

# DARQ in India: Opportunities, Barriers and Corporate Insights on Disruptive Digital Technologies

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## ABSTRACT

The convergence of Distributed Ledger Technology, Artificial Intelligence, Extended Reality, and Quantum Computing—collectively referred to as DARQ technologies—is significantly transforming global enterprise ecosystems. This study investigates the opportunities, barriers, and corporate perceptions associated with DARQ adoption in India, with a specific focus on organizational readiness, strategic intent, and risk evaluation among corporate executives and white-collar professionals. The research adopts a mixed-method approach, combining quantitative data collected from 320 respondents across key sectors including information technology, banking and financial services, manufacturing, healthcare, and retail, along with qualitative insights from industry professionals. Statistical tools such as descriptive analysis, multiple regression, and structural equation modelling are employed to examine the relationships between perceived usefulness, organizational readiness, environmental support, adoption intention, and threat perception. The findings indicate strong optimism toward Artificial Intelligence and block chain technologies as immediate drivers of operational efficiency and competitive advantage. Perceived usefulness emerges as the most significant determinant of adoption intention, while organizational readiness significantly influences expected breakthrough outcomes. However, threat perception—particularly related to cyber security risks, workforce displacement, and regulatory uncertainty—negatively impacts adoption decisions. Quantum computing is perceived as a long-term strategic technology with limited short-term applicability. The study contributes to the understanding of emerging technology adoption in developing economies and provides practical insights for policymakers and corporate leaders to facilitate sustainable and secure implementation of DARQ technologies in India.

**Keywords:** DARQ Technologies; Artificial Intelligence; Block chain; Technology Adoption; Corporate Perception; Digital Transformation

## INTRODUCTION

The rapid advancement of digital technologies has fundamentally transformed the global economic landscape, giving rise to a new class of converging innovations collectively known as DARQ—Distributed Ledger Technology (DLT), Artificial Intelligence (AI), Extended Reality (XR), and Quantum Computing. These technologies are not only enhancing operational efficiency but are also redefining business models, governance frameworks, and competitive strategies across industries. India, as one of the fastest-growing digital economies, is uniquely positioned to leverage DARQ technologies for sustainable growth and global competitiveness. Government-led initiatives such as Digital India, Start-up India, and national-level AI and quantum missions reflect a strong policy commitment toward technological advancement. Simultaneously, Indian corporations across sectors are increasingly exploring DARQ applications to improve productivity, transparency, and customer engagement. However, the adoption of such transformative technologies is influenced by multiple factors beyond technical feasibility. Corporate executives play a crucial role in shaping adoption decisions through their perceptions of usefulness, organizational readiness, and associated risks. Understanding these perceptions is essential for evaluating the real potential of DARQ technologies in the Indian context.

**Conceptual Framework of DARQ Technologies:** DARQ technologies represent a cluster of interconnected innovations that collectively drive digital transformation.

**Distributed Ledger Technology (Block chain):** Distributed Ledger Technology enables decentralized, secure, and transparent data management systems. Its applications include financial transactions, supply chain tracking, smart contracts, and digital identity systems.

**Artificial Intelligence (AI):** Artificial Intelligence enables machines to simulate human intelligence, supporting automation, predictive analytics, and data-driven decision-making across industries.

**Extended Reality (XR):** Extended Reality encompasses Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), enabling immersive environments for training, simulation, and collaboration.

**Quantum Computing:** Quantum computing leverages quantum-mechanical principles to solve complex problems in areas such as cryptography, optimization, and scientific research. It remains a long-term technological frontier.

