PUNE INTERNATIONAL CENTRE

Designing Courses on Digital Public Infrastructure

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Contributors

- Mr. Dinanath Kholkar
- Ms. Nupur Kulkarni
- Dr. Vivek Bhartiya
- Dr. Rajesh Ingle
- Mr. Gireendra Kasmalkar
- Mr. Parth Lawate
- Mr. Santosh Khare
- Dr. Pradeep Mane

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Editorial Team

Mr. Dinanath Kholkar, Ms. Nupur Kulkarni, Mr. Pradeep Nair, and Mr. Pranav Chandane

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Abbreviations

Organisations/Bodies	
AICTE	All India Council for Technical Education
AISSMS IOIT	All India Shri Shivaji Memorial Society Institute of Information Technology
C-DAC	Centre for Development of Advanced Computing
C4GT	Code for GovTech
EY	Ernst & Young
GSTN	Goods and Services Tax Network
ICRIER	Indian Council for Research on International Economic Relations
IIT	Indian Institute of Technology
KPMG	Klynveld Peat Marwick Goerdeler
MeitY	Ministry of Electronics and Information Technology
MIT-ADT	Maharashtra Institute of Technology Art, Design and Technology University
NACE	National Association of Colleges and Employers
NASSCOM	National Association of Software and Service Companies
NBA	National Board of Accreditation
NIT	National Institute of Technology
NPCI	National Payments Corporation of India
OECD	Organisation for Economic Co-operation and Development
ORF	Observer Research Foundation
TCS	Tata Consultancy Services
UGC	University Grants Commission
UNDP	United Nations Development Programme
WEF	World Economic Forum
Concepts/Terms	
AIML	Artificial Intelligence and Machine Learning
API	Application Programming Interface
ATAL FDP	AICTE Training and Learning Faculty Development Programme
AWS	Amazon Web Services
C	Credits
CO	Course Outcome

CoWIN	COVID-19 Vaccine Intelligence Network
CS	Computer Science
CTARA	Centre for Technology Alternatives for Rural Areas
DaaS	Data as a Service
DEPA	Data Empowerment and Protection Architecture
DID	Decentralized Identifier
DPI	Digital Public Infrastructure
DPG	Digital Public Good
DS	Data Science
eNAM	National Agriculture Market
FPS	Fast Payment System
GCP	Google Cloud Platform
GDPR	General Data Protection Regulation
IT	Information Technology
KYC	Know Your Customer
L	Lecture
MSME	Micro, Small and Medium Enterprises
NEP	National Education Policy
NPTEL	National Programme on Technology Enhanced Learning
ONDC	Open Network for Digital Commerce
OTP	One-Time Password
P	Practical
PIX	Pix Instant Payment System (Brazil)
PO	Programme Outcome
PSD2	Payment Services Directive 2
PSP	Payment Service Provider
RAMP	Raising and Accelerating MSME Performance
SDG	Sustainable Development Goals
T	Tutorial
UPI	Unified Payments Interface
USA	United States of America
ZKP	Zero-Knowledge Proof

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Executive Summary

India leads the Digital Public Infrastructure (DPI) transformation, harnessing platforms such as Aadhaar, the Unified Payments Interface (UPI), and the Open Network for Digital Commerce (ONDC) to transform governance, financial inclusion, and digital services. The G20 Task Force Report on DPI (Department of Economic Affairs, 2024) highlights how India's DPI framework has significantly accelerated economic progress, setting an example for countries worldwide. However, while DPI adoption is growing, there is a major gap in formal education and skill development in this field, leaving professionals unprepared for emerging opportunities.

This policy paper proposes introducing two DPI courses (one mandatory and one elective) for engineering students to address this gap. The courses align with AICTE (All India Council for Technical Education) and NEP (National Education Policy) 2020 objectives and are designed based on insights from the OECD (Organisation for Economic Co-operation and Development) Digital Government Index 2023 (OECD, 2024), which underscores the role of digital governance, and the World Bank DPI Framework (Varma, 2023), which outlines best practices globally. The curriculum will be structured in two levels: a Foundational Mandatory Course for all engineering students and an Advanced Elective Course for Computer Science, Artificial Intelligence, and Data Science students. The foundational course can be further expanded in other fields like management, social sciences, etc.

This initiative aligns with India's Digital Economy Vision, as outlined by MeitY (Ministry of Electronics and Information Technology) and ICRIER (Indian Council for Research on International Economic Relations) (ICRIER, 2025), which estimates that India's digital economy will contribute nearly 20% of national income by 2029-30. The Digital India Mission, launched in 2015 by MeitY, aims to transform India into a digitally empowered society by enhancing connectivity, digital literacy, and e-governance. It drives DPI adoption through initiatives like Aadhaar and UPI, fostering innovation and inclusion. By integrating DPI education, students will be better equipped for emerging careers in fintech, digital governance, and global DPI collaborations, as highlighted during India's G20 Presidency (Department of Economic Affairs, 2024). The curriculum is being developed in collaboration with industry leaders and DPI/DPG experts to ensure relevance and employability.

