How Do Degradation and Obsolescence Issues Impact Cost Over Time?

by George Blood

• George Blood Audio/Video/Film

• *Originally given Association of Recorded Sound Collections, May 2011*
2” Quadruplex video
a model of obsolescence

Primary Video Format 1956 - 1980
Library of Congress holds 130,000 tapes
2” Quadruplex video
a model of obsolescence

Refurbishing heads
- Lifespan: 500 hours (13 weeks)
- Suppliers: One

- Labor: 3-5 days
- Remaining Artisans: One (aged 81)
2” Quadruplex video
a model of obsolescence

Cost:

2009  $3,500
2010  $3,800
2011  $4,200
2012  $5,200

49% increase in 4 years
Lacquer Recording
- in Different Sizes

Transfer time:
- About 1 hour
- ~$100.00

Courtesy of GSU
Palmitic Acid

Transfer time:
• About 1.25 hours
• ~$125.00

Courtesy of GSU
16” Lacquer Disc

Technology Will Save Us!
I.R.E.N.E.
Technology to the rescue?

- Camera alone: $150,000, total cost ~$250,000?
- Time to scan and reconstruct broken disc: 5 hours
- $500, plus amortized cost of scanner
Lacquer Discs
Cost of Waiting, per 1,000 discs

- Now: $100,000.00
- Palmitic Acid: $125,000.00
- Via I.R.E.N.E.: $750,000.00
Lacquer Discs
Cost of Waiting, per 1,000 discs

- Now: $25,000.00
- Palmitic Acid: $31,500.00
- Via I.R.E.N.E.: $131,500.00
Pain is beginning

• Only currently manufactured cassette deck (Otari): $11,000.00 (90 days for delivery, prepaid)

• Only currently manufactured microcassette deck (JBTech): $7,000.00

• Plastic 10.5” reels
  Minimum order: 10,000 pieces

• Lapping Tape (for video heads), no longer manufactured
  $40,000.00 to retool and make even 1 roll

• Head assembly for 1” Type C Video machine, NOS
  $16,000.00

• Studer 1/4” tape machines
  more valuable “parted out” than whole
Pain is here

- **Ampex AVR-1 compressed air diaphragm**
  Unavailable at any price

- **Ampex AVR-1 vacuum column sensor “glass”**
  Unavailable at any price

- **Sony PCM-70x0 series DAT machine capstan motors**
  Unavailable at any price

- **Alignment tapes**
  Only available new for reel-to-reel audio, one supplier
  None available for analog video

- **Technics SP-15 turntable, main bearing, logic IC**
  Unavailable at any price
  *Now available from TimeStep UK*

- **Playback stylus for disc stampers**
  Unavailable at any price
Pain continues (since 2011)

- **Kodak declared bankruptcy**
  Ektachrome no longer made; some motion picture stocks, too

- **Fuji motion picture film**
  No longer making fine grain negative, or print film

- **Sony ½” tape machines (BetacamSP, DigitalBetacam, etc)**
  Last call for orders October 2011

- **Applied Magnetics, Belgium (last manufacturer in Europe)**
  May 2013, last call for audio heads, sold inventory to USA

- **Sony HD tape machines**
  Production ended December 2014

- **Harry Boettcher, Ampex Northeast Regional Service Rep.**
  RIP
Pain continues (since 2014)

- Rank/Cintel maker of motion picture scanners
  Liquidated in bankruptcy

- Cube-Tec
  Reorganized in bankruptcy

- Front Porch Digital (SAMMA video encoders)
  November 2012, lays off 8 staff in SAMMA product line
  Sometime in 2014 “free” player for SAMMA files no longer available

- RMGI magnetic tape manufacturing
  Ends production of magnetic tape – one boutique maker in York, PA

- Otari MX-5050 out of production
  June 2015, Otari runs out of PC boards and decides not to refresh

- Taiyo Yuden (inventor of CDR) announces will stop making all optical discs in Dec 2015
If the audiovisual media in your collection is not digitized by you,

it probably won’t be digitized by your successor.
What’s That?! 