## LITERATURE REVIEW

The DARQ framework—comprising Distributed Ledger, AI, Extended Reality, and Quantum Computing—represents the next frontier of digital transformation in India, offering profound opportunities for sectoral evolution in finance, healthcare, and retail through autonomous and immersive systems (Accenture, 2019; Dutta & Bose, 2022). While Indian enterprises are aggressively leveraging AI and DLT to drive immediate ROI and bridge service gaps for underserved populations, the broader adoption of the DARQ ecosystem faces significant systemic barriers, including a specialized talent shortage in quantum algorithms, high infrastructure costs for MSMEs, and a "wait-and-watch" regulatory environment regarding data privacy (Soni, 2019; Bhattacharya, 2022; Vardhan & Gupta, 2023). Current corporate insights suggest a strategy of selective experimentation, where firms prioritize "Quantum-readiness" and AI-driven diagnostics while navigating the digital divide between urban hubs and Tier-2 cities (Bansal, 2019; NASSCOM, 2021). Ultimately, the transition into a post-digital India depends on a concerted effort to align government policy with private sector upskilling to transform these disruptive technologies from experimental pilots into scalable industrial standards.

### Research Gap

The review of existing literature reveals the following gaps:

1. Most studies focus on individual technologies rather than integrated DARQ systems
2. Limited research on executive perception in the Indian context
3. Insufficient empirical studies across multiple sectors
4. Lack of focus on threat perception as a moderating factor

## RESEARCH METHODOLOGY

This chapter outlines the research design, sampling framework, data collection methods, measurement constructs, and analytical techniques used to examine corporate perceptions of DARQ technologies in India. The methodology is designed to ensure reliability, validity, and robustness of the findings.

### Research Design

The study adopts a mixed-method explanatory research design, integrating both quantitative and qualitative approaches.

- The quantitative component focuses on measuring relationships between key variables such as perceived usefulness, organizational readiness, and adoption intention.
- The qualitative component provides supporting insights into executive perspectives, strategic concerns, and sector-specific dynamics.

This design is appropriate as it enables both statistical validation and contextual interpretation of DARQ adoption.

## Population and Sampling Design

**Target Population:** The target population consists of:

- Corporate executives (CIOs, CTOs, Strategy Heads)
- Senior managers and professionals
- White-collar employees involved in technology adoption

**Sectoral Coverage:** The study includes respondents from the following sectors:

- Information Technology (IT & ITES)
- Banking and Financial Services (BFSI)
- Manufacturing
- Healthcare
- Retail and E-commerce

**Sampling Technique:** A stratified purposive sampling method is used to ensure representation across sectors and managerial levels.

## Sample Size

- Total respondents: **320**
- Justification:
  - Suitable for **regression** analysis
  - Adequate for Structural Equation Modelling (SEM)
  - Ensures statistical reliability

## Data Collection Method

### Primary Data

Primary data is collected using a **structured questionnaire**.

- Scale: **5-point Likert Scale**
  - 1 = Strongly Disagree
  - 5 = Strongly Agree

### Questionnaire Design: Survey Structure and Constructs

Section	Construct	Example Statement
A	Executive Awareness (EA)	“I am well-informed about DARQ technologies.”
B	Perceived Usefulness (PU)	“DARQ technologies improve organizational efficiency.”
C	Breakthrough Expectations (BE)	“AI and block chain will transform operations.”
D	Implementation Barriers (IB)	“Skill gaps hinder adoption.”
E	Threat Perception (TP)	“DARQ increases cyber security risks.”
F	Adoption Intention (AI)	“Our organization plans to adopt DARQ technologies.”

## Variables of the Study

### Independent Variables

- Perceived Usefulness (PU)
- Organizational Readiness (OR)
- Environmental Support (ES)
- Executive Awareness (EA)

## Dependent Variables

- Adoption Intention (AI)
- Breakthrough Expectations (BE)
- Threat Perception (TP)

## Hypotheses Development

The study proposes the following hypotheses:

- **H1:** Perceived usefulness positively influences adoption intention
- **H2:** Organizational readiness positively influences breakthrough expectations
- **H3:** Environmental support reduces implementation barriers
- **H4:** Threat perception negatively influences adoption intention
- **H5:** Executive awareness mediates the relationship between perceived usefulness and adoption intention

## Analytical Tools and Techniques

The study employs the following statistical tools:

- Descriptive Statistics – To summarize respondent characteristics
- Multiple Regression Analysis – To test relationships between variables
- Structural Equation Modeling (SEM) – To analyze direct and indirect effects
- Factor Analysis – To validate constructs

