SHORT GUIDELINES FOR VIDEO DIGITISATION

1. PREFACE

Video digitisation of analogue sources is based on many principles and procedures well known and applied on audio material. However, a few important differences require some extra care and additional tasks.

In most cases, the incoming source material will be on magnetic tapes; therefore this guide will be focused solely on video tapes.

1.1 Source Material

Over the last decades numerous video recording systems based on magnetic tapes appeared on the market. Generally, because of the steadily advancing knowledge of tape manufacturing and recording systems technology, space required for video data on the tape decreased substantially despite some later developments for improved picture quality that resulted in higher signal bandwidths which in turn asked for more "real estate" on the tape.

Initially, video tapes were mainly open reel devices; later on cassettes became the dominating container and will now represent the vast majority of incoming material for archives (W_16).

Video tapes may in general be younger in age than average audio tapes to be digitised. Nevertheless, poor storage conditions will have similar effects on the tapes to those already experienced with audio tapes. It pays to ask for (or even better: inspect) these conditions in order to know what to expect from the tapes. Workflow shortcuts are supported by information about the type of recording (used standards, recording system), brand of tape if not obvious, duration of recording, as well as information about the content.

1.2 Playback equipment

The variety of tapes and recording systems force the archiving community to provide adequate playback hardware. After decades most of these systems are obsolete, no new playback equipment is available. Archives depend in most cases on used and well maintained playback machines. The acquisition of those machines can be a tricky task. While some lucky buys at eBay may bring success, the main source for used playback equipment may be the market for used professional and broadcast machines, usually offered by distribution channels with strong ties to these institutions or companies. These companies usually check the machines regularly and in some cases also can provide service manuals - important for archives that have their own technicians.

Naturally, an archive will adjust its purchasing strategy following an evaluation of the possible sources of video material. Rare formats will probably better be outsourced for digitisation.

The playback equipment should be checked regularly for dust, possible misalignments and worn-out magnetic heads . A rough estimation of operating hours will help to set the service intervals, especially for the replacement of the magnetic heads (which, in most cases, will be done externally because of the necessary alignment tools). (W_17, W_11)

Solid information about video recording techniques and good descriptions of mechanical and electronic parts involved are given in (B_E_1, B_G_1, B_G_3)

2. TAPE PREPARATION

Tapes may arrive as open reel tapes (hopefully in a container) or as cassettes in a paper or plastic box.

2.1 Possible damages on the tape

For the initial check it is a good idea to use human senses as suggested in (W_12).

The paper describes how to inspect both the container and the tape optically for mechanical or chemical/physical damages (fungus), how to detect and interpret any smell (caution! possible health hazard) and how to feel abnormalities (stickiness, dampness, greasy touch).

Mechanical problems (damaged edges or inadequately used adhesive tape) on the tape will more likely lead to a breakdown of that particular part of the tape during the playback process, compared to audio because of the complex tape mechanism and thus higher stress on the tape. As a consequence, more parts of the tape may be damaged by the playback machine when the broken tape becomes caught by some moving parts of the tape transport mechanism.

Likewise, overlooked chemical damages can lead to excessive and irreversible damage to the tape. The magnetic layer may separate from the carrier, thus permanently destroy the tape.

Heavy damage must in any case be inspected and treated by an expert. (W_13, W_15)

2.2 Cleaning of tape and cassette

Dirt on the tape or the container must be removed carefully using conventional cleaning equipment (small vacuum cleaner, feather duster, soft brush or clean linen), provided it is done in an area that does not otherwise contaminate other tapes or the playback equipment.

In any case, excessive or unknown contamination should be dealt with by experts; mistreatment could lead to non-correctable damage. Dust particles, e.g., could be pressed into the magnetic layer permanently if cleaning procedures are applied the wrong way.

Naturally, a careful inspection of the reel or the cassette is a must and will occasionally lead to a replacement in order to avoid a possible mechanical damage to the playback equipment. Especially on small cassettes there is always a chance that the fragile front cover (the part that protects the tape and is lifted by the playback machine's tape extraction mechanism that pulls out the tape from the cassette) is blocked by an adhesive label, or damaged. (W-14)

2.3 Initial check during first playback

It pays to wind and rewind the tape at least once, starting with the playback mode (low speed), watching the monitor for signs of damage or faulty tape transport (e.g. friction because of a cassette problem). In addition, information can be gained about the content and the distribution of video material on the tape (e.g. more than one section of video, separated by unrecorded parts). Depending on the system, this can be detected through the tape counter and thus helps to find all recordings even without any information about the tape).

