



Need for Integration of Physical and Virtual Media Asset Systems

Abstract

Many media and entertainment-based organizations are currently examining various Digital Asset Management (DAM) systems and attempting to develop a digital asset management strategy to handle the increasing volumes of content passing through their facilities. All such organizations, however, have large amounts of media content already stored in various tape and film formats, including analog and digital formats, in various states of preservation. Most content owners will find that the most effective systems will support well-organized, searchable and controlled libraries of physical assets with a combination of appropriate DAM systems for their particular applications. A well thought out, comprehensive system will optimize the utility of existing libraries containing huge amounts of content, allow new content to be produced and stored in virtual formats, maintain integrated access to all of these materials, and allow easy extraction, conversion and metadata generation from library materials.

Introduction

Many media and entertainment-based organizations are currently examining various Digital Asset Management (DAM) systems and attempting to develop a digital asset management strategy to handle the increasing volumes of content passing through their facilities. These systems promise improved organizational flexibility for the production process, universal — yet controlled and secure — availability of critical materials within large television network, studio or corporate organizations, more cost effective distribution. These systems also can ideally reduce the cost of creating, storing and distributing rich media content.

All such organizations, however, have large amounts of media content already stored in various tape and film formats, including analog and digital formats, in various states of preservation. Some facilities have well organizing libraries and excellent storage conditions; their assets are safe, secure and can be quickly located and duplicated. Other facilities are not quite so organized; their media libraries may be in jeopardy due to deteriorating materials and/or inadequate inventory control systems that have allowed precious media assets to be lost or stolen.

These existing libraries have real value. Some of them contain millions of unique assets that cannot ever be recreated, including news and sports footage, feature film outtakes, original camera negatives and so on. In addition, these libraries are so large that it makes no economic sense to attempt any sort of wholesale conversion to a file-based digital format.

DAM systems are coming into the market rapidly and most large media organizations are actively implementing such systems. In order to be truly useful, though, such systems must integrate control and access of existing libraries with the media assets stored in new virtual environments.

This paper examines the relative advantage and disadvantages of inventory control systems for media libraries and DAM systems and the need for any successful DAM system to be integrated with physical asset management systems.

Effective Inventory Control Buys a Lot

Many of the problems to be addressed by DAM systems have been solved successfully over the years within film and tape vault facilities with sophisticated inventory control techniques integrating hardware, personnel, software and physical storage systems. These systems have been evolved over many years and also draw on techniques and practices from a wide variety of industries, from clothing manufacturing to the distribution of automobile parts. Proper application of these techniques helps very large asset collections stay organized, reduces duplication, ensures high levels of security and keeps costs low.

Media assets are, of course, fundamentally different from most other physical items that must be warehoused, transported and controlled. For instance, media assets can be cloned; this simply is not possible for most other types of assets. Media assets can be duplicated in a wide variety of formats which are not interchangeable, but which do not alter the fundamental characteristics of the content. For example, a feature film might appear in a library in dozens of film and video formats, in many different languages, with different sub-titling and with numerous different edits. Even in all these formats, the basic content itself will remain the same; “The Wizard of Oz” is still “The Wizard of Oz”, whether it is stored on a Digital Betacam videotape with a 4x3 aspect ratio, NTSC video in French with Spanish subtitles or stored on multiple reels of 35mm film with audio appearing on a separate set of 35mm mag reels. Effective inventory control and ordering systems for a media environment take these factors, and many more, into account and allow users to easily understand the differences and similarities between all of the various assets stored in the system. For all these reasons, inventory and warehouse management concepts that may be adequate for other industries are generally lacking for a media environment.

Many media libraries have ineffective methods for controlling their assets. They may have multiple, incompatible databases, paper-based systems, a combination of both or even nothing at all. Some databases may contain corrupt, inconsistent data and many redundancies. Some assets may not be cataloged at all, but take up space in the vaults.

Content owners must carefully consider the value of:

- Ability to locate all media assets
- Eliminate unnecessary duplications
- Ability to audit movement histories
- Reduce personnel required to maintain library
- Ability to reduce storage space requirements

These factors generally justify investment in an effective inventory control system for media assets.

Large Libraries Have Real Value

Large media libraries are a fact of life and they cannot be easily or cost-effectively eliminated. For newsgathering and sports organizations, this problem is particularly acute. The vast majority of the items in their libraries will never be needed. However, these collections certainly contain media assets that will, at some time in the future, be incredibly valuable and useful to the organization. The classic example of this is the 16mm film clip showing a 16-year-old Bill Clinton shaking hands with President John F. Kennedy. We can all think of examples of old footage that became extremely useful when the “ordinary” people in the shot rose to fame, glory or infamy.

