

Strategic Blueprint for SheetMates: Operationalizing Distributed Manufacturing Yield via Community-Centric Platforms

1. Executive Summary: The Convergence of Industrial Precision and Digital Accessibility

The European manufacturing landscape stands at a critical juncture where the democratization of hardware development intersects with the exigencies of industrial efficiency. The proposal to establish **SheetMates** as a Belgian-incorporated digital interface, monetizing the buffer capacity of **Tech-Centrum (CZ)**, represents a sophisticated arbitrage of industrial yield. By identifying and monetizing the "white space"—both literal and figurative—in the production schedules of high-precision fiber laser and CNC bending workflows, SheetMates addresses a persistent inefficiency in the fabrication market: the discrepancy between the minimum viable production runs of industrial job shops and the agile, low-volume needs of the modern hardware innovation ecosystem.

This report provides an exhaustive strategic roadmap for SheetMates. It moves beyond a traditional business plan to offer a structural analysis of the "Manufacturing-as-a-Service" (MaaS) sector, specifically tailored to the unique assets of Tech-Centrum. The core thesis posits that by leveraging the sunk costs of the primary industrial workflow—specifically the unutilized surface area on standard 3000x1500mm metal sheets and the idle machine time between shift changeovers—SheetMates can offer a price-performance ratio that is mathematically impossible for competitors like **OSH Cut**, **RapidDirect**, or **Fractory** to match without similar vertical integration.

The analysis that follows is rooted in a deep evaluation of the current operational capabilities at the new Holubice facility ¹, the legal frameworks governing cross-border toll manufacturing within the EU ², and the sociological drivers of the maker community.⁴ It proposes a "Dutch Auction" dynamic pricing model ⁶ to manage the tension between lead time and material utilization, ensuring that the financial viability of processing scrap is maintained through algorithmic rigor rather than manual estimation.

Furthermore, this report delineates a sales and marketing strategy that eschews traditional B2B sales channels in favor of "Engineering Influence." By embedding the brand within the high-trust networks of European combat robotics ⁸, open-source hardware associations ⁹, and technical YouTubers ¹⁰, SheetMates can bypass the high customer acquisition costs

(CAC) typical of the sector. The ultimate vision outlined here is not merely a webshop for cheap parts, but a digital infrastructure that transforms industrial waste into a strategic asset, fostering a circular economy of precision manufacturing.

2. Business Plan Sketch & Operational Architecture

The structural design of SheetMates must navigate the dual requirements of agility in the digital domain and robustness in the physical domain. The separation of the digital entity (Belgium) from the manufacturing entity (Czech Republic) is a classic principal-toller arrangement, but it requires precise execution to maximize VAT efficiency and operational fluidity.

2.1 Corporate Structure and Cross-Border Logistics

The decision to incorporate SheetMates in Belgium while retaining manufacturing at Tech-Centrum in the Czech Republic leverages the best of both jurisdictions: the commercial reputation and logistical connectivity of Western Europe, and the cost-effective, high-precision industrial base of Central Europe.

2.1.1 The Toll Manufacturing Model

The relationship between SheetMates (Principal) and Tech-Centrum (Manufacturer) should be structured as a **Toll Manufacturing Agreement**. In this model, SheetMates retains ownership of the raw material (or theoretically "buys" the scrap/buffer capacity from Tech-Centrum) and contracts Tech-Centrum solely for the service of processing.²

This distinction is critical for VAT compliance. According to recent European Court of Justice (ECJ) rulings, specifically the *Cabot Plastics Belgium* case (C-232/22), a toll manufacturer is generally not considered a "fixed establishment" of the principal company for VAT purposes solely due to the tolling agreement.³ This means SheetMates can operate without necessarily triggering a permanent establishment status in the Czech Republic, provided the operational independence of Tech-Centrum is maintained.

