

# CINEMA DISTRIBUTION IN THE AGE OF DIGITAL PROJECTION

CHARLOTTE CROFTS

It has become almost axiomatic to state that the transition to digital technologies represents a momentous period of change for the cinema. As Angelo D'Alessio of the *European Digital Cinema Form* suggests, "the Cinema industry is confronting unparalleled levels of complexity, dynamic change and pressure to innovate." But it is the final move to digital distribution that signals a complete paradigm shift for the industry: "the recent introduction of digital technologies into the final links in the production and distribution chain is, in fact, a 'tipping point' that fundamentally changes the industry's economics and practices" ("Digital Dilemma" 8).

The rollout of digital distribution is contingent upon the wider infrastructure, the adoption of digital projection by the cinema operators, and the provision of digital content, so there is some unavoidable cross-over into the areas of cinema exhibition and production in the following discussion of what is a complex and rapidly shifting ecology of interests at stake in the conversion to digital cinema. As Marcus Weiss noted back in 1999 on the eve of the first wave of digital projection, "for these changes to take place, they must be accepted by the creative community, the production studios, the distributors, the exhibitors and finally the public". For as long as cinema has been a business, there have been close connections between production, exhibition and distribution and this is ever more true at this time of unparalleled technological change. As a result, it is often difficult to separate these strands of the industry. However, this essay is about distribution, so I will confine my observations to this, touching on exhibition, production and reception only to highlight connections.<sup>1</sup>

In this paper I explore the different ways in which digital projection has been adopted by the cinema distribution and exhibition industries in the UK, the European Union (EU) and the United States, arguing that whilst in America digital projection has largely been embraced on a commercial basis, in Europe, where there was initially a slower take up of digital distribution, there has been a tendency for governments to subsidize the technology for cultural reasons. I examine the current state of digital projection, exploring why has it taken longer for digital technologies to permeate into distribution and exhibition (as opposed to image capture and post production), and looking at the aesthetic and economic drivers and challenges which have delayed the full-scale conversion to digital cinema (D-cinema). The essay ends by exploring the dilemma of digital distribution for the viability of the 35mm release print, the impact of this on film stock production, and how this will affect film preservation, even of those films that are born digital.

## 1. Digital Rollout

### 1.1 The Current State of Play

One of the key issues is the question of why, despite the apparent pace of change, it is taking so long for digital distribution and exhibition to become universal, and why distribution is so far behind other areas of the industry in its adoption of digital technology. Whereas high-definition digital image capture and particularly the "Digital Intermediate" (DI) have been embraced for some time in the realms of production and postproduction respectively, distribution is still lagging behind. Although things are moving swiftly, we are further away from a completely digital distribution system than might be expected. Despite the rapid increase in the rate of worldwide

conversion to D-Cinema, or high-end digital screens (those conforming to the DCI specification of 2K<sup>ii</sup> or more), we are not yet at 100% roll out. The current pace of change is so fast that it is difficult to keep up with the statistics; however, drawing on intelligence data from *Screen Digest*, *UK Film Council Statistical Yearbook*, amongst others (figure 1), it is clear that after the first wave of digital projection in 1999 there was initially a very slow uptake of digital distribution until 2005 when things began to take off. Momentum gathered in 2009, with the success of *Avatar* (Cameron) and developments in 3D. But even by year-end 2010, only 24% of worldwide screens were digital, with 38% of UK and 42% of US screens having been converted.

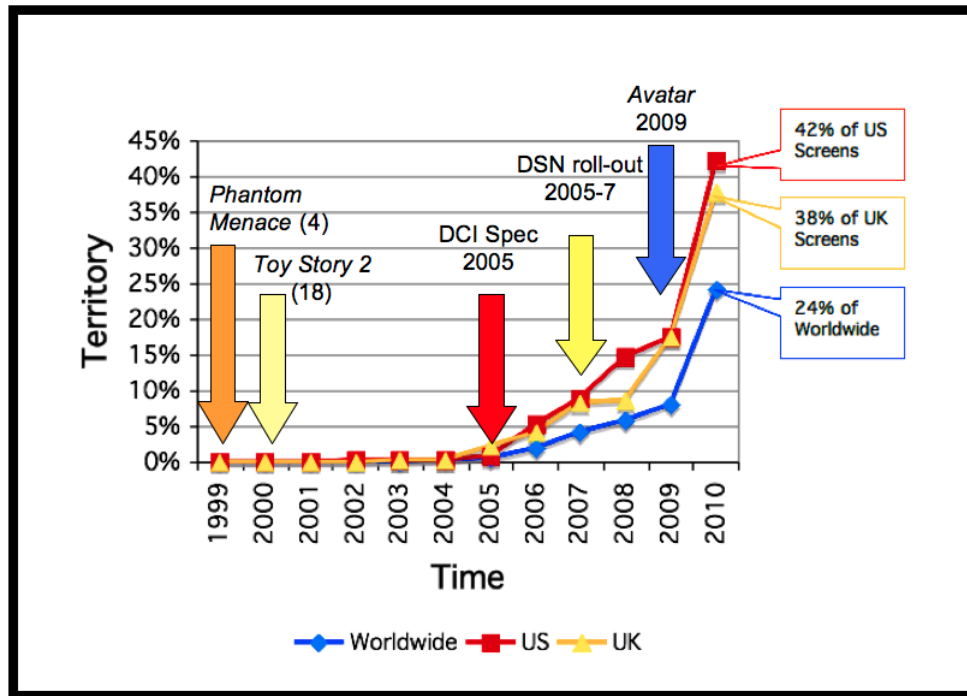


Fig.1. Digital Roll-out by Territory to Year-End 2010<sup>iii</sup>

The adoption of digital cinema only really started to gather steam in 2005 when the DCI Specification was agreed and concerns about interoperability and piracy were addressed (both discussed in Sections 3.2 and 2.4 respectively). In Britain this also coincided with the UK Film Council’s Digital Screen Network, which rolled out between 2005-7. However, the current upswing began in 2009, once the digital infrastructure had enough critical mass to demonstrate a business case to exhibitors who were sitting on the fence, and it has been largely powered by Virtual Print Fee agreements (see Section 3.3.1), 3D and, increasingly, Alternative Content.

It is interesting to note that the US is losing its lead in the race to convert, increasing by 42% in 2009, compared to a 196% increase in Europe, with France being the European leader, and the UK coming in second. Asia is rapidly catching up, with an increase of 137%, particularly China, “with about 3 screens added per day, a faster pace than anywhere else. Within five years, the country should have 20,000 screens, more than triple its current total. And unlike in the U.S., most of the new screens are digital and 3-D capable” (D’Altorio).

