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Claire Fox

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MicroMV: A Tiny Lack of Legacy

A camcorder that fits in your back pocket. A tape format that fits in the palm of your hand. The potential to casually capture fleeting moments without thinking about technology. These were the consumer dreams of the early 2000s as they were perceived by Sony. As such, Sony developed the technology needed to adapt the popular amateur video technology of the day – the miniDV tape – and made it 70% smaller. They called this tape the MicroMV, and it was (and remains) the smallest tape format ever released on the consumer market. The tape measures 1.8 x 1.2 x 0.3 inches, records 60 minutes of NTSC or PAL-compatible video, and exports to software bundled with the camera purchase. *Videomaker.com* recognized one of the MicroMV-compatible camcorder models as the "Most Innovative Camcorder" in its 2002 Best Products of the Year Awards, writing that "[in their] tests, the quality of the unique MICROMV-format video was indistinguishable from comparable Mini DV camcorders under normal viewing. With a style that looks like no other camcorder, this was a fun and easy camera to use."[1]

In 2018, nearly everyone in the United States carries a camera in their pocket in the form of a smartphone. Smartphones and their compatible digital formats have enabled users to record

[1] D. Eric Franks. "The 2002 Videomaker Best Products of the Year Awards." Accessed 18 November 2018. https://www.videomaker.com/article/f22/9212-the-2002-videomaker-best-products-of-the-year-awards

home video-style content with compulsive spontaneity, and then easily edit that content with in-app software. The decision-making around capture, editing, and sharing occurs without much ceremony, in a manner that feels aligned with those 2002 goals (a push toward portability and user-friendly workflow) of the MicroMV. And yet, ask a home video enthusiast or a filmmaker or an audiovisual archivist about MicroMV, and it's unlikely that they've ever heard of it, let alone experienced it. Indeed, neither the MicroMV nor its related camcorders make an appearance on Sony's "Product & Technology Milestones" timelines on its corporate website.[2] With its goals that seem so analogous to our use of audiovisual devices today, why is the MicroMV format nearly absent from today's historical understanding of contemporary home video creation?

The Home Video Timeline

The timeline of commercially viable magnetic tape formats popularly begins in 1956, with the introduction of 2" Quadruplex tape (or 2" Quad) from Ampex.[3] By 2002, a visual perusal of the timeline demonstrated a generational decrease in size, whether the tape was open-reel or housed within a cassette. Sony viewed this trend in the timeline as an opportunity to seize what the market wanted: an even smaller tape as the logical next step. "When you compare the size of videocassettes, you can see that Hi8 cassettes are a full generation ahead of standard VHS. And Mini DV is a full generation ahead of Hi8 tapes. But prepare for a shock. The

[2] Sony. "Product and Technology Milestones." Accessed 18 November 2018. https://www.sony.net/SonyInfo/CorporateInfo/History/sonyhistory.html

[3] Mona Jimenez and Platt, Liss. *Videotape Identification and Assessment Guide.* Austin: Texas Commission on the Arts, 2004 (hereafter cited as *Jimenez and Platt*).

MICROMV cassette is 70% smaller than Mini DV!"[4] To provide this timeline with some numbers: VHS was released in 1976, and measured 7 3/8" x 4 1/16" x 1". Hi8 was released in 1989, and measured 3 11/16" x 2 3/8" x 9/16". MiniDV was released in 1995, and measures 2 9/16" x 1 7/8" x 7/16".[5] Sony audaciously claimed the assumed "next generation" position in this timeline with the MicroMV measuring 1 3/4" x 1 1/8" x 1/4" (see **Appendix** for images).

Sony certainly had commercial gains in mind when it developed the MicroMV. The user manual itself claims that "[d]ecades of camcorder experience has taught us: small sells."[6] Consumer interest in videotaping had slowed over the years, and Sony was looking to revitalize the market. New technology can always attract interest, but this degree of size reduction meant new territory for the way users performed home video recording. If a camcorder could fit in a shirt pocket, that meant it could be as versatile as a still photography camera, and go where other camcorders couldn't: it would become "ultra-portable." This ultra-portability suggested that there would be more opportunities to create videos, simply because users could take the camcorder to more locations with more ease.