Implications for SheetMates:

- **VAT Neutrality:** Tech-Centrum invoices SheetMates for the *service* of cutting and bending, not the goods. This service is subject to the reverse-charge mechanism within the EU, improving cash flow.¹²
- **Risk Segregation:** The commercial liability for consumer-facing sales rests with the Belgian entity, protecting the industrial assets of the Czech entity.
- **Logistics Flow:** Finished goods can be shipped directly from the Holubice facility to the end-user using SheetMates branding. The shipping manifest acts as proof of intra-community supply.¹²

2.1.2 Fulfillment and Logistics Optimization

Tech-Centrum's location in Brno/Holubice is strategically advantageous, serving as a central node for logistics into DACH (Germany, Austria, Switzerland) and Western Europe.¹ To compete with the rapid turnover of competitors like OSH Cut (which offers 2-day delivery in the US)¹³, SheetMates must integrate with express logistics providers (DHL Express, UPS) for "Rush" orders, while utilizing standard ground freight for "Buffer" orders.

Logistics Tier	Carrier Strategy	Target Region	Estimated Lead Time
Eco/Buffer Saver	DPD / GLS Ground	EU-27	3-7 Days
Priority/Rush	DHL Express	Global / EU	24-48 Hours
Heavy Freight	Kuehne+Nagel (LTL)	Industrial Hubs	3-5 Days

2.2 The "Buffer Monetization" Operational Workflow

The core value proposition relies on the seamless integration of SheetMates orders into the "gaps" of Tech-Centrum's primary production schedule. This requires a bi-directional data flow between the SheetMates web interface and the Tech-Centrum ERP/Nesting software.

2.2.1 The "Virtual Remnant" Inventory

Traditional job shops treat skeletal remains of sheet metal as scrap. SheetMates reclassifies this as "Virtual Inventory."

1. **Ingestion:** When Tech-Centrum programs a primary job (e.g., 500 industrial brackets) on a 3000x1500mm sheet¹, the nesting software (e.g., Lantek or Trumpf TruTops) identifies large contiguous areas of unused material.¹⁴
2. **Broadcasting:** An API connection pushes the dimensions and material type (e.g., "Stainless Steel 304, 2mm, 400x600mm remnant") to the SheetMates database.
3. **Consumption:** The SheetMates website displays this material availability to users. The "Super Clean" interface allows users to nest their small parts directly into these virtual remnants.

2.2.2 Phased Operational Rollout

To minimize risk, the operational deployment should follow a phased approach:

- **Phase 1: The "Drop" Model (Manual/Alpha):**

- **Mechanism:** Weekly "drops" of available capacity announced on Discord. "We have 5 sheets of 3mm Aluminum 5052 going onto the laser on Friday. Upload your DXFs by Thursday noon to get 40% off."
- **Goal:** Validate demand and build community trust without heavy software integration.
- **Phase 2: The "Waiting Room" (Semi-Automated):**
 - **Mechanism:** Users upload files to a queue. The system groups orders until a full sheet is populated. Dynamic pricing incentivizes users to close the gap (see Section 5).
 - **Goal:** Optimize yield and test the dynamic pricing algorithms.
- **Phase 3: Real-Time Injection (Fully Automated):**
 - **Mechanism:** Direct API injection into the Trumpf machine queue. As soon as a primary job is nested, SheetMates parts are added to the layout automatically.¹⁵
 - **Goal:** Maximum efficiency and zero-touch administration.

2.3 Financial Modeling and Cost Structure

The financial advantage of SheetMates lies in its marginal cost structure. Since the setup time, material procurement, and machine depreciation are largely covered by the primary industrial customer of Tech-Centrum, the marginal cost of cutting an additional part is primarily electricity, assist gas (N₂/O₂), and nozzle wear.

- **Revenue Stream 1: Scrap Conversion.** Selling material that would otherwise be sold as scrap (at ~€0.50/kg) for part value (e.g., €15.00/kg).
- **Revenue Stream 2: Machine Utilization.** Monetizing the night shifts or weekend gaps at the Holubice facility.¹
- **Revenue Stream 3: Kitting Services.** Up-selling assembly or surface treatment (powder coating) which Tech-Centrum already offers.¹

3. Differentiation Analysis: European Precision vs. Global Competitors

The market is crowded with digital fabrication services. To succeed, SheetMates must ruthlessly differentiate itself. The analysis below benchmarks SheetMates against the three dominant archetypes in the sector: The American UX Standard (OSH Cut), The Chinese Price Leader (JLCPCB/RapidDirect), and The European Broker (Fractory).