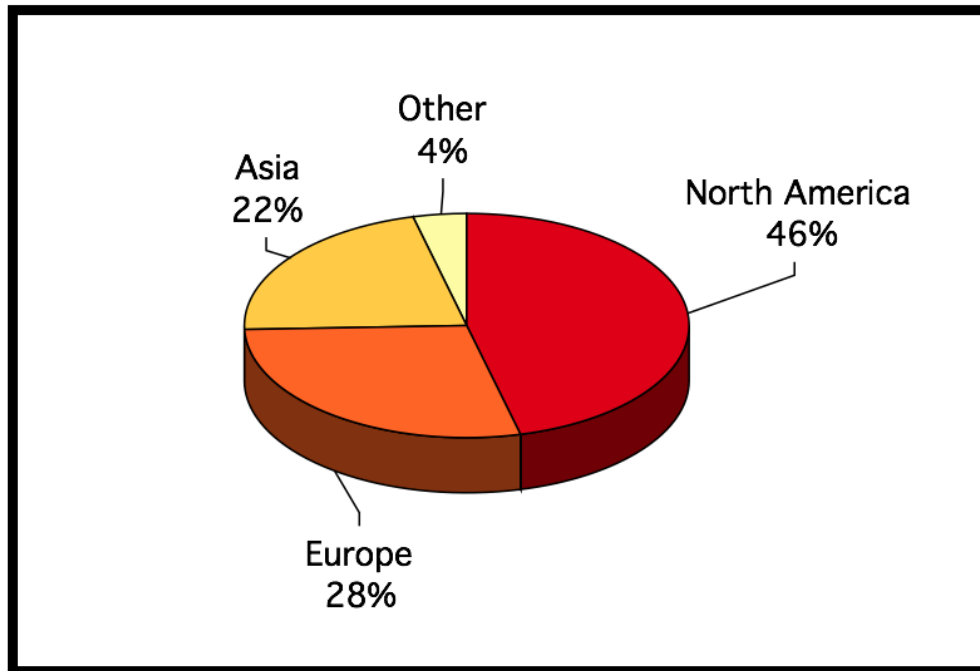


Fig.2. Worldwide share of digital screens by the end of 2010<sup>v</sup>

At the time of writing, therefore, the majority of screens worldwide are still using 35mm film projection. Which means that, during this transitional period, a dual-distribution system is operating, with film still running along-side digital projection. This is unwieldy both for programmers and distributors (Cosgrove). Without having a blanket digital infrastructure digital distribution is impossible, as distributors still have to operate with both 35mm film release prints and Digital Cinema Distribution Masters (DCDMs). According to Karagosian, “it’s the distributors that will hurt with mixed installations” (“Tracking When”). As Karagosian points out:

Naturally, distributors need all screens converted to digital in order to complete the transition to digital distribution. But the majority of these new screens weren’t installed under a deployment agreement. No monies are committed to fitting out the remaining screens with digital projectors, leaving a less-than-desirable footprint of projection technologies that requires dual film and digital distribution. While 2009 was witness to an incredible growth in digital screens the question we were left is how will the industry make the transition to 100 percent digital projection? (“Year 11”)

Even as early as 1999, Lucasfilm’s Rick McCallum had identified that one of the key obstacles to the conversion to digital cinema was the need for “business as usual” operation in the exhibition industry: “the infrastructure is so locked in, it will take years to accomplish digital distribution” (Putman). The current increase in pace towards digital conversion could be fuelled by a sense of urgency to end this dual-distribution gridlock:

Industry professionals have recognised that the digitization of cinemas is an irreversible trend, and that it is crucial to reduce the transition time in order to minimise the extra costs of simultaneously maintaining two distribution methods, and the ensuing difficulties for some films in obtaining distribution (Lauvaux).

There is disagreement about precisely when distribution will finally become entirely digital.

David Hancock predicts 127,000 digital screens by 2015, which is still just under 85% of worldwide screens (“Digital Screen Numbers”). Karagosian predicts that in the United States film “cutoff” will be complete by 2018 or later, with the rest of the world contingent upon “a range of factors including which regions use English language prints, where VPFs have been pushed, where VPFs haven’t been pushed and where government subsidies exist” (“Tracking”).

## **2. Digital Adoption – The Key Drivers**

### **2.1 Aesthetics and Workflows**

The key argument for digital distribution is one of aesthetics. Digital projection offers a cleaner image than film:

Although in today’s cinema, copies have a very good quality the medium deteriorates fairly quickly and has to be replaced to maintain a good show quality. Typical prints suffer degeneration through repeated use, color drift, cracks in audio etc. These are all eliminated with digital projections (Kirovski *et al* 228).

Back in the early days of digital projection, the studios were keen to arrive at an all-digital workflow, but at that time film projectors were seen as the “weak link in the chain” (Putman). According to McCallum, producer of *Star Wars Episode 1 - The Phantom Menace* (Lucas 1999) - the first film to be digitally distributed, albeit in just four theatres - “the idea was to create a system where you’re in a completely digital realm. Not only the digital arena where you capture the images, but most importantly in the distribution process, in a way where there is no loss of quality from one print to the next” (Putman). From a cinematographer’s perspective, the ability to control the end product and know that it will be the same every time it is projected (rather than deteriorating every time it passes through the projection gate), remains a strong driver for digital projection. Founder of the *Cinematography Mailing List*, Geoff Boyle states that digital projection is not a patch on a pristine 65mm print (“The Look”), but “once a 35mm print goes off on its rounds you’re lucky to get 1.3K in real terms, DCI really does do better than this” (Personal Email).

### **2.2 Cost**

Another key incentive driving the conversion to digital cinema is the cost saving for distributors in the manufacture and transportation of release prints. With digital distribution, there are two available systems of delivery: streaming via high-speed internet cable or dedicated satellite link or, more commonly, shipment by express courier on specialist hard disks, which are designed especially for use with digital cinema servers. Both of these methods do away with the costly and cumbersome 35mm release print (one feature film requires roughly 10 reels of film weighing approximately 4Kg [8.8lb] per reel, plus packaging). According to McCallum:

The six major studios spend \$850 million a year to have release prints made. Getting a driver to pick up the print, take it to the airport, having another driver pick it up at the airport where it is going, plus the freight and the insurance add over \$450 million a year. So, you’re talking between \$1.2 to \$1.3 billion a year in distribution costs (Putnam).

Whilst Weiss claims that “the economics become obvious,” the potential savings of the digital release print are currently not experienced by all distributors, as they have to pay what’s known as a Virtual Print Fee (VPF) to help finance the equipment (as I explain in section 3.3.1 below).

### 2.3 Sustainability – or Greenwash?

There are also clearly environmental costs in the manufacture and transportation of the film stock. Cinedigm – one of the major 3<sup>rd</sup> party integrators and alternative content providers – claims that D-cinema is greener, than film:

Today, we all know we need to do what's best for the environment. In the movie world, digital cinema rather than old style 35 millimeter film IS what's best for the environment. ... So even when movies need to be trucked, the carbon emissions footprint is smaller due to smaller, lighter shipping containers" ("Digital Cinema is Green").

However, these claims disregard the issue of electronic waste or, rather appropriately, WEEE (waste electronic and electrical equipment). As I have argued elsewhere, "the equipment obsolescence cycle for anything computer based is so short that it negates the absence of environmental damage from photochemical processes. Whilst film generates a great deal of carbon and uses dangerous chemicals in its manufacture and processing, it will last for several centuries; film projection equipment also has a proven longevity. But digital projectors and/or servers are likely to have to be replaced every two years, and the RAID or MAID array storage of digital data burns kilowatts of power a year" ("Digital Decay" 31, n48)<sup>v</sup>. This is not to mention the environmental cost of the electricity used to power and cool the data storage servers (see "Digital Dilemma" Section 4 below).<sup>vi</sup> There is therefore the problem of what happens to this "Digital Detritus" (Weber): all the toxic raw materials and rare metals, such as lead, cadmium, mercury, chromium, used in the manufacture of digital equipment. Whilst some of the manufacturers do offer "computer take back" (Christie, NEC), it is naïve to think that digital distribution is automatically "greener" than film.

### 2.4 Piracy

Back in 2003 Microsoft Research on Digital Rights Management (DRM) identified piracy as one of the perceived threats of digital distribution. Notwithstanding the alleged benefits of digital cinema:

The studios are still reluctant to jump into the digital age. An important concern regarding digital and conventional cinema is the danger of widespread piracy. Piracy already costs Hollywood an estimated two billion dollars annually, and digital cinema without proper copyright enforcement could increase this number (Kirovski, Peinado and Petitcolas 1).