This versatility wouldn't be as revolutionary as the introduction of the first self-contained video tape recording systems, like the Sony Portapak in 1967 or the Sony Betamovie in 1983. Those systems provided individuals with the tools to film their own lives outside of a studio set or broadcast booth, which completely changed the way individuals engaged with the world around them. MicroMV's change in portability may have been subtle, but it represented a shift in

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[4] Sony. (2004). *The MicroMV Story: User Manual.* Retrieved from www.sony.com/electronics/support/res/manuals/W000/W0005513M.pdf (hereafter cited as *The MicroMV Story*).

[5] *Jimenez and Platt.*

[6] *The MicroMV Story.*

the way people created images. In 2002, creating a home video was still a special occasion, something you might plan ahead to do on a birthday or a wedding. Sony wanted to capture a market where making videos could be more casual: an individual grabbing their camcorder on the way out the door, maybe to take video of an event, or maybe just to record a day out with friends. According to an interview conducted by consumer electronics trade journal *Twice*, Sony camcorder marketing manager Al Jason said that the "typical consumer uses a camcorder once a month for about half an hour and then puts it back into the closet. One way to change this was to develop a camcorder that is very, very different."[7] In 2018, we know that the convenience of taking video on our phones has changed the way we interact with our surroundings. In 2002, this shift was just beginning.

Encoding Digital Video in a Small Space: The MPEG-2

The researchers at Sony who developed MicroMV and its compatible cameras had to find methods of writing and reading data on as small of a surface area as possible, with the basic concept being to reduce the size of the tape so they could reduce the size of the camcorder. While previous magnetic tape formats had used a variety of containers, codecs, and compression schemes that changed over formats, brands, and the users capabilities of transcoding formats to meet their needs, MicroMV's ingenuity all came down to the use of different forms of MPEG-2.

The basis of the MicroMV file structure is its lossy MPEG-2 compression scheme. MPEG-2 compression uses a group of pictures (GOP) structure, which implements the IBP method of compression. Intra frames (I) are assigned as reference points, and predicted pictures

[7] Greg Tarr, "Sony Bows to MicroMV Camcorder." Accessed 18 November 2018. https://www.twice.com/news/sony-bows-micromv-camcorder-26654

(P) and bidirectional pictures (B) made up of motion vectors and picture blocks containing less data than the intra frames compose the image over time in a temporal compression scheme. This method of using reference frames with reliant P and B frames derived from the source video "accounts for the great efficiency of MPEG encoding."[8] This compression scheme is common for DVD, which is usually compressed to around 4 to 6 megabits per second (mbps). Unlike DVD, MicroMV is compressed to a higher rate of 12 mbps, which enables the camcorders to create video quality nearly identical to DV formats, but with occasional artifacts.[9] For comparison, DV tapes were compressed to 25 mbps, which produced a good quality image, but each frame was compressed individually and needed to occupy more space on the tape. MPEG-2 achieved a more efficient compression scheme with its IBP method, which allowed information to take up less space on tape, but that efficiency did come at a price. While the slightly inferior image quality was nearly imperceptible, the IBP pattern meant that during editing, it became difficult to cut to specific frames within digital editing software because the B and P frames didn't contain all of the information necessary to stand alone.

The codec for MicroMV is MPEG-2, which is the same codec used in optical media like standard definition DVDs. MPEG-2 is a distribution codec, which refers to a group of codecs that are heavily compressed and "based on reducing bandwidth as much as possible while providing robust error recovery for less-than-perfect signal paths."[10] As such, it continues the

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[8] Weynand, Diana, Vance Piccin, and Marcus Weise. *How Video Works: From Broadcast to the Cloud.* New York, NY: Focal Press, 2016, p. 188 (hereafter cited as *Weynand, Piccin, and Weise).*

[9] Douglas Dixon, "Video Editing with Sony's MICROMV." *Manifest Technology: Making Sense of Digital Media Technology* (blog), July 2003, https://www.manifest-tech.com/media_pc/micromv.htm.

