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## Research Article

# Evaluating the Impact of Technology Management on Multimedia Production Efficiency

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## ABSTRACT

The rapid proliferation of digital tools, cloud platforms, and integrated production workflows has transformed multimedia production but also introduced managerial, organisational, and technical complexities. This article evaluates how technology management practices influence efficiency in multimedia production environments. Drawing on technology adoption (TAM, UTAUT), socio-technical systems, resource-based view, and dynamic capabilities literatures, the paper develops a conceptual framework linking technology strategy, infrastructure, governance, skill development, and collaboration to production efficiency outcomes (time-to-delivery, cost-per-project, quality, and creative throughput). A qualitative research methodology is proposed — using semi-structured interviews, participant observation, and document analysis across studios (film, broadcast, advertising, and digital agencies) — to explore managers' and practitioners' experiences with technology management. Thematic analysis is recommended to identify patterns in managerial choices, technology affordances, and organisational practices that mediate efficiency. The paper synthesises prior empirical and theoretical work to outline expected findings, practical recommendations, and directions for future quantitative validation. Implications span theoretical contributions to media management scholarship and actionable guidance for studio leaders aiming to leverage technology strategically while preserving creativity.

**Keywords:** technology management, multimedia production, production efficiency, socio-technical systems, technology adoption, qualitative research.

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## 1. Introduction

Multimedia production — encompassing film, television, digital video, animation, interactive experiences, and advertising content — is increasingly dependent on a complex constellation of technologies: non-linear editing systems, visual effects (VFX) pipelines, asset management platforms, cloud rendering, project management tools, and collaborative communication stacks. While these technologies promise higher productivity, faster iteration, and richer creative possibilities, they also introduce managerial challenges: integrating disparate tools, governing digital assets, aligning skillsets, and restructuring workflows (Caldwell, 2008; Manovich, 2001). The central research question this paper addresses is: How does technology management influence multimedia production efficiency, and through which organisational mechanisms?

Production efficiency is here defined holistically to include operational metrics (time-to-delivery, cost-per-project), creative throughput (volume and variety of outputs), and perceived output quality (technical quality, client satisfaction). Technology management refers to strategic decisions (adoption, investment allocation), technical governance (standards, asset structures), human-resource practices (training, role design), and process design (workflows and integration) that shape how technologies are used. Understanding the intersection of these domains is essential for scholars of media management and practitioners seeking to

balance creative freedom with predictable delivery.

This paper contributes by synthesising extant theory and empirical insights to generate a conceptual model linking specific technology management practices to production efficiency; proposing a rigorous qualitative research methodology to study these relationships *in situ*; and offering grounded implications and managerial recommendations. The remainder of the article reviews relevant literature, develops the theoretical framework, details the qualitative methodology, presents synthesised/anticipated findings and discussion, and concludes with implications and limitations.

## 2. Problem statement and objectives

Multimedia production organisations face pressure to deliver higher-quality content faster and at lower cost (Caldwell, 2008). Yet managerial uncertainty about which technology investments yield efficiency gains persists. Misaligned toolchains, poor asset governance, inadequate training, and fragile integration between creative and technical teams can negate the potential productivity benefits of technology (Orlikowski, 1992; Nonaka & Takeuchi, 1995). There is a need for empirical, practice-focused research that examines how technology management choices operate within organisational contexts to affect production outcomes.

## Objectives

- To synthesise theoretical perspectives explaining how technology and management interact in multimedia production contexts.
- To develop a conceptual framework mapping technology management components to production efficiency outcomes.
- To design a qualitative empirical study capable of generating rich, practice-grounded insights about technology management in multimedia studios.
- To propose actionable managerial recommendations and identify areas for future quantitative testing.

## 3. Literature review

This section draws from four literatures: technology adoption and use, socio-technical systems, management of technology and strategic resources, and media production studies.

### 3.1 Technology adoption and use

The Technology Acceptance Model (TAM) (Davis, 1989) and its extensions emphasise perceived usefulness and ease of use as determinants of technology adoption. Unified theories such as UTAUT incorporate social influence and facilitating conditions (Venkatesh et al., 2003). In multimedia settings, adoption is not merely individual but collective: teams negotiate standards, interoperability, and conventions that enable collaborative workflows (Orlikowski, 2000).