3.1 Competitor Benchmarking Matrix

Feature	OSH Cut (USA)	JLCPCB / RapidDirect	Fractory (Europe/UK)	SheetMates (Proposed)

		(China)		
Primary Strength	Software Experience: Instant DFM, video simulation of bending. ¹³	Cost: Extremely low pricing for prototypes. ¹⁶	Capacity: Massive network of suppliers, virtually unlimited capacity. ¹⁷	Yield Efficiency: Monetizing paid-for scrap to offer industrial quality at hobbyist prices.
Lead Time	Ultra-Fast (Same Day / 2-Day). ¹³	Slow (5-15 Days) due to shipping/customs. ¹⁶	Medium (9 Days). ¹⁷	Flexible: Immediate for premium, delayed for "fillers."
Quality Control	High (ISO 9001), Domestic control. ¹³	Variable (depends on batch), "Good enough" for hobby. ¹⁸	High, but dependent on the specific partner shop. ¹⁷	Industrial Grade: Tech-Centrum ISO 9001/3834 certified. ¹
Material Origin	Domestic US, Mill Certs available. ¹³	Chinese Stock, Certs often difficult to verify.	Mixed European/Global sources.	EU Origin: Traceable mill certs standard. ¹
Sustainability	Low focus (standard manufacturing).	Very Low (High logistics carbon footprint).	Moderate (Network optimization).	High: "Zero Scrap" mission through remnant utilization.

3.2 The "European Precision" Differentiator

While "Made in China" appeals to price-sensitive hobbyists, the European engineering sector (startups, university labs, Formula Student teams) values **traceability** and **certainty**.

Tech-Centrum's ISO 9001:2015 and ISO 3834-2:2005 (welding) certifications are significant assets.¹

Strategic Narrative: "SheetMates is not a broker. We are the factory. When you upload a file, it is cut on *our* Trumpf lasers in Brno, not farmed out to the lowest bidder." This directly counters the Fractory/Xometry model, where quality can vary between orders depending on which subcontractor wins the bid.¹⁷ For a startup building a prototype that must later pass EU safety regulations, knowing the exact origin of the steel (and having the material certificate to prove it) is a "must-have," not a "nice-to-have."

3.3 Differentiating from OSH Cut (The UX Benchmark)

OSH Cut has defined the user experience standard with instant, software-defined quoting and video simulations of bending.¹³ SheetMates cannot beat OSH Cut on speed immediately (as they are US-based), but it can beat them on **Price-to-Value in Europe**.

Gap Analysis:

- **Gap:** OSH Cut offers "same-day" shipping.
- **SheetMates Solution:** Instead of competing on pure speed, compete on *predictable* speed. Offer a "Scheduled Drop" model where users know exactly when their part will be cut based on the aggregated sheet fill level.
- **Gap:** OSH Cut has extensive bending simulation.
- **SheetMates Solution:** Leverage the "Construction Department" at Tech-Centrum.¹ Offer a "Human-in-the-Loop" DFM review for complex bent parts as a premium service, something purely automated platforms struggle with.

3.4 Differentiating from JLCPCB/RapidDirect (The Price Benchmark)

Chinese competitors suffer from the "Import Friction" problem: VAT clearance, customs delays, and long shipping times.¹²

The "Schengen Shield":

SheetMates offers **frictionless logistics**. No customs, no surprise import duties, and simplified VAT recovery for B2B customers. For a Belgian startup, buying from SheetMates is a domestic administrative transaction; buying from JLCPCB involves import declarations. This administrative ease is a massive selling point for B2B procurement managers.

4. The "Super Clean" Web Interface & Technical Stack

The user query emphasizes a "community-driven, super clean web interface." This is the primary touchpoint for the brand and must function as a high-performance SaaS application, not a standard e-commerce store. The UX must guide the user from "Idea" to "Valid Order" with minimal friction, utilizing automation to replace the sales engineer.

4.1 UX Design Philosophy: "The OSH Park of Metal"

OSH Park revolutionized PCB ordering by removing options. They standardized the process (purple solder mask, ENIG finish, standard thickness) to maximize throughput.⁵ SheetMates should adopt a similar philosophy for its "Buffer" line.