[10] *Weynand, Piccin, and Weise*, p. 273.

trend of heavily compressing the video stream to enable its encoding on a smaller tape format. Similar to DVDs, this codec allows MicroMV camcorders to record an "Index frame" (different from an intra picture, and not part of the compression scheme) every time a new clip is created, which serves as a reference point for users as they navigate through their clips on camcorder LCD viewscreens as they would a DVD chapter menu.[11] While the MPEG-2 codec is designed to work with standard definition DVD, many users complained on forums that the MPEG-2 codec used with MicroMV was not suitable for converting material captured on MicroMV to DVD or other common playback formats of the time.[12]

The container for MicroMV is an MPEG-2 transport stream (M2TS). Like the MPEG-2 codec itself, M2TS was designed for use with broadcast systems. The M2TS wrapper contains audio, video, and program and system information protocol (PSIP) data. All of that data is broken into tiny packets and assigned packet IDs (PIDs), which are broadcast at a constant bitrate (CBR) to the receiver, where the streams are then multiplexed to represent the video image. The use of M2TS suggests a weak signal path, as M2TS was used for unreliable transmissions like satellite broadcast. In this case, the M2TS provides a smaller file size than, for example, an MPEG-2 program stream, which wraps every frame individually and is generally associated with reliable media sources including DVDS.[13] All of this information is then encoded onto a metal-evaporated tape, which is a tape construction designed for high-density

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[11] *The MicroMV Story*.

[12] "Doom9's Forum." *Doom9.org* (online forum), February 2002, https://forum.doom9.org/showthread.php?p=938737

[13] Afterdawn.com. "MPEG-2 Transport Stream." Accessed 18 November 2018. https://www.afterdawn.com/glossary/term.cfm/mpeg2_transport_stream

data storage, maximizing the small amount of space available on the MicroMV tape.[14] What enabled the use of this tape format was the application of a magneto-resistive read head to a helical scan consumer-use camcorder, which was able to read the high-density data encoding.[15]

Tiny Tapes, Tiny Cameras

Sony created four MicroMV-compatible camcorders. In November 2001 (before the tape format was released), Sony released the first generation: the DCR-IP5 ($950) and the DCR-IP7. Both of these vertically-oriented camcorders measured roughly 4" x 2" and weighed 13 ounces, living up to expectations for being lightweight and compact.[16] The camcorders included A/V input and output ports and an IEEE i.LINK 1394 Firewire port to connect the camcorders to PC computers. The 2.5 inch LCD monitors folded out from the left side of the body of the camcorder, which provided users with the ability to clearly view what they were recording, and additionally provided users with the ability to view the MPEG-2 Index frames of each clip they had recorded as a method of sorting through the material they had created prior to importing it into editing software. The cameras also had zoom lenses that could be controlled from a toggle switch on the right side of the camera.[17] The IP7 differed from the IP5 in a few ways. One was

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[14] Anthony D Alfano and Bharat Bhushan. "Magnetic evaluation of advanced metal-evaporated tape in an advanced linear tape drive." *ScienceDirect*. January 2007. https://www.sciencedirect.com/science/article/abs/pii/S0304885306007785#fig1

[15] K. Tsuneki, Y. Kotani, K. Iesaka, M. Mizuno, N. Kondo, and Y. Yanagi. "Development of MicroMV Magnetic Recording System." *Intermag Europe 2002 Digest of Technical Papers* (2002): BP 16-17.

[16] Tarr, Greg. "Sony Introduces 2nd Generation MicroMV Camcorders." *Twice* (2002), p. 24 (hereafter cited as *2nd Generation*).

[17] Bloomberg Business. "Sony DCR-IP5." Accessed 18 November 2018. https://www.bloomberg.com/news/articles/2002-07-23/sony-dcr-ip5

that it included a Memory Stick (a Sony proprietary flash memory product) slot, so users could insert a 128 MB flash memory card and record still images as JPEGs and could additionally record low-res video. It also supported Bluetooth connectivity, allowing users to go into NETWORK mode in Web, email, and browser modes so they could export their organized collections and browse their email in a read-only mode.[18] Both these cameras received praise for achieving their promised portability, but frequently dealt with complaints about their tiny control buttons and toggles, which were too tiny for most fingers to easily operate.

The second and last generation of MicroMV cameras was released in September 2002. The DCR-IP55 ($1,500) and the DCR-IP220 ($1,999) were both steps up from the DCR-IP5 and IP7; as such, Sony discontinued the IP7 for its redundancy, but kept the IP5 available to offer a lower price-point for the line of camcorders.[19] The IP55 and the IP220 both included the integrated Memory Stick flash memory storage drive of the IP7, with the IP55 offering 1 megapixel resolution and the IP220 offering up to 2 megapixel resolution for still images (according to one account, it was the first camcorder to offer this high of resolution).[20] Both cameras also had improved charge-coupled device (CCD) sensors, which allowed the IP55 to record 520 lines on the MicroMV tapes, and 530 lines on the IP220 tapes. Additionally, both models included improved zoom lenses, Bluetooth connectivity, and the IP220 could connect to AOL. In terms of camera body changes, these second-generation cameras also switched to being horizontally-oriented for video recording. The IP55 included a side-mounted handle grip that folded down and away from the camera, giving the user a stable grip. The IP220, on the other

