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Models of ICT Innovation

A Focus on the Cinema Sector

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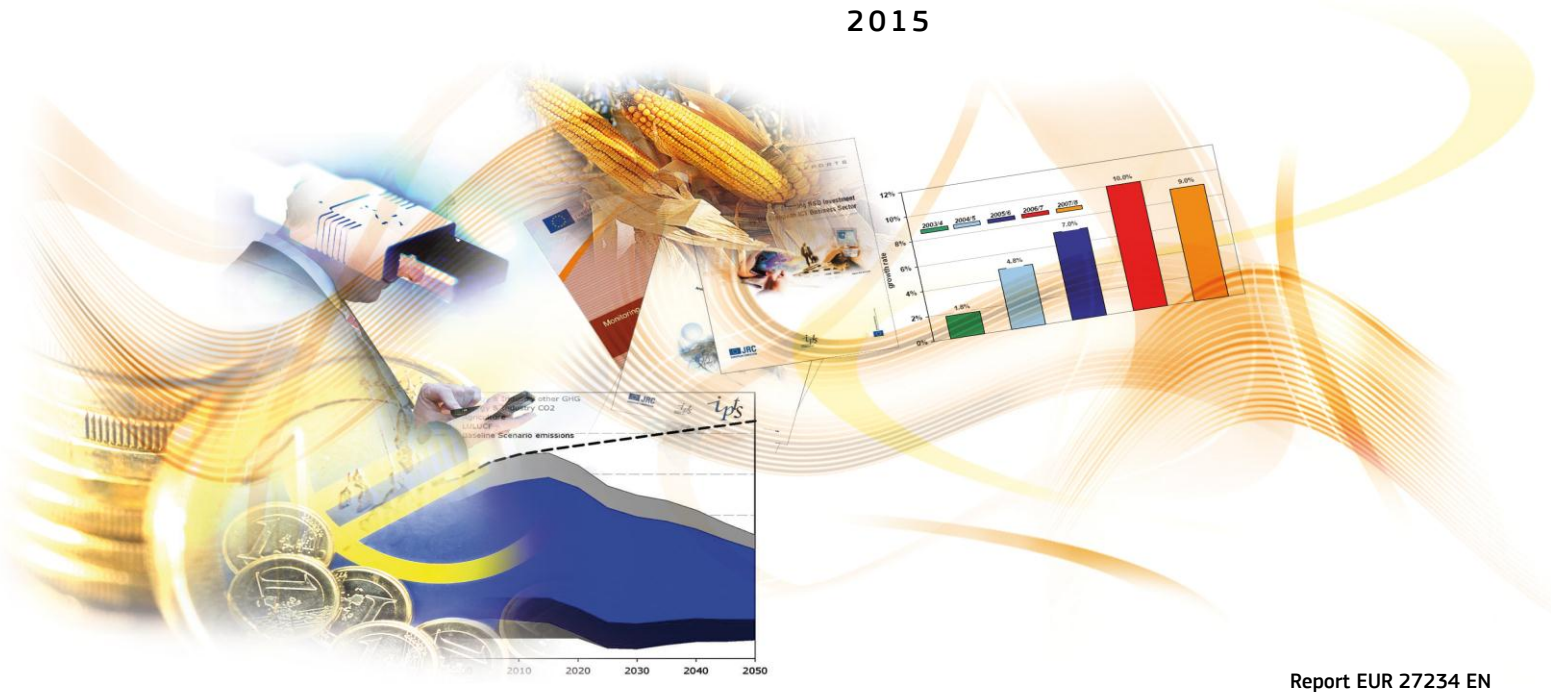

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Abstract

The report starts by looking at the competing and overlapping definitions of creative industries, media and content industries. Chapter 1 investigates the fate of R&D and innovation in the creative industries and in the broader Telecom Media and Technology sectors. Chapter 2 summarizes past studies on innovation in distinct media and content industries (videogames, music recording and newspapers publishing) and draws some lessons from them. Chapter 3 delves more deeply into the specific case of cinema. This chapter investigates the film industry's complex and evolving relationship with technologies and technological inventions. Chapter 4 offers a short cross-comparison with R&D in the book publishing industry. Chapter 5 deals with policy issues triggered by the observed digital changes. Chapter 6 concludes with a brief assessment of EU strengths and weaknesses, and offers some recommendations.

Preface

In order to reinforce understanding of innovation in the ICT sector and of ICT-enabled innovation in the rest of the economy, IPTS and DG CONNECT launched a 3-year research programme on *European Innovation Policies for the Digital Shift* (EURIPIDIS) in 2013.

The purpose of the EURIPIDIS project is to provide evidence-based support to the policies, instruments and measurement needs of DG CONNECT for enhancing ICT Innovation in Europe, as part of the Digital Agenda for Europe and of the ICT priority of Horizon 2020, paying particular attention to the improvement of the transfer of best research ideas to the market.

EURIPIDIS aims to:

- Better understand how ICT innovation works, both at the level of actors such as firms, and at the level of the ICT "innovation system" in the EU,
- Assess the EU's current ICT innovation performance, by attempting to measure ICT innovation in Europe and measuring the impact of existing policies and instruments (such as FP7 and Horizon 2020).
- Explore and suggest how policy makers could make ICT innovation in the EU work better.

Within this overall context, the IPTS commissioned Professor P J Benghozi, Research Director at the National Centre for Scientific Research (CNRS) and Head of the Research Unit in Economics and Management (CRG) at the Ecole Polytechnique (Paris, France) to carry out a study. This study aims to document the models of ICT innovation selected by stakeholders in the cinema industry, tracking specific case studies worth investigating and the emergence of renewed practices of innovation.

The report aims provides information about where R&D takes place in this cultural sector, which economic actors are taking charge and are implementing ICT innovations, where these players are located in the value chain, and how they are articulated with other stakeholders.

The report reveals that numerous specialized technological companies have introduced a different model of innovation in the production stage of the content and media industry, as compared to the disruptive model of innovation usually observed in the distribution stage. The report suggests that these divergent models interact and complement one another in a broadening ecosystem where there are strong trends towards vertical and horizontal integration. The technological dynamics are also encouraging these specialized technological companies' market to grow towards other sectors (automotive, domotics and health could be candidates) with an offering of innovative solutions including facial and landscape recognition, sound solutions, visual effects, 3D, etc. Altogether, these transformations are affecting the very nature of the cinema industry and its industrial structure, possibly favouring the emergence of creative enterprises. The report concludes with some policy recommendations inviting a review of current policies that may not be suitable for the contemporary conditions of the industry.

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Executive Summary

This report presents the findings of a study of digital age innovation models in what are often referred to as the "creative industries". The study attempted to track the various forms of innovation (R&D- and non-R&D based) within an environment disrupted by digitization and characterized by fast evolving relationships between legacy players and new entrants, mostly from the Information and Communication Technologies (ICT) sectors, e.g., Apple, Microsoft, Google or Yahoo.

The study aimed to identify where and how technology-enabled innovation takes place in the cultural sectors, which players are taking charge of R&D, where they are located in the value chain, and how they are interrelated with content producers. It focused specifically on the case of the cinema industry, while taking into account several other cultural industries, from a qualitative perspective based on firm-level case studies.

This report investigates the importance of those technologies (ICT) for a sector, the cinema industry, and how various players handle the technologies and the changes they implement or might generate. The report is therefore technology oriented, to that extent it is s not a classical report about an industry, but rather one about technological innovation and how it develops within a sector. Consequently, the report is not meant to provide an overall study of the economics of the cinema industry.[1]

R&D in the creative industries

How does technology-enabled innovation develop in the creative industries, which generally show rather low levels of R&D expenditure? What is/are the "model(s) of innovation"?

Creative companies and/or media companies are generally known for their limited investment in R&D. Academics and consultancies usually agree that most of the R&D and technological innovation takes place outside the creative industries and is supported by outsiders, mainly from the ICT industries.

Analysing the R&D expenditure of the wider Telecom Media Technology (TMT) ecosystem, which integrates a broad set of interdependent companies from the IT, telecommunications, media and internet industries, it is immediately clear that IT multinationals have much larger R&D expenditure and are highly R&D intensive. By contrast, even the largest multinationals in the creative industries do very little R&D.

However, the study shows the important role played by numerous smaller-sized companies in content-related technology innovation. The study highlights the fact that some of these companies have grown to a respectable size (qualifying, for example, for the Industrial Scoreboard[2]), and herald the emergence of a new type of multinational (global but medium-sized). These medium-sized companies, called here specialised technology suppliers (STS), are seen as the "new middlemen" or intermediaries. They liaise between companies and layers of the TMT ecosystem, building mostly on their software expertise, to enable further digitization of other players.

The study confirms that R&D investments are not made evenly across the creative industries. R&D exists, but it is not concentrated in legacy areas such as content creation and production (the "upstream"). Instead, it can be found in distribution and service provision and also in infrastructures,

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1 For an overall economic and statistical approach of the media and content industries, see the EC JRC IPTS reports on media and content industries (reports are available at: http://is.jrc.ec.europa.eu/pages/ISG/MCI.html). See especially De Vinck and Lindmark (2012), "The Film Sector".

2 The Industrial Scoreboard, published by the JRC-IPTS, ranks worldwide the top 2000 companies from all sectors by R&D expenditures. Available at: http://iri.jrc.ec.europa.eu/home.

digital rights management, user metrics and analytics (the "downstream").[3] It then sometimes feeds back to creation and production.

However, within the creative industries, the videogames and cinema industries tell us a different story. These sectors have different access to finance and risk structures as compared to the other creative industries, probably because they are considered as high-tech (cinema), or even "born digital" (video games). They need much higher initial investment than, for example, music and publishing, and usually also offer much higher returns. In this context of high initial investment, it may be that production and fabrication can support technological development (and need to do so): e.g. in the case of the videogames industry.[4] The study explores and confirms this hypothesis in the case of cinema industry: the financing capacity (though limited) of the cinema industry may allow it to play an innovation initiator role.

Brief comparative lessons from the media and content industries.

Comparing videogames, music recording and book and newspaper publishing with the cinema industry allows us to map and locate the specific phases of R&D within their respective value chains. It also makes it possible to highlight their varied strategic technological responses.

The video games industry is an interesting case of a "born-digital creative industry". It is an economically highly significant industry, global from the start, where technology is essential. In this industry, different forms of monetization and business models have proliferated with the regular arrival of disruptive new entrants. It builds on its strong ties with the digital technology industries (equipment, operating systems, telecom operators ...) and has succeeded rather well in surfing on the successive waves of Internet, mobile technology and social media applications. Although some companies make significant R&D expenditure (Quantic Dream, Tencent...), the sector's links with R&D are not always evident or explicit, as illustrated by new mobile games and online games companies. This is not the case with existing or past console games companies (Sony, Microsoft,..). This context opens up opportunities for a variety of models of innovation as illustrated by the case study of the Finnish firm, Rovio. This casual puzzle game company (“Angry Birds”) has transformed itself into an entertainment company which distributes and produces films. The video games industry is exploring interaction with its customers through various means (communities, data mining for compiling viewers’ recommendations: Zynga) and expanding into the other media (cinema: Rovio) and industries (gamification). Video games have shown that technology provides considerable opportunities for new forms of use on the move (mobility), building new competitive positions and restructuring the value chain.

The music industry had demonstrated in the past its ability to control successive waves of technology (e.g. CDs) and their integration into the value chain of technology providers (Sony, Philips, RCA ...). However, it found itself facing a new configuration with the arrival of Internet advanced mobile communication and social media applications. The industry could not build on its former experience as the latest technology wave had not been inserted into the traditional value chain of the music sector. Hence, disruptive distribution initiatives (downloading, streaming) initiated by newcomers on the Internet (Spotify, Pandora, Netflix) generated a revolution in business models and an important growth in (global) audience reach. However, these initiatives disrupted the economy and structure of the legacy music industry, instead of stimulating the traditional market for recorded music. It triggered radically new forms of consumption, as well as new relationships with IT and telecom players.

The newspaper publishing industry is also trying to adapt itself to the digital revolution. In particular, newspapers must cope with competition from new forms of information production that disrupt the flow of revenues they were getting from readership, directly or indirectly (advertising). The case is

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[3] Of course, considering data analytics as downstream is still referring to an old analytical framework for an industry that is more and more driven by the users' requests. This point is discussed in the study.

[4] See for example JRC-IPTS reports on the videogames industry. Available at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=3759

interesting because here digital developments are based above all on deconstructing the traditional models of content aggregation. The newspaper industry illustrates again how technological innovations have forced it to explore a multiplicity of sustainable business models in search of an optimal solution. In addition, the evolution towards multimedia content sites (Naspers, Schibsted, Sonoma) raises questions about the upcoming frontiers for the industry. For example, the case study of "Vice" illustrates how to build a global platform out of a print music magazine, prioritizing video over print but at the same keeping the print business running successfully.

The book publishing sector illustrates how technological innovation and R&D can take place simultaneously in several technical layers, at different paces. Digital libraries, publishing-related community blogs, social media and social networking sites are emerging as key tools for attracting new clients and fostering the diffusion of e-books (Amazon's Kindle, Kobo). Specialised technological companies (new intermediaries that provide e-readers, tablets, etc. and usher in changes in format) are emerging and supporting publishers in the production of content. Collaborative e-book distribution platforms created by consortia of major publishers and coproduction agreements among publishers and developers who specialize in the area of new technologies are other key developments. In this context, the role played by publishers and their technological investments is not pivotal. Publishers are adapting their editorial strategy to successive new digital demands, but they are not leading this evolution with a convincing strategy. For example, e-pub and pdf formats have not been a choice, but an imposition at the international level by IT providers. The book publishing industry exemplifies publishers' difficulties in structuring a collective technical response to the powerful Internet actors.

To summarise, technological companies are strongly challenging legacy players in the media industries with disruptive propositions – original products, online and mobile channels of distribution, experimental business models, social media, data analytics, etc. They have a real capacity to monetize these by accessing a massive and global audience (Spotify, Rovio, Vice). These new players are offering unprecedented solutions for aggregating and distributing content, and designing original ways of marketing and transaction adapted to new schemes (free subscriptions, micro-payments, premium services, etc.). In the broader TMT perspective, technological intermediaries and economic actors supporting and supported by technologies, such as Google, Amazon, Apple or other ISPs, dominate. The economic importance of these companies is much greater than that of cultural actors and explains their ability to quickly build their space in the cultural landscape, using technological innovations that impose new disruptive economic models. Also, these newcomers are quicker to identify opportunities in a new environment which they themselves have largely created. This may mean that innovation is mainly left to these challengers, with the risk that they radically disrupt the traditional industry. The study of the cinema industry sheds some additional light on this hypothesis.

Observations from the cinema industry

Of the traditional creative industries, the cinema is the most technological. It has undergone successive waves of technical innovation (sound, colour…). This report explores some recent forms of innovation and observable configurations in the industry: specific technological fields of the cinema, innovations introduced by young IT and digital companies, the incremental and non-disruptive approaches promoted by the major players (e.g. US and EU 'majors').

These developments are reflected by original new models of innovation, poorly documented in the literature and interesting to highlight because they seem to cover all types of innovation. These models are based on particular forms of collaboration, formalized through the decisive role of new intermediaries (firms or individuals). These new players, usually specialized technological suppliers (STS), are building their position by using their technological expertise to serve the creative dimension of cultural works. New mediations are emerging which are sometimes formalised by the employment, for example, of a Supervising Technical Director, who liaises between the core film team and the technical IT crews.

Several case studies in our study show the growing role played by specialized technology companies. The specific analysis of some companies and “iconic” clusters raises questions about their place in the economy of the sector: the nature of collaboration at different levels of the value chain (from the production stage to the exhibition stage in theatres), the strategy to capitalize on competitive resources from mastering technologies (equipment, patents and know-how), the investment economy (risk sharing and allocation of the created value), the convergence with nearby sectors thanks to the multimedia developments and online distribution and the expansion towards other sectors of the economy.

In the cinema field, many high-tech companies have thus emerged and survived, which contribute, to some extent, to a renewal of the technical cinema industries of the past. These new specialized technological suppliers (STS) are medium-sized companies. They have mastered ICT skills overall but are themselves active and specialized in only a small number of technical areas. Their growth 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.

Innovation configurations of this kind contribute to the dynamics of geographical clusters focused on cinema (in Montreal – Canada, Soho – London, Wellington – New Zealand). These ecosystems combine production companies, service providers and specialized technological companies (like visual effects companies), and where technological skills also feed links with universities.

Innovation models, introduced by these industrial technology intermediaries, seem to offer a change in the business culture of the cinema sector. The industry may be evolving from the "project-based model" (concentrated on the production of a movie - its core model since the 40s) to a "business-based model". In the latter scheme, R&D and technological accumulation can take place via technology companies, though they are mainly financed by the film production budget.

Also, technological innovation in the production stage of a "business-based model" rebalances internal relations within the sector. It redefines competitive conditions, reorganizes value chains, and challenges the domination of the distribution networks (mainly by large IT companies) for the benefit of stakeholders in the production stage (the content producers and creators). What may be important here is that both upstream and downstream stages are actively transforming themselves rather than submitting to the unilateral dominance of one or the other. Second, this technology-oriented shift may offer an opportunity to move away from stranded investments in tailor-made but non-reusable technologies. The lab model (“film as lab”, illustrated by companies like Dreamworks, Zoetrope) has been used by some pioneering examples to take advantage of this opportunity. At the same time, the creative conditions of the work itself, the status of film as lab, as illustrated in various examples, are still very much under the control of the directors.

In this complex value network and its capitalization structure, some of the players are or will be able to achieve more commercial autonomy and extend their customer base to nearby sectors such as video games (Image Metrics) or broadcasting (Avid, Mc Guff, Massive, Weta) advertising (Buf, Ymagis), and medical imagery (Image Metrics).

An additional observation is that though technologies are repeatedly renewed, changes have required time in the cinema industry, and innovations have been adopted over a long period. In the case of digital technologies, it took more than three decades to introduce them into the three main streams: production, distribution, and exhibition. A generational effect can be observed in these chronologies, starting from the mid 80s and the advent of the PC. By contrast, new intermediaries (like Ymagis, Akamai, UFO Movies, Netflix, etc.) are quickly bridging these streams and bringing content to digital theatres or to online distributors,

Finally, the examples reviewed reveal that, because of this fast changing technological environment, the balance between the two complementary visions of the industry – technological innovation and artistic creation – is evolving towards a more technology-oriented vision in both production and distribution.

Rebalancing relations within an extended ecosystem?

The study highlights an apparent discrepancy between two trends.

On the one hand, the ICT industry newcomers have introduced a disruptive innovation model. They are bringing in and mandating their own standards and business culture, and in terms of distribution, they are replacing the incumbents and imposing their rules on content producers. These IT companies are using technological resources in new and completely different ways from the traditional content industries. Instead of merely enhancing the legacy content production process, user interfaces or distribution channels, they are building their strategy around their activities and ICT-enabled services: HBO with its well-known series “Game of Thrones”, Netflix with its reinvention of the video rental business, Pandora with automated radio creation and Zynga with its use of Big Data to link game design and business models.

On the other hand, the cinema case shows that an incremental innovation model has also emerged. Specialized ICT industry suppliers are building mutually beneficial collaborative relationships at the production stage, promoting a kind of "Art meets Science" relationship, which could even shift the film industry from a project-based approach to a more stable business logic.

The discrepancy between these two trends is perhaps even more complex that it seems. New distributors are in fact slipping gradually into the shoes of producers (e.g. Netflix, and Amazon most recently) and producers are imposing innovative technology on distributors (3D).

In addition, the relationship between production and distribution is challenged by the growing attention paid to the organization of demand and the structuring of consumer contributions. Indeed, these new configurations are also based on new technologies (recommendation algorithm, home studio) and new tools, which support crowd management (social networks, crowdsourcing process, crowdfunding). These tools interact with the historical streams of the cinema industry (production, distribution and exhibition). An increased number of distribution channels combined with the potential to directly address the public reinforced the need to pay attention to audience reach/demand/distribution. In this new environment, demand is crucial and IT companies are better equipped to deal with it.

New relationships between new players and legacy players are enacted through three different trends, which are contradictory but also mutually reinforcing. The first is characterized by the new forms of dominance brought in by the new players at the distribution/exhibition stage (downstream domination). The second is related to the technological innovation generated by new forms of collaboration between the cinema industry and specialized technology providers at the production stage, enacted by new intermediaries (upstream domination). The third is the shift of media consumption from push to pull, which creates a tension between the logic of prototype (a film) firmly rooted in this industry and the growing momentum for a logic of demand.

These tensions lead us to redefine the opening question of the analysis. Rather than simply questioning the lack of technological strategy or R&D in creative industries, the focus moves to more exactly debating the effectiveness and consistency of the technological approaches implemented by their economic actors.

The report is structured as follows:

- Chapter 1 investigates the fate of R&D and innovation in the creative industries and in the broader Telecom Media and Technology sectors.
- Chapter 2 summarizes lessons from past studies on innovation in the different media and content industries: videogames, music recording and newspapers publishing.
- Chapter 3 delves more deeply in the case of cinema.
- Chapter 4 offers a short cross-comparison of R&D in the book publishing industry.
- Chapter 5 deals with policy issues triggered by the observed digital changes.
- Chapter 6 offers some conclusions.

1. Chasing innovation in the creative industries

Over the last two decades, the term creative industry has been widely used in the academic literature and in public relations. The term, however, remains unclear. It makes it difficult, in particular, to adequately characterize the dynamic technology and innovation in the field of media and culture.

To address this gap, the first chapter of the report seeks to specify the types of industrial systems that exist in the creative industries. To this aim, it develops an assessment and a critical discussion of existing works, feeding them with emblematic cases and comparative empirical data. This first part characterizes the different types of innovation. The observations serve to emphasize that R & D is not globally invested as such, and structured in the creative industries; it exists nonetheless both in terms of physical infrastructure and applications. In the most technical creative industries, innovative initiatives succeed in finance; technology specialist companies exist and are sometimes large.

The discussion also analyses how innovation and creation are blended, depending on the way knowledge and skills contribute to their creation and their accumulation. These articulations between innovation and creation open up the opportunities for disruptive and incremental developments. They also question the structure of the creative industries in the way in which their ephemeral project organization or cumulative structure generates various innovative methods and knowledge creation.

1.1 What are the creative industries?

Issues concerning the definition, identification and measurement of creative industries are still an open and evolving debate.[5] Indeed, the very definition of the creative, content or cultural industries is not stabilised. As noted by Creative SpIN report (2012, 7): "*Culture and the creative industries are difficult to grasp. Due to the broad meaning of culture and creativity, different definitions have been proposed and a standardised one does not yet exist, not at European or at international level*".

In Europe, the seminal definition of creative industries came from the UK: the Department for Culture, Media and Sport Creative Task Force formalised the definition of creative industries as "*those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property*" (DCMS, 1998 and 2001: 5).

Still, a decade later, creative industries are still described as "a mixed bag" by Deutsche Bank Research (2011). The ESSnet-Culture report (see Box 1) notes in a similar fashion: "*The concept is used in various documents and it is not standardized.* (ESSnet-Culture, 2012: 57). The report adds" *Not only can the notion of 'creativity' not be statistically measured but also the notion of 'industries' has different meanings, ESSnet-Culture strongly recommends when speaking about creative and cultural industries, to clearly mention the sectors that are covered.*"

The coverage of the resulting grouping of industrial activities under one banner is impressive and shows that the historical aggregation of a variety of domains under one same category has not made it easier observing R&D or the innovative processes in and across those industries, gauging their economic weigh, analysing their commonalities or differences or measuring their spillovers in the rest of the economy. The same applies for the media and content industries, a subset of the creative industries (UNCTAD Creative Economy Reports, 2008, 2010, De Prato et al, 2014, Leurdjik 2012a).

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[5] It is not the purpose of this report to review all available models. The US Bureau of Economic Analysis (2013), the CIRAC 2003 report for the Australian National Office for the Information Economy or the MCI studies of the JRC-IPTS (2012) offer additional examples of useful intents and synthesis.

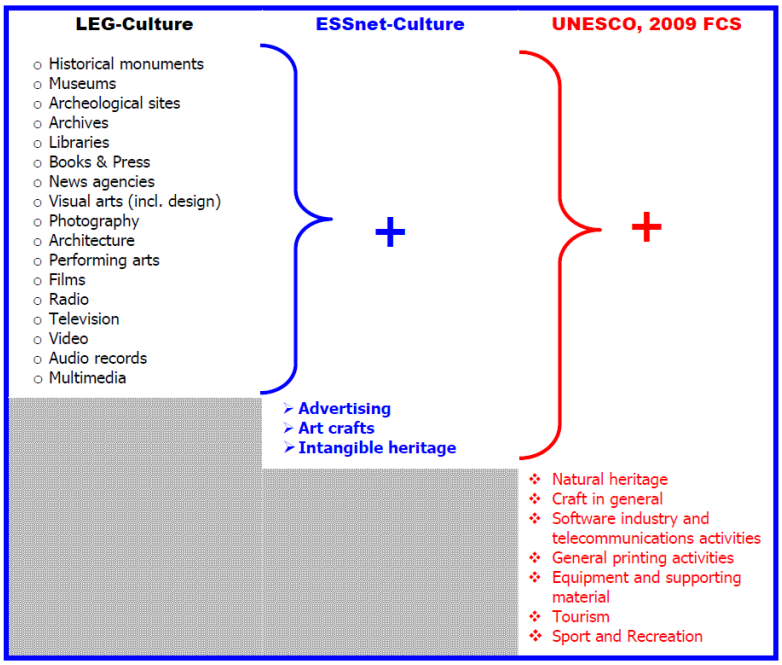
Additional recent research at NESTA gauges the creative industries across the whole of the economy, according to the level of creative intensity measured by the amount of people in "creative occupations" as defined by the literature (Mateos-Garcia, 2014).[6]

As further explained (See Section 1.3), part of this confusing aggregation might be seen as an attempt to push forward these industries higher on the policy agenda. Still, many of them show, in first instance, little observable R&D (See Section 1.4): this commonality is the first motivation of the study. It raises a question about the source and trajectory towards ICT-enabled innovation. To investigate this question, the report focuses in its later chapters on the Cinema industry.

Box 1: The European Statistical System Network on Culture (ESSnet-Culture)

The European Commission and Eurostat in particular, carried out a significant work back in 1997 on structuring the data and the methodology for cultural statistics, which led to the establishment of the Leadership Group Culture (LEG-Culture). The recent publication of the Working Group European Statistical System Network on Culture (ESSnet-Culture) is a new step for the European cultural statistical cooperation. The final report ESSnet-Culture is certainly a milestone in establishing international consensus in such area. The ESSnet-Culture framework rests on three key concepts: cultural domain, function, and dimension.