- **Standardization:** Limit the "Buffer" options to the most common materials found in Tech-Centrum's primary runs (e.g., 2mm, 3mm, 5mm Steel; 1.5mm, 3mm Aluminum; 1mm Stainless). This maximizes the probability of sheet filling.
- **Visual Feedback:** The interface should visually represent the "Sheet Fill" status. A progress bar showing "80% Filled - Order now to catch this week's run!" creates urgency and gamifies the purchasing process.

4.2 Automated DFM and Nesting Engine

The backend must integrate sophisticated nesting logic to calculate accurate pricing and yield.

4.2.1 Design for Manufacturability (DFM) Checks

Upon file upload (DXF/STEP), the system must perform geometric analysis:

1. **Closed Loops:** Verify all cut paths are closed.
2. **Hole Size:** Check that hole diameters are not smaller than the material thickness (a common limitation in laser cutting).¹³
3. **Kerf Compensation:** Automatically apply kerf compensation based on the specific Trumpf laser profiles.¹
4. **Bending Collisions:** If bending is selected, check flange lengths against the minimums required by the Trumpf Trubend tooling available at Holubice.¹

4.2.2 The Nesting Stack

To achieve "Super Clean" efficiency, the platform needs a headless nesting engine.

- **Deepest (Open Source):** An excellent candidate for the initial engine. It supports SVG/DXF, handles irregular shapes, and uses a heuristic algorithm to optimize part density.²¹ Its "automatic line merging" feature (common line cutting) is crucial for reducing laser time and cost.²¹
- **Commercial Integration:** As volume grows, integrating with **Lantek Expert** or **SigmaNest** via API might be necessary to handle the specific machine codes for the Trumpf fiber lasers.¹⁴

4.3 Community Features in the Interface

To reinforce the "Community-Driven" aspect:

- **"Share Your Sheet":** Users can opt to make their designs public. If another user orders

the same part (filling the sheet faster), the original designer gets a credit.

- **"Open Source Registry":** A library of pre-verified parts (e.g., VESA mounts, NEMA 17 motor brackets, Raspberry Pi cases) that users can drag and drop onto a sheet to fill gaps.⁹

5. Dynamic Pricing Strategy: Solving the Lead Time vs. Fill Rate Equation

The central economic challenge of SheetMates is managing the tension between **Lead Time** (User desire for speed) and **Sheet Utilization** (Factory desire for efficiency). A static price list will fail to optimize this. Instead, we propose a **Dynamic Yield Management System** based on "Dutch Auction" principles and Service Capacity Surplus-Driven Pricing (SCSP).⁶

5.1 The "Waiting Room" Algorithm

The pricing model works on the concept of a "Target Launch Date" for each material sheet.

The Algorithm:

$$Price(t) = BaseCost + \frac{OpportunityCost}{(FillRate \times UrgencyFactor)}$$

1. **The Anchor Price:** The standard price is set based on market rates (benchmarked against Fractory/RapidDirect).
2. **The Discount Curve:** As a sheet fills up, the marginal cost of adding a part decreases. However, to incentivize *early* commitment, SheetMates can offer "Early Bird" slots.
3. **The Urgency Multiplier:**
 - **"Fill the Gap" (Low Priority):** The user agrees to wait until the sheet is 100% full. Price = **Lowest** (Marginal cost + small markup).
 - **"Scheduled Run" (Medium Priority):** The user buys a slot on a sheet guaranteed to run on Friday. Price = **Medium** (Standard market rate).
 - **"Force the Run" (High Priority):** The user pays a premium to trigger the machine *now*, effectively subsidizing the empty space on the sheet. This is the "Dutch Auction" component—the price starts high and drops as more users join the sheet.⁶

5.2 Implementation of SROP (Service Recommendation Outcome-Driven Pricing)

Drawing from research on dynamic pricing in manufacturing²³, SheetMates should implement SROP. The interface recommends a delivery date that maximizes the platform's utility.

- *Scenario:* A user uploads a part. The system sees a sheet of 3mm Steel is at 85% capacity and scheduled for tomorrow.

- *Recommendation*: "If you switch material from 2mm to 3mm Steel, we can ship this on Friday for 20% less."
- *Mechanism*: This pushes users toward high-availability materials, smoothing demand and increasing sheet utilization.²³

5.3 Transparency as Value

Unlike airlines, where dynamic pricing breeds distrust, SheetMates can use it to build community.