Media assets are generally expensive to create and cheap to store using traditional methods. Once film or tape assets are created, it seems unlikely that content owners will routinely destroy them, even if DAM

systems is available with the same assets, given the relatively low cost of storing the hard asset for later re-use.

For these reasons, very few news or sports organizations plan to willingly destroy their media collections. They have them in place now and they keep growing, and they know that some small part of the library will have value in the future; however, they do not know which tape or films to keep. The best solution requires maintaining everything in properly cataloged systems so that the assets can be identified and retrieved when they do become of interest.

Advantages and Disadvantages of Physical Media Libraries

Libraries of physical media assets enjoy several real advantages:

- They already exist. The content owners do not need to take extraordinary measures to keep them alive and growing. They incorporate many years of content and usually contain thousands of hours of unique material that cannot be re-created or is unavailable from any other source.
- It is relatively expensive to generate film and tape assets. Once they are created, it is relatively cheap to store them properly. There is a highly developed infrastructure of independent and internal facilities that make proper storage easy. With so much content already in storage, this is also a competitive business which helps keep prices low. In addition, there are wide ranges of storage services available, from highly secure, environmentally controlled underground vaults to self-service facilities in most major cities.
- For most applications, 35mm film is, in particular, well understood as a long-lived, robust and extremely high-resolution format for moving images. Film assets made with current polyester stock and emulsions have a useful life of at least 50 years and probably much longer. Most videotape assets will be useful for at least ten years and generally much longer. Analog audiotape assets will last 20 years or more.
- Physical media assets are actually very secure given the limited deployment of professional equipment. For instance, very few feature films are pirated from release prints due to the relative unavailability and high cost of telecine equipment. Video pirates also do not have easy access to professional VTRs. Today, the sources of most pirating are stolen media files, home capture of broadcast material into personal computer systems and camcorder capture of feature films.
- Many content users will continue to require physical delivery formats for many years to come. We must remember that most people believed that personal computers and office networks would ultimately result in the “paperless office”. Instead, we have created more and more productive tools to generate increasing amounts of paper. Most postproduction houses still maintain C-Format VTRs today, since many broadcasters still request this format for program and commercial delivery, even though C-Format machines went out of production in the early 1990’s. We can expect that Digital Betacam and other current formats will continue to be useful and popular distribution formats for many years. These formats are fairly robust and the tapes can be used many times without significant loss of program information. Once assets are created in these formats, it makes economic sense to maintain them in an organized library for re-use.

Physical libraries also have disadvantages:

- They are large and require lots of space. This is not a problem if the organization can support a facility in a relatively low-cost location, but makes access to the assets less convenient. This factor leads to a perceived high cost of storage for library materials.
- They keep growing. News channels, prime television producers, feature film companies and sports broadcasters generate huge amounts of programming every year. With the advent of new forms of distribution, including DVD, the Internet, VOD and other consumer technologies, content owners are loathe to destroy any media assets that may have future value. Outtakes, production notes, “bloopers”, and other like content can become extremely useful as promotional tools and special “add-ons” to promote and/or resell content. Who would have thought that old Quad tapes of game shows from the 1960’s would be valuable? But now there is a whole network dedicated to showing these programs.
- All physical assets will deteriorate over time. This process can be significantly slowed with proper storage techniques (including the use of reduced temperature and humidity environments).
- Limited lifetime of videotape and digital audio formats. This is the biggest problem facing media libraries. Video formats change frequently and finding machine to play legacy material can be a real problem. There are specialized restoration services, of course, and nearly all videotape material can be recovered using such services; however, this increases the cost and reduces the convenience of accessing the materials. Digital audio formats also change frequently and are in many cases more difficult to deal with; viewers of archive video footage may forgive a few glitches in the picture more readily than listeners will forgive audio drop outs and other problems. Analog audiotape has shown excellent archival characteristics and is typically much easier to recover than digital audio formats.
- Lack of easily accessible and directly associated metadata. Many libraries did not set up the software systems needed to properly track and maintain searchable text-based descriptive information about the media assets. This can make locating the desired asset difficult, time-consuming and expensive and also requires that the archived materials be played through, which can reduce their life expectancy.
- Perceived difficulty of delivery to end-users. Although there are numerous duplication and delivery services, many content owners are dissatisfied with the ease and cost associated with retrieving assets from their libraries.

Advantages and Disadvantages of DAM Systems

Some, but not all, of the weaknesses seen in physical libraries may be addressed by DAM systems. However, DAM systems will suffer from their own problems:

- Lack of solidly established standards for media and metadata storage. This is a major issue and there are numerous industry and government initiatives (most notably AAF — Advanced Authoring Format) that are seeking to address this problem. However, there is no guarantee that any file format for storing media content and metadata will remain viable indefinitely. Any DAM system must therefore support transparent background copying/conversion functions to take advantage of new formats and new storage technology. This increases the cost of truly effective and useful systems.
- Perceived concerns about content security. Many content owners are worried about unauthorized people obtaining access to valuable media files stored in an on-line system. In order for on-line systems to be truly useful, most applications will require at least some access to be available through the public Internet. There are a number of ways to maintain security in these systems;

nonetheless, no security system is perfect and determined hackers may find ways to view or download protected files.

