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“The new middlemen of the digital age: the case of cinema”

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Abstract

Purpose – The purpose of this paper is to enquire into various forms of innovation and observable configurations in films are observable and document the specific technological fields in cinema, and innovations brought by young IT and digital companies.

Design/methodology/approach – The paper is based on desk research, a review of literature, review of the technical journals, analysis of annual reports and meeting with experts and industry participants.

Findings – It identifies in most cases the presence of information and communication technologies (ICT) companies, new middlemen of the digital age, that integrate in one or another way the core activity of the cinema industry. These companies (“specialized technological companies” with edge R&D) are playing the rather recent role of “new middlemen” liaising between the different layers of a transformed industrial environment described as the “new ICT ecosystem”.

Research limitations/implications – The size of the sample (case studies) as the paper relies on some emblematic cases which come with some limits for any generalisation. Besides, most of the information is derived from company websites, complemented by trade press which clearly comes with some constraints in terms of accuracy.

Social implications – The paper concludes delineating some potential policy interventions, and identifies the challenges ahead with a focus on the EU.

Originality/value – Innovation is not so frequently dealt with in the studies of the cultural sectors. One very important issue is neglected both in the scientific literature and in the committed reports: the characteristic and the management of R&D in the creative industries, especially in the cultural sector. The paper shed some light on this issue.

Keywords Innovation, Cinema, R&D, Creative industries, ICT ecosystem, Specialised technological companies

Introduction

Innovation in creative industries is a new and emerging topic, not yet precisely investigated (Brandellero and Kloosterman, 2010; Green et al., 2007). Innovation is in general considered as a means to develop new creative contents. Nonetheless, while investments in basic and applied research are seen as crucial for competitive advantage in goods and services of industrial sectors, the characteristics and the management of R&D in the creative industries are usually neglected. Even the few studies that aim at investigating the potential of R&D to support the creative industries (e.g. Foundation for Research, Science and Technology, 2003; Cunningham et al., 2004) do not provide any analysis of the processes and/or technologies adopted.

However, technological innovation is not a fresh issue in the worlds of culture and media. In the last decades, all these industries underwent significant transformations of their production processes (digital recording, computerized editing of films, desktop publishing), not to mention the transformation due to the introduction and development of computers within the firms (business processes). This weight of the technological innovations gives a special magnitude to the firms that control, manage technologies, and are able to devote the necessary investments: whether it may be physical recorded media (CD or Blue Ray e.g.), consumers' devices (e-readers or tablets), content platforms (Appstores or User Generated Content) or network infrastructure.

Parts of the challenges cultural industries have been facing in the digital age originate from the rise of powerful new intermediators (Bailey & Bakos, 1997). The digital revolution is actually often considered as a revolution of the intermediation in its various components but namely information and third-party. New players emerge and offer unprecedented solutions for aggregating and distributing content, designing original terms of marketing and transaction adapted to this new framework (free subscriptions, micro-payments). Therefore, the weight of technology is also the weight of intermediaries and economic actors supporting and supported by these technologies (cf. Brousseau, 2002).

The intermediaries support the emergence of a new digital ecosystem, around computing and software activities, information processing and new communication interactions with a new allocation of tasks and beyond, with the rise of new forms of industrial partnerships and customer relations (Corallo et al. 2007).

Most of the analyses studying the effect of the Internet and the ICTs on cultural industries (Benghozi and Paris 2007, Benghozi 2011) are predominantly interested in the new business models, the new value chain structuring and new forms of consumers' uses (Pratt 2008, Cunningham, 2009, De Vinck and Lindmark, 2012). Besides, if customers are not all "techies" they are becoming more technology savvy. Yet, it is interesting to note that the development of technologies open up new - completely unprecedented - forms of intermediation.

From this point of view, the cinema industry is an interesting case to investigate through an exploratory study. The aim of the paper is to track and to characterize the changes in the cinema industry that design a new role for technology-based intermediation and support the emergence of new intermediaries. Our contribution is therefore focusing on selected case-studies of new intermediaries in the cinema industry through a description of their role and position within the wider ecosystem of IT and media. The paper successively reviews examples of technological innovations in the production stage of the cinema industry and in its distribution/exhibition stream. It identifies in most cases the presence of ICT companies,

new middlemen of the digital age, that integrate in one or another way the core activity of the cinema industry.

Our assumption is that with the ICTs, there is not only the movement of disintermediation/reintermediation related to the digital world - this is the most frequent argument in the literature -, but also an unprecedented reinvestment of intermediation functions from the control of technology and R&D, which has consequences for the dominant players, the location as well as the industry value chain. We verified this argument through an analysis of the actual cinema industry. In order to do so, in this paper we have chosen to investigate and rely on some emblematic cases: Weta Digital (a visual effect company from New Zealand) and the UK Soho visual effects cluster, DreamWorks (a US motion picture company produced animation film), Ymagis (a EU digital distribution company) and Netflix (a US distribution company of home entertainment). The companies have been selected so as to highlight some innovative elements in each of the segment of the cinema industry as well as to identify the role of specialized technology providers.

The sample collected allows us to demonstrate some unusual technological strategies and positioning taking place in the creative industries. However, most of the information is derived from company websites, complemented by trade press which clearly comes with some constraints in terms of accuracy. Nevertheless, it raises questions, even if the onus is still on further research to sustain some of the findings.

The paper is structured as follows. Section 1 opens with a short introduction on innovation in the cinema industry. Section 2 focuses on various modes of collaboration between the players of the production chain, from within or outside the cinema industry based on the role of visual effect companies. Section 3 looks at the production of a movie not only as a project but also as a lab in the case of Dreamwork. Sections 4 and 5 explore the transformation of the distribution (digital and 3D theaters) and exhibition streams (digital home entertainment). Every section therefore focuses on one selected case-study. Discussion and some concluding remarks follow.

The paper¹ is based on desk research, a review of literature, review of the technical journals, analysis of annual reports, and meeting with experts² and industry participants. The paper is part of an on-going research project on R&D and non R&D innovation in the creative industries

1. Innovation in the cinema industry: a quick view³

During the past decades, the digital shift not only reshuffled the business models of the cinema industry but also impacted all the structure of their value chain. It delineates new forms of intermediation processes also stressing the changes in the power relationships brought by the powerful downstream players. These dynamics are especially interesting to explore in the case of cinema industry since it had, from the start, an important technological component, and relied on a number of crucial technological breakthroughs.

¹ The paper is based on a report (2015) for the EC JRC-IPTS: *Models of innovation and R&D or non-R&D in the Creative and Content Industries: A focus on the cinema sector*. Other examples and case studies are to be found in this report. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of their institutions.

² The main findings were presented during two IPTS workshops : Sevilla November 2014, Brussels, March 2015.

³ For a more comprehensive introduction and discussion of innovation in the creative industries see chapter 1 « Chasing innovation in the creative industries » of our report (pp. 9-26).

Among the historical creative industries, the cinema is the most technological-based. Its history has been staked by technical innovations on a greater or lesser extent. The ubiquity of technology has helped to build a complex ecosystem that mixes various players in the technical, production and distribution sectors. Articulations between technical innovations and nature of content appeared there, therefore, particularly noticeable.

From a strictly economic point of view, the cinema was arguably one of the first creative industries, and one of the heaviest. It is firstly heavy regarding the investments in production. Whatever the country, films are long and complex to produce, but also extremely expensive cultural contents (years of preparation, numerous staff, and costs of tens of millions of euros). But cinema is also a heavy industry regarding its distribution network and corresponding considerable investments and capital expenditures - according to the European Audio-visual Observatory (2014): in 2013, 39,783 screens in the USA and 29,958 screens in Europe.

