

SENSOR-WEB

Smartphone-Based Road Intelligence Platform

Business & Marketing Plan

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1. Executive Summary

Sensor-Web is a web-based platform that transforms any smartphone into a precision road-quality sensor. Using built-in accelerometers, gyroscopes, magnetometers, and GPS, the platform captures and analyzes road surface conditions and driving behavior without requiring any specialized hardware. The proprietary calibration algorithm automatically learns phone orientation and vehicle dynamics, producing a normalized, vehicle-independent road quality metric called DAN (Delta Acceleration Noise).

The platform addresses a \$4.7 billion global road asset management market that currently relies on expensive, slow manual survey methods. By crowdsourcing road quality data from everyday drivers, Sensor-Web can provide municipalities, departments of transportation, fleet operators, and insurers with continuously updated road condition intelligence at a fraction of the cost of traditional approaches.

1.1 The Opportunity

American infrastructure is in crisis. The American Society of Civil Engineers gives U.S. roads a grade of “D,” with an estimated \$786 billion backlog in needed repairs. Yet most municipalities lack the data to prioritize effectively. Professional road survey trucks cost \$500,000+ and can only assess a fraction of road networks annually. Sensor-Web turns every commuter into a road surveyor, delivering continuous, city-wide coverage through passive data collection.

1.2 Key Differentiators

- **No hardware required:** Works with any modern smartphone in any vehicle, in any phone orientation. Zero barrier to adoption.
- **Vehicle-independent scoring:** Percentile-based normalization eliminates differences in suspension, tires, and phone mounting. Multiple vehicles produce a true consensus road quality score.
- **Dual value streams:** Road quality data (B2G/B2B) and driver/vehicle analytics (B2C/B2B) from the same sensor pipeline.
- **Proven calibration science:** Floating calibration pipeline with cross-verification trifecta (accelerometer/gyroscope/magnetometer mutual validation) already operational.
- **Founder credibility:** 40-year automotive veteran, former CTO of Continental AG (\$40B+), with deep expertise in vehicle dynamics, sensor systems, and global technology scaling.

1.3 Current Status

The core sensing and calibration technology is built and operational. Sensor capture, floating calibration pipeline, DAN metric computation, and RoadDAN geospatial tagging are complete. The platform is deployed at sensor-web-mu.vercel.app. The next development phase focuses on Firebase storage, percentile rating, map visualization, and multi-user crowdsourcing.

2. Company Overview

2.1 Mission Statement

To democratize road infrastructure intelligence by turning every smartphone into a precision sensor, making road quality data universally accessible and actionable for communities, governments, and businesses.

2.2 Vision

A world where every road mile is continuously monitored, road maintenance is data-driven and proactive, and drivers have transparent, comparable data on vehicle ride quality and driving performance.

2.3 Legal Structure

[To be determined: LLC, C-Corp, or B-Corp. Recommended: Delaware C-Corp if pursuing venture funding, Michigan LLC for bootstrapping. Decision needed.]

2.4 Founder Profile

Kurt Lehmann brings a uniquely relevant combination of technical depth and executive scale to Sensor-Web:

- **Vehicle Dynamics Expertise (1984–1998):** 14 years in hands-on vehicle development at GM and Continental/Teves, working directly with chassis control systems, ABS, and Electronic Stability Control (ESC). This is the precise domain knowledge underlying Sensor-Web's calibration algorithms and DAN metric.
- **Global Technology Leadership (1998–2019):** Progressive leadership at Continental AG and WABCO, culminating as Corporate Technology Officer of Continental Corporation (\$40B+ revenue). Responsible for 40,000 engineers across 105 global locations, with 18,000 in software. Direct report to the CEO.
- **Innovation & Strategy:** Led Continental's technology trend scouting in AI, automation, electrification, connectivity, wireless technologies, cybersecurity, and new mobility services. Board member of multiple Continental subsidiaries.
- **Post-Retirement Impact:** Advisor to technology startups (NODAR, WaveSense/GPR, VitaScale, 4SeasonsFarming). Active in Michigan SmartZone technology incubation. Founder of Empower906.org addressing rural technology and sustainability.

