# THIRD PARTY EVALUATION OF THE TECHNOLOGY DEVELOPMENT AND INVESTMENT PROMOTION

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**PREPARED BY :**
Dr Pawan K Taneja

INDIAN INSTITUTE OF PUBLIC ADMINISTRATION (IIPA), NEW DELHI

# EXECUTIVE SUMMARY

## ABOUT THE SCHEME

The **Technology Development and Investment Promotion (TDIP)** is a flagship initiative of the **Department of Telecommunications (DoT)** aimed at strengthening India's indigenous telecom innovation ecosystem. The programme brings together five key implementing agencies — **TSDSI, TEPC, TCIL, TCoE India, and C-DOT** — each addressing a distinct part of the innovation lifecycle, from research and standards development to commercialisation and exports.

Primary interventions include establishing 100 5G Use Case Labs across higher education institutions, expanding India's participation in global standards bodies (ITU, 3GPP, oneM2M), promoting Indian telecom products globally through events such as MWC, GITEX, and AfricaCom, and advancing frontier R&D in **quantum-secure communication technologies**. Collectively, TDIP seeks to position India as a **self-reliant and globally competitive telecom hub**, aligned with the visions of **Atmanirbhar Bharat** and **India's 6G Mission**.

## ABOUT THE STUDY

This evaluation of TDIP was conducted to assess its **relevance, effectiveness, efficiency, impact, sustainability, and coherence** during the **15th Finance Commission (FY 2021–26)** period. The study applied a comprehensive methodology combining **financial performance review, institutional analysis, and output–outcome mapping**.

It involved consultations with all implementing agencies — **TSDSI, TEPC, TCIL, TCoE India, and C-DOT** — and field assessments of selected **5G Use Case Labs** to verify on-ground implementation. The evaluation followed **OECD-DAC criteria** and **Government of India's scheme continuation and rationalization guidelines**, providing an evidence-based foundation for policy recommendations under the **16th Finance Commission (FY 2026–31)**.

## FINANCIAL PERFORMANCE (FY 2021–26)

TDIP's expenditure grew steadily from **₹2.96 crore in FY 2021–22** to **₹73.71 crore in FY 2023–24**, reflecting rapid expansion on account of 5G lab initiatives , standard participation and global engagement phases.

- **FY 2024–25** (mid-year actuals: ₹23.58 crore) shows steady disbursement toward 100 Labs rollout, TSDSI global fees, and TEPC's international events.

- The proposed outlay for the **16th Finance Commission (FY 2026–31)** averages **₹37–40 crore per year**, ensuring continuity for key functions such as 5G lab O&M, standardization participation, global branding, and quantum R&D. This financial trajectory demonstrates improved absorption capacity and sets the stage for a leaner, performance-linked continuation phase.

# INSTITUTIONAL PERFORMANCE SUMMARY

The institutional evaluation of the **Technology Development and Investment Promotion (TDIP)** assessed six key entities — **TSDSI, TEPC, TCIL, TCoE India, C-DOT, and the 100 5G Use Case Labs** — using the **OECD-DAC evaluation criteria** of *relevance, effectiveness, efficiency, impact, sustainability,* and *coherence*.

TDIP's institutional ecosystem collectively demonstrates **high strategic relevance** to the **National Digital Communications Policy (NDCP) 2018**, the **Atmanirbhar Bharat mission**, and the **6G Vision framework**, positioning India as a credible player in global telecom innovation.

- **Telecommunications Standards Development Society, India (TSDSI):** TSDSI achieved **high relevance and global influence**, leading India's participation in international standardization platforms (ITU, 3GPP, oneM2M). It successfully hosted **14 international meetings** and enabled a significant surge in Indian contributors (over 1,500 participants by FY25). Continued public support and increased industry co-funding will be key to sustaining this global standards leadership.

- **Telecom Equipment and Services Export Promotion Council (TEPC):** TEPC demonstrated **strong effectiveness** in brand promotion through participation in major global events (MWC, GITEX, AfricaCom, IMC), supporting over **200 startups and MSMEs**. However, **export conversion tracking and deal attribution** remain weak, requiring structured post-event follow-up and measurable outcome KPIs for future funding cycles.

- **Telecommunications Consultants India Limited (TCIL) and the 100 5G Use Case Labs**: 100 5G labs have been successfully set up by TCIL nationwide, forming the core infrastructure of the TDIP as announced in the 2023-24 Union Budget. The nationwide rollout of 100 labs across higher education institutions has created a robust foundation for **skills, R&D, and prototype testing**. While implementation has been timely and multi-vendor diversification achieved, there is a need for **standardized utilization metrics** (student engagement, startup incubation, IP generation) to ensure consistent performance across institutions.

