

TECHNICAL WHITE PAPER

READINESS LEVEL FRAMEWORKS

Aligning Technology and Innovation
Maturity to Reduce R&D Risk and
Improve ROI

MARCH 2026

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Executive Overview

Readiness level frameworks have become indispensable tools for R&D-intensive enterprises seeking to manage the inherently risky journey from scientific discovery to commercial deployment. These frameworks provide a structured, measurable vocabulary for assessing maturity, making go/no-go investment decisions, and aligning diverse stakeholders—from bench scientists to C-suite executives to government funding bodies—around a common understanding of progress.

This white paper provides a comprehensive examination of the two most important readiness frameworks available to innovation-driven organizations. Part I examines Technology Readiness Levels (TRL)—the foundational framework developed by NASA in 1974, standardized through ISO 16290:2013, and adopted globally across government, aerospace, defense, pharmaceutical, automotive, and corporate R&D. A data-driven transition section then examines how TRL’s acknowledged limitations catalyzed the development of multi-dimensional assessment. Part II examines Innovation Readiness Levels (IRL), most prominently the KTH model, which adds customer, business model, intellectual property, team, and funding readiness dimensions.

Each part includes deep analysis of how IP Management solutions integrate with the framework, plus a detailed use case demonstrating how IP.com’s InnovationQ+ and IQ Ideas+ platforms accelerate innovation pipelines while avoiding unnecessary risks and costs. The white paper concludes with a unified argument that regardless of which framework an enterprise adopts, IP.com’s solutions represent an industry standard best practice for responsible, efficient innovation management.

The Central Thesis: Whether you measure readiness through TRL’s nine-level technical maturity scale or IRL’s six-dimensional innovation assessment, intellectual property intelligence is the connective tissue that de-risks investment, protects competitive advantage, and accelerates time-to-market at every stage. IP.com’s solution suite is purpose-built to deliver this intelligence.

PART I

Technology Readiness Levels

The Foundational Framework for Measuring Technical Maturity

Origins and Evolution of the TRL Framework

From NASA to Global Standard

The TRL methodology was originated by Stan Sadin at NASA Headquarters in 1974. Ray Chase at NASA's Jet Propulsion Laboratory was the first to apply it to the proposed Jupiter Orbiter spacecraft. The original framework included seven levels, but by the 1990s, NASA adopted the nine-level scale. In 1995, John C. Mankins published a seminal paper that extended the scale and proposed expanded descriptions for each TRL. The U.S. Air Force adopted TRLs in the 1990s, and in 1999, the U.S. General Accounting Office recommended wider DoD use, finding that immature technology increased overall program risk. The DoD formally endorsed TRLs in 2001, with the most recent TRA Guidebook updated in February 2025.

International Adoption and ISO Standardization

The European Space Agency adopted TRL in the mid-2000s, and the European Commission advised EU-funded projects to adopt it in 2010. TRLs were formally implemented in Horizon 2020 (2014–2020) and Horizon Europe. In 2013, ISO canonized TRL through ISO 16290:2013, “Space systems — Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment.” While primarily applicable to space systems, the definitions are broadly used across sectors.

ISO and Related Standards:

ISO 16290:2013 — Primary TRL standard (space systems, broadly applied)

ISO 56002:2019 — Innovation management systems guidance

ECSS-E-HB-11A — ESA Technology Readiness assessment handbook

IEEE 14741 / ISO 9001 / ISO 31000 — Related technology assessment, quality, and risk management standards

The Nine Technology Readiness Levels

The TRL scale consists of nine distinct levels. The following table provides descriptions alongside IP actions at each stage:

TRL	Stage Name	Description	IP & Innovation Actions
1	Basic Principles Observed	Fundamental scientific principles identified and documented.	Initial prior art landscape search. Invention disclosure capture begins.
2	Technology Concept Formulated	Potential applications identified. Conceptual models developed.	Novelty scoring on early disclosures. Competitive landscape mapping.
3	Experimental Proof of Concept	Active R&D begins. Lab studies validate predictions. First proof of concept.	Patentability assessment. Detailed prior art search. Consider provisional filing.
4	Technology Validated in Lab	Components integrated and tested in lab. Early prototype.	File patent application(s). FTO analysis. Design-around strategy. Portfolio gap analysis.
5	Technology Validated in Relevant Environment	Components tested in simulated operational environment.	Continuation/divisional filings. Competitive patent monitoring. Licensing assessment.
6	Technology Demonstrated in Relevant Environment	Functional prototype tested in high-fidelity simulated conditions.	Comprehensive FTO. Patent portfolio expansion. IP due diligence for partnerships.
7	System Prototype in Operational Environment	Technology tested in actual operational environment.	Final FTO clearance. Defensive publication strategy. IP licensing agreements.
8	System Complete and Qualified	Technology proven in final form under expected conditions.	IP enforcement and monitoring. Competitor patent watch. Trademark filings.
9	Actual System Proven in Operations	Fully deployed, operational, commercially available.	Ongoing portfolio management. IP valuation and ROI. Patent maintenance decisions.