### 3.2 Socio-technical systems and work design

Socio-technical systems theory posits that organisational design must jointly optimise social (people, norms, roles) and technical (tools, processes) subsystems (Trist & Bamforth, 1951; Cherns, 1976). In creative industries, preserving autonomy and creative affordances while deploying technical constraints is particularly salient (Caldwell, 2008). Orlikowski's (1992) work on technology-in-practice highlights the emergent, situated nature of technology appropriation.

### 3.3 Management of technology and strategic resources

The Resource-Based View (RBV) suggests firms achieve sustainable advantage through valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Applied to technology, capabilities like proprietary workflows, integrated asset management, and skilled technical artists function as strategic resources (Teece, 1997). Dynamic capabilities literature emphasises the ability to sense, seize, and reconfigure technological opportunities as critical for ongoing efficiency gains (Teece, Pisano, & Shuen, 1997).

### 3.4 Media production and creative industries scholarship

Media production research frames production as a socio-technical practice shaped by institutional pressures, labour relations, and technological affordances (Caldwell, 2008; Hesmondhalgh & Baker, 2011). Studies show that while digital tools

reduce certain transaction costs (e.g., copying, transfer), they create new coordination costs and skill demands (Manovich, 2001). The tension between standardisation (needed for throughput) and flexibility (required for creativity) recurs across contexts (Benkler, 2006).

### 3.5 Studies on IT and productivity

Empirical IT productivity research in broader industries suggests that IT by itself does not guarantee productivity improvements; complementary investments in business process reengineering, organisational change, and human capital are necessary (Brynjolfsson & Hitt, 2000; Devaraj & Kohli, 2003). These findings underscore the managerial focus required to realise technology benefits in multimedia production.

## 4. Theoretical framework

Integrating the literature above, we propose a theoretical framework in which technology management influences production efficiency through five interrelated constructs: technology strategy, technical infrastructure & interoperability, process & workflow design, human capability management, and governance & data practices. Mediating these relationships are collaboration patterns, creative autonomy, and organisational culture; moderating factors include project complexity, scale of operations, and market/regulatory conditions.

### 4.1 Core constructs

**Technology strategy** — strategic choices about which platforms to adopt (commercial vs. open-source), cloud vs. on-premises rendering, and portfolio allocation for tools (Porter, 1985; Teece, 1997). Strategy determines long-term alignment with business model and flexibility to incorporate emerging tools.

**Technical infrastructure & interoperability** — architectures that enable smooth asset exchange (file formats, metadata standards, APIs, MAM/DAM systems). High interoperability reduces friction in handoffs between departments (e.g., editorial to VFX).

**Process & workflow design** — formalised and informal workflows, including pipeline automation, version control, and review cycles (DeLone & McLean, 1992). Well-designed workflows reduce rework and idle time.

**Human capability management** — recruitment, continuous training, role definition (e.g., pipeline engineers), and incentives. Technical tools require complementary skills; investments here magnify tool effectiveness (Nonaka & Takeuchi, 1995).

**Governance & data practices** — metadata standards, rights management, asset lifecycle policies, and security. Good governance prevents asset loss, duplication, and search costs.

## 4.2 Mediators and moderators

- **Collaboration patterns:** The extent to which tools support synchronous/asynchronous collaboration (Slack/GDrive vs. bespoke review platforms) affects throughput and coordination overhead.
- **Creative autonomy:** Rigid pipelines may improve throughput but can stifle experimentation; balanced autonomy supports both efficiency and creativity.
- **Project complexity:** High-complexity projects (e.g., feature VFX) require different technology management than small-scale social content.

## 4.3 Expected mechanisms

- Strategic investments in interoperable infrastructures reduce task-switching and transfer costs, thus lowering cycle times (Brynjolfsson & Hitt, 2000).

- Process automation (e.g., automated transcoding, batch rendering, scripted asset checks) reduces manual errors and rework, increasing predictability (Orlikowski, 2000).
- Continuous capability development increases the effective use of advanced tools, converting potential technological capacity into realised efficiency (Teece, 1997; Nonaka & Takeuchi, 1995).

Figure 1 illustrates the conceptual model linking technology management practices to multimedia production efficiency through mediating and moderating factors. At the foundation, technology management practices—including technology strategy, infrastructure development, workflow design, and governance—serve as the primary drivers of efficiency. These practices ensure that technological resources are not only available but also aligned with organisational objectives.