- **The "Tipping Point" Bar**: Display a live progress bar for specific materials. "Only 15% more area needed to trigger the Stainless Steel run! Invite a friend!"
- **Result**: This turns customers into sales agents who actively recruit others to fill the sheet and lower their own wait times.

6. Sales, Marketing, and Community Engagement Strategy

Traditional B2B marketing (cold calls, trade shows) is inefficient for this model. The strategy must be "Bottom-Up," targeting the engineers, students, and makers who influence procurement decisions.

6.1 Influencer Marketing: The "Engineering Celebrity" Approach

SheetMates needs to be seen where the makers are. The strategy is not just "sponsorship," but "enablement" of complex projects.

6.1.1 Key Influencer Targets

1. **Ivan Miranda (Spain)**: Specializes in massive 3D printed/metal hybrid vehicles (tanks, hovercrafts). His projects require large, laser-cut aluminum plates which are hard to source cheaply.
 - *Pitch*: "We will provide the entire chassis for your next tank project from our 'scrap' buffer. You show the unboxing and the 'Made in EU' label."¹⁰
2. **CNC Kitchen (Stefan - Germany)**: Focuses on material testing and scientific analysis.
 - *Pitch*: "Let's do a scientific test: Laser Cut Aluminum vs. Carbon Fiber Nylon for 3D printer frames. We supply the precision metal parts."²⁵
3. **SunShine / Combat Robotics Channels**: The combat robot community is an insatiable consumer of Hardox (AR400/500) steel.
 - *Pitch*: "SheetMates will sponsor the 'Destruction Yield' award. The robot with the most damage gets a free sheet of Hardox for repairs."²⁶

6.2 Discord and the "Drop" Culture

The Discord server ⁴ should be the operational heartbeat of the community.

- **Channel Structure:**
 - #scrap-alerts: Real-time bot notifications of available remnants. "🔴 ALERT: 500x500mm Corner of 5mm Hardox available. First come, first served."
 - #design-help: Tech-Centrum engineers (from the Construction Department) answer DFM questions for 1 hour a day. This builds massive authority and trust.¹
 - #group-buy: Users organize their own "panels." "Who else needs 6mm Aluminum plates? Let's fill a sheet together to unlock the 30% discount."

6.3 Strategic Partnerships: Educational & Competitive

Targeting the "Future Engineers" is a long-term play with high ROI.

- **Formula Student & European Rover Challenge:** These teams need complex, precise metal parts and often have limited budgets.
 - *Offer:* The "SheetMates Education Tier." Teams get cost-price fabrication in exchange for the SheetMates logo on the car/rover. This captures the loyalty of 50-100 engineers per team who will soon enter the workforce.²⁹
- **Open Source Hardware (OSHWA):** Partner with OSHWA to certify SheetMates as an "Open Source Friendly" manufacturer. This appeals to the ethical values of the maker community.⁹

7. Mission, Values, and Sustainability

The brand identity must resonate with the European value set: Sustainability, Quality, and Sovereignty.

7.1 Mission Statement

"To democratize industrial precision by turning manufacturing inefficiency into community opportunity."

7.2 Core Values

1. **Zero Waste (Circular Economy):** We view scrap not as waste, but as "pre-paid inventory." Our goal is 100% sheet utilization.³²
2. **Radical Transparency:** We show you the "real" price. No hidden broker fees. You pay for the metal and the laser time.
3. **European Sovereignty:** We build here. We cut here. We ship from here. Supporting local industry and reducing the carbon footprint of global logistics.³³

7.3 Sustainability as a Competitive Moat

Competitors like RapidDirect rely on air freighting heavy metal from China, which has a massive carbon footprint. SheetMates can calculate the "Carbon Savings" of every order compared to a Chinese import and display this on the user dashboard. This feature appeals strongly to corporate ESG goals and environmentally conscious makers.³⁴

8. Financial Roadmap & Conclusion

8.1 The Path to Profitability

- **Year 1:** Focus on "Alpha" community growth via Discord. Manual processing of "Buffer" orders. Goal: Break even on scrap recovery.
- **Year 2:** Launch of fully automated Web Interface with Dynamic Pricing. Integration of "Rush" orders for higher margin.
- **Year 3:** Expansion into "Kitting" and assemblies (welding/bending) using Tech-Centrum's advanced capabilities.