Grouping Convention: TRL 1–3 is the “research” phase, TRL 4–6 the “development” phase, and TRL 7–9 the “deployment” phase. The TRL 3→4 transition is the “valley of death” where many technologies fail.

Adoption Across Organizations and Industries

Government and Military

NASA requires TRL 6+ for flight systems. The DoD uses TRLs throughout its Adaptive Acquisition Framework. The European Commission requires TRL designations for all Horizon Europe funding: RIA targets TRL 4–6, IA targets TRL 6–8. SBIR Phase I targets TRL 1–3, Phase II TRL 4–6.

Aerospace, Defense, and Corporate Innovation

Boeing's processes are structured around TRL milestones, with ~90% of costs accruing at TRL 7+. Lockheed Martin, RTX, Northrop Grumman, and Airbus all use TRL-gated development. The NIH Catalyze program maps IP activities to TRL levels. Intel Capital and Siemens Ventures use Investment Readiness Level scoring alongside TRL. Venture capital firms structure funding rounds by TRL: seed at TRL 2–4, Series A at TRL 4–6, later rounds at TRL 7+.

Complementary Readiness Frameworks

TRL does not exist in isolation. Complementary frameworks include Manufacturing Readiness Level (MRL, 1–10 scale for production capability), Commercial Readiness Level (CRL, market adoption and business model), Investment Readiness Level (team, market, financial, legal/IP readiness), Integration Readiness Level (component-to-system integration), Design Readiness Level (manufacturability), and System Readiness Level (combined TRL + IRL across all system components).

IP Management Within the TRL Framework

Every TRL transition represents not only a technical milestone but a critical IP decision point.

TRL 1–3: Research Phase — Foundation of IP Strategy

The research phase is where Idea Management creates the most leverage. AI-driven novelty scoring—such as IP.com’s patented TVR—automatically scores each invention disclosure against the global prior art landscape. The NIH Catalyze program explicitly requires IP search at TRL 1–2 and provisional patent filing at TRL 3–4, demonstrating that leading institutions recognize IP assessment as integral to TRL progression.

TRL 4–6: Development Phase — IP Protection Intensifies

This is the critical window for FTO analysis. Delaying FTO past TRL 4 significantly increases blocking patent risk when design-around options are more expensive. TRL 4–6 is also the optimal window for building a robust patent portfolio and conducting IP due diligence for partnerships.

TRL 7–9: Deployment Phase — IP as Competitive Moat

Comprehensive final FTO clearance is essential before scale manufacturing. Continuous competitive patent monitoring detects infringers and threats. At TRL 9, the portfolio must be actively managed: maintenance decisions, licensing optimization, and valuation analysis.

Strategic Synthesis: IP as the Backbone of TRL

- 1. Front-Load IP Intelligence.** Prior art searches and novelty scoring at TRL 1–3 prevent costly surprises.
- 2. Use FTO as a Stage Gate.** Formal FTO requirements at TRL 4 and TRL 7 prevent unresolved IP risks.
- 3. Build Portfolio at TRL 4–6.** Treat patent filing as an ongoing development activity, not a one-time event.
- 4. IP Analytics for Portfolio Decisions.** Data-driven decisions on where to invest, pivot, partner, or license.
- 5. Bridge the Valley of Death with IP Value.** Strong IP positions attract investment at the critical TRL 3–6 transition.