In their paper, Kirovski, Peinado and Petitcolas set forth a distribution protocol for digital content which is very similar to the one later adopted by the first DCI specification in 2005 (described in Section 3.2).

A digital print is formed when the content, or Digital Source Master (DSM) is shaped into a Digital Cinema Distribution Master (DCDM) which conforms to the DCI specification (*Sustainability of Digital Formats*). This is then compressed and encrypted for transport to the theater as a DCP (Digital Cinema Package, also known as a Digital Cinema Initiatives Package) which uses an encryption key or KDM (Key Delivery Message) to unlock the digital print which is then unpackaged, decrypted, and decompressed back into the DCDM when it is "ingested" onto the theater's digital cinema server for exhibition. Each KDM contains a unique, time-limited security key for the movie that will only work on one digital cinema server, and only if that server is connected to an authorised projector, which means that if the KDM is delivered to the wrong server or wrong location then "it will not work and thus such errors cannot compromise the security of the movie" (Karagosian, "Digital Cinema Technology").

However, the KDM, as with other forms of digital rights management, is a double-edged sword (see Scahill). The very technology intended to protect against piracy could be misused by

distributors to control exhibitors' access to media and influence their programming and this could be one of the factors that is inhibiting exhibitors from adopting the new technology. As Karagosian points out:

If misapplied, electronic security could become a tool for forcing changes in their business relationship. Electronic security brings with it the potential of electronically driven business controls in the form of *digital rights management* that could bias the business relationship in favor of distributors. Here again, a business discussion is required to bring confidence to business partners before equipment is widely installed (Karagosian, "Motivating Factors").

As Richard Warren of Brief Encounters Film Festival asserts, the UK Film Council's aims to increase access to specialized film by installing the Digital Screen Network have been hampered by the DCI specification:

The key point is the KDM. Despite the best intentions of the creators of the DCP system, rather than making the cinema screens accessible to all filmmakers they actually run the risk of restricting the screening abilities of independent filmmakers by insisting on the encoding restrictions that independent filmmakers can't afford.<sup>vii</sup>

Nevertheless, anti-piracy measures remain a driver for adoption, afforded by new developments in digital distribution technology. According to Weiss:

Piracy is a major, if not the major concern of producers and distributors. As soon as the first print is made of a film it is subject to theft in a variety of ways. By digitizing and encrypting the images much as the cable and satellite companies do with television signals, it is possible to sharply curtail theft of material. The systems developed for safeguarding the storage and transmission of features are extremely sophisticated and while not bullet proof, as nothing is, are of such complexity as to provide excellent protection (Weiss).

As Michael Karagosian points out "piracy offers several significant motivating factors for digital cinema":

Piracy is a problem generally associated with digital content, but in the case of digital cinema, piracy could become an ally. With digital, it will be much easier to provide forensic marking of movies, as with fingerprinting technologies, to trace camcorder theft ("Motivating Factors").

## **2.5 Digital Access**

Another often-overlooked advantage of digital distribution is in the area of accessibility (see "Access to the Cinema"). As Karagosian points out, "one of the possible benefits of digital cinema is access for those with visual and auditory disabilities" ("Enabling the Disabled"). The digital release print represents a cost saving for the distributor because it is easier and cheaper to release multiple versions of a digital print, in comparison to subtitling a film print: "if a caption is printed directly on the film print, then the film print is no longer useful for non-caption showings. Worst case, for the studio, this approach doubles the number of prints that must be distributed" (Karagosian, "Enabling the Disabled"). There have been recent advances towards agreeing a standard specification for closed caption technology and audio description, with multiple delivery systems emerging in a competitive market, including wireless cup-holder displays and closed caption glasses (Karagosian, "Update").<sup>viii</sup>

### **3. Digital Logjam – Obstacles to Adoption**

So why in 2011 are we still waiting? One of the key issues is that the different parties have different interests and the current business model needs to change.

#### **3.1 Film’s Reliability as a Medium**

One of the issues that initially stalled the take up of digital cinema distribution is the fact that film technology is reliable, interoperable and universal – giving exhibitors little incentive to “upgrade”. As Karagosian points out, “film has been with us over 100 years. The maturity of the technology has allowed the movie exhibition business to operate on narrow margins that only allow cinema owners to upgrade their equipment every 15 years or so” (“Is A Digital”). The cost-saving impetuous for the distributors is not shared by the exhibitors who lack any incentive to invest in expensive digital equipment when their conventional film projectors work perfectly well already (Katz et al). Film projectors are comparatively cheap and easy to maintain, compared to digital cinema systems, which comprise a computer server on which to store the digital media, as well as the projector itself – both of which become obsolete more quickly than the previous technology and are more expensive to replace and maintain.<sup>ix</sup>

#### **3.2 The Need for Standardization**

Another initial barrier to the roll out of digital projection has been the issue of standardization of file format, image resolution and the need for an agreed specification to match the international interoperability currently enjoyed by 35mm film. As Cohen points out, “distributors want a single standard, not a repeat of the release print digital sound rollout, when competing proprietary formats forced studios to produce prints in three or more versions”. Writing in 2002 the ITU (International Telecommunications Union) identifies the need for “global cooperation” in the search for a standard:

To ensure worldwide D-cinema interoperability for this new audiovisual service, end-to-end standards will be required, and such D-cinema standards are now under study in several standards organizations around the world (MPEG, EDCF, SMPTE, ISO, IEC, etc.) and in at least three industry groups (DVB, MPA and NATO). More importantly, ITU, as a UN-treaty organization, is responsible for international standards involving radio-frequency spectrum, satellite, cable, and terrestrial broadcasting as well as for international production, postproduction, and recording standards for international programme exchange (“Digital Cinema”).

To tackle this issue of standardization, the *Digital Cinema Initiatives* (DCI) was formed in 2002 by six major Hollywood studios (Disney, Fox, Paramount, Sony Pictures Entertainment, Universal and Warner Bros.).<sup>x</sup> According to their website, “DCI’s primary purpose is to establish and document voluntary specifications for an open architecture for digital cinema that ensures a uniform and high level of technical performance, reliability and quality control”. The first DCI specification (Version 1.0), published in 2005, was developed from work carried out by SMPTE (the Society of Motion Picture and Television Engineers) and ISO (the International Standards Organization), amongst others and is built upon standards, such as the Motion JPEG 2000 for moving images and PCM/WAV (Waveform Audio File Format) for sound. Version 1.1, and an addendum on stereoscopic 3D, were released in 2007, followed by Version 1.2 in 2008. As Buckingham is keen to point out, whilst it has been pushed forward by the Hollywood studios “it’s actually not a DCI standard, it’s an ISO standard. It’s an international standard: Hollywood drove it but it’s not a Hollywood standard” (Personal Interview).

### 3.3 Conflicting Business Interests

From the beginning, one of the key issues has been, and still remains, the conflicting interests of the various stakeholders, and the question of who should pay?

#### 3.3.1 The Virtual Print Fee Model

The exhibitors clearly think that the distributors should pay. According to the UK-based *Cinema Exhibitors' Association* website:

While the benefits to the cinema-goer will become increasingly apparent, it remains the case that the key financial benefits from these developments accrue to the distributor ... The CEA therefore strongly believes that it is the studios and distributors, rather than the exhibitors, who should meet the bulk of the costs for this transition (*Cinema Exhibitors Association*).

