configuration

Parameter	Specification
Machine Platform	DN Solutions DVF 5000 (5-axis vertical)
Spindle Interface	HSK-A63, 18,000 RPM
ATC Capacity	120 tools per machine (identical loadout)
Controller	Siemens Sinumerik One
Work Envelope	500 x 400 x 459 mm (19.7 x 15.7 x 18.1 in)
Table	540 mm diameter rotary
Material	6061-T651 aluminum (single-material strategy)

The single-material strategy (6061-T651) eliminates material mix-up risk, simplifies AI-CAM automation with one set of feeds, speeds, and tool life parameters, and reduces stock management complexity. 6061-T651 covers the vast majority of prototype and low-volume production needs for robotics, aerospace, and industrial hardware customers.

1.2 Unit Economics (Target)

The financial model is built on a \$600 average selling price (ASP) per part at an average machining time of 1 hour, yielding an effective rate of \$600/hour. The fundamental advantage is utilization: At scale, MachenIt targets 7 days/week, 22 hours/day, 80% machine availability, and 90% spindle-on efficiency at scale, producing approximately 5,766 parts per machine per year at \$3.46M revenue per machine. This compares to the industry average of 5 days/week, 10 hours/day, 75% availability, 65% efficiency: 1,243 parts per machine per year at \$746K revenue. A 4.6x revenue multiplier per machine is the core of the business model.

Metric	Industry Average	MachenIt Target
Days / Week	5	7
Hours / Day	10	22
Machine Availability	75%	80%
Spindle-On Efficiency	65%	90%
Effective Hours / Year	1,913	6,406
Parts / Machine / Year (at 1 hr avg)	1,243	5,766
Revenue / Machine / Year	\$746K	\$3.46M

2. Alpha Facility

The Alpha Facility is the initial proving ground for MachenIt operations. It is an 8,000 square foot space designed for phased machine deployment, beginning with a single DVF 5000 in July 2026 and scaling to 3 machines by May 2027. The Alpha Facility operates at startup-appropriate parameters: 5 days/week, 8 hours/day, with availability and efficiency ramping as the team learns. We have been scouting locations in the Boston area and have narrowed it down to Sudbury, Danvers, and Waltham for now. The decision on the location is still pending

2.1 Alpha Facility Parameters

Parameter	Specification
Facility Size	8,000 sq ft
Rent	\$14/sq ft/year (\$9,333/month)
Max Machines	5 (3 deployed in Year 1)
Operating Schedule	5 days/week, 8 hours/day
Utilities	\$3,000/month
Insurance	\$2,000/month
Maintenance	\$2,000/month
Other Overhead	\$6,000/month
Total Facility OpEx	\$22,333/month (\$268K/year)

2.2 Phased Machine Deployment

Machines are deployed incrementally as the operations team proves readiness, the AI-CAM automation rate improves, and customer demand materializes. Each new machine is financed through an equipment loan (90% loan / 10% down payment at 6% over 5 years).

Milestone	Date	Machines	Notes
Machine 1 deployed	Jul 2026	1	First revenue, \$40K down + \$6,960/mo DS
Machine 2 deployed	Dec 2026	2	Ramp capacity, \$40K down + \$13,920/mo DS
Machine 3 deployed	May 2027	3	Alpha at working capacity, \$20,880/mo DS
Year 1 ends	Feb 2027	2	Year 1 revenue: ~\$260K
Facility 1 (MA) begins	Sep 2027	2 + Alpha 3	Transition to 50K sqft production facility

2.3 Alpha Utilization Ramp

The financial model assumes conservative ramp-up of machine availability and spindle efficiency as the team gains experience and the AI-CAM system matures:

Month	Machine Availability	Spindle Efficiency	Effective Utilization
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Nov 2026 (Month 5)	45%	45%	20%
Jan 2027 (Month 7)	55%	50%	28%
Mar 2027 (Month 9)	55%	55%	30%
Jun 2027 (Month 12)	60%	65%	39%
At-Scale Target	80%	90%	72%

Year 1 gross margins are negative (-69%) because direct labor costs dwarf revenue at low utilization. The model shows breakeven gross margin in early Year 2 as utilization improves and labor is spread across more parts.