IP.com Solutions Mapped to the TRL Framework

IP.com Solution	Primary TRL	Value Delivered
IQ Ideas+	TRL 1–3	Structured invention disclosure capture, workflow management, inventor collaboration.
Technology Vitality Report (TVR)	TRL 1–4	AI-driven, patented novelty scoring. Rapid prioritization and patent-vs-publish decisions.
InnovationQ+ Prior Art Search	TRL 1–9	Comprehensive prior art search across patents, applications, and non-patent literature.
FTO & Patentability Analysis	TRL 3–7	Detailed FTO and patentability assessment. Blocking patent identification and design-around.
Competitive Intelligence	TRL 2–9	Patent landscape analytics, competitor filing trends, citation mapping, technology monitoring.
Patent Analytics & Portfolio Mgmt	TRL 6–9	Portfolio valuation, benchmarking, maintenance optimization, strategic analytics.

TRL Use Case: Aerospace Sensor Program

A Fortune 500 aerospace contractor is developing a next-generation infrared sensor array for satellite-based Earth observation under a DoD contract requiring formal TRL assessments. The R&D team generates ~80 invention disclosures per year.

Without IP.com

Disclosures pile up in email and spreadsheets. IP counsel manually reviews a handful while higher-value disclosures go unexamined. Ad hoc prior art searches produce inconsistent results. No systematic FTO until TRL 6, when a blocking patent is discovered requiring a \$4.2M redesign and 8-month delay. A competitor files on a manufacturing process the team considered novel but never searched.

With IP.com

TRL 1–3: IQ Ideas+ captures all 80 disclosures. TVR scores each within 48 hours. Top 15 prioritized for prosecution, 8 flagged for defensive publication. InnovationQ+ searches at TRL 2 reveal the competitor's manufacturing work 18 months before they file, enabling a pre-emptive provisional application.

TRL 4–6: FTO analysis at TRL 4 identifies the blocking patent two years early. Design-around costs \$380K—avoiding \$4.2M. Competitive monitoring reveals a foreign competitor's patent cluster, informing strategic continuation filings.

TRL 7–9: Final FTO confirms freedom to deploy. Portfolio of 12 granted patents and 6 pending supports a \$28M follow-on contract.

Quantified Impact

Metric	Without IP.com	With IP.com	Impact
Late-stage redesign	\$4.2M	\$380K (early design-around)	\$3.8M saved
Schedule delay	8 months	0 months	8 months recovered
Disclosures evaluated	~12 of 80 (15%)	80 of 80 (100%)	6.7x coverage
Blocking patent found	TRL 6 (late)	TRL 4 (early)	2 years earlier
Competitor filing	Lost opportunity	Pre-empted (provisional filed)	Method secured
Portfolio leverage	Weak (ad hoc)	Strong (12+6 portfolio)	\$28M contract supported

THE BRIDGE

From Technology Readiness to Innovation Readiness

Why TRL Alone Is Not Enough — and How the Field Evolved

The Limits of Technology Readiness

TRL has proven its value over five decades. But as adoption spread, a critical pattern emerged: technically mature technologies were failing—not because of engineering shortcomings, but because of gaps in dimensions TRL was never designed to measure.

The Evidence

- **40–90% of innovation projects fail** to reach commercial success (Cannon & Edmondson, 2005; Rhaiem & Amara, 2021).
- **In 75% of failure cases, the root cause is market misalignment**, not technical inadequacy (UMI Innovation, 2023).
- **Commercial viability explains 39% of innovation success variance** (Chatterjee et al., 2023)—yet TRL has no mechanism for assessing it.
- **54% of innovating organizations struggle** to bridge innovation strategy and business strategy (PwC, 2017).
- **Dedicated transition teams at high-risk TRL handoffs reduce failures ~50%** and shorten transitions ~30% (Bonvillian, 2024, MIT Press).
- **Boeing’s analyses show ~90% of costs accrue at TRL 7+**, meaning late-detected failures are catastrophically expensive.

The Evolution: From TRL to IRL

In 2008, KTH Royal Institute of Technology encountered NASA’s TRL during a Silicon Valley visit. They recognized its power—and its fundamental limitation: it measured only one dimension. By 2013, KTH had developed the six-dimension IRL model, informed by patterns across 400+ innovation projects. Technologies that reached high TRL but neglected IP protection, market validation, or business model development routinely stalled in the “valley of death.” The IRL framework made these imbalances visible—and actionable.

The evolution from TRL to IRL was not a rejection of TRL but an extension. TRL became one of six dimensions within IRL. The KTH model explicitly incorporates the full NASA-derived TRL scale, preserving decades of practice and ISO 16290:2013 while adding the breadth TRL alone could not provide.