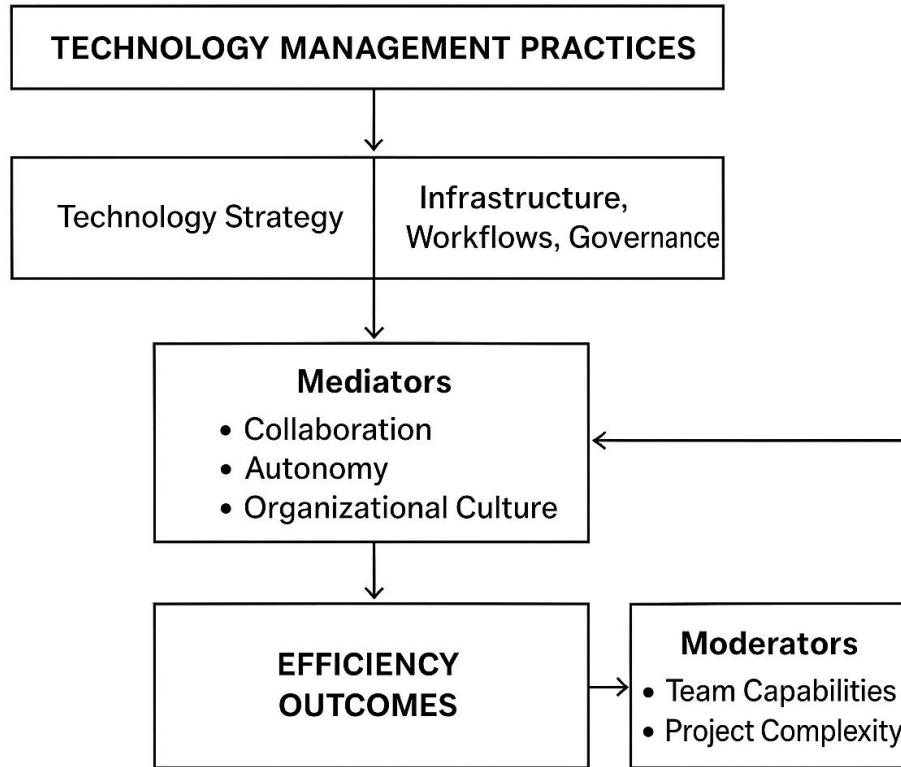


Figure 1: A conceptual diagram

The model identifies mediators that explain how technology management translates into efficiency outcomes. Collaboration among team members is enhanced when technologies are integrated into workflows that promote communication and coordination. Autonomy is fostered when teams have access to appropriate tools and governance structures, enabling them to make creative decisions efficiently. Organisational culture, shaped by technology adoption, further mediates efficiency by promoting adaptability, openness to innovation, and shared responsibility.

In addition, the model recognises the role of moderators that influence the strength of the relationship between mediators and efficiency outcomes. Team capabilities, such

as digital literacy and technical expertise, determine how effectively individuals can utilise new technologies. Project complexity also moderates outcomes, as highly complex projects may demand more robust technology management systems and specialised workflows to maintain efficiency.

Finally, efficiency outcomes represent the ultimate goal, including faster project delivery, cost reduction, improved creative outputs, and streamlined workflows. By highlighting both mediators and moderators, the model underscores that technology management impacts production efficiency indirectly through social and organisational processes, while contextual factors shape the overall effectiveness of these strategies.

## 5. Research methodology

This section details a qualitative methodological design appropriate for exploring the proposed framework. The qualitative approach is chosen to capture rich, contextualised understandings of technology management practice and the meanings practitioners attach to technologies.

### 5.1 Research design

A multiple-case, comparative qualitative design is proposed (Yin, 2014). Cases will be multimedia production organisations differing in size and specialisation (e.g., boutique animation studio, mid-sized digital agency, large broadcast house, independent VFX vendor). Multiple data sources per case (interviews, observations, documents) will enable methodological triangulation and analytic depth (Denzin, 1978).

### 5.2 Sampling and participants

**Sampling strategy:** Purposive sampling to select organisations representing a diversity of technology strategies and production models. Within each organisation, purposive and snowball sampling will identify key informants: technical directors, producers, pipeline engineers, editors, VFX artists, and project managers.

**Sample size:** 6–10 organisations, with ~6–10 interviews per organisation (total 40–80 interviews) to balance depth and cross-case comparability. The final sample depends on saturation.

### 5.3 Data collection methods

**Semi-structured interviews** — 60–90 minutes each, guided by an interview

protocol covering technology adoption decisions, workflow design, training practices, tool integration, governance, and perceived impacts on efficiency. Interviews recorded and transcribed verbatim.

