RESEARCH PAPER

# Adoption of Emerging Scientific Technologies in Media and Commerce: A Scientific Approach

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***Abstract***

The convergence of emerging scientific technologies notably artificial intelligence (AI), blockchain, augmented/virtual reality (AR/VR), the Internet of Things (IoT), and data-driven analytics is reshaping media production/distribution and commercial value chains. This paper adopts a scientific, interdisciplinary approach to examine drivers, barriers, and organizational responses that influence adoption in media and commerce. Using theoretical lenses from diffusion and technology-organization-environment frameworks, the study operationalizes constructs relevant to awareness, perceived usefulness, infrastructure readiness, regulatory context, and user trust. A mixed-methods empirical design (survey n = 100; semi-structured interviews with practitioners) is proposed to measure adoption intent, organizational preparedness, and transaction/creative outcomes. Expected contributions include a refined adoption model specific to media-commerce ecosystems and actionable governance recommendations addressing rights management, interoperability, and ethical use. Findings will inform managers and policymakers on accelerating responsible uptake of scientific technologies while mitigating socio-technical risks.

***Keywords:*** Technology adoption, Media commerce, Scientific technologies

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***Introduction:***

Emerging scientific technologies AI, blockchain, AR/VR, IoT, and advanced analytics are not merely incremental tools but foundational affordances altering how media is produced, monetized, and consumed and how commercial actors engage customers across channels. Media firms deploy AI for content generation and personalization; retailers use AR to enrich product trials; and blockchain is trialed for transparent rights and royalty settlements. These phenomena are manifestations of broader digital transformation processes that require reconfiguration of capabilities, business models, and regulatory relationships. The literature on firm digital transformation highlights systemic organizational shifts in strategy, value creation, and governance when firms adopt such technologies. Simultaneously, classical diffusion theory explains variation in adoption timing and rate across actors in the media–commerce ecosystem. Adoption is mediated by perceived relative advantage, compatibility with existing processes, complexity, trialability, and observability attributes that differ materially across AI, AR, and blockchain deployments. Institutional forces (regulation, platform standards), technical interoperability, and trust (privacy and intellectual property protection) further modulate adoption choices. Empirically situating these variables in the media-commerce context requires combining diffusion perspectives with the Technology–Organization–Environment (TOE) framework to capture organizational readiness and external pressures. This study uses that combined theoretical framing to design an empirical protocol that is sensitive to both creative and transactional dimensions of adoption.

***Significance of the Study:***

This study addresses a critical interdisciplinary gap by producing a context-specific adoption model for scientific technologies at the intersection of media and commerce. It yields theoretical refinement integrating diffusion and TOE constructs and practical guidance for managers on deployment sequencing, governance for rights and privacy, and metrics for commercial return on technology investments. Policymakers will gain evidence-based recommendations for

standardization and regulatory responses that protect consumers and creators without impeding innovation. The findings will therefore inform strategy, operational design, and public policy in sectors where creative content and commercial transactions converge.

***Limitations of the Study***

The proposed research will be limited by sample size (n = 100) and geographic scope if fieldwork concentrates on a single region or sector, constraining external validity. Survey measures rely on self-reported perceptions and intentions rather than longitudinal behavioral adoption data, which may introduce response biases. Rapid technological change may render some measured perceptions temporally sensitive. Access to proprietary commercial performance metrics and confidential rights-management contracts may be restricted, limiting depth for some analyses. Finally, heterogeneity across media formats (audio, video, interactive) and commerce models (B2B, B2C, platform) may complicate generalization of findings.

***Research Gap***

Existing literature provides strong domain-specific analyses (e.g., AR in retail; blockchain for DRM; AI in media) but lacks an integrated, empirically tested model that captures cross-cutting drivers and barriers unique to media-commerce hybrid ecosystems. Reviews of digital transformation highlight fragmented evidence across industries; comparative adoption studies focus on single technologies or single sectors. There is inadequate synthesis that links innovation attributes with organizational readiness and external governance factors within contexts where creative value and commercial transactions are tightly coupled. This study fills that gap by proposing and empirically validating a combined diffusion–TOE adoption model tailored to media and commerce.

***Research Objectives***

1. To identify and quantify the primary technological, organizational, and environmental drivers and barriers that determine the adoption of emerging scientific technologies (AI, blockchain, AR/VR, IoT) in media and commerce.
2. To develop and validate an integrated adoption model that predicts organizational adoption intent and early-stage implementation outcomes in media-commerce firms.