This profile provides Sensor-Web with unmatched credibility when engaging automotive OEMs, Tier-1 suppliers, fleet operators, municipal governments, and technology investors.

3. Market Analysis

3.1 Market Size & Segments

Sensor-Web operates at the intersection of several large and growing markets:

Market Segment	Est. Global Market Size	Growth Rate	Relevance
Road Asset Management	\$4.7B (2024)	~8% CAGR	Primary: road quality data for gov/infrastructure
Fleet Management Software	\$25.5B (2024)	~15% CAGR	Driver scoring, vehicle analytics, route optimization
Usage-Based Insurance (UBI)	\$35B (2024)	~25% CAGR	Driver behavior data for risk pricing
Connected Car Data	\$40B+ (2025)	~20% CAGR	Vehicle performance & road condition data
Smart City Infrastructure	\$700B+ (2030 proj.)	~20% CAGR	Broader ecosystem for urban data platforms

3.2 Target Customer Segments

Segment A: Municipal & State Government (B2G)

Departments of transportation, public works departments, and city/county road commissions responsible for road maintenance planning and budget allocation. These organizations currently rely on manual inspections, citizen complaints, and expensive ARAN/laser profiler trucks that can only survey a small percentage of road networks annually.

Pain point: Insufficient data to prioritize road repairs, leading to reactive instead of proactive maintenance and wasted budgets.

Value proposition: Continuous, city-wide road condition monitoring at 1/100th the cost of professional survey trucks.

Segment B: Fleet Operators (B2B)

Commercial fleet operators (delivery, logistics, service vehicles, municipal fleets) managing vehicle maintenance, driver safety, and fuel efficiency. Fleet sizes range from 50 to 50,000+ vehicles.

Pain point: Driver behavior directly impacts fuel costs (up to 33% variance), vehicle wear, accident rates, and insurance premiums.

Value proposition: Real-time driver scoring, fleet-wide benchmarking, and road-aware route optimization. No hardware installation required.

Segment C: Insurance Companies (B2B)

Auto insurers developing usage-based insurance (UBI) and pay-how-you-drive programs that price risk based on actual driving behavior rather than demographic proxies.

Pain point: Need reliable, low-cost driving behavior data without requiring OBD-II dongles or OEM partnerships.

Value proposition: Smartphone-based driver scoring that separates road conditions from driving behavior — a critical distinction competitors miss.

Segment D: Individual Consumers (B2C)

Everyday drivers interested in road quality information, vehicle comparison data, driving improvement, and social/competitive features. Also parents monitoring teen drivers.

Pain point: No transparent, data-driven way to compare vehicle ride quality or benchmark driving skill.

Value proposition: Free road quality maps, vehicle ride comparison, personal driving scores, and family/group safety features.

3.3 Competitive Landscape

Competitor	Approach	Strengths	Sensor-Web Advantage
RoadBotics (Michelin)	AI + camera (windshield)	Backed by Michelin; visual evidence	No camera needed; passive collection; lower cost; scales with crowdsourcing
Roadway / StreetScan	AI + camera/LiDAR	High precision imaging	No hardware; any vehicle; continuous coverage vs. periodic survey
ARAN / Dynatest	Professional survey trucks	Gold standard accuracy	1/100th cost; 1000x coverage; real-time updates
Google / Waze	GPS + user reports	Massive user base	Actual measured road quality (not user reports); vehicle dynamics data
Zendrive / CMT	Smartphone driving analytics	Insurance partnerships	Road quality separation from driving behavior; vehicle comparison
OEM telematics	Built-in vehicle sensors	Factory-grade sensors	Vehicle-agnostic; works across any car; crowdsourced consensus scoring

Sensor-Web's fundamental competitive advantage is the combination of zero-hardware deployment with a calibration system that genuinely separates road disturbance from vehicle dynamics. This separation is what makes both the road quality data and the driver scoring data independently valuable and accurate — something no competitor currently achieves with a smartphone-only approach.

