A Preliminary Analysis of the Intelligent Transformation Path of Television Technology (Postprint)

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Abstract

Each era's media social landscape bears distinct technological imprints, with technological advancements serving as a tremendous driving force for media transformation—from papermaking and movable type printing to steam technology, electronic technology, and today's internet and mobile internet technologies. As television media, when we calmly and rationally confront the media impact brought by technological innovation, and when we face the era trend of ubiquitous connectivity, ubiquitous networks, and ubiquitous screens, we cannot help but ponder: Where is television technology heading in the future? Smart transformation may be the foremost possibility for the future.

Full Text

On the Path to Intelligent Transformation of Television Technology

Abstract: Every era's media landscape bears distinct technological imprints. From papermaking, movable type printing, steam technology, and electronic technology to today's internet and mobile internet technologies, media transformations have been powerfully driven by technological forces. As television media practitioners, when we calmly and rationally confront the media impact brought by technological innovation, we must also consider the question that arises from facing the ubiquitous trends of connectivity, networks, and screens: Where lies the future of television technology?

Intelligent transformation may be the primary possibility for the future.

Keywords: television technology; intelligent; transformation

1. Will Disruptive Technologies Emerge Within Television?

The concept of disruptive technology was first proposed by Harvard Business School Professor C. Christensen in 1997. In his paper "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail," he categorized technologies as either incremental or disruptive. Some technologies "typically enter from low-end or fringe markets, characterized by simplicity, convenience, and low cost in their initial stages. Through continuous improvement in performance and functionality, they eventually replace existing technologies, create new markets, and establish new value systems"—these are disruptive technologies. Subsequently, the United States began holding annual Disruptive Technology conferences in 2004, and in 2005, the U.S. Defense Research and Engineering Agency published "Disruptive Technology: The Uncertain Future," elevating disruptive technology to a strategic level. Since then, disruptive technology has become the next sought-after breakthrough across industries.

During this critical period of media iteration and upgrading, television also hopes to generate new chemical reactions through integration with internet technology and achieve renewal. However, this involves two core questions: First, the question posed by Polish poet Miłosz regarding "captive minds"—will television itself produce disruptive technology? Second, the question raised by Hemingway's "The Killers"—the bottleneck for disruptive technology does not lie in the technology itself, but rather in established media rules that constrain it.

From the long history of television technology innovation, television's meta-technology was the discovery of the chemical element selenium and its photo-electric properties. Swedish scientist Berzelius and British scientist Joseph May respectively discovered selenium and its property of converting light into electric current. Since then, all efforts in television technology, such as John Baird's assembly of the first television set in Britain in 1925, have represented concrete, tangible, and diversified upgrades utilizing selenium's characteristics.

1.1 Transmission Technology

From ground open broadcasting, community antenna systems, closed-circuit cable television, cable network television, and cable digital television to satellite television, transmission technologies have evolved alongside developments in digital compression and conditional access technologies, presenting multiple technical ecosystems characterized by more transmission methods, faster speeds, better quality, more stable signals, and more secure networks. Internationally, four major transmission standards have emerged in Europe, the United States, Japan, and China: DVB-T, ATSC, ISDB-T, and DTMB. These technologies, together with fiber optics, wavelength division multiplexing, microwaves, GPRS, and SDH digital technologies, have formed a comprehensive transmission technology network system with unprecedented technological capacity and innovation stock.

Taking cable television communication technology as an example, it essentially integrates electronic technologies including television, microwave, digital communication, automatic control, remote telemetry, and computer technology. Even in the current era of internet and mobile internet development, its power remains undiminished. Hybrid Fiber-Coaxial (HFC) networks can broadcast both analog and digital television, transmit data, and connect to the Internet. However, even when developed to the extreme, television transmission technology faces three ultimate bottlenecks: first, limited channel resources; second, mass communication content strategies; and third, single-process, strongly linear transmission design. Although the average number of channels available to American households increased from 18.8 in 1985 to 104.2 in 2006, this does not signify the emergence of disruptive technology in television transmission—only quantitative change. Even under the influence of internet and mobile internet, new television forms such as IPTV and Internet TV have emerged, but these three ultimate bottleneck issues remain unresolved. In the current context of personalization, socialization, and interactivity, these bottleneck issues appear even more severe and urgent.