The seminal economic model of cinema has been established, very early, at the very beginning of the XXth century, as a service economy: copies are rented to be released in theatres and viewers pay for an admission. As a consequence, it structured itself, historically, around three very different poles in terms of investment and business models: production (developing feature films), distribution (supporting logistics for circulating copies and providing financial intermediation to collect revenues from box office) and exhibition (theatres). During the past three decades, digital technologies have been introduced in the three main streams (production, distribution, and exhibition) that characterize the value chain of the cinema industry (De Vinck and Lindmark, 2012, 2014).

The specific dynamics of these segments explain the paradoxical forces at work in the entire industry faced with globalization on the one hand, the emergence of new distribution on-line channels on the other hand, triggering differentiated effects that gradually undermine the former coherence of the industry. Technological companies use technological resources, on a completely different economic way from cultural industries. They do not focus on the production stage but build their strategy in order to strengthen the demand for their platform and the various services it can support thanks to complementary technologies (mobile, social media, cloud, search). Therefore, they reinvent the traditional innovation and business models of cultural industries. Consequently, a dilemma stems from the digitization: a tension between the “prototype” model firmly rooted in the content industry and the high-tech industrial rationale that is gaining much momentum. The question that raises the cinema, as a hi-tech industry, is how it operates the links between content and technology in order to create value for all the players of the value chain. The cinema industry seems to blend in a specific way science and technology with the artistic dimension.

Various forms of innovation and observable configurations in films are observable: specific technological fields in cinema, innovations brought by young IT and digital companies, the incremental and non-disruptive approaches promoted by the Majors. This variety of situations helps to highlight the growing role of specialized technology companies. The specific analysis of some companies and iconic clusters results in questions about their place in the economy of the sector: the nature of collaborations at different levels of the value chain (from production to theatres), the strategy to capitalize on competitive resources from mastering technologies (equipment, patents and know-how), investment economy (risk sharing and allocation of the created value), convergence with nearby sectors thanks to the multimedia developments and online distribution.

In the digital age, most of the changes brought by disruptive technologies seem to be driven by external actors to creative industries sectors: insiders undertake, in contrast, only low investments in R&D and technology. The new phase of digitization is triggering changes

impacting the entire value chain of the cinema industry, offering new opportunities and raising challenges for new players as well as policy makers trying to catch up.

The actors of cinema industries appear to invest in R&D and technological innovation, but in a way that appears concealed and not in areas where one would expect: digital technologies. The economic actors in the cinema sector significantly invest in technology, but in the traditional processes of production and distribution, rather than in the most threatening disruptive digital mutations. These developments are reflected as such by original new models, based on particular forms of specific collaboration formalized through the decisive role of new middlemen. These new actors are building their position by organizing the dialogue between their expertise in high tech skills and the creative dimension of cultural works. Many high-tech companies have thus emerged and persisted in the field of cinema, contributing thereby, in some extent, to a renewal of the historical technical industries of cinema. These new specialized technological supplier companies are medium sized, they master global ICT skills but are active and specialize themselves in a small number of technical areas. Their model places particular emphasis on specific operations - rather unusual in this area - such as the management of assets, patenting and the innovative technological spill-over to other industries. Such innovation configurations contribute to the dynamics of the geographical clusters focused on cinema (Soho, Wellington).

These companies are playing the rather recent role of "new middlemen" liaising between the different layers of a transformed industrial environment described alternatively under the notion of the "new ICT ecosystem" (Arlandis, Ciriani, 2010; BCG 2011; Fransman, 2010, 2014) or "Telecom Media Technology (TMT)" according to other consultancies (AT. Kearney, 2011; Mc Kinsey 2010; PriceWaterhouseCoopers, 2014). These "new middlemen"⁴ are often the output of previous R&D investments, and/or spin-off from universities (e.g. Akamai⁵ from the MIT).

Besides, the case studies demonstrate that the emergence and technological strategies of the middlemen can actually take place in very different industrial designs: they can arise within the traditional production chain of the cinema⁶, or come out from single film projects or result from the existing infrastructure developed at the exhibition stage. The case studies highlights the co-existence of two models of innovation: a disruptive one and an incremental one a disruptive innovation model stemming the ICT industry newcomers that are using technological resources in new and completely different ways from the traditional content industries. However at the same time, the cinema case shows that an incremental innovation model has also emerged with specialized ICT industry suppliers building mutually beneficial collaborative relationships at the production stage.

2. Digital technologies in the production stream: the rise of visual effects.

The production segment gains widely from technological innovations supported by the other economic actors. Indeed, the decrease of the cost of hardware and software triggered the creation of small evolving companies in the special effects subsector. Each stage of the

⁴ The notion was used by the art historian who taught at the London Warburg, Michael Baxandall in his book *Patterns of Intention: On the Historical Explanation of Pictures*, (1985) to account for the role of scientists/artists (Baxandall, 1985: 89-93) to connect the scientific world of optic and the pictorial universe, focusing on the example of Chardin's *A lady taking tea*. The companies regrouped here are also blending scientific and artistic expertise.

⁵ A content delivery network company, the leading provider of cloud services. The company is the primary player in content delivery expediting space.

⁶ For the cinema value network, see : De Vinck and Lindmark (2014: 121), Bloore (2009).

filming stream offers now opportunities for technical cooperation and innovation: negotiating with “tech firms” for special assistance during pre-production, genuine collaboration and innovation during the production stage, and the most obvious and easier to spot post-production moment with the adding of special effects. It opens up a space for challengers and newcomers to enter the field, bringing along some innovations in any of the streams (digital editing, visual effects in production, on-line distribution, and digital screens) elbowing their way to create their own spot within the ecosystem.

The cinema industry seems to blend in a specific way science and technology with the artistic dimension. This section focuses on the way it is displayed through a set of players and relationships in the production stream. Therefore, it follows the evolution of technologies (pre-production, production and post-production), analyses the new dynamics triggered by post-production techniques (visual effects) in the case of the UK, and ends with a short focus on the case-study of Weta Digital⁷.

2.1 Production technologies

Historically, filmmakers relied on storyboards, concept artwork, and physical models to help them plan their visions. Today, pre-visualization (previs)⁸ techniques are being leveraged throughout the entertainment industry. They are even used to help filmmakers and studios to raise funding for projects in development. “Double Negative”⁹, the UK leading provider of visual effects for film stressed how the company “*collaborates with film makers from the first stages of projects; producing ideas and concept imagery and developing previs and VFX*”¹⁰ production plans” (company website).

“Previs” teams complement and accelerate this process by using computer animation tools to represent the filmmaker’s choices in motion. This new segment of the industry claims that “previs” team can create a teaser trailer or a sample scene at a fraction of the cost of the final endeavor. During the production, real-world measurements can be derived from the “previs” shots to help streamline the live-action setups (Third Floor Inc¹¹ website, 2014). Productions’ technical quality levels have been also enhanced thanks to new equipment and software generations and more reasonable costs to devise innovative machines and action cameras.

After the success of *Avatar* in 2009, Hollywood rediscovered the 3D format and Bollywood in India was following with the success of *Haunted* in 2011. This film is only the second 3D film made in India¹².

⁷ The paper does not deal with other important technology providers like camera suppliers and sound suppliers, one can find a presentation in the report see Table 7: « Specific technologies for cinema », pp.51-52, Box 19 p.71 for sound technology, and the case study of the camera maker Aaton, Box 12 pp.56-57.

⁸ Previs is an abbreviated term for “pre-visualization”, the process of visualizing and improving a project before the final endeavour is attempted.