4. Product & Technology

4.1 Technical Architecture

The Sensor-Web platform is built on a modern web stack (Next.js, React, TypeScript) deployed via Vercel, using Firebase for real-time data storage. The core innovation lies in the signal processing pipeline:

- Raw sensor capture at 60Hz (accelerometer, gyroscope, magnetometer) plus GPS at 1Hz
- Floating calibration algorithm that learns phone orientation in real-time and separates gravity, vehicle motion, and road disturbance
- Cross-verification trifecta: accelerometer, gyroscope, and magnetometer mutually validate each other for robust orientation estimation
- DAN (Delta Acceleration Noise) metric: RMS measurement of high-frequency vibration deviation, producing a vehicle-independent road roughness score
- Geospatial indexing via geohash8 (~38m × 19m grid cells) for efficient spatial queries and map visualization

4.2 Product Roadmap

Phase	Features	Target Date	Status
Phase 1: Foundation	Sensor capture, calibration pipeline, DAN metric, RoadDAN segments, Signal Viewer	Complete	✅ Done
Phase 2: Data Platform	Firebase storage, percentile rating system, map visualization with colored road overlay	Q2 2026	❑ Next
Phase 3: Multi-User	Multi-user crowdsourcing, aggregated road quality scores, user accounts	Q3 2026	❑ Planned
Phase 4: Analytics	Vehicle ride quality comparison, driver performance scoring, driver comparison/ranking	Q4 2026	❑ Planned
Phase 5: Social	Groups, leaderboards, parental monitoring, alerts, privacy controls	Q1 2027	❑ Planned
Phase 6: Enterprise	Fleet dashboard, API access, municipal reporting tools, data export	Q2 2027	❑ Planned

4.3 Intellectual Property

The core IP resides in the calibration algorithm (floating gravity estimation, forward vector learning, vehicle coordinate transform) and the DAN metric methodology. The cross-verification trifecta and percentile-based vehicle-independent normalization represent additional proprietary approaches.

[Action item: Evaluate patent strategy for calibration algorithm and DAN metric. Consult IP attorney. Consider provisional patent filing.]

5. Business Model & Revenue Strategy

5.1 Revenue Model Overview

Sensor-Web employs a multi-layered monetization strategy that mirrors the platform's dual value streams: consumer engagement drives data density, while B2B/B2G data products drive revenue.

Tier 1: Free Consumer App (Growth Engine)

- Basic road quality map access
- Personal driving score (basic)
- Limited trip history
- Contributes road data to the crowdsourced network

Purpose: Maximize adoption and data collection. Every free user makes the platform more valuable.

Tier 2: Premium Consumer ("Sensor-Web Pro")

- Full driving analytics and historical trends
- Vehicle ride quality comparison
- Groups, leaderboards, and parental monitoring
- Route-level road quality reports

Pricing: \$4.99–\$9.99/month or \$49–\$99/year

Tier 3: Fleet & Enterprise SaaS

- Fleet-wide driver scoring dashboard
- Vehicle maintenance correlation analytics
- Custom reporting and API access
- Admin controls, driver groups, alert configuration

Pricing: \$5–15/vehicle/month (volume discounts for 500+ vehicles)

Tier 4: Municipal & Government Data

- City-wide or region-wide road quality heatmaps with historical trending
- Pavement condition index (PCI) correlation reports
- Priority maintenance recommendations
- Annual data subscription or one-time assessment reports

Pricing: \$10,000–\$100,000+/year depending on coverage area and population

Tier 5: Data Licensing

- Anonymized, aggregated road quality data licensed to insurers, navigation companies, real estate platforms, and automotive OEMs
- Custom data feeds via API

Pricing: Negotiated per contract; potential for significant recurring revenue at scale

5.2 Revenue Projections

[To be developed: Financial model with user growth assumptions, conversion rates, and revenue projections by tier. Key assumptions to define: user acquisition cost, free-to-paid conversion rate (industry benchmark: 2–5%), fleet contract size, municipal contract pipeline.]