And, according to Greg Steiner:

Theaters have argued (rightfully so) that since the studios are saving an estimated \$2,000 per print by distributing digitally, a portion of those savings should go to help theaters pay for the cost of installing the new digital projection equipment. The plan calls for these fees to be paid out over the next eight to ten years. Presumably, once the projection equipment is paid for in full, these fees would no longer be assessed (Steiner).

This became known as the Virtual Print Fee (VPF) model. According to *Arts Alliance Media* (AAM)<sup>xi</sup>, the VPF is a method of financing the conversion to digital projection whereby a third party “integrator” (such as AAM) takes the financial and technological risk involved in outlaying and maintaining the equipment, recouping the cost over an agreed period (ten years in the case of AAM) via payments mainly from distributors (but also from exhibitors who pay a “usage and maintenance fee”):



**Fig.3. Virtual Print Fee (VPF) diagram showing the three-way relationship between distributor, exhibitor and third-party integrator (Source: “Virtual Print Fee Questions”).**

The payments represent the savings that distributors make by not having to make and transport 35mm release prints. VPF is the method through which the majority of US screens are becoming digital and it is dominated by the major Studio-backed distributors, but it is increasingly becoming the module used in Europe: “My belief is that the studios will continue with VPFs, in Europe at least, longer than in the US” (Karagosian, “Tracking When”). The actual fee is calculated using a “turn rate”, an indicator of the programming policy of each cinema. According to Buckingham, “the result is a relation between the number of films screened and how close to the film’s release date they were screened, using a simple scoring system” (“Supporting D-Cinema”). The fee declines according to the week release number.

There are concerns about the VPF, namely its impact on independent distributors and specialized film. In fact, at the moment it is often not cheaper for independent films to be



distributed digitally. According to Peter Buckingham, director of the recently abolished UK Film Council's Distribution and Exhibition wing and chair of the Roll-out Working Group of the European Digital Cinema Forum, digital prints can often be more expensive than film. Speaking at the *Europa Cinemas Network Conference 2010*, Buckingham reveals that

With the advent of digital technology, the labs have radically reduced the price of 35mm prints, which now often cost less than digital prints in the UK. On a case by case basis, we've shown that for digital releases with less than 51 screens, just one single film would actually save money. For releases with less than 150 screens, only subtitled films in the original version would save money. The VPF model is thus primarily adapted to big releases and doesn't allow distributors of small films to save money (*Europa Cinemas*).

Whilst films with a WPR (Widest Point of Release) of over 240 screens do experience a cost saving with digital distribution, worryingly, as Buckingham points out, "all of the independent English language films in this sample using this VPF rate would have paid higher release costs than had they released on 35mm (assuming they all have a discounted rate of at least 20%)" ("Supporting D-Cinema").

Buckingham highlights the problems of financing the conversion to digital projection using the VPF model from the perspective of both cinema exhibitors and distributors:

The stress is coming from two sides, one: certain cinemas are not going to be able to engineer enough VPFs and therefore may go out of business. On the corresponding side, certain cinema releases may have some or vastly increased costs, because of the nature of the VPFs which would adversely affect the distribution of independent films, specifically on platform releases" (Buckingham, Personal Interview).

Buckingham continues, "there is a very rapid understanding that actually one of the kernels of this, which was to decrease the cost of distributing a print, was actually a good thing and is now under threat from the VPF model" (*ibid.*).

### 3.3.2 Digital Shortfall

A further problem has been highlighted by the European Commission: "The current commercial financing models rely primarily on VPF payments ... The VPF model may not provide a sufficient revenue stream for smaller and arthouse cinemas offering European programming" (*European Commission*" 6). David Hancock from *Screen Digest* has dubbed this the "digital shortfall" ("Digital Cinema Moves"). Hancock estimates that the total cost of European digital conversion will be 2,123 million Euros, most of which will be funded by the VPF or the exhibitors themselves, but he foresees a shortfall of 465.6 million Euros (see figure 4) for those "art-house screens, part-time cinemas, multi-arts venues, and repertory cinemas ... most at risk of failing to find funding for conversion to digital" (*ibid.*):

**Image Removed Due To Copyright Restrictions**

**Fig.4. European Digital Shortfall (Source: Hancock, “Digital Cinema Moves”).**

According to the *European Digital Cinema Forum* (EDCF), the “current VPF deal is just not compelling” for many exhibitors (Monk, Buckle and Lambrechsten). As Hancock asserts:

The rapid progress of the digital cinema conversion in many countries is requiring an equally rapid appraisal of how to cover costs for those cinemas that may not fit into a commercially-funded conversion model leaving around 4-5,000 European cinema screens that need to find a funding solution outside of these routes (Hancock, “Digital Cinema Moves”).

Karagosian elaborates, “following the expiration of VPF rollout periods, the growth rate of digital screens will dramatically reduce, and the incentive to convert the remaining screens will be driven by competition in the marketplace and the pending termination of film distribution” (“Tracking When”). However, as Hancock suggests, “this does not mean these screens are necessarily at risk of closure, but it does underline that other approaches must, and are, being found” (“Digital Cinema Moves”). Two different solutions seem to be emerging in Europe: government subsidy and independent funding groups. In the UK the *Cinema Exhibitors’ Association* has set up the UK Digital Funding Group, “bringing together a group of exhibitors to use scale to organise a rollout” (Hancock, “Digital Cinema Moves”; see also “Digital Funding Group”). Funding groups are also being set up in the US within the National Association of Theater Owners’, Cinema Buying Group.

### **3.3.3 Government Subsidy**

Many territories in Europe, along with the *European Commission* MEDIA Programme, are exploring support fund options, as well as “a guarantee system, which will underwrite loans granted to smaller exhibitors for digitization” in France and a tax credit system offered as an incentive in Italy (Hancock, *ibid.*). The digital shortfall is not just an issue for exhibitors, it is also a problem for distributors, particularly in the distribution of specialized film. Given the European Commission’s remit to strive to promote and preserve cultural difference, citing the *UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions*, there is clearly an incentive to subsidize digital conversion. For example, the European Commission has called for “public intervention at national, regional or local level,” suggesting that “if the transition to digital projection causes cinemas to close down, this could clearly jeopardise cultural diversity” (“*European Commission*” 9):

The objective of the European Commission action plan is to create a favourable environment for the digital exhibition of European films. Different initiatives have been and will be launched to support the take-up of and the investment in new digital technologies. With the help of the European Structural Funds and the new MEDIA scheme, the ultimate objective of the Commission is also to promote European citizens’ access to digital cinema (“*European Commission*” 10).

In the UK, the conversion to digital distribution was kick-started by the government funded, UK Film Council’s Digital Screen Network, which was developed specifically to increase the distribution of specialized film. Peter Buckingham says:

Our motto was no cinema left behind and no distribution release adversely affected. Both of which are still at risk and nothing at the moment that’s been done either here or in Europe has so far said that this has been solved, apart from France who’ve just passed a law on it and Norway who own the cinemas anyway. But in the more free market, or the areas where subsidy is slightly less collective and spasmodic, which at the moment is the rest of Europe,

both of those things are still absolutely hugely problematic and no-one's particularly found a solution about it (Buckingham, Personal Interview).