Figure 1: **Comparison of cultural domains covered by the European and Unesco Frameworks for cultural statistics**



"The concept of Creative and Cultural Industries (CCIs) is often used by different stakeholders, especially by policy makers (in different fields of economic or social policy) and, in particular when economic data on CCIs are presented. The concept is used in various documents and it is not standardized. It also extends to different realities (creative industries, creative goods, creative economy, creative cities, creative regions, creative class etc.) and covers different cultural sectors in academic documents or national strategies. Starting from a core set of relatively basic cultural fields (heritage and fine arts in general) and broadening it to wider activities (publishing, audio-visual, design, architecture) and peripheral fields (software, telecommunications, ICT), the CCIs notion often seems generic and broad and does not merely include cultural/artistic creation. Not only can the notion of 'creativity' not be statistically measured but also the notion of 'industries' has different meanings, ESSnet-Culture strongly recommends when speaking about creative and cultural industries, to clearly mention the sectors that are covered". (ESSnet-Culture, 2012: 57).

Source: Eurostat, EssNet Culture Final report

[6] See JRC-IPTS workshop: http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/NRDICCIWorkshop.htm

1.2 Mingling R&D, innovation and creation in the creative industries

Investigating innovation within creative industries is a new and emerging topic (Brandellero, Kloosterman, 2010; Green *et al.*, 2007). This is even all the more true regarding R&D and technological matters.

Innovation is not so frequently dealt with in the studies of the cultural sectors. This is an area of investigation where the claim of "creation" prevails. As highlighted by Bakhshi et al (2010a: 3), one faces two *"entrenched prejudices"* when looking at the arts and cultural sector: *"First, arts and culture are excluded from R&D by definitions based on its Science and Technology (S&T) origins. Second, the arts and cultural sector relies on a conception of creativity that mystifies too much of its work, preventing it from accessing valuable public resources".*

According to the Australian report QUT CIRAC Cutler & Company (2003: 6), produced as part of the Australian Government's Creative Industries Cluster Study, "*the nature of R&D and innovation within the creative and content industries generally has not been closely examined*". The report adds that "*these industries have tended to be at the fringes of national discussions about science and innovation policy, and of related funding and industry programmes*".

In New Zealand, R&D requirements of creative industries were analysed in a report undertaken by the Foundation for Research, Science and Technology (2003) as creative industries were considered as one of the three focus areas of the Growth and Innovation Framework (GIF). This report was an attempt at addressing the question "what is the potential of R&D to support the creative industries?": "*R&D was more often seen as a means of reducing costs, rather than a means of improving products in order to enter new markets (...) Establishing a creative industries consortium (a formal public-private partnership) would therefore be the most effective means to consolidate focused research effort over the long term*" (Foundation for Research, Science and Technology, 2003: 12 and 22).

The explanation provided by Potts (2009: 141) that "*R&D has a different meaning in creative industries...in effect constituting a normal business model, not an exceptional (i.e. un-incentivised) activity*" is not convincing, and rather mystifying, as it simply shifts the issue away. Just like in the case of the Bain report,[7] equating the first segment of the value chain "creation/ production rights" with R&D, there is no benefit in equating R&D with creation, nor in the case of Potts in diluting the meaning of R&D: both options would make the difference between R&D-based innovation and non-R&D-based innovation losing any significance, and most likely missing the observation of specific models of innovation. The difference between innovation and creation may be about the nature of knowledge involved, accumulative or not (Barrère & Santagata quoted by Paris, 2014),[8] and such difference could affect heavily the industrial structure and the business models of the companies.

Green et al (2007: 58) introduce to another perspective: the "hidden" character of innovation. They note: "*the creative sectors are under-represented in innovation and R&D surveys. These surveys tend not to sample the small establishments and self-employed individuals that are common features of these industries*". As a consequence, they stress that a good deal of conventional innovation in creative industries is 'hidden'.

Green et al (2007) state also that some less standard forms of innovation are likely to escape scrutiny. They describe these forms of innovation as "*'hidden' by virtue of being distinctive when compared with those traditionally studied*". Indeed, some innovation dynamics may completely be

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[7] In a recent report, the consultancy Bain (2013: 12) seems to equate the first segment of the value chain "creation/ production rights" with R&D per se. However, if stressing the role on the creation side may help catching part of the "hidden innovation", it may not be completely consistent to equate "creation" and "R&D". The focus on "artist and repertoire" even if extended to new forms of talent scouting through new platforms, does not appear to be equivalent to solid R&D, for instance like in the videogames industry with large companies allocating significant resources (Green et al, 2007).

[8] See JRC-IPTS workshop: http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/NRDICCIWorkshop.htm

hidden or forgotten, especially when relating to R&D and technology and, therefore, supported by outsiders or newcomers. To that extent, innovation may be hidden but in a sense that differs from the one initially pinpointed: cultural industries invest in content, most of the time through the development of creative projects or endeavours which tend to overshadow the scientific and technological dimension that is also present and sometimes core to the content.

Jisun (2010) underlines the singularity of innovation patterns in creative industries: innovative creative products are mostly reliant on non-technological "soft" innovation (Stoneman, 2007) linked to the creation of new ideas or the recombination of existing ones. T. Paris suggests that creative dynamism comes from the relationship between 'soft' (ideas, desires, and talents) and 'hard' (materiality, organization, tech…) (Paris, 2014).[9] In this context, Mussinelli (2010, 2011) expects industrial partnerships and consortia to emerge for applying open innovation among several companies in order to advance on new innovation axes.

The above-mentioned views find their way in many investigations about creative and cultural industries at national level. Green *et al.* (2007), investigate product design and video games in the UK. More specifically, they explore the different types of innovation in the creative industries and they examine how innovation is unnoticed or under-reported in official R&D and innovation statistics. They found that "*many dynamic innovations in the creative industries are not captured through technological innovation alone, nor is there a clear distinction between product and process innovation*" (Green *et al.*, 2007: 2). The video games development sector analysis reveals that innovation is focused on the resolution of current problems within projects rather than on the development of new commercial opportunities in their own right. Therefore, it is seen as content, design, process or artistic innovation. It is hidden innovation, in another sense, because it is considered as part of the usual process of video game development.

Focusing on media and publishing in the Netherlands, Stam et al. (2008: 125-126) similarly argue that "*it seems that, (…), innovation is an implicit part of daily operations and less often regarded as something that requires explicit actions*".

Cunningham et al. (2004: 4) and QUT CIRAC Cutler & Company (2003: 29) state that "*the many different research fields involved with creative industries do not relate to each other well and the potential linkages are seldom articulated into an R&D strategy involving the linkages between ICT, creative content, and educational and services industry content*", but without suggesting a solution to this gap.

With a focus on Australia, Eltham (2009: 235) underlines that "*in the sphere of innovation policy, Australia has long suffered from an inability to conceptualise the creative industries as worthy of research and development funding*".

Finally, Muller *et al.* (2009; 2008: 2) examined the creative enterprises from Austria. They argue that "*creative industries are intensive users of technology and often demand adaptations and new developments of technology, providing innovation impulses to technology producers*". They show that creative industries have a strong performance in technological innovation. They claim that creative industries support innovation in several other sectors through downstream creative inputs in the form of ideas for new products (content innovation), supplementary products and services like software, or marketing support for product innovations. These inputs can also interfere upstream: creative industries as key users of new technologies need information and communication technologies (ICTs) as innovative inputs from suppliers such as technology producers.

Last but not least, innovation in the creative industries appears to be a moving target. Following the classification of innovation in the art and cultural sector proposed by Bakhshi and Throsby (2010: 16), four forms of innovation are identified:

- Innovation in audience reach: broadening, deepening, and diversifying,

[9] See JRC-IPTS workshop: http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/NRDICCIWorkshop.htm

- Innovation in value creation: economic and cultural,
- Innovation in art-form development,
- Innovation in business management and governance: new consumption spaces, production means and business models.

Their analysis reveals than now each form of innovation is impacted by digitalisation. For instance, with audience reach, any new media technology had two basic effects: first, to enable to do more of the same, and two, to do new things. Applied to video media, this translates into two dimensions of use: a broadening/ widening (expansion of regular TV, more at different time), and a deepening: the extent of signals to sensory receptors, to eyes, ears, nose/skin/mouth, toward the entertainment of total immersion with the user participation. For the first time content/ media will be based on an individualistic experience as opposed to the times where such experience has to be shared (theatre, music). Examples of the new content models are: immersive films/ games (like "*Pirates of the Caribbean 2*"[10]), immersive sports, marketing test drive cars, travelogue.

The cinema case study presented later in this report will help confirming that the industry is an intensive user of technology, incorporating a variety of innovations, with the support of a creative organizational meeting of "soft" and "hard", and therefore developing strong and requesting relations with R&D intensive technology suppliers.

1.3 The economic public policy perspective on creative Industries

Most part of the literature on creative industries can be perceived as an attempt to push forward these industries higher on the policy agenda. This is more obviously the case for some of the reports mandated by governments (Austria, Australia, New Zealand…). They do find some sound reasons, but at the same time they introduce some circular reasoning, mixing creation/innovation with some forms of R&D as illustrated by the addition of software and engineering to the list of creative industries studied in the Austrian case (Creative Industry Survey Austria, Muller et al, 2009). This was also characteristic of the UK Department for Culture, Media and Sports (DCMS) seminal typology.

Criticising such all-encompassing perspectives, Bakhshi et al (2009: 171) quote authors stating boldly that creative industries are "*an area were 'R&D' is the main activity, while production is secondary*" (Lash & Urry, 1994). However, Bakhshi et al (2010; 9) carefully signalled: As suggested by Bakhshi et al (2010; 9), one should as well remain cautious with mingling experimentation and innovation: *"experimentation and innovation in content and form are inherent to the arts*". Being an "inherent form" for the art does not necessarily allow confusing creative experimentation with R&D.

Blending notions as seen above is confusing. No wonder it raises some strong criticism. For instance, Garnham (2005: 16) considered that the use and policy impact of the term "creative industries" *"serves as a slogan, as a shorthand reference to, and thus mobilises unreflectively, a range of supporting theoretical and political positions*".

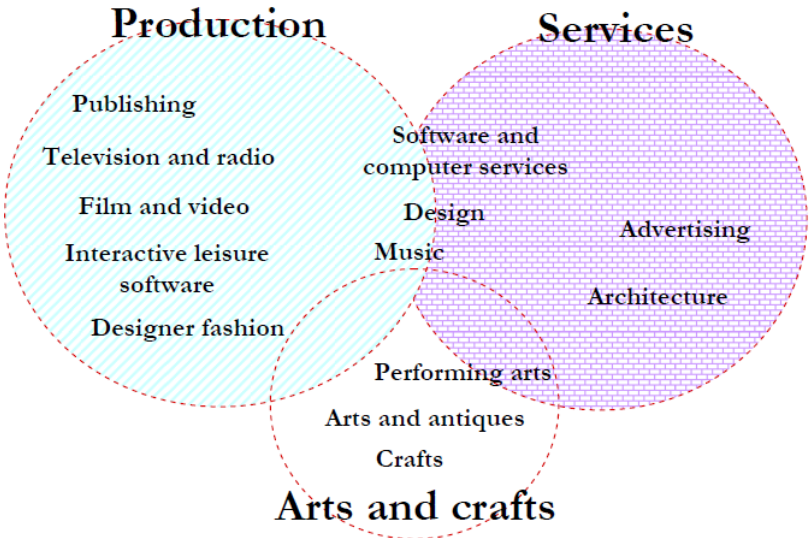
Green et al (2007) acknowledged that the definition used by DCMS "*has been useful in reinforcing the importance of these sectors for policymakers and others, especially their economic importance, and in challenging the traditional forms of policy intervention in support of arts and culture (typically, through subsidies and grants)*" (Green et al, 2007: 44). But obviously, this might have been done at the risk of confusion and the resulting failure in understanding the R&D and/or innovative processes at hand.

[10] A 2006 American fantasy swashbuckler film.

The Frontiers Economics 2006 report commissioned by the DCMS stayed rather cautious and stressed the heterogeneity of the 13 sectors[11] for which DCMS is responsible: as "*they face a range of different issues and have a range of industry structures. This means that they cannot all be grouped under a single definition when thinking about policy*" (Frontiers Economics, 2006: 8). As a consequence, 13 sectors were assembled in three main industry groups (see Figure 2):[12]

- "production industries, characterised by the production of physical or tangible products (for example the production of CDs in the music industry);
- service industries providing services to customers (for example architecture);
- and arts and crafts".

Figure 2: The three main industry groups



Source: Frontiers Economics (2006: 8)

Described as "a very mixed bag" by the Deutsche Bank Research (DBR), they "fall under eleven statistical subgroups stemming from the retail, business-related and other services sectors" (Deutsche Bank Research, 2011: 2). DBR considered: "Generally speaking, the creative industries can be roughly divided into three groups: mainly market-based (software, advertising, design, architecture), culture-related with much the nature of a public good (art, the performing arts) and not clearly attributable activities with elements from both categories (books, film, music, press and broadcasting)" (Deutsche Bank Research, 2011: 3).

The Frontier report notes the disproportion between the production industries generating almost 80% of the gross value added and the "arts and crafts" only just 2% of the total of the creative industries (Frontiers, 2006: 8). DBR shared this view: "The economic importance of the creative industries largely emanates from the four market-based segments: they account for 52% of the related total revenues and 65% of the related workforce. The culture-related segments, by contrast, account for only 4% and 5%, respectively".[13] Adding: "The strongest driver of growth was software/ games, which at the same time carries the largest weight". Besides, due to digitization, the

[11] Advertising; architecture; the art and antiques market; crafts; design; designer fashion; film and video; interactive leisure software (such as computer games); music; the performing arts; publishing; software and computer services; and television and radio.

[12] Alternatives presentations and grouping of these sectors can be found in Annex 1: The various components of "economic" industries.

[13] Based on German Federal Statistics.

boundaries started moving from product to services, the shift to on-line and mobile games being another illustration of that trend.

In a statement, released in December 2013 with the US National Endowment for the Arts (NEA), BEA[14] gives the following figures: Arts and Cultural Production account for 3.2% (US $504 Billion) of Gross Domestic Product in 2011. The statement adds: "In 2011, six industries accounted for 45% of ACP value added: motion picture and video industries, advertising services (creative content only), cable television production, TV and radio broadcasting, newspaper and magazine publishing, and the performing arts and independent artists" (BEA/NEA, 2013).

Whatever the definition and the agenda, despite of a lack of consensus on the real meaning of the notion "creative industries", there is some agreement about the locus of the economic power, about where the added value comes from. Therefore, it seems logical to concentrate on these industries often labelled as well media and content industries (production industries in Figure 2) and on one of those as case study. These industries have been heavily impacted by the digital shift (Simon, 2012) which brings some authors to consider them as "enabling industries" (Potts, 2009: 141).

Considering this choice policy-relevant, the case study selected for this report - the Cinema industry - intends to concentrate on a production industry with a relatively strong economic weight.[15]

1.4 Looking for R&D in the creative industries[16]

Observable R&D expenditures in the creative industries

As already said earlier, the scarcity of specific studies on the management of R&D in the creative industries (Green et al., 2007) echoes the fact that creative companies lack wide investments in R&D. One of the first reasons used to explain the poor level of investments in R&D is linked to the general size of these companies. Most of the firms in the creative industries are SMEs (Bouquillion, Le Corf, 2010) with related difficulties in financing R&D activities.

Notwithstanding, also large creative companies are known for underinvesting in R&D projects (Foundation for Research, Science and Technology, 2003). Therefore, other explanations have to be proposed to explain this: this second explanation could be that companies in the creative industries are considering that they take already so much commercial and aesthetic risk by creating new content that they cannot support additional technical risks and therefore prefer to build on the R&D outcomes originating from other industrial sectors instead of investing directly in R&D ventures.

Thirdly, each creative project turns out to be an innovative and prototype project. Companies consider "R&D" as being more related to investments in projects and contents rather than directly referring to the design and innovation on processes, infrastructure and devices. The innovative activity will stay hidden within the project production budget.

In their empirical study of creative industries and innovation in Austria, Müller et al (2009: 155) came up with some interesting ratio for R&D[17] (Table 1): "*31% of the creative enterprises in Austria*

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[14] In 2013, the US Bureau of Economic Analysis (BEA) introduced a satellite account (Art and Cultural Production Satellite Account: ACPSA), based on the concentric models of cultural industries proposed by Throsby in 2010 and using 2002 data.

[15] As a reminder, the JRC-IPTS has produced a vast literature about the Videogames industry. This was motivated by the same criteria. see at: http://is.jrc.ec.europa.eu/pages/ISG/MCI.html

[16] See Annex 3 "R&D in the media industries" for an overview of some empirical evidence.

[17] Based on the activities listed by DCMS to which they added engineering and consulting:
- Content: film, (computer) games, journalism, authors, music, performing arts, photography, sound studios; accounting for 5% of all creative enterprises,
- Design: arts and crafts, design and fashion, graphic design, engineering design, web design; accounting for 9%,
- Software: programming and computer services (excluding web design and computer games);
- Architecture: architecture including landscaping and urban planning; 19%;

conduct in-house R&D" but they add that this "*is driven by two sectors, engineering and software*". The ratio is much lower among the other industries covered in their study: "*only a fifth to a fourth engages in R&D activities*".

They then compared the figures with those from the Community Innovation Survey (CIS, 2005: 156) and found that "*creative enterprises turn out to be significantly more innovative than enterprises from other knowledge intensive sectors. Among the creative enterprises with 10 or more employees, 86% have introduced product or process innovations within a three-year time period, compared to 56% among enterprises from knowledge-intensive sectors*". They also found that these industries supported innovation as lead users of new technologies, thereby acting in a way as "enabling industries".[18]

Table 1: Innovation indicators for creative enterprises in Austria.

Share of enterprises (%)	That introduced any type of innovation	Conducting in-house R&D
Content	77	21
Design	71	20
Architecture	53	24
Advertising	80	25
Software	78	46
Publishing	82	14
Creative industries (core)	**71**	**28**
Consultancy	77	34
Engineering	71	47
Creative industries (extended)	**71**	**31**

Source: Creative Industry Survey Austria 2008. Weighted data

These optimistic conclusions may come from the integration of engineering and software in the broad group of creative industries. Those are the acknowledged engine of R&D and innovation activities, an aspect the authors stress in their final conclusion adding in contrast that "*the Architecture and Content sectors have rather few links to the innovation activities* » (CIRAC, 2003:167). Besides, the distribution of firms of 10 and more employees is likely to differ greatly from knowledge intensive sectors such as computer services to for instance the chemical industries. Larger firms although innovating with products and processes may be more dominated by some industrial routine than creative SMEs. This may be a bias in the approach. Muller et al (2009) do note though that just 16% of their sample employ 10 or more people.

Observing company-level data of the Industrial Scoreboard (2013),[19] and leaving aside a (unfavourable) comparison with the data of the overall ICT sector,[20] companies of the creative industries[21] are allocating only a small share of their revenues to R&D: declining from around 3% (2007) to around 2% over the period 2008-2012. In fact, these expenditures were already standing below 2% over the period 2004-2008, a share most likely still overestimated as the data is biased

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• Advertising: planning, creating and putting in place advertising campaigns, public relations management, market research, advertising services;

• Publishing: publishing of books, newspapers and other printed matter, including printing services

The last four sectors account for 13-16 %.

[18] As also stressed by Potts (2009: 141, quoting Hartley, 2009): "general enabling social technology".

[19] The Industrial Scoreboard is a JRC-IPTS report. See at http://iri.jrc.ec.europa.eu/scoreboard13.html

[20] See Annex 3 for an approach of the R&D expenditures in the Telecom Media Technology ecosystem

[21] In the subsequent examples, the report focus on the subset of Media and Content industries, including the Cinema

in the Industrial Scoreboard towards large companies selected as top R&D investors. As stated above, this weak performance is usually explained as a result of the very structure of the sector characterized by the presence of small firms and the low propensity of firms to give importance to R&D activities.

Overall, in the Industrial Scoreboard, the low level of R&D expenditures seems to have been the standard case for media and content industries players. Comcast and Disney (see Box 2), the 1st two media companies listed in the Forbes 2014 Global 2000 List (see Annex 7), are not presented in the industrial Scoreboard, for the low level of their R&D expenditures.

Box 2: Disney

Disney was founded on October 16, 1923, by Walt Disney and Roy O. Disney as the Disney Brothers Cartoon Studio, and established itself as a leader in the American animation industry before diversifying into live-action film production, television, and theme parks.

The Walt Disney Company is the largest media conglomerate in the world in terms of revenues with US $ 45,041 billion as of 2013:

- Media Networks (cable networks, broadcasting): 20, 356,
- Parks & resorts: 14,087,
- Studio entertainment: 5,979,
- Consumer Products: 3,555,
- Interactive (it includes console games and the Japan mobile business): 1,064.

Disney's technological developments are well known and include the use of stereophonic surround sound for "Fantasia", experimentation with wide-screen technology, inaugural adoption of three-strip technicolour film, and early efforts at fostering depth in the animated image. J. P. Telotte (2008) argues, that the use of cutting-edge film and media technologies have proven fundamental to the company's identity .However, there is no mention of any R&D expenditures in the "Investing Activities" section. Nevertheless, the portal offers a link to "Disney Research" introduced as an informal collaboration of the Walt Disney Company with various labs including Pittsburgh's Carnegie Mellon University (CMU) and the Swiss Federal Institute of Technology Zürich (ETH Zurich), under a five year commitment. These labs conduct research and development for Walt Disney Parks & Resorts division, Disney Media Networks, ESPN, Walt Disney Animation Studios, Walt Disney Motion Pictures Group, Disney Interactive Media Group and Pixar Animation Studios. The labs will include computer animation, computational cinematography, autonomous interactive characters, robotics and user interfaces and others in its R&D efforts.

Besides its subsidiary, Walt Disney Imagineering is the design and development arm responsible for the creation and construction of Disney theme parks worldwide. Over the years, Walt Disney Imagineering has been granted over 115 patents in areas such as ride systems, special effects, interactive technology, live entertainment, fibre optics, and advanced audio systems. WDI is responsible for technological advances such as the Circle-Vision 360° film technique and the FastPass virtual queuing system. Imagineering is perhaps best known for its development of Audio-Animatronics, a form of robotics created for use in shows and attractions in the theme parks that allowed Disney to animate things in three dimensions instead of just two.

In 2014, Disney agreed to acquire Maker Studios, the leading network of online video content on YouTube. The purchase will allow the company huge advantages in the fast-growing short-form online video industry. That same year, Disney launched its first Disney Accelerator with companies focused on a range of products including connected toys, mobile video, STEM applications, social media, advertising technology and more. A second programme was launched in 2015.

Source: Disney Portal, Annual Report (2013: 2). www.DisneyAccelerator.com. Forbes www.forbes.com/sites/vannale/2014/05/07/global-2000-the-worlds-largest-media-companies-of-2014/

However, various EU companies appear in the ranking. Vivendi (France) ranks 1st (Table 2) for its level of R&D in absolute terms[22] but displays a low 2.5% ratio of R%D expenditures to revenues.

Reed Elsevier (UK), a major of the publishing sector, ranks 2nd for R&D expenditures with an R&D intensity of 4.14%. The company is technology oriented, investing US $ 500 million every year, claiming to be the fourth largest digital content provider in the world (Annual Report, 2013: 9). The firm pioneered the use of Big Data with its High Performance Computing Cluster Systems (HPCC), "one of the most advanced, fast-performing Big Data processing technologies available today" (Annual Report 2013: 10).

Technicolor (France), following-up on the bankruptcy of Thomson (see below for more), invested 4.5% of its revenues from sales in 2013.

The level of expenditures of broadcasters is equally low (below 2% of the sales), notwithstanding the technological orientation of the sector with its strong industrial components and complex network of players. This stays true even for "new" companies like Sky (UK) relying on more recent channels of distribution.

In the multimedia sub-sector two leading non-European companies show major investments in R&D: Dolby[23] and Sony (see Table 2).[24] Sony is ranking 24th in the Industrial Scoreboard (2013). Both companies show significant R&D investments.

In that context, Youview TV (UK), spotted by the Scoreboard, emerges as an exceptional case. The company is a young UK provider of digital TV who started offering services in July 2012. It introduced its own standard IPTV set-top box, and its technical orientation may account for the amazing 83.9% ratio, after one year of operation.

Another example identified in the Industrial Scoreboard because of the volume of its R&D expenditures, is Rocksteady Studios, a UK video game developer based in Highgate, London which shows a 56% R&D ratio! Founded in 2004, the studio was acquired by Time Warner in February 2010. The developer is renowned for its games "Batman: Arkham Asylum" and "Batman: Arkham City".

Table 2: Top ranking global media companies by R&D expenditures (2012)

Rank	World Rank	Name	Country	R&D Expenditures (€ million)	Sales (€ million)	R&D Intensity (%)
1	153	Vivendi	France	718.0	28 994.0	2.5
2	296	Reed Elsevier	UK	312.2	7.523	4.14[25]
3	340	Dai Nippon Printing	Japan	269.9	12 668.0	2.1
4	492	Technicolor	France	160.0	3 580.0	4.5
5	609	British Sky Broadcasting	UK	120.8	8 122.0	1.5
6	675	Dolby Lab USA	USA	106.2	702.0	**15.1**
7	801	Avid Technology	USA	88.3	513.1	**17.2**

[22] One may suspect that the level of R&D expenditures may be linked to the video games subsidiaries (Activision Blizzard) on the media conglomerate. As, on October 11, 2013, Vivendi deconsolidated Activision Blizzard pursuant to the sale of 88% of its interest, it may appear in the 2014 financial data. Activision Blizzard Annual report for 2013 gives a 604 million US $ for "product development" amounting to 12% of total net revenues. *Source*: Annual Report 2013.

[23] For Dolby Labs see also Chapter 3.

[24] On these data, see also Nepelski and Stancik, 2011, available at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=4379

[25] Computed by authors from two different sources: Hernandez et al, Scoreboard for R&D, annual report 2013 for sales.

Table 3: **Top ranking EU media companies by R&D expenditures (2012).**

Rank	EU Rank	Name	Country	R&D Expenditures (€ million)	Sales (€ million)	R&D Intensity (%)
1	47	Vivendi	France	718.0	28 994.0	2.5
2	84	Reed Elsevier	UK	312.2	7 523	4.14
3	149	Technicolor	France	160.0	3 580.0	4.5
4	184	British Sky Broadcasting	UK	120.8	8 122.0	1.5
6	371	IPSOS France Media	France	41.8	1 789.5	2.4
7	389	Eniro[26]	Sweden	39.3	466.0	8.4
8	431	Youview TV	UK	32.8	39.1	83.9
9	534	Euromonitor[27]	UK	15.6	77.5	28.2
10	831	Il Sole 24 Ore	Italy	8.6	430.9	2.0
11	881	Rocksteady Studios	UK	7.4	13.3	56.0
12	898	ITV	UK	7.2	2 626.4	0.3
13	917	JC Decaux	France	6.9	2 622.8	0.3
14	992	TF 1	France	5.4	2 620.6	0.2

Source: Authors, data from the Scoreboard 2013, World - 2000 companies ranked by R&D, EU top 1000 companies ranked by R&D. Annual reports. Major R&D intensities in bold, authors' emphasis.