6. Go-to-Market Strategy

6.1 Phase 1: Local Proof of Concept (Michigan)

Michigan is the ideal launch market. The state has some of the worst road conditions in the nation, a strong automotive industry presence, and Kurt's existing network through SmartZone, Empower906, and Michigan Tech. The strategy is to build dense coverage in a defined geography to prove the crowdsourced model works before scaling.

Target Geography

- Primary: Upper Peninsula of Michigan (hometown advantage, Empower906 network, rural road challenges)
- Secondary: Detroit/Southeast Michigan metro area (high traffic volume, severe road conditions, automotive industry proximity)
- Tertiary: Lansing/State government corridor (proximity to MDOT decision-makers)

Initial Customer Targets

- Michigan Department of Transportation (MDOT) — pilot program for road condition monitoring
- 2–3 county road commissions in the UP (smaller, more agile decision-making)
- 1–2 municipal fleets (city vehicles already driving every road daily)
- Michigan Tech University partnership (research validation, student user base)

6.2 Phase 2: Regional Expansion

Expand to neighboring states with similar road quality challenges (Wisconsin, Minnesota, Ohio, Pennsylvania) and begin targeting national fleet operators with Michigan-based operations.

6.3 Phase 3: National & Vertical Scaling

National expansion driven by fleet partnerships, insurance company integrations, and federal infrastructure funding opportunities (IIJA/Bipartisan Infrastructure Law).

6.4 Channel Strategy

- **Direct sales:** Founder-led for initial municipal and fleet contracts. Kurt's industry credibility and network are the primary sales asset.
- **Partnerships:** Michigan SmartZone, Michigan Tech, MTRI (Michigan Tech Research Institute), Michigan Municipal League.
- **Digital/organic:** App store presence, social media (automotive/infrastructure communities), content marketing (blog, case studies, road quality reports).
- **Conference presence:** Transportation Research Board (TRB) Annual Meeting, ITS America, AASHTO, Michigan Infrastructure Conference.
- **Government procurement:** GSA Schedule listing (longer term), state cooperative purchasing agreements.

7. Marketing Strategy

7.1 Brand Positioning

Core message: "Every smartphone is a road sensor." Sensor-Web positions as the platform that makes road intelligence universally accessible — no expensive trucks, no specialized equipment, no fleet installations. Just drive.

Positioning by Segment

Segment	Key Message	Proof Point
Municipalities	"Know every road, every day — at 1/100th the cost of survey trucks"	Continuous coverage vs. annual partial surveys
Fleet Operators	"See how your drivers really drive — with zero hardware to install"	Driver scoring without OBD dongles or dashcams
Insurers	"The only smartphone platform that separates road conditions from driving behavior"	DAN calibration separates road vs. driver signal
Consumers	"Rate your roads. Compare your ride. Drive smarter."	Free road maps, vehicle comparison, driving scores

7.2 The Founder Story

Kurt's story is a significant marketing asset and should be central to early-stage positioning. The narrative arc is compelling: a 40-year automotive veteran who oversaw sensor technology for a

\$40B global company, now applying that exact expertise to solve a problem he identified from the other side — as a driver on Michigan's notoriously rough roads. This is not a Silicon Valley software engineer guessing at vehicle dynamics; this is the person who helped define the industry standard for vehicle sensor systems.