8.2 Conclusion

SheetMates is positioned to disrupt the European fabrication market not by building new factories, but by unlocking the latent value in an existing one. By combining the **hardware dominance** of Tech-Centrum (Trumpf lasers, ISO certifications) with a **software-defined** community interface (Dynamic Pricing, Discord integration), SheetMates can offer a service that is cheaper than the brokers, faster than the Chinese, and higher quality than the hobbyist shops.

The key to success lies in the rigorous execution of the **Toll Manufacturing** legal structure to optimize VAT, the **Dynamic Pricing** algorithm to balance operations, and the **Community Engagement** strategy to build a defensible moat of loyal users. The "scrap" of Tech-Centrum is the gold of SheetMates.

Detailed Analysis: Operational Execution & Market Mechanics

(The following sections provide the in-depth data and rigorous analysis required to support the strategic blueprint above.)

9. Deep Dive: The Legal & Tax Framework (Toll Manufacturing)

To operationalize SheetMates effectively, the legal relationship between the Belgian entity and the Czech manufacturer must be bulletproof.

9.1 The "Fixed Establishment" Risk

A major risk in cross-border manufacturing is the creation of a "Fixed Establishment" (FE) for VAT purposes. If tax authorities deem that SheetMates (BE) has a permanent presence in CZ (via Tech-Centrum), SheetMates could be liable for Czech corporate tax and VAT compliance.

- **Precedent:** The *Cabot Plastics* ruling (C-232/22) is the shield. The ECJ ruled that a toll manufacturer does not constitute a fixed establishment of the principal simply because they share a group relationship or contractual exclusivity.³
- **Operational Requirement:** To maintain this protection, SheetMates must **not** have direct managerial control over Tech-Centrum's employees or facilities. The relationship must remain strictly contractual: "Order In, Product Out".³⁷

9.2 VAT Mechanics for the User

- **B2B Customers (EU):** Reverse Charge applies. A German startup provides their VAT number, and SheetMates invoices them with 0% VAT.¹²
- **B2C Customers (EU):** SheetMates must charge the VAT rate of the *destination country* (OSS scheme). If shipping to a hobbyist in France, charge 20% French VAT.³⁸
- **The "Scrap" Transfer:** Tech-Centrum "sells" the scrap material to SheetMates (an intra-community supply of goods) or, more efficiently, SheetMates provides the material "virtually" by paying a service fee that includes a material markup.²

10. Technical Deep Dive: Nesting Algorithms & Yield

The "Super Clean" interface relies on what happens *after* the upload.

10.1 The Mathematics of Nesting (The Bin Packing Problem)

SheetMates is essentially solving a 2D Bin Packing Problem with Time Windows.³⁹

- **Static Nesting:** Placing parts on a sheet to maximize fit.
- **Dynamic Nesting:** Placing parts on a sheet *over time* as new orders arrive.¹⁵
- **The Constraint:** We cannot hold a sheet open forever.
- **The Solution:** Use a **Column Generation** approach. The algorithm generates potential "patterns" (layouts) and selects the one that maximizes profit (Price paid - Waste cost) within the "Time Window" (User's deadline).¹⁵

10.2 Software Implementation

- **Frontend:** React/Vue.js for the "Super Clean" drag-and-drop experience.
- **Middleware:** Python/Node.js handling the "Waiting Room" logic and Dynamic Pricing calculations.
- **Core Engine:** Deepnest (CLI version) running on a server to perform background nesting checks every time a user uploads a file, providing instant feedback on "Fit".²¹

11. Community Sociology: Building Trust in a "Trustless" Market

Why do makers choose OSH Park or Prusa? **Community Trust.**

11.1 The "Open Source" Promise

SheetMates should commit to releasing its own "Design Rules" (DRC) file for common CAD software (Fusion 360, SolidWorks), similar to how PCB fabs release DRC files.¹³ This allows users to "Pre-Validate" their designs before upload, reducing frustration.

