Product Vision Document: The Teach by Doing (TbD) Ingestion Engine

Product: Teach by Doing (TbD) / PAD Ingestion Core

Version: 1.0 (Nov 2025 Baseline)

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Purpose: To define the single, critical component required to solve the Data Gap and launch the full Pathways as Data (PAD) ecosystem.

1. Introduction: The Core Thesis

The TbD engine is the **on-ramp for all knowledge** into the Pathways as Data system. It transforms an expert's recorded action (video/screen capture) into a structured, machine-readable asset called a "Pathway."

The Dual-Use Architecture

The core value of PAD is that the pathway asset is immediately usable by two entities:

1. **For Humans:** It generates **zero-cost, human-readable documentation** (like an instant recipe from a recorded video).
2. **For AI:** It is an **Executable Instruction Set** that a robot, co-pilot, or AI agent can follow perfectly.

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2. The Problem We Are Solving (The Gaps)

TbD directly targets the three fundamental gaps blocking the PAD vision:

Gap	Problem Statement	Example of Failure
Data Gap	Expert knowledge is siloed, making it impossible to acquire labeled training data at scale.	DED manufacturing scrap rates (10-30%) due to inconsistent human expertise.

Tech Gap	Automation requires specialized (and expensive) AI/robotics engineers to manually program workflows.	Surgeons and technicians cannot train AI; they must rely on external programmers (Prompt Literacy Gap).
Strategy Gap	Without a structured data format, the entire vision remains theoretical and cannot be scaled or monetized.	We cannot build a "Pathway Marketplace" without a consistent, verifiable product to sell.

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3. Product Architecture: From Video to Structure (V1-V4)

The TbD engine is built on a scalable, cloud-native architecture that moves from simple observation to intelligent, temporal understanding.

3.1 The Scalable Foundation (V2.0 Baseline)

- **Decoupled Architecture:** The system uses a **Fan-Out Architecture** on GCP (Cloud Run, Pub/Sub, GCS) to safely process long-running videos without timeouts. This is now fully deployed and stable.
- **The Bridge Stack:** V1/V2 utilize a standard Computer Vision (CV) stack (OpenCV, Tesseract) as a temporary "bridge" to generate initial data, bypassing the stalled external VCU dependency.

3.2 The Intelligence Core (V3.0/V4.0 Focus)

The core value is added by advanced processing layers:

Layer	Function	Technical Rationale
V3.0: Semantic Enrichment	Replaces simple text with human-readable descriptions.	Uses **SSIM Differencing** for precise "Active Region" detection and **Gemini 2.5 Pro** to generate **zero-cost human documentation**.

V4.0: Temporal Grounding	**Solves the VCU Dependency.** Uses a custom **LSTM/RNN Temporal Encoder Microservice** to enforce sequential logic and *remember* the preceding steps.	This is the "Temporal Grounding Bridge" that makes the asset executable and necessary for complex actions like "baking a cake".

4. Business & Monetization Hooks

The TbD engine is the foundation for all revenue in the PAD hybrid model:

A. The ARM-Style IP Strategy

- Every Pathway generated by TbD is a piece of **licensable intellectual property**.
- The final JSON structure includes mandatory **Marketplace Metadata** (e.g., license_tier, compliance_tag) to ensure it's ready for commercialization.

B. The Compliance & Data Moat

- TbD is built with **"Compliance-by-Design."** This is critical for the Medical vertical.
- The system creates the **fully auditable digital log** required by standards like AS9100 (Manufacturing) and HIPAA (Medical), turning a regulatory burden into a valuable data asset.
- The ingestion pipeline is the single source of data for the "compendium" or **Data Moat**, which is the long-term competitive advantage.

5. Strategic Roadmap (2026 Baseline)

The original 2025 timeline is now an internal historical record[1]. This roadmap reflects a realistic, accelerated timeline starting with the core build and moving toward full agent integration.

Phase	Timeframe	Key Milestone	Strategic Value
Phase 1: Ingestion Gateway	**Q1 2026**	**TbD V4.0 Launch.** Full GCP decoupling, Semantic Enrichment, and **Temporal Grounding Bridge** deployment.	**Control the Timeline:** Unblocks the PAD roadmap from the external VCU dependency.

Phase 2: Agent Execution Core	**Q2 2026**	**VCU Final Integration (External or Internal V5.0).** Formal launch of the **Risk Agent** and **Simulation Agent**.	**Launch the Brain:** Activates the predictive and simulation capabilities required for the Manufacturing MVP.
Phase 3: Cross-Domain Readiness	**Q3 2026**	**Final Sensor Bridge.** Integration with the **IoT-Action Bridge** (MQTT/WebSockets) to accept **DED machine telemetry** data.	**Physical World Integration:** Moves beyond software to monitor and control industrial/exoskeleton processes.
Phase 4: Marketplace Launch	**Q4 2026**	**Pathway Marketplace API Finalization.** Finalize licensing, delivery, and reporting hooks (Ankush's domain).	**Monetization:** Activates the full royalty and revenue-share model across all verticals.