### **3.3.4 e-Cinema**

A worrying issue for distributors is whether a two-tier distribution system will emerge as a strategy to fill the digital shortfall. The quandary is whether cinemas should be allowed to go down the e-cinema route, using digital projection equipment that does not conform to the DCI standard. I asked Peter Buckingham what would happen if cinemas that are the second, third, fourth run cinemas chose to go down this route, as is happening in Ireland and elsewhere?<sup>xii</sup> He saw this as “very, very dangerous”, particularly for independent distribution (Personal Interview).<sup>xiii</sup> But e-cinema is being put forward as an alternative to the DCI specification by government bodies, such as the European Commission. As Hancock suggests,

The EC [European Commission] states that the use of public money should be undertaken with a view to preventing closure of cinemas with a high proportion of art-house programming and should follow the principle of technological neutrality, funding digital projection equipment that the exhibitor thinks is suitable for the particular auditorium and audience, to some extent regardless of wider market considerations” (“MEDIA Programme”).

Citing the Irish digital funding scheme (Hancock, “Ireland”), Hancock warns that “this is fine as long as it is clearly understood by all parties that operating at the lower standard will exclude those cinemas from screening Hollywood and some mainstream European content, for the foreseeable future at least” (“MEDIA Programme”). The politics is that e-cinema is seen as a way to guarantee cultural diversity, “given the duty to explore all options to support European content and cinemas and to act in accordance with EU law, the position is understandable. It seems to suggest that standards are both a good idea and yet can be bypassed to suit the needs of less viable cinemas” (“MEDIA Programme”). However, as Buckingham attests, this is highly problematic:

From a filmmaker, or from a cinematic perspective it's not right for the first time in cinematic history to say that Hollywood deserves a better visual experience on the screen than European or art house cinema, and European and art house cinema is not so bothered about quality of the image of the screen and therefore it is perfectly OK having a second-rate or two-tier system. For me, that breaks 100 years of cinema and it really is a kind of betrayal or misunderstanding of what cinematic experience is really like” (Buckingham, Personal Interview).<sup>xiv</sup>

## **4. Digital Dilemma**

The elephant in the room in this discussion of digital distribution is the increasingly urgent issue of preservation. According to Hancock, there will be “more digital screens than 35mm screens in the world by the end of this year [2011], signifying the beginning of the end for a global format that has served us well for over 100 years and outlasted nearly all of its analog counterparts in other mass media” (“Toward a Global”). Once the distribution chain has become completely digital there will be no need for the 35mm release print, which forms the bulk of film stock manufacturers' trade, and therefore little or no commercial incentive to manufacture 35mm film stock at all.<sup>xv</sup> Film “cutoff” - as Karagosian calls it (“Tracking When”) - whenever it eventually comes, has huge implications for the future exploitation of moving picture assets, given that film is largely agreed to be the safest format for archiving and future proofing even those “films” that are born digital.

According to Kodak, it is commonly held within the industry that “the best way to archive digital imagery is on film”, citing film as US broadcaster “HBO's preferred medium of storage”

("Film is the Only"). There is to date no one stable format or platform for digital preservation, and the risks of digital decay, or "bit rot," and built in obsolescence are yet to be resolved (see Crofts, "Digital Decay" 10-12). Indeed, as I have argued elsewhere, "the standard recommended by the DCI is not suitable for film preservation. Given that it allows for the use of lossy compression, the film data in the form it would be distributed to a DCI-compliant digital projector server would not necessarily be the data one would be aiming to preserve" (*ibid.* 15). As Kodak points out,

There are many issues to discuss such as resolution, file formats, media types etc. But, simply said, digital is not archival. As technology advances and Moore's Law dictates a change in hardware, software and media every 18 months and with the studios receiving petabytes of information on both features and TV production on various media types and file formats, it's an over whelming issue" (Kodak, "Effects of Digital").

There is a general agreement that "because of the degradation of signals and the obsolescence of formats and standards, digital media is much more volatile than film" (Kodak, "The Digital Dilemma"). On the other hand, archival color separations, also known as YCMs (yellow, cyan and magenta), printed on black and white polyester film stock and stored under humidity and temperature controlled conditions have a long track record as a stable and comparatively cheap storage solution (Kodak, "Film is the Only"). It's basic physics. You can't hold a computer disc up to the light and see the image. You will always be able to do this with celluloid.

Whilst we may be suspicious of Kodak's motive, this is not just the opinion of the film stock manufacturers. It is corroborated by an *Academy of Motion Picture Arts and Sciences* (AMPAS), Science and Technology Council report, which states that:

There is virtually unanimous agreement within the industry that film separation masters, whether created using three-strip or successive exposure techniques, are a safe and affordable archival master. Some may argue that pure born-digital motion pictures (digitally shot or animated with computerized tools) are degraded when film grain, no matter how fine, is added to the images; but the film masters are still well above the historical notion of "highest quality," and are thus far more than capable of delivering the quality necessary and expected for all re-purposed distribution needs ("Digital Dilemma" 51).

Even Pixar Animation Studios, makers of *Toy Story 2* (Lasseter and Brannon 1999), the first movie to have an entirely digital workflow, from production to distribution, concurs. Bill Kinder Director of Editorial and Post Production attests that even though their films are born digital, entirely made up of Computer Generated Images (CGI), they still keep archival color separations on film "so that we have a physical print we can stash away:"

I guess until we've had a hundred years of stable computer files, it's really just speculation whether the files will last. I've seen them not last for even a few years, so, you know. ... Pixar of course has a pretty good understanding of how to preserve data and we have an unbelievable support system for backing up and retrieving files. But until someone comes along and says not to I'll always say it's a good idea to keep it on film. (Kinder, [!!!])

Film storage is also cheaper than digital. According to Kodak, the cost of preserving digital content is estimated to be "11 times more expensive than film" (Kodak, "Film is the Only"). This is supported by Michael Cieply who, responding to the publication of the "Digital Dilemma" report, warns that "digital productions face higher preservation costs" than 35mm productions, "to store a digital master record of a movie costs about \$12,514 a year, versus the \$1,059 it costs to keep a conventional film master". What is interesting is that those costs increase when you take

into consideration the sheer amount of data generated by digital productions and the issue of built-in obsolescence which requires that data to be regularly transferred to the latest format. As Cieply argues:

To keep the enormous swarm of data produced when a picture is ‘born digital’ ... pushes the cost of preservation to \$208,569 a year, vastly higher than the \$486 it costs to toss the equivalent camera negatives, audio recordings, on-set photographs and annotated scripts of an all-film production into the cold-storage vault” (Cieply).

Again, it is also important to factor in the ecological cost here, given the huge amount of resources, not to mention electricity, needed to manufacture and maintain the storage servers. Thus, one of the perceived advantages of digital distribution, the cost and environmental savings of not having to create and transport bulky 35mm release prints, may in fact be transitory. Any short-term savings not already consumed by the Virtual Print Fee payments, need to be offset against the longer-term cost (both monetary and ecological) of maintaining the archive.

Given that a third of the major studios’ income is derived from the back catalogue (according to Global Media Intelligence, cited in Cieply), the cost of backing up all that data (or indeed the cost of not backing it up) is profound. This is causing increasing concern in the industry, as the AMPAS report goes on to warn:

We have heard from several studios that the growth of alternate digital distribution channels – television, Internet, mobile, and so on – has fractured yesterday’s relatively simple asset and inventory management process and corporate structure, and expectations for future fulfillment do not always match up with the realities of current practice (“Digital Dilemma” 52).

With the library being the most profitable wing of the film industry, this has huge implications for the longevity of the medium and screen heritage in general. The cinema release is just the shop window for the film “asset” which becomes “content” to be exploited in perpetuity across a network of digital “platforms” from DVD and Blu-Ray Disk to HD broadcast and VoD (video on demand). But without the means to preserve it, that content might not be available for exploitation by all the platforms that haven’t even been invented yet. In its wholesale conversion to digital, then, cinema is just as at risk of what has been termed the “digital Dark Ages” as any other electronic storage medium (Bollacker; Kuny). It is important at this critical moment in cinema’s history, to reflect on the impact that this shift to digital has on the film archive and our ability to preserve it. Having written about this very issue in 2008 (“Digital Decay”) it is disturbing to return to the subject three years later to find that the situation still remains largely the same.