This paper will eventually serve as a recommendation from Pune International Centre (PIC) to AICTE and other academic bodies, advocating for DPI credit courses. This initiative will cultivate a digitally skilled workforce, ensuring India's continued leadership in the DPI domain. It will also provide momentum to initiatives like RAMP (Raising and Accelerating MSME Performance) by creating an adequate talent pool. A well-informed young generation will be a key contributor to the next generation of DPI and take Digital India global.

Introduction

In today's rapidly evolving digital world, DPI has become a driving force behind economic growth, governance transformation, and financial inclusion. India's Digital Public Infrastructure (DPI) has proven transformative in advancing the nation towards a more inclusive and efficient economic framework. By harnessing digital platforms and technologies, DPI has significantly improved service accessibility and delivered far-reaching benefits across diverse sectors (Ministry of Finance, 2025).

India's success with Aadhaar, UPI, DigiLocker, and ONDC has demonstrated the immense potential of DPI. The G20 Task Force Report on DPI (Department of Economic Affairs, 2024) highlights that in April 2024 alone, India facilitated 13 billion UPI transactions worth $230 billion, while direct benefit transfers have provided banking access to over 500 million individuals.

Despite its widespread adoption, DPI education remains absent from formal engineering curricula. The OECD Digital Government Index 2023 (OECD, 2024) emphasises the need for digital governance education, while the United Nations Development Programme (UNDP) DPI Playbook (UNDP, 2023) stresses the importance of structured skill development to support DPI expansion. To bridge this gap, academic institutions must integrate DPI into engineering education, equipping students with both conceptual knowledge and hands-on expertise in building DPI solutions.

Objectives of the paper are to:

- Propose two structured DPI courses for engineering students under AICTE.
- Define their curriculum framework, covering theoretical foundations, case studies, and hands-on learning.
- Outline an implementation strategy involving industry collaborations, faculty training, and internship opportunities.
- Highlight career prospects for DPI-trained graduates in India and abroad in Digital Public Goods (DPG) built on top of DPI.

This paper, developed by Pune International Centre (PIC) along with Digital India Mission, AICTE, industry leaders, and academic experts, *provides a strategic roadmap for integrating DPI education into engineering programmes*. By taking this step, India can solidify its position as a global leader in DPI innovation while building a future-ready global workforce.

Need for inclusion of Digital Public Infrastructure as a credit course

Bridging the Skill Gap: The World Bank DPI Framework (Varma, 2023) highlights the growing demand for trained professionals to manage and enhance DPI systems. The World Economic Forum (WEF) has highlighted the critical role of digital literacy in modern education and emphasised the need for a strong innovation ecosystem to drive technological advancements and economic growth (Massally, 2022). This course will prepare students for roles in government technology, fintech, and digital governance.

Global DPI Expansion: Countries across Africa, Latin America, and Southeast Asia are exploring India's DPI model (Department of Economic Affairs, 2024). Skilled graduates in this field will have global job opportunities.

Economic and Employment Potential: According to the ICRIER study on India's Digital Economy (ICRIER, 2025), by 2029-30, the digital economy is projected to surpass agriculture and manufacturing in national income contribution. DPI-trained professionals will play a key role in driving this growth and innovating new DPGs through the startup ecosystem.

Alignment with AICTE & NEP 2020: The NEP 2020 policy (ICRIER, 2025) highlights the need for digital skill development and interdisciplinary learning, making DPI an ideal addition to engineering education.

Global Case Studies Supporting DPI Education:

- Estonia's X-Road and Singapore's GovTech models demonstrate how DPI-focused education fosters innovation and strengthens governance (OECD, 2024).
- Brazil's PIX digital payment system, inspired by India's UPI, showcases how DPI training can revolutionise financial inclusion and digital transactions (Varma, 2023).
- Reports from the World Bank and UNDP emphasise that DPI is a crucial enabler for achieving Sustainable Development Goals (SDGs) and economic transformation (UNDP, 2023).

Need for an elective course:

(For Third-Year students in Computer Engineering (CS), Information Technology (IT), Artificial Intelligence and Machine Learning (AIML), Cybersecurity, and Data Science (DS) Undergraduates)

The advanced elective course is designed for third-year students in CS, IT, AIML, Cybersecurity, and DS because, by this stage, they have acquired essential technical skills in areas like programming, data structures, algorithms, and system design through their prior coursework. This foundational knowledge is critical for understanding and applying complex DPI concepts, such as scalable system architectures, data security, and interoperability, which are integral to developing and managing platforms like Aadhaar, UPI, and ONDC. Offering the course as an elective in the third year ensures students in these specialised streams can delve deeper into DPI's technical and practical aspects, preparing them for advanced roles in digital governance, fintech, and global DPI initiatives.