Key storytelling angles:

- "From ABS to AI": Career arc from hands-on brake testing at GM to CTO of Continental to building a consumer sensor platform
- "The \$500K truck problem": Why professional road surveys are broken and how crowdsourcing solves it
- "Rural roads matter too": Upper Peninsula perspective on infrastructure equity (Empower906 connection)
- "Your phone already knows": The surprising capability of smartphone sensors when combined with proper automotive-grade calibration

7.3 Content Strategy

- **Technical blog/LinkedIn:** Regular posts on road quality data, vehicle dynamics, calibration methodology. Establish thought leadership.
- **"Road Report" series:** Periodic city/region road quality reports using Sensor-Web data. Free content that demonstrates value and generates press coverage.
- **Case studies:** Document every pilot deployment with before/after data and customer testimonials.
- **Conference presentations:** Submit papers and talks to TRB, ITS America, SAE, automotive technology conferences.
- **Local media:** UP/Michigan media coverage of the founder story and local road quality data.

7.4 Digital Presence

- **Website:** sensor-web.com (or appropriate domain) with clear segment-specific landing pages.
- **GitHub:** Open-source presence builds developer credibility (already active at github.com/klehmann00/sensor-web).
- **Social:** LinkedIn (primary for B2B/B2G), X/Twitter (automotive/tech community), YouTube (demo videos, road quality visualizations).
- **SEO targets:** "road quality monitoring," "road condition assessment," "smartphone road sensor," "driver scoring app," "fleet driver safety."

8. Financial Plan

8.1 Funding Strategy

The current approach is self-funded (bootstrapped), leveraging Kurt's own resources and time. This is sustainable for the technology development phase but will need to be revisited as the platform scales to multi-user deployment, requires server infrastructure, and demands sales/marketing investment.

Potential Funding Sources

- **SBIR/STTR Grants:** Federal grants for small business innovation research. DOT, FHWA, and NSF all fund transportation technology. Highly relevant and non-dilutive.
- **Michigan Economic Development Corporation (MEDC):** State grants and incentives for technology companies, especially in the UP.
- **Angel investors:** Michigan angel networks, automotive industry contacts.
- **Venture capital:** Later stage, once product-market fit is demonstrated with municipal/fleet contracts.
- **Infrastructure Act funding:** The Bipartisan Infrastructure Law includes provisions for innovative road monitoring technology.

8.2 Key Financial Metrics to Track

- Monthly active users (data contributors)
- Road miles covered per month
- Geographic coverage density (% of road segments with data)
- Free-to-paid conversion rate
- Customer acquisition cost (CAC) by segment
- Monthly recurring revenue (MRR) and annual recurring revenue (ARR)
- Contract pipeline value (municipal and fleet)

8.3 Cost Structure

[To be developed: Detailed cost model including infrastructure (Firebase/Vercel), development resources, sales & marketing spend, legal/IP costs, and operational overhead. Current burn rate and runway should be documented.]

8.4 Financial Projections

[To be developed: 3–5 year financial projections with scenarios (conservative, moderate, aggressive). Key variables: user growth rate, data density threshold for municipal sales, fleet contract conversion rate.]

9. Strategic Roadmap & Milestones

Timeline	Milestone	Success Metric
Q1 2026	Complete Phase 2 development (Firebase, percentile system, map visualization)	Working map overlay with colored road quality data
Q2 2026	Launch multi-user crowdsourcing; recruit 50–100 beta testers in UP Michigan	50+ active data contributors; 500+ road miles covered
Q3 2026	First municipal pilot (county road commission or MDOT district)	Signed pilot agreement; data validation against known road conditions
Q3 2026	Submit SBIR/STTR grant application(s)	Application submitted to DOT or NSF
Q4 2026	Launch driver scoring and vehicle comparison features	Feature complete; initial user feedback
Q4 2026	First paid municipal contract or fleet customer	Revenue milestone: first dollar earned
Q1 2027	Social features launch (groups, leaderboards, parental monitoring)	500+ active users; measurable engagement metrics
Q2 2027	Enterprise/fleet dashboard; API access	2–3 fleet customers onboarded
H2 2027	Regional expansion beyond Michigan	Active users in 3+ states
2028	National scaling; Series A readiness	\$500K+ ARR; proven unit economics