## Reliability and Validity Testing

### Reliability

- Measured using **Cronbach's Alpha**
- Acceptable threshold:  $\alpha \geq 0.70$

### Validity

- Kaiser-Meyer-Olkin (KMO) Test:  $\geq 0.6$  indicates sampling adequacy
- Bartlett's Test of Sphericity:  $p < 0.05$  indicates significance
- Convergent Validity:  $AVE \geq 0.5$
- Discriminant Validity: Ensures construct distinction

## Data Analysis Tools

- SPSS – Descriptive and regression analysis
- AMOS / SmartPLS – Structural Equation Modeling
- MS Excel – Data cleaning and preliminary analysis

## Qualitative Component

A subset of 20–30 senior executives is interviewed using a semi-structured format.

## Key Themes:

- Strategic outlook on DARQ
- Sector-specific challenges
- Ethical concerns
- Policy expectations

The qualitative responses are analysed using thematic analysis to support quantitative findings.

Ethical Considerations. The study adheres to strict ethical standards:

- Participation is voluntary
- Informed consent is obtained
- Confidentiality is maintained
- Data is reported in aggregate form
- No sensitive corporate information is disclosed

## RESULTS AND DISCUSSION

This chapter presents the empirical findings of the study and provides a detailed analysis of corporate perceptions regarding DARQ technologies in India. The results are organized into descriptive statistics, reliability and validity tests, regression analysis, and sectoral insights, followed by a comprehensive discussion of key findings.

### Sector-wise Distribution: Sector-wise Distribution of Respondents (N = 320)

Sector	Number of Respondents	Percentage (%)
IT & ITES	82	25.6
Banking & Financial Services	74	23.1
Manufacturing	63	19.7
Healthcare	51	15.9
Retail & E-commerce	50	15.6
<b>Total</b>	<b>320</b>	<b>100</b>

The sample reflects a balanced representation across major sectors, with the IT sector contributing the highest share. This ensures that the findings capture diverse industry perspectives on DARQ adoption.

### Respondent Profile by Designation: Designation-wise Distribution

Designation Level	Percentage (%)
Senior Executives (C-Level)	28
Middle Management	46
Technical Professionals	26
<b>Total</b>	<b>100</b>

The presence of both strategic and operational roles strengthens the reliability of insights, as it captures decision-making as well as implementation perspectives.

### Descriptive Statistics: Descriptive Statistics of Key Constructs

Construct	Mean	Std. Deviation	Interpretation
Executive Awareness (EA)	3.92	0.71	High awareness
Perceived Usefulness (PU)	4.18	0.64	Strong usefulness
Organizational Readiness (OR)	3.41	0.83	Moderate readiness
Environmental Support (ES)	3.28	0.89	Moderate support
Breakthrough Expectations (BE)	4.26	0.59	Very high expectation
Threat Perception (TP)	3.87	0.76	High concern
Adoption Intention (AI)	3.95	0.68	Strong intention

The results indicate strong perceived usefulness and high breakthrough expectations, suggesting optimism toward DARQ technologies. However, moderate organizational readiness and environmental support indicate structural limitations. High threat perception reflects caution among executives.

## Reliability and Validity Analysis

### Reliability Testing: Cronbach's Alpha Values

Construct	Alpha Value
EA	0.82
PU	0.88
OR	0.79
TP	0.84
BE	0.86

All constructs exceed the threshold value of 0.70, confirming internal consistency and reliability of the measurement scales.

### Validity Testing: KMO and Bartlett's Test

Test	Value
KMO Measure	0.84
Bartlett's Test (p-value)	<0.001

The KMO value indicates sampling adequacy, and the significant Bartlett's test confirms that factor analysis is appropriate.

### Regression Analysis:

#### Adoption Intention Model: Regression Results for Adoption Intention

Variable	Beta Coefficient	t-value	Significance
Perceived Usefulness (PU)	0.42	7.84	p < 0.001
Organizational Readiness (OR)	0.29	5.63	p < 0.001
Environmental Support (ES)	0.18	3.91	p < 0.01
Threat Perception (TP)	-0.21	-4.72	p < 0.01
<b>R<sup>2</sup></b>	<b>0.63</b>		
<b>Adjusted R<sup>2</sup></b>	<b>0.61</b>		

Perceived usefulness is the strongest predictor of adoption intention, followed by organizational readiness. Threat perception has a significant negative effect, indicating that higher perceived risks reduce adoption likelihood.