General Course Structure

A. Definition of Credit

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

Table 1. *Definition of Credit*

B. Course Code and Definitions

Course Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits
PO	Programme Outcome
CO	Course Outcome
DPI	Digital Public Infrastructure

Table 2. *Course Code and Definitions*

C. Course Structure

There are two courses that can be offered:

1. Digital Public Infrastructure 101 – A mandatory course for First-Year students across all Engineering branches

2. Digital Public Infrastructure 201 – An elective for Third-Year students in CS, IT, AIML, Cybersecurity, and DS Undergraduates.

Sr. No.	Course Code	Title	L	T	P	C	Pre-requisites
1	DPI101	**Digital Public Infrastructure 101** Overview and Key Concepts	1	1	0	2	None
2	DPI201	**Digital Public Infrastructure 201** Building on India Stack: Hands-On with Digital Public Infrastructure	1	1	2	3	DPI101

Table 3. *Course Details*

Course Objectives

Course DPI101 (For All Engineering Streams)

DPI101 Course Objectives:

1. To provide fundamental knowledge of Digital Public Infrastructure, including its role in governance, digital finance, and public services.
2. To develop awareness about India's DPI ecosystem, including Aadhaar, UPI, ONDC, and Data Empowerment Protection Architecture (DEPA), and their impact on the economy and society.
3. To introduce students to global DPI models, helping them understand the international relevance of India's DPI success.
4. To encourage interdisciplinary learning by integrating concepts from engineering, public policy, and digital governance.
5. To prepare students for employment opportunities in DPI-aligned industries such as digital banking, e-governance, and digital commerce.

Course DPI201 (For CS, AIML, and Data Science Students)

DPI201 Course Objectives:

1. To provide technical expertise in DPI architecture, Application Programming Interfaces (API), and security frameworks, enabling students to build applications on India Stack.
2. To equip students with hands-on skills in DPI implementation, including digital identity management, consent frameworks, and secure data exchange.
3. To foster research and innovation in DPI, encouraging students to work on new-age solutions for digital inclusion, financial technology, and open commerce.
4. To enable students to develop industrial DPI-based solutions, leveraging AI, blockchain, cybersecurity, and technology management principles
5. To build entrepreneurial capabilities in the DPI domain, preparing students to lead DPI startups and contribute to India's global digital expansion.

Programme Outcomes (PO) and Course Outcomes (CO)

Programme Outcomes (PO)

POs are statements that describe what students are expected to know and be able to do upon graduating from the programme. NBA (National Board of Accreditation) has defined the following twelve POs for engineering graduates, aligning with the Graduate Attributes outlined by the Washington Accord. Here, they are reproduced verbatim from the National Board of Accreditation (NBA) standards (NBA, 2012):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Source: NBA's Manual for Accreditation of Undergraduate Engineering Programs, 2012

Figure 1. *Programme Outcomes according to NBA* **(**NBA, 2012)**)**

Course Outcomes (CO) for DPI101:

Students will be able to:

CO1 (Remember & Understand): Explain the fundamental concepts, components, and significance of DPI.

CO2 (Analyse & Evaluate): Examine the role of DPI in governance, financial inclusion, and digital transformation.

CO3 (Apply & Create): Develop DPI-based solutions to address real-world public service challenges, such as digital identity, payments, and open marketplaces.

CO4 (Evaluate & Assess): Assess security, privacy, and ethical concerns in DPI implementation, considering global regulations like GDPR and India's Data Protection Bill.

Articulation Matrix for DPI101

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	3	2	-	-	2	-	2
CO2	2	3	2	2	-	3	3	2	-	2	-	3
CO3	2	3	3	2	3	2	3	2	2	3	2	3
CO4	1	2	2	3	2	3	2	3	-	2	-	2

Table 4. *Articulation Matrix for DPI101*

Course Outcomes (CO) for DPI201:

Students will be able to:

CO1 (Understand & Apply): Demonstrate proficiency in India Stack APIs, including Aadhaar, UPI, DigiLocker, and ONDC, for DPI application development.

CO2 (Apply & Analyse): Implement security and scalability solutions for DPI using AI-based fraud detection, containerisation, and blockchain-based identity verification.

CO3 (Create & Evaluate): Design and deploy DPI-driven platforms, applying concepts like decentralised identity (DID), Open Banking APIs, and consent-based data sharing.

CO4 (Analyse & Evaluate): Perform security testing and threat modelling for DPI infrastructures, simulating real-world cyber threats and applying mitigation strategies.