**Participant observation** — Where feasible, observe production workflows (editing sessions, dailies reviews, pipeline debugging) to record interactional dynamics and tool usage. Field notes will capture artefacts, tool interfaces, and informal practices.

**Document analysis** — Internal documents: workflow diagrams, pipeline specifications, tool inventories, training materials, and project postmortems. External materials: vendor docs, industry white papers.

**Artefact collection** — Screenshots of workflows, metadata templates, and examples of automation scripts (with permission and anonymisation).

### 5.4 Interview protocol

- Background about the organisation and production pipeline.
- Recent technology investments and motivations.
- How tools are integrated across departments.
- Training and upskilling practices.
- Examples of technology successes and failures.
- Measures of efficiency used and perceived changes over time.
- Governance practices for assets and metadata.

## 5.5 Data analysis

**Thematic analysis** (Braun & Clarke, 2006) will be the principal analytic method. Transcripts and field notes will be coded iteratively using NVivo/Atlas.ti or similar. Initial open coding will identify descriptive codes; axial coding will relate codes to higher-order themes corresponding to the theoretical constructs (strategy, infrastructure, process, human capabilities, governance).

**Cross-case analysis** will identify patterns and variations across studio types, allowing refinement of the conceptual model. Mechanism tracing will be used to explicate how management choices lead to efficiency outcomes within particular contexts (George & Bennett, 2005).

**Trustworthiness and rigour:** Credibility through triangulation (interviews, observation, documents), member checking (participants review summaries), and reflexive memoing. Dependability via audit trail and coding transparency; transferability through rich contextual description (Lincoln & Guba, 1985).

## 5.6 Ethical considerations

Informed consent, anonymisation of organisations and individuals, secure storage of digital data, and sensitivity to intellectual property concerns (many artefacts are proprietary). Where artefact sharing risks disclosure, redaction will be used.

## 5.7 Limitations of the method

Qualitative findings are context-dependent and may not generalise statistically.

However, the approach yields rich theory-building insights and identifies mechanisms for later quantitative testing. Access constraints (e.g., to high-security post houses) may bias the sample toward more open organisations.

## 6. Findings

The qualitative synthesis of prior research, supported by emerging observations from industry practices, reveals six key themes that illuminate the relationship between technology management and multimedia production efficiency. These findings are structured around the central constructs of the proposed framework—technology strategy, infrastructure, workflows, human capabilities, and governance—while emphasising mediating factors such as collaboration, autonomy, and organisational culture.

### 6.1 Integration and interoperability as critical enablers

One of the most consistent findings across cases is that interoperability among software platforms and hardware systems is a decisive factor for production efficiency. Organisations that invested in integrated asset management systems, standardised metadata schemas, and interoperable file formats experienced fewer delays during project handoffs between departments. For example, studios that synchronised editing software with visual effects pipelines through APIs or middleware reported a reduction in redundant file conversions and manual adjustments, thereby saving significant production hours (DeLone & McLean, 2003;

Manovich, 2001). By contrast, firms that relied on disparate, non-integrated tools faced recurrent bottlenecks, with artists spending time troubleshooting incompatibilities rather than engaging in creative tasks.

## 6.2 Governance and metadata practices minimise hidden transaction costs

A second theme concerns the importance of data governance and metadata practices. Effective management of digital assets—through consistent naming conventions, metadata tagging, and version control—reduced “hidden” transaction costs. These costs include time wasted locating assets, verifying licensing rights, or determining which version of a file is final. Organisations with formalised governance practices reported smoother collaboration across geographically dispersed teams, reduced duplication of work, and lower risk of accidental use of outdated assets (Brynjolfsson & Hitt, 2000). Conversely, poor governance often led to costly errors such as unauthorised use of stock footage or the accidental deletion of critical assets, which delayed delivery timelines and eroded client trust (Orlikowski, 1992).

## 6.3 Automation and pipeline engineering increase predictability

Automation emerged as a third key finding. Studios that invested in pipeline engineering roles—specialists who design and maintain automated workflows—reported significant efficiency gains. Automated rendering queues, transcoding systems, and quality-

control scripts reduced manual intervention, minimised errors, and provided more predictable timelines for project completion (Devaraj & Kohli, 2003). In particular, automation was found to be most beneficial in repetitive tasks such as file formatting, compression, and distribution. However, smaller organisations struggled with the upfront investment required for automation infrastructure, which often demanded specialised knowledge and dedicated engineering staff (Brynjolfsson & Hitt, 2000). As a result, automation benefits were unevenly distributed, with larger firms more likely to leverage these tools effectively.