⁹ In 2014 the company merged with Prime Focus World located in Mumbai. In 1997, Prime Focus Limited was established with 4 core team members in a garage in Mumbai, India. The company became global with a presence in key centres of creative content production, Los Angeles, New York, London, and Vancouver. Source:

www.dneg.com/news/double_negative_and_prime_focus_world_announce_merger_723.html#sthash.dFWB5nI4.dpuf

¹⁰ For Visual Effects or Visual F/X. The site WikiFX lists resources about the use of special effects (VFX) in movies, advertisements and TV Series, listing some 258 VFX studios. <http://wiki-fx.net/wp-content/uploads/2013/08/Black-Background-Collapsar-1080x1920.jpg>

¹¹ A pre-visualization studio based in Los Angeles and London, established in May 2011.

¹² India’s (and the world’s) first 3D movie was Chotta Chetan’s 1997 digital version: it earned 60 times its initial investment (Anand, 2011).

2.2 Post-production technologies: the rise of the Soho cluster.

According to Camors et al. (2006: 67), the decrease of the cost of hardware and software triggered the creation of small companies evolving in the special effects subsector¹³ with, for instance in France or the UK, most firms with less than 10 employees.

Livingstone and Hope (2011: 25) focused on the UK visual effects industries: visual effects are presented as one of the fastest growing creative industries in the world and the fastest growing component of the UK's film industry over the last ten years, with a growth of 16.8%, and an employment of 5,000 people, between 2006 and 2008: the four largest UK visual effects companies are "Double Negative", "Framestore", "Cinesite" and "MPC", all based in Soho.

As Hope put it: *"Digital technologies have transformed the filmmaking process, and will continue to do so, giving film-makers new ways to tell their stories. VFX sits in the vanguard of these changes, with increases in VFX budgets from between 10% and 50% of the overall budget. This can be £20 million-£25 million on just one film"* (quoted by Osborne, 2013). Visual effects are presented as high-tech dream factories: they help film-makers reducing the production costs of shooting outdoors scenes or recreating period settings.

Disruptive technologies, like the spread of 3D in films, brought market changes. Eight out of the ten top grossing films in 2009 had a strong visual effects component. In the last 20 years *"the UK has been transformed into a global centre for VFX, taking market share from the rest of the world. Between 1997 and 2004, employment and turnover of the four largest VFX companies in the industry increased in real terms by 444 per cent and 540 per cent respectively and growth has continued"* (Livingstone and Hope, 2011: 11)¹⁴. The authors stress that *"It is hard to think of a Hollywood blockbuster over the last five years which has not benefited from the creative expertise of talent working in Soho's visual effects hub. "Double Negative", "Framestore", "MPC" and "Cinesite" – four of the largest visual effects companies in the world – have all been involved in these films"* (Livingstone and Hope, 2011: 13).

The UK is also a global center for visual effects work in commercials, with "The Mill", "Framestore" and "MPC" attracting work from all over the world. The UK also hosts some of the world-leading companies producing technology and tools for the visual effects industry. "The Foundry", for instance, has developed "Nuke", the industry standard for compositing. According to the survey undertaken by Livingstone and Hope (2011), the UK visual effects industry is dominated by a small number of large organizations (the largest four accounting for almost 60% of the overall workforce) and a large number of very small companies.

Specialist companies, employing hundreds of animators, artists and programmers, like the ones in Soho, are providing visual effects through deep collaborations with film clients: these companies and their technical experts are plying between the core filmmaking team and their technical counterparts as we will see in the next section with the case of DreamWorks.

¹³ The BFI defined this subsector as follows: *"Visual effects activity includes, but is not limited to: Pre-visualisation, Concept Design, Data Acquisition (motion capture, cyber scans, lidar scanning, set surveys, photogrammetry shoots), Computer Generated Images (CGI), Character/Creature Animation, Colour Correction, 2D Compositing, 3D Animation, 3D Modelling, Digital Intermediate, Virtual Sets/Studios, Digital Matte Painting, Lighting and Rendering"* (BFI, 2013: 3).

¹⁴ Some examples of visual effects in the UK and Hollywood blockbusters: *Batman Begins, The Dark Knight, Bourne Ultimatum, Prince Caspian, The Voyage of the Dawn Treader, Avatar, Clash of the Titans, Prince of Persia, The Sorcerer's Apprentice, The Da Vinci Code*. The UK companies have also helped bring J.K. Rowling's Harry Potter books to the screen, (Livingstone and Hope, 2011: 13).

However, recently, due to the intense competition for blockbusters within the oligopoly of the US industry, the pressure increases on costs putting some of the companies in a more difficult position. This pressure on cost drove, for instance, “Double Negative” to merge, in June 2014, with the Mumbai based VFX company “Prime Focus” so as “to weather” what has been described as the present “VFX crisis” (DeRuvo, 2014).

2.3 Weta Digital, a company based in Wellington, New Zealand.

Weta Digital, a New Zealand tech company, provides another interesting case of product development and product innovation undertaken on behalf of clients. The company contributed to the world wide success of *Lord of the Rings*¹⁵, Spielberg’s *The adventures of Tintin*¹⁶, and *Avatar*¹⁷.

Weta was founded in 1993 by a group of young New Zealand filmmakers. Weta, offers rendering, virtual studio and simulation. Weta Digital described itself as “*a world leading visual effects company based in Wellington, New Zealand*”. The company was later split into two specialized entities, Weta Digital (digital effects) and Weta Workshop (physical effects). The company provides a suite of digital production services for feature films and high end commercials, from concept design to cutting edge 3D animation.

Weta Digital has developed several proprietary software packages. For instance, the shooting of *The Lord of the Rings* film trilogy led to the creation of “Multiple Agent Simulation System in Virtual Environment” (MASSIVE): a high-end computer animation and artificial intelligence software package used for generating crowd-related visual effects for film and television. Its flagship feature is the ability to quickly and easily create thousands (or up to millions with current advances in computer processing power) of agents that all act as individuals as opposed to content creators individually animating or programming the agents by hand. Peter Jackson required software that allowed armies of hundreds of thousands of soldiers to fight, a problem that had not been solved in film-making before. The company Massive Software was created to bring this technology to film and television and has become the leading software for crowd related visual effects and autonomous character animation according to the company website.

Weta digital was the lead visual effects company for *Avatar*, employing up to 900 persons. For James Cameron's "Avatar", Weta modified MASSIVE to give life to the flora and fauna on Pandora. The film demanded shooting on a virtual stage. New technologies were developed for supporting software and a new production pipeline in order to reach a new level of creative and technological excellence, delivering the film in 3D.

The company highlights its research activity: “active in both practical and foundational research and development”, and working in partnership with universities and other centres of research as well as other visual effects facilities. The New Zealand pioneer prides itself of being part of a network of creative companies based in the Wellington suburb of Miramar, Park Road Post Production, Stone Street Studios and Portsmouth Rentals.

¹⁵ Academy Award in 2002, 2003, 2004 for Best Visual Effects

¹⁶ Annie Award in 2011 Animated Effects in an Animated Film.

¹⁷ Academy Award in 2011 for Best Visual Effects and an impressive number of similar awards.

3. From project-based film making to the capitalising R&D lab model? The case of DreamWorks. This section focuses on DreamWorks (see Box 1), a US company that can be seen as a pioneer (like Pixar; see Paris, 2010). The company claims being on the edge of technological innovation for animation techniques. DreamWorks offers an interesting example of a firm combining technology and the “artistic” dimension for the creation of full features animation films. On its website, under the technology section, the technological component is introduced under the title: “where arts meet technology”. This technological component is held central by the company (Annual Report 2012: 1).

This company is good illustration of the fact that film production is very project-based, requiring the cooperation of several kinds of expertise all along the value chain; coordination is a key aspect so as to blend in a specific way science and technology with the artistic dimension as we just saw for the production stream. Besides, according to Benghozi (1988), production costs are sunk costs as each film can be considered as a prototype. The result is that movie production no longer takes place within integrated structures: artists, technicians, technical suppliers, locations are all independent and each production requires a new project, new contracts... It is, therefore, difficult to accumulate the technical expertise and to capitalize on R&D: the mobilization of new technologies for creative innovations can be carried out only during a specific movie project. This stimulates, at the same time, the creation and/or specialization of technical post production companies that invest specifically in certain equipment or technological solutions and then improve them contributing on different feature films.