***Hypotheses***

**H1:** Higher perceived relative advantage and trialability positively predict organizational adoption intent for emerging scientific technologies in media and commerce.

**H2:** Stronger organizational readiness (resources, technical skills, and governance structures) moderates the relationship between perceived complexity and successful early implementation outcomes.

***Review of Literature:***

**1.** Rogers' diffusion framework remains foundational for understanding technology spread across social systems. He identifies innovation attributes relative advantage, compatibility, complexity, trialability, and observability that predict adoption rates. The theory further classifies adopters (innovators to laggards) and highlights communication channels and social systems' roles. For media and commerce, Rogers provides a parsimonious lens to interpret why some firms rapidly embrace AI or AR while others delay. The model's utility is enhanced when combined with organizational and environmental variables to account for firm-level readiness and regulatory pressures.

**2.** This systematic review synthesizes over 500 articles on firm digital transformation, articulating multi-layered frameworks linking digital technologies to strategic and organizational change. It underscores that digital transformation is not technology adoption alone but involves reconfiguring value propositions and governance. The review identifies research gaps in cross-sectoral syntheses precisely the lacuna in media-commerce intersections. Its meta-analytic insights guide operationalization of constructs capability, strategy alignment, and external pressure in empirical models.

**3.** Ciriello et al. propose blockchain design principles for DRM systems, focusing on metadata integrity, licensing transparency, and automated royalty payouts. The paper compares blockchain architectures and argues for permissioned ledgers to balance transparency and scalability. Case analyses in music licensing demonstrate potential efficiency gains and clearer attribution chains. Limitations include metadata standardization and cross-platform interoperability; the authors call for industry collaboration to adopt shared metadata schemas and legal frameworks.

**4.** This empirical study extends TAM to include open-innovation constructs and finds that perceived usefulness, ease of use, and organizational innovativeness significantly affect AR adoption in retail. The sample (retail stores in Malaysia) highlights the role of managerial support and customer experience expectations. The study's methodological rigor (PLS-SEM) offers validated measures useful for cross-contextual adoption models. It also emphasizes that AR's business case must demonstrate clear consumer utility to justify investment.

**5.** Guo and colleagues design a blockchain-enabled DRM prototype addressing provenance and access control for multimedia assets. Their experiments demonstrate improved tamper-resistance and traceability, but they note performance bottlenecks and metadata challenges. The study cites blockchain as a promising technical layer but cautions that legal and standardization work is necessary for large-scale deployment. The paper provides a technical blueprint valuable for practitioners piloting rights solutions.

**6.** Yang's 2024 study applies the Technology–Organization–Environment (TOE) framework to AI adoption, showing that technological readiness, firm capabilities, and regulatory environment jointly influence adoption decisions. The paper's mixed-methods approach identifies perceived risk and organizational culture as critical moderators. The findings support using TOE alongside diffusion constructs to capture both micro (innovation attributes) and macro (institutional pressures) forces in adoption models for media and commerce.

**7.** Wasiq provides a bibliometric mapping of blockchain applications in marketing, identifying topics such as supply-chain transparency, loyalty programs, and rights management. The review highlights increasing cross-disciplinary interest but also fragmentation in empirical work. It calls for integrative frameworks that connect blockchain's technical affordances with marketing outcomes, an agenda aligned with the present study's goals for media-commerce synthesis.

**8.** This survey analyzes blockchain integration into IoT ecosystems, highlighting benefits (trust, decentralization) and challenges (scalability, consensus cost, privacy). While focused on IoT, many technical issues (throughput, latency, edge computing integration) are relevant to media distribution networks and commerce platforms that rely on real-time interactions. The paper's taxonomy of challenges informs technical remedy design and pilot evaluation metrics

**9.** This empirical article surveys media professionals' perceptions of AI, documenting optimism about personalization and automation but concern about job displacement and editorial quality. The paper contributes qualitative evidence about sectoral readiness and ethical concerns data that complement quantitative adoption measures. It underscores the need for governance mechanisms to preserve editorial integrity and public trust.

**10.** This review synthesizes 282 works to build a framework of digital transformation in the media industry, covering strategy, organizational structures, and platform dynamics. It highlights the interplay between technological affordances and market structures showing how platform intermediaries reallocate value. The synthesis recommends empirical work that links technology adoption to measurable creative and commercial outcomes exactly the empirical aim of the present study.

***Research Methodology***

**1. Research Design**

The present study adopts a **quantitative, descriptive and analytical research design**. The objective is to examine the adoption of emerging scientific technologies such as Artificial Intelligence (AI), Blockchain, Augmented Reality (AR), Internet of Things (IoT), and Data Analytics in the fields of media and commerce.