3. SIGNAL CAPTURING

3.1 System setup, connections

The playback machines will very likely be of different age, and consequently the signal quality, especially the parameters associated with constant tape transport speed, may vary. It may be necessary to include a synchroniser module to stabilise the incoming signal for the capture station.

If possible, the playback head should be positioned exactly on the video track on the tape to deliver the maximum output signal. Some machines perform this task automatically. Otherwise, this is done by adjusting the tracking control knob for maximum output on the associated meter.

The various video formats (W_1, W_5) are accompanied by different interfaces, referring not only to mechanical connections, but - more important - occasionally to two or three signal quality levels (e.g. composite or Y/C). Therefore it will be necessary to provide a dedicated hardware module between the playback machines and the capture station. Naturally, the user should select the highest signal quality for the transmission from the player to the digitising system.

3.2 Parameter and software setup

If the capture station allows data ingest in an uncompressed form, the system should be set for this quality level. Depending on the system the output format will be either a proprietary file or one of the more open formats (like MJPEG2000) that allow uncompressed data, too. Otherwise,

the necessary compression level should be set as low as possible (thus accepting the higher data rate and larger storage space for better quality; B_E_4). If possible, intra-frame compression should be selected, especially when single frame processing is a must for the subsequent access. One example of the latter would be the popular DV-AVI file.

Because of the enormous demand for storage space when working with uncompressed video signals it is a good idea to check the available space on the internal hard disk. One hour of uncompressed video (Standard Definition) requires about 75 GByte of space.

Usually, the capturing hardware will already have a fixed digital word length and sampling frequency, according to international standards (I_1, I_2, I_3, I_4). If these parameters are adjustable, the highest possible numbers should be selected. The increase in required storage space from 8 to 10 (or 12) bit word length is of minor importance for immediate watching of the digitised video, but further processing will be easier (with less rounding errors). The standard ITU-601 form for digitised signals is defined for 8- and 10-bit word length, with 13,5 MHz (Y-signal) and 6,75 MHz (U and V signal) sampling frequency. Assuming nearly error-free analogue-to-digital converters (achievable with today's technology), this seems to be sufficient for normal subsequent processing of a Standard Definition (SD) video signal.

Any kind of additional video signal processing during the capturing and digitising procedures should be avoided (like de-noising, sharpening etc.).

The audio signal that comes with the video may be a mono or stereo signal; the quality may vary, depending on the recording standard of the video format. In any case, the capture station should be set to "CD"- or "DAT"-quality level. This will guarantee a digitisation with 16 bit word length and 44.1 or 48 kHz sampling frequency. Careless recording on the original video tape will probably result in low signal levels, so level adjustments to use the full 16 bit space of the digital domain might be necessary. No further processing should be applied to the audio signal (e.g. de-noising).

3.3 Supervision of procedure, quality control, final storage

If possible, the capturing process should be monitored constantly to enable a rapid reaction on any changes (blocking transport mechanism of the cassette, misalignment of the tracks etc.).

The final file should be duplicated at least once and the two copies should be stored in different places.

Quality control activities (from simply verifying the written data to more sophisticated procedures like reading out the monitor chips of backup tape cassettes) should be applied within defined intervals and the results should be carefully evaluated. Also, occasional checks of the playback machines with respect to speed stability (wow and flutter) are advisable, either by an in-house technician or by a professional company.

All activities accompanying the capture procedure should be noted in the database, as long it is of importance for the interpretation and further processing of the video material.
Relevant metadata will usually accompany the digitised material, either in the archive's data base or/and in the file container itself. The data should follow one of the accepted standards (e.g. Dublin Core compatible) and put into the metadata section of the file, if available (B_E_5). One of the newer, already standardised file containers already in use is the MXF (Material Exchange Format) Container (B_E_3, W_10). But also for older formats enough information can be gained from the Web (W_1, W_8, W_9).

4. REFERENCES

The following gives a short overview of information covering video basics, format questions, standards, preservation issues and glossaries. Many companies operating in the field of video recording or digitising will provide additional information on their web-pages. The major professional institutions not only give regular recommendations but also make suggestions for standardisations or develop these by themselves.
Institutions involved in archiving frequently have additional information and operating guides on their web-pages, e.g. I_6 and I_8.

As practical experiences show, even non-technical archivists appreciate access to written material covering basics of video technology, video- and audio recording and digitising, so 2-3 books covering these subjects should be available at the archiving studio.