The Key Insight: IRL does not replace TRL—it encompasses it. A technology at TRL 7 with IPRL 2 (no IP protection) is heading for a costly surprise. A technology at TRL 6 with CRL 3 (unvalidated market) is building something nobody confirmed they want. IRL makes these risks visible when corrective action is cheapest.

PART II

Innovation Readiness Levels

The Multi-Dimensional Framework for Holistic Innovation Assessment

The Six Dimensions of Innovation Readiness

The KTH IRL model assesses innovation maturity across six interdependent dimensions, each on a 1–9 scale. Differences of more than 2–3 levels between dimensions can become inhibiting to overall progress.

Dimension	Abbreviation	Core Question	Scale
Customer Readiness Level	CRL	Have we confirmed real market need?	1–9
Technology Readiness Level	TRL	Is our solution technically developed?	1–9
Business Model Readiness Level	BRL	Is the business model sustainable?	1–9
IPR Readiness Level	IPRL	Is our IP clarified, protected, managed?	1–9
Team Readiness Level	TMRL	Do we have the right competencies?	1–9
Funding Readiness Level	FRL	Is funding secured for each phase?	1–9

CRL, TRL, BRL, IPRL, TMRL, FRL

CRL measures progression from identifying a user need to achieving broad adoption. TRL mirrors NASA’s scale but is interpreted broadly as solution readiness. BRL assesses business model viability including financial, social, and environmental sustainability. IPRL measures IP protection progression—the dimension most directly relevant to IP.com. TMRL evaluates team competencies, structure, and alignment. FRL assesses funding readiness across all development phases.

The IPR Readiness Level (IPRL): A Deep Dive

The KTH model defines nine specific levels of IP readiness:

IPRL	Stage Description	Key Criteria	IP.com Solutions Engaged
1	Hypothesizing on Possible IPR	Vague ideas about possible patents, software, copyright.	Initial awareness—no active tooling.
2	IPR Identified; Ownership Clarified	IPR forms identified. Ownership clarified and controlled.	IQ Ideas+ captures disclosures, establishes ownership.
3	Detailed Description; Initial Searches	Detailed disclosures. Initial technical field and IPR searches.	InnovationQ+ prior art search. TVR novelty scoring.
4	Patentability Confirmed; Business Relevance	Protection confirmed. Decision on why to protect (business relevance).	Patentability analysis. Competitive landscape mapping.
5	First Filing; Draft IPR Strategy	Draft IPR strategy. First patent application filed.	FTO initiated. Competitive intelligence for filing strategy.
6	IPR Strategy Implemented; Initial FTO	Strategy implemented. Positive response. Initial FTO completed.	Comprehensive FTO. Landscape analytics for positioning.
7	All Relevant IPR Filed; National Phase	All IPR filed. National/regional phase entry.	Competitive monitoring. Portfolio gap analysis.
8	Full IP Management; Complete FTO	Strategy fully managed. Patent granted. Complete FTO. No oppositions.	Full analytics, portfolio management, enforcement monitoring.
9	Strong IPR; Patents Maintained	Strong IPR. Patents granted/maintained in all relevant countries.	Portfolio optimization, competitive intelligence, licensing.

ISO Standards and IRL Alignment

IRL aligns with the ISO 56000 family: ISO 56000:2020 (Fundamentals and Vocabulary), ISO 56001:2024 (Requirements—the certifiable standard that explicitly requires IP management), ISO 56002:2019 (Guidance—the “Support” clause specifically addresses IP infrastructure), ISO 56003:2019 (Innovation Partnerships), and ISO 56004:2019 (Innovation Assessment). ISO 56002 emphasizes that IP management must be “at the service of the organization’s innovation objectives.”

IRL Adoption Across Organizations

KTH Innovation has supported 400+ projects since 2013. Imperial College, DTU, Aalto University, and ETH Zurich have adopted the model. Vinnova (€300M+ annual budget) introduced it across 29 national incubators. Volvo, Ericsson, and Siemens Nordic use it for internal and startup evaluation. The H&M Foundation uses it in the Global Change Award. Over 100 organizations registered within the first week of its Creative Commons release in 2021. The EIC has featured it at summits, and KTH is scheduling an IRL Summit for June 2026.