Box 1. The US DreamWorks Animation SKG.

DreamWorks Animation, a motion picture company, started operation as an animation division of Old DreamWorks Studios, an entertainment company formed in October 1994 by Steven Spielberg, Jeffrey Katzenberg and David Geffen. The company was divested from Old DreamWorks Studios on October 27, 2004, after a public offering in October 2004 and the direct transfer of certain of the assets and liabilities, as well as some of its subsidiaries. In 2012, Classic Media has been acquired, the first acquisition since becoming a public company. Classic Media owns a very large and valuable independent collection of characters and branded assets. The company is located in California, Glendale where the headquarters are located, and in Redwood City. As of December 31, 2012, the company employed approximately 2,400 people. Of that total, approximately 1,520 were directly employed in the production of films as animators, modelers, story artists, visual development artists, layout artists, editors, technical directors, lighters and visual effects artists and production staff, approximately 310 were primarily engaged in supporting and developing animation technology.

DreamWorks Animation creates “high-quality entertainment”, including CG (“computer-generated”) animated feature films, television specials and series and live entertainment properties, meant for audiences around the world. The company claims having “world-class creative talent”, a strong and experienced management team and advanced filmmaking technology and techniques. All of DreamWorks Animation’s feature films are produced in 3D.

The Animated Filmmaking Process

The filmmaking process starts with an idea. Inspiration for a film comes from many sources—from in-house staff, from freelance writers or from existing literary or other works. Successful ideas are generally written up as a treatment (or story description) and then proceed to a screenplay, followed by the storyboarding process and then finally into the production process. Excluding the script and early development phase, the production process, from storyboarding to filming out the final image, for a full-length feature film can take approximately three to four years (see Table 9).

The company employs small collaborative teams that are responsible for preparing storylines and ideas for the initial stages of development. These teams, through a system of creative development controls, are responsible for ensuring that ideas follow the best creative path within a desired budget and schedule parameters. The

complexity of each project, the background environments, the characters and all of the elements in a project create a very intricate and time-consuming process that differs for each project.

The Company's introduction of stereoscopic 3D for its films provides the filmmakers with additional variables to review and decide upon during this production phase. Finally, in the post-production phase, the core visuals and dialogue are in place and important elements such as sound effects and the music/score are added.

To maximize the capabilities of each of their datacentres, DreamWorks Animation (DWA) has gone to great lengths to increase the capabilities and densities of their existing locations. In 1997, the average DWA datacentre had a density of 15 watts/square foot with 1,500 cores, whereas in 2012 that number has increased to 250 watts/square foot with 25,000 cores. Another change is the shift from managing 100% of their render infrastructure, which is now just 80% with the remaining 20% rendering happening in the cloud. This lets DreamWorks Animation remain dynamic and nimble during peak months and reduce operating costs when demands are lower.

The company has several patent applications pending in the U.S. or other countries, and relies on a combination of patents, copyright and trade secret protection and non-disclosure agreements to establish and protect their proprietary rights

Source: company website, www.dreamworksanimation.com/, www.dreamworkstudios.com/about/history, Annual Report 2012.

The assumption here is that a large part of technological innovation in the film industry takes place and is made through successive movies and the collaboration of the different involved parties. Coordination is therefore a key aspect although its scope may vary in time and space. As the animation company DreamWorks puts it: *"It's no secret that it takes a rather large village to create an animated film"* (company website, 2014). As De Vinck and Lindmark (2012: 23) summed it up: *"The movie business encompasses a range of activities that cumulatively, and in a mutually reinforcing way, create value"*.

Dreamworks exemplifies a business based on a few prototypes (see Figure 1 for a breakdown of the revenue between films released in 2010, 2011), its business is currently substantially dependent upon the success of a limited number of film releases (around two or three animated feature films per year). As it derives a significant percentage of its revenues from a single source -the production of animated family entertainment- the revenues are likely to fluctuate. As of 2012, the company had revenues of around \$ 750 million (27.1% from current year theatrical release, 30.1% from prior year theatrical releases, 22.6% from library, 4.8% from the new subsidiary Classic Media, leaving 14.1% for other sources of revenue), (Annual Report 2012: 55), and around 707 million in 2013¹⁸.

The company relies on heavy investments in the latest technology including cloud technology. Interestingly, one of the consequences is to define the core filmmaking team for its specific endeavors as being constituted of directors, producers, production designers and VFX supervisors. It does not only emphasize the traditional role of directors and producers, but then adds their technological counterparts, production designers and VFX supervisors to that core team. The company also stresses the role of a technical middleman, the supervising technical director (Sup TDs) who manages all the technology (software and hardware) for a feature film, defines the workflow and the process itself. This middleman reports to the core team (Hueso, 2014, company website).

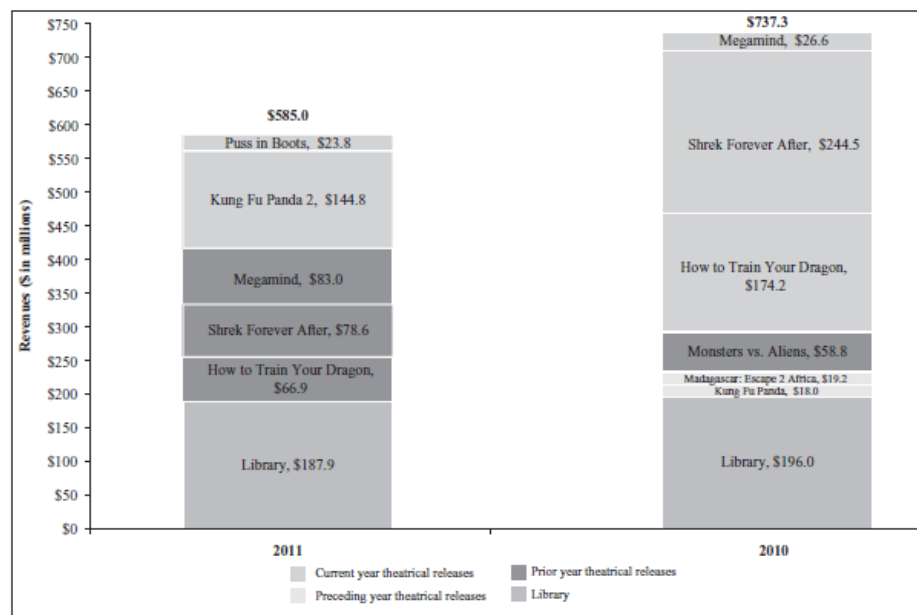
This indicates the possible existence of an R&D team, but there is no other mention of its existence, and one cannot find the precise R&D expenditures in the annual reports. However, the latest annual report gives 4.9 US million \$ for all product development which amount to a

¹⁸ Source: Wall Street Journal, www.marketwatch.com/investing/stock/dwa/financials

0.65% ratio to the sales. This is not impressive for a tech-oriented company.¹⁹ However, this may be consistent with the important size of the workforce involved in production (1,520 direct employees for film production, see Box 1).

The company does record some of its technological achievements and developments, for instance with lighting software. In 1996, DreamWorks animation engineers saw the opportunity to change the lighting workflow and developed a state-of-the-art tool to advance the way light is applied to an animated film. One can assume that these engineers were part of an R&D team as the company computes 310 persons “*primarily engaged in supporting and developing*” its animation technology (Annual Report 2012: 14).

Figure 1. The components of the theatrical release revenues (2010, 2011).



Source: DreamWorks, Annual Report 2012: 63.