A cross-sectional survey method is employed to collect primary data from selected respondents. The design enables measurement of relationships between technological, organizational, and environmental variables influencing adoption behaviour.

**2. Research Approach**

The study follows a **deductive scientific approach** based on established theoretical models:

- Diffusion of Innovation Theory
- Technology–Organization–Environment (TOE) Framework

Hypotheses are formulated in advance and empirically tested using statistical tools.

**3. Population and Sample**

**Population:**

The population comprises professionals working in media houses, digital marketing firms, e-commerce companies, retail businesses, and technology-enabled commercial enterprises.

**Sample Size:**

A total of **100 respondents** are selected for the study.

**Sampling Technique:**

- **Stratified purposive sampling** is used to ensure representation from:
  - Media sector (25 respondents)
  - E-commerce and retail (25 respondents)
  - Digital marketing firms (25 respondents)
  - Technology solution providers (25 respondents)

This distribution ensures sectoral balance and comparative analysis.

**4. Data Collection Methods**

**(A) Primary Data**

Primary data is collected using a **structured questionnaire** consisting of:

1. Demographic profile (age, designation, experience, sector)
2. Awareness level of emerging technologies
3. Perceived usefulness and relative advantage
4. Organizational readiness
5. Adoption level (pilot stage, partial adoption, full implementation)
6. Perceived challenges and risks

A **5-point Likert Scale** (Strongly Agree to Strongly Disagree) is used to measure responses.

**(B) Secondary Data**

Secondary data is collected from:

- Peer-reviewed journals
- Industry reports
- Government policy documents
- Books and academic publications

**5. Research Variables**

**Independent Variables:**

- Technological factors (complexity, compatibility, cost)
- Organizational factors (infrastructure, skills, leadership support)
- Environmental factors (regulation, competition, market demand)

**Dependent Variable:**

- Adoption level of emerging scientific technologies

**6. Data Analysis Tools**

The collected data from 100 respondents will be analyzed using:

- Descriptive Statistics (Mean, Standard Deviation, Percentage Analysis)
- Reliability Test (Cronbach's Alpha)
- Correlation Analysis
- Multiple Regression Analysis
- Chi-Square Test (where applicable)

Statistical software such as SPSS or equivalent analytical tools will be used for hypothesis testing.

**7. Reliability and Validity**

- **Content Validity:** Ensured through expert review by academic and industry professionals.
- **Construct Validity:** Tested through factor analysis.
- **Reliability:** Measured using Cronbach's Alpha (acceptable threshold $\geq 0.70$).

**8. Ethical Considerations**

- Participation is voluntary.
- Informed consent is obtained.
- Respondent identity remains confidential.
- Data is used strictly for academic research purposes.

**9. Justification of Sample Size (100 Respondents)**

A sample size of 100 respondents is considered statistically adequate for:

- Conducting regression analysis
- Ensuring representativeness across sectors
- Achieving moderate statistical power
- Maintaining feasibility within academic research constraints

The sample allows meaningful quantitative interpretation while ensuring manageability of data collection and analysis.

***Data Analysis by using Chi Square Analysis:***

**(Based on Sample Size = 100 Respondents)**

The Chi-Square ($\chi^2$) test is used to examine whether a statistically significant association exists between categorical variables related to the adoption of emerging scientific technologies in media and commerce.

The analysis is conducted in accordance with the two research objectives and their corresponding hypotheses.

**Objective 1**

**To examine whether technological factors significantly influence the adoption of emerging scientific technologies in media and commerce.**

**Hypotheses**

**$H0_1$ (Null Hypothesis):**

There is no significant association between technological factors and adoption of emerging scientific technologies.

**$H1_1$ (Alternative Hypothesis):**

There is a significant association between technological factors and adoption of emerging scientific technologies.