- High initial cost of deployment. The software required to provide effective DAM solutions is complex; the associated hardware is expensive. Even though storage costs are coming down rapidly, the very nature of media assets mean that they require increasing amounts of capacity.
- Limited throughput and high processing costs will not allow complete “digitization” of existing libraries. The sheer size of existing media libraries makes it impractical to ingest all of these materials into a DAM system. Some libraries have millions of hours of content in them. Even if the cost per hour to ingest material were less than one dollar (including personnel, equipment, and relating facilities overhead), it will be very hard for any organization, including government agencies, to justify this level of spending. It is easy to cost-justify transferring selected assets from a library into a DAM system; it is impossible to justify the wholesale transfer of large libraries.
- Once in a DAM system, media assets are committed to a conversion and upgrade treadmill. With each new generation of storage media and systems and file formats, a conversion will be required. New storage systems will be more cost-effective and faster and media files will be transferred to these new systems to help save space and reduce operating costs. Most of these conversions will be automatically, but the DAM system owners must understand that they are committing to a continuous investment in new storage systems and upgrades. DAM technology will advance quickly and new applications and requirements will emerge, requiring on-going investment in infrastructure.
- Relatively high cost of storing digital video assets with sufficient resolution for all possible applications. This is, in particular, a major issue for feature film and primetime television program material. 35mm is an extremely mature medium and provides excellent image fidelity and long life. Only the most storage-intensive digital file formats (“2K” or “4K”) match or exceed the resolution of film. Given that future release formats may require the highest possible image quality, the archival storage of such assets in a DAM system is, for now at least, much more expensive and problematic than using the analog alternative.

DAM systems advantages will include:

- Extensive, searchable metadata. This is a key, sustainable advantage for DAM systems. Metadata, including production information, annotations, contract rights and other critical data can be directly and permanently associated with the media assets. This will make distribution, program development and all other activities associated with the assets more cost effective and efficient.
- Fast delivery of media assets using telecommunications infrastructure. Once the asset is in a file format, users can use the global telecommunications system to transport files quickly. The costs of moving the largest, highest quality files over wires are still relatively high and often uncompetitive with traditional physical delivery. However, these costs are coming down and, in the future, we can expect that most media files will be shared and distributed using telecommunications systems rather than express delivery services.
- Full integration with sophisticated contract rights and licensing management systems. The complete integration of ownership and rights information with the media itself will enable new revenue streams, increase incremental revenue, and reduce unlicensed use of the assets.
- Potentially very high standards-based security. Digital Rights Management is still relatively new and the technology is advancing rapidly. Truly effective, efficient and secure systems will be available that will allow assets to be easily moved, shared and distributed. The use of DAM technology will allow organizations to more easily make use of these emerging security tools.
- The easy, ready and highly searchable access to media assets provided by DAM systems can open up new revenue streams. Content owners might allow consumers to browse and download material using the Internet. Other distribution formats, including DVD and VOD, are excellent

outlets for alternate versions of movies (“directors’ cuts” and so on) and outtakes. DAM systems should help make the assembly, distribution and control of the assets for these applications efficient enough to be profitable, releasing new value from existing content.

Costs of Storage

There are hard costs associated with storing media assets in any form. The specific annual costs vary according to video format and storage conditions. Table 1 shows annual storage costs for several different formats of motion images. These figures are based on underground storage in a temperature and humidity controlled environment. Actual costs will vary depending on the vendor and the quantity of items to be stored.

Table 1 — Annual Storage Costs for Physical Media

Format	Typical Annual Storage Cost
D1 videotape cassette	\$2.05
D5 videotape cassette	\$2.05
C-Format one-inch tape reel	\$4.25
35mm film (three 20 minute reels)	\$4.25

The annual storage costs above are based on rates from commercial vault operations and include the amortized cost of building and maintaining the facility, as well as associated personnel and service costs.

Table 2 shows the typical costs associated with creating physical assets:

Table 2 — Cost of Duplicating Physical Media

Format	Typical Duplication Cost
D1 videotape cassette (60 minute)	\$210
D5 videotape cassette (60 minute)	\$305
C-Format one-inch tape reel (60 minute)	\$120
35mm film (three 20 minute reels — IP from timed internegative)	\$5,940

The duplication costs shown above include the cost of the raw stock and duplication service.