There is some indication of partnerships with other tech companies but no mention of any related patent even in their technical papers²⁰. Those technical papers (usually a one page document with reference to more scientific publications written by the same author from the company) simply describe the processes used for a specific film. However, the Annual report (2013: 28) does underline patent applications.

Within the company, other new technical functions are appearing like for instance “crowds supervisors”, a function that appeared as a side project to later become “a new art form in app development”²¹. For example, to bring the scale of the circus to life in *Madagascar 3: Europe’s Most Wanted* (2012); the largest, most detailed crowd in the company film’s history with 35,361 characters in the scene was created.

The production segment gains widely from technological innovations supported by the other economic actors, for instance the company has strong relationships with Hewlett-Packard. Producers get more opportunities – without investing themselves - to distribute their films and to widen physical and virtual admissions. Indeed, the decrease of the cost of hardware and

¹⁹ Marketwatch, subsidiary of the *Wall Street Journal*, classifies all the product development expenditures under “Research & Development”, indicating that same amount of 4.9, and 3.35 US million \$ for 2013.

²⁰ See the official website under the section “technical papers” : www.dreamworksanimation.com/

²¹ Source: www.dreamworksanimation.com/insidedwa/ourpeople/bradherman).

software triggered the creation of small evolving companies in the special effects subsector. Each stage of the filming stream offers now opportunity for technical cooperation and innovation: negotiating with “tech firms” for special assistance during pre-production, genuine collaboration and innovation during the production stage, and the most obvious and easier to spot post-production moment with the adding of special effects. It opens up a space for challengers and newcomers to enter the field, bringing along some innovations in any of the streams (digital editing, visual effects in production, on-line distribution, and digital screens) elbowing their way to create their own spot within the ecosystem.

4. The digitization of theatre's screens: the case of Ymagis.

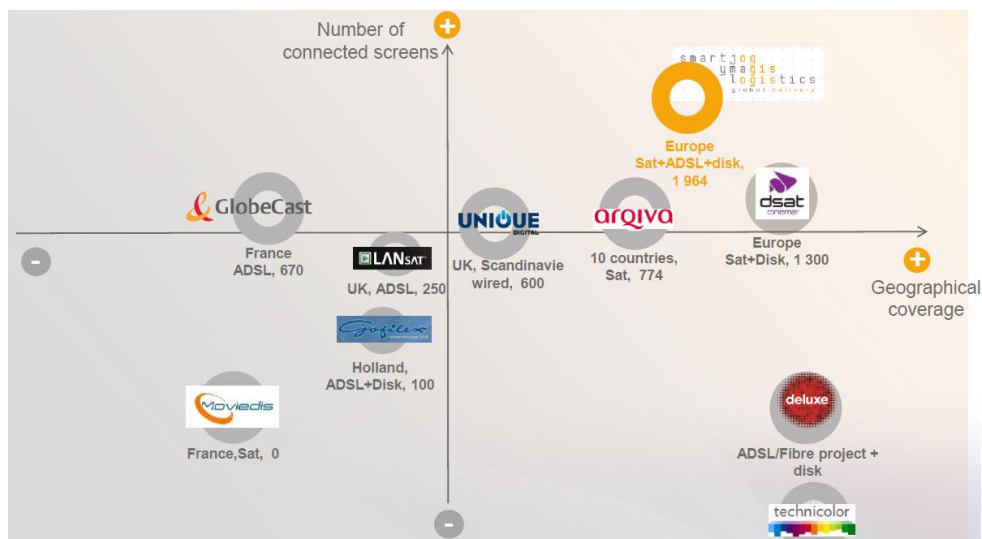
The distribution segment is faced with disruptive technological innovations supported by digital technologies and calling for huge investments (VoD platforms, 3D equipment...), but it benefits from worldwide distribution of attractive (US) blockbusters. Consequently, some new innovative companies like Ymagis, have spotted a window of opportunity to develop fast in this area of digital film distribution to theatres. These companies provide assistance to producers, distributors and exhibitors. They offer services to assist in the production of feature-length films, the distribution of content (encryption, valuation, duplication, and transport), the sale and installation of cinema equipment, maintenance and facilities management of digital projection, equipment, sale and rental of 3D glasses, post-production of content.

In the traditional cinema business film distributors, advertising companies and alternative content providers were responsible for the prints' cost. According to Ymagis in the digital world these costs are significantly reduced, by up to 90%. De Vinck and Lindmark (2012: 110) confirm how digitisation has been changing the theatrical exhibition landscape. If we follow their analysis, digital cinema provides benefits in terms of consistent projection quality, programming flexibility (including alternative content) and the cost-savings associated with digital distribution. The film *Avatar* induced theatre owners to equip more of their cinemas with 3D technology (Grover et al., 2010).

The worldwide growth of digital cinema screens has been impressive with a growth of about 30,000 screens over 2012-2013. As of April 2013, there were over 90,000 digital cinema screens in the world (Karagosian, 2013). In the EU, 87% of the screens were converted to digital projection screens in 2013 (EAO, 2014: 14) (see Figure 2 for the state of competition for film distribution). The penetration reached 93% that same year in the US but reached 96% in China with 67% of them equipped for 3D projection. South Korea is fully digitized since that same year, and India loomed around 95%²² (EAO, 2014: 43-57).

²² EAO noted it was unclear how the figures were calculated.

Figure 2. The competitive environment of digital film distribution in Europe



Source: Ymagis, company website

4.1 Ymagis: a specialist in digital technology for the film industry.

In this context, the French start-up Ymagis introduces itself broadly as a “specialist in digital technologies for the film industry” (press release July 2014) (see Box 2). Ymagis assists cinema exhibitors to tackle the digital revolution by providing financing to help them bear the costs of the transition from 35mm to digital projection. It is conceived around a financial option to support the equipment of theatres for digital exhibition, the company indeed blends financial and technical services. Borrowing a contractual arrangement from the US, Ymagis takes a toll on the delivery of contents: the virtual print fee (VPF)²³. In turn, the virtual print fee subsidy paid by distributors like Ymagis, is helping exhibitors with the financial burden of replacing film projectors with digital ones. Ymagis was deriving most of its revenues in 2013, from their “toll” funding option, and only the remaining from the more traditional activities of the cinema technical industry sub-sector. Together with its strong growth, this sound financial arrangement may account for the ability of the firm to attract funding (venture capital and floatation).

Ymagis provides assistance to producers, distributors and exhibitors. It supplies services to assist in the production of feature-length films, the distribution of content (encryption, valuation, duplication, and transport). The services offered include the sale and installation of cinema equipment, maintenance and facilities management of digital projection, equipment, sale and rental of 3D glasses, post-production of content, and the preparation and delivery of Digital Cinema Package (DCP) and Key Delivery Message (KDM). Ymagis relies on the agreements it has concluded with over 100 distributors and advertising agencies in Europe, including US Majors (Walt Disney, Paramount Pictures, Sony Pictures, Warner Brothers, Universal Pictures and 20th Century Fox). Their business model consists in matching exhibitors’ costs to distributors’ savings, through long term contracts with most of the content providers, in order to ensure that most of them contribute with a percentage of their costs’ savings to the deployment of digital projection systems. The Virtual Print Fees (VPF), or Digital Transition Fees, are invoiced by the group and received from distributors of content, particularly feature-length films, upon delivery of each digital copy to the movie theatre.