R&D expenditures in the cinema industries?

In the cinema industries, one could have expected its more "technical industries"[28]to play a major role in R&D,[29] considering them as the "labs" of the industry. However, these industries have even been described (in the French case) as a stagnating link in an expanding value chain (Imaginove, 2014: 9). Such statement, focusing on the French cinema industry, seems to ignore the dire situation in those technical industries as witnessed by leading players such as Laboratoires Éclair, Technicolor (formerly Thomson) or innovative camera manufacturer Aaton, all on the verge of bankruptcy.

In the EU, Thomson used to be one of the companies competing with US and Japanese firms to produce equipment and provide audio-visual services. The firm was faced with serious challenges at the turn of the century and devised an ambitious plan to move into digital distribution, aiming at becoming the number one firm in the field, targeting first the US market. The plan failed. The company, now renamed Technicolor refocused on core activities, still manages an important portfolio of patents that generated 15% of its revenues in 2012. In 2013, Technicolor employed

[26] Eniro is a search company in the media industry, with operations in Sweden, Norway, Denmark, Finland and Poland. In 2013, 80% of the company's revenues derived from digital media (excluding directory assistance services). *Source*: company website.

[27] Euromonitor International Ltd is a London-based market intelligence firm, providing market research, business intelligence reports, and data to industry. The firm was founded in 1972.

[28] The segment covers: shooting (manufacturers equipment and film, shooting rentals, shooting studios/set, mobile production unit), post-production (labs photochemical/digital/video, image and sound post—production, dubbing and subtitling), diffusion (screening and broadcasting, duplications (prints/KDM), DVD), archiving, storage, and restoration. In 2012, all these activities reached €1,1 billion in France according to the French Trade association FICAM (2014) for a panel of 109 companies: post-production accounted for 17%, immediately followed by dubbing/ subtitling and mobile production unit with 15%, then shooting studios and shooting rentals with 13% each.

[29] Cf. Figure 9 for an overview of the players within the cinema technical industries.

around 350 researchers and experts spread among four research centres: Rennes, Paris, Hanover, and Palo-Alto (company sites: 2014). The company invested 4.5% of its revenues from sales in 2013 (Scoreboard 2013).

Éclair, another French company founded in 1907, active in all segments of the subsector (production/distribution/ archiving/storage and restoration) followed a similar pattern and went almost bankrupt in 2009: its revenues and workforce have been cut by two since 2009.[30] The company went through several "social plans" but seemed to re-emerge and to try taking the lead on the French market as – according to the company website - "*a pioneer of digital post-production*". The company from Epinay (Paris area) introduced itself as "*an innovator for more than a century*" (company website). The company prides itself on being the only company with an R&D programme which addresses all these segments. The company was agreed and labelled within the French government project "grand emprunt numérique" (146 men/month over two years). Laboratoires Éclair claims to have an in-house R&D team working with a US-based company, Front Park Digital, specialised in "*digital asset management solutions for migrating, managing and delivering media content*" (company site). For distribution of copies, Éclair "created the first European Digital Cinema Package" (DCP) in 2005" (company website) and implemented a digital distribution hub in 2011 (see also Figure 11 "The competitive environment of digital film distribution in Europe"). The two companies, after some downsizing, seem to have refocused on R&D.

Part of the reason has to do with the fact that this sub segment is treated more as a plain supplier rather than a leading technical partner. A report for the French Centre National du Cinéma (CNC), (Lepers and Portugal, 2013), mandated to assess the economic strengths and weaknesses of this sub-sector, stressed that this technical part of the cinema industry is perceived as a "commodity" and not as the core value of the industry. The authors emphasized the negative aspects of this relationship (Lepers and Portugal, 2013: 25) and suggested some rebalancing and an improved consideration of R&D. Besides, the report underlined that this segment also suffered from serious economic challenges.

Potential U turns in the cinema industry: windows of opportunity for new (R&D) players?

On the other hand, some technical industries are faring better than others (see Chapter 3: UK post-production). The entry of emerging new players may signal a change in the legacy relationships with these suppliers, between "creation" and technical provision of services, brought by digitization, pervasive computing and new distribution channels. Even in the case of the French industries, some start-ups managed to emerge recently.

For instance, Ymagis (France), founded in 2007 by executives from the world of cinema and high technologies, shows an amazing growth curve. The firm covers activities of the technical industries (production, post-production, storage) but focuses on digital distribution of digital copies (company website, 2014, see Box 15). It claims to be an innovation company with half of its workforce being engineers and technicians, devoting 11% of its revenues to R&D in 2007 in its labs (Paris, Barcelona, Berlin), (Ymagis, 2014).

Similarly, due to the growing role of software activities, some companies in the creative industries are reaching R&D intensity ratios that are much closer to the ones for regular technology-oriented or technology producing companies. This is also, for instance, the case of the digital content-creation solutions provider Avid (see Box 12 and Table 4) spending on R&D up to 17% of its net revenues, (US $678 million in 2011, 513 in 2012).[31]

All of the above motivates for a closer investigation in additional cases of the cinema industry. Many companies are likely to escape usual investigation because of their sheer size even if some of them are publicly traded like Avid. This is all the more important to analyse as it may indicate the emergence of a new digital ecosystem with companies originating from the content sector broadly

[30] Lucas (2013). *Usine Nouvelle*, May 2013: www.usinenouvelle.com/article/pepites-digitales-en-v-f.N196885

[31] Source: Annual Report 2011: 20, Scoreboard data.

defined (like the Content Delivery Networks, Akamai). They provide IT services to all kinds of customers such as the Media Group Vice, see Box 3.

For a growing number of observers, these companies are now playing the rather recent role of "new middlemen" liaising between the different layers of a transformed industrial environment described alternatively under the notion of “new ICT ecosystem” (Arlandis et al., 2010, BCG 2011, Fransman, 2010, 2014) or "Telecom Media Technology (TMT)" according to other consultancies (AT. Kearney, Booz&Co,[32] 2011; Mc Kinsey 2010; PwC 2014).

These "new middlemen”[33] are often the output of previous R&D investments, and/or spin-off from universities. To offer here an example, Akamai, a content delivery network originated from the MIT (Box 3), from research on the dynamic routing of contents. Akamai provides services to content providers bringing their contents closer to the customer.

[32] Global Telecom, Media and Technology (TMT) ecosystem see Annex 3.

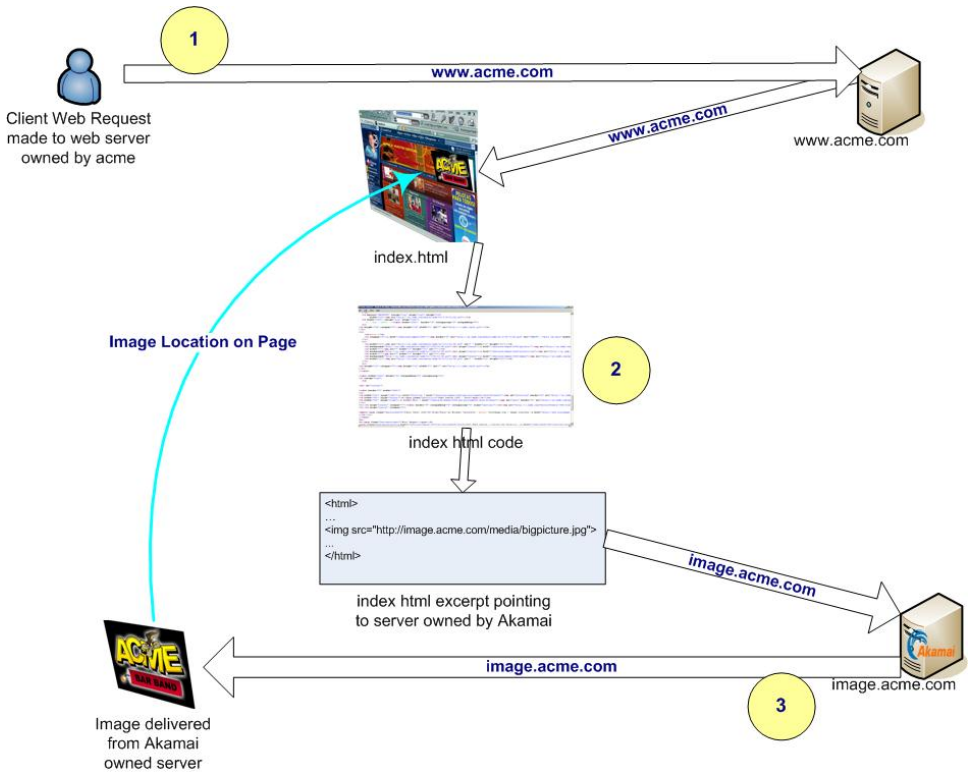
[33] The notion was used by the art historian who taught at the London Warburg, Michael Baxandall in his book *Patterns of Intention: On the Historical Explanation of Pictures*, (1985) to account for the role of scientists/artists (Baxandall, 1985: 89-93) to connect the scientific world of optic and 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.

Box 3: Akamai, a spin-off from the MIT

A content delivery network is designed to distribute content over a network and maximize bandwidth. Its purpose is to improve quality of service by taking data traffic off the major backbone of the Internet. These specific specialized sub networks (like Akamai, Limelight networks or Level 3) are being deployed to offer enhanced services to content providers, placing content on the 'network edge' closer to the customer (instead of a central server) to reduce the latency for video delivery.

In 1995, MIT Professor of Applied Mathematics, Tom Leighton, was joined by other scientists with expertise in computer science and data networking to develop the mathematical algorithms necessary to handle the dynamic routing of content and solve what was, by then, a frustrating problem for Internet users. These world-class scientists developed a set of breakthrough algorithms for intelligently routing and replicating content over a large network of distributed servers — without relying on centralized servers typically used by Web site owners today.

The company, incorporated in August 1998, launched commercial service in April 1999 and announced Yahoo as a customer. Akamai, located in Cambridge (US, Mass) is now the leading provider of cloud services for delivering, optimizing and securing online content and business applications. The company is the primary player in content delivery expediting space. It was started in 1998 to use advanced computing techniques to deliver a streamlined web experience to the end user. Its first customer was Yahoo. Since 1998 Akamai has retained content delivery as its core business, but has also branched out with two tiers of professional Internet consulting services along with related digital media and site delivery solutions. These businesses target firms seeking to deliver a rich user experience quickly and consistently. Akamai has deployed the most pervasive, highly-distributed cloud optimization platform with over 150,000 servers in 92 countries within over 1,200 networks.



Akamai Technologies, Inc. publicly traded (since 1999) had annual revenue of $1.58 billion for 2013, up 18% year-over-year, and employs currently over 4,300 employees. As of 31 December 2013, the company had 1,017 R&D employees, with R&D expenses of $93.9 million, $74.7 million and $52.3 million for the years ended 31 December, 2013, 2012 and 2011, respectively. As of January 2015, its market cap reached 10.73 billion USD.

Source: Company website, Annual Report 2013, www.crunchbase.com/organization/akamai-technologies , http://www.ft.com/intl/cms/s/0/ad0811e4-a14f-11e4-8d19-00144feab7de.html#axzz3PYuEcXtE

The following table documents R&D expenditures in selected companies involved in the cinema industry. Taking into account the wider "Telecom Media Technology (TMT)" ecosystem, it appears that IT MNEs have much larger R&D expenditures,[34] and are highly R&D intensive, while even the large multinational firms of the creative industries show rather small R&D efforts.

Table 4: R&D expenditures in media and content industries: some examples.

	R&D Expenditures (million)	**Revenues (million)**	**% of revenues**	**Size of R&D team**	**Sector**	**Country**
Akamai (2013)	$ 93.9	$ 1 580		1 017	Content distribution	USA
Avid (2011)	$ 118.1	$ 678	17%	NA	Cinema technical industries	USA
Aaton	NA		NA	NA	Cinema Manufacturing	France
Buf (2013)	NA	€ 10	NA	NA	Cinema technical industries	France
Dolby (2013)		$ 807	19%[35]		Multimedia equipment	USA
Double Negative	NA	£14,299 (2005)		Europe's largest VFX R&D team	Cinema technical industries	UK
DreamWorks (2012)	$ 4.9[36]	$ 749	NA	310[37]	Cinema Motion Picture Producers and Studios	USA
Image Metrics	NA	NA	NA	The company indicates 60 man-years of research between 2000 and 2014. R&D centre in the UK	Cinema technical industries and video games	UK
Eclair	NA		NA	NA	Cinema technical industries	France
Sony (2014)	4 132 (2008) multimedia	6 662 Group level	NA	NA	Multimedia equipment	Japan
Quantic Dream	NA	NA	NA	External contractors most likely	Video games	France
Technicolor (2012)	NA	€ 3 500	NA	350	Cinema technical industries	France

[34] Even when the R&D are quickly identified in annual reports it remains difficult to see how much R&D is allocated by these IT firms to R&D for the creative industries.

[35] Generally accepted accounting principles (GAAP) R&D only. Company website.

[36] Total for product and development as a proxy. Product development costs primarily consist of research and development costs related to technology initiatives or costs incurred pursuant to development agreements with third-party software developers (Annual Report 2012: 54).

[37] Estimated from indication in the company's annual report.

	R&D Expenditures (million)	Revenues (million)	% of revenues	Size of R&D team	Sector	Country
Tencent (2012)	NA	$ 6 983.3	Over 50%	NA	Video games, Internet service portal	China
Vivendi (2013)	NA	€ 22 135	NA	NA	Content and telecom	France
Ymagis (2013)		€ 47.3	11%		Cinema technical industries Digital distribution	France
Zoetrope	NA	Estimated[38] $20 to 50 million	NA		Cinema Motion Picture Producers and Studios	USA

Source: Compiled by the authors from companies' website, Internet sources and annual reports.

However, some of the evidence gathered shows the existence of smaller-sized companies' efforts in technology-related content and the possible emergence of larger companies (hence able to show in the industrial Scoreboard). These smaller-sized companies', specialised technology suppliers as suggested, are "new middlemen" liaising between companies and layers of the new ecosystem, bringing and building mostly on their software expertise to enable further digitization of other players.

In Chapter 2, a new reading of past studies and several case studies in the content industries help further illustrating the above observations. In Chapter 3, the report takes an in-depth look at the cinema industry and considers numerous company cases (See Table 4) to flesh out the role of each player, the relationships established in the ecosystem –disruption or incremental integration? - and their potential consequences for industrial structure or business models.

1. 5 Research questions

All of the above observations, hypothesis and data help discussing the research questions of this study.

The very initial question of the study stated:

With a rather low level of R&D expenditures, how does technology-enabled innovation develop in the creative industries? What is/are the "model(s) of innovation" at stake?

This initial research question generates a set of related questions:

- Where does technological innovation happen in the value chain?
- Who are the main players and what are their relations?
- Is there a broader "ecosystem" observable, and what are its characteristics?
- How do different worlds "co-exist and collaborate" in that ecosystem?
- Which features of which of those worlds institute the rules of the co-existence?
- How does the model plug in the creative value chain from creators to consumers including producers and distributors?
- Who is financing the various public and private players?

[38] *Source*: Manta, 2014. www.manta.com/c/mm2hh86/american-zoetrope

- What is their market strategy and position on the market in terms of local/global market access?

The answers to those questions build initially on top of already investigated points in earlier studies (such as the MCI series)[39] but also add some additional hypothesis.

Do Hi-tech creative industries, such as the Cinema, show innovative behaviours that are different from the other creative industries?

As we have shown above, academics and consultancies support the argument that the main part of the R&D and technological innovation takes place outside the creative industries and is supported by outsiders, mainly from the ICT industries.

Still, within the creative industries, the videogames[40] and cinema[41] industries might tell us a different and complementary story. These sectors present different access to finance and risk structure, probably because considered as high-tech, when not "born digital" (Videogames). They call for much higher initial investments than for example music and publishing, and usually offer also much higher returns In such cases of high investments, production and fabrication might be able (and need to) support technological developments: this is the case in the videogames industry. We will explore such hypothesis in the case of cinema industry.

If such is the case, the scenario might call for a different approach than the one usually observed with the MCI, as the financing capacity (although restrained) of the cinema industry might enable an innovation initiator role which has scarcely been observed among the MCI over the last decades.[42]

Is there an alternative scenario, next to the disruptive one?

The assumption that the hi-tech creative industries might develop different innovative trajectories might open the way for an alternative scenario. The almost traditional scenario in the MCI[43] is one of radical transformation of the downstream distribution stage by ICT newcomers, disrupting the existing value chain. Those newcomers then develop a strong dominance of the downstream industrial activities and intent to control the upstream one, the production, building global ecosystems backed-up by platform dominance and testing disruptive business models. In all such cases, the content producers become mere suppliers without control on the new intermediary. They complain about those intermediaries not paying the "fair "share of the content production and supporting its inherent risks, and claim they put at risk the quality and social value of content itself, that is: culture (Fontaine, 2014).[44]

A new scenario, which the report aims at investigating, is that of a less disruptive situation, one of incremental change embedded in cultural and media content development, in cooperation and knowledge integration with ICT providers in such a way that it benefits to both parties. In such a scenario, the economic dynamic is not any more resulting from the vertical integration by newcomers, stepping downstream in the value chain in order to control exclusivity of attractive contents. It becomes a scenario of cooperation or integration of ICT providers stepping upstream in the value chain in order to enhance the content production, and from that improved position force the power relation to a more balanced equilibrium between production and distribution. A rather optimistic scenario.

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[39] See at: http://is.jrc.ec.europa.eu/pages/ISG/MCI.html

[40] See in particular: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=3759

[41] See in particular: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5021

[42] See at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?CFID=15941aca-9d96-4ea0-bfc7-ea99cb5a2195&CFTOKEN=0&id=5900

[43] For more see at: http://is.jrc.ec.europa.eu/pages/ISG/MCI.html

[44] Almost symmetrically, the telco operators – as pipeline owners -, complain about the newcomers not paying a fair price for the use of the infrastructure, putting at risk the quality of service and jeopardizing the deployment of the networks needed.

With digitalisation, is there a clash of managerial culture that could affect the cinema industry?

The assumption is that in the cinema industry, the technology suppliers that will be observed are "specialized technological companies" with edge R&D, in-house or contracted equipment (i.e. server farms), diverse collaboration with academia and other knowledge environments, and multi-customers portfolios. The business model of the technology supplier relies on market growth (thanks to technological standard and proprietary solution), expansion to other customers and other industrial sectors. In the integrative or cooperative model, they would emerge and have a growing – while fragile - role of intermediaries in the creative industries.

A dilemma stemming from this model of digitization is therefore that we have now a tension between the prototype-rationale firmly rooted in the content industry confronted to the high-tech industrial rationale that is gaining momentum. Indeed, the usual business model of the cinema industry is built upon the prototype/project logic, creating blockbusters for peak consumption periods, differentiated markets and windowing strategies.

The question then arises if we will see an unachieved and potential shift towards a "creative enterprise model" in the cinema, articulating both logics with a possible momentum towards a more industrial and technological one?

Does one or another innovation scenario affect the industrial structure?

Still, as an additional hypothesis to be investigated, such economic dynamic could contribute to disengage the production and distribution processes: developments in content production would divest themselves from online distribution. The digitization of the distribution channels happened historically first and it influenced the economic balance of the upstream activity. As a consequence, distribution legacy players (logistics segment) have tended to disappear and have been replaced by newcomers who are often (large) ICT platforms (Amazon, Netflix, etc.) or ICT equipment suppliers (Sony, Barco,..).

Technological companies, especially from the ICT, use technological resources in a completely different way from the creative industries. At the distribution stage, ICT companies 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 the cultural industries: Amazon and Netflix use data-mining systems to enhance the quality of their suggestions, compile users' choices and recommendations to develop advertisement. All this results in important process innovations and domination by these ICT platforms, which have almost become monopolies.

But somehow, such an evolution did not affect, so far, the organization of the production process. For example, the shift from DVD rental to streaming by Netflix did not affect the production of feature films.

Is there room for public intervention in the innovative drive of creative industries?

Insofar as digitization passes all through the value chain and influences the generation of revenues, it raises several important issues regarding public policies for culture.

An important part of the literature on creative industries is perceived and criticised as an attempt to push these industries higher up the policy agenda, as noted in Section 1.3. This does not mean that the policies cannot be grounded. Indeed, public intervention in the creative industries is fairly common and built upon the externalities for society at large (cultural, societal, etc.), (Unesco, 2005) generated by these merit goods.

With a slightly different perspective, the European Competitiveness Report (EC, 2009) stresses that the economic rationale for government intervention in favour of cultural industries is based on the notion that this sector constitutes a significant locus of economic dynamism in the post-industrial world. This argument justifies public intervention beyond the mere correction of an imperfect market and market failures: governments intervene directly (subsidies in the case of cinema in

France, or zero VAT on books in the UK, for instance) or indirectly (various tax breaks, and reduced postal rates for the distribution of newspapers or books).

The traditional subsidies of culture aim at stimulating the creation process, supporting – to a lesser extent – the distribution channels and the demand for contents. These policies are still marked and shaped by the influence of traditional cultural perspectives: the relevance of their design might become debateable in the digital era.

With digital distribution, the new digital environment is jeopardizing a funding system[45] based on box office revenues collected on the domestic market structure ("territorial" for movies theatres or bookstores e.g.) with the growth of alternative distribution channels and services provided by suppliers located outside the national territories or even outside the EU. From such a perspective, one can discuss the possible relevance of legislative initiatives like in France for establishing a single price for *digital* books, similar in spirit to the measure introduced in 1982 and which had helped maintain the active network of independent bookstores.

On the production side, the "legacy" funding system takes too little into consideration the key dimension of R&D: support to technological companies and enhancement of the ecosystem for the technical industries interacting with the creative industries.

Digitalization – and its important technological dimension - supposes to think over creative and culture policies in a very different way. It calls to go far beyond traditional sectorial perspectives (policies for music, audio-visual, videogames, publishing…) or undifferentiated industrial policies (patents, antitrust, entrepreneurship…). It suggests, secondly, thinking over specific policies in tune with the dynamics of the ICT sector, its technologies and its R&D activities.

1.6 Conclusions

Creative companies and/or media companies are generally known for a lack of wide investments in R&D. The elements we reviewed so far do confirm this (too) broad view.

Part of it, as we highlighted may have to do with the methodological approaches to track this specific kind of expenditures. However this first review, without being comprehensive, does bring some important nuances in terms of the reality of some R&D being done and of the various forms of innovation taking place. It points to the role of the specialised technological providers that may intervene at several entry point of any legacy value chain.

To challenge a too simplistic view about R&D and innovation in the creative industries, this report positions itself at the crossroad of three little stabilised issues:

- the non-RD characteristic of the creative industries taken as initial motivation for investigating their innovation processes (prototype-based, project-oriented) in the digital era,
- the very definition of the creative industries, where the choice of a strong economic activity, the cinema industry, serves as solution,
- the confusion innovation / creation, where the option is to focus on the technological innovation per se, as the object of observation.

With these elements to start with, the report intends to illustrate and explain technological innovation in the cinema industry, and henceforth answer the research questions listed above.

[45] Cinema is organized as a service economy, on a rental basis, for the copies to be released in theatres and for the viewers to pay for an admission ("renting their seats"). See Chapter 3.

2. Lessons from past studies on innovation in the media and content industries[46]

This chapter summarizes and draws some lessons from past studies on innovation in distinct media and content industries: videogames, music recording and newspapers publishing. It ventures into the symbiotic relationships between these industries and the distribution industries as illustrated in Figure 18. Each section offers a brief historical background, followed by an updated specific case-study focusing on some specific facet of innovation.

The video games industry is an interesting case of a "born digital creative industry". They illustrate the situation of a highly significant industry, global from the start, where the share of technology is of course essential. This industry promotes the proliferation of various forms of monetization and business models; it causes the regular arrival of new entrants who bear disruptive perspectives; it requires a strong link with the digital technology industries (equipment, operating systems, telecom operators ...). However, the sector does not always exhibit evident and explicit links with R & D: this is clearly the case of new mobile games and online games, unlike what exists and existed for console games.

The music industry had demonstrated in the past its ability to control successive waves of technology (think of the CD) and their integration in the value chain of technology providers (Sony, Philips, RCA ...). Yet it found itself facing a new configuration with the arrival of the Internet. The industry could not build on its former experience as the latest technology wave has not been inserted in the traditional value chain of the music sector. It has instead resulted in radically new forms of consumption, as well as new forms of relationship with OEMs and telecom players.

The newspaper publishing industry is also faced with the search of a stable solution to adapt itself to the digital revolution. In particular, newspaper must cope with the competition of new forms of information production that disrupt the flow of revenues they were getting from readership, such as advertising. The case is interesting because digital developments are based above all, in this case, on deconstructing the traditional models of content aggregation. In addition, their evolution towards multimedia content sites raises the question of new upcoming frontiers of the industry.

The movements observed in all these areas call for the emergence of new players building their position from technical intermediation functions. The conclusion seeks for commonalities and sets the basis for the in-depth cinema case study that follows.

2.1 Video games

History in a nutshell

The birth of the video game industry was concomitant with the emergence of the public microcomputer. The video game sector is born and relies initially during a time period of thirty years, on the games consoles. This physical console market faces today, as one can easily observe, a significant decline.

It is offset by the development of new channels, the web game, cloud gaming and gaming on mobile media (mobile phones and tablets) as well as the extension of the field of video games to non-recreational activities ("gamification").

At the same time, the original business model of the video game, inspired by the publishers' (equipment purchase support for a game to install or use on a console) is outdated as the business

[46] The chapter builds on some of the Media and Content (MCI) IPTS series reports, concentrating on a sample of innovation models the sectors dealt with in these reports. See list of references for music, newspaper and video games under De Prato et al 2012, Leurdijk et al 2012, Simon 2012a, b. The book publishing industry - included in the series - is not dealt with in this chapter but specifically presented regarding R&D in a following section of this report, see Chapter 4. The broadcasting industry is not covered either.

models of video games become diverse: pay per play, freemium, crowdfunding, bundling and subscriptions, for example. For example, the free-to-play[47] business model is now dominating in the world-wide market for mobile games (Mobile Game Arch Roadmap, 2013). Today, the video game industry has gained a considerable economic weight with its channels that tackle specific constraints depending on the nature of the games and their economic models.

Furthermore, the advent of the Internet and mobile technology introduced newcomers and disruptive and innovative business models into the video game industry. These new comers and their innovative scenarios are re-shaping the landscape of the traditional industry. During the 1st semester of 2013, Tencent (Box 4) , a Chinese company that was not even included in the top 20 in 2009 became n°1 overtaking Activision Blizzard (ranking 1 in 2012) (Newzoo, 2014, De Prato et al, 2010: 41).

Box 4: Tencent (China).