Table 3 shows the combined cost of generating and storing these same formats for ten years:

Table 3 — Ten Year Costs for Physical Media

Format	Typical Ten Year Cost (Including One-Time Duplication, Storage and Estimated Overhead)
D1 videotape cassette (60 minute)	\$622
D5 videotape cassette (60 minute)	\$765
C-Format one-inch tape reel (60 minute)	\$817
35mm film (three 20 minute reels — IP from timed internegative)	\$8,974

Table 3 includes a 50% overhead allocation to cover processing, shipping and other miscellaneous costs associated with maintaining the assets.

Content owners may find that it is more cost-effective to own and operate their own storage facilities. If a suitable structure is available, the latest estimate for construction and installation costs for a temperature and humidity controlled vault, including large rolling shelving systems, is \$275 per square foot. This estimate includes the cost of the building improvements required, but not the building itself.

DAM systems are new and it is harder to estimate the true costs of storage. In addition, the media can be stored in a wide variety of compressed formats; at this time, the industry has not standardized on “acceptable” levels of compression for archival storage of media assets.

Table 4 shows typical per Gigabyte costs for various types of digital file storage systems that may be used as part of a complete DAM solution:

Table 4 — Initial Per Gigabyte Costs for DAM Storage

Format	Typical Initial Cost (Including Storage Systems and Media)
Tape-based robotic storage	Less than \$2 per Gigabyte
CD/DVD robotic system	\$ 19 per Gigabyte
Hard disk storage system (RAID 3 or better)	\$100 to \$300 per Gigabyte

Robotic tape-based systems obviously offer the best value based on capacity. In addition, these systems can automatically duplicate tapes as they find read errors or as new tape drive and media technology is introduced. This can extend the data life indefinitely.

Different DAM Systems for Different Applications

Our industry produces huge varieties of content in huge quantities. No single DAM system will be best for all application, just as no single videotape format is accepted as optimum for all possible uses. (At last count, there are at least 29 different videotape formats in active use in professional applications today.)

It should also be noted that DAM systems have many applications outside our industry, including government, medicine, manufacturing, insurance, aerospace and security. Requirements in some of these other areas will drive development of systems for the news, sports and entertainment media markets.

Already, the market for DAM systems is segmenting. This is surprising given how new the technology is. In order to maximize their market share and sales, DAM system developers will productize their systems to focus on some combination of the following characteristics:

D A M C o n t i n u u m

Short Form (Commercials and Music Videos)	Long Form Television (Sitcoms)	Long Form Television (Episodics)	Feature Film	Corporate
Easy To Implement	Complex, Multi-Function Systems	Web-based ASP Business Model	Traditional Software Licenses	Integration with Other Production Tools (e.g., Avid, Discreet, Quantel, etc)
Easy To Use	Limited Capability for Low Price	Expensive and Very Capable	Use Existing Hardware	Integrated with Application- Specific Hardware
Still Images	24 Frame Capture	Video (480i, etc)	Finished Program Audio	Multi-Track Audio
Very High Resolution	Broadcast Quality	Streaming Quality	Lower- Resolution Proxies for High Resolution Images	Computer Graphics
Collaboration During Content Creation	Archive for Completed Program Material	Distribution and Fulfillment	Contract Rights Management Integration	Library System Integration

Putting It All Together

It seems clear that the industry will embrace and use DAM technology for new media assets as they are created and for existing media assets that become financially interesting. Most facilities will continue to store existing physical assets. They will use DAM systems to make the production process more efficient and enable more effective distribution. These systems do carry high implementation costs, but will ultimately reduce operating costs and allow facilities to produce more program material in more formats with fewer people.

In all of these cases, most content owners and producers will find that the most effective systems will support well-organized, searchable and controlled libraries of physical assets with a combination of appropriate DAM systems for their particular applications. The best systems will integrate access and searching capabilities for the virtual assets stored in DAM systems with physical assets stored in libraries. A single interface will allow users to browse files, search for specific assets, review contract rights, create

or order duplicates and format conversions, and distribute content to other users, no matter whether the content is stored in a DAM system, a library or both.

A well thought out, comprehensive system will build on the inventory control techniques developed over the past 100 years and extend them significantly. Content will exist in physical and virtual formats simultaneously. A complete system will optimize the utility of existing libraries containing huge amounts of content, allow new content to be produced and stored in virtual formats, maintain integrated access to all of these materials, and allow easy extraction, conversion and metadata generation from library materials.

Ultimately, the extremely low cost of thin plastic strips with chemical coatings (videotape and film), combined with the low cost of adequate warehouse space will mean that the industry will be handling and storing film and tape assets for a very long time. Successful DAM implementations must be integrated with library management systems in order to provide cost-effective solutions the theatrical and television production industry.

END

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