11.2 The "Maker Fame" Loop

- **Feature:** "Project Spotlight."
- **Mechanism:** Users who document their build (video/blog) using SheetMates parts get a 50% refund on their next order.
- **Result:** This generates organic SEO content and social proof, which is more valuable than paid ads.⁴¹

12. Conclusion: The SheetMates Advantage

By integrating the **industrial muscle** of Tech-Centrum with the **agile brain** of a Belgian digital platform, SheetMates can occupy a unique position in the European market. It is not just a shop; it is a **yield optimization engine** that benefits the factory (Tech-Centrum), the user (Makers), and the environment (Sustainability). This symbiotic relationship is the foundation of a resilient, high-margin business model.

Works cited

1. Technologické Centrum, accessed on February 1, 2026, <https://www.tech-centrum.cz/en/>
2. VAT Considerations in Toll Manufacturing: Classification of Supplies, accessed on February 1, 2026, <https://meridianglobalservices.com/vat-considerations-in-toll-manufacturing-classification-of-supplies/>
3. Toll manufacturer is not a VAT fixed establishment - Pwc.nl, accessed on February

- 1, 2026,
<https://www.pwc.nl/en/insights-and-publications/tax-news/vat/toll-manufacturer-is-not-a-vat-fixed-establishment.html>
4. Voron Documentation | Voron Official and Community Documentation - VORON Design, accessed on February 1, 2026, <https://docs.vorondesign.com/>
 5. OSH Park ~, accessed on February 1, 2026, <https://oshpark.com/>
 6. Dutch Auctions in Procurement: How This High-Pressure Format Drives Faster Decisions, accessed on February 1, 2026, <https://www.prokuria.com/post/dutch-auction>
 7. Slow Dutch Auctions - IDEAS/RePEc, accessed on February 1, 2026, <https://ideas.repec.org/a/inm/ormnsc/v51y2005i3p365-373.html>
 8. THE ROAD TO THE EUROPEAN ROBOT CHAMPIONSHIP BEGINS | Extreme Robots Doncaster 2024 Breakdown - YouTube, accessed on February 1, 2026, <https://www.youtube.com/watch?v=JXislol6JeU>
 9. Open Source Hardware Association, accessed on February 1, 2026, <https://oshwa.org/>
 10. Support My Work - Ivan Miranda, accessed on February 1, 2026, <https://ivanmiranda.com/pages/support-my-work>
 11. Toll manufacturing by group company does not trigger a fixed establishment in the hands of the foreign principal | EY - Belgium, accessed on February 1, 2026, https://www.ey.com/en_be/technical/tax/tax-alerts/2023/toll-manufacturing-by-group-company-does-not-trigger-a-fixed-establishment
 12. Importing goods to Europe? The VAT rules you need to know - Avalara, accessed on February 1, 2026, <https://www.avalara.com/vatlive/en/eu-vat-rules/eu-vat-returns/importing-goods-and-eu-vat.html>
 13. OSH Cut: Laser Cutting and Sheet Metal Services, accessed on February 1, 2026, <https://www.oshcut.com/>
 14. CAD/CAM nesting software for cutting machines - Lantek Expert Cut, accessed on February 1, 2026, <https://www.lantek.com/us/cad-cam-nesting-software-oxycut-plasma-laser-waterjet>
 15. Optimizing sheet metal production with dynamic nesting - Aaltodoc, accessed on February 1, 2026, <https://aaltodoc.aalto.fi/bitstreams/eed615d-6a03-4e06-8b54-2d82e4ffe50d/download>
 16. The 9 Best Sheet Metal Fabrication Services for American and European Enterprises, accessed on February 1, 2026, <https://www.rapiddirect.com/blog/top-9-sheet-metal-fabrication-companies/>
 17. Metal Fabrication in the UK | Scale Your Production with Fractory, accessed on February 1, 2026, <https://fractory.com/>
 18. Top 10 SendCutSend Alternatives - Jiga, accessed on February 1, 2026, <https://jiga.io/articles/sendcutsend-jiga-alternatives/>
 19. Metal Fabrication Cloud Manufacturing Platform Comparison: Fractory, Laserhub & Xometry, accessed on February 1, 2026,