Founded in November 1998, Tencent has grown into one of China's largest and most used Internet service portals. On June 16, 2004, Tencent Holdings Limited went public on the main board of the Hong Kong Stock Exchange. In 2012, total revenues were US $6,983.3 million, an increase of 54% over the year ended 31 December, 2011. Revenue for the year 2014 was RMB60 billion (9.6 US $ billion/ €8.44 billion), up 38%. E-commerce and media firm Naspers, Africa's biggest company by market value, invested in the new-born firm in 2001, and owns about a third of Tencent (34%).

As one of the four online platforms of Tencent, Tencent Games (QQ Game Platform for online games) is an online game developer and operator, and is recognized as the largest online game community in China. In the PC gaming market, Tencent published six of the top 10 games in China (2014). Other services include QQ IM, Qzone (the leading social networking service platform in China), Weixin and WeChat (a next-generation communications service for smartphones); as well as an eCommerce open platform. Tenpay has a 21% share of the online payment market. At 31 March 2014, QQ IM had 848 million monthly active user accounts and 200 million peak concurrent user accounts; Qzone had 644 million monthly user accounts; Weixin known as WeChat internationally, had a combined 39 6million monthly users, evolving from a pure communications service into a multifunctional platform.

More than 50% of Tencent employees are R&D staff. Tencent has obtained patents relating to the technologies in various areas: instant messaging, e-commerce, online payment services, search engine, information security, gaming, and many more. In 2007, Tencent invested more than RMB 100 million in setting up the Tencent Research Institute, China's first Internet research institute, with campuses in Beijing, Shanghai, and Shenzhen. The institute focuses on the self-development of core Internet technologies, in pursuing its development and innovation for the industry.

Sources: Company website, De Prato et al (2014a) based on www.tencent.com/en-us/at/abouttencent.shtml , www.tencent.com/en-us/content/ir/news/2013/attachments/20130320.pdf http://www.naspers-reports.com/2014/per-op-internet.php

The development of the mobile Internet supported the expansion of the video game sector, which represents a significant share of sales on the Apple AppStore, e.g. half of all mobile phone users play and major video game players today are on Facebook and Apple. Finally, one can note that many Asian video games giants (See Table 5) were born on-line, e.g. in Japan and China, South Korea to a lesser extent.[48]

[47] With free basic features (free trial period, full version for a fee) which is alternatively called also free-to-play (F2P: the content is made available for free on line).

[48] Nexon was ranking 11 in 2013.

Table 5: World top 10 companies by game revenues (2013)

Rank	Company	Country	Revenues US$ billion
1	Tencent	China	5.267
2	Microsoft*	US	4.696
3	Activision Blizzard	US	4.583
4	Sony*	Japan	4.329
5	EA	US	3.661
6	Nintendo	Japan	2.393
7	Apple*	US	2.373
8	King.com	US	1.884
9	DeNa	Japan	1.609
10	GungHo Entertainment	Japan	1.554

* Based on estimates

Source: Newzoo (2014).[49] The data is based on analysis of annual and quarterly financial reports of the universe of relevant publicly listed companies. Revenues exclude hardware sales and other non-game sales where possible.

Since 2004, the online and wireless market has grown with remarkable rapidity, driven by the increase in the number of broadband subscribers, the innovation in available games, the transition to handheld devices, and the newest generation consoles. On-line and wireless video games have become the second largest product segments of the video games industry, reaching a 44% share (on-line games: 32%; mobile games: 12%), (Idate, 2012).

Social networks like Facebook contributed to popularize games on these platforms (e.g. Zynga's "Farmville") offering simple games, however based on servers allowing the kind of interaction offered by Massive Multiplayer Online Games (MMOGs), fuelling audience and revenue growth in the online games segment. Riot Games is a company founded in 2006. It released its game "League of Legends" in 2009 to become the most played PC game claiming over 67 million plays on average per month. The company stresses the link with the users (*player experience first*) and introduced a new middleman; the community manager. According to A. Kerr (2014), community managers are becoming a growing category of the work force, at least in the Irish game industry.

Thus, on line and mobile games acted as an engine of change within the video games industry. The alternative business models which users face when entering the world of online games are actually rather different from those they were used to (De Prato et al, 2012, De Prato, Sanz and Simon, 2014, De Prato, Feijoo and Simon, 2014, Feijoo et al, 2013). Besides, online and mobile games are not only bringing new business models but adding "new pirate-proof opportunities", with the business model ("freemium") enabling greater freedom in how much gamers pay. Since its inception as a digital artefact, one of the main threats to existing market structure appears to have been piracy. However, the industry is, first and foremost, relying on its capability to invest in the development and introduction of disruptive technologies, rather than on litigation.

As shown above, despite its relatively short history, the video game industry has become nowadays a huge economic sector addressing every kind of channel: PC, tablet, TV, on-line and mobile phone. From an economic point of view, the importance of the global video game market is illustrated by some few key figures: this sector has reached a turnover[50] of €60 billion worldwide (Warman, 2013: 9).

In the cultural industries, video games occupy a unique place. In addition to its newest technological component and its mass audience nature (with 1.2 billion active gamers worldwide as of 2013), the

[49] See www.newzoo.com/free/rankings/top-25-companies-by-game-revenues/#bubkvLzRXq5XPlSD.99

[50] Estimated by consultancy Newzoo.

video game industry is distinguished by an essential characteristic: its interactive dimension. Most creative industries are based on the value of contents, while a video game mostly relies on interaction. This difference does not simply influence the nature of the projects. It also has a significant impact on how video game companies perceive, design and organize innovation. As we already mentioned in Chapter 1, most creative companies aim at innovating to settle current hindrances on projects rather than to cultivate new commercial opportunities in their own right: it is regarded as part of the routine process of video game development.

Green et al. (2007) specified that "*of the companies interviewed during this research none had a rigorous method for measuring R&D expenditure – or estimating the return from this activity. Even studios that did have a dedicated R&D team with an associated budget felt that R&D could not practically be separated from the inventive and innovation processes which was part of the routine practice of problem-led development and creativity*"(Green *et al*., 2007: 44).

In other words, measuring R&D is not considered a pivotal activity for most firms. Referring to the definitions of R&D by the OECD Frascati manual (described as "*the veritable bible for R&D policymakers*"), Bakhshi et al (2010a: 3) stressed that under such conditions "*only 5% of development spending in an even obviously high-tech creative industry like games development qualifies as R&D for tax credit purposes in the UK (Games Investor Consulting, 2007)"*.

These results come from the different meaning given to innovation in the creative industries. Each project requires unique technical developments, which has an impact on the investment and funding arrangements. Consequently, the video games industry is characterized by a large range of business models differing from one platform to another; depending on the type of game, the game company's strategy, the target customer, etc.

For instance, in the analysis of the French video games sector, PIPAME (2012: 72) claims that "*most part of videogame companies has their own game engine that is the technical block that enables to develop contents. These engines generally come from R&D programmes and they are constantly updated, according the technological evolutions, requirements and platforms. Very few companies purchase these technologies on the market because of prohibitive costs (excepted, in our study, Ubisoft and Cyanide, which get their own proprietary engines). Thus, technological assets are the strongest item, from accounting viewpoint. Some enterprises like Quantic Dream* (see Box 5) *have R&D units that go beyond the only technological dimension and focus on game play, interactivity and also emotion. To be noted that jobs of R&D coordinator are rarely created and that developed technologies are rarely documented* ".[51]

Box 5: R&D in the video games industry: Quantic dreams (France)

The studio was founded in 1997 and it has gained, over the years, international recognition for its contribution to interactive narration. The studio is considered as one of the leading motion capture studios, in particular for the creation of real-time 3D Virtual Actors. The studio created "Heavy Rain" (released in 2010 the ninth bestselling title worldwide on the platform Playstation 3, reaching 2.4 million users since) developed with Sony Computer Entertainment. 90% of its revenues are coming from international sales. "Beyond: Two Souls" (2013) had a €23 million budget, the development of the game took 28 months.

Quantic Dream works with Chinese teams for 3D landscape and 3D "raw" characters, as well as with a supplier from Philippines. The company claimed developing proprietary technologies including some very advanced tools that allow the company to benefit from what they describe as "a unique approach to the production pipeline". The Paris firm is a pioneer in the convergence of cinema and videogames as it has been using short films to prepare their videogames project. To that end they are using our latest techniques in matters of motion capture, animation, image processing and what not. The company stresses that this approach enable them to do a lot of R&D[52] before starting the actual production work.

Sources: Company website, De Fondaumière, Minutes of the École de Paris Meetings.

[51] Authors' translation

[52] No data available.

However, other studies point at the emergence of third party development companies between the late 80s and the early 90s, creating the first separated middleware modules to handle the graphics in video games. Those modules produced by third parties evolved into small flexible and lightweight components, in charge of the management of more specific functionalities. Although the landscape of third party development companies changes fast, the EU is second to the US with, for instance, two German middleware companies, Crytek and Trinigy, appearing at the source of the most popular core game engines (De Prato et al, 2010: 77).[53]

This context opens up opportunities for a variety of models of innovation.

The case of "Angry Birds" (Rovio, Finland)

Rovio, the Finnish company responsible for the game "Angry Birds", a casual puzzle game, is offering an interesting case study. The company was founded in 2003 by three students from the Helsinki University of Technology and is focused on online video games distribution. Early 2009 the company was close to bankruptcy, having developed 51 games prior to the release of "Angry Birds", for publishers like Namco or EA. Its highly successful "Angry Birds" franchise was launched in 2009 and in its first development the company invested around €140,000. The Finnish start-up hit 1 billion downloads, with "Angry Birds", in May 2012, with paid downloads accounting for more than 25% of total downloads, and 2 billion downloads in 2013. The company claimed more than 263 million monthly active users at the end of 2012.

It achieved an estimated revenue for all of its business models created around the franchise (including the sales of cuddly toy animals of its characters) of more than €152 million in 2012, up from €75.6 million in 2011, with estimated profits of €55.5 million.[54] Over 800 employees were working for Rovio in 2013 across its offices around the world (Table 6).

New channels of distribution (on-line, mobile) have been a key element of the strategy of the company so as to set up an innovative business model that frees the company from the overwhelming influence of publishers like EA. Indeed, the founders took the step of making and distributing their own video games on line, and to move later to free to play, another example of a winning strategy.

The company is also going global with a significant presence in the leading EU games clusters (Nordic clusters, London), and its locations in Asia (China, Japan, and South Korea). Indeed, Rovio opened its Chinese office at the beginning of 2012, and its first "Angry Birds" activity park in Shanghai at the end of that same year. The company invested in new business areas, such as animation and video distribution, ventured into new business models in games, and consolidated its market position in consumer products licensing, thereby "*setting its foot strongly into the entertainment business*" to quote the company (Rovio Entertainment Report, 2013: 1). In March 2013, Rovio launched ToonsTV (with content from Rovio Animation Studio) potentially turning every Angry Birds game into a video distribution channel, as of December 2014, ToonsTV reached 4 billion views in 230 countries with the biggest audiences in US, UK, China, Mexico and Russia.[55]

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[53] More information available at : www.gamemiddleware.org/

[54] *Source*: www.rovio.com, www.neogames.fi/wp-content/uploads/2013/05/GameIdustryFinland11_2013.pdf

[55] ToonsTV features Angry Birds Toons, Piggy Tales, Angry Birds Stella and third party content from Xilam, Vooz, The Jim Henson Company, National Geographic and Graphic India. *Source* : http://www.rovio.com/en/news/press-releases/597/toonstv-reaches-4-billion-views

Table 6: Rovio, a global company.

HQ	Games Studio	Games Studio	Branch Office	Branch Office (Consumer Products)	Branch Office	Branch Office	Branch Office
Espoo, Finland	Tampere, Finland	Stockholm, Sweden	Shanghai, China	Santa Monica, CA, U.S.A	Seoul, South Korea	Tokyo, Japan	London, U.K.

Source: Rovio.com

With or without any direct public support, the company must have benefited from being part of the Finnish cluster of video games, like other successful Finnish video games companies (Supercell for instance with the world hit "Clash of Clan's"[56]). Policy makers are very active in Nordic countries to support IT ventures (with the Finnish National Technology Agency, Tekes or the Nordic Game Program), (Chapple 2014, Simon 2012c).

Rovio, a company registered in Finland as Rovio Entertainment Ltd, does not disclose the distribution of expenses and revenues, making it difficult to assess the part allocated to R&D. However, its innovation model seems to have rather been built around the combination of relevant distribution channels for their casual puzzle game, "Angry Birds" under a new business model.

The videogames industry is a "born digital" industry which shows many of the innovative characteristics that can be observed, but with less intensity, in other creative industries.

As the Rovio case illustrates, the videogames industry innovates on all 4 forms of innovation described by Bakhshi and Throsby (2010). Therefore young companies appear to strongly challenge legacy publishers with rather disruptive propositions – original products, on-line and mobile channels of distribution, experimental business models, etc. - and real capacity to monetize these by accessing a massive and global audience.

They apparently rely little on clearly defined R&D structures, due in part for the specific interactive characteristic of their products, but show past links with universities and with vibrant clusters. Large projects (and investments) might, with time, induce collaborative links with existing majors (Quantic Dreams / Sony).

2.2 Music recording industry

History in a nutshell

For the music recording industry,[57] the advent of digitization in the 80s was a breath of fresh air: the success of the CD was such that all fans were driven to renew their music libraries. As a consequence, the entire music industry enjoyed an extraordinary expansion. Likewise, the industry tried several times to reproduce this phenomenon by multiplying technological innovations that were supposed to improve the quality and portability of music. But all these attempts were unsuccessful: the digital audio cassette Philips (DCC) was a failure, the Sony Mini Disc remained very marginal.

The expectations raised by new digital technologies faded away just as quickly for two important reasons. The first is that the preliminary wave of CD technology also marked the beginning of the era of digitization, reproducibility and the threat of potentially devastating infringements to copyright according to the industry. The second stems from the network economy that pairs the dematerialization of recorded music with the development of the Internet: it opens a revolution in business models on an unexpected scale, and, far from stimulating the traditional market for

[56] " Clash of Clan's", launched in 2012, published by Supercell, a company founded in 2010 (Finland): 0.4 million monthly active players generating monthly revenues of around US$ 20 million. 2013 revenues: $ 892 million. *Source*: www.neogames.fi/wp-content/uploads/2013/05/GameIdustryFinland11_2013.pdf.

[57] One of the segments of the music industry.

recorded music, disrupted its economy and its structure (Benghozi and Paris, 2001). According to Blanc and Huault (2014: 10): "In the recorded music industry, new technologies accompanying the digital revolution threaten existing business models and offer new structures to create, produce and distribute music". Digitalization and the Internet have had therefore a profound impact on the music industry (Hadida and Paris, 2014).

Traditionally artists earned their income from live music performances, but in addition, from the beginning of the 20th century on, income from recordings came to play a major role. Nowadays, music is a case of an historical upturn (Cameron and Bazelon, 2011) where revenues are again coming from performances and related rights rather than from royalties redistributed by music recording companies. Consumers' habits are changing and, essentially, "peer-to-peer music downloads both complement CD album purchases when downloads are used to 'sample' before purchase, and substitute for them when music albums are perceived to be overpriced" (Hadida and Paris, 2014: 84).

To deal with this trend toward more reliance on live performances, record companies offer now a more comprehensive portfolio of services, from recordings, to live performances, merchandising and the rights for online services, radio plays, use of the music in films, games and TV series, the so-called "360 degrees deals" to artists.. Nevertheless, new intermediaries like Live Nation and AEG are competing with record companies for that kind of deals with artists. For instance, in 2007, Madonna left Warner Music to sign such a deal with Live Nation, sharing revenues from music sales, performances, merchandise and the right to her name (Cameron and Bazelon, 2011: 13).

In the history of the music industry, "CDs represent a concrete object, which is part of a fairly rigid socio-technological system" (Blanc and Huault, 2014: 20). Replacing the standard vinyl album[58] in the 80s and enabled by the technical evolution of recording technologies, the CD represented the symbol of music as a commodity. Like the secular printed book in the publishing industry, the CD in the music industry is perceived by buyers as a "persistent object". "CDs are part of a more complex technological system, they are well adapted to distribution, their sound quality is as high as expected by most consumers and they are a reliable and persistent storage for music. The values around CDs are related to these material qualities and CDs have been used as a key object of the recorded music industry during more than a glorious decade" (Blanc and Huault, 2014: 17).

The second digital revolution produced a switch from CDs to digital files while shaking the market structure of the industry. However, as expressed by Blanc and Huault (2014: 18), the consequence of the emergence of virtual stores, such as iTunes, has been that "files have become the mirrors of CDs, associated with a picture on a record sleeve, an artist, the title of the music, and thus associated with an artwork and an author".

New technologies are opening new forms of experience, more immersive (watch video games and films in 3D), leading to a shift in the forms of consumption, to experience/performance. This is also true for music. Experience has always been a part of music, the music industry business is moving away from selling CDs toward the performance process. Artists concentrate on tours rather than touring to promote the CDs as they used to (Rogers and Preston, 2011, Page et al, 2011).

The case of Spotify (Sweden)

Spotify was founded in 2006 by Stockholm born Daniek Ek and Martin Lorentzon and launched for public access in October 2008. Spotify is a Swedish streaming[59] digital music service,[60] headquartered in London, offering on-demand access to a library of over 20 million tracksoffering, as an alternative to downloads. Spotify offers unlimited access to this library for $10, €10 or £10 a

[58] Introduced by Columbia Records in 1948, the LP (Long Play), or 33 1/3 rpm microgroove vinyl record became a new standard by the entire record industry.

[59] "Streaming" refers to the process of delivery by a provider media to the end user, constantly, as a "stream".

[60] The company relies on the European software expertise using Vorbis for audio compression technology.

month. The company also offers free trial subscriptions, supported in part by advertising, in an attempt to attract users to the service and convert them into paying customers. Spotify is currently available in 57 markets:[61] with more than 40 million active users[62], and over 10 million paying subscribers. In December 2013 the company made its service available for free on mobile and tablet. The music service created over 1.5 billion playlists so far and is adding over 2,000 songs per day.

Since its launch in Sweden in 2008, Spotify has driven more than a billion US dollars to rights holders. Spotify claims to be already the second biggest source of digital music revenue for labels in Europe (IFPI, 2011) and "the biggest and most successful music streaming service of its kind globally" (company website, 2014). Spotify drew attention through his prediction of the Grammy Awards based on the analysis of its customers' data.

In 2011, the company inked a partnership with Facebook that boosted its number of users. In 2012, Spotify's revenue grew to €435 million, up from €187.83 million in 2011. However, this achievement in terms of growth and penetration does not translate into profit so far; since its foundation, the social network accumulated a net loss of 200 million U.S. dollars (Brustein, 2014: 1). In that particular case, as opposed to the video games case, scale does not seem to work anymore as the magic recipe: the advertising based free subscriptions are expensive for Spotify since they trigger fees to be paid to music rights holders whenever a track is streamed. The contracts are structured in such a way that about 70% of its revenue goes to royalties; any other costs of business have to be covered by what remains (Brustein, 2014: 1), (without emphasizing the transaction costs involved in negotiating the rights). The question is then what is the threshold to reach for that 30% cut to generate enough revenues to pay the bills and post a profit.

However, some experts are sceptical about the potential profitability, and they deem that the current business model for streaming music is "inherently unprofitable." (Andrew Sheehy from Generator Research, quoted by Brustein). The report released in 2013 by Generator Research stated: "Our analysis is that no current music subscription service—including marquee brands like Pandora, Spotify, and Rhapsody—can ever be profitable, even if they execute perfectly." (Brustein, 2014: 1). This pessimism may be grounded as the new company does not have the bargaining power of Apple or Amazon to change the contractual conditions for royalties. The conservative behaviour of the music recording companies has been reinforced as they faced substantial revenue losses in subsequent years, until 2012 when they benefited from a slight increase, the first since 1999 (IFPI, 2013). As noted by Leurdjik et al (2012c: 93), the main strategic challenge for Spotify is to reach the point where it will become a profitable business, by building and securing a strong customer base, in combination with closing profitable license deals with all major music labels so as to derive the most of the economies of scale (a large music catalogue and consumer base).

In its presentation the company explains that its "dream" is "to make all the world's music available instantly to everyone, wherever and whenever they want it", making it "easier than ever to discover, manage and share music"..., "while making sure that artists get a fair deal". However, streaming has been controversial among musicians from the beginning according to Brustein (2014: 2), some artists even refusing to make new music available through streaming services as they deem the revenues far too low compared to other sources. This has also been the initial reaction of the recording industry that was getting more from downloads on iTunes that the proposed royalty per streamed song.

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[61] Andorra, Argentina, Austria, Australia, Belgium, Bolivia, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, El Salvador, Estonia, Finland, France, Germany, Greece, Guatemala, Honduras, Hong Kong, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Monaco, New Zealand, Netherlands, Nicaragua, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Singapore, Slovakia, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, Uruguay and USA.

[62] Users active within the previous 30 days.

The business model that the Swedish start-up was aiming to develop (combining free and pay subscription, offering itemized music and playlists) may have one element missing to become successful as long as one element of the equation is constant: the royalty fee. The music industry is clinging to past business plans and runs the risk of shooting itself in the feet, suppressing a growing stream of revenues, taking into account that the gone customers may not come back at all. However, Beats Music, Spotify's US competitor since early 2014 has just been bought by Apple and that may open up the deals.

As stressed by Leurdijk et al (2014: 141), in the music industry, the record companies were late to respond to the opportunities and threats of increased Internet use and advanced equipment in private homes. Along the same argument, Blanc and Huault (2014: 19) state: "The Internet is perceived as a potential threat that must be turned into a method to promote artists and not just to diffuse their work for free. This statement reflects a conservative view stating that the Internet should be used to develop the existing business model rather than to radically change it".

Consequently, disruptive initiatives of distribution (downloading, streaming) initiated by newcomers on the Internet, such as illustrated with Spotify, generated a revolution in business models and an important growth in (global) audience reach, but far from stimulating the traditional market for recorded music, these initiatives disrupted its economy and its structure (Benghozi and Paris, 2001). Central to the still resulting conflicts between the traditional players and the newcomers is the issue of royalties and the fair retribution of each party (artist, publisher, distributor), this unsolved aspect putting at risk value creation (scaling does not work) and the sustainability of the broadened and diversified audience.

2.3 Newspaper publishing industry

The newspaper publishing industry is undergoing major changes. Like in the other creative industries, ICT enables the multiplication of organizational patterns and forms of competition between traditional newspapers and new information providers. The range of organizations is accompanied by the emergence of new players - digital platforms - corresponding to as many different and multiple business models. In creative industries more than in traditional industrial sectors, the ability to develop new services and structuring new business models is the new joint that may operate between technological information media on the one hand, new forms of content delivery on the other hand. The arrival on the market place of technology suppliers to deliver the contents, ISPs[63] or OTTs,[64] not only brought a rebalancing, but it upset the business models and architecture of the newspaper industry: dematerialization of media and flat-rate purchases are free tips emerged out of an iceberg.

History in a nutshell

According to Leurdijk and Nieuwenhuis (2014: 147), throughout the 20th century, the newspaper market was dominated by media conglomerates owning newspaper chains. A process of increased concentration and consolidation in the international newspaper industry took place during the second half of the 20th century. The newspaper sector became a mature sector, strongly linked to geographical location.

Internet and the ICT supported new configurations: alternative online distribution, new actors, new services, and new forms of producing information... It called for new strategies and required new ways to build competitive positions. In the traditional newspaper industries, producing quality news involves six main functions: administration, formatting and layout design, content writing, titling and distribution. The integration of new technologies - such as layout tools and electronic correction, offset and typesetting, etc. - have always predetermined organizational forms used by publishers

[63] ISP: Internet service provider.

[64] OTT: over-the-top. In the fields of broadcasting and content delivery, OTT content means online delivery of video and audio without the Internet service provider being involved in the control or distribution of the content itself. The traffic is not managed.

and enabled the variety of the press. By adopting more or less decentralized organizations, the publishers of the mainstream press adapt their cost structures by choosing to outsource or not the main functions such as writing, printing and distribution, and sale of advertising space. In the same line, the publishers choose their models of income generation among free newspapers funded entirely by advertising or alternative monetization models of their content.

Despite a multiplicity of organizational patterns, one aspect remains common: the traditional press is based on an aggregation of content and multiple activities in a unique package that is the newsprint.

However, the impact of Internet technologies also affects this core function because the very notion of copy disappears with the electronic media. Investments required to produce thousands of newsprints are replaced by investments in software solutions and qualified staff to the online edition: customer relationship is easier but of a different nature, the cost of distribution and storage is almost zero; the update of information is continuous; hierarchical procedures, proofreading and verification by content editors are increasingly under the control of journalists themselves, collective production of content based on original forms of participation is taking place.

As demonstrated by Lyubareva and Benghozi (2014), the newspaper industry is deeply "destabilized" by the abundance of content with varied arrangements. This overload challenges the traditional modes of remuneration of editors, distributors and journalists. The effect is all the more powerful than this online offer outcompetes, for different reasons, the emergence of some radically new free proposals in traditional circuits, supported by innovations in the traditional printing technologies. According to Rothmann and Koch (2014: 67), "*the initial effects of digital change on the newspaper industry are comparable to those observed in other creative industries, such as the music industry*".

This creative industry has been deeply impacted by the Internet revolution at a time when the well-established newspaper business models were under several challenges. Indeed, the erosion of readership started decades ago and nowadays the fast decline of newspapers revenues does not appear to be slowing down. Newspaper publishers responded in a variety of ways to the changed market conditions of the last two decades: free newspapers, Sunday newspapers, other new print products, and quality in print with new printing presses (Leurdijk and Nieuwenhuis, 2014: 158-159). Incumbent newspapers were initially reluctant to explore the new avenues enabled by the digital shift, even if some leading brands were pioneers in their own right. In the 80s, French regional newspapers were leaders with the precursor of the Internet, the French "télématique", but were unable to jump into the next wave brought by the Internet. Some newspapers like *The Guardian, Wall Street Journal*, and *New York Times* have been quite successful with the introduction of on-line news. More broadly, newspapers publishers intensified efforts to deliver news on line, and more quickly to bring out tablet-based apps throughout 2011 (Pew, 2012).

Nonetheless, an analysis of selected German case-studies highlighted that the newspaper industry until now "*has not been able to profit from digitalization on a major scale*" because the newspaper publishers "*transferred a failing strategic pattern from the print business to the digital business in order to revive the advertising–circulation spiral*" (Rothmann and Koch, 2014: 67 and 81). The case of the Finnish group Sanoma (Box 6) illustrates as well the difficulties to define the right strategy even when being proactive in the new field of on-line services.