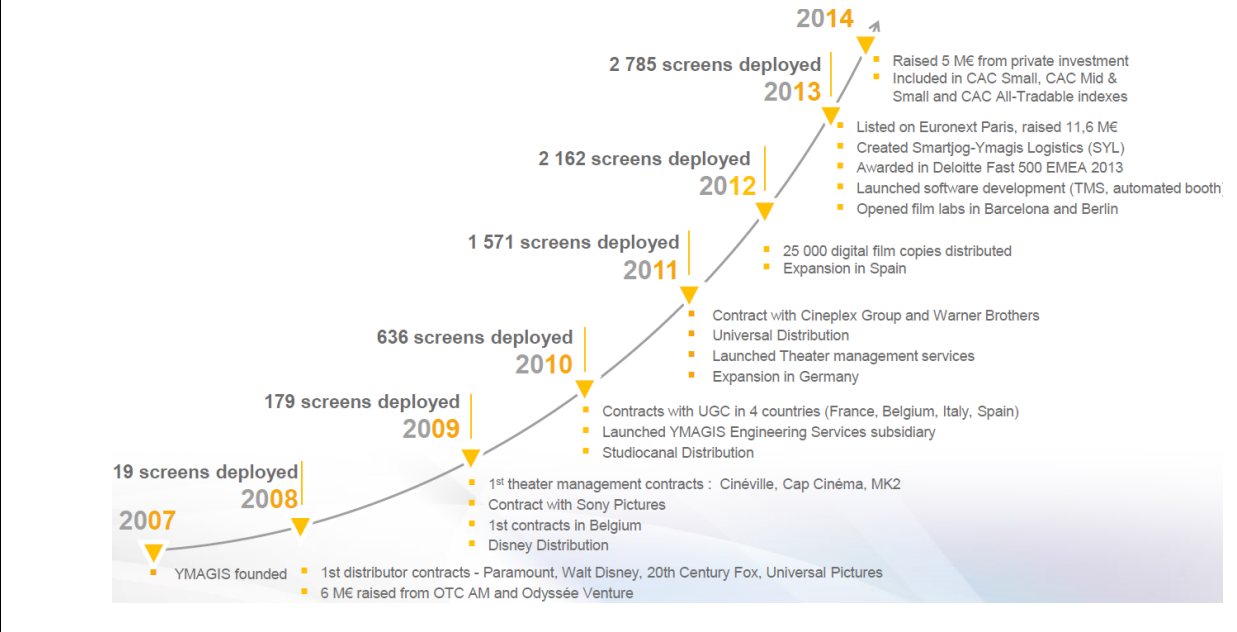
²³ Virtual print fee, remuneration paid to Ymagis by the supplier of digital format content, mainly distributors of feature-length films. Source: Ymagis.

The company presents itself as focused on innovation, with almost half of the staff composed of engineers and technicians, and the integrated laboratories working on post-production and the distribution of copies (Barcelona, Berlin, Paris). The firm develops proprietary software solutions (TCS, TMS). The company claims that because of its integration of software programs and operational services, its technological expertise has strongly contributed to the success of the group in France as well as abroad.

Box 2. The French Ymagis, a European leader in the sales of digital cinema equipment to cinema exhibitors.

Ymagis claims to be an integrated offer that covers the entire value chain: from production to distribution and operations. As of 2013, the company had a € 47.3m of turnover (+19.1% compared with 2012), 2,785 screens already installed by end December 2013 (from 19 in 2008), 188 exhibitor-clients by end December 2013, an operating profit of almost 15%, and 138 employees.

With a commercial presence in 8 countries, 38% of its turnover is generated outside France. The start-up was financed at first by its founders, and, at the end of 2008, two investment funds (OTC Asset Management and Odyssee Venture) agreed to invest in the company. The company went public in 2013. In the same year a joint venture was created with TDF, Smartjog, presented as the first service of integrated logistics for the cinema industry in Europe.



Source: company website 2014

The young firm has set a very ambitious objective: to become the leading European provider of digital services and technologies for the film industry. Besides, Ymagis intends to expand its field of operations to include operational services (ticketing software, digital displays in entrance halls, spectator profiling...) by building on its leading position that it already occupies in digital projection technologies and services. In July 2014, the company announced it reached an agreement to acquire the DCinex group so as to create the European leader in the provision of digital services and equipment to the cinema industry. With 5,800 screens in 15 countries in Europe under VPF contracts, Ymagis will own the largest network in Europe of cinemas operated under VPF contracts.

5. Behind the screen: towards on-line distribution for Internet-connected devices: the case of Netflix.

New forms of distribution not only bring new streams of revenues, but opened up new opportunities for new entrants, in particular for innovative companies. The US Netflix provides an interesting case-study of a niche provider, using a very antiquated distribution channel (the mail) to send VHS then DVD, later morphing into a global company. Netflix claimed to be (Annual Report, 2014: 1) “*the world’s leading Internet television network with over 62 million members in over 50 countries enjoying more than 100 million hours of TV shows and movies per day*”²⁴.

The company was established in 1997 as an online solution for the problem of late fees when renting movies. The Netflix web site, launched in April 1998, was initially focused on the plain delivery by mail of DVDs (via pre-paid mailing envelopes) on a rental basis. Their streaming service was launched in 2007. In 2008, Netflix partnered with consumer electronics companies to stream on the Xbox 360, Blu-ray disc players, TV set-top boxes and the Apple Macintosh computer. The company initiated its international expansion in Canada in 2010 and has since launched services in Latin America and Europe where they anticipate “a substantial expansion” of the service in 2014. A highly fruitful strategy, as between 2010 and 2013 their revenues doubled: from 2,162 US \$ billion to 4,374 US \$ billion, but up from just 270.4 million ten years earlier, in 2003, when just relying on mail delivery. As of 2013, Netflix invested 9% of its revenues in “technology and development.”

Netflix has three operating segments: domestic streaming, international streaming and domestic DVD. The streaming segments derive their revenues from monthly membership fees (priced at \$ 7.99 for the domestic segment, and between \$ 7 and \$ 14 for the international segment), the domestic DVD segment from monthly membership fees for solely DVD-by-mail, priced according to plans that varies from \$4.99 to \$43.99. This last segment is now declining.

The company interacts now with various players within a complex network of commercial relationships. Netflix relies on a number of partners for the supply of contents, their distribution, and streams of additional revenues. The company acquires content through a variety of revenue deals. Typically, Netflix enters into multi-year, fixed-fee licenses. In 2012, DreamWorks, for example entered into direct arrangements with Netflix to exploit the titles through SVOD services in the U.S. market (DreamWorks annual report 2012: 48).

Netflix is getting involved in content production, offering original programming such as Award winning “*House of cards*” (\$ 100 million cost of 13 episodes seasons), or original documentaries like “*Battered Bastards of Baseball*” and “*Mission Blue*”. Netflix produced its hit show, “*House of Cards*”, after analysing the data from their consumer base (million “plays” per day, million searches, plus tags and other metadata) (Carr, 2013). Netflix has been transformed using big data analytics to ‘give people what they want’. Predicting what its customers will want to watch next is the primary goal of Netflix’s data strategy (De Prato and Simon, 2015). In 2014, the company was planning to substantially increase the investments in original content, representing less than 10% of the overall global content expense (Annual Report 2013: 28).

In addition to the broad slate of international viewable, there are also many local and European titles available on Netflix across the new countries. Netflix is actively pursuing

²⁴ More than one billion hours of TV shows and movies per month (Annual Report 2013:1)

strategies to bolster its local content for these markets, including creating its own series, ‘Marseille’, in France.

Secondly, to offer instant streaming of content to various devices, the company uses services of third-party cloud computing providers -Amazon Web Services (AWS) in particular- and content delivery networks (Level 3 Communications) in order to stream this content to the consumer. Netflix has also built its own single-purpose content delivery network, Open Connect. For its DVD mailing service, it relies on a US-wide network of shipping centres. Thirdly, it gets advertising space and other marketing services from a variety of partners. The latter includes the provision of free trial subscriptions (De Vinck, Lindmark, 2012). Netflix launched its 4K²⁵ stream early April 2014 moving ahead of its competitors to display higher quality pictures (Technicolor, 2014). Many titles are already available in high-definition and with Dolby Digital Plus 5.1 surround sound.