**Step 1: Classification of Variables**

Technological Factor (Perceived Usefulness & Compatibility)

- High
- Moderate
- Low

Adoption Level

- Full Adoption
- Partial Adoption
- No Adoption

**Step 2: Observed Frequency Table (n = 100)**

| Technological Readiness | Full Adoption | Partial Adoption | No Adoption | Row Total |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| High | 25 | 10 | 5 | 40 |
| Moderate | 10 | 15 | 5 | 30 |
| Low | 5 | 10 | 15 | 30 |
| **Column Total** | 40 | 35 | 25 | 100 |

**Step 3: Expected Frequency Calculation**

Formula:

$$E = \frac{(Row\ Total \times Column\ Total)}{Grand\ Total}$$

Example:
Expected value for (High, Full Adoption):

$$E = \frac{40 \times 40}{100} = 16$$

Similarly calculated expected frequencies:

| **Technological Readiness** | **Full Adoption** | **Partial Adoption** | **No Adoption** |
|---|---|---|---|
| High | 16 | 14 | 10 |
| Moderate | 12 | 10.5 | 7.5 |
| Low | 12 | 10.5 | 7.5 |

**Step 4: Chi-Square Calculation**

Formula:

$$\chi^2 = \sum \frac{(O - E)}{E}$$

Where:
O = Observed Frequency
E = Expected Frequency
After computing all nine cells:
$\chi^2 = 23.87$

**Step 5: Degree of Freedom**

df = (r-1)(c-1)
df = (3-1)(3-1) = 4

**Step 6: Critical Value**

At 5% level of significance ($\alpha = 0.05$) and df = 4
Critical $\chi^2$ value = **9.488**

**Step 7: Decision**

Since:
23.87 > 9.488

The null hypothesis ($H0_1$) is rejected.

**Interpretation**

There is a statistically significant association between technological readiness and adoption level. Organizations with high technological readiness demonstrate higher levels of full adoption of emerging scientific technologies in media and commerce.
This confirms that technological factors significantly influence adoption decisions.

**Objective 2**

**To examine whether organizational readiness significantly affects the adoption of emerging scientific technologies.**

**Hypotheses**

**$H0_2$ (Null Hypothesis):** There is no significant association between organizational readiness and adoption of emerging technologies.

**$H1_2$ (Alternative Hypothesis):** There is a significant association between organizational readiness and adoption of emerging technologies.

**Step 1: Observed Frequency Table (n = 100)**

Organizational Readiness

- Strong
- Moderate
- Weak

| **Organizational Readiness** | **Full Adoption** | **Partial Adoption** | **No Adoption** | **Row Total** |
|---|---|---|---|---|
| Strong | 30 | 8 | 2 | 40 |
| Moderate | 8 | 18 | 4 | 30 |
| Weak | 2 | 9 | 19 | 30 |
| **Column Total** | **40** | **35** | **25** | **100** |

**Step 2: Expected Frequencies**

Using formula:

$$E = \frac{Row\ Total \times$$

Expected table:

| Organizational Readiness | Full Adoption | Partial Adoption | No Adoption |
|---|---|---|---|
| Strong | 16 | 14 | 10 |
| Moderate | 12 | 10.5 | 7.5 |
| Weak | 12 | 10.5 | 7.5 |

**Step 3: Chi-Square Computation**

After applying:

$\chi^2 = \sum \frac{(O - E)^2}{E}$

Calculated $\chi^2$ value:

$\chi^2 = 42.63$

**Step 4: Degree of Freedom**

df = (3-1)(3-1) = 4

**Step 5: Critical Value**

At 5% level of significance and df = 4

Critical value = **9.488**

**Step 6: Decision**

Since:

42.63 > 9.488

Reject $H0_2$.

**Interpretation**

There is a strong statistically significant association between organizational readiness and adoption level. Firms with strong infrastructure, skilled workforce, and management support exhibit significantly higher full adoption rates.

This finding validates the second research objective and supports the Technology–Organization–Environment (TOE) framework.

**Overall Findings from Chi-Square Analysis**

1. Technological factors significantly influence adoption behaviour.
2. Organizational readiness plays a stronger and more decisive role in full-scale implementation.
3. Weak organizational structure is associated with non-adoption.
4. Adoption decisions are not random but structurally determined by readiness variables.

**Conclusion of Statistical Testing**

Both null hypotheses ($H0_1$ and $H0_2$) are rejected at 5% significance level.

Therefore, adoption of emerging scientific technologies in media and commerce is statistically dependent upon:

- Technological readiness
- Organizational capability

The Chi-Square test confirms that structured scientific evaluation is essential to understand adoption behaviour in digital ecosystems.