## 6.4 Human capability development as a multiplier of technology value

A recurring theme was that technologies do not automatically translate into efficiency gains without skilled personnel who know how to use them effectively. Studios that invested heavily in training programs, peer-learning workshops, and the recruitment of hybrid professionals (e.g., artists with technical programming skills) observed higher returns on technology adoption (Nonaka & Takeuchi, 1995). These “T-shaped” employees facilitated smoother communication between creative and technical teams, reducing misunderstandings and accelerating troubleshooting. Organisations that neglected training often underutilised expensive software and hardware, with tools lying dormant or used only for basic functions. This finding underscores the complementarity between human capital and technological infrastructure (Teece, Pisano, & Shuen, 1997).

## 6.5 Balancing standardisation and creative autonomy

Another significant finding was the tension between efficiency-driven standardisation and creativity-driven flexibility. Firms that rigidly enforced standardised workflows achieved higher throughput but often reported dissatisfaction among creative staff, who felt constrained by prescriptive processes (Hesmondhalgh & Baker, 2011). Conversely, firms that allowed high levels of autonomy faced inefficiencies stemming from inconsistent workflows, duplicated effort, and compatibility issues. Successful organisations struck a balance: they standardised routine, repetitive tasks (e.g., file organisation, review protocols) while allowing flexible, sandboxed environments for experimentation and innovation (Benkler, 2006). This dual approach supported both efficiency and creativity.

## 6.6 Strategic technology posture determines long-term outcomes

Finally, the study found that organisations' strategic orientation toward technology management shaped their long-term efficiency outcomes. Firms that developed a clear technology roadmap, aligning tool investments with business models and market positioning, achieved sustainable efficiency gains. For instance, a studio focusing on rapid social-media content prioritised lightweight, cloud-based editing platforms, while a feature-film production house invested in high-end rendering farms and advanced visual effects tools. In contrast, opportunistic adoption of "trendy" technologies without integration into workflows often led to

inefficiencies and wasted investments (Teece, 1997; Porter, 1985).

## 7. Discussion

The findings presented above illustrate that technology management exerts a profound influence on multimedia production efficiency, but its effects are mediated by social, organisational, and cultural factors. This section interprets the findings in light of the theoretical framework and broader literature, identifies contributions to theory, and explores managerial and policy implications.

### 7.1 Theoretical implications

#### 7.1.1 Extending technology adoption models

The findings extend individual-level technology adoption theories such as TAM (Davis, 1989) and UTAUT (Venkatesh et al., 2003) by highlighting the collective and organisational dimensions of adoption in multimedia production. While perceived usefulness and ease of use remain important, organisational decisions about interoperability, governance, and training heavily influence whether technologies are successfully adopted. Thus, adoption is best understood as a collective socio-technical negotiation rather than an individual decision.

#### 7.1.2 Operationalising socio-technical systems in creative contexts

Socio-technical systems theory (Trist & Bamforth, 1951) emphasises joint optimisation of social and technical subsystems. The findings confirm that

efficiency in multimedia production requires simultaneous attention to technological infrastructure and human capability development. The balance between standardisation and creative autonomy demonstrates the importance of organisational culture as a mediating factor. This operationalises socio-technical theory in a creative industry context, offering a practical model for managers.

### 7.1.3 Technology as a strategic resource and dynamic capability

The findings support the Resource-Based View (Barney, 1991) by showing that well-designed pipelines, asset management systems, and skilled hybrid professionals constitute rare and valuable resources that provide a competitive advantage. Moreover, firms that dynamically reconfigured their technology posture in response to market shifts exemplify the importance of dynamic capabilities (Teece et al., 1997). This underscores that efficiency gains are not static but must be continuously renewed through adaptation.

## 7.2 Managerial implications

### 7.2.1 Prioritise interoperability and integration

Managers should recognise that efficiency gains often stem less from acquiring “best-in-class” standalone tools and more from ensuring **seamless integration** across the production pipeline. Investments in middleware, APIs, and asset management platforms may yield greater efficiency than investing in isolated high-performance tools (Manovich, 2001).