Articulation Matrix for DPI201

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	2	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	3	-	2	2	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	2	3	3	3	2	3	-	2	2	3

Table 5. *Articulation Matrix for DPI201*

Note: The PO-CO articulation matrices for both courses are designed to align the prescribed syllabus objectives with the established NBA Programme Outcomes, serving as a flexible template that accommodates diverse implementation approaches and associated challenges.

Course Content

Course DPI101 (For All Engineering Streams)

Title: Digital Public Infrastructure (DPI): Overview and Key Concepts

Focus: High-level understanding of DPI concepts, societal impact, and case studies.

Course Description: This course provides a comprehensive overview of Digital Public Infrastructure, its components, and its role in solving societal challenges. The focus is on understanding the design, principles, and societal applications of DPI with minimal technical depth. Case studies of DPI implementations, including Aadhaar, UPI, and ONDC, will be discussed.

Module 1: Introduction to DPI

- Definition and need for DPI.
- Characteristics of DPI: Scalability, interoperability, privacy.
- Global DPI initiatives: Estonia's X-Road, Singapore's GovTech, and India Stack.
- DPI and Sustainable Development Goals (SDGs) – How DPI supports financial inclusion, governance, and digital equity.

Module 2: Key Components of DPI

- Decentralised Identity Management (DID) – Use of blockchain for secure identity verification.
- Digital Identity: Aadhaar as a case study.
- Payment Systems: UPI and its impact on financial inclusion.
- Real-time payment systems – Exploring frameworks beyond UPI, like FedNow (USA), PIX (Brazil), and FPS (UK).
- Data Empowerment: Consent-driven data sharing (DEPA).
- Open Marketplaces: Overview of ONDC and its potential for e-commerce.

Module 3: Societal Impacts of DPI

- Financial inclusion through UPI.
- Transforming governance with digital identity.
- Ethical challenges: Privacy, inclusion, and data security.

- DPI's role in cross-border digital infrastructure – Adoption of India's DPI model by different countries (e.g., Brazil's PIX, Africa's DPI projects).
- Geopolitics and Emerging Markets: Overview of DPI's geopolitical implications (e.g., cyber threats, data sovereignty) and opportunities in emerging markets (e.g., Africa, Southeast Asia).
- DPI as a foundation for innovation and startups – Economics of various components of DPI

Module 4: DPI Governance and Policy

- Overview of data privacy laws (General Data Protection Regulation (GDPR), Indian Data Protection Bill, and UNDP DPI Playbook).
- Principles of Open Banking – UK's Open Banking, Europe's PSD2, and how they compare with UPI & ONDC.
- Principles of open standards vs. proprietary systems.
- Zero-Knowledge Proofs (ZKP) in DPI – Privacy-enhancing cryptographic techniques for data sharing without revealing identity.
- Ensuring inclusion and addressing biases.

Module 5: Case Studies and Applications

- Aadhaar: Digital identity-enabling government schemes.
- UPI: Democratising digital payments.
- ONDC: Decentralised digital marketplaces.
- Smart Contracts & DPI – How Ethereum-based contracts can automate governance and payments.
- International examples: Estonia's X-Road and GovTech Singapore.
- Hands-on API Integration – Exploring Open Banking APIs for personal finance management, lending, and investment tracking.

Institutional Technical Setup

Basic API Demonstration Environment: Postman (Free version) for explaining UPI, Aadhaar, and DigiLocker APIs (without hands-on development).

Course DPI201 (For CS, AIML, and Data Science Students)

Title: Digital Public Infrastructure (DPI) — Building on India Stack: Hands-On with Digital Public Infrastructure

Focus: In-depth understanding of DPI architecture with hands-on experience in building applications on top of India Stack.

Course Description: This course dives deep into the technical components of Digital Public Infrastructure, specifically India Stack, including Aadhaar, UPI, DigiLocker, and DEPA. Students will gain hands-on experience building applications on top of India Stack using open APIs, understanding system architecture, security measures, and scalability challenges. The course will also introduce modern cloud-based deployment models, security risks, and AI-driven fraud detection techniques to enhance students' ability to develop secure and scalable DPI solutions.

Module 1: Introduction to India Stack and DPI

- Core principles: Open standards, modularity, and inclusion.
- Overview of India Stack components: Aadhaar, e-Sign, DigiLocker, UPI, DEPA.
- Use cases: Governance, payments, e-commerce, and data sharing.
- Cloud Infrastructure for DPI – Using AWS, GCP, or Azure for scalable and secure DPI deployment.

Module 2: Aadhaar and Digital Identity

- Architecture and implementation of Aadhaar.
- Authentication mechanisms: One-Time Password (OTP), biometrics, multi-factor authentication.
- Building identity-based systems using Aadhaar APIs.
- Containerisation & Microservices – How Docker & Kubernetes can optimise Aadhaar authentication workflows.