3. Facility Layout

The Alpha Facility occupies approximately 8,000 square feet organized into seven functional zones designed for efficient material flow, operator visibility, and clean separation between precision and dirty operations. A 3-ton overhead bridge crane spans the machine bay for billet handling, vise swaps, and machine maintenance.

3.1 Zone Map

Zone	Function	Key Equipment
A: Machine Bay	CNC machining, per-machine workbenches	DVF 5000s, Lista benches, vise racks
B-Clean: Toolroom	Tool assembly, presetting, shrink fit	Haimer i4.0, VIO Linear, Tool Dynamic, HSK cabinet
B-Dirty: Toolroom	Grinding, sanding, deburring, tumbling	Bench grinder, belt sander, Rosler tumbler, blast cabinet
C: Metrology Lab	Final inspection, gauge storage, QC	Standridge 4x8 plate, TESA-Hite 700, QM-Height 600, Surftest SJ-210
D: Workholding	Vise storage, jaw inventory	Lang zero-point system, swappable vises
E: SLS Area	Soft jaw printing, depowdering	2x Formlabs Fuse 1+ 30W, Sift, Blast
F: Stock/Shipping	Billet storage, cutting, packing	Billet racks, Jet bandsaw, packing bench, chip management

3.2 Machine Arrangement

DVF 5000s are arranged in a 2-row facing configuration with a 5-foot center aisle. Each machine has a dedicated workbench with PACKOUT side-mount positioned immediately in front. Machine spacing is 4 feet minimum between units for door swing and maintenance access. The overhead crane (3-ton, 50-foot span) covers the entire machine bay.

3.3 Material Flow

Material enters through the roll-up door on the west wall into the stock/shipping zone. Billets are cut on the bandsaw if required, staged on racks, and flow east into the machine bay. After machining, parts move to the dirty toolroom for deburr/finishing, then to the metrology lab for inspection. Inspected parts return to shipping. SLS soft jaws flow from the SLS area into the machine bay. Tools flow from the clean toolroom to machines.

4. Stock Program

A standardized billet catalog of 6061-T651 rectangular bar stock eliminates per-job material procurement delays. The AI-CAM system automatically selects the smallest billet that envelops the part geometry. Material cost is modeled at 14% of revenue in Year 1, declining to 10% at scale as volume purchasing and optimization improve.

4.1 Billet Catalog

Size Class	Billet Dimensions (inches)	Typical Use
Small	4x4x4, 4x4x6, 4x6x6	Brackets, small housings, sensor mounts
Medium-Small	6x6x6, 6x6x8, 6x8x8	Motor mounts, gearbox housings
Medium	8x8x8, 8x8x10, 8x10x10	Robot joint assemblies, enclosures
Medium-Large	10x10x10, 10x10x12, 10x12x12	Structural frames, large housings
Large	12x12x12, 12x12x16	Base plates, large structural components
Max Envelope	12x16x16, 16x16x16	Full-envelope parts, custom fixturing blanks

- Saw-cut tolerance: ± 0.020 inches on Jet HVBS-712D horizontal bandsaw
- All billets barcode/RFID tracked from receiving through machining
- Min/max inventory thresholds with automated reorder triggers
- Automated billet selection by AI-CAM based on part bounding box

5. Fixturing Strategy

A two-tier fixturing system enables zero-setup for first operations and rapid custom fixturing for second operations.

5.1 First Operations: Lang Makro-Grip on Zero-Point

- Lang Quick-Point zero-point base plates permanently mounted to each DVF 5000 table
- Swappable Lang Makro-Grip 125 5-axis vises in three sizes:
 - Small (155mm range): 4x4 through 6x6 billets
 - Medium (255mm range): 6x8 through 10x10 billets
 - Large (355mm range): 10x12 through 16x16 billets
- Zero-point interface: <0.005mm repeatability, <30 second vise swap
- 3 vise sizes per machine, stored on near-machine staging racks
- Lang stamping unit for form-fit clamping, tungsten-carbide jaw coating kit

5.2 Second Operations: SLS-Printed Soft Jaws

- 2x Formlabs Fuse 1+ 30W SLS printers (Nylon 12, Nylon 12 GF, Nylon 11, TPU)
- Formlabs Fuse Sift depowdering + Fuse Blast media blasting
- Dedicated SLS workbench with downdraft ventilation, HEPA vacuum, PPE
- Automated soft jaw design from first-op geometry, 12-16 hour print cycles

6. Tooling Strategy

Each DVF 5000 carries an identical 120-tool HSK-A63 magazine, purpose-built for high-mix 6061 aluminum with zero tapping. Tooling and consumables are modeled at 4% of revenue across all years. All cutting tools held in Haimer shrink fit holders.