## **5. Conclusion**

Writing about the conversion to digital distribution in the midst of this period of momentous technological and, indeed, cultural transition is a complex but fascinating business. It allows us to reflect on other significant moments of change in the history of cinema distribution (the shift from nitrate to acetate stock, the coming of purpose-built cinemas, sound, color, widescreen, etc.), with an awareness that they were equally complex, involving a delicate balance between the interests of numerous stakeholders: exhibitors, distributors, studios, independents, manufacturers, filmmakers and audiences. It certainly undercuts the ideology of “progressive technological determinism” put forward by the manufactures (and some academics) in which technology is seen as seamlessly evolving into some perfect future form, rather than technological change being socially, politically and historically situated and contested (Winston). As argued elsewhere:

as with other technological developments in the history of film, standardization seems to be not necessarily about choosing the best long-term resolution, but a question of the economics of scale, whereby the industry has compromised in order to encourage early adoption of the technology” (Crofts, “Digital Decay” 15).

Digital distribution is here to stay. A rapid increase in take up in recent years has been fuelled by the VPF model, the attraction of 3D and Alternative Content and their potential to provide premium revenue streams for exhibitors, with Europe and Asia currently increasing their share of digital screens at a faster rate than the United States. Whilst there is disagreement about precisely when “film cut off” will occur, and what exact impact this will have on the production of 35mm film stock, the “digital dilemma” identified by the Academy back in 2007 remains unresolved. Ironically, the very studios that banded together to agree a digital distribution standard are affected by the very lack of an agreed preservation standard. Changes in digital technology have:

tended to arrive piecemeal, and so rapidly that the industry has not yet had a chance to step back and consider the digital revolution and its long-term implications as a whole. Even some of the artists who have been the most evangelical about the new world of digital motion pictures sometimes seem not to have thoroughly explored the question of what happens to a digital production once it leaves the theaters and begins its life as a long-term (if all goes well) studio asset” (“Digital Dilemma”, Foreword).

If as much effort went into developing an agreed digital storage standard as went into the DCI Specification, then the future of our moving image heritage might be more secure.

#### WORKS CITED

- “Access to the Cinema”. *Royal National Institute for Deaf People (RNID)*.  
<[http://www.rnid.org.uk/howyoucanhelp/campaignwithus/ourcampaigns/key\\_issues/access\\_to\\_entertainment/cinema\\_subtitling/](http://www.rnid.org.uk/howyoucanhelp/campaignwithus/ourcampaigns/key_issues/access_to_entertainment/cinema_subtitling/)> Accessed: 20 March 2011.
- Bollacker, Kurt D. “Avoiding a Digital Dark Age”, *American Scientist*. 98.2 (2010), 106.
- “Bollywood Scores a First in Adopting Digital Cinema”. *India Daily*. 22 Dec 2005.  
<<http://www.indiadaily.org/entry/bollywood-scores-a-first-in-adopting-digitalcinema/>>  
Accessed: 19 Feb 2011.
- Boyle, Geoff. Personal Email. 20 Mar 2011.
- . “The Look: Exhibition and Display”. *The Look From Capture to Display: Digital Cinema Aesthetics and Workflows Symposium*. University of Bristol. Watershed Media Centre, Bristol, England. 1 April 2011. Panel Discussion with Charlotte Crofts.
- Buckingham, Peter. Personal Interview. 3 Dec 2010. Unpublished.
- . “Supporting D-Cinema with Data”. *Europa Cinemas 15<sup>th</sup> Network Conference*. Paris, 18-21 Nov 2010. Powerpoint presentation.
- Bhushan, Nyay. “Bollywood Billions: Indian Distribution and Production Change with the Times”. *Film Journal International*. 1 Dec 2008.  
<[http://www.filmjournal.com/filmjournal/content\\_display/news-and-features/features/movies/e3i72ce5cb5941da1cd05399b795709e311](http://www.filmjournal.com/filmjournal/content_display/news-and-features/features/movies/e3i72ce5cb5941da1cd05399b795709e311)> Accessed: 19 February 2011.
- British Film Advisory Council (BSAC)*. <[www.bsac.uk.com](http://www.bsac.uk.com)>.
- Cinema Buying Group*. <<http://www.cbgpurchasing.com>>.
- Cinema Exhibitors Association*. <<http://www.cinematuk.org.uk/keyissues/digitalcinema/>>.
- Cinematography Mailing List*. <<http://www.cinematography.net/index.htm>> Accessed: 20 Mar 2011.
- Cieply, Michael. “The Afterlife Is Expensive for Digital Movies”. *New York Times*. 23 December

2007. <<http://www.nytimes.com/2007/12/23/business/media/23steal.html>> Accessed: 20 Mar 2011.
- Cohen, Steven B. "Digital Distribution: It's Tantalizingly Close, But Many Issues Remain Unresolved". *The Editors Guild Magazine*, Vol. 23, No. 4 - July/August 2002. <[http://www.editorsguild.com/v2/magazine/Newsletter/JulAug02/digital\\_distribution.html](http://www.editorsguild.com/v2/magazine/Newsletter/JulAug02/digital_distribution.html)>
- Cosgrove, Mark. Head of Programming, *Watershed Media Centre*, Bristol, UK. Personal Interview. 16 July 2010.
- Crofts, Charlotte. "Digital Decay". *The Moving Image* 8.2 (2008): xiii-35.
- . "The Look: Exhibition and Display". *The Look From Capture to Exhibition: Digital Cinema Aesthetics and Workflows Symposium*. University of Bristol. Watershed Media Centre, Bristol, England. 1 April 2011. Panel Discussion, with Geoff Boyle.
- D'Alessio, Angelo. "Digital Cinema Review". *The Digital Cinema Revolution: EDCF Symposium*, Rome. 21 Oct 2009. Powerpoint Presentation. <[http://www.edcf.net/edcf\\_docs/D'Alessio%2021Oct\\_09\\_D-Cinema\\_Rome.pdf](http://www.edcf.net/edcf_docs/D'Alessio%2021Oct_09_D-Cinema_Rome.pdf)>
- D'Altorio, Tony . "The Chinese Film Industry Is Set To Surpass North America's". *Daily Markets*. 1 March 2011. <<http://www.dailymarkets.com/stock/2011/03/01/the-chinese-film-industry-is-set-to-surpass-north-america's/>> Accessed: 10 March 2011.
- Dean, Tacita. "Save Celluloid, For Art's Sake". *The Guardian*. 23 Feb 2011: 22
- "Digital Cinema". *International Telecommunications Union News Magazine*. Jan 2002. <<http://www.itu.int/itunews/issue/2002/01/digital-cinema.html>> Accessed: 20 Mar 2011.
- Digital Cinema Initiatives*. <<http://www.dcimovies.com/>>.
- "Digital Cinema is Green". <<http://www.cinedigm.com/digitalcinemaisgreen.html>> Accessed: 9 April 2011.
- "Digital Cinema Up and Running: Accelerating Roll-Out in the US while Europe Pause to Reflect". *Screen Digest*, April 2007.
- "The Digital Dilemma: Strategic Issues in Archiving and Accessing Digital Motion Picture Materials". *Academy of Motion Picture Arts and Sciences (AMPAS), Science and Technology Council*. 2007. <<http://www.oscars.org/science-technology/council/projects/digitaldilemma>>.
- "Digital Funding Group to Be Formally Established". *Cinema Exhibitors' Association Limited*. 8 January 2010. <[http://www.cinemauk.org.uk/mediacentre/\\_81/](http://www.cinemauk.org.uk/mediacentre/_81/)> Accessed: 20 April 2011.
- Europa Cinemas: 15<sup>th</sup> Network Conference Report*. 18-21 Nov 2010. Accessed: 9 April.
- "European Commission Communication on the Opportunities and Challenges for European Cinema in the Digital Era". 24 Sept 2010. <[http://ec.europa.eu/culture/media/programme/overview/consultations/docs/COMM\\_PDF\\_COM\\_2010\\_0487\\_F\\_EN\\_COMMUNICATION.pdf](http://ec.europa.eu/culture/media/programme/overview/consultations/docs/COMM_PDF_COM_2010_0487_F_EN_COMMUNICATION.pdf)> Accessed: 9 April 2011.
- European Commission MEDIA Programme*. <[http://ec.europa.eu/culture/media/index\\_en.htm](http://ec.europa.eu/culture/media/index_en.htm)>
- European Digital Cinema Forum*. <<http://www.edcf.net>>
- "G&D; DCP; Demystified". *Capture Playground*. <<http://wearecapture.com/blog>> Accessed 7 April 2011.
- Goode, Ian. "Cinema in the Country: the Rural Cinema Scheme - Orkney (1946-67)". *PostScript: Essays in Film and the Humanities*, Vol. 30, No. 2 (current issue).
- Hancock, David. "Digital Cinema Moves Into the Mainstream". *Screen Digest*. 21 June 2010.
- . "Digital Screen Numbers and Forecasts to 2015 Are Finalised". *Screen Digest*. 26 January 2011.
- . "Ireland Opens Up Second Round of Digital Cinema Funding". *Screen Digest*. 14 October 2010.
- . "MEDIA Programme Launches Digital Cinema Strategy". *Screen Digest*. 25 Oct 2010.
- . "Toward a Global Majority: Exhibitors Embrace D-Cinema at Accelerated Pace". *Film Journal International*. 24 March 2011. <<http://www.etcenter.org/2011/03/toward-a-global-majority-exhibitors-embrace-d-cinema-at-accelerated-pace-3d-screen-count-data/>> Accessed: 8 April 2011.