- **Telecom Centres of Excellence (TCoE) India:** TCoE India has played an important role in **ecosystem enablement and outreach**, organizing hackathons, IMC pavilions, innovation challenges, and digital twin pilots. Its activities have significantly expanded TDIP's grassroots reach. Going forward, TCoE must transition from event-driven outputs to a **conversion-driven model**, systematically tracking outcomes such as incubations, pilots, and IP creation through a centralized MIS framework.

- **Centre for Development of Telematics (C-DOT):** C-DOT's contribution lies in **strategic frontier R&D**, particularly in **quantum-secure communication and post-quantum encryption**. Prototypes such as MDI-QKD, SPD, and CPQE have been validated nationally and published internationally (e.g., ITU Kaleidoscope 2024). The next step is to establish **certification pathways (FIPS/CC)** and pilot deployments under the **National Quantum Mission** to transition these innovations into deployable products.

### OVERALL ASSESSMENT

TDIP's institutional network exhibits **strong alignment, moderate-to-high effectiveness, and growing global visibility**. The next phase should focus on upgrading the 5G labs in consonance with upcoming 6G technologies, enhanced participation of Startups / MSME in Telecom Standardization Activities, Augment the C-DOT's Collaborative Research and Innovation Activities strengthening **commercialization linkages, ensuring consistent outcome measurement, and embedding sustainability models** across institutions. With these refinements, TDIP can evolve from a foundational innovation framework into a **globally benchmarked model of telecom R&D, standardization, and export-led growth**.

## KEY STRENGTHS

- Established **100 5G Use Case Labs** as nationwide innovation and learning hubs.
- Strengthened India's **standards diplomacy** through TSDSI and Global collaborations.
- Expanded **export visibility** via TEPC participation in flagship global events.
- Enabled ecosystem-wide engagement through **TCoE India's hackathons and outreach programs**.
- Delivered **quantum-secure communication prototypes** through C-DOT, establishing India's foothold in strategic R&D.

## MAJOR GAPS

- **Underutilization of labs** and limited conversion of prototypes into market-ready products.
- **Overlapping institutional mandates**, leading to diffuse accountability.
- **Delayed fund disbursement** and uneven monitoring mechanisms.
- **Weak commercialization and certification pipelines** for quantum and export-linked technologies.

## CROSS-CUTTING RECOMMENDATIONS

The evaluation of the **Technology Development and Investment Promotion (TDIP)** highlights that while the scheme has achieved considerable success in establishing infrastructure and positioning India in global standards forums, its long-term impact depends on deeper reforms in governance, accountability, commercialization and sustainability.

The following **cross-cutting recommendations** are designed to ensure that TDIP evolves into a **performance-driven, globally benchmarked innovation framework**—linking R&D, standards, and exports into a coherent and measurable ecosystem.

## 1. Clarify and Consolidate Institutional Roles

The evaluation found overlapping mandates among TSDSI, TEPC, TCIL, TCoE India, and C-DOT, which at times dilute accountability and efficiency. The next phase must establish a **clear functional matrix** for each institution:

- **TSDSI**: Lead national and international standards development, represent India in global SDOs (ITU, 3GPP, oneM2M), and drive standards adoption domestically.
- **TEPC**: Focus on export promotion, global branding, and deal-conversion programs for Indian telecom products.
- **TCIL**: Serve as the project management and implementation backbone for labs, testbeds, and infrastructure.
- **TCoE India**: Act as the ecosystem integrator, connecting academia, startups, and industry through hackathons, pilots, and innovation challenges.
- **C-DOT**: Continue leading frontier telecom R&D, especially in **quantum-secure communication**, **post-quantum cryptography**, and **6G** technologies.

Clearly delineating these roles will help eliminate duplication, strengthen accountability, and enable each agency to build **deep domain expertise** aligned with TDIP's strategic objectives.

## 2. Adopt an Outcome-Oriented Results Framework

Currently, TDIP measures outputs (labs established, events held, papers submitted) more consistently than outcomes (startups commercialized, IP licensed, exports realized). The next phase should embed a **SMART-based Results Framework** (Specific, Measurable, Achievable, Relevant, Time-bound) that links funding directly to performance indicators such as:

- Number of **patents filed, licensed, or commercialized**.
- **Startups incubated**, pilots deployed, and products launched from TDIP-supported labs.
- **Standards proposals** submitted and accepted by global bodies.
- **Export volume and deals** facilitated through TEPC-led events.
- **Lab utilization rates**, including students trained, prototypes developed, and startups supported.