However, other legacy groups managed the digital shift with very positive results. This is the case of the South African group Napster and of the Norwegian media group Schibsted (Box 7). Both originated from the print media, the publishing company Schibsteds Forlag was founded in 1839, and Napster (named Die Nasionale Pers, Afrikaans for the National Press), started as a printer and publisher of newspapers and magazines in 1915 in Cape Town. Both group started to diversify in the 80s (Napsters into broadcasting) and 90s (Schibsteds buying international papers outside Norway). Both groups are now leading global e-commerce companies. Naspers counts itself as the world's third-largest player in e-commerce after Alibaba and Amazon by desktop Internet visitors,

citing comScore data. The two companies established a joint-venture for e-commerce at the end of 2014.

Box 6: The Sanoma Group

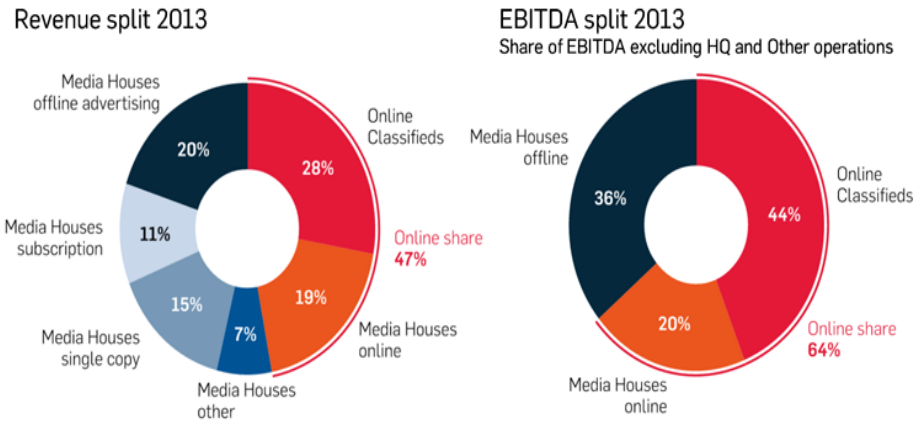
In the EU, the Sanoma group provides an interesting case both of diversification and pioneering on line services (Leurdijk and Nieuwenhuis, 2012b: 95-105), some of the subsidiaries like Nu.nl in the Netherlands, bought in 2005, are leaders on their domestic market, with a very successful mobile website. The company claimed to be amongst the largest media and learning companies in Europe, with over 10,000 professional employees as of 2013, and key markets in Finland, The Netherlands, Belgium and Central and Eastern Europe (Sanoma website, 2014). Sanoma Corporation was founded in 1860 as a textbook publisher. Sanoma has a long history of acquisitions and mergers and of launching and divesting activities. Sanoma Corporation started expanding into the news publishing business in 1890 when acquiring the newspaper "Päivälehti", now "Helsingin Sanomat" (Leurdijk and Nieuwenhuis, 2012b: 95).

The Sanoma Group comprised six Strategic Business Units in 2013: Sanoma News, Sanoma Media Belgium, Sanoma Media Finland, Sanoma Media Netherlands, Sanoma Media Russia & CEE and Sanoma Learning. In 2013, their revenues were split between three segments: media (magazines, custom media, events, websites, mobile sites, apps and TV operations), news (leading newspaper publisher in Finland and a digital media producer) and learning (learning materials and solutions). However in spite of its proactive strategy, in 2013, Sanoma's net sales decreased by 6.6% and amounted to €2,218.7 million (2012: €2,376.3 million, 2011: €2,378.1 million). Such a decrease is mainly due to the continued deterioration in advertising markets and single copy sales. Advertising sales decreased by 10.0% to €779.6 million (2012: € 866.7 million) as a result of weak print advertising markets in major operating countries. Online advertising increased by 2.2%, while TV and radio advertising decreased by 4.6% and print advertising by 20.3%. Circulation sales decreased by 4.6% to €783.9 million (2012: €821.2 million) (Annual Report 2013: 8).

Source: Annual Report (2013), Leurdijk and Nieuwenhuis, (2012b)

Box 7: Out of Norway: Schibsted

In 1839 Christian Michael Schibsted founded the publishing company Schibsteds Forlag and in 1860 he started publishing Christiania Adresseblad, from 1885 known as Aftenposten. In 1989, Schibsted went from being a family-owned company to a corporation, and was listed on Oslo Stock Exchange in 1992. In the 1990s and 2000s Schibsted bought a number of international newspapers. The company describes itself as a global media group operating on 5 continents, in more than 40 markets with more than one billion people combined, and hubs in Barcelona, Oslo, Rio, Singapore and Stockholm Schibsted's present activities are related to media products in the field of newspapers, online classifieds, publishing, multimedia and mobile services. The company has its headquarters in Oslo, Norway and is listed on Oslo Stock Exchange. In 2013, operating revenues were 15,232 billion NOK (€1,774 billion).



Schibsted has approximately 6,900 employees and operates in 29 countries. In addition to Norway, the company is also a major player on the Swedish market and operates in further 14 European countries (Denmark, Finland, Ireland, Belgium, France, Spain, Portugal, Austria, Italy, Switzerland, Hungary, Romania, Greece and Belarus), eight countries in Asia and the Pacific (India, Singapore, Philippines, Malaysia, Vietnam, Indonesia, China and New Zealand), 12 countries in Latin America

(Mexico, Dominican Republic, Guatemala, Costa Rica, Colombia, Venezuela, Peru, Bolivia, Chile, Brazil, Uruguay and Argentina) as well as five African countries (Morocco, Algeria, Tunisia, Egypt, and Nigeria). In the majority of these countries are run only online-based businesses.

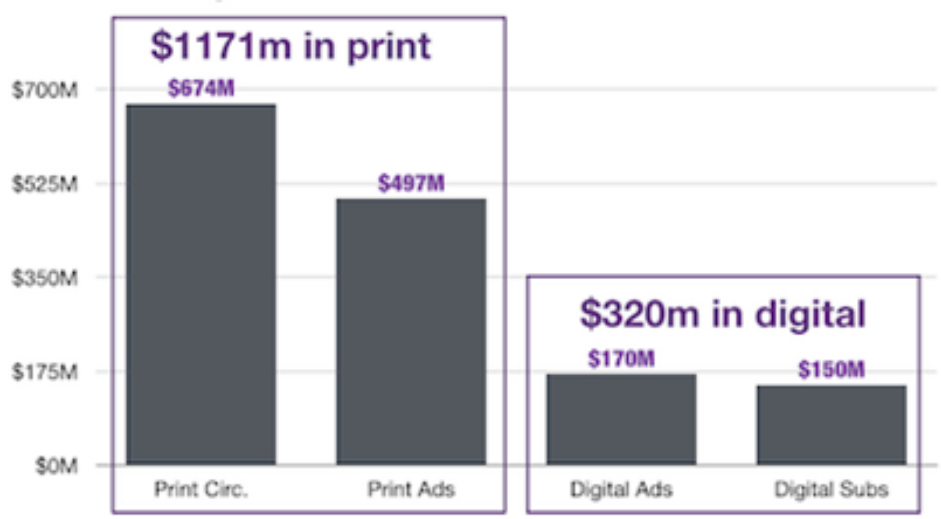
The group is currently organized into Online Classifieds, Schibsted Media House Norway, Sweden Schibsted Media House and Media Houses International. The group is mainly grown through acquisitions since the IPO in 1992, when Schibsted was purely a Norwegian group, which consisted of wholly owned operations Aftenposten, Verdens Gang and Schibsted Trykk and minority stakes in six regional and local newspapers in Norway. Schibsted Classified Media (SCM) operates most of Schibsted's online classifieds business. SCM have operations in several mature markets in Western Europe and in growing markets in Asia, Eastern Europe and Latin America.

Source: Annual Report (2013), http://www.schibsted.com/en/About-Schibsted/

Proactive legacy players and pure players

Taking the proactive route does not appear easy, however, some US newspaper companies are now taking a much more aggressive approach to digital transition: for instance, Digital First Media is pursuing a 'digital-first' strategy at the Journal Register and MediaNews Group papers; digital revenues went up from 5% of the revenues in 2010 to 30% in 2012 (Simon, 2014: 32). "The Guardian" adopted as well a "digital first" strategy which lead the UK newspaper to compensate, for the first time in 2012, their losses on the print market with revenues from the digital edition (Henley, 2014: 169). In 2013, audience wise with around 5 million print copies but over 29 million unique visitors per month, the "New York Times" "*is now predominantly digital*", according to Filloux (2014a) who, however, specifies that "*most of its revenue still comes from print*" (circulation and advertising dollars: see Figure 3).

Figure 3: The New York Times: distribution of revenue (2013)



Source: F Filloud (2014a), MondayNote.

The case of "Vice"

Vice started in 1994 in Montreal as the Voice of Montreal, with government funding, as some community service. The name was changed to "Vice "in 1996 as a niche music magazine.

Vice originally founded its website as Viceland.com in 1996. In 2007, VBS.tv began to prioritize videos over print, and had a number of shows for free such as "The Vice Guide to Travel". In 2011, both Viceland.com and VBS.tv were combined into VICE.com. The website has expanded and diversified to include a network of online video channels, including TheCreatorsProject.com, Motherboard.tv and Fightland.com, Noisey.com and Thu.mp.

According to Garrahan, the co-founder Shane Smith was quick to realise that video would drive advertising on the internet. The strategy was to build a global platform: "*I want us to be the next MTV, ESPN and CNN rolled into one,*" Shane once declared. In 2013, 21st Century Fox group acquired a 5% stake in Vice Media in a deal that valued it at $1.4bn. As of June 2014, Time Warner was negotiating to acquire a stake of more than 30%, which would value Vice at $2bn.

In 2014, the company has become an international brand with staff into 36 countries, an ever-expanding nebula of immersive investigative journalism. It turned it into a multiplatform brand, operating a global network of digital channels covering news, sport, technology and music. Vice has a news show on Time Warner's HBO network, a branding agency that has produced campaigns for clients such as Vodafone and Nike, and production facilities that churn out 70 original news-driven video series. As summarised by Levine (2007): "*Vice magazine has built a small media empire out of a raw, ironic sensibility, risqué photographs and a willingness to deal in taboo subjects*". The print magazine has 1M readers globally with revenues in 2012 of around $200m (Garrahan, 2012).

On the other hand, the "Vice" story illustrates how to build a global platform out of a print music magazine, prioritizing video over print while at the same keeping the print business running successfully.

Pew (2012b) followed this search for new business models and identified some other 'revenue' success stories in the US. Among the few success stories of newspapers identified by Pew (Pew 2013), it is worth noting the case of "The Santa Rosa (Calif.) Press Democrat" (circulation 53,292). Its success appeared to be linked to the creation, in 2011, of some research branch: "*the Media Lab, a sophisticated digital agency that provides a full range of online marketing services to merchants. In its first year, the lab accounted for roughly 25% of the paper's digital revenue and is expected to grow revenue by about 60% in 2013*".

Various weblogs have grown into important players on the news market – for example, the US Huffington Post and the South Korean OhMyNews. European examples are Agoravox, Baksheesh, Street 89 and Mediapart (France), Readers Edition, Opinio (Germany), You Reporter (Italy), Nyhetsverket (Sweden) and Nu.jij (part of Nu.nl, the Netherlands), (Leurdijk and Nieuwenhuis, 2014: 156). These newcomers are trying to make the best out of the participatory nature of the Internet, they are pioneering new ways to open up a dialogue with their readers.

This role of newcomers is still strengthening, as noted by the Pew report (Pew 2014). "*Digital players have exploded onto the news scene, bringing technological knowhow and new money and luring top talent.*" The report also indicates that new players, new investors are bringing new financial sources into news operations: "*A new breed of entrepreneurs – like Jeff Bezos,[65] John Henry[66] and Pierre Omidyar[67] -- are investing their own money in the industry, in some cases creating wholly new entities and in others looking to bring new life to long-standing ones. Among their best credentials – beyond deep pockets – is that they are tech industry insiders and news media outsiders*" (Pew 2014: 2).

More surprisingly amid pullbacks in global coverage from mainstream media, in spite of the trend of legacy players to further reduce their costs to face their decline of revenues, the new digital natives are investing in expensive quality global coverage of news. "*Thirty of the largest digital-only news organizations account for about 3,000 jobs and one area of investment is global coverage. "Vice Media "has 35 overseas bureaus; "The Huffington Post" hopes to grow to 15 countries from 11 this year; "BuzzFeed" hired a foreign editor to oversee its expansion into places like Mumbai, Mexico City, Berlin and Tokyo. The two-year-old business-oriented "Quartz" has reporters in London, Bangkok and Hong Kong, and its editorial staff speaks 19 languages.*" (Pew 2014: 5).

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65 Founder and CEO of Amazon who bought *The Washington Post* in 2013.

66 Investor and owner of *The Boston Globe*

67 Founder and chairman of eBay. He created First Look Media, a group that aims to present new forms of independent journalism. Its first publication, digital magazine *The Intercept*, was launched in February 2014.

Newcomers are not only bringing talents and a whole range of technical resources, they are keen on riding on the willingness of users to interact, to co-produce which amounts to an innovation in productions means and business models. The "Vice" case is clearly a case of innovation in audience reach, broadening, deepening and diversifying the way news were distributed to their customers.

The successful legacy players have been first and foremost building on their valuable brand so as to innovate as well in the way they are dealing with their customers. For instance under the motto of "open journalism", "The Guardian" sought establishing new forms of relationships with their readers while training their professional journalists to new techniques such as "liveblogging", video, data journalism (Henley, 2014: 170).

2. 4 Conclusions: The surge of new intermediaries as a common trend?

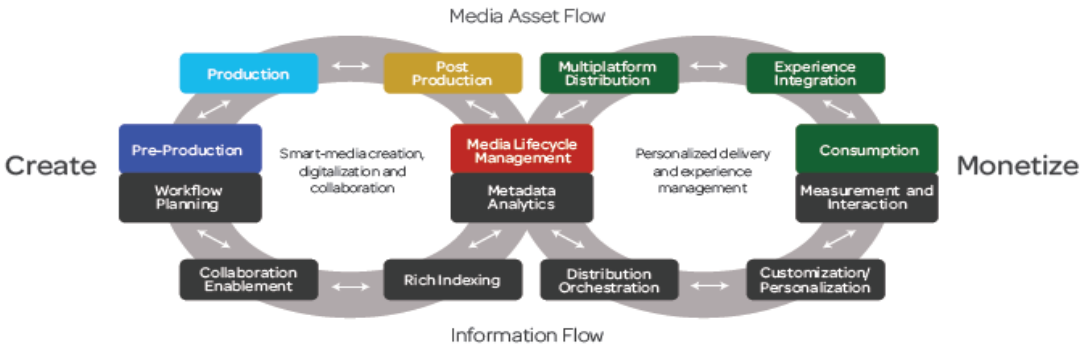
It may be too early to draw any conclusions from those past studies, however one can certainly stress the multiplication of newcomers in the industry, and the impacts already observable.

New value networks

New players display specific value networks, including numerous technical intermediaries (like the example of Akamai for content distribution) in contrast with past linear value chains.[68] The value chain has been drastically altered and is getting more complex. This leads the consultancy PwC to claim: "*It's not a value chain anymore. It's an ecosystem of networked collaborators who commit to solve a specific part of the industry problem*" (quoted by Avid White Paper, 2014: 4).

The Avid White Paper sums up its view in Figure 4 focusing on the tension between creation and monetization and the various intermediation steps. This adds up to the tension between the artistic dimension and the technological dimension with now technological intermediaries that seem to be best placed to monetize the contents, or to capitalize on their past investments especially when targeting the global market.

Figure 4: The new media value chain

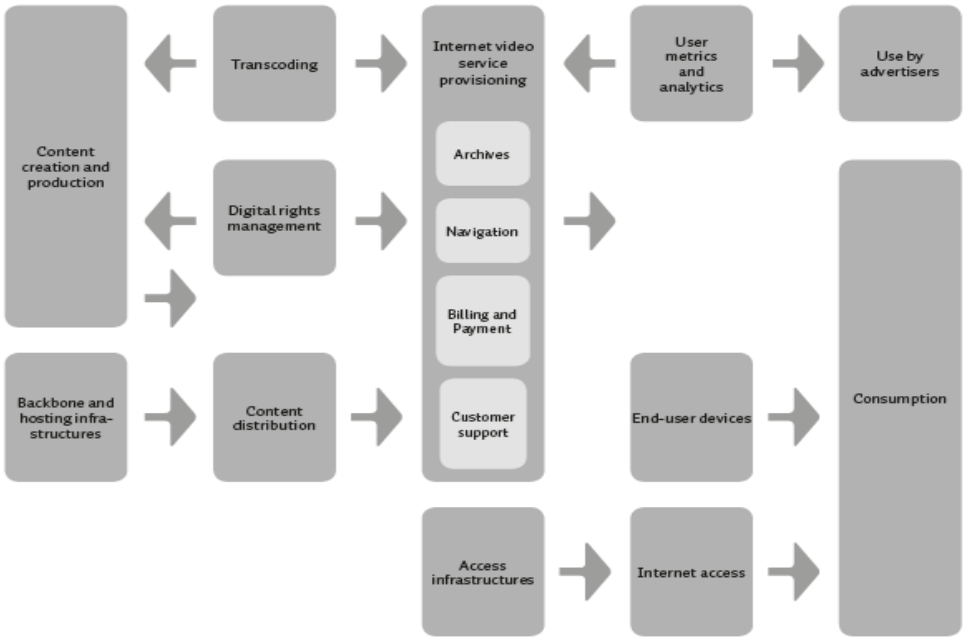


Source: Avid White Paper (2014

Figure 5 also shows that the locus of potential R&D may not just concentrate on legacy areas such as content creation and production but may emerge at various places, not only on the distribution and service provision part but also infrastructures, digital rights management and user metrics and analytics (dealing with "Big Data").

[68] Compare Figure 8, "the traditional film sector value chain" with Figure 4 "the new media value chain") as already illustrated with the case of Netflix but also with the Internet video services value chain (Figure 5).

Figure 5: The value network for Internet video services



Source: Poel (2013: 119)

Surfing on innovations

Contrary to what is often claimed by legacy players, the newcomers do invest but their agenda and strategic goal differ from the goals of incumbents. That may not be enough to keep the legacy players happy and lobbying for extending the contribution of newcomers to the "funding of creation". Amazon created his own studios (Amazon Studios) to invest in original content after launching its "Prime Instant Video" (PIV) services in 2011, and then created its video games studio. Amazon commissioned its own original content TV shows: releasing in 2013, the TV series 2013 'Alpha's House' directed by Gary Trudeau,[69] others followed, and in January 2015 the company struck a deal with Woody Allen for TV series. Hulu took the same route for original productions (Grece, 2014: 164). We will deal with the involvement of Netflix in production in the next chapter. Google owns its studio as well.[70] Alibaba, the Chinese e-commerce group whose sales rival eBay and Amazon combined, long ago created its own film and television company, along with two online video portals: leTV and Iqiyi (Worldcrunch, 2014). In China, as noted by Variety (2015:), "Internet behemoths Baidu, Alibaba and Tencent (dubbed "BAT" in the Chinese press) are engaged in a race to change the way the country's film industry operates"; they act as "soup-to-nuts integrators of all the components along the movie life cycle, either through organic growth, acquisition or alliance" (Frater, 2015).

New digital natives are investing in expensive quality global coverage of news. Such players are bringing new kind of expertise and talents but are keener to explore and set new forms of

[69] The creator of 'Doonesbury'.

[70] The company founded its own Cultural Institute in 2011. The Cultural Institute includes the Google Art Project, which features high-resolution images of art works from museums in over 40 countries; the World Wonders Project, which presents three-dimensional recreations of world heritage sites; and archival exhibitions, many in partnership with museums around the world. See www.google.com/culturalinstitute

interactions with their customers[71] that legacy players were either reluctant or unable to develop. They also pioneer the use of data mining for compiling viewers' recommendations (Amazon, Netflix, Pandora, Spotify, Zynga…) (Simon, 2015). The video games industry explores interaction and expands into the other media and industries (gamification).

This investment flowing from newcomers is a common feature of new media players as illustrated historically by the growth of cable networks and the creation of CNN, the series from HBO, the films from Canal+, and now much more recently with Netflix and the role of pure players for on-line news

Experimenting new channels of distribution allows companies to innovate in products and service: Rovio took the step of making and distributing their own video games on line, and created a global hit with "Angry Birds". New distribution channels delineate new spaces. Distributors, as clearly illustrated by the case of Amazon, are best placed to draw the consequences of new forms of relationships between edited contents and consumers.

Publishers (in a broad sense) used to manage this kind of relationships especially when the firms were integrated vertical firms: digitization shifted the process. Amazon introduced his Kindle e-reader dealing directly with customers. Amazon is making the best out of the sophisticated ecosystem (recommendations, tools for self-publishing, on demand publishing, 14 imprints under the flagship of Amazon Publishing,[72] a leading community of readers, Goodreads…) built around its Kindle since 2007. The giant from Seattle is now trying to duplicate its successful experience around a new ecosystem for audio-visual contents based on its new device Fire, launched in 2014.

YouTube started exploiting "amateurs" video, a move that left initially legacy players sceptical, but not Google who bought the company fast enough, one year only after the site was launched. The company anticipated new forms of demand, a new blend of supply and demand brought by User Generated Contents (UGC).

These new players were betting on innovation in audience reach. On the distribution side, Amazon, one of the fastest growing business in the Internet's history (Blackman and Forge, 2012), created new ways of buying and distributing books and went further with the introduction of its Kindle e-reader (De Prato and Simon, 2012: 13), a far cry from just shipping books from a warehouse in Seattle (Forge et al, 2013: 60).

Forge et al (2013: 61) noted that "Amazon is adept at reading the market, pursuing customers progressively into new areas, preferring to innovate incrementally while keeping a close eye on the innovations of competitors". As noted by Benghozi and Salvador (2013: 22): "Since 1998, Amazon created a new way of buying books and distributing books with its website Amazon.com. Amazon makes every activity related to human readers online".

Hence the introduction of its own device, the Kindle reader, seemed logical. Amazon is now introducing its Android-based smartphone[73] Fire, with capabilities of sending TV shows and movies

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[71] In the example of "The Guardian", customers are part of the "*ecosystem of networked collaborators*" becoming collaborators in their own right. The same holds for "The Huffington Post" relying more heavily on its readers. Recommendations for Amazon are an example for the book industry.

[72] AmazonEncore (Rediscovered Works), AmazonCrossing (Translated Works), Thomas & Mercer (Mystery, Thrillers, and Suspense), Montlake Romance (Romance), 47North (Science Fiction, Fantasy, and Horror), Little A (Literary Fiction) , Skyscape (Teen and Young Adult), Two Lions (Children's Picture Books, Books, and Novels), Jet City Comics (Comics and Graphic Novels), Lake Union Publishing (Contemporary and Historical Fiction, Memoir and Popular Nonfiction), StoryFront (Short Fiction), Grand Harbor Press (Personal Growth and Self-Help), Waterfall Press (Christian Nonfiction and Fiction), Amazon Publishing (Nonfiction, Memoirs, and General Fiction).

[73] Fire runs a 2.2GHz quad-core Qualcomm processor, has a 4.7-inch screen, a 13 megapixel rear-facing camera and 2.1 megapixel front-facing sensor, and supports nine LTE bands. It is available with 32GB or 64GB of storage and uses Amazon's latest forked version of Android, Fire OS 3.5.0. Fire, features a display which shows three-dimensional images that responds to movement, along with image, text and audio

to Fire TV devices (the TV service of Amazon[74]), giving mobile access to the company ecosystem with more than "33 million songs, apps, games, movies, TV shows and books" (Ferguson, 2014a).

All these are cases of innovation in art-form, audience reach, value creation and business management to quote Bakhshi and Throsby (2010). Of course, the few case studies accounted for up in this chapter are too anecdotal to offer any definitive conclusions. Nevertheless, they give serious indications about the role of newcomers and the consequences of new forms of relationships between edited contents and consumers, and the new spaces created in particular by new distribution channels. The JRC-IPTS studies[75] point at the tension between the artistic dimension and the technological dimension with technological intermediaries being best placed to monetize the contents, or to capitalize on their past investments especially when targeting the global market.

They also show that, because of initial defensive or conservative behaviour from legacy players, considering that Internet should be used to develop the existing business model rather than to (radically) change it, much of the initiative has been left to these newcomers that are more agile for identifying opportunities in a new environment. This may mean as well that innovation is left to these challengers at risk of disrupting the traditional industry.

Chapter 3, dedicated to an in-depth investigation in the Cinema industry, will bring more cases, allowing us to enrich the above observations and gain a better understanding of ICT-enabled innovation. It should also allow us to confirm or moderate some of the above initial assumptions about the dynamics at stake and the role of new players.

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recognition. A dedicated processor and real-time computer vision algorithm then adjusts the image accordingly. The technology allows apps and games to be more immersive.

[74] The Amazon Fire TV box allows users to download and use app and games — as well as stream movies, television and music — to their HD TVs via their mobile device. *Source*: Ferguson, 2014b.

[75] See at http://is.jrc.ec.europa.eu/pages/ISG/MCI.html. In particular: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?CFID=15941aca-9d96-4ea0-bfc7-ea99cb5a2195&CFTOKEN=0&id=5900

3. Case study: the cinema industry

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 in that case, therefore, particularly noticeable.

The chapter explores 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. The specific analysis of some companies and "iconic" clusters brings 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.

3.1 Introduction

A sketchy portrait of an industry

It is important to remind that, among the creative economies, the film industries appear to be heavy industries. They are firstly heavy regarding their investments in production. Whatever the country, films are long and complex to produce, but also extremely expensive cultural contents; a film requires months and years of preparation and filming, it commonly mobilizes hundreds of artistic and technical staff and costs millions or tens of millions of euros. But cinema is also a heavy industry regarding its distribution network: in 2013, the 39 783 screens in the United States and 29 958 screens in Europe designed a dedicated network constituting considerable investments and capital.

From a strictly economic point of view, the cinema was arguably one of the first creative industries. His seminal economic model has been established, very early, at the very beginning of the 20th century. Cinema is organized as a service, on a rental basis, for the copies to be released in theatres and for the viewers to pay for an admission ("renting their seats").

As a consequence, it structured itself, historically, around three very different poles in terms of investment and business models, poles that this chapter explores successively:

- production: developing feature films,
- distribution: supporting logistics for circulating copies and providing financial intermediation to collect revenues from ticket,
- and exhibition: network of the screens.

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).

De Vinck and Lindmark detail the 'streams' implied in film-related value adding activities. The "negative" stream (pre-production, production and post-production) accumulates value through the production of a film. The pre-production stage encompasses various elements such as acquisition, finance, development and assembling the cast and crew. It includes creative (script writing, casting etc.), financial (budgeting, business planning etc.), legal (rights clearance, negotiations etc.) and commercial issues. The production stage includes production design and organization as well as the actual shooting of the film, while post-production includes activities such as processing of negatives, adding of special effects, editing up the 'final cut' as well as sound and music production and editing (De Vinck and Lindmark, 2012: 23). Other players may intervene in the next two

streams (distribution and exhibition) even if in the case of integrated firms, the players were already involved in the negative "stream".