- Hancock, Simon. "Iceland Looks to Serve the World". *BBC Click*.  
 <[http://news.bbc.co.uk/1/hi/programmes/click\\_online/8297237.stm](http://news.bbc.co.uk/1/hi/programmes/click_online/8297237.stm)> Accessed: 20 April 2011.
- Hefflinger, Mark. "Digital Cinema Screen Conversions Rose 121% in 2010". *Digital Media Wire Daily*. 9 Feb 2011. Accessed: 9 April.
- ITU – *International Telecommunications Union*.  
 <<http://www.itu.int/itu-news/issue/2002/01/digital-cinema.html>> Accessed: 27 April 2011.
- Karagosian, Michael. "Digital Cinema Progress Report for 2009". April 2009.  
 <<http://mkpe.com/publications/d-cinema/reports/2009-april-cinema-report.php>> Accessed: 20 April 2011.
- . "Digital Cinema Technology: Frequently Asked Questions".  
 <[http://www.mkpe.com/digital\\_cinema/faqs/tech\\_faqs.php](http://www.mkpe.com/digital_cinema/faqs/tech_faqs.php)> Accessed: 20 Mar 2011.
- . "Enabling the Disabled to See Movies". *Digital Cinema Report*. 2009.  
 <<http://www.digitalcinemareport.com/digital-cinema-hearing-impaired-SMPTE-standards-closed-caption-closed-subtitle>> Accessed: 20 March 2011.
- . "Is A Digital Cinema Rollout Imminent?". *INS Asia Magazine*. Oct 2004.  
 <<http://www.mkpe.com/publications/d-cinema/insasia/imminent.php>> Accessed: 25 March 2011.
- . "Motivating Factors". *INS Asia Magazine*. Feb 2004. <[http://www.mkpe.com/publications/d-cinema/insasia/motivating\\_factors.php](http://www.mkpe.com/publications/d-cinema/insasia/motivating_factors.php)> Accessed: 19 March 2011.
- . "Tracking When Film Distribution Ends". *Digital Cinema Report*. 15 Mar 2011.  
 <<http://www.digitalcinemareport.com/node/2284>> Accessed: 19 March 2011.
- . "Update On Digital Cinema Support for those with Disabilities". Dec 2010.  
 <[http://mkpe.com/publications/d-cinema/misc/disabilities\\_update.php](http://mkpe.com/publications/d-cinema/misc/disabilities_update.php)> Accessed: 20 March 2011.
- . "Year 11 and We're Still Talking About Rollout". *Digital Cinema Report*.  
 <<http://www.digitalcinemareport.com/Michael-Karagosian-digital-cinema-rollout-technology>> Accessed: 20 March 2011.
- Katz, Mike, Frelinghuysen, John, Bhatia, Krishan. "Digital Cinema: Breaking the Logjam". Booz Allen Hamilton Inc. 2002.
- Kinder, Bill. "'Digital Projections': An Interview with Bill Kinder, Director of Editorial and Post Production, Pixar". *PostScript: Essays in Film and the Humanities* (forthcoming issue).
- Kirovski, Darko, Peinado, Marcus and Petitcolas, Fabien A.P. "Digital Rights Management for Digital Cinema". *Multimedia Systems*. Volume 9, Number 3, Sept 2003, 228-238.
- Kodak. "'The Digital Dilemma' – Academy Report Addresses Future of Today's Films".  
 <<http://motion.kodak.com/motion/uploadedFiles/digitaldilemma.pdf>> Accessed: 18 Dec 2010.
- . "The Effects of Digital on Motion Picture Library Assets".  
 <[http://motion.kodak.com/GB/en/motion/Products/Customer\\_Testimonials/Why\\_Compromise/archive\\_one\\_sheet.htm](http://motion.kodak.com/GB/en/motion/Products/Customer_Testimonials/Why_Compromise/archive_one_sheet.htm)> Accessed: 27 April 2011.
- . "Film Is The Only True Archival Medium: 100+ years of Accessibility".  
 <[http://motion.kodak.com/GB/en/motion/Products/Customer\\_Testimonials/Archive/index.htm](http://motion.kodak.com/GB/en/motion/Products/Customer_Testimonials/Archive/index.htm)> Accessed: 18 Dec 2010.
- Kuny, Terry. "A Digital Dark Ages? Challenges in the Preservation of Electronic Information" *63<sup>rd</sup> IFLA – International Federation of Library Associations and Institutions) Council and General Conference*. 1997.
- Lauvaux, Eric. "Virtual Print Fee to Fund the Digitisation of Cinemas". *International Law Office*, 4 November 2010.  
 <<http://www.internationallawoffice.com/Newsletters/detail.aspx?g=2e54f21d-75d6-4535-aff3-cbfb1ba695db>>. Accessed: 17 April 2011.
- MKPE Consulting LLC. <[www.mkpe.com](http://www.mkpe.com)>.



Monk, David, Buckle, Gerald and Lambrechtsen, Michael. "D Cinema in Europe – Stalled?: An EDCF Overview". *Cinema Expo International 2008*. Amsterdam. June 2008. Powerpoint. *Motion Picture Association of America* (MPAA). <[www.mpa.org](http://www.mpa.org)>.