Identifying Audio Formats 

CDLC 2018 
George Blood 
George Blood Audio/Video/Film/Data
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Mechanical Sound Recordings
Cylinders: Basic Traits

- Shaped like cylinders
- Acoustic recordings
- 4.25” x 2” across (some 8” long)
- 100 or 200 tpi (turns per inch)
- Hand-wound spring motor ~160 rpm
Cylinder player
Cylinders: Common Ailments

- Incompatible formats
  - 100 & 200 tpi cylinders not interchangeable
  - 4.25” & 8” length cylinders not interchangeable

- Shrinkage & Out-of-round
  - Fixed-pitch worm gear on player cannot reproduce

- Noisy mechanical playback

- Horns on different machines sound different

- No absolute speed standard

- Fragile

- Made from highly flammable materials
Mechanical Sound Recordings

Discs
Analog Discs: 78 rpm
78 rpm Discs: Basic Traits

• Groove and Stylus size varies
  – 1.0 mil to 3.0 mil or larger

• Playback equalization varies
  – 2 sets of parameters

• Speed varies
  – From 70.29 rpm to 80 rpm

• Center hole usually isn’t centered

• Made from shellac (furniture finish) and rocks
  – Other materials used to change properties
  – Chip and break easily
  – Heavy
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78 rpm Lacquer: Basic Traits

- Many traits same as commercial 78s
  - Stylus size varies
  - Speed varies
  - Equalization varies

- Center hole IS in center

- Base
  - Aluminum
  - Glass

- Recording layer (cellulose nitrate laminate)

- Heavy

- Handwritten or typed labels common

- Wide range of common sizes: 10–16”

- Extra holes
Extra holes on 78 rpm Lacquer
Lacquer Recording Discs Come in Different Sizes

• 10”
• 12”
• 16”

Notice “erased” track

Courtesy of GSU
16” Lacquer Disks: Basic Traits

• Duration
  – 15 minutes

• Playback parameters (similar to 78 rpms)
  – Stylus size varies
  – Equalization varies

• Labeling (similar to 78 rpm lacquer)
  – Frequently handwritten or typed label

• Composition same as smaller 78 rpm lacquer

• Speed different from smaller 78 rpms
  – Standardized at 33 1/3 rpm

• Play from center to outer edge (usually)
16” Lacquer Disc

Plays from Center

Delaminating
Palmitic Acid

Courtesy of GSU
All analog formats are obsolete.  
All digital formats on tape or removable media are obsolete.

Lacquer discs deteriorate rapidly and should be prioritized for processing
78s vs. LPs: Basic Traits

• Labeling: LP = “Long Playing”, “MicroGroove”

• Size
  – 78s usually 10”
  – LPs usually 12” (or 7” for “45s”)

• Speed
  – 78s are 70.29 to 80 rpm
  – LPs are either 33 1/3 or 45 rpm

• Duration
  – 78s less than 3 minutes
  – LPs 15-20 minutes

• Materials
  – 78s made from shellac, chip and break
  – LPs made from PVC, are flexible
Magnetic Tape Recordings

Wire Recordings
Wire Recordings: Basic Traits

- Steel wire
- Used for dictating and telephone recorders
- War time applications
- Pre-1946: Non standard spool sizes
- Post 1946: Standardized
  - 2 3/4" in diameter, approx. 3/4" thick
Wire Recordings: Common Ailments

- Non-stainless steel, Lesser quality steel, Poor environmental conditions
- Tangles
- Loose wire pack
- Poorly calibrated playback machines
Magnetic Tape

- Acetate tape
- Polyester Tape
- Philips Compact Audio Cassette
Philips Compact Audio Cassette: Common Problems

- Almost always mechanical
  - Pressure pad loose or missing
  - Shell deformed
  - Guides rusted
  - Rollers failed
  - Leader splices come undone

- Deformed tape
  - Probably caused by a mechanical problem
Philips Compact Audio Cassette

- Most problems solvable by changing shell
  - 5-screw shells are easy to disassemble
  - Sonic-welded shells are very difficult to disassemble
Compact Audio Cassette Variations
Analog Tape

- Comes in many sizes
  - How long does it play?
    - Tape speed
    - Reel size
    - Tape thickness
    - Track format

Courtesy of GSU
Analog Tape: Basic Traits

• Many Speeds (all multiples of 2)
  – 30 ips
  – 15 ips
  – 7 1/2 ips
  – 3 3/4 ips
  – 1 7/8 ips
  – 15/16 ips
Analog Tape: More Basic Traits

- Many Speeds (all multiples of 2)
  - 30, 15, 7 1/2, 3 3/4, 1 7/8, 15/16 ips

- Many reel sizes
  - 14”, 12”, 10 1/2”, 7”, 5”, 4”, 3”, 2”

- Different thickness
  - 1.5 mil, 1.0 mil, 0.5 mil

- Different track formats
  - Full track, half track, quarter track, multi-track
Track Formats for 1/4” Tape