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[18] Sony. (2002). *Network Function Operating Instructions.* Retrieved from https://www.sony.com/electronics/support/res/manuals/W000/W0002927M.pdf

[19] *2nd Generation.*

hand, changed the orientation of its LCD viewscreen, so rather than flipping out from the side, it flipped up from the back and could pivot to face the subject if necessary. The viewscreens on both models were touch screens and included a stylus, which made it easier for users to access controls than the previous models' buttons.

MovieShaker Software and Proprietary Issues

MicroMV camcorders came bundled with a proprietary Sony editing software called MovieShaker. This editing software offered users a straightforward platform for joining image clips together into a timeline, which they could then export into an .mmv file format and save onto a separate MicroMV tape for storage. To begin, users would import video from their camcorder by connecting their PC computer to the camcorder via the i.LINK 1394 cable or, if their camcorder supported it, wirelessly via Bluetooth. All imported clips would arrive in the Clip Tray, and if a clip became part of a video project, it was dragged into the Project Tray.[21] From there, MovieShaker operated in two modes: Normal Mode and Shake Mode. In Normal Mode, users were able to choose the order of clips they wanted to see in their timeline, and then add transition effects between them. They could further display clips (called "scenes" in the software) in the Edit Tray, which allowed them to add visual effects to their clips. In Shake Mode, the user could click a button and have a 30-second movie automatically generated with the clips they'd imported.

When MicroMV was first released, MovieShaker was the only editing software compatible with the format. By the end of 2002, Sony had developed a proprietary model of

[21] Sony Movie Shaker Manual. "What you can do with Movieshaker." Accessed 18 November 2018. http://www.underwaterphotography.com/Video-Editing/Sony-Movie-Shaker/index.asp

Pinnacle Systems - Studio 8 and Ulead VideoStudio 7. While these two additional editing systems provided users with more options in editing their projects, the lack of flexibility with editing software highlighted many users' difficulties with the format in general.

Upon its release, every component of MicroMV was proprietary: its tape, its cassette, its camcorders, its editing software, and even its Firewire cables.[22] This could be understood as promoting ease of use for a customer base, since every product was designed to work harmoniously with the others in the MicroMV ecosystem. However, users quickly took to forums to express their discontent,[23] and developed scripts to transcode .mmv files to more versatile .mpg files in an attempt to find editing workarounds.[24]

New Technology and the Persistence of Familiarity

When considering the generational decrease in size of tape-based cassette formats, MicroMV hits all the right marks: it made use of the appropriate compression scheme, codec, and container to encode information on a very small amount of space, and then developed the technology necessary to read it. The tapes were so small that journalists often described them as looking more like toys than feasible technology.[25] However, it's important to consider other

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[22] David Pogue. "STATE OF THE ART; Downsizing Videotape, Yet Again." 21 March 2002. Accessed 18 November 2018 (hereafter cited as *The New York Times).* https://www.nytimes.com/2002/03/21/technology/state-of-the-art-downsizing-videotape-yet-again.html

[23] "Doom9's Forum." *Doom9.org* (blog), February 2002, https://forum.doom9.org/showthread.php?p=938737

[24] "MMV2MPG," *The New York Times.* Accessed 18 November. https://www.videohelp.com/software/mmv2mpg

[25] *The New York Times.*

kinds of audiovisual formats that were being created concurrently – and even prior – to the release of MicroMV.

While miniDV was initially released in 1995, optical media including DVDs were released that same year. Shortly thereafter, flash memory cards were released in 1998. These formats were smaller and more efficient than MicroMV, and were even incorporated into the MicroMV workflow itself. The MicroMV tape borrowed from DVD encoding to achieve its small size, and three out of the four MicroMV-compatible camcorders used Sony Memory Sticks to record still images and low-res video files. While Sony had constructed a grand timeline where an ever-smaller tape-based format was next in line, it was apparent by 2002 that new methods of recording audiovisual material were on the rise. Why create a tape at all?