Module 3: UPI: Design and Integration

- UPI architecture: Payment Service Providers (PSPs), banks, and user apps.
- Deep dive into UPI APIs for payments and reconciliation.
- Hands-on: Create a mock UPI-based payment system.
- Load Balancing & High Availability – Designing DPI services to handle millions of transactions per second.

Module 4: DEPA and Data Empowerment

- Consent-driven data sharing: DEPA architecture.
- Secure data access via APIs.
- Hands-on: Build a consent management system for data sharing.
- AI in DPI Security – Using AI-based fraud detection for financial transactions, biometric authentication, and digital KYC.

Module 5: Open Digital Marketplaces (ONDC)

- Role of ONDC in democratising e-commerce.
- API-driven design for cataloguing, inventory, and orders.
- Hands-on: Develop a prototype marketplace application using ONDC principles.

Module 6: Security, Scalability, and Interoperability

- API security: Open Authorisation (OAuth), tokenisation, and encryption.
- Threat Modelling & DPI Attacks – How DPI infrastructures can be hacked (Aadhaar leaks, UPI frauds) and countermeasures.
- Ethical Hacking & DPI – Teaching students to penetration test DPI APIs and simulate security vulnerabilities.
- Scalability strategies for DPI applications.
- Best practices, design concepts, and considerations for developing large-scale implementations covering availability, scalability, reliability, maintainability, and security.
- Interoperability, and Modularity through open standards and protocols.

Hands-On Practical

1. **Aadhaar Integration:**
    - Use Aadhaar APIs to authenticate users and fetch basic demographic data.
    - Simulate identity verification workflows using Kubernetes-based microservices.
2. **Build a UPI-Like Payment System:**
    - Implement basic payment flows with mock bank accounts.
    - Simulate fund transfers and transaction histories using Flask/Django.
    - Implement AI-based fraud detection mechanisms to secure transactions.
3. **Develop a Consent Management System:**
    - Create a system where users can grant/revoke consent for data sharing.
    - Use Python/JavaScript to handle user permissions and audit trails.
4. **Build an ONDC Marketplace Prototype:**
    - Create APIs for listing products, searching, and placing orders.
    - Build a lightweight UI for buyers and sellers to interact with the platform.
5. **Hackathon to build solutions/prototypes by students using India Stack:**
    - Institutes will organise a Hackathon where students will develop secure, scalable DPI applications while testing API security through ethical hacking simulations.

Institutional Technical Setup:

1. Cloud & Infrastructure for DPI Development

- Cloud Subscriptions (AWS/GCP/Azure): Minimum 10-20 cloud instances for DPI application development.
- Containerisation & Microservices: Docker & Kubernetes setup to teach scalability and authentication workflows for Aadhaar and UPI.
- Load Balancing & High Availability: API Gateway (Kong, Apigee, AWS API Gateway) to simulate UPI-scale transaction handling.

2. DPI-Specific API Access & Licensing

- India Stack API Sandbox Access: Institutional registration with NPCI, DigiLocker, Aadhaar API programmes for hands-on experimentation.
- Open Banking API Licenses: Access to PSD2 (Europe), UK Open Banking, Brazil's PIX for comparative study with UPI & ONDC.
- Blockchain & Decentralised Identity: Institutional access to Ethereum testnets (Goerli, Sepolia) for exploring smart contracts and zero-knowledge proofs in DPI.
- DPI as a Packaged Solution (DaaS): CDPI's pre-packaged DPI kits (e.g., digital authentication APIs) for building scalable applications, with institutional support.
- Code for GovTech (C4GT): Access to open-source DPI projects (e.g., Sunbird RC) for hands-on development, with institutional coordination.

3. Security & Ethical Hacking Lab

- DPI Threat Simulation & Ethical Hacking: Hands-on tools like Burp Suite, Metasploit, Wireshark for DPI penetration testing.
- AI-Based Fraud Detection: Platforms like Feedzai, Simility for real-time anomaly detection in financial transactions.

Course Tools

For Both DPI101 and DPI201

1. **General Tools:**
    - OpenID, OAuth, Postman (for API testing), Swagger (API design).
    - GitHub repositories for open-source DPI tools.
    - India Stack sandbox environments (if publicly available).

For DPI201

1. **Programming Platforms:**
    - Python (Flask/Django), Node.js for building backend systems.
    - SQLite/MySQL for lightweight databases.
    - React/HTML for building lightweight UIs.
    - Java, Spring boot, Kafka
    - Code4GovTech
2. **Sandbox Environments:**
    - Aadhaar, UPI, DEPA, and ONDC APIs for prototyping.
    - AWS Educate/Google Cloud for hosting applications.
    - A scaled-down version of India stack (university edition) can also be requested and can be used for training the students.

Implementation Strategy and Assessment

The implementation strategy may consist of, but is not limited to, the following steps:

Phase 1: Course Design & Policy Alignment

Objective: Develop a robust curriculum framework and align it with AICTE regulations.