The industry is also characterized by a "reversing cost structure" whereby only a small part of the price paid by consumers is dedicated to creation and production. This reversed cost structure is linked to the rental model under last in/ first out[76] allocation of revenues (Ilott, 2014).[77]

Distributors play an unusual role as gatekeepers due to their scarcity under the traditional model. Distribution has always been the centre of power, as illustrated by the case of the majors based in Hollywood; a domination that led to a famous antitrust case,[78] divesting production from distribution in the late 40s. However a number of key US studios[79] continue to dominate mainstream films. They are part of an oligopoly of vertically integrated firms that have raised significant barriers to entry for other smaller companies (De Vinck & Lindmark, 2012: 7-8).

The specific dynamics of each of these segments – production, distribution, exhibition - 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. They now make it difficult to analyse the film market as an autonomous whole, without taking into account the differences between the film production industry on one hand and the exhibition and distribution film industry on the other.

To sum up, the distribution and exhibition 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. On the other hand, the production segment gains widely from technological innovations brought by other economic actors. Producers get more opportunities – without investing themselves - to distribute their films and to widen physical and virtual admissions.

However, the rise of new players from the world of broadcasting, media, telecommunications and computer industries contributes to broaden further the gap between production and distribution. As noted by Simon (2012a) and De Prato et al. (2014a), on a global scale, the balance of power has shifted towards the downstream, away from the upstream, or from the production side of the media toward the distribution side. However, as we will see in this following chapter, this downstream domination does not hinder innovation and specific models of innovation to develop on the production side. This is probably one of the most relevant observations in this chapter

The economic impact of technology

Historically, as stressed by Waterman (2005), commercial media industries in the US have benefited greatly from the introduction of technologies over the last four decades. The introduction of each new technology triggered additional streams or revenues (broadcasting, cable, pay TV, DVD…). Figure 6 shows how home video boosted the US domestic cinema market; revenues from distribution on the international markets displayed the same curve (Waterman, 2011). The revenues from the distribution of films in the US followed a positive pattern (see Figure 7 for details) with a recent decline of revenues until 2011, but growing again after.

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[76] Last-in/first-out (LIFO), an accounting technique meaning that the most recently produced items are recorded as sold first, in the case of cinema the last player in the value chain (distribution/ exhibition) will get the first payment.

[77] Presentation at the JRC-IPTS workshop, November 2104: http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/NRDICCIWorkshop.htm

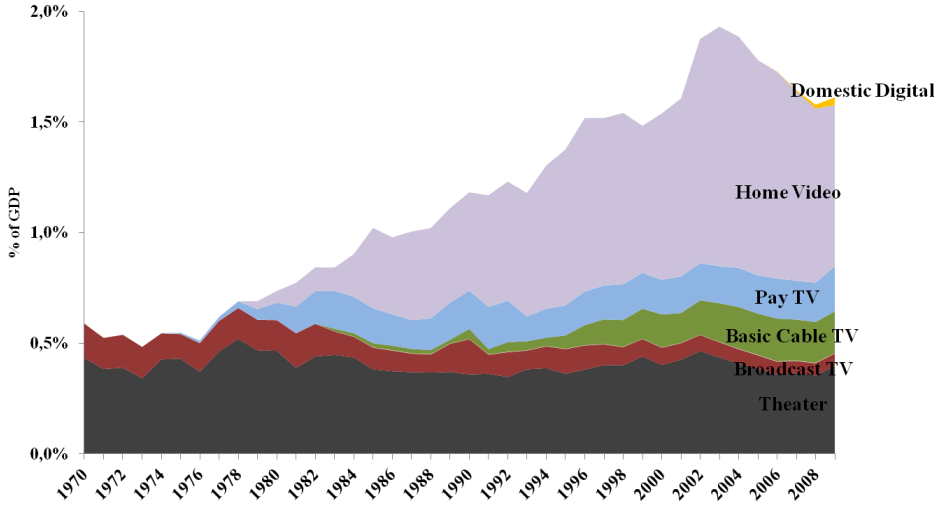
[78] The Hollywood Antitrust Case of 1948 against the "Big Five" (Loew's/MGM, Paramount, 20th Century-Fox, Warner Bros., and RKO): United States v. Paramount Pictures, Inc., 334 US 131 (1948).

[79] The so-called 'majors': Paramount Pictures, Sony Pictures, Twentieth Century Fox, Universal, Walt Disney and Warner Bros.

It is worth stressing that the development of home video was initially perceived as a threat by the cinema industry. The industry even tried to freeze the deployment of VCRs by taking Sony to the courts for inducing infringement of copyright (Sony-Betamax 1976 case). Videotape soon provided the main source of revenues: it moved from the death knell to being its saviour. It took some time to stabilize and the industry went through zigs and zags to define the appropriate business models (rental vs. sales debate in the 80s).

In more recent years, online revenues (VOD online and SVOD) are growing but accounted in the EU for less than 1% of the total audio-visual market in 2010. In the US, since about 2000, online video streaming has become widespread, but its overall proportion of all TV viewing still remains under 2% (Waterman and Ji, 2012), with a revenues share of only 1.5% in 2010. Therefore, the increasing on demand spending does not yet compensate for the ongoing decline of physical home video.

Figure 6: U.S. Movie Distributor Revenues,[80] Domestic Market as % GDP 1970-2009



Source: Waterman (2005, 2011); SNL Kagan (2010)

A hi-tech industry?

Cinema has from the start had an important technological component, and relied on a number of crucial technological breakthroughs. Neal et al. (2012) argue that a series of technological inventions, combined to bring about the projection of moving pictures, have created the film industry.

In the 1870s, the main inventions have been advances in still photography and the invention of celluloid. Other subsequent inventions include the zoopraxiscope (a lantern that produced the illusion of movement with photos printed on rotating glass), or earlier the phenakistiscope, plastic, electricity and incandescent light bulbs.

In such a historical perspective, a number of prominent periods of technological change show to have affected the film sector more or less radically since its establishment: the introduction of sound film (1920s-1930s), colour film (1930s-1960s), the television screen (1950s-1960s), widescreen and 3D experiments (1950s) and the introduction of home video systems (1970s-1980s), (De Vinck and Lindmark, 2012: 20).

Some quick examples[81] can illustrate the way technology interacts with the evolution of aesthetic of cinema: a new handheld camera allowed J.L. Godard's chief operator (R Coutard) to shoot differently "*A bout de souffle*" signing the birth of the "Nouvelle Vague". The new portable devices

[80] Revenues from merchandise are not included.

[81] A thorough exploration of these complex relationships is far beyond the focus of this report.

play a similar role for the birth of "cinema vérité" (J Rouch), for the growth of the Canadian documentary school in the 60s.

Years later, J L Godard tried[82] to make the most of the invention of another camera by J.P. Beauvialla. This engineer founded his own company "Aaton" (see Box 11), in the late sixties, to design the camera Beauvialla was looking for to shoot the film he had in mind. Bouncing on the opportunities opened by mobile phones, Godard created also his own rudimentary 3D camera out of two mobile phones fitted with lenses for his last film "*Goodbye-to-language*" (2014). A. Fleischer (a French filmmaker, photographer and writer)[83] and Pippo Delbono (an Italian playwright and director)[84] shot films with a mobile phone (Odin, 2014: 47). In the 90s, P. Greenaway directed "Prospero's Books" (1991), pioneering the use of digital image manipulation (using Hi-Vision video inserts and the Quantel Paintbox system), often overlaying multiple moving and still pictures with animations.

In the 70s, US director F F Coppola was not satisfied either by some of the shooting techniques dating back to the beginning of the century; his company American Zoetrope (see Box 17), founded in 1969, introduced the use of automated equipment and digital electronics to filmmaking. He invented the "Silverfish", an electronic hub for all of the sounds and images during the production of the films.

There are a number of recurring elements in those transitions, even if the exact modalities and speed of each transition have varied. First of all, all of these innovations were adopted over relatively long periods of time and built upon previous technological and other evolutions in the film sector. Important drivers of technological adoption include the transition costs, the availability of technological standards, the audience response and availability of content, and the willingness of filmmakers/ producers to embrace the new technologies.

Besides, as stressed by De Vinck and Lindmark (2012: 20): "*periods of technological transition usually bring about opportunities for smaller or independent sector players to achieve a more competitive position in the film value network*". They take the example of the coming of sound that enabled two challengers (Warner Bros. and Fox) to enter the market through their involvement with the Vitaphone and Movietone sound systems. By the same token, the introduction of TV and later of video and cable opened up windows of opportunities for independent producers.

De Vinck and Lindmark (2012) add that in most cases legacy players were reluctant to embrace the changes, what they describe as "*a systematic reluctance of incumbent players vis-à-vis disruptive changes that potentially affect their existing business models and relationships*". They add logically: "*This recurrent defensive stance of the dominant players, most of all the Hollywood studios, is important to keep in mind in view of the response to current digital challenges*".

In the 70s, the fight over the Sony-Betamax standard illustrates this conservative and defensive attitude of legacy players. Indeed, the studios alleged that because Sony was manufacturing a device that could be used for copyright infringement, the company should be held liable for any infringement committed by its purchasers. This 1976 legal challenge initiated by Universal Studios and Disney against Sony ended with a final US Supreme Court decision in 1984 (Sony-Betamax case)[85] which clearly stated that using a technology (VCR) was not blameable per se (Simon 2012 a: 88; Simon, 2012b: 30). Against the expectations of the cinema industry, the Supreme Court's decision was trying to keep a balance between technological innovation and the protection of existing rights. Not only the studios did not win their case, but the Supreme Court introduced a new

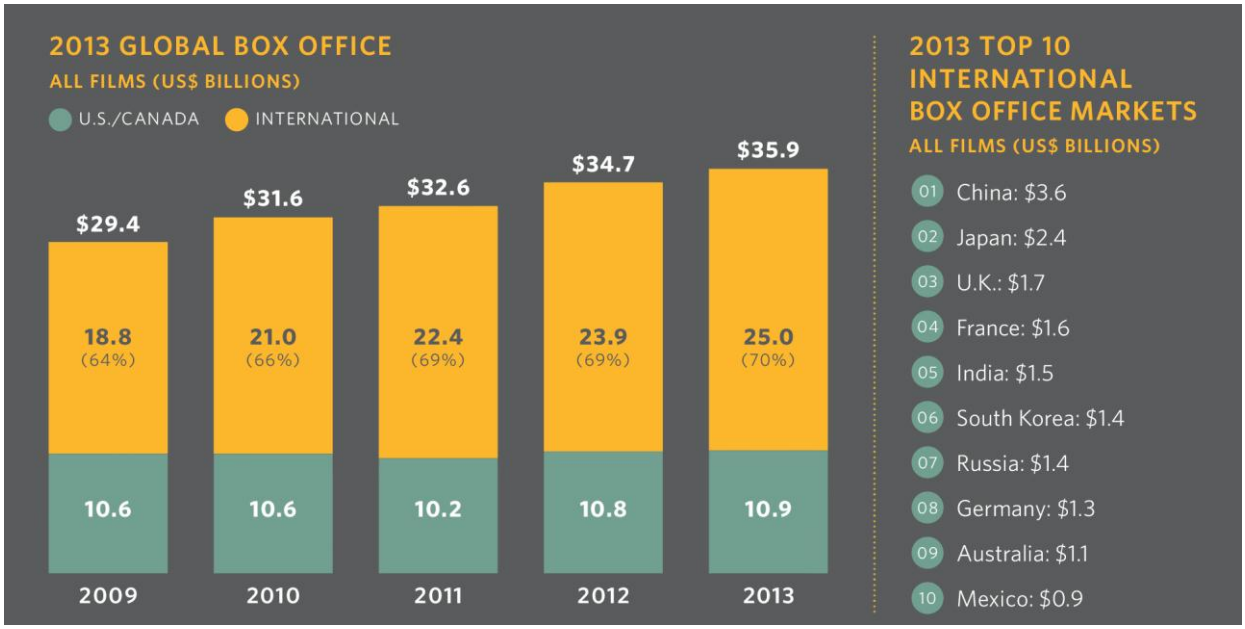
[82] «*Prénom Carmen*», (1983).
[83] "Un film sans fil" (2006).
[84] "Amore e Carne", 2010.
[85] Sony Corp. of America v. Universal City Studios, Inc., 464 U.S. 417 (1984).

protection of liability under the "Sony Safe Harbour" decision for substantial non-infringing uses (Samuelson, 2006: 1).[86]

The atmosphere changed recently (as well as in other industries like broadcasting), (Simon, 2014). To illustrate this change one can quote the powerful US Trade Association (MPAA) that now claims: "*If you love films, you love technology*", stressing *"It comes as no surprise to us that movie lovers love tech – the movie going experience itself is a high tech one. From digital sound to 3-D to CGI,*[87] *movies are on the cutting edge of technological innovation*" (MPAA, 2014).

The relationships between technology and content appear more positive as the number of digital projection screens has been increasing very quickly reaching 97% in China (EAO, 2014: 51) and new distribution channels are progressing as well (see Section 3.3). This more optimistic mood is grounded in the growth of the international market: "*the international market*[88] *has grown 33% over the past five years – and was up 5% in 2013 to a historic high of $25 billion. Growing markets in Russia, Brazil, Mexico, and of course China are responsible for the meteoric rise. This year, China is again the number one international box office market, and it becomes the first international market to eclipse $3 billion"* (MPAA, 2014). Worldwide box office for all films released around the world also reached in 2013 US $35.9 billion (see Figure 7).

Figure 7: Global Box Office (2014).



Source: Motion Picture Association of America (MPAA) (2014).

Certainly the question raised by cinema, as a hi-tech industry, is how it deals with "Liaisons dangereuses"[89] between content and technology and ends up creating value for all players.

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[86] *"The safe harbour protects technology developers who know, or have reason to know, that their products are being widely used for infringing purposes, as long as the technologies have, or are capable of, substantial non-infringing uses (SNIUs)"* (Samuelson, 2005: 1).

[87] Computer graphic imagery, 3D computer graphics.

[88] Not accounting US and Canada

[89] R Vadim (1959), S Frears (1988) based Pierre Choderlos de Laclos. Had been transposed in a South-Korean environment: "Untold Scandal", E J-Yong (2003) and "Dangerous Liaisons", Jin-Ho Hur (2012).

Coordination within the value chain: "A rather large village"

The film sector clearly displays a complex set of players and relationships (see Traditional value chain: Figure 8 and Players: Box 8). Unlike other sectors of the media or IT industries, characterised by a rather strict division of labour within its value chain, the cinema industry seems to blend in a specific way science and technology with the artistic dimension. The balance between the two dimensions may shift occasionally especially at times of fast technological changes, thereby creating tensions between two visions (technological/artistic). Therefore coordination is a key aspect although its scope may vary in time and space. Or, 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).

Box 8: A multitude of players

- Creative talent (screenwriters, directors, actors and actresses etc.) and their business representation (agents, managers);
- Business entrepreneurs and company players (producers, distributors, sales agents, exhibitors);
- Finance players (financiers and investors, including banks, subsidy players, but also broadcasters and distributors);
- Technical industries (production/ distribution/ archiving/ storage and restauration);
- Theatrical (exhibitors) and non-theatrical delivery players (broadcasters, telecom players, home video retailers and renters, internet content service providers).

In addition, each category comprises different types of companies, including:

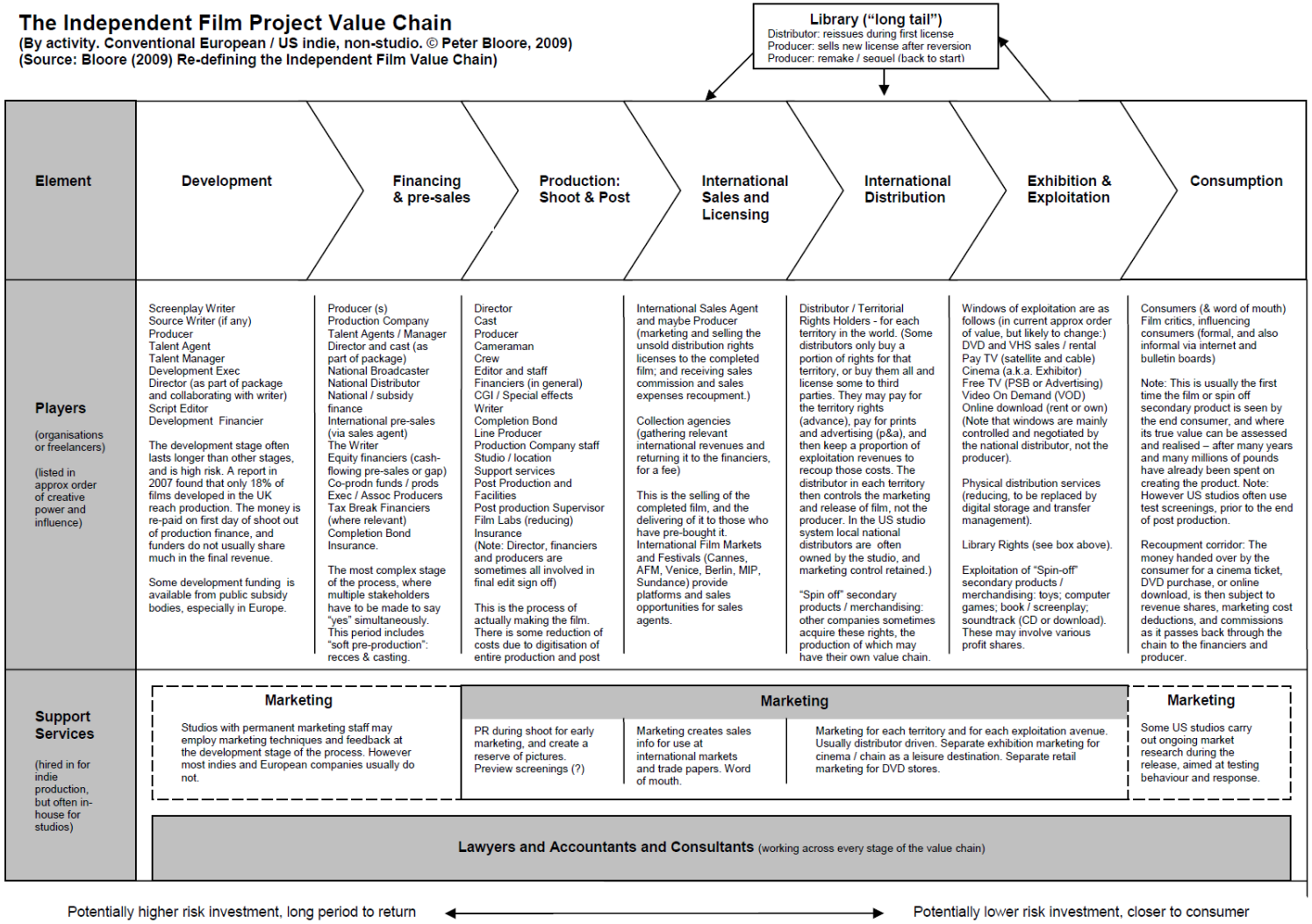
- Individual creative entrepreneurs;
- Small or medium-sized companies, often nationally anchored and not integrated;
- National large companies, sometimes vertically or horizontally integrated;
- National powerhouses that are also leading international players (e.g. The Weinstein Company, Lions Gate, Summit Entertainment, Studio Canal; Pathé);
- Hollywood studios and their affiliates.

Source: De Vinck & Lindmark (2012: 6)

The following sections of this chapter explore various modes of coordination between those numerous and fragmented players. They focus on the way these elements and the R&D dimension are brought together within the specific case of a film. The chapter successively reviews examples of technological innovation in the production stage of the cinema industry and in its distribution/ exhibition. Its main observation is to identify in most cases the presence of ICT companies, new intermediaries of the digital age, that integrate in one or another way to the core activity of the cinema industry.

The chapter further documents the different resources and the management required for a project – the film as a prototype. The chapter explores whether, in sharp contrast with other industries like the book publishing industry, the cinema industry does not rely only on the technical expertise and the R&D done elsewhere. This assumption is in line with the undercapitalization that characterises the sector and its fragmentation, which may prevent any significant investment in R&D. It remains to be seen if it is also the case for larger firms.

Figure 8: The traditional film sector value chain



Source: Bloore (2009) Re-defining the Independent Film Value Chain.

3.2 Technological innovation in the cinema production

Table 7 classifies the various technologies used in the production stage in three groups:

- the specific technologies for cinema (filming technologies, production and post-production, distribution)
- the generic technologies tailored to the cinema industry,
- and technologies linked to specific movies.

The next sections review some technological innovations along these broad categories. The section focuses on various modes of collaboration between the players of the production chain, players from within or outside the cinema industry, and ends with a specific section looking at the production of a movie not only as a project but as a lab.

Table 7: Specific technologies for cinema, generic technologies adapted to cinema, technologies for specific movies (some representative examples).

SPECIFIC DIGITAL TECHNOLOGIES FOR CINEMA	**Year of creation and country of involved firms**	**Technology application in specific movies (some examples)**
Filming technologies		
Photography, celluloid, zoopraxiscope		
Z-Screen		Walt Disney's Chicken Little 3D (2005)
Technology SXRD	Sony: 1946, Japan	
Light Stage systen	Image Metrics: 2000, UK and USA	The Curious Case of Benjamin Button (2008)
Production technologies		
Innovative machines, action cameras	Panavision: 1953, USA	
Sound: Cantar	Aaton : 1971, France	
Immersive sound: Dolby Atmos and Barco Auro 11.1	Dolby: 1965, UK and USA Barco: 1934, Belgium	
Stereoscopic 3D	Binocle3D : 1998, France	Avatar
Post-production technologies		
Archive-consecrated Arri scanner (film-stock immersion)		Lumières numériques
Visual effects	Double Negative: 1998, UK Framestore: 2001, UK Cinesite: 1993, UK and 2014 Canada MPC: 1989, UK Rhythm & Hues: 1987, USA Buf: 1984, France Crazy Horse Effects: 2001, USA Look Effects: 1998, USA Lola VFX: 2008, USA Legacy Effects: 2000, USA	Life of Pi, The Golden Compass, The Dark Knight, The Lion, the Witch and the Wardrobe, Batman Begins, 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, Harry Potter, Inception, Iron Man II, Deathly Hallows
Nuke, the industry standard software for compositing	The Foundry: 1996, UK	
Technology that damages illicit recordings	DominINC, content security subsidiary of Paris-based Technicolor, which opened a demo centre in Burbank, CA	

GENERIC DIGITAL TECHNOLOGIES ADAPTED TO CINEMA	Year of creation and country of involved firms	Technology application in specific movies (some examples)
Innovative "Made in France" equipment	LocaCiné, France	
Drones	Studio Fly, France	
Solutions for creating panoramas, interactive virtual tours, and 360° videos	Kolor, 2004, France	
Reality Scann	Opseene, 2012, France	
Movies based on video games	Legendary Pictures, 2005, USA Atlas Entertainment, 1989, USA Vertigo Entertainment, 2001, USA	Need For Speed (Disney), Prince of Persia: Sands of Time and the Resident Evil and Mortal Kombat series, Minecraft, The Lego Movie
DIGITAL TECHNOLOGIES FOR SPECIFIC MOVIES	**Year of creation and country of involved firms**	**Technology application in specific movies (some examples)**
Motion capture technology that employed active LED markers	PhaseSpace, 1994, USA	Spider-Man
Robotic surrogates (nanotechnology)		Surrogates
High-resolution RED Epic cameras recording video		The Hobbit
3D technology	DreamWorks, US, 1994, (Box 17), Pixar Animation Studios, 1979, US LucasFilm Limited, 1971, USA Sony Pictures Imageworks, 2003, Canada American Zootrope, 1969, US (Box 18)	Avatar

Specific digital technologies for the cinema

Digital production comes with cost-efficiencies, increased flexibility and quality improvements. It is also bringing costs down for distribution, and duplicating prints. The theatrical 'digital print' or DCP is around ten times less expensive than a 35 mm film print (De Vinck and Lindmark, 2012, 100).

The general view towards digitizing production has been positive (Eliashberg et al., 2006). The production stream is now digitized and this is moving downstream, reaching the exhibition stream. Digital-cinema advocates say that the technology not only lowers costs, but adds piracy protection, and provides new sources of revenue to theatre owners by helping them show live events such as concerts and soccer matches. It becomes potentially easier for producers to connect with business partners as well as with the audience at the earliest stages of a film project (crowdsourcing). As the MPAA, Executive Vice President and Chief Technology Officer, stated in May 2014: "*On the IT and Internet side, the rapid advances in these technology segments are now being broadly applied to content creation, distribution and consumption across all aspects of the media and entertainment industry in ways that are driving rapid advances, better content and lower costs*" (Mc Coskey, 2014).

Filming technologies

Lighting and skin movement are pivotal for creating realistic virtual characters. The development and application of the Light Stage System show how technicians and filmmakers cooperate (Table 8). Cameron pioneered a specially designed camera built into a 6-inch boom that allowed the facial

expressions of the actors to be captured and digitally recorded for the animators to use later. Light Stage System has been developed by Prof. Paul Debevec at University of California Berkeley and University of Southern California for *Avatar.*[90] *"A Light Stage is a device which lights a subject with controllable illumination, providing the ability to create or simulate any combination of colours, intensities, and directions of illumination over the range of directions from which light can come"* (Debevec, 2012: 1).

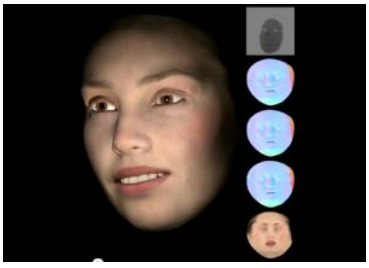
Table 8: Light Stage technology

Step 1: Light Stage	Inside the Light Stage 156 lights dim in different patterns to capture actress Emily O'Brien's face in any lighting condition. Polarized lenses separate the light bouncing off her face {specular light) from the light her face absorbs.
Step 2: Specular Light	By looking at just the light bouncing off her, animators get a perfect map of every nook and cranny in Emily's face.
Step 3: Movement	Debevec has Emily make 33 different facial expressions. Those images give animators information about how her skin moves.
Step 4: The puppet	The Light Stage information is laid onto a digital mesh frame of Emily's head to create a puppet, or rig.
Step 5: Acting	Animators can then move the rig to make digital Emily act. Add the voice and you can't tell it's not the real thing.

Source: Pomerantz (2010: 63).

Other innovations brought by *Avatar* include a new system for lighting massive areas like Pandora's jungle. Similarly, "*with a company called Image Metrics*[91]*he*[92] *created the "Digital Emily Project" to demonstrate the technology*" (Pomerantz, 2010: 62-63 and Picture 1, see also Box 9 below).