*National Association of Theater Owners* (NATO). <[www.natoonline.org](http://www.natoonline.org)>.

"Phantom Menace, Digital Edition". *StarWars.com*. 25 Jun 1999.  
<<http://www.starwars.com/episode-i/release/theater/news19990625.html>> Accessed: 20 Mar 2010.

*Pixar Animation Studios Ltd.* <[www.pixar.com](http://www.pixar.com)>.

Putman, Peter H. "A Digital Force: Lucasfilm On Electronic Cinema". 1 Oct 1999. *Digital Content Producer*. <[http://digitalcontentproducer.com/mag/video\\_digital\\_force\\_lucasfilm/](http://digitalcontentproducer.com/mag/video_digital_force_lucasfilm/)> Accessed: 27 April 2011.

*Screen Digest*. <[www.screendigest.com](http://www.screendigest.com)>

Scahill, Andrew. "The Sieve or the Scalpel: The Family Movie Act of 2004, Infantile Citizenship, and the Rhetoric of Censorship". *PostScript: Essays in Film and the Humanities*, Vol. 30, No. 2 (current issue).

Slater, Jim. "Cinema Expo Says... 4K is the Future of Cinema ... For Now At Least!"

Steiner, Greg. "Theatrical Distribution: 35mm Print or Digital Cinema?" 28 Oct 2008.  
<<http://qstationfilms.blogspot.com/2008/10/theatrical-distribution-35mm-print-or.html>> Accessed: 9 April.

*Sustainability of Digital Formats Planning for the Library of Congress Collections*.  
<<http://www.digitalpreservation.gov/formats/fdd/fdd000200.shtml>> Accessed: 19 March 2011.

Swinson, Peter R. "DCI and Other Film Formats". November 2005.  
<[http://www.edcf.net/edcf\\_docs/DCI%20and%20OTHER%20Film%20Formats.pdf](http://www.edcf.net/edcf_docs/DCI%20and%20OTHER%20Film%20Formats.pdf)> Accessed: 20 Mar 2011.

*Terra Media*. <[www.terramedia.co.uk](http://www.terramedia.co.uk)>.

*UK Film Council Statistical Yearbook*. 2009.

*UK Film Council Statistical Yearbook*. 2010.

"Virtual Print Fee Questions and Answers From Arts Alliance Media".  
<<http://www.artsalliancemediacom/vpf/documents/VPFQandA.pdf>> Accessed: 20 April 2011.

Warren, Richard. Programme Coordinator Brief Encounters Film Festival, Bristol. Personal Email. 7 April 2011.

Weber, Daniel. "Digital Detritus: The Growing Problem of Electronic Waste". *Canfei Nesharim Science and Technology Advisory Board*.  
<<http://www.canfeinesharim.org/learning/environmental.php?page=16579>> Accessed: 25 March 2011.

Weiss, Marcus. "Digital Cinema: Marcus Weiss Gives Insight to This New Wave of Digital Technology". *DGA Magazine*. Vol. 24, No. 3 - September 1999, revised 2004.  
<<http://digitalhidef.com/index.php?q=node/5>> Accessed: 20 March 2011.

Winston, Brian. *Technologies of Seeing: Photography, Cinematography, and Television*. London: BFI, 1997.

*White Horse Pictures* <[www.whitehorsepictures.co.uk](http://www.whitehorsepictures.co.uk)>.

## NOTES

<sup>i</sup> Some of the modes and methods of current digital exhibition are explored in my interview with Bill Kinder, Director of Editorial and Post Production at Pixar (see Kinder).

<sup>ii</sup> The DCI (see Section 3.2) specifies two projection resolutions, 2K and 4K. The K stands for a thousand pixels, with 2K having 2048 horizontal pixels. As Swinson asserts, "Kodak identified that original 35mm camera negative could capture resolutions with detail smaller than 12µm

---

[micrometres] in the film's emulsion. To capture this detail would require sampling the film with pixel sizes as small as 6µm. These sampling sizes have translated into a 35mm academy film width sampling of 3656 pixels and for Super35mm sampling width 4096 pixels. This is where 4K is derived from" (Swinson). Interestingly, those early digital projections back in 1999 were only at 1.3K resolution (Slater).

<sup>iii</sup> Based on intelligence from *Screen Digest*, *UK Film Council's Statistical Yearbook 2009 and 2010*, *MKPE Consulting LLC*, *Terra Media*, *Pixar Animation Studios Ltd.*, *British Film Advisory Council (BSAC)*, *National Association of Theater Owners (NATO)* and *Motion Picture Association of America (MPAA)*.

<sup>iv</sup> Based on intelligence from *Screen Digest* and the *UK Film Council Statistical Yearbook 2010*.

<sup>v</sup> RAID stands for Redundant Array of Independent Disks and MAID stands for Massive Array of Idle Disks, both refer to computer data storage systems.

<sup>vi</sup> According to Simon Hancock, "data centres are already producing as much CO<sub>2</sub> as airlines".

<sup>vii</sup> Warren cites the example of one UK short, *Gin and Dry* (Plewes 2010), distributed by the Picture House cinema chain, that found creative ways of getting around the DCP and KDM encryption requirements ("G&D; DCP: Demystified").

<sup>viii</sup> "Closed caption technology for digital cinema is rapidly moving forward with the successful standardization of SMPTE 430-10 and 430-11 for the SMPTE CSP/RPL closed caption protocol, an Ethernet-based protocol designed for connecting closed caption systems with digital cinema servers" (Karagosian, "Update").

<sup>ix</sup> Karagosian states that the cost of ownership is 200-300% higher than the cost of film projectors ("Digital Cinema Progress Report for 2009").

<sup>x</sup> There were initially seven, but Metro-Goldwyn-Mayer dropped out before the first DCI Specification was released in 2005 (*Digital Cinema Initiatives*).

<sup>xi</sup> In 2007, Arts Alliance Media (the company that won the tender for the UK Film Council's Digital Screen Network) was listed as the third biggest third-party integrator mentioned in *Screen Digest*, 2007 ("Digital Cinema Up and Running").

<sup>xii</sup> According to Hancock, Ireland has a "dual funding stream" for DCI-compliant equipment and equipment "below the global cinema standard), "to allow smaller non-mainstream exhibitors to match their equipment choice with their potential income and cost base" (Hancock, "Ireland"). The Indian cinema industry adopted e-cinema before DCI specification was agreed ("Bollywood Scores a First" and Bhushan).

<sup>xiii</sup> However, the UK Film Council's Rural Cinema Pilot Scheme is currently exploring e-Cinema as a solution for film societies, using Blu-Ray and other projectors, together with mobile DCI projectors (see *White Horse Pictures*; also Goode).

<sup>xiv</sup> It should perhaps be noted that 70mm and other widescreen formats had already created a tiered system with respect to traditional film exhibition.

<sup>xv</sup> Whilst the death of film has been heralded for decades, it is by no means guaranteed that the end of film distribution will lead to the end of film stock manufacture. As Geoff Boyle claims, film as an acquisition medium could have a renaissance if bespoke film stocks were marketed as a high-end alternative ("The Look"). However, the 35mm release print is big business for film stock manufacturers and "whilst the actual sales figures remain trade secrets, it is fairly safe to assume that the bulk of their trade comes from 35mm release prints, not origination stock" (Crofts, "Digital Decay" 24). It is more likely that 35mm stock will go the same way as 16mm and 8mm, and gradually cease to be manufactured, as publicly bemoaned by artist Tacita Dean in the press ("Save Celluloid") and in her 16mm film *Kodak* (2006), documenting the closure of Kodak's factory in France.