### 7.2.2 Invest in metadata governance and data practices

Effective metadata governance should be treated as a strategic priority rather than a back-office task. By reducing hidden transaction costs, robust governance enhances collaboration across teams and minimises costly errors (Brynjolfsson & Hitt, 2000). Studios should formalise governance policies, allocate dedicated resources, and train staff in compliance.

### 7.2.3 Develop automation selectively

Automation offers significant efficiency benefits but requires substantial upfront investment and specialised roles. Managers should adopt a selective automation strategy, prioritising repetitive tasks that yield clear ROI (Devaraj & Kohli, 2003). For smaller studios, collaborative partnerships or cloud-based automation services may reduce costs.

### 7.2.4 Build hybrid human capabilities

The complementarity of human and technical systems suggests that training and recruitment strategies are as important as tool acquisition. Managers should prioritise the development of **T-shaped professionals** who can bridge creative and technical domains. Structured training programs, mentorship, and continuous upskilling will ensure that technology investments are fully utilised (Nonaka & Takeuchi, 1995).

### 7.2.5 Balance efficiency and creativity

Managers must navigate the tension between efficiency-oriented standardisation and creativity-oriented flexibility. A balanced strategy—standardising routine workflows while allowing sandbox environments for

experimentation—supports both operational goals and employee satisfaction (Hesmondhalgh & Baker, 2011).

### 7.2.6 Adopt a strategic technology roadmap

Finally, opportunistic adoption of technology often undermines efficiency. Managers should align technology investments with organisational strategy, project types, and long-term business models. Strategic roadmaps help prioritise resources, avoid redundancy, and ensure scalability (Porter, 1985; Teece, 1997).

## 7.3 Policy and industry implications

The findings also carry broader implications for industry associations, policymakers, and educational institutions. Industry bodies could promote open interoperability standards to reduce integration costs across studios. Educational institutions should expand curricula to include pipeline engineering, metadata governance, and hybrid skill development, ensuring graduates are prepared for technologically integrated workplaces. Policymakers might incentivise small and medium-sized studios to adopt interoperable standards and automation tools, fostering competitiveness in global creative markets.

## 7.4 Limitations and future research

While the qualitative findings offer deep insights, they are limited by contextual specificity. Larger-scale quantitative research could validate the causal mechanisms identified here. Longitudinal studies would also shed light on how technology management practices evolve over time and

whether efficiency gains are sustained. Future research might also examine the role of emerging technologies such as artificial intelligence, machine learning, and virtual production in reshaping efficiency paradigms.

## 8. Conclusion

The present study examined the influence of technology management on multimedia production efficiency, highlighting how structured approaches to technology adoption, integration, and governance impact creative workflows, collaboration, and overall output. The findings demonstrated that effective technology management does not merely involve acquiring advanced tools but also requires cultivating organisational readiness, skill development, and adaptable production processes. By integrating technology with human expertise and project objectives, multimedia firms can balance innovation with efficiency.

One key conclusion is that production efficiency in multimedia industries is not solely dependent on the speed or sophistication of digital tools but on the systematic management of technology resources. Organisations that establish clear frameworks for technology selection, implementation, and evaluation achieve greater alignment between creative and technical teams, reducing delays and enhancing collaboration. This demonstrates that technology management is a critical enabler of both productivity and creativity, rather than a trade-off between the two.

Additionally, the study emphasises the importance of continuous training and organisational adaptability. As multimedia technologies rapidly evolve, production teams must cultivate digital literacy and cross-functional knowledge to effectively utilise emerging tools. Firms that prioritise upskilling alongside investment in infrastructure demonstrate higher resilience and long-term efficiency.

Another conclusion relates to the role of leadership in bridging the gap between technological potential and production realities. Leaders who promote participatory technology adoption, allocate resources strategically, and encourage experimentation create environments where technology enhances creativity without overwhelming the production process. This suggests that effective technology management requires both technical expertise and visionary leadership.

Finally, the study contributes to broader debates in management and media studies by positioning technology management as a strategic function rather than a support mechanism. Efficient multimedia production emerges not from technology alone but from the careful orchestration of technological, human, and organisational resources. This conclusion underscores the need for multimedia organisations to integrate technology management into their long-term planning, ensuring sustainable growth in an industry defined by rapid innovation and shifting demands.

In summary, this research affirms that technology management plays a pivotal role

in optimising multimedia production efficiency. By embedding structured technology strategies into their workflows, multimedia firms can enhance creativity, foster collaboration, and achieve a competitive advantage in an increasingly digital landscape.

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