1.2 Experience Technology

Since NBC began black-and-white television broadcasting of the New York World's Fair in 1939 and the FCC initiated the color television era in 1953, clearer images have remained an important direction for television technology. In the 1950s, the emergence of two new television systems—cable television and television multiplex broadcasting—significantly improved picture quality. In the 1970s and 1980s, the UK's Independent Broadcasting Authority and Germany's ITT company achieved further leaps in image quality through digital television. To this day, television technology continues to innovate along the track of digital television, with LCD television, 4K high-definition technology, and 8K high-definition technology. Developed countries in Europe, America, and Japan have even introduced Super-HD and Ultra-HD technologies, pushing the clarity direction of television image quality to an unprecedented height.

Simultaneously, with the development of internet technology, particularly mobile internet technology, multi-interaction and multi-scenario capabilities have become another direction for television technology. Interaction technologies include traditional interaction technologies (remote control, subtitles, gesture recognition, facial recognition) and multi-screen interaction technologies based on the Shanlian protocol, which solves cross-operability issues between different operating systems and terminal devices. Scenario technologies enable television viewing not only in the living room but also on computers, mobile phones, as well as in vehicles, waiting pavilions, buildings, and railway systems. Although related to transmission methods, the ultimate direction of these technologies is better user experience.

These interaction and scenario technologies have derived new industry ecosystems in terms of television's high quality, proximity, coverage, and flexibility,

satisfying audience needs for better, faster, and more convenient television viewing. However, these technologies essentially represent the full-form, full-mode, and full-scenario presentation of television, without resolving two ultimate questions: First, is television or video still a media form needed by users? Second, can the experience based on television or video still lead or satisfy user needs? Without answering these questions, all paths toward television technology excellence merely circle within confined boundaries.

1.3 Integration Technology

Integration technologies such as television photography, television art, studio technology, and television editing have modularized, artisticized, and productized broadcast content. New-era television set design strives for perfection in panorama, depth, and motion; new-era television art continuously breaks through in lighting frame design, foreground design, and scene space details and texture; new-era stage art technology, through the application of LED and holographic projection, has continuously improved performance effects and program quality. It can be said that television has become a distribution center and testing ground for various emerging technologies.

However, emerging technologies do not equal disruptive technologies. Current applications of emerging technologies merely please the public in form. Typically, new-era television pleases audiences in four ways: first, replacing the time-sequence-based channel model with a space-based platform model; second, replacing the irreversibility and non-repeatability of one-time broadcasting with repeated and cross-time transmission; third, replacing the mass communication model based on sharing with a personalized communication model characterized by exclusive enjoyment; fourth, adding strong interactive integration elements such as danmaku, comments, and re-creation to modularized, fixed, and closed content integration features, forming new trends.

Despite the rapid advancement of television integration technology, it faces a paradox: the reconciliation paradox of simultaneous acceptance and resistance. That is, should television technology's core competitiveness—audiovisual information collection and processing capabilities and authority based on media brand—completely surrender to internet technology, or should it adhere to platform characteristics and excel at mass communication? Facing assimilation on one side and marginalization on the other, how to construct the subjectivity of television form during the construction of new mainstream media and emerging media groups becomes a meta-proposition and fundamental question for future television communication.

1.4 Measurement Technology

Television communication effect measurement technology began with Nielsen's completion of national ratings reports (NTI) and regional reports (NSI) in the mid-20th century. Throughout its long evolution, it has experienced innovations

in survey tools from diary cards to people meters, and expansions in survey samples from households to extended home viewing and extended channels. With the development of audio-image matching technology and embedded identification code technology, frame-by-frame statistics accurate to seconds have become possible. Innovations such as Arbitron's "Portable People Meter," Nielsen's "Anywhere Anytime Media Measurement" initiative, the Coalition for Innovative Media Measurement's (CIMM) digital set-top box return path roadmap, and Rentrak's time-shifted viewing measurement technology have long freed ratings measurement from the image of the silent "couch potato," actively influencing media organizations and advertisers.

Especially in the new era of cross-screen communication, cross-screen measurement has become the ultimate challenge for measurement technology. According to research by Professor Liu Yannan and other scholars, cross-screen audience viewing methods include watching live broadcasts, program replays, and on-demand content on large, medium, and small screens, as well as video-on-demand on internet platforms. Multi-scenario, autonomous fragmentation, multi-tasking, and integrated viewing behaviors make user identifiability insufficient, posing significant difficulties for cross-screen measurement. Whether collected from the audience end or server end, issues of single-source vs. multi-source, small data vs. big data, and inconsistent standards persist.