This framework should be integrated into a **central MIS dashboard** accessible to DoT, ensuring real-time tracking of progress against targets and creating accountability across institutions.

## 3. Link Funding to Milestones and Verified Deliverables

To improve efficiency and accountability, TDIP should transition from **grant-based allocations** to **milestone-linked disbursements**. Funds should be released in stages tied to tangible deliverables such as:

- Completion of lab commissioning and utilization milestones.
- Demonstrated IP filings, prototypes, or pilot deployments.
- Export or collaboration agreements signed post-event.
- Industry co-funding or PPP partnerships established.

This model would promote **timely fund utilization**, reduce end-year spending pressures, and ensure that every rupee invested delivers measurable outputs and outcomes.

## 4. Establish a Unified Monitoring, Evaluation, and MIS Framework

A robust **Monitoring and Information System (MIS)** is critical for coherence across multiple implementing agencies.
The proposed **"Bharat 5G–Innovation Portal"** should serve as the central digital platform for:

- Tracking **fund disbursement, project progress, and lab performance**.
- Integrating data from TSDSI, TEPC, TCIL, TCoE, and C-DOT for unified analysis.
- Generating quarterly dashboards highlighting key performance metrics, delays, or underutilization.
- Enabling real-time visibility for policymakers and supporting **data-driven decision-making**. Such an integrated digital ecosystem would transform TDIP into a **transparent, accountable, and learning-oriented programme**.

## 5. Strengthen Governance and Institutional Capacity

The governance architecture should be reinforced under DoT, responsible for scheme coordination, performance review, and inter-agency convergence. Capacity-building initiatives must target:

- **Lab personnel and researchers** on project management, IPR handling, and commercialization.
- **Startups and MSMEs** on technology readiness, certification, and market entry.
- **Implementing agencies** on GFR compliance, milestone reporting, and sustainability planning. In addition, **third-party monitoring and independent evaluations** should be institutionalized to provide unbiased feedback and course corrections during implementation.

## 6. Embed Sustainability and Public–Private Partnerships (PPPs)

To ensure long-term viability, TDIP must reduce its reliance on government grants by integrating **PPP-based revenue models**.

- Labs and Centres of Excellence should offer **testing, training, and certification services** on a fee-for-service basis.
- Industry memberships and sponsorships can fund hackathons, challenges, and joint R&D initiatives.
- PPPs with telecom operators, OEMs, and startups can sustain lab O&M and accelerate technology adoption.
  Embedding sustainability clauses into all project approvals will ensure that assets created under TDIP remain operational and impactful beyond the scheme's funding cycle.

## 7. Strengthen Commercialization and Export Pathways

TDIP must move from visibility to verifiable commercial outcomes.

- **TEPC** should adopt an outcome-based funding model tied to measurable export metrics—such as deals signed, leads converted, and markets entered.
- **TCoE India** should own the conversion pipeline from hackathons → incubations → pilots → demonstrations → exports, ensuring seamless progression of innovations.
- **C-DOT** should receive targeted support for **field pilots, certification (FIPS/CC)**, and integration with the **National Quantum Mission**, ensuring India's leadership in quantum-secure communication.

## 8. Foster Convergence Across the Ecosystem

TDIP's strength lies in its ecosystem approach; however, coordination between components must be institutionalized.
A structured **Ecosystem Convergence Framework** should connect:

- Labs and TSDSI for early identification of standards-ready innovations.
- Academic Institutions, Startups and TEPC for international market access and visibility.
- Academia and industry through TCoE-facilitated co-development programs.
- R&D outcomes from C-DOT with national deployment missions.

Such horizontal linkages will ensure that innovations are not siloed but flow seamlessly through the value chain—from ideation and validation to standardization, certification, and global deployment.

# THE WAY FORWARD (FY 2026–31)

As India's telecom ecosystem transitions from 5G adoption to the era of **6G, AI-driven networks, IoT, and quantum-secure communication**, the **Technology Development and Investment Promotion (TDIP)** must evolve from being primarily an infrastructure-building scheme to becoming a **conversion, scaling, and global leadership framework**. The next phase should consolidate the strong foundations laid during the 15th Finance Commission period and expand into future-facing domains that ensure both **national self-reliance** and **global competitiveness**.