6.1 Endmills (Slots 1-30)

Helical (Harvey Performance) 3-flute aluminum-specific endmills at every diameter from 1/16 to 1/2 inch in corner radius roughers, square finishers, and ball nose, each in standard reach (~80mm) and long reach (ZG130, ~130mm).

6.2 Face Mills (Slots 31-32)

- Seco R220.53 series: 2 inch (5 inserts) and 3 inch (7 inserts), 45 degree lead angle
- Seco XOMX 120408TR-ME08 F40M aluminum-specific inserts

6.3 Holemaking: Valor Drills (Slots 37-56)

- Imperial tap drills: #4-40 through 1/2-13 (8 sizes)
- Metric tap drills: M3 through M12 (7 sizes)
- Spot drills: 90 and 120 degree carbide
- 10 reserved slots for customer-specific needs

6.4 Threading: Emuge Hybrid Strategy (Slots 57-78)

Tier 1: Emuge Thriller Drill-Thread Mills (10 tools)

- Combined drill + thread mill in one tool, covers 80%+ of common thread sizes
- #4-40, #6-32, #8-32, #10-32, 1/4-20, 3/8-16, M4, M5, M6, M8

Tier 2: Emuge Threads-All Single Profile (12 tools)

- One tool per pitch covers all diameters: 6 imperial TPI + 6 metric pitches
- Complete coverage from #4 through 1/2 inch and M3 through M16

Why Thread Milling Over Tapping

- Broken thread mill does not seize in hole: part is salvageable
- Thread mills run in standard Haimer shrink fit holders: no tapping chucks
- AI-CAM controls thread depth, class of fit, and handedness in code

6.5 Holders: Haimer HSK-A63 Shrink Fit

- Standard Shrink Fit (A63.140/A63.144), Power Mini Shrink (A63.184), Face Mill Arbors (A63.050)

- ~52 unique holders per machine, ~260 across a 5-machine fleet

7. Toolroom Equipment

7.1 Clean Toolroom

- Haimer Power Clamp Premium i4.0: top-of-line shrink fit machine, NG coil auto-detect, 5 cooling bodies
- Haimer Power Cooler for rapid cooling
- Haimer Microset VIO Linear presetter: +/-2 micron repeatability, RFID, Sinumerik post-processor
- Haimer Tool Dynamic Micro balancer for HSK-A63 assemblies
- Lista HSK-A63 cabinet (120 positions), bench-top racks, wall-mount clips, endmill tube storage
- CDI torque wrenches, Wiha TorqueVario, complete Wera/Knipex hand tool set
- Stainless cleanroom workbench, HSK taper maintenance supplies

7.2 Dirty Toolroom

- Jet JBG-8A bench grinder (8 inch, variable speed)
- Jet JSG-96 belt/disc sander (6x48 inch belt + 9 inch disc)
- Rosler R 180 vibratory tumble finisher (1.8 cu ft, ceramic media)
- Blast cabinet (bench-top 25 inch siphon)
- Jet dust collector (1HP, wall-mount), heavy-duty deburr bench
- Jet HVBS-712D horizontal bandsaw (located in stock zone)

8. Machine-Side Equipment

Each DVF 5000 has an identical workbench station. Standardizing bench equipment ensures any operator can work at any station and the cell is fully replicable.