Picture 1: Digital Emily (2009)



Source: Image Metrics

Box 9: R&D spin-off Image Metrics

Image Metrics was founded in Manchester, U.K in 2000 by an R&D team – comprised of PhDs, physicists, engineers and technologists – focused on advancing consumer applications around computer vision, facial analysis and recognition technologies. Their early work served as the foundation for technology breakthroughs in real-time, nuanced facial expression, self-representation, and personalized content control, along with human-computer interfaces for digital devices, in games, apps and other online environments. Additional applications in the medical and security fields were researched and developed, that led later to a spin-off of a medical imagery company In 2012, Image Metrics spins out its professional animation software business (Faceware Technologies Inc) to focus on developing new consumer applications of its core technologies.

In 2006, the company is issued its first patent in the area of computer vision. The company holds since numerous patents in facial recognition, analysis and animation technologies. The company's proprietary algorithms capture, recognize and analyze nuanced facial expressions and emotions in real-time using nothing more than a standard webcam. Using the same core technology that was once only available to elite

[90] Debevec won an Oscar for his work on *Avata.*
[91] A 3D facial animation company headquartered in Manchester and Santa Monica (Box 5).
[92] Debevec.

professional animators, Image Metrics now delivers a vital element to companies looking to enable immersive, new experiences on devices, in games and in other online environments.Sony Computer Entertainment of America was the first company, in 2002, to use Image Metrics' facial animation technology in the launch of its acclaimed action-adventure video game, "The Getaway". The technology has since been used in more than 40 AAA gaming titles, including such titles as "Rockstar Games'", "Grand Theft Auto IV" (2008), "Red Dead Redemption "(2010) and "Bungie's Halo: Reach" (2010).

In 2012, the company released its Live Driver software development kit to enable developers to easily incorporate real-time facial animation for digital characters into games, apps and devices.

Source: Company website, 2014.

The Curious Case of Benjamin Button[93] (see Picture 2) illustrates again the Light Stage technology. They "took photos of silicon busts of Pitt's head at different ages to give the effects supervisors the information they needed to light it from any angle, under varying conditions. They could then animate a digital puppet created from the old heads using Pitt's facial movements. Once the information was captured and stored digitally, the moviemaker Preeg and the visual effects supervisor Barba processed the data. Preeg and Barba earned an Academy Award, and the output was "realistic enough that many outside of Hollywood didn't even realize they were watching a digital face rather than a real Pitt with heavy makeup" (Pomerantz, 2010: 63-64).

Picture 2: The Curious Case of Benjamin Button

Source: Image Metrics.

Weta Digital, a New Zealand tech company (see Box 10), contributed as well to the world wide success of *Lord of the Rings,*[94] Spielberg's *The adventures of Tintin,*[95] and *Avatar.*[96] Weta was founded in 1993 by a group of young New Zealand filmmakers including Peter Jackson, Richard Taylor and Jamie Selkirk. For the shooting of the *Lord of the Rings*, the Wellington firm created software for crowd related visual effects (MASSIVE). Then, Weta digital was the lead visual effects company for *Avatar,* employing up to 900 persons.

Box 10: Weta Digital, a company based in Wellington, New Zealand.

Weta, created in 1993, 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"

[93] A "digital" Brad Pitt starts out old and grows young, 2008. Image Metrics was also involved.
[94] Academy Award in 2002, 2003, 2004 for Best Visual Effects.
[95] Annie Award in 2011 Animated Effects in an Animated Film.
[96] Academy Award in 2011 for Best Visual Effects and an impressive number of similar awards.

(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. 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.

Source: Company website.

Working on Steven Spielberg's *Close Encounters Of The Third Kind*, Douglas Trumbull and Richard Yuricich pioneered the first real-time on-location digital recording of camera motion in collaboration with Jerry Jeffress, who built the electronics. Doug's father, Donald Trumbull, engineered the physical motion control rigs, and Entertainment Effects Group (EEG) was the first company to composite motion control shots in 65mm. They pioneered the "smoke room" technique for miniature atmosphere control, the salt/fresh water tank technique for cloud creation, and complex "soft matte" techniques for retaining glows and lens flares within composite shots (Trumbull company, 2014).

In such cases of product development and product innovation undertaken on behalf of clients, *"this tends to have the character of formalized R&D"* according to Green et al (2007: 48) as illustrated with Weta but also by the UK firm "Double Negative".[97] 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*[98] *and VFX*[99] *production plans*". The company highlights, on its website, the role of its R&D: "*our VFX R&D team (Europe's largest) create the tools for our artists*".

Production technologies

Historically, filmmakers relied on storyboards, concept artwork, and physical models to help them plan their visions. Today, pre-visualization (previs) techniques are being leveraged throughout the entertainment industry. They are even used to help filmmakers and studios to rise funding for projects in development. "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

[97] 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

[98] Previs is an abbreviated term for "pre-visualization", the process of visualizing and improving a project before the final endeavour is attempted.

[99] 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

the final endeavour. During the production, real-world measurements can be derived from the "previs" shots to help streamline the live-action setups (Third Floor Inc[100] website, 2014).

Productions' technical quality levels have been also enhanced thanks to new equipment and software generations and more reasonable costs to devise innovative machine and action cameras (cf. Box 11).

Box 11: Improving picture quality. Some views from the industry

"With picture quality identical to the 20,000 cameras of the 1990s, the latest GoPro[101] is emblematic of an era when we can get outstanding takes for very little budget output" (Imaginove, 2014: 5).

"*Panavision has developed full film-shoot solutions where the camera is the pivot point: storage, bandwidth and format are reliant on it. Panavision Rush Management ensures the safe and automatic flow of data, with a service-oriented approach. In concrete terms we begin upstream by determining workflows so as to set up adapted soft and hardware systems, while ensuring very simple management of the dailies. We've perfected hard disk structures which are compatible with filming/postproduction, and it's all online, with real-time data access. So we've moved from simple camera rentals to renting full filming systems*" (Patrick Leplat, technical director Panavision France, Imaginove, 2014: 10).

"*Stereoscopic 3D is experiencing a strong resurgence,[102] with moviemakers no longer using the technique primarily as a gimmicky audience-draw consisting of objects poking from the screen into the theatre space. In today's cinema, stereoscopic 3D is being used more subtly as an aspect of storytelling to enhance immersion into environments that appear to invite the viewer inside. The film Avatar is a testament to this shift in how moviemakers now use stereoscopic 3D, and yet the movie industry is not alone in embracing the technique*" (Kroeker, 2010: 14).

Source: Imaginove (2014: 5, 10), Kroeker, (2010: 14)

After the success of *Avatar* in 2009, Hollywood rediscovered the 3D format (see Box 11) and Bollywood in India was following with the success of *Haunted* in 2011. This film is only the second 3D film made in India.[103] "*Filmmakers claim theatres in India did not have the technology in place to screen 3D movies; theatre owners retort there were never enough 3D movies being made to warrant the investment to make their screens 3D enabled. But the Hollywood 3D bonanza of recent years has prompted a change. Film technology company, UFO Moviez,[104] has developed a 3D-compliant technology which has already been installed on 110 screens across the country on a revenue sharing basis*" (Anand, 2011: 106) (see next section).

Cinema audio has evolved very slowly: the past 20 years or so have not really brought significant innovations. In 1975, Dolby Labs[105] introduced its Dolby Stereo[106]that contributed to the success in 1977 of both Lucas' *Star Wars* and Spielberg's *Close Encounters of the Third Kind*. In 1980, Zoetrope with "Apocalypse Now" started moving toward digital sound by adapting recording studio equipment to the film mixing studio. Dolby 3D Digital Cinema was demonstrated to film industry in 2007 (Dolby, 2014).

The transformation began in the 2000s with new generations of mixers, new tool adjustments, and the competencies in digital technologies of sound engineers. Aaton pioneered these changes (see

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

[101] A high-definition personal camera known for being lightweight, rugged, wearable or mountable in unusual places such as outside planes, cars, boats or army tanks.

[102] "The first screening of a 3D film took place at Astor Theatre, New York, on June 10, 1915. The anaglyphic process involved in shooting a 3D movie was developed by E.S. Porter, W.E. Waddell. The first 3D feature film was Nat Deverich's 'The Power of Love' released in 1922. The first 3D film with stereophonic sound was Warner Brothers' 'House of Wax' in 1953", Anand (2011: 104), see also Pomerantz (2010 b).

[103] 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).

[104] UFO Moviez India Limited is an India based company.

[105] US company specializing in audio noise reduction and audio encoding/compression.

[106] A 35 mm stereo optical release print format.

Box 12). According to Veyrat (technical director of the company Miroslav Pilon[107]), "*Digital technologies have been totally mastered since the 2000s and have revolutionized the way we produce: considerably faster production times, less cost. Digital has also democratized certain uses and simplified post-production, making it easier to work more conjointly: foley artist,[108] sound designer and mixer can work on a parallel before centralizing all of the sound tracks*." (Imaginove, 2014: 11).

Box 12: Aaton

Aaton is a motion picture equipment manufacturer, based in Grenoble, France. Aaton was founded by Eclair engineer Jean-Pierre Beauviala, whose efforts have been primarily focused on making quiet, portable motion picture hardware suitable for impromptu field use, such as for documentaries. In 1967, Jean-Pierre Beauviala was planning to make a film, however he realized that the equipment corresponding to the project as he had imagined did not exist. Consequently, he decided to construct such equipment. The company introduces itself as "the champion of handheld cinematography". Aaton made a name for itself with innovations which are now widespread in the film industry: in-camera time recording, Super16, and built-in video-assist, film code readers and accurate data management for non-linear editing systems.

Aaton was perceived as some kind of model of innovative SME, being the only French company building motion picture cameras. Aaton worked in closed cooperation with filmmakers (Jean-Luc Godard, Jean Rouch, Raymond Depardon, Louis Malle…), allowing them to become co-creators of the innovation from Aaton.

A t model for all motion picture cameras they have produced is the "cat-on-the-shoulder", a small, light, quiet motion picture camera. After several initial prototypes, the Aaton LTR 16 mm camera became available on the market in the late 1970s. It has been succeeded by several improved models, including the LTR, LTR 54, XTR, X0, XTRplus, and XTRProd. The currently available product line offers the Xterà (successor to the XTRProd), a specialized small 16mm camera (A-Minima) and a 35mm model (35-III).

Aaton also pioneered the linking of time code to motion pictures in the acquisition stage. Aaton code was one of the earliest schemes for encoding a time code signal in the frame margins of 16mm film, allowing rigorous synchronization of audio and film in post-production. The Cantar launched by Aaton changed radically multi-track sound recording (immediate transfers and sound source identification included in the initial data processing).

Aaton invested heavily in R&D to design a new digital camera, Pénélope Delta. However, the company went bankrupt in 2013, and was bought that same year by Transvideo. The Delta model was discontinued. In June 2013, Aaton has become Aaton-Digital.

Source: Aaton website, Imaginove, (2014: 10), J.M. Frodon, (Slate.fr, 2013).

American Zoetrope has also been a pioneer for the introduction of non-linear editing, a technique used in digital systems where a digital source (such as digitized film, video or audio) is used to create an edited version, not by rearranging the source file, but by creating a detailed list of edit points. Avid then took on and became the standard (see Box 13).

Box 13: Avid: moving to non-linear editing

Avid Technology, Inc. is an American company specializing in video and audio production technology; specifically, digital non-linear editing (NLE) systems, management and distribution services. It was created in 1987 by a marketing manager from Apollo Computer, Inc, and became a publicly traded company in 1993. The company describes itself as "*a leading provider of digital media content-creation products and solutions for audio, film, video, and broadcast professionals, as well as artists and creative enthusiasts*". By 31 December, 2011, with revenues of around 678 million US $ (but up to 929.5 in 2007) the company had a workforce of 1,787 employees and 490 external contractors.

A prototype of their first digital nonlinear editing system (the Avid/1) was publicly introduced in 1989 at the National Association of Broadcasters (NAB) convention. The Avid/1 was based around an Apple Macintosh II computer, with special hardware and software of Avid's own design installed. By the early 1990s, Avid

[107] A recording studio and post production services, located in Lyon, France.

[108] A foley artist 'recreates' sound effects for film, television and radio productions on a foley stage in a Post Production Studio.

products began to replace such tools as the Moviola, Steenbeck, and KEM flatbed editors, allowing editors to handle their film creations with greater ease. By 1994 only three feature films used the new digital editing system. By 1995 dozens had switched to Avid, and it signalled the beginning of the end of cutting celluloid. In 1994 Avid introduced Open Media Framework (OMF) as an open standard file format for sharing media and related metadata.

In 2006 Avid launched new products such as Avid Interplay and Unity Isis. Avid used to be considered just a "video editing" company, but now has consolidated a well-rounded multimedia generation technology company. Avid has released home versions of their professional line of editors, such as Xpress DV and lower cost professional versions (primarily to compete with software such as Final Cut Pro and Adobe Premiere) such as Xpress Pro. Additionally, Avid Free DV was available as a free download.

Their R&D efforts are focused on the development of digital media content-creation tools and workgroup solutions that operate primarily on the Mac and Windows platforms. R&D efforts also include networking and storage initiatives intended to deliver standards-based media transfer and media asset management tools, as well as stand-alone and network-attached media storage systems for workgroups. In addition to its internal R&D efforts, the company is offshoring an increasing portion of certain R&D projects to internationally based partners. R&D expenditures for 2011, 2010 and 2009 were $118.1 million, $120.2 million and $121.0 million (but up to 150.7 in 2007), respectively, which represented 17%, 18% and 19% of the net revenues, respectively.

At December 31, 2011, the company held 207 U.S. patents, with expiration dates through 2030, and had also registered or applied to register various trademarks and service marks in the United States and a number of foreign countries, including Avid, Media Composer, NewsCutter, Pro Tools, M-Audio and Sibelius.

Source: Company website, Annual report 2011.

Post-production technologies

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 subsector[109] with, for instance in France or UK, most firms with less than 10 employees. Mac Guff (Box 14) and Buf (Box 15) illustrate this trend of small innovative post-production companies; the latter has a work force of 200 employees.

Box 14: Mac Guff Studio

Mac Guff is a French animation and visual effects company. It has been founded in 1986 and since then it has produced a handful of cartoons (from “Kirikou” to “Dragon Hunters”). The company headquarter is located in Paris, with offices also in Los Angeles, USA. The name Mac Guff was inspired by the term 'MacGuffin', a term and technique popularized by Alfred Hitchcock. In 2012, the company had revenues of €7, 936 million.

Mac Guff is one of the main European digital visual effects design studios. Its activity goes from the film industry, to advertising, television programs and music videos. Mac Guff’s mastery and development of “proprietary” software tools is conducted in constant collaboration with graphic artists. This process makes possible to meet the most demanding and innovative visual requirements. The “creative approach” lies at the heart of all the company projects. Each film requires a concept, an idea or a story to be developed and transcribed into concrete imagery. And each time, every creation requires the combination of an artistic goal and its technical and logical dimension.

Mac Guff is specialized in the creation of computer-generated imagery for commercials, music videos and feature films. The Universal film *Despicable Me* (realized by Chris Renaud and Pierre Coffin in 2010) has been entirely manufactured in 3D in Paris by Mac Guff studio. This film cost just $69 million and earned $251 million in the U.S. and $543 million worldwide. *Despicable Me* was one of the first movies to get the international tax credit for foreign films shot in France.

[109] 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, 2012: 3)

The company has been acquired by Universal and became part of the company of an expert in 3D American animation, Chris Meledandri's Illumination Entertainment. As a consequence, mid-2011 Mac Guff has been split into two companies: the animation department has been acquired by Illumination Entertainment (Universal Studios). The new company renamed "Illumination Mac Guff" (capital worth €3.25 million), is now exclusively dedicated to animating Illumination/Universal features. "Mac Guff" continues creating visual effects on live-action movies. The Universal buyout brought extra resources and allowed Mac Guff to be more proactive. The company is now mixing French and American work habits and studios' experience.

Source: Company website and Internet sources (2014): www.societe.com/societe/mac-guff-ligne-338438781.html

Box 15: Buf

Founded in 1984 as one of the few pioneers of computer generated images (CGI) at the time, Buf has been providing since visual effects for more than 100 films and 850 commercials. In 2012, the company had a turnover of €7.9 million, 10 million in 2013, down from €29 million in 2009.

Buf has been involved in the making of "Life of Pi" (see Box 16), in the series of "Arthur" for Luc Besson, and in "Avatar" (the tunnel). Buf prides itself for its ongoing commitment to advanced technologies and artistic craftsmanship: for the "bullet time effect" seen in "The Matrix", originally developed for Michel Gondry's video clips; and the "camera mapping" techniques which allowed David Fincher to introduce a new visual language in "Fight Club". Buf's work force amounts to 200 employees, with computer graphics artists and engineers, located in Paris, Brussels, and Montreal facilities and a liaison office in Los Angeles. The size of the Paris studio has been shrinking while the Brussels and Montreal studios were growing. Moving to Montreal also meant having access to the tax facilities offered by the Canadian authorities: a 53.8% tax credit instead of 20% in France.

Since its inception, Buf's primary focus has been devoted to its in-house research and development team which aims at creating the software and "pipeline(s)" needed to fully realize any director's vision. The research and development team along with the art department and production teams, has created therefore a "coherent" pipeline to provide creatively open solutions that are meant to meet productions biggest challenges in full computer-generated animated films and live action movies. From modelling, dynamics, animation, high end rendering to project and asset management, Buf brings to life the most elaborate tools in visual effects. BUF exclusively uses its own proprietary software from pre-visualization to final render. What the company describes as a "pipeline" involves 15 developers from major international universities.

Source: Company website, Internet sources (www.verif.com/societe/BUF-COMPAGNIE-320074388/), Brousseau-Pouliot (2014)

Livingstone and Hope (2011) focused on the UK visual effects industries:[110] 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 (Livingstone and Hope, 2011: 25).

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).

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).[111] The authors stress that *"It is hard to think of a*

[110] And also on the video games industry.

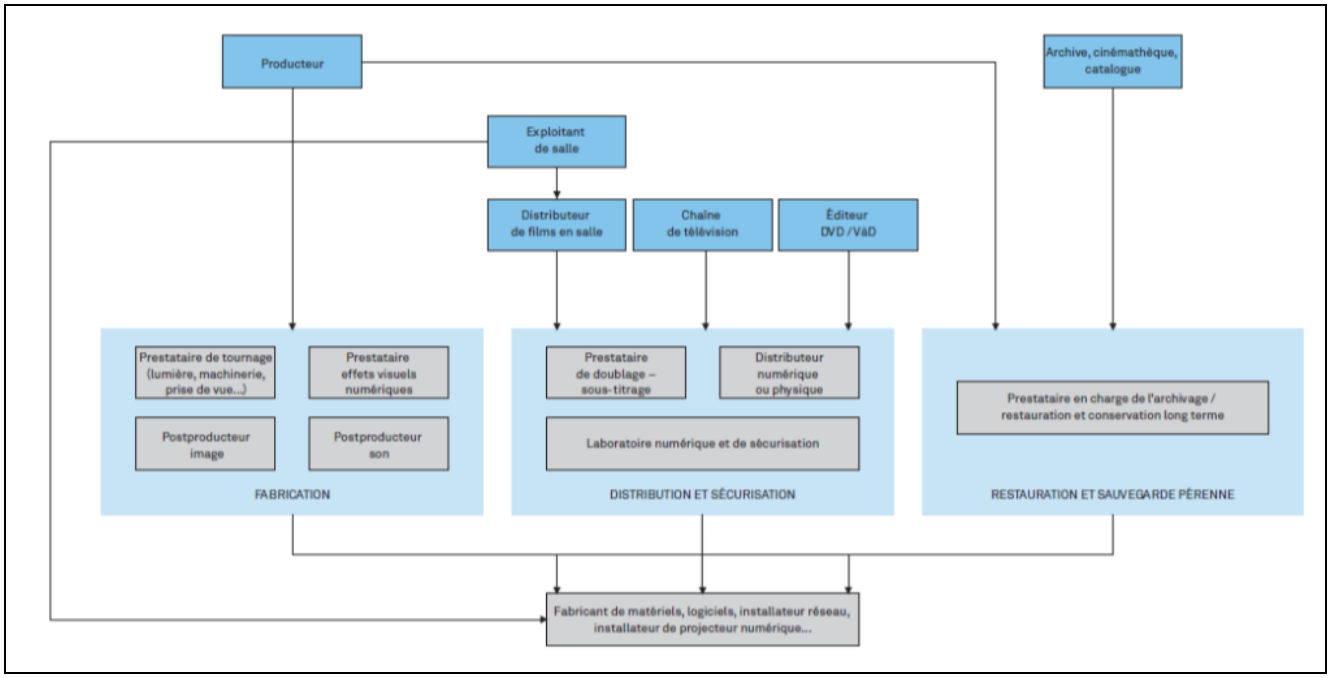
[111] Some examples of visual effects in the UK and Hollywood blockbusters: *Batman Begins, The Dark Knight, Bourne Ultimatum, Prince Caspian, The Voyage of the Dawn Treader, Avatar, Clash of the Titans, Prince of*

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). "Double Negative", already quoted, was founded in 1998 and prides itself to have "*grown to become one of the industry's success stories and is now Europe's largest provider of visual effects for Film (operating from locations in both London and Singapore)*" (company website, 2014).

The UK is also a global centre 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". 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. Nonetheless, the level of expertise necessary for producing high quality visual effects is rare.

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.

Figure 9: **The players within the cinema technical industries (production/ distribution/ archiving, storage, and restoration).**



Source: CNC (2014: 157)

Specialist companies, employing hundreds of animators, artists and programmers, like the ones in Soho, are providing visual effects though deep collaborations with film clients. In sharp contract with other "technical industries" (see Figure 9 for the components) from other countries, these UK industries appear to have been able to avoid being just treated like part of the 'facilities' sector. On the opposite, Livingstone and Hope stressed that "*they often participate in projects from their very inception. Many provide expert advice during the pre-production and production stages, after which they create and integrate visual effects with live footage. As with video games, visual effects companies draw on support services such as technology and tools developers*" (Livingstone and

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).

Hope, 2011: 24). These companies and their technical experts are plying between the core filmmaking team and their technical counterparts as we will see with the case of DreamWorks. 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"[112] in order "to weather" what has been described as the present "VFX crisis" (DeRuvo, 2014).

"*Already some Indian companies have become so adept at converting conventional films into the 3D format that Hollywood has begun outsourcing work to them. Mumbai-based post production and visual effects studio Prime Focus has just completed the conversion of "Chronicles of Narnia: Voyage of the Dawn Treader" into the 3D format, using its own proprietary software called View D*" (Anand, 2011: 106). US VFX company Rhythm & Hues had offices in Mumbai when hired for the making of Ang Lee's *Life of Pi* (see Box 16).

Box 16: Visual effect in the making of Ang Lee's *Life of Pi* (2012)

The film director Lee relied on many technological techniques to bring *Life of Pi* to the screen: he argued to share the award with "all 3,000" with whom he created an entire virtual world. Lee and his crew relied on technology in the form of visual effects and 3D filming. First of all, Lee learned that 3D did particularly well with water. So, he used a water tank in Taiwan to stand in for the Pacific Ocean and spent a year making a "previs," in the form of an animated version of the film to serve as a guide. "For a 2-hour movie with an hour and a half of visual effects (VFX), the crew included lead VFX company Rhythm & Hues along with other VFX firms including MPC, Buf, Crazy Horse, Look Effects, Lola VFX, and Legacy Effects".

Director Lee is optimistic about 3D: the market response about the *Life of Pi* revealed that the audiences worldwide that are least enthusiastic about 3D are American audiences; in other parts of the world, 3D is much more popular. Lee added that in China, the film was released solely in 3D: over 80% of the film's box-office returns came from outside the United States.

The main steps in the design of the film were:

- Many of the shots on the lifeboat with the tiger are composites of human actor Suraj Sharma and his animal costar.
- Once Sharma is in place, the shooting stage is digitally removed and the water and sky outlined for additional effects work.
-The tiger, filmed separately in a manner similar to the one in which Sharma was shot, is then slotted into the scene.
- The real tiger and computer generated images (CGI) rendering of one are each used multiple times throughout "Life of Pi", so it's difficult to tell which you're viewing at any given moment.

Source: Steele (2013: 3, 6).

To the three stages of the negative streams, we should add from our specific perspective, that each stage offers opportunity for technical cooperation and innovation: negotiating with "tech firms" (Buf, Double Negative, Light Stage System, Weta) 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 (including musical ones). Additionally, various analysts observe trends that might mark the future of the industry and of its models of innovation: the videogames company, and the lab-company.

[112] Prime Focus began in Mumbai over 15 years ago as a commercial post-production facility providing top-tier technology solutions (visual Effects, 3D conversion, and animation) to clients to become an international firm with a team of over 4,500 professionals across the globe, with offices in London, Los Angeles, Vancouver and New York. *Source*: company website.

Trend: convergence with video games?

Videogame and cinema demonstrate clear overlapping of technologies. For example, parallax scrolling is a special scrolling technique in computer graphics, wherein background images move by the camera slower than foreground images, creating an illusion of depth in a 2D video game and adding to the immersion. Although the technique grew out of the multi-plane camera technique used in traditional animation since the 1930s, it was popularized among video games in the 1982 arcade game *Moon Patrol*. Hence, a frequent reference to a "strolling effect" (Martin, 2014) was later to be re-interpreted by the cinema for instance in *Avalon* (Mamoru Oshii, 2001). One can notice some influence of videogames for instance for staging fights/ battle on the 1st person (1st person shooting) as exemplified by Hong Kong director Wong Kar-Wai in his "The Grandmaster" (2013), but also in films like "Tiger and Dragon" (Ang Lee, 2000), or "Elephant" (Pernin, J. , 2014: 664).

This technological convergence stands for some kind of industrial convergence as well. Brookey (2010) stresses that "*…over the years, the technology of video games has improved sufficiently to allow games to offer cinematic visual and complex narratives. In other words, video games have become more like movies, and consequently more movies had become video games*" (Brookey: 4). One may venture to stress that this increasing interchange carries some more common formal, aesthetic elements, most likely due to the fact that technological players like the new post-production firms in the UK (a leading country for game development), or companies like Weta Digital, may contribute to bridge the two sectors through some formal or informal exchange within some "Tech" clusters. Quantic Dream (see Box 5) uses film to prepare video games. The CEO of the company acknowledged being influenced by directors such as Hitchcock, Kubrick or David Lynch for the making of their hit "Heavy Rain". Quantic Dream participated to the Tribeca film festival[113], showing games play. Livingstone and Hope state (2011: 4): "*The video games and visual effects industries play to the UK's twin strengths in creativity and technology*".

Additional factors support this industrial convergence. The proximity of the DVD standards for retailing films and games helped for marketing purposes (Brookey: 14-16). In 2015, Microsoft will produce and distribute its own unique content for the 78 million Xbox consoles being used worldwide, including a project with Steven Spielberg based on the extremely popular "Halo" series (McCoskey, 2014b). As a consequence: "*Now, the "crossover" between cinema and video games is being produced by dedicated subsidiaries with games manufacturers such as Ubisoft in the cinema and by franchises*" (Salmon, 2012: 20).