#### Breakthrough Expectation Model: Regression Results for Breakthrough Expectations

Variable	Beta Coefficient	Significance
Adoption Intention	0.51	p < 0.001
Organizational Readiness	0.27	p < 0.01
<b>R<sup>2</sup></b>	<b>0.58</b>	

Organizations with higher adoption intention and readiness are more likely to expect significant technological breakthroughs.

## Sectoral Analysis

### Sector-wise Insights: Sectoral Adoption Insights

Sector	Key Observation
IT & ITES	Highest AI readiness
BFSI	Strong block chain focus; high cyber security concerns
Manufacturing	XR used for training and simulation
Healthcare	AI adoption with regulatory sensitivity
Retail	Moderate adoption across technologies

### Breakthrough Expectations Across DARQ: Technology-wise Breakthrough Areas

Technology	Key Application Area
AI	Predictive analytics & automation
Block chain	Transparent supply chains
XR	Workforce training
Quantum	Advanced financial modelling

### Threat Analysis: Major Threat Perceptions

Threat Factor	Mean Score
Cyber security Risks	4.12
Workforce Displacement	3.95
Regulatory Uncertainty	3.84
Ethical AI Bias	3.77
Quantum Security Risks	3.68

### Structural Equation Modelling (SEM) Results Model Fit Indices:

Index	Value
CFI	0.93
RMSEA	0.05
GFI	0.91

The model demonstrates a good fit, confirming the validity of the conceptual framework. Executive awareness influences adoption indirectly through perceived usefulness, while threat perception moderates' adoption behaviour.

The findings reveal that Indian corporate executives exhibit strong optimism toward DARQ technologies, particularly Artificial Intelligence and block chain, which are perceived as immediate drivers of operational efficiency and innovation. However, this optimism is tempered by moderate organizational readiness and significant threat perception.

Perceived usefulness emerges as the most critical factor influencing adoption, indicating that executives prioritize tangible business benefits over technological novelty. Organizational readiness plays a crucial role in determining both adoption intention and expected outcomes, highlighting the importance of internal capabilities. Threat perception acts as a significant deterrent, suggesting that concerns related to cyber security, workforce displacement, and regulatory uncertainty must be addressed to accelerate adoption. Sectoral variations further indicate that DARQ adoption is context-specific, with different industries prioritizing different technologies based on their operational needs. Overall, the results suggest that while India is well-positioned to adopt DARQ technologies, successful implementation will depend on balancing innovation with risk management and strengthening organizational preparedness.

## CONCLUSION

The study examined corporate executives' perceptions of DARQ technologies—Distributed Ledger Technology, Distributed Ledger Technology, Artificial Intelligence, Extended Reality, and Quantum Computing—in the Indian context. The findings indicate that Indian organizations demonstrate strong awareness and optimism regarding the transformative potential of these technologies. Among the DARQ components, Artificial Intelligence and blockchain emerged as the most impactful in the short term, particularly in areas such as predictive analytics, automation, and transparent supply chain management. Extended Reality is gaining traction in training and simulation, while quantum computing is viewed as a long-term strategic technology with limited immediate applicability. Perceived usefulness was identified as the most significant determinant of adoption intention, indicating that executives are primarily driven by tangible business benefits such as efficiency gains, cost reduction, and competitive advantage. Organizational readiness also plays a crucial role, influencing both adoption intention and expected breakthrough outcomes. However, the study reveals a gap between strategic intent and operational preparedness, as organizations face challenges related to skill shortages, legacy systems, and integration complexities. Threat perception was found to have a significant negative impact on adoption. Concerns related to cyber security risks, workforce displacement, regulatory uncertainty, and ethical issues act as barriers to implementation. This highlights the importance of balancing innovation with risk management in the adoption of DARQ technologies.

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