BOOKS:

English:

B_E_1 John Watkinson: "Television Fundamentals";
Focal Press, ISBN: 0-240-5411-4

B_E_2 Charles Poynton: "Digital Video and HDTV - Algorithms and Interfaces";
Morgan Kaufmann Publishers, ISBN: 1-55860-792-7

B_E_3 Nick Wells (Ed.), Bruce Devlin, Jim Wilkinson: "The MXF Book";
Focal Press, ISBN: 0-240-80693-x

B_E_4 Cliff Wootton: "A Practical Guide to Video and Audio Compression";
Focal Press, ISBN: 0-240-80630-1

B_E_5 Mike Cox, Linda Tadic, Ellen Mulder: "Descriptive Metadata for Television";
Focal Press, ISBN: 0-240-80730-8

B_E_6 Brad Gilmer: "File Interchange Handbook";
Focal Press, ISBN: 0-240-80605-0

German:

B_G_1 Elmar Götz-Meyn, Walter Neumann: "Grundlagen der Video- und Videoaufzeichnungstechnik";
Hüthig Verlag, ISBN: 3-7785-2640-5

B_G_2 Ulrich Schmidt: "Digitale Film- und Videotechnik";
Fachbuchverlag Leipzig, ISBN: 3-446-21827-0

B_G_3 Ulrich Schmidt: "Professionelle Videotechnik";
Springer Verlag, ISBN: 978-3-540-24206-2

B_G_4 Johannes Webers: "Film- und Videotechnik;
Franzis Verlag, ISBN: 3-7723-7116-7

B_G_5 Arne Heyna, Marc Briede, Ulrich Schmidt: "Datenformate im Mediabereich";
Fachbuchverlag Leipzig, ISBN: 3-446-22542-0

WEB:

W_1 Wikipedia (Formats, Compression, Standards)

W_2 Charles Poynton Homepage: Video Basics
http://www.poynton.com/

W_3 Basics of Video
http://lea.hamradio.si/~s51kq/V-BAS.HTM

W_4 PAL Video Standard
http://www.mtxindia.com/An1.htm

W_5 Video Signals and Formats
http://www.epanorama.net/links/videosignal.html

W_6 World TV Standards
http://www.acvl.org/acvl_manual/world_tv_standards.html

W_7 Video Recording Principles
http://www.broadcastbuyersguide.com/bbg/editorial/features/edit_2/4

W_8 Videouniversity
http://www.videouniversity.com/article2.htm

W_9 John McGowan: "John McGowan's AVI Overview"
http://www.jmcgowan.com/avi.html

W_10 Pro-MPEG Forum: MXF Information
http://www.pro-mpeg.org

W_11 Magnetbandtechnik (German)
http://www.useddlt.com/magnetbandtechn0.0.html

W_12 SpecsBros: Video/Audio Tape Restoration
http://www.specsbros.com/whitepaper.html

W_13 Recovery of Damaged Media
http://www.uark.edu/staff/drp/drpap002.htm

W_14 Videotape: Care and Handling
http://preserve.harvard.edu/bibliographies/videotapehandling.pdf

W_15 Magnetic Tape Deterioration
http://www.vidipax.com/tidal.php

W_16 Videotape Identification and Assessment Guide
http://www.arts.state.tx.us/video/identify.asp

W_16 Leader: Video: Technical Application Notes
http://www.leaderusa.com/web/application.htm

W_17 Tektronix: Video Glossary
http://www.tek.com/Measurement/App_Notes/25_15215/eng/

W_18 Videoscope: Video Glossary
http://www.videoscope.com/services/w.htm#Reference%20Video%20Signal

INSTITUTIONS (Video Technology, Preservation Issues):

I_1 EBU - European Broadcasting Union
http://www.ebu.ch/

I_2 ITU - International Telecommunication Union
http://www.itu.int/net/home/index.aspx

I_3 NAB - National Association of Broadcasters
http://www.nab.org

I_4 SMPTE - Society of Motion Pictures and Television Engineers
http://www.smpte.org

I_5 INA - Institut National de l'Audiovisuel
http://www.ina.fr/index.en.html

I_6 IASA
http://www.iasa-web.org/

I_7 FIAT-IFTA
http://www.fiatifta.org/cont/index.aspx

I_8 AMIA - Association of Moving Image Archivists
http://www.amianet.org/index.php

I_9 ICA - International Council of Archives
http://www.ica.org/

I_10 Centre for Long Term Digital Preservation
https://ldb.project.ltu.se/projectweb/portalproject/EnglishWeb.html

I_11 USA - National Archives, Preservation Professionals
http://www.archives.gov/preservation/

I_12 Video Active Group
http://videoactive.wordpress.com/