What is new here is the role of new segments of the value chain compared to a legacy value chain that included four segments only: creation/production rights, aggregator/publisher, distribution and consumption. Netflix is making the most out of the new segments brought by digitization: enabling technology services (new forms of billing and payments are important components as well) and connectivity (core network, interchange, retail Internet access), (Kearney, 2010). Partnerships with consumer electronics companies are also an important feature as devices are proliferating. This case-study illustrates as well how one can jump from segment of the value chain upstream building a delivery network, and downstream with an involvement in content production and not just in aggregation. This indicates the potential role of digital platforms (Benghozi, 2014) to set up a new balance between available brand contents and original contents.

Netflix has been able to build its own “*ecosystem for Internet-connected devices*”. Its model of innovation, not unlike Amazon’s approach, concentrates on how to find the most accurate delivery modes for the content it buys and now starts producing. This form of innovation in audience reach ushered in a new commitment to create the contents required for the distribution. It happened earlier with cable networks in the US in the 70ies, with Pay TV/ Subscription TV in the 80ies (Canal +; BSkyB) in the EU, Canal + becoming a leading financier of cinema. Besides, Netflix displays some kind of bottom up model of innovation built around its customer together with innovation in business management so as to mobilize the resources needed, bringing together all the threads, first technical and then content creation.

5. Discussion and some concluding remarks: a new symbiosis within an extended ecosystem

The paper has focused on five case studies (from the EU, US, and New Zealand) to document the role of newcomers and the consequences of new forms of relationships between edited contents and consumers. Our sample, although limited in size, allows us to illustrate various

²⁵ Ultra HD/4K TV is the next generation of High Definition (HD) TV which offers four times higher resolution than the current highest standard HD, with 4096 x 2160 resolution and pixels one quarter the size of traditional 1080p projectors, 4K delivers smooth, lifelike images with fewer artefacts, even on the largest home theatre screens (up to 180"). *Source*: Sony, <http://store.sony.com>. 4K adaptive bitrate streams generally requiring between 10 - 20 Mbps of bandwidth: globally, 11% of connections to the Akamai network were at speeds of 15 Mbps or above in the first quarter. Seven of the top 10 countries/regions on the 4K readiness list overlapped with those on the global high broadband connectivity list. South Korea led the list with 60% 4K readiness, while Japan had 32% of its connections at that level in the first quarter. *Source*: Akamai: www.akamai.com/stateoftheinternet.

forms of cooperation between the cinema industry and specialized technology providers within or without the cinema industry. UK VFX companies, located in Soho, are providing visual effects through deep collaborations with film clients, constantly liaising between the core filmmaking team and their technical counterparts. By the same token, Weta Digital provides an interesting case of product development and product innovation undertaken on behalf of clients, at the same time capitalizing on their products for future work (MASSIVE).

Coordination, as noted, is a key aspect of film production. The case of Dreamworks illustrates how a large part of technological innovation in the film industry takes place and is made through successive movies and the collaboration of the different involved parties. Besides, it shows as well how the company gains from technological innovations supported by other economic actors.

As a provider of an array of services to assist in the production of feature-length films, the distribution of content (encryption, valuation, duplication, and transport), Ymagis attributes its success to its integration of software programs and operational services.

Outside, the legacy three main segments of the cinema industry we reviewed, Netflix is making the most out of the new segments brought by digitization: enabling technology services (new forms of billing and payments are important components as well), Big Data techniques using a multitude of algorithms for doing personalization and recommendation, and connectivity (core network, interchange, cloud services, retail Internet access).

In other words, such new middlemen bridge the cinema streams like Ymagis bringing the content to digital theatres, or like Akamai to on-line distributors, Netflix, etc. New mediations are emerging within each stream and beyond organizations; they can morph sometimes in the very human and physical status of a Supervising Technical Director, liaising between the core film team and the technical IT crews which is the case with Dreamworks.

The paper emphasized the various forms of innovation and observable configurations in films: specific technological fields in cinema, innovations brought by young IT and digital companies, the incremental and non-disruptive approaches promoted by the majors. This variety of situations helps to highlight the growing role of specialized technology companies. Through the cases we analysed, one can note that because of the nowadays fast changing technological environment, the relationships between the two complementary visions of the industry (technological/artistic) are evolving toward a more technology oriented vision. This may offer an opportunity to move away from the doom of stranded investments in tailor-made but non-reusable technologies. Within a complex value network, some of the players are able to achieve some commercial autonomy, to extend their customer base to closer sectors such as video games, broadcasting, advertising but also medical imagery..

At the same time, the conditions of creation of the work itself, the status of film as lab are still much under the control of the directors. Digitization enabled the technical sub-segment of the cinema industry that was looked upon as the weak link of the value chain to flourish anew, new start-ups to proliferate due to the declining cost of complex production tools (special effects). It became the research branch of the film industry, relying on the artistic brief but going beyond its part in the project management of a film, of film as a single but ephemeral lab. Digitization is bringing this industry back to life, and the cases reviewed seem to show a growth that looks being based on a market approach rather than on public subsidies. All this does not mean that public intervention is absent; however it may have followed routes that differ from a standard direct support approach as well as from traditional policies at stake in the cultural areas.

Innovation models thus brought about around industrial technology brokers accompanying a change in culture of the cinema sector. The industry passes from the "project-based model", its core model since the 40's, to a "business-based model." In the latter scheme, R&D and technological accumulation can take place via technology companies, even if they are mainly financed by the film production budget. It operates on this occasion a rebalancing of internal relations within the sector: a redefinition of the competitive conditions on the one hand, the reorganization of value chains challenging the domination of the distribution networks for the benefit of stakeholders in the production on the other hand.

In conclusion, beyond an apparent discrepancy, two trends emerges. On the one hand, a disruptive innovation model is brought by the ICT industry newcomers winning with their standards and business culture, in terms of film distribution, replacing the incumbents and imposing their rules to content producers. On the other hand, an incremental innovation model is established by specialized suppliers of the ICT industry building mutually beneficial collaborative relationships in the stage of production, promoting some sort of relationship "*Art meets Science*" which could even shift the film industry from a project based approach to a more stable business logic.

