MoE's INNOVATION CELL (GOVERNMENT OF INDIA)

What is a Technology Readiness Levels?

Technology Readiness Levels (TRL) constitute a standardized framework used to assess the maturity of a particular technology.

Originally developed by NASA, the TRL scale provides a common reference for researchers, industry professionals, investors, and policymakers.

TRL 1 **TRL 2** **TRL 3** **TRL 4**

TRL 5 **TRL 6** **TRL 7** **TRL 8** **TRL 9**

It facilitates informed decision-making by clearly indicating a technology's current stage of development, the progress achieved, and the subsequent steps required for advancement toward commercialization.

Importance of TRL:

- **Measures tech maturity** – Clear picture of readiness for deployment.
- **Reduces risk** – Identifies gaps before large investments.
- **Guides funding** – Helps investors and agencies decide support levels.
- **Improves planning** – Aligns R&D with market needs and timelines.
- **Enables communication** – Common language between scientists, businesses, and policymakers.
- **Supports scaling decisions** – Avoids premature commercialization.
- **Tracks progress** – Monitors innovation journey from concept to launch.

Where Ideas Are Born

TRL 1

Basic Principles Observed:
Science is still in the lab. Think theoretical papers, not prototypes.

TRL 2

Technology Concept Formulated:
Ideas take shape — hypotheses, possible applications, research models.

TRL 3

Experimental Proof of Concept
You've tested it somewhere, somehow. Initial results are promising.

These stages are high-risk but high-potential. It's where startups and scientists live.

Development & Validation

TRL 4

Lab Validation
You've built a working model. Think "mini version" of your idea in the lab.

TRL 5

Relevant Environment Validation
Your tech survives outside the lab. A step closer to reality.

TRL 6

Prototype Demonstrated in Relevant Environment
Think field-testing, pilot programs, limited public exposure.

Now, it's not just theory — it's real, and it works (at least in controlled settings).

Demonstration to Deployment

TRL 7

System Prototype in Operational Environment

Almost there — testing your system where it's actually going to be used.

TRL 8

System Complete and Qualified

It's built. It's tested. It works. You've got certifications or approvals.

TRL 9

Actual System Proven in Operational Environment

Final stop. Your tech is now ready for full-scale deployment. Commercialization begins

Making it Market-Ready: TRL 7 to 9 in Action

Characteristics of TRL

TRL 1-9 scale

Measures technology readiness from concept to proven use.

Each level must be completed before advancing

Stepwise progression

Mixed data usage

Incorporates test and validation data.

Provides a clear and standard measure of technology status.

Universal standard

Risk guide

Aids in making informed investment decisions.

Originated at NASA and is now used across many sectors

Widespread adoption

Real tests required

Higher levels necessitate testing in real-world conditions,

Solely measures technical readiness, not market or business aspects

Tech focus

Decision aid

Supports go/no-go decisions and funding allocations

Ready to apply TRL to your projects? Here's how:

- **Assess Current TRL:** Map your tech to the TRL scale to understand its maturity.
- **Plan Next Steps:** Identify gaps (e.g., need more testing? Funding?).
- **Communicate Clearly:** Use TRL to align teams, investors, or clients on progress.
- **Mitigate Risks:** Avoid jumping from TRL 3 to TRL 9 without proper validation.

TRL isn't just for techies. Marketers, investors, and policymakers can use it to make smarter decisions!

This framework helps innovators stay grounded and focused.