The **strategic direction** for TDIP in the 16th Finance Commission period (FY 2026–31) should rest on three pillars — **continuation, scaling and redesign**, each reinforcing the other:

1. **Continuation – Consolidating Achievements and Institutional Momentum:** TDIP's achievements, including 100 5G Use Case Labs, enhanced participation in international standards through TSDSI, and global promotion via TEPC, must be preserved and nurtured. Continuation ensures that institutional capacities built over the past cycle—such as TCIL's implementation experience, TCoE's ecosystem outreach, and C-DOT's R&D expertise—remain functional and productive. This phase should focus on ensuring operational stability of labs, continuity of standards representation, consistent funding for ongoing pilots and quantum projects and promotion of indigenous telecom products.

2. **Scaling – Expanding Scope Beyond 5G and Deepening Industry Integration:** TDIP should scale up to include **6G testbeds**, **Open RAN innovation**, **AI and edge computing for networks**, **satellite communication systems**, and **IoT applications for smart infrastructure, agriculture, and healthcare**. The scheme must also integrate stronger **industry-academia partnerships** to ensure that research translates into deployable use cases. Scaling should emphasize building a **pan-India network of interconnected labs**, leveraging shared resources and promoting collaborative innovation. Furthermore, TDIP should extend its reach globally by facilitating joint R&D and co-development projects with other countries and international research consortiums.

3. **Redesign – Embedding Performance, Sustainability, and Governance Reforms:** The next phase should embed **performance-linked disbursements**, where funds are released against verified milestones such as patents filed, pilots completed, startups incubated, and export conversions achieved. A **unified digital MIS** should be institutionalized to track real-time progress across all implementing entities, ensuring transparency and accountability. TDIP should also transition towards **financial sustainability** through PPPs, membership models, and fee-for-service mechanisms. These models would ensure that labs and Centres of Excellence continue to operate effectively even after the scheme's active funding phase ends.

4. **Global Leadership and Standards Diplomacy:** India's presence in global standardization platforms must be strengthened further. TSDSI should be positioned as a **global hub for 6G standardization and Global South collaboration**, supported by targeted fellowships, expert task forces, support to start-ups in standard participation, and hosting of international study group meetings. By embedding Indian innovations in global frameworks, TDIP can help shape emerging technologies and safeguard India's strategic interests in telecom governance.

5. **Commercialization and Export Acceleration:** Under TEPC and TCoE's combined leadership, TDIP should create **structured Innovation-to-Market (I2M)** and **Export Conversion Frameworks**. This would ensure that technologies developed in labs and startups are systematically incubated, validated, certified, and showcased in global markets. Post-event tracking systems and deal-conversion metrics should become integral to TEPC's funding model, ensuring measurable returns on export promotion grants.

6. **Frontier R&D and Quantum Innovation:** C-DOT's work in quantum-secure communication and post-quantum encryption should evolve into **multi-site field pilots** with telecom operators, defence networks, and critical infrastructure sectors. TDIP should fund the creation of **national certification frameworks (FIPS/CC)** for these technologies and align them with the **National Quantum Mission**, making India a global hub for secure communication R&D. Further, TDIP should also extend support to the CDOT in their Collaborative Research and Innovation Activities program.

7. **Capacity Building and Ecosystem Convergence:** TDIP should strengthen talent pipelines through lab-linked training programs, skill certification modules, and hackathons that transition into funded pilot projects. TCoE India should be institutionalised as the **ecosystem integrator**, bridging the gap between labs, startups, industry, and global outreach platforms such as IMC. Regular innovation summits, startup expos, and academic workshops should become part of an annual TDIP calendar to foster continuity, visibility, and collaboration.

8. **Integrated Five-Pillar Implementation Framework:** To drive synergy and coherence across institutions, TDIP 2.0 should operate through a **five-pillar structure**:

    - **Standards & Global Positioning** – TSDSI leading India's voice in global telecom governance.
    - **Exports & Market Access** – TEPC focusing on conversion of event visibility into tangible trade outcomes.
    - **R&D & Infrastructure** – TCIL and the 100 Labs enabling applied research, skills, and IP creation.
    - **Ecosystem Conversion** – TCoE India ensuring hackathons, pilots, and startups move toward commercialization.
    - **Frontier Technologies & Security** – C-DOT advancing quantum-secure and next-generation telecom systems.

Together, these reforms will help TDIP transition from a **grant-based scheme to a performance-oriented innovation accelerator** — one that integrates R&D, standardization, commercialization, and exports into a unified value chain.

# CONCLUSION

The evaluation confirms that **TDIP is a strategically vital, high-impact programme** that has successfully laid the foundation for India's telecom innovation ecosystem. With sharper institutional clarity, milestone-based funding, robust MIS, certification pathways, and stronger industry partnerships, TDIP can evolve into a **world-**

**class model of innovation governance**—one that transitions India from a **technology adopter to a global telecom technology leader** in the coming decade.