References

- A.T. Kearney (2011), "A viable future model for the Internet. Investment, innovation and more efficient use of the Internet for the benefit of all sectors of the value chain".
- Anand J. (2011), "Cinema's born-again Avatar", *Business Today*, August 21st, pp. 104-107.
- AppAnnie (2014), Apps and the Evolution of Video Content Distribution in Europe, December 2014. https://s3.amazonaws.com/files.appannie.com/reports/Apps-Evolution-Video-Content-Distribution-Europe.pdf?mkt_tok=3RkMMJWWfF9wsRonvqnPZKXonjHpfSx67O4rX6G%2BIMI%2F0ER3fOvrPUfGjI4ARMZjI%2BSLDwEYGJlv6SgFSrfEMbF13rgPUxU%3D
- Arlandis, A. and Ciriani, S. (2010), "How firms interact and perform in the ICT ecosystem?", *Communications & Strategies*, n° 79.
- Bailey, Joseph P., and J. Yannis Bakos. 1997. An Exploratory Study of the Emerging Role of Electronic Intermediaries. *International Journal of Electronic Commerce* 1 (3):7-20.
- Baxandall, M. (1985), *Patterns of Intention: On the Historical Explanation of Pictures*, New Haven and London, Yale University Press.
- Benghozi, P.J, Salvador, E., Simon, J.P., *Models of innovation and R&D or non-R&D in the Creative and Content Industries: A focus on the cinema sector*. <http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/documents/JRC95536.pdf>
- Benghozi P.-J. (2014), "Plateformes : quels enjeux pour la régulation?", *Les Cahiers de l'Arcep*, October, pp. 56-57.
- Benghozi, P.-J. (1988), "Good bye Mr. Lumière !", *Cultural Economics*, Special Issue "A European Perspective".
- Benghozi, P.-J. (2011), The Cultural economics at the digital age : The second shockwave ?, *The economics of Media and content industry - 1st MCI Workshop*, Sevilla, 30-31 May 2011
- Benghozi, P.J. et T. Paris (2007). "The Economics and Business Models of Prescription in the Internet" in *Internet Economics*. E. Brousseau and N. Curien, Cambridge University Press.
- Bloore, P., (2009), "Re-defining the Independent Film Value Chain". BFI, London. Available at: www.industry.bfi.org.uk/media/pdf/h/b/Film_Value_Chain_Paper.pdf
- Boston Consulting Group (BCG), (2011), "The new rules of openness", *Liberty Global Policy Series*, January 2011.
- Brandellero, A. M. C and Kloosterman, R. C (2010) 'Keeping the market at bay: exploring the loci of innovation in the cultural industries', *Creative Industries Journal*, 3(1), pp. 61-77.
- British Film Institute (BFI) (2013), *BFI Response to HM Treasury Visual Effects Consultations*". www.bfi.org.uk/...uk/.../bfi-response-to-hm-treasury
- Brousseau, E. (2002), "Governance of Transaction by Commercial Intermediaries: An Analysis of the Re-engineering of Intermediation by Electronic Commerce", *International Journal of the Economics of Business*, vol. 9, N° 3, pp. 353-374.
- Camors C., Soulard O., Guery P. (2006), Les industries culturelles en Ile-de-France, Etude réalisée pour le compte du Conseil Régional d'Ile-de-France, IAURIF, April.
- Carr, D., (2013), "Giving Viewers What They Want", *New York Times*. Available at: <http://www.nytimes.com/2013/02/25/business/media/for-house-of-cards-using-big-data-to-guarantee-its-popularity.html?pagewanted=all&r=0>
- Corallo A., Passiante G., Prencipe A. 2007, *The Digital Business Ecosystem*, Cheltenham, UK, Edward Elgar Publishing.
- Cunningham, Stuart D. (2009) 'Trojan horse or Rorschach blot? Creative industries discourse around the world', *International journal of cultural policy*, 15(4), pp. 375-386.

- Cunningham, Stuart D., Cutler, Terry A., Hearn, Greg N., Ryan, Mark D. and Keane, Michael A. (2004) ‘An innovation agenda for the creative industries: where is the R&D?’, *Media International Australia Incorporating Culture and Policy: quarterly journal of media research and resources*, 112, pp. 174–185.
- De Prato, G., Simon, J.P., (2015), “Is data really the new “oil” of the 21st century or just another snake oil? Looking at uses and users (private/public)”. Paper presented at the 26th European Regional Conference of the International Telecommunications Society, San Lorenzo de El Escorial, Spain, 24th – 27th June 2015
- De Vinck, S. & Lindmark, S. (2012). *Statistical, ecosystems and competitiveness analysis of the Media and Content Industries: The Film Sector*. JRC Technical Reports. Luxembourg: European Union, 170 p. Available at: <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5021>
- De Vinck, S. & Lindmark, S. (2014). In De Prato, G., Sanz, E., Simon, J.P, (ed.) (2014), *Digital Media Worlds; The new media economy*, Oxford, Palgrave.
- DeRuvo, J., (2014),” Prime Focus Merges with Double Negative to Weather Visual Effects Storm”. *doddleNEWS*. Available at: <http://news.doddleme.com/blogs/post-production/prime-focus-merges-with-double-negative-to-weather-visual-effects-storm/>
- European Audio-visual Observatory (EAO) (2014), *Focus 2014, World Film Market Trends*, Marché
- Experfy, (2014), “Big Data Goes to the Movies”, <http://www.experfy.com/blog/big-data-goes-movies/>
- Foundation for Research, Science and Technology (2003), *R&D Strategy for creative industries-a discussion paper*, New Zealand.
- Fransman, M., (2010), *The new ICT ecosystem. Implications for Europe*, Cambridge University Press, 2010.
- Fransman, M., (2014), *Models of Innovation in Global ICT Firms: The Emerging Global Innovation Ecosystems*, Seville: JRC-IPTS.
- Green, L., Miles, I. and Rutter, J. (2007) ‘Hidden innovation in the creative sectors’, Manchester Institute for Innovation Research, NESTA WP.
- Grover R., Lowry T., White M. (2010), “King of the world (again)”, *Business Week*, February 1&8, pp. 48-53.
- Hueso, N. (2014), “Supervising technical directors”, company website. www.dreamworksanimation.com/?a=theater
- Karagosian, M., “Update on the Digital Cinema roll-out”, Presentation at the NABShow, April 2013. <http://mkpe.com/publications/d-cinema/presentations/NAB-TSC2013-Karagosian-Cinema-Rollout-w-text.pdf>
- Kearney, A. T. (2010), ‘The Economics of the Internet’, *The Vodafone Policy Paper Series*, no. 11, April, Available at: http://www.vodafone.com/content/dam/vodafone/about/public_policy/policy_papers/public_policy_series_11.pdf
- KPMG (2014), *Film and TV Availability in the Digital Age*, <http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/film-tv-report.pdf>
- Livingstone I., Hope A. (2011), *Next Gen. Transforming the UK into the world’s leading talent hub for the video games and visual effects industries*, Nesta report.
- McKinsey, (2010), *TMT in mutation. Essays in Digital Transformation*, Volume 2, December 2010.
- Paris, T., (2010), *Manager la créativité. Innover en s’inspirant de Pixar, Ducasse, les Ateliers Jean Nouvel, Hermes...* ; Paris, Pearson.
- Pratt, Andy C. (2008) ‘Cultural commodity chains, cultural clusters, or cultural production chains?’, *Growth and Change*, 39(1), pp. 95–103.

Preimesberger C. (2011), “Dreamworks: advanced technologies bring movies to life”, *eWeek*, June 20th, pp. 14-21.

PriceWaterhouseCoopers (2014), Global Entertainment and Media Outlook 2014-2018, Available at: www.pwc.com/gx/en/index.jhtml?ld=no

Technicolor, (2014), “Ultra HD. Sooner than expected?”, *White Paper*. Available: www.technicolor.com

Annual Reports

Netflix (2015), Annual Report 2013, 2014.

Ymagis, Annual Report 2013.

DreamWorks Animation SKG, Annual Report 2012 and 2013.

Company websites, last consulted June 2014.

Buf: <http://buf.com/philosophy/?PHPSESSID=c90140a264088061fc5e971fcbea32e4>

Dolby Labs: www.dolby.com/us/en/about-us/who-we-are/dolby-history/index.html?onlnk=al-sc

Double Negative: www.dneg.com/

Douglas Trumbull Com: <http://douglastrumbull.com/films>

DreamWorks: www.dreamworksanimation.com/

Image Metrics: www.image-metrics.com/company/history/

Massive Software: www.massivesoftware.com/about.html

Netflix: <https://pr.netflix.com/WebClient/loginPageSalesNetWorksAction.do?contentGroupId=10477&contentGroup=Company+Timeline>

Prime Focus: <http://www.primefocusworld.com/about/>

UFO Moviez: www.ufomoviez.com/About_Us.aspx?pgindex=OP

Technicolor: www.technicolor.com/en/who-we-are/technology

Third Floor Inc: www.thethirdfloorinc.com/publish/what-is-previs-1e8852/

Ultraviolet: <https://www.uvvu.com/>

Weta Digital: www.wetafx.co.nz/research

Ymagis: www.ymagis.com/fr/francais-investisseurs/francais-documentation/