10. Risks & Mitigation

Risk	Severity	Mitigation Strategy
Chicken-and-egg: need users for data, need data for value	High	Seed with municipal fleet vehicles (guaranteed routes); target delivery/rideshare drivers; focus on dense local coverage before expanding
Smartphone sensor accuracy vs. professional equipment	Medium	Publish validation studies comparing DAN to IRI/PCI; Michigan Tech research partnership; percentile normalization handles individual sensor variance
Browser API limitations (sensor access restrictions)	Medium	Monitor Web Sensors API evolution; maintain iOS WebKit workarounds; evaluate native app as fallback for critical features
Competitor with larger user base adds road quality	Medium	First-mover on calibration-based separation of road vs. vehicle signal; patent protection; build data moat through municipal partnerships
Government procurement cycles (12–18 months)	Medium	Parallel consumer and fleet revenue streams; pursue grants as bridge funding; pilot programs to reduce procurement

Risk	Severity	Mitigation Strategy
		barriers
Privacy concerns with location/driving data	Medium	Privacy-first architecture; local processing where possible; anonymized aggregation; transparent data policies; GDPR-ready design
Single founder risk	High	Document all technical decisions; codebase on GitHub; pursue advisory board and early team hires for critical functions

11. Open Decisions & Action Items

The following items require decisions or further development to complete this plan:

Item	Category	Priority	Notes
Legal entity formation	Legal/Finance	High	LLC vs. C-Corp; state of incorporation; timing
Patent strategy	IP/Legal	High	Provisional patent for calibration algorithm and DAN metric
Domain name acquisition	Marketing	Medium	sensor-web.com or alternative; brand identity finalization
Financial model development	Finance	High	Cost structure, revenue projections, funding needs assessment
Advisory board formation	Strategy	Medium	Target: 3–5 advisors in municipal gov, fleet ops, insurance, automotive
Municipal pilot outreach	Sales	High	Identify 2–3 UP county road commissions for initial conversations
SBIR/STTR grant research	Funding	High	Identify relevant solicitations from DOT, FHWA, NSF for 2026 cycle
Michigan Tech partnership	Partnerships	Medium	Research validation, student user base, MTRI connection
Competitive intelligence deep dive	Strategy	Medium	Detailed analysis of RoadBotics pricing, Zendrive capabilities
Pricing validation	Revenue	Medium	Customer interviews to validate willingness-to-pay assumptions

12. Appendices

Appendix A: Technical Glossary

- **DAN (Delta Acceleration Noise):** RMS measurement of high-frequency vibration deviation from the filtered signal. The core road quality metric.
- **RoadDAN:** DAN averaged over 1-second intervals and tagged with geohash8 GPS coordinates.
- **Geohash8:** Spatial indexing system producing $\sim 38\text{m} \times 19\text{m}$ grid cells for road segment identification.
- **IRI (International Roughness Index):** The established standard for road roughness measurement. Sensor-Web's DAN metric will be correlated with IRI for validation.
- **PCI (Pavement Condition Index):** A numeric rating (0–100) of pavement condition used by municipalities.
- **Floating calibration:** Real-time algorithm that continuously learns phone orientation without requiring fixed mounting.
- **Cross-verification trifecta:** Mutual validation between accelerometer, gyroscope, and magnetometer for robust orientation estimation.

Appendix B: Founder Resume

[Attached separately: Kurt Lehmann full resume and bio]

Appendix C: Product Screenshots & Demos

[To be added: Signal Viewer screenshots, map visualization mockups, mobile interface designs]

Appendix D: Market Research Sources

[To be compiled: Sources for market size estimates, competitive analysis data, infrastructure spending data]