8.1 Workbench

- Lista 72x30 inch heavy-duty workbench with 7-drawer cabinet and foam inserts
- Wilton 746 bench vise, pegboard panel, overhead LED light bar, anti-fatigue mat
- Milwaukee PACKOUT mounting plate + compact and low-profile organizers

8.2 Hand Tools (per bench)

- Wera: Kraftform Kompakt 60, Zyklon Speed ratchet sets (1/4 + 3/8 + 1/2), Hex-Plus L-keys, Joker combo wrenches, T-handle hex, Chisel driver set
- Knipex: Cobra 3pc set, Pliers Wrench, diagonal cutters, needle nose, TwinGrip, snap ring sets
- Milwaukee: dead blow set, ball peen, brass drifts, center punch, Fastback knife, tape measure, pry bars
- Noga/Shaviv deburring: NogaGrip + blades, Mini-Scraper, swivel-blade, Mango II set, needle files

8.3 M12 Cordless Platform (per bench)

- M12 FUEL stubby impact (3/8), right-angle die grinder (1/4), compact vacuum, 2x ratchets
- Shockwave socket sets (3/8 and 1/4, SAE + metric), 2x 4.0Ah batteries + charger

8.4 Measuring Equipment (per bench)

- Mitutoyo 6 + 12 inch digital calipers (Absolute IP67)
- Mitutoyo 0-1, 1-2, 2-3, 3-4 inch digital micrometers (IP65)
- Depth micrometer 0-6 inch, dial test indicator + mag base, combination square, Haimer 3D Taster

9. Metrology Lab

The metrology lab provides final inspection beyond on-machine probing. Inspection equipment capex is budgeted at \$45K in Year 1, growing to \$500K in Year 2 with CMM procurement.

9.1 Primary Equipment

- Standridge 48x96x8 inch Grade A granite surface plate on rolling stand
- TESA-Hite 700 electronic height gauge (0-28 inch, +/-2.5 micron)
- Mitutoyo QM-Height 600 digital height gauge (0-24 inch)
- Mitutoyo Surftest SJ-210 portable roughness tester
- CMM: budgeted for Year 2 (\$85K+, benchtop CNC)

9.2 Gauge Inventory

- Thread plug + ring gauge sets: UNC, UNF, metric (GO/NO-GO)
- Pin gauge sets: 0.011-0.500 inch, metric 1.00-10.00mm, Class ZZ
- Mitutoyo 81-piece gauge block set, Grade 1 steel
- Digimatic bore gauges: 0.275-2.000 inch, all digital with setting rings
- Full 0-6 inch digital micrometer set with SPC output

9.3 Lab Environment

- Vibration-isolated workbench with granite insert, Waldmann LED task lamps
- Fluke 971 thermometer/hygrometer, HEPA air filtration, anti-static mats

10. Inspection System

10.1 On-Machine Probing

- Renishaw OMP40-2/OMP60 spindle probe (ATC Slot 101)
- Renishaw TS27R table-mounted tool setter (Slot 102)
- Probing in every cycle: datum, in-process, and final dimension checks
- Inspection data logged to QMS and customer portal automatically

10.2 Metrology Lab Verification

Parts flagged by on-machine probing, first-article parts, and customer-specified inspection requirements route to the metrology lab for surface plate verification using height gauges, bore gauges, thread gauges, and the Surftest SJ-210.

11. Production Workflow

Step	Activity	Automation Level
1. Order Intake	Customer uploads STEP/IGES via portal. Geometry validation and instant quoting at \$600 ASP.	Fully automated
2. DFM Review	Manufacturability check against DVF 5000 envelope, tool access, tolerances.	Automated + human override
3. AI-CAM Generation	Toolpaths generated against fixed 120-tool library. Stock selection, fixturing plan.	Automated (target 80%+)
4. Soft Jaw Queue	If second op required, jaw geometry auto-designed and queued to Fuse SLS.	Automated
5. Job Scheduling	ERP/MES orchestrates machine queue with load balancing.	Automated
6. Billet Prep	Billet pulled from stock, cut if needed, stamped, staged at machine.	Manual
7. Op 1 Machining	Billet loaded, touch probing for datum. Thriller thread mills, full cycle.	Auto machining, manual load
8. Op 2 Machining	SLS soft jaws installed, part loaded, probing, back-side features.	Auto machining, manual load
9. Deburr/Inspect	Edge break, tumble finish. Route to metrology lab for final QC.	Manual
10. Ship	Digital inspection report attached. Customer portal updated.	Auto reporting, manual pack