1. **AICTE & Regulatory Approvals:**
    - AICTE approves the DPI courses and establishes standardised credit-hour requirements (Deloitte, 2023).
    - The course aligns with National Education Policy (NEP) 2020, which emphasises digital skill development (Appaya, 2024).
2. **Curriculum Development & Industry Consultation:**
    - AICTE forms an expert advisory group, including DPI leaders, policymakers, and industry partners such as NPCI (for UPI), ONDC, and MeitY (Deloitte, 2023).
    - Incorporate the case studies from India Stack, and global success models like Estonia's X-Road, and Brazil's PIX into the syllabus (Appaya, 2024).

Phase 2: Pilot Implementation & Faculty Training

Objective: Test the course in select universities and build faculty capacity.

3. **Pilot Programme in Select Institutions:**
    - AICTE launches a DPI pilot course in 10–15 engineering colleges across different states, covering Indian Institutes of Technology (IITs), National Institutes of Technology (NITs), and state universities (Rodgers, 2022).
    - The pilot phase evaluates student engagement, curriculum effectiveness, and faculty feedback (Vignare, 2021).

4. **Faculty Training & Certification:**

- AICTE partners with MeitY, bodies like Centre for Development of Advanced Computing (C-DAC), and National Association of Software and Services Companies (NASSCOM) FutureSkills to provide faculty training workshops (Rodgers, 2022).
- Faculty members obtain certification in DPI concepts through short-term online courses and in-person boot camps (Deloitte, 2023) through All India Council for Technical Education Training and Learning Academy Faculty Development Programme (ATAL FDP)
- Faculty certification alone may not lead to capacity building. It goes beyond participation and also includes assessment systems that evaluate knowledge, pedagogical skill, classroom implementation capacity, and actual learner impact. These aspects get considered during the pilot phase.

Phase 3: Nationwide Rollout & Industry Collaboration

Objective: Expand the DPI course to all AICTE-affiliated institutions and integrate internships.

5. **Full-Scale AICTE Implementation:**

- After successful pilot evaluation, AICTE mandates DPI101 as a mandatory subject across all engineering colleges (Appaya, 2024) and DPI201 as an open elective for Third-Year students of CS, AIML, and DS.
- AICTE releases a "Model Curriculum Document" similar to other elective courses (Fox, n.d.)

6. **Industry-Led Internships & Hiring Pathways:**

- Collaborate with fintech, e-governance, and AI-based DPI startups to provide summer internships (Deloitte, 2023)
- AICTE facilitates job fairs focused on DPI-related careers in partnership with relevant stakeholders like National Payments Corporation of India (NPCI), ONDC, and leading corporations (Appaya, 2024)

Phase 4: Continuous Improvement & Global DPI Leadership

Objective: Keep the course updated and expand DPI education globally.

7. **Annual Course Review & Updates:**

    - AICTE mandates periodic syllabus updates based on industry needs and global DPI trends (Vignare, 2021). Content from platforms like Karmayogi Bharat can be leveraged.
    - Emerging AI-driven DPI models and blockchain-based governance frameworks be incorporated into advanced modules (Deloitte, 2023).

8. **India's Global DPI Expansion & Knowledge Sharing:**

    - The World Bank notes that India's DPI model is being adopted globally, especially in Africa and Southeast Asia (Appaya, 2024).
    - AICTE works with G20 digital initiatives to create a Global DPI Curriculum Exchange Programme for students and researchers (Deloitte, 2023).

Future Possibilities for Expanding DPI Education

Bridging the DPI Learning Gap

To bridge the one-year gap between DPI101 in the first year and DPI201 in the third year, colleges could establish DPI corners or walls with resources and updates. Open-source clubs could also provide a space for students to explore DPI concepts and projects year-round. These initiatives could sustain engagement and skill-building during the discontinuity.

Incorporating Student Feedback as an Implementation Strategy

Colleges could integrate student inputs and feedback into DPI course design and implementation. Gathering perspectives from DPI101 and DPI201 learners could refine content, teaching methods, and practicals to better align with student needs and industry trends. This participatory approach could enhance engagement, ensuring the curriculum evolves dynamically to prepare students effectively for DPI-related opportunities.

Offering DPI as a Minor Course

AICTE could consider introducing Digital Public Infrastructure (DPI) as a minor course option for undergraduate students in engineering institutes under its governance. Similar to how some institutes offer a minor in German Language to enhance students' employability in German companies, a DPI minor would equip engineering students with specialised skills critical to the growing digital economy. This could open doors to career opportunities in sectors like fintech, digital governance, and e-commerce. For instance, the NASSCOM-Arthur D. Little report underscores that DPI innovations, such as UPI and ONDC, are driving significant economic growth, creating a strong demand for professionals skilled in digital infrastructure development (NASSCOM & Arthur D. Little, 2024).