IP Management as the Engine of Innovation Readiness

Powering the IPRL Dimension

IPRL 1–3 (Foundation): IQ Ideas+ captures structured disclosures. TVR provides automated novelty scoring. InnovationQ+ delivers comprehensive prior art search—exactly what IPRL 3 requires.

IPRL 4–6 (Strategy & Filing): InnovationQ+ patentability analysis confirms protection scope. FTO analysis identifies blocking patents. Competitive intelligence informs filing strategy and business alignment.

IPRL 7–9 (Management & Enforcement): Ongoing patent analytics, portfolio optimization, competitive monitoring, enforcement surveillance, and valuation capabilities support full IP management.

Cross-Cutting Impact Across All Dimensions

IRL Dimension	How IP Intelligence Creates Value
Customer Readiness (CRL)	Patent landscape reveals unmet needs and competitive white space, validating market opportunity.
Technology Readiness (TRL)	Prior art search prevents duplicative R&D. Patent analytics identify technology trends.
Business Model Readiness (BRL)	IP portfolio strength impacts licensing potential, partnership leverage, defensive positioning.
IPR Readiness (IPRL)	Direct impact across all nine levels. IP.com is the primary capability enabler.
Team Readiness (TMRL)	IP tools bridge R&D and legal teams. Automated scoring democratizes IP awareness.
Funding Readiness (FRL)	Strong IP positions provide tangible evidence of value that attracts investment.

IP.com Solutions Mapped to the IRL Framework

IP.com Solution	IRL Dimensions	Levels	Value Delivered
IQ Ideas+	IPRL, CRL, TMRL	1–4	Structured disclosure capture. Bridges R&D and IP teams.
TVR	IPRL, TRL, FRL	2–5	Patented AI novelty scoring. Evidence for funding applications.
InnovationQ+ Prior Art	IPRL, TRL, CRL	2–9	Comprehensive search supporting every IPRL gate.
FTO & Patentability	IPRL, BRL	3–8	Blocking patent identification. Design-around strategy. Filing strategies.
Competitive Intelligence	IPRL, CRL, BRL, FRL	3–9	Landscape analytics, competitor trends, citations. Informs all dimensions.
Portfolio Management	IPRL, BRL, FRL	7–9	Valuation, benchmarking, maintenance optimization.

IRL Use Case: University Spin-Off in Clean Energy Storage

A materials science group has developed a novel solid-state electrolyte for lithium batteries. The TTO uses KTH IRL to assess readiness across all six dimensions.

Initial Assessment (Spider Diagram)

Classic deep-tech imbalance: TRL 4 (lab-validated), but CRL 2, BRL 1, IPRL 1, TMRL 2, FRL 2. The spider diagram makes the imbalance visible—IPRL at 1 means no idea whether the innovation is novel, protectable, or free to operate.

IP.com-Enabled Advancement

Phase 1 — IPRL 1→4 (Months 1–3): IQ Ideas+ captures detailed disclosures. TVR reveals core chemistry is highly novel (92nd percentile) but manufacturing method has prior art overlap. InnovationQ+ identifies 47 relevant patent families. Patentability analysis confirms strong claims for chemistry; manufacturing approach redesigned. Provisional patent filed. IPRL advances from 1 to 4 in three months.

Phase 2 — Multi-Dimensional Advancement (Months 4–9): Competitive intelligence reveals three major manufacturers filing in adjacent spaces but none overlapping the spin-off's chemistry. This advances CRL (validated white space), BRL (identified licensing targets), and FRL (IP valuation data for investor pitch). FTO confirms freedom to operate. PCT application filed. IP portfolio anchors a \$2.4M Series Seed raise.

Phase 3 — Full IRL Advancement (Months 10–18): Competitive monitoring catches a blocking patent application; team files opposition within 9 months. Portfolio management supports EU and Japan filings aligned with licensing targets. By month 18, balanced advancement across all six dimensions.