This means that even when measurement technology develops to its extreme, it still cannot answer the question of user identity in the context of media convergence. Specifically, where are users? Are they at the device end, the platform side, or in e-commerce malls and Taobao platforms? If this problem cannot be solved, television measurement remains essentially a mass communication approach and small-data mindset, making it difficult to adapt to the potential of intelligent television.

2.1 Returning to Basic Science

Stokes proposed the Pasteur Quadrant, emphasizing the significance of basic science. However, in considering the path to intelligent transformation of television technology, we must first clarify the conceptual definition of technology itself. In fact, technological capability does not equal technological innovation capability. Technological capability focuses on digesting, using, adapting, and modifying existing technologies, while technological innovation capability emphasizes inventing and implementing new technologies in practice.

Since Schumpeter proposed the concept of technological innovation in the early 20th century, technological process innovation, economic process innovation, and management process innovation have each had their own rhythms but have always remained in a co-evolutionary trend and trajectory. Therefore, we believe that the definition of media technology should emphasize technological capability rather than technological innovation capability. The strength of technological capability is determined by innovation capability, and its most essential

carrier lies in basic science.

Specifically in the field of news and media, Future Today released the "2018 Media Industry Technology Trends Report" in October 2017, introducing 75 technology trends primarily focused on vertical subdivisions of artificial intelligence. Additionally, research institutions such as the Pew Research Center have released technology trend reports, mostly focusing on applications of artificial intelligence, IoT, and other technologies. In fact, basic science related to individuals may or will inevitably have a critical impact on the intelligent transformation of television technology.

2.2 Moving Toward Ubiquitous Networks

The development of network communication technology, particularly the emergence of the Internet of Things and ubiquitous networks, has made the era of "everything is media" possible. In the future, both people and objects will be digitized and placed in the information ocean of networks. Relying on big data analysis and real-time monitoring technologies, scenarios where people can intelligently perceive their surrounding environment will soon become reality.

Ubiquitous networks connect and intelligently apply to various subjects including people, objects, organizations, and institutions, while communication activities and feedback control permeate every stage from information collection, communication layer transmission, computing layer processing, to application layer feedback. Harvard Professor Piero Scaruffi pointed out in the "2017 Future Media Trends Report" that "user experience technology, big data, the new content era, streaming media, mobile applications, virtual reality and augmented reality coexisting, maker culture, monetization, new platforms, artificial intelligence and robot writing" will become the ten major trends in future media development.

Regarding future media trends, Peng Lan believes everything will become media; Kurzweil believes it will penetrate to the thinking level; Luan Yimei believes it will be human-centered media convergence; Zhou Xiaoping believes it will embed into social and personal activities to become information complexes; Shen Yang focuses on the evolution of media connotation and functions toward holographic, omniscient, and omnipotent due to disintermediation; Guo Quanzhong and Cai Wei believe future media will be internet-dominated; Song Jianwu and Xiong Zhonghui advocate for strong connections between future media and users. None of these perspectives escape television thinking.

In 2017, Gartner proposed the concept of "digital twin," listing the dynamic software model of physical things or systems as one of the top ten strategic technology development trends. Since the operation of "digital twin" largely relies on sensors, it can fully depend on wearable smart devices or other sensors. In this process, the relationship between people and objects will also rise from the physical perception level to the data interaction level.

Future media should be widely connected with all walks of life. Traditional media currently face three prominent problems in seeking media convergence: first, the emergent order problem caused by competing technologies, making the media transformation environment too complex to address; second, the last-mile problem from addition to integration, resulting in unclear paths for media convergence development; third, the user boundary problem brought by cross-screen and cross-domain media consumption, making user measurement technology unable to measure media convergence outcomes.

These media convergence problems are essentially technical problems, and the solutions can only return to the essence of media technology. The essence of media technology is pathway construction. The influence of physical pathways built by traditional media technology is declining, while the digital pathway ecology formed by emerging media technology remains in a state of disorder, disconnection, and unregulated growth. Therefore, rethinking media technology, granting rules to media technology, and enabling media technology to generate efficiency have become inevitable paths for future media technology.

Thinking, rules, and efficiency are the connotations of technology and will inevitably be the core of media technology's intelligent upgrade under new circumstances. As for television+ or internet+, both are connection patterns. No matter how many connections exist, they must face the emergence of consumer surplus. In a world where everything is connected, the connotation of technology is no longer the medium, because the medium has become digitized, virtualized, de-physicalized, and decentralized. Whether networked, mobile, or future intelligent, media technology has only one core attribute: connection. Future television technology must also dilute its industry attributes and embrace the entire social ecology.

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Note: Figure translations are in progress. See original paper for figures.