From the start, Sony's creation of the MicroMV was an appeal to the casual home video creator. While many of these consumers were hobbyists who studied the medium, others just wanted to have the ability to pick up a camera, create a video, and not have to consider too many factors regarding what to buy and how it worked. In a 2010 article from *TVTechnology.com* titled "Is HDV Dead?", the writer considers the persistence of HDV's tape-based format, even on the sets of well-known TV reality show (in the case of this article, they used *Deadliest Catch* as a case study). By 2010, of course, not only was optical media and flash memory readily available, but smartphones were additionally ubiquitous and capable of recording video. Why would a TV show continue recording on a tape-based format?

"There's plenty of tapeless video being recorded," the *TVTechnology.com* writer says, "but producers and production insurance companies are wrestling with the issues of storage and long-term archiving of the media. When you analyze the world of HDV, it turns out that quite a few event photographers, reality TV series producers and broadcasters still rely heavily on tape-

based media."[26] This understanding of tape-based format usage has to do with the way users engage with formats based on what they find familiar, or what they know works best for them in their particular environment. HDV may not be the "best" format for a reality TV show, but producers frequently function in an environment where they don't have time to thoroughly consider every possible option, especially when considering technology upgrades. "Best," in these cases, becomes what's most readily available and requires the least amount of resource allocation.

The same likely held true for users that made up the wider consumer video market in the early 2000s. While people wanted to have "what's next" or "the best product" in the abstract, they also wanted to know that what they might spend their money on was something reliable, something they felt would certainly work. Optical media and flash memory were still relatively new, and although the technology wrangled to create a functioning MicroMV tape may have exhibited a certain scrappiness, the tape itself visually referenced the feeling of being as reliable and familiar as a VHS.

However, there were issues working against casual users, preventing them from adopting the familiar technology that had been designed for them. The most perceptible one was the cost of the camcorders, as they were roughly $500 more expensive than their DV and miniDV counterparts. This meant that the price-point came to serve as barrier to entry for this new model, and primarily the early-adopter hobbyists who could afford to experiment were able to purchase the cameras. While many of these individuals were thrilled by the ability to capture high-quality video on such a small tape, the inability to connect those captured images with their choice of editing software seemed absurd. Consumer electronics hobbyists and enthusiasts weren't

[26] *TV Technology*. "Is HDV Dead?" Accessed 18 November 2018. https://www.tvtechnology.com/news/is-hdv-dead

interested in entering Shake Mode as much as they cared about manipulating the newly created images they'd made with their ultra-portable camera. These individuals took to forums to express their discontent, and as a result, the format quickly fell out of style.

Preservation Concerns

The MicroMV never gained traction, and Sony stopped supporting the format in 2006.[27] However, it wasn't until 2016 that Sony announced that it would stop the shipping and manufacture of the tapes. This announcement was overshadowed by Sony's announcement at the same time that they would be discontinuing the sale of Betamax tapes, which were a known and beloved format across two generations of home video production.[28] In spite of this lingering lack of support before its retirement, the disappearance of the tape happened swiftly, and it seems as though the tape didn't spread too far into the consumer market. There are a few digitization companies that offer transfer services for MicroMV tapes, copying them to DVDs for further preservation and playback. I attempted to reach out to Southtree, one of these digitization companies, which is based in Chattanooga, TN.[29] I was unable to reach anyone in production, but a helpful customer service agent told me that out of 220,000 total emails they've received for service requests, just shy of 300 were for services regarding MicroMV.[30]

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[27] Jason Curtis. "MicroMV (2001-2006)". Accessed 7 October 2018. www.obsoletemedia.org/micromv/

[28] Luna, Justin. "Sony bids farewell to Betamax and MicroMV tapes." Accessed 7 October 2018. https://www.neowin.net/news/sony-bids-farewell-to-betamax-and-micromv-tapes.

[29] Southtree. *MICROMV to DVD or Digital Service. https://southtree.com/products/micromv-to-dvd-service.*

[30] Southtree Customer Service, email to the author. November 14, 2018.