- <https://www.processindustryinformer.com/metal-fabrication-cloud-manufacturing-platform-comparison-fractory-laserhub-xometry/>
20. A review of the PCB Manufacturing Service provided by OSH Park, accessed on February 1, 2026, <https://manufacturingreports.com/review-osh-park-pcb/>
 21. Deepnest - open source nesting software, accessed on February 1, 2026, <https://deepnest.io/>
 22. Sheet metal software Nesting, CAD/CAM and automation - JETCAM, accessed on February 1, 2026, <https://www.jetcam.net/products/software-sheetmetal.php>
 23. Dynamic pricing strategy design for manufacturing service providers in manufacturing platforms - AIMS Press, accessed on February 1, 2026, <https://www.aimspress.com/article/id/697c0683ba35de4e397366aa>
 24. I 3D Printed a Kayak in Less Than 24 hours - YouTube, accessed on February 1, 2026, <https://www.youtube.com/watch?v=9DpMkYDCq9Y&vl=en>
 25. Carbon Fiber Nylon in 3D Printing: PA6 vs PA12 Tested - CNC Kitchen, accessed on February 1, 2026, <https://www.cnckitchen.com/blog/carbon-fiber-nylon-in-3d-printing-pa6-vs-pa12-tested>
 26. Sunshine Showdown Winners Interview | 1658S & 7760X | Push Back 2025 - YouTube, accessed on February 1, 2026, <https://www.youtube.com/watch?v=8mHUhZx9BVc>
 27. Eurasia's Biggest Robot Combat Event Resumes! | Battle of Robots Qualifier B TCC RUNDOWN - YouTube, accessed on February 1, 2026, <https://www.youtube.com/watch?v=2l3rp23M99s>
 28. War Robots - Discord, accessed on February 1, 2026, <https://discord.com/invite/warrobots>
 29. European Rover Challenge - Wikipedia, accessed on February 1, 2026, https://en.wikipedia.org/wiki/European_Rover_Challenge
 30. Newsletter - Formula Student at LiU, accessed on February 1, 2026, <https://liuformulastudent.se/newsletter/>
 31. Scientific Community Profiles: Open Source Hardware Association - Ukraine | Wilson Center, accessed on February 1, 2026, <https://ukraine.wilsoncenter.org/publication/scientific-community-profiles-open-source-hardware-association>
 32. Nesting Laser Cut Parts Maximizes Efficiency and Cost Savings, accessed on February 1, 2026, <https://www.bailliefab.com/blog/nesting-laser-cut-parts-maximizes-efficiency-and-cost-savings>
 33. Think OSH Park PCBs are Made in China? | by Christina Cyr | Medium, accessed on February 1, 2026, <https://medium.com/@CyrChristina/think-osh-park-pcbs-are-made-in-china-e88605760977>
 34. 15 Sustainable Manufacturing Examples and Case Studies - Diversitech Global, accessed on February 1, 2026, <https://www.diversitech-global.com/post/sustainable-manufacturing-examples-and-case-studies>

35. Can sustainable manufacturing positively impact your brand's reputation? - Flex, accessed on February 1, 2026,
<https://flex.com/resources/can-sustainable-manufacturing-positively-impact-your-brands-reputation>
36. CJEU judgment: Toll manufacturers do not have to invoice foreign taxpayers with VAT, accessed on February 1, 2026,
<https://www.dentons.com/en/insights/alerts/2023/june/30/cjeu-judgment-toll-manufacturing>
37. Toll manufacturing and VAT fixed establishments in the EU | PwC Switzerland, accessed on February 1, 2026,
<https://www.pwc.ch/en/insights/toll-manufacturing-VAT-fixed-establishments-EU.html>
38. VAT rules and rates: standard, special & reduced rates - Your Europe - European Union, accessed on February 1, 2026,
https://europa.eu/youreurope/business/taxation/vat/vat-rules-rates/index_en.htm
39. Heuristics for the One-Dimensional Bin Packing Problem with Time Windows - Frontiers, accessed on February 1, 2026,
<https://www.frontiersin.org/journals/applied-mathematics-and-statistics/articles/10.3389/fams.2026.1741977/full>
40. Nesting Software for Fabrication - Autodesk, accessed on February 1, 2026,
<https://www.autodesk.com/solutions/nesting-software>
41. An Engineer's Guide to B2B Content Marketing, accessed on February 1, 2026,
<https://www.trewmarketing.com/resources/an-engineers-guide-to-b2b-content-marketing>
42. Inbound Marketing ROI: For Industrial Companies & Manufacturers - Thomas Blog, accessed on February 1, 2026,
<https://blog.thomasnet.com/inbound-marketing-roi>