Engineering students with a DPI minor could secure roles in organisations like the National Payments Corporation of India (NPCI) or tech firms building DPI solutions. Furthermore, research indicates that minors enhance employability by providing specialised expertise as a study by the National Association of Colleges and Employers (NACE) found that 82% of employers prioritise candidates with diverse technical skill sets (NACE, 2025). By offering a DPI minor in AICTE-governed institutes, students can gain a competitive edge in a job market increasingly driven by digital infrastructure innovations.

Expanding DPI Education to Other Disciplines and Frameworks

DPI education could extend to fields like management and law to nurture well-rounded professionals. Management students might explore DPI's role in financial inclusion, preparing for leadership in fintech or policy roles. Law students could study DPI's impact on data privacy, equipping them to shape digital regulations. Offering DPI as an elective or certificate course could foster interdisciplinary talent for a digital era, as global discussions highlight the need for diverse skills in digital ecosystems (WEF, 2023). For instance, integrating DPI into courses such as IIT Bombay's CTARA MTech in Technology and Development could enhance its focus on tech-driven rural solutions, leveraging DPI's scalability and inclusion potential.

Extending DPI beyond AICTE to UGC and autonomous institutes could broaden its impact. UGC could integrate DPI into university curricula, while autonomous institutes might pilot innovative DPI modules. This could create graduates ready to contribute to digital public goods, aligning with global DPI adoption trends (WEF, 2023). Such efforts could establish India as a hub for interdisciplinary DPI education.

CBSE could introduce a DPI chapter in Social Science (Economics/Civics) for Class 9 or 10 to spark early interest. Highlighting UPI or Aadhaar's role in governance and inclusion could inspire students to explore DPI further. Integrating contemporary tech topics in schools is gaining traction, making this a promising avenue.

NPTEL could expand DPI courses for Bachelor's students, following IIT Kanpur's 'e-Masters in Smart Governance and Digital Public Infrastructure' (IIT Kanpur, 2024). A foundational course on UPI or ONDC could attract students across fields, boosting employability through accessible learning. NPTEL's growing enrolment reflects demand for such forward-thinking education.

Fostering Industry Collaborations for DPI Skills

Colleges could collaborate with firms like TCS, Wipro, Infosys, and consulting giants (e.g., KPMG, EY, Deloitte, PwC), leveraging their DPI practices for innovations like UPI and ONDC (NASSCOM & Arthur D. Little, 2024). These partnerships could align skill requirements, offer internships, and validate training, enhancing student employability. Connecting academia with industry expertise could prepare a workforce adept at meeting the growing demand for DPI skills.

There are categories in DPI with some matured DPIs like Aadhaar, UPI, FASTag, GSTN, etc., some budding ones like ONDC, Ayushman Bharat Digital Mission, and some having the potential to scale in the next 10-15 years (NASSCOM & Arthur D. Little, 2024). The DPIs are also spread across sectors—from eNAM in agriculture to Swayam, eSanjeevani and BHIM in education, health and financial services, respectively, and many such platforms (NASSCOM & Arthur D. Little, 2024) as shown in Figure 1. Hence, engagements with the industry will also help in matching the evolving nature of DPI space with appropriate skill development.

Figure 2. *Spread of DPI Architecture Across Sectors* **(**From (NASSCOM & Arthur D. Little, 2024)**)**

Engaging Startups via Policy Organisations

Policy recommending organisations like PIC, Observer Research Foundation (ORF), and Pune Public Policy Festival could organise startup-focused engagements to explore DPI opportunities and internships. Connecting students with startups and key stakeholders such as innovators and regulators could foster practical experience and innovation in DPI applications. These initiatives could bridge education and entrepreneurial ecosystems, preparing a workforce to contribute to India's growing DPI startup landscape.

Collaborating with Digital India Mission

AICTE could form a working group with the Digital India Mission to operationalise sandbox access and content sharing for DPI education. This collaboration could streamline access to real-world DPI tools and resources, enhancing hands-on learning. By aligning academic efforts with national digital initiatives, it could ensure students gain practical skills relevant to India's DPI ecosystem.

Roundtable on DPI Course Recommendation Paper

On 21 March 2025, a roundtable convened researchers, students, industry experts, and academics affiliated with PIC to explore the importance of Digital Public Infrastructure (DPI) courses, their syllabi, and feasible strategies for implementation. Participants expressed keen interest in ongoing discussions through future sessions to devise practical approaches. Their objective was to determine effective ways to integrate DPI education into contemporary curricula, with potential expansion into disciplines beyond engineering.

Mr. Dinanath Kholkar, PIC's Research Track Lead for Science, Technology, and National Innovation Ecosystem, underscored that many students remain unaware of India's significant DPI progress. He emphasised the initiative's goal of creating formal courses to foster a thorough understanding of DPI among all students.