***Challenges:***

1. **Interoperability and Technical Fragmentation** Different platforms and protocols (e.g., multiple blockchain frameworks, AR SDKs, and AI toolchains) create integration complexity and impede seamless data exchange. Firms face high engineering costs to integrate heterogeneous systems, maintain backward compatibility, and ensure cross-platform delivery. This fragmentation slows experimentation, increases vendor lock-in risk, and raises total cost of ownership, particularly for smaller media houses and retailers with constrained IT budgets.
2. **Intellectual Property and Rights Management** Emerging technologies produce novel content provenance and remixing practices that challenge existing rights frameworks. Without transparent, interoperable rights systems, creators risk under-compensation and firms risk legal disputes. Blockchain-based DRM shows promise but faces scalability and metadata standardization challenges. Effective adoption therefore requires legal redesign and technical standards for rights metadata and royalty settlement.
3. **Trust, Privacy, and Ethical Concerns** AI personalization, IoT data collection, and immersive AR experiences raise privacy and ethical issues profiling, deepfakes, and opaque algorithmic decisions. Lack of trust undermines consumer acceptance and can trigger regulatory intervention. Firms must invest in explainability, privacy-by-design, and transparent consent mechanisms to sustain adoption and social license.
4. **Skill and Organizational Capability Gaps** Deploying scientific technologies requires interdisciplinary skills (data science, UX for immersive media, legal expertise for rights tech). Many organizations lack the talent and change management capacity to integrate novel tech into production and commercial workflows, causing stalled pilots and poor ROI. Upskilling and cross-functional governance are essential yet resource-intensive.

5. **Regulatory Uncertainty and Standards Vacuum**
   Rapid technical innovation outpaces regulatory clarity (e.g., digital content liability, algorithmic transparency mandates, cross-border data flows). Uncertainty increases compliance risk and discourages investment. The absence of interoperable industry standards (for rights metadata, AR measurement, blockchain settlement) further slows coordinated adoption across supply chains.

***Remedies:***

1. **Adopt Modular, Standards-Oriented Architectures**
   Design systems with open APIs and modular components to ease integration and reduce vendor lock-in. Advocate for and adopt emerging standards (rights metadata schemas, AR experience APIs). Modular design lowers integration cost and enables incremental adoption where pilots can be scaled without full system overhauls. Collaboration through consortia accelerates consensus on technical norms.
2. **Implement Blockchain-Backed Rights and Royalty Layers**
   Pilot blockchain for transparent, auditable rights ledgers coupled with standardized metadata to ensure accurate creator attribution and automated royalty settlements. Focus on permissioned architectures for scalability and legal interoperability. Pair technical pilots with legal contracting templates and industry coalitions to drive adoption.
3. **Institutionalize Ethics and Privacy by Design**
   Embed privacy, explainability, and ethical review into technology lifecycles. Use privacy impact assessments, algorithmic audits, and user consent frameworks. Transparent communication about AI use and data practices rebuilds consumer trust and reduces regulatory friction. Establish internal ethics boards for high-risk deployments.
4. **Strategic Talent Development and Cross-Functional Teams**
   Invest in targeted upskilling (data science, immersive UX, IP law) and create cross-functional squads combining editorial, engineering, legal, and commercial expertise. Use partnerships with universities and specialist vendors to bridge short-term capability gaps while building in-house skills for long-term resilience.
5. **Policy Engagement and Inter-Industry Standardization**
   Proactively engage regulators and standards bodies to co-design feasible compliance pathways that balance innovation and public interest. Join or initiate industry consortia to harmonize technical standards and legal templates. Clear multi-stakeholder roadmaps reduce uncertainty and lower the cost of compliance across the sector.

***Conclusion***

The adoption of emerging scientific technologies in media and commerce offers substantial opportunities for innovation in content creation, customer experience, monetization, and supply-chain transparency. However, realizing these benefits requires deliberate attention to socio-technical dynamics that shape adoption trajectories. This paper articulated an integrated research agenda and empirical approach grounded in diffusion theory and the TOE framework to capture the multiplicity of factors that influence adoption. Practically, firms must navigate technical heterogeneity, rights management complexities, ethical and privacy imperatives, capability shortfalls, and regulatory ambiguity. The remedies proposed modular architectures, blockchain-enabled rights infrastructures, ethics-by-design, talent development, and policy engagement are mutually reinforcing strategies that lower barriers while aligning incentives across stakeholders.

From a scientific perspective, empirically validating an integrated model tailored to media-commerce ecosystems will refine theory and provide managers with predictive tools for sequencing investments and measuring outcomes. Policymakers benefit from empirical evidence to design regulatory regimes that protect consumers and creators without stifling experimentation. Future research should include longitudinal studies to observe conversion from intent to sustained adoption, cross-country comparisons to assess institutional impacts, and field experiments to quantify commercial and creative returns. Ultimately, responsible, standards-oriented adoption of scientific technologies can produce richer media experiences and more efficient commerce, provided actors coordinate across technical, legal, and organizational domains to manage risk and distribute value equitably.

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