At present, MicroMV has yet to surface as a tape format in need of large-scale preservation, and it's possible it could stay that way. However, it's possible that in the future, collections of forgotten MicroMV tapes could surface and need attention due to the same concerns as other tape-based formats: poor storage conditions, vinegar syndrome, mold, and sticky-shed. If or when those tapes require archival processing, archivists have already determined the best possible workflow is to treat MicroMV as though it is HDV. HDV (High Definition Video) was created in 2003, just one year after MicroMV, as part of a consortium of leading consumer electronics businesses: Sony, JVC, Canon, and Sharp. Similar to MicroMV, HDV is a codec derived from MPEG-2 that facilitates the encoding of high-definition video onto DV tapes. The tapes create a Quicktime container, with an H.262 compression scheme.[31] HDV has achieved popularity as an accessible, affordable format over the years, and is still in use in some production scenarios today. Luckily, this persistent tape format has qualities similar enough to MicroMV that if the occasion were to arise, HDV could help pull another tape format out of obscurity.

[31] *TV Technology*. "Is HDV Dead?" Accessed 18 November 2018. https://www.tvtechnology.com/news/is-hdv-dead

APPENDIX: Images of MicroMV tape and standard-sized matchbook. All photos by the author.

Annotated Bibliography

Afterdawn.com. “MPEG-2 Transport Stream.” Accessed 18 November 2018. https://www.afterdawn.com/glossary/term.cfm/mpeg2_transport_stream

In my research, I was finding competing conversations about the function of an MPEG-2 Transport Stream. This iteration, from the website’s glossary, provided clarity.

Alfano, Anthony D. and Bharat Bhushan. “Magnetic evaluation of advanced metal-evaporated tape in an advanced linear tape drive.” *ScienceDirect*. January 2007. https://www.sciencedirect.com/science/article/abs/pii/S0304885306007785#fig1

This study offered useful information regarding metal-evaporated tape functions.

Bloomberg Business. “Sony DCR-IP5.” Accessed 18 November 2018. https://www.bloomberg.com/news/articles/2002-07-23/sony-dcr-ip5

This post on Bloomberg Business provided me with one user’s perspective on using the MicroMV-compativle DCR-IP5 camcorder.

Barrett, Colin. “Transferring MICROMV – the last videocassette format.” *Simply DV* (blog), October 10, 2013, http://simplydv.biz/2013/10/transfer-sony-micromv-video-dcr-ip45/.

This blog provides helpful technical information, but also provides some narrative for the way the author personally observed the MicroMV format.

Curtis, Jason. “MicroMV (2001-2006)”. Accessed 7 October 2018. www.obsoletemedia.org/micromv/

This website provides clear technical specifications of the format.

Dixon, Douglas. “Video Editing with Sony’s MICROMV.” *Manifest Technology: Making Sense of Digital Media Technology* (blog), July 2003, https://www.manifest-tech.com/media_pc/micromv.htm.

This blog provides excellent background of the various editing softwares that were used to edit and transcode MicroMV tapes. As a lack of ease in editing was part of the format’s downfall, this resource has been valuable for me as I determined the path of the format’s obsolescence.

“Doom9’s Forum.” *Doom9.org* (online forum), February 2002, https://forum.doom9.org/showthread.php?p=938737

Doom9 was the username for an Austrian college student who created a website about DVD codecs, which he named after his username. This particular inactive website is from

a forum discussion on Doom9.org. Users discuss about the viability of MicroMV, specifically in terms of containers and codecs, was very helpful for my research.

Franks, D. Eric. “The 2002 Videomaker Best Products of the Year Awards.” Accessed 18 November 2018. https://www.videomaker.com/article/f22/9212-the-2002-videomaker-best-products-of-the-year-awards

This article provides industry context for the MicroMV camcorders. I initially imagined that MicroMV had been a flop from the start, but this article shows that it was a respected product in its first year.

Jimenez, Mona and Platt, Liss. *Videotape Identification and Assessment Guide.* Austin: Texas Commission on the Arts, 2004.

This guide was an indispensable and reliable reference point as I gathered information for a home video format timeline.

Long, Don. “Make for something very tiny from Sony; MicroMV unit is state of the art, but there are better choices if editing is your thing.” *Toronto Star*. March 21, 2002. www.proquest.com.

This newspaper article from 2002 is a helpful consumer perspective about the format shortly after its release.

Luna, Justin. “Sony bids farewell to Betamax and MicroMV tapes.” Accessed 7 October 2018. https://www.neowin.net/news/sony-bids-farewell-to-betamax-and-micromv-tapes.

This article provides a date for Sony’s decision to discontinue the MicroMV format.

“MMV2MPG,” *The New York Times.* Accessed 18 November. https://www.videohelp.com/software/mmv2mpg

Users wrote scripts to transcode .MMV files to other more open file types. This is one such script.