Facilitated by Dr. Vivek Bhartiya of TCS, Dr. Rajesh Ingle, formerly Vice Chancellor of Symbiosis Skills and Professional University, and Dr. Pradeep Mane, Principal of AISSMS IOIT, the session provided valuable insights into a proposed syllabus framework. Developed under PIC's advocacy programme, this proposal is intended for submission to regulatory authorities like AICTE.

The dialogue underscored the integration of DPI courses with the National Education Policy (NEP), addressing the difficulties of embedding new subjects within an already demanding academic system. Attendees exchanged insights and strategies to address these hurdles.

A prominent theme was workforce development, with consensus on the importance of continuous learning and skill upgrading to adapt to evolving job market needs. Participants discussed the difficulties of attracting and retaining skilled professionals amid swift technological and economic changes, endorsing training initiatives and partnerships with academic institutions to equip workers for future demands.

Dr. Deepak Shikarpur, Director at Kinetic Communications Ltd., suggested tying educational outcomes to tangible employment incentives, asserting that such measures could enhance engagement and effectiveness. Dr. Madhura Vipra, CEO of Medvolt Tech, stressed the inclusion of critical topics like data security, legal considerations, and a gold data standard in the DPI syllabus.

Mr. Parth Lawate, Co-Founder and Entrepreneur at Tekdi Technologies, queried whether the curriculum should emphasise building DPI systems or utilising existing frameworks. Mr. Navin Kabra, Founder and Entrepreneur of ReliScore.com, advocated concentrating on essential foundational

material for DPI courses, given the field's extensive scope, rather than covering every possible use case. Ms. Rekha Sugandhi, Director at MITADT, expressed apprehension about introducing a new course into India's rigorous educational system, suggesting that DPI be structured as a minor rather than an elective to facilitate its adoption.

The dialogue also examined the impact of global crises, such as the COVID-19 pandemic, citing India's effective use of DPI via platforms like CoWIN as a valuable educational case study.

Glimpses from the Roundtable

Annexure

Experts invited to the roundtable on March 21st, 2025:

S. No.	Organisation/Area of Work	Representative(s)
1	All India Council of Technical Education	Dr. Amit Dutta
2	Centre for Digital Public Infrastructure	Dr. Pramod Verma Vijay Vujjini Tanushka Vaid
3	Institute of Management Development and Research	Dr. Shikha Jain
5	Defence Institute of Advanced Technology	Dr. Sangeeta Kale
5	Institute of Electrical and Electronics Engineers Pune Section	Dr. Rajesh Ingle Harsh Maske Anish Walke
6	College of Engineering Pune	Dr. Sunil Bhirud Dr. Vahida Attar
7	MIT Art, Design and Technology	Dr. Rekha Sugandhi Dr. Prashant Dhotre Dr. Mohit Dubey Dr. Virendra Shete
8	Vishwakarma Institute of Technology	Dr. Vivek Deshpande Dr. Amar Buchade

9	All India Shri Shivaji Memorial Society's Institute of Information Technology	Dr. Pradeep Mane Dr. Chetan Aher
10	Symbiosis International University Symbiosis School of Economics	Dr. Ramakrishnan Raman Dr. Jyoti Chandiramani
11	Indian Institute of Technology Kanpur	Dr. Sanjay Dhande
12	Flame University	Dr. Yugank Goyal
13	Sir Parashurambhau College	Arundhati Agte
14	Tata Consultancy Services Alumni Group FORTESS	Dr. Vivek Bhartiya Sanjay Bhargav Anita Rajan
15	Tata Consultancy Services	Hrishikesh Dhande Ravindra Naik
16	Tekdi Technologies	Parth Lawate Ashwin Date Mandar Wadhavekar
17	MaxxUp Lab	Suniti Nanda
18	ReliScore	Dr. Navin Kabra
19	Flipkart	Dr. Mayur Datar
20	Pentathlon Ventures	Gireendra Kasmalkar
21	Ideas to Impacts Hub	Tushar Shetty
22	IT Consultancy	Santosh Khare

23	MedVolt.AI	Dr. Madhura Vipra
24	Mahratta Chamber of Commerce, Industries, and Agriculture	Amit Paranjape Gauri Kale
25	Pune Public Policy Festival	Dr. Sahil Deo
26	Pune International Centre	Dinanath Kholkar Dr. Deepak Shikarpur Dr. Ajit Ranade Maj. Gen. Nitin Gadkari (Retd.) Prashant Girbane Mahesh Deodhar Dr. Ajay Shah Madhukar Kotwal Abhay Vaidya Nupur Kulkarni Dr. Koena Lahiri Hritika Patil

Note: Certain experts were unable to participate in person and contributed their insights via virtual platforms. Others designated colleagues to represent them at the event.

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