Full Track    Half Track    Stereo    1/4 Track
Track Formats for 1/4” Tape

- Full Track
- Half Track Mono
- Half Track Stereo
- Quarter Track

Courtesy of IU/FACET
2” and 1” Analog recording tape

Courtesy of GSU
Disassembly of a Metal Reel
Common Mistake: handling 1/4” tape on hub

- DO NOT handle tapes without reel flanges (sides)!
Analog Tape: Composition

- **Oxide Layer Emulsion**
  - Iron Oxide (rust)
  - Binder (glue)

<table>
<thead>
<tr>
<th>Iron Oxide (rust) in Binder (glue)</th>
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- **Base**
  - Paper (very rare)
  - Acetate (translucent)
  - Polyester (=Mylar™)
Identification of Acetate Tape

- Acetate Tape is Translucent
- Polyester Tape is Opaque
Acetate Tape: Common Ailments

- Dimensionally unstable
  - Grows / shrinks with humidity or Vinegar Syndrome

Acetate tapes
Vinegar Syndrome after exposure to moisture
Acetate Tape: More Common Ailments

- Dimensionally unstable
  - Grows/shrinks with humidity

- Brittle
  - Breaks easily

- Vinegar Syndrome
  - Breakdown causes vinegar-like odor
    - Gets worse faster and faster
    - Contaminates surrounding media
    - Ultimately makes tapes too sticky to play
  - A-D Strips from IPI diagnose severity
  - Treatment with Molecular Sieves from Kodak (doesn’t work)

- Lubricant failure
  - No known cure
Polyester Tape: Basic Traits

• Opaque
• Handles nicely
  – “Flows” nicely in machine
  – Easily cut & spliced
• Dimensionally stable in air
• Lubricants rarely fail
• Much higher fidelity than acetates
• Does not break (it stretches!)
Acetate vs. Polyester Tape

- Acetate tape (left) breaks
- Polyester tape (right) stretches
Polyester Tape Ailment: Sticky Shed Syndrome

Quick way to identify:

- Tape should come off reel smoothly as on right
- On left tape sticks to next layer
Optical Discs

Compact Discs

MiniDiscs
Compact Disc
Basic Traits

• Bottom is polycarbonate
  – Injection molded
  – Durable & “repairable”
• Coated with reflective layer
  – Sputtered, few atoms thick
  – Sometimes Gold, Usually aluminum
• Top is lacquer
  – Spills over sides & into center hole to seal
  – Very fragile, damage usually fatal
• Label
How CDs/CDRs are read

- CD Surface is flat or “pitted”
  - “Pits” and “Lands”
  - Lands reflect laser, pits do not
- CD-R Surface is flat or “cloudy”
  - Flat surface or “obstructed” after burned
  - Lands reflect laser, “recorded dots” do not
- Land is a “one”, otherwise “zero”
How CDs/CDRs are read

• Optical Pickup
• Constant Linear Velocity
  – Read from center
    • Spiral track of pits running from inside diameter to outside
      – Spin faster at center -- about 500 rpm
      – Spin slower at edge -- about 200 rpm
      – All pits read at same speed
How CDRs are written

• Green
  – Cyanine dye
  – Easier to read and write
  – (was) Less UV stable

• Gold
  – Phthalocyanine dye
  – (were) Hard to read and write
  – Inherently UV stable
Reflective Layer of CD-R

- Gold
  - Expensive
  - Doesn’t oxide (rust)
- Aluminum
  - Inexpensive
  - Vulnerable to “CD Rot” if air gets to it due to damage or defect
Labeling CD-Rs

- **Paper Labels**
  - Deform
  - Acrylic adhesive feared (not proven) to react with lacquer (protective) layer
- **Unlabeled**
  - Serial number (unique to each CD-R) is recorded separately
  - If list is lost, media is unlabeled/unidentifiable
- **“Special Markers”**
  - Untested
- **Ink Jet**
- **Thermal Transfer**
  - Generally require special extra coating on lacquer for printing

- Do any of these technologies interact with the media?
  - No test data available
MiniDiscs
Basic Traits

• Prerecorded
  – Similar to CDs
  – Single shutter for playback only

• Recordable
  – Considerably different than CDs and Prerecorded
  – Two shutters
  – Magnetic head physically touches disc surface when recording
MiniDiscs
Preservation Issues

- Propriety Format
- Magnetic Fields
- UTOC Error
Questions?

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