Pogue, David. “STATE OF THE ART; Downsizing Videotape, Yet Again.” 21 March 2002. Accessed 18 November 2018. https://www.nytimes.com/2002/03/21/technology/state-of-the-art-downsizing-videotape-yet-again.html

This review of the MicroMV format from the *New York Times* provided me with a larger narrative arc to understand the rise and fall of this tape format.

Sony. (2002). *DCR-IP5: User manual.* Retrieved from https://www.sony.com/electronics/support/camcorders-tape-camcorders/dcr-ip5.

This user manual is specifically geared toward a camera designed for use with MicroMV tapes, and further provides a range of user guides over the years that relate to the format.

Sony Movie Shaker Manual. “What you can do with Movieshaker.” Accessed 18 November 2018. http://www.underwaterphotography.com/Video-Editing/Sony-Movie-Shaker/index.asp

It appears that this website might date back to 1996, although that seems impossible. Regardless, it is a very old website experiencing link rot, but it provided me with valuable information about the Movie Shaker Software.

Sony. (2002). *Network Function Operating Instructions.* Retrieved from https://www.sony.com/electronics/support/res/manuals/W000/W0002927M.pdf

This user manual provided helpful details about Bluetooth connectivity and the design of the LCD viewscreen user interface.

Sony. (2004). *The MicroMV Story: User Manual.* Retrieved from www.sony.com/electronics/support/res/manuals/W000/W0005513M.pdf.

This user guide is a specific part of the DCR-IP5 guide mentioned above, and provides helpful technical specifications about the medium and the way it should be perceived by users.

Sony. “Product and Technology Milestones.” Accessed 18 November 2018. https://www.sony.net/SonyInfo/CorporateInfo/History/sonyhistory.html

This timeline showed me that MicroMV does not have an explicit place in Sony’s historical record.

Southtree Customer Service, email to the author. November 14, 2018.

I was unable to connect with anyone in production at this digitization company, but their customer service department was willing to demonstrate information suggesting that people still want to have their MicroMV tapes archived.

Southtree. *MICROMV to DVD or Digital Service. https://southtree.com/products/micromv-to-dvd-service.*

Southtree is a company based in Tennessee that provides digitization services, and specifically offers transfer for MicroMV tapes. I reached out to them to find more information about their process and decision to include MicroMV as part of their offerings. They could not connect me with anyone beyond customer service, but the agent I spoke with reassured me that they still get calls about MicroMV.

Smith, Duncan. “Converting MMV files to other file formats.” *Duncan’s Blog* (blog), May 9, 2007, http://duncanjasmith.blogspot.com/2007/05/mmv-format-to-useful-format.html.

This resource provides context for how to convert MMV files to MPEG-2, which was the supposed primary file format created from MicroMV tapes.

Tarr, Greg. “Sony Introduces 2nd Generation MicroMV Camcorders.” *Twice* (2002), p. 24.

This magazine clipping contains detailed information about the second-generation of MicroMV-compatible cameras, which allowed me to draw more conclusions between camcorder models.

Tarr, Greg. “Sony Bows to MicroMV Camcorder.” Accessed 18 November 2018. https://www.twice.com/news/sony-bows-micromv-camcorder-26654

This article provided optimistic context for the future of the MicroMV, with concrete details about file formats and highlighting Sony’s hopes for the product.

Tsuneki, K., Y. Kotani, K. Iesaka, M. Mizuno, N. Kondo, and Y. Yanagi. “Development of MicroMV Magnetic Recording System.” *Intermag Europe 2002 Digest of Technical Papers* (2002): BP 16-17.

This article provides scientific context for the creation of MicroMV technology.

TV Technology. “Is HDV Dead?” Accessed 18 November 2018. https://www.tvtechnology.com/news/is-hdv-dead

HDV has been acknowledged as a proper workflow mirror to MicroMV. Resources writing about HDV have been illuminating in my understanding of MicroMV. This article is particularly helpful with regard to defining the inertia that keeps users tied to the formats they’re familiar with.

Weynand, Diana, Vance Piccin, and Marcus Weise. *How Video Works: From Broadcast to the Cloud.* New York, NY: Focal Press, 2016.

This book provided a valuable, credible resource about video formats amidst a sea of blog and forum posts. I primarily consulted the chapters about MPEG compression and codecs.