Quantified Impact

Metric	Without IP.com	With IP.com	Impact
IPRL advancement	12–18 months (manual)	3 months to IPRL 4	4–6x faster
Manufacturing overlap	Discovered at TRL 6	Discovered at IPRL 3	Redesign cost avoided
Competitive white space	Never mapped	Month 2 (47 families)	CRL/BRL accelerated
Venture funding	Delayed/smaller raise	\$2.4M Seed (IP-anchored)	Valuation supported
Competitor blocking patent	Missed	Caught and opposed	Method preserved
IRL dimensions tracked	TRL only	All 6 dimensions	Holistic readiness

CONCLUSION**IP.com: The Industry Standard Best Practice**

Regardless of Framework, IP Intelligence Is the Common Denominator of Innovation Success

Unified Conclusion: IP.com as Industry Standard Best Practice

Two Frameworks, One Imperative

TRL provides the granular, ISO-standardized vocabulary for assessing technical maturity. IRL extends this into a multi-dimensional model addressing the full spectrum of commercial success factors. They differ in scope, adoption, and ISO alignment—but they share one critical commonality: in both frameworks, intellectual property management is not optional. It is essential at every stage of maturation.

The Common Denominator

- **At early stages (TRL 1–3 / IPRL 1–3):** Structured disclosure capture, automated novelty scoring, and initial patentability assessment. Without these, innovations are lost, duplicative R&D is pursued, and filing windows close.
- **At mid-stages (TRL 4–6 / IPRL 4–6):** Comprehensive FTO analysis, competitive intelligence, and strategic portfolio development. Without these, blocking patents are discovered too late and partnership negotiations lack IP leverage.
- **At advanced stages (TRL 7–9 / IPRL 7–9):** Ongoing monitoring, portfolio optimization, enforcement surveillance, and IP-driven analytics. Without these, market entry proceeds with uncharacterized risk.

Why IP.com Should Be Considered Industry Standard Best Practice

1. **Comprehensive Stage Coverage.** IP.com spans the full lifecycle from disclosure capture through portfolio management. No other single platform addresses every TRL and IPRL gate with purpose-built tools.
2. **Patented, AI-Driven Objectivity.** The TVR provides patented novelty scoring that eliminates subjectivity and bottlenecks. The difference between evaluating 15% of disclosures and 100%.
3. **Framework-Agnostic Applicability.** IP.com maps to both TRL and IRL. Organizations using either—or both—benefit from a single platform serving both assessment models.

4. **Measurable Risk Reduction.** This white paper documents: \$3.8M in avoided redesign costs, 8 months recovered schedule, blocking patents found 2 years earlier, \$2.4M venture funding anchored by IP data, and 4–6x faster IPRL advancement.
5. **ISO Standards Alignment.** IP.com supports the IP management requirements of ISO 16290:2013 (TRL), ISO 56001:2024 (Innovation Management Requirements), and ISO 56002:2019 (Innovation Management Guidance).

Recommendations

1. **Adopt a dual-framework approach.** Use TRL for technical depth and IRL for cross-dimensional breadth. Assess all dimensions at every stage gate.
2. **Embed IP.com at every readiness gate.** Novelty scoring at TRL 1–3 / IPRL 1–3. FTO at TRL 4 and 7 / IPRL 5–6. Intelligence and portfolio management at TRL 6–9 / IPRL 7–9.
3. **Treat IPRL as a first-class metric.** IP readiness should be reported alongside technology, customer, and business readiness at every portfolio review.
4. **Use IP intelligence to bridge the valley of death.** Data-characterized IP positions attract investment at the critical TRL 3–6 / IPRL 3–6 transition.
5. **Benchmark against ISO 56001/56002.** Ensure your innovation management system meets international IP management infrastructure requirements. IP.com provides the platform.

The Bottom Line:

TRL asks: “Is this technology mature enough?”

IRL asks: “Is this innovation ready?”

IP.com answers the question that underpins both: “Is the intellectual property identified, protected, and strategically positioned to maximize commercial success?”

The most successful R&D organizations answer all three questions simultaneously at every stage gate. IP.com is how they do it.

Sources: NASA TRL Framework; ISO 16290:2013; ISO 56000:2020; ISO 56001:2024; ISO 56002:2019; DoD TRA Guidebook (Feb 2025); EU Horizon Europe; ESA Technology Readiness Handbooks; KTH Innovation Readiness Level Model and User Guide; Vinnova; NIH Catalyze Program; IEEE P-IRL Framework (2023); University of Cambridge Centre for Technology Management; IP Business Academy; IPRL Research (Voitko & Pasichnyk, 2023);

Cannon & Edmondson (2005); Rhaïem & Amara (2021); Chatterjee et al. (2023); Bonvillian (2024, MIT Press); PwC Innovation Benchmark (2017); and multiple industry publications.