Vision: from project-based film making to the capitalising R&D lab model?

Film production is very project-based, requiring the cooperation of several kinds of expertise all along the value chain. 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 improves them contributing on different feature films.

The case of *Minority Report* provides a good illustration from this viewpoint. The visual realism of the movie was achieved through help from people who wanted to develop precisely what was being depicted, "*creating pre-product placements for technologies that do not yet exist. The consultant John Underkoffler worked up the cinematic depiction as if it was an actual prototype. He was already on the path from experimental set-ups at MIT to a company commercializing this kind of*

interface, but the film made it easier to sell the whole concept to investors" (Turney, 2013: 24). According to Turney, the success of this cinematic visualization was grounded in a very close relationship between film-makers and technologists. Without overstating this kind of relationship, one can note that in 2014, the US film industry trade association (MPAA) claimed: "*The once imaginary gesture technology found in films like "Minority Report" have transcended their fictional roots to become real-world technological advancements. And movies like Inception, Prometheus, and Iron Man continue to inspire futuristic gadgets and technology*" (MPAA, 2014a).

The assumption here is that a large part of technological innovation in the film industry takes place and is made through successive movies, through the very collaboration of the different involved parties, within the "*large village*" to recycle DreamWorks' metaphor. 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*". Such a cumulative process however is likely to fall out of the radar of any investigation of standard R&D expenditures. Besides, it is likely to shift the burden of the expenditures as they will be covered by a film budget to the technical companies such as Aaton. This may represent some kind of "hidden" outsourcing in the sense of "hidden" innovation.

This section focuses on two case studies that can be seen as visionary: DreamWorks and Zoetrope. Both companies claim being on the edge of technological innovation, the former for animation techniques, the latter for production efficiency and digital editing. The two companies share another feature, both being founded by filmmakers, S. Spielberg for DreamWorks, F.F. Coppola and G. Lucas for Zoetrope**.** The case of "Avatar" as some kind of working lab generating technological innovations was already hinted at. One of Weta Digital first projects was to provide visual effects for Peter Jackson's film "Heavenly Creatures". The filmmaker was one of the founders of the company. The company was then involved in "The Lord of the Rings" trilogy and "King Kong". All these films are blockbuster films requiring a small army of artists and technicians and hence a complex coordination of various forms of expertise.

Equivalent European case studies are not be found. For instance, the available public information stemming from firms attracting interest like Europacorp or Gaumont[114] (described though as a "mini-major")[115] do not mention any specific commitment to R&D, neither to technology. In terms of access to IT, the common elements between the two seems to be the sub-contracting of special effects to the same company, Buf. Buf indeed started its operation working on the hit "Les visiteurs" (Gaumont, 1993), and provided visual effects for "Arthur" (1, 2006, 2, 2008, 3, 2009), "Adèle Blanc Sec" (2009) and others for director L. Besson.

DreamWorks: a leading model?

DreamWorks offers an interesting example of cooperation within the firms of different technical resources, of a firm combining technology and the "artistic" dimension for the creation of full features animation films. As its CEO, J. Katzenberg, puts it: "*…We have transformed over the years from hand-drawn animation to computer-generated films to being a leader in 3D entertainment. Our strategy has remained the same: to produce great stories that are creatively driven and technologically state-of-the-art*" (Company website, 2014: www.dreamworksanimation.com/media/insidedwa/ourculture/cat0/slide1.jpg). On its website, under the technology section, the technological component is introduced under the title: "*where arts meet technology*" (see the technology section of Box 17 DreamWorks SKG[116]). This technological component is held central by the company (Annual Report 2012: 1). In its introduction to the 2012

[114] 2013-2014 turnover: slightly over €35.5 million. Ironically the website on the firm only mentioned for technology its founder, the engineer-turned-inventor Louis Gaumont in 1900. Gaumont, formed in 1895, is a leading European production company with a film library holding over 900 titles. It is the world's seventh largest mini-major film studio.

[115] In the 80s, Gaumont produced two Besson's films: « Le grand bleu » and « La cinquième dimension ».

[116] For Spielberg, Katzenberg, and Geffen.

Annual Report (2013: 1), the CEO stresses that technology development "*is designed not only to increase the creative productivity of our artists, but also to reduce the length of our production cycle and meaningfully lower our film costs".* In addition he adds that, from a strategic viewpoint, they plan to expand their expertise beyond their core business, "*in areas ranging from software to mobile games to short-form content*". As a consequence of lowering costs brought by technology, barriers to entry into the animation field have decreased.

Dreamworks exemplifies a business based on a few prototypes (see Figure 10 for a breakdown of the revenue between films released in 2010, 2011), their 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 they derive a significant percentage of their revenues from a single source, the production of animated family entertainment, their 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 2013.[117]

The company relies on heavy investments in the latest technology including cloud technology. They aim at to reducing the cost of their working installation when the work schedule is less busy (see Box 17). Interestingly, one of the consequences is to define the core filmmaking team for its specific endeavours as being constituted of directors, producers, production designers and VFX supervisors. It does not only emphasize the traditional role of directors and producers but also 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). It is worth noting that when introducing this new middleman, the company adds: "*But they're not just techies*", to rebalance on the artistic side (Hueso, 2014). It also mentions that the SupTD meets "*with research & development to discuss what new technologies will be needed*".

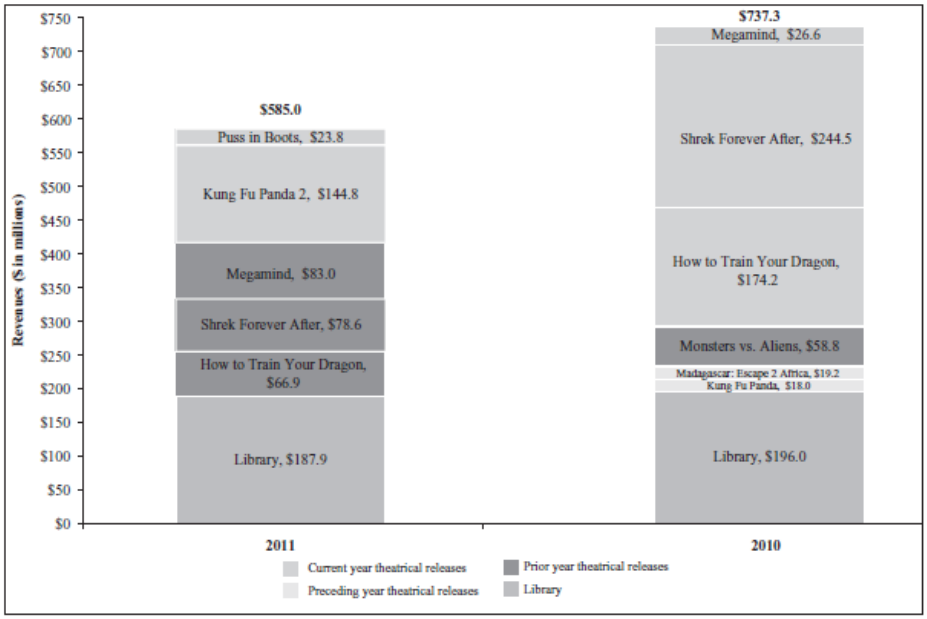
This indicates the possible existence of an R&D team, but there is no other mention of its existence, and one cannot find the precise R&D expenditures in the annual reports. However, the report gives $4.9 US million for all product development which amount to a 0.65% ratio to the sales. This is not impressive for a tech-oriented company.[118] However, this may be consistent with the important size of the workforce involved in production, with the "*rather large village to create an animated film*" (1520 direct employees for film production, see Box 17).

The company does record some of its technological achievements and developments, for instance with lighting software. Like in the case of Zoetrope (next section), the company was dissatisfied with the state of the available technology as in the early 90s, current lighting software was not evolving quickly enough to keep up with the pace of DreamWorks Animation's ambitious productions. 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 where 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).

[117] Wall Street Journal, www.marketwatch.com/investing/stock/dwa/financials

[118] 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.

Figure 10: The components of the theatrical release revenues (2010, 2011)



Source: Annual Report 2012: 63.

There is some indication of partnerships with other tech companies (see Box 6) but no mention of any related patent even in their technical papers.[119] 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 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*".[120] 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.

Box 17: DreamWorks Animation SKG

DreamWorks Animation SKG, Inc. (DWA) is an American animation studio based in Glendale, California that creates animated feature films, television programs, and online virtual worlds. The company was founded in 1994 by director and producer Steven Spielberg, music executive David Geffen, and former Disney executive Jeffrey Katzenberg. The company started operation as an animation division of Old DreamWorks Studios. It 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, modellers, 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

[119] See website under the section "technical papers" : www.dreamworksanimation.com/
[120] See website: www.dreamworksanimation.com/insidedwa/ourpeople/*bradherman*).

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.

In 1998, DreamWorks released Spielberg's critically acclaimed World War II drama, "Saving Private Ryan," as well as its first two animated features, "Antz" and "The Prince of Egypt." DreamWorks Animation claims to be the largest animation studio in the world. The Company has theatrically released a total of 27 animated feature films, including the franchise properties of "Shrek", "Madagascar", "Kung Fu Panda", "How to Train Your Dragon", "Puss In Boots" and "The Croods", with films like "Shrek the Third", "Shrek 2" and "Madagascar" being the highest-grossing animated films in the domestic box office in their respective years of release.

These feature films bring currently the source of a substantial portion of the revenue. The firm derives revenue from their distributors' worldwide exploitation of feature films in theatres and in ancillary markets such as home entertainment, digital and pay and free broadcast television. As of 2012, the distribution agreement with Paramount was terminated, and an agreement was signed with 20th Century Fox. In addition, the company earns revenues from the licensing and merchandising of films and characters in markets around the world. In 2012, DreamWorks created a partnership in China through a joint venture in China to establish the leading Chinese-branded family entertainment company, Oriental DreamWorks.

As part of its computer-generated filmmaking and other processes, the company developed a variety of software tools and other intellectual property. Occasionally they may seek to exploit their intellectual property in applications other than their traditional filmmaking business, directly or in partnership with technology companies or other business partners. Besides, the company has strategic alliances with McDonald's, Hewlett-Packard, Intel, Autodesk, Oracle, Polycom and RedHat.

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.

Technology: "Where arts meet technology"

Technology plays an important role in the production of projects. The company focuses on user interface and tool development enabling their artists to use existing and emerging technologies, allowing the company to leverage the artistic talent. In addition, the company works under strategic relationships with leading technology companies that allow it to benefit from third-party advancements and technology at the early stages of their introduction.

The technology required for one film includes 300+ graphics workstations, 60+ million render hours, 17,000 cores used simultaneously, and upwards of 200+TB of disk space. The standard is Hewlett Packard (HP).

DreamWorks runs its own animation data centre in Redwood City. One reason is that the animation field is, like any other entertainment field, a massive consumer of storage. Moreover, animation specifically calls for a special set of technology and needs to wind - as a movie or TV show - through a typical multi-year development cycle. Storage requirements for a new movie from DreamWorks Animation start out with scanned artwork or hand drawn artwork on tablets, scaling up all the way through to the final end product movie. Along the way though, every frame is handled by several artists and sound experts as DreamWorks strives to deliver their next blockbuster. Storage scales heavily as the show moves into production, then scale down almost as fast as data gets archived toward the end.

The company summarizes that a rundown of the hardware takes to bring 2-3 DreamWorks movies to life per year with 8-10 in production at any given time, in the following fashion:

Previsualization:

- Scanned hand-drawn artwork, or artwork created on input devices like Cintiq tablets,
- Standard artist work station - HP z800,
- Data is stored in HP x9000 storage arrays or Netapp FAS level arrays.

Preproduction

- Data gets migrated to faster Netapp FAS storage arrays,
- Transactional data is stored on 3PAR arrays,
- Production users use HP z800 or HP z820 workstations.

Rendering Process

- Rendering is performed on some 3,000 HP C-Class server blades. Blades are reused from movie to movie and are made up of a variety of Sandy Bridge, Westmere and Nehalem systems,
- Disaster recovery data is stored on HDS XP20000s and HP x9000s.

Production Release

- Data gets migrated to a series of deep store HP x9000 series systems,
- Archives are created and data gets off lined as needed.

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.

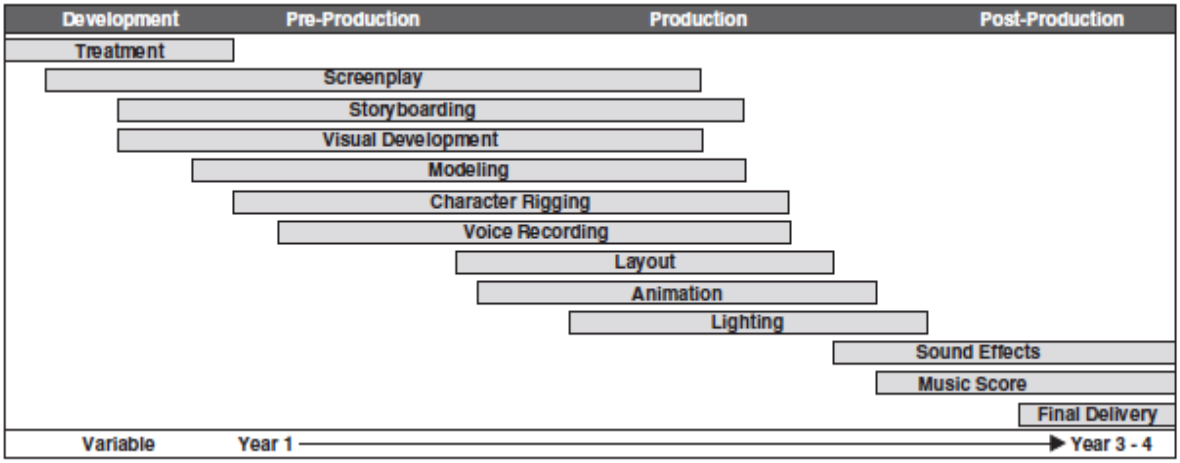
Their engineers and thought leaders share their work by publishing important technological advances that help to create "amazing" effects. The group received a multitude of technical awards and accolades. The company has several patent applications pending in the U.S. or other countries, and relies on a combination of patents, copyright and trade secret protection and non-disclosure agreements to establish and protect our proprietary rights.

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

Preimesberger (2011: 14), talking about DreamWorks,[121] explains that "an animated movie - whether or not it's 3D - takes four to five years to produce, and the equipment stays with the production from start to finish, so the studio gets its money's worth from its investments". (see Table 9, Timeline). Tools and technology are reinvented for every movie. DreamWorks replaces all new workstations about every 6 months, with the hardware and software improving incrementally with each new purchase. A lot of time is also spent on performance-optimizing the software. Furthermore, a typical 4-year movie project coincides with current improvement cycles in information technology: DreamWorks thinks that it is best to buy new hardware, because it will pay for itself in about one year. "The power and efficiency of ever-improving hardware and software platforms enable animation artists to do more in less time, so that more iteration of scenes and characters can be created. This results in more choices of art for the directors and producers" (Preimesberger, 2011: 16).

[121] DreamWorks Animation SKG, Inc. (DWA) is an American animation studio based in Glendale, California that creates animated feature films, television programs, and online virtual worlds. The company was founded in 1994 by director and producer Steven Spielberg, music executive David Geffen, and former Disney executive Jeffrey Katzenberg.

Table 9: Timeline for a full-length feature film



Source: Dreamworks website.

According to Preimesberger (2011: 18), 90-minute long 3D films made in 2011, like "Kung Fu Panda 2", required 100TB of storage capacity in the studio's data centre farm. DreamWorks uses HP's data centre in Las Vegas and Cerelink's in Corrales (New Mexico). "*Despite all the additional work and technology that goes into a high-quality, two-camera, 3D rendition movie like Kung Fu Panda 2, the overall costs for these movies are actually going down at DreamWorks". All this is possible because the entire process is fast and efficient, so artists can collaborate more often and faster. DreamWorks has tools and technologies that allow dealing with massive amounts of data and ever-increasing complexity, but always with an improved experience for artists. "Of course, all this requires a huge storage capacity. Dream-Works, which uses mostly NetApp and HP for its data storage needs, may have actually lost count of exactly how much storage it owns*" (Preimesberger, 2011: 20).

DreamWorks is the first movie studio to use multicore-powered workstations: most of its computer graphics[122] stations have 12-core machines capable of 24-thread computing. "*Where it once took 8 hours to render a single frame of a 3D movie, it now takes only several minutes. That's huge in terms of time and cost savings. The HP Z-series workstations offer about 50% more cache than previous versions (up to 24GB), which helps speed processing in a big way. Intel Xeon 5600 Westmere processors inside the workstations also run cooler, require less power and cooling energy, and have improved security features*" (Preimesberger, 2011: 20).

DreamWorks uses Adobe Creative Studio for everything that goes on the screen: "*that's where mathematics, science, HPC (high-performance computing), artistry and the professionalism of the artists all come together. Every square inch of a moving character is plotted out: how it moves, how it interacts with other characters, how it is affected by wind and water, and how hair moves and falls*" (Preimesberger, 2011: 20).

Finally, a separate CG unit is in charge of hair,[123] fur and clothing. Surfacing is of key importance in 3D presentations. Lighting, shadows, perspective and other visual factors have to be perfectly orchestrated. In short, actually, multicore processors, dynamic allocation of computing power and incredible amounts of storage make the difference for DreamWorks compared to the past.

American Zoetrope: the difficult fate of a deviant pioneer?

American Zoetrope (see Box 18) provides another example of a firm founded by directors (Francis Ford Coppola and Georges Lucas). Coppola, after touring Europe at the end of the 60s, decided he would build a "deviant studio" to conceive and implement creative, "unconventional approaches to

[122] 3D computer graphics.

[123] See for instance the "technical paper" on "ISHair: Importance Sampling for Hair Scattering".

filmmaking". Opened on 12 December 1969, American Zoetrope[124] was an early adopter of digital filmmaking, including some of the earliest uses of HDTV. The studio has produced not only the films of Coppola (including "Apocalypse Now", "Bram Stoker's Dracula" and "Tetro"), but also George Lucas's pre-Star Wars films (THX 1138), as well as many other directors as Tim Burton, Jean-Luc Godard, Akira Kurosawa, Andrei Sergeyevich Mikhalkov-Konchalovsky, Wim Wenders and Godfrey Reggio (company website[125]). Since its inception, the maverick company produced over 60 films.

According to estimates by the specialised firm Manta (2014), the company has an annual revenue of $20 to 50 million[126] and employs a staff of approximately 20 to 49.[127] A total for a year of US $31.27 million that fits Manta's estimation. R&D data are not available and the company looks too small to host any R&D division, part of the vision seems to dwell with the founder Coppola. Although the company seems to have working links with the University of California as hinted at by the presence as VP of Coppola's former UCLA professor (see Box 19).

The story of the company is not exactly straightforward, as Bart (2000) puts it, calling Coppola "*a Renaissance technophile*": "*For 30 years, Zoetrope, Coppola's production company, has ricocheted between blockbusters and bankruptcies, owning studios then losing them but always plowing ahead with new ventures*". The story shows how it is difficult to capitalize on the tools created for a specific film, as illustrated by the case of the joint-venture Zowi (Zoetrope/ Western Images) to provide services to other companies, though data are not available to assess properly the real fate of this venture.[128]

In 2014, the company received California tax credits[129] for Gia Coppola's "Mainstream", a $2.3 million credit for $9.3 million in costs for American Zoetrope. American Zoetrope also received tax credits in previous years for "The Bling Ring" (2013, directed by Sofia Coppola) and "A Glimpse Inside the Mind of Charles Swan III." (2012, directed by Roman Coppola), (Mc Nary, 2014).

The company was founded with the mission of finding creative, fast, and economic approaches to film. The company claims having embraced new technology and innovatively applying it to movie production, and pioneered unconventional filmmaking techniques. For instance, the company prides itself of the first use of social network over the Internet in 1999. American Zoetrope introduced the use of automated equipment and digital electronics in filmmaking ("electronic assist" method).

Box 18: American Zoetrope

Coppola was looking for ways of applying electronic technology that would increase production efficiency without compromising the quality. One outcome was the "Silverfish", an AirStream RV that provided audio support sets as well an environment for both creating and editing film. The Silverfish enabled pre-production, production, and post-production to occur simultaneously, building on the potential advantages of using videotape to record movie footage, so as to review movie clips on video immediately after filming and use them to shape the next day's shooting, instead of sending to a lab before viewing it.

Zoetrope also refined the Telecine[130] process and adapted it for offline film editing. Specialized database logging provided filmmakers with access to all relevant information. With the project Ulysses, Coppola contracted with software developers in the mid-80s to build a comprehensive film editing system that would

[124] A 19th century technology for animating a sequence of still images, like the phenakistoscope. A Zoetrope produces an illusion of action from a rapid succession of static pictures using a cylinder with slits cut vertically in the sides.

[125] There is a link to Coppola's winery.

[126] Ironically, F.F. Coppola seems to have been able to make more money out of his winery that from the film company. Variety reported in 2000 that his winery was one of the fastest growing in California, generating some $ 35 million in annual revenues (Bart, 2000). Coppola is also running hotels and resorts.

[127] Google Finance (2014) gives the following figures (million US $) for three quarters of 2013 and the first of 2014: Q.1 2014: 6.70, Q.4 2013: 8.42, Q.3 2013: 7.56, Q.2 2013 8.59.

[128] The two companies were very cautious, stating in 1997: "*The goal is to break even or be marginally profitable by the end of the year*" (Variety 1997a).

[129] The California Film Commission administers the five-year-old program.

[130] The process of transferring motion picture film into video.

use large Unix-based computers and servers in an effort to automate the filmmaking process. Though Ulysses never came into full fruition, the final product would have been the forerunner of standard functions today such as automated budgeting and scripting programs. Contributions to sound came with "Apocalypse Now" in 1980 moving toward digital sound by adapting recording studio equipment to the film mixing studio. Coppola has been an early user of MIDI technology for soundtracks.

Coppola's 1982 film "One from the Heart" became the "scratchpad" to test new electronics. He filmed it entirely onstage using cameras with video "taps" that produced a precisely framed image on a television monitor. Coppola could record and edit that video quickly to see if scenes cut together well.

In the 90s, American Zoetrope and San Francisco's Western Images launched a joint venture Zowi, to provide filmmakers with services that facilitated pre-visualization, visual effects design and non-linear editing. An enabling technology was behind this venture, which had been co-developed by Zoetrope to edit Coppola's 1992 film "Dracula." It later became one of the industry standards. Zoetrope also provided the foundation for the next step in filmmaking: electronic nonlinear editing. In 1989, the editing of "the Godfather, Part 3" used the Montage Picture Processor, an ancestor to today's digital Avid editing systems.[131] Coppola's penchant for experimentation led him to direct a 3-D theme park film for Disney as early as 1986, the Michael Jackson vehicle "Captain Eo".

Dr. Ray Fielding, Coppola's former UCLA professor was Zoetrope's VP. Fielding who became dean of Florida State University's Film School later, observed that "*today, many people do with software what we had to do with hardware*", (Variety, 1997).

American Zoetrope is now owned entirely by Coppola's son and daughter, directors Roman and Sofia Coppola.

Source: Company website (2014), Variety (1997a, b).

3.3 Cinema distribution and exhibition

The digitalization of theatre screens: Avatar or the 3D syndrome

In the 70s, French cinema owner Jean Charles Edeline,[132] became chairman of the Union Générale Cinématographique (UGC)[133]. He was appointed in 1974 chairman of the Société Française de Production (SFP)[134] of the public entity created after the divestiture of the French Public Broadcasting. He committed the company to an ambitious strategic plan to distribute films even in remote areas throughout the French territory. The plan failed but four decades later, an Indian company, UFO Moviez (see next section and Box 22) managed to bring features films digitally to second-tier cities in India.

In the traditional cinema business film distributors, advertising companies and alternative content providers were responsible for the print costs. According to Ymagis in the digital world these costs are significantly reduced, by up to 90%.

De Vinck and Lindmark (2012: p.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. "*However, theatre owners are confronted with high initial investments, while most of the benefits accrue to the distributors. Three main drivers of digital cinema have nevertheless pushed its roll-out, in particular in the last five years (somewhat earlier in the US than elsewhere): (1) the DCI[135] standard; (2) the development of a number of financing*

[131] A digital nonlinear editing system used in the television and video industry to create television shows, feature films, and commercials.

[132] Originally owning a theatre in Versailles, he was chairman of the trade association of movie theatres: Fédération Nationale des cinémas Français.

[133] Now the second largest cinema operator in Europe.

[134] The company after years of financial trouble was privatised in 2001, bought by Euro Media Télévision, a subsidiary of the Bolloré Group.

[135] Digital Copy Initiatives: specifications or ISO norms on D-Cinema.

solutions in order to solve the distributor-exhibitor quandary, most prominently the Virtual Print Fee (VPF) (see Box 16); (3) the revival of 3D movies. Digital cinema may also offer an opportunity for theatres to broaden and diversify their activities, possibly also exhibiting more European films. Still, small exhibitors are at risk of not making the transition".

"Avatar" induced theatre owners to equip more of their cinemas with 3D technology (Grover et al., 2010). « *The progress of digital cinema in Asia is also being driven by the increasing popularity of large-screen auditoriums which feature the absolute best in comfort and incorporate the most advanced technologies in 3D and 4K projection. Many of these are also being equipped with the latest premium sound, choosing between Dolby Atmos™ or Barco's Auro 11.1 soundtrack format, the two leading immersive sound formats. Digital Light Processing Cinema™ technology-licensed manufacturers Christie, Barco and NEC are all enjoying brisk sales throughout the APAC region*" (Mead, 2013b).

Schuck and Sharp (2012) describe fundamental aspects of digital cinema projectors relating to 3D operation. Two major digital cinema projector platforms are presented: Digital Light Processing (DLP, Texas Instruments Inc., USA) and Silicon X-tal Reflective Display (SXRD, Sony Electronics Inc., Tokyo, Japan).

The ZScreen is the RealD's first product for DLP-based digital cinema: it was introduced in 100 theatres for the opening of Walt Disney's "Chicken Little 3D" in 2005. "*The Zscreen is a field-sequential device, exhibiting the left eye image for a single flash, followed by the right eye image for a single flash*" (Schuck and Sharp, 2012: 672).

Box 19: Sound technology innovation

Dolby (2014: 3) quotes Director G. Lucas stating that "*sound is half the experience*." No wonder that « *Cinema sound is back in the spotlight and exhibitors around the world are being asked to evaluate new soundtrack formats being offered by Dolby Laboratories, Barco, and possibly others that may come in the future. Immersive sound has become the general industry term used to describe these new advanced formats, all capable of delivering more channels and therefore a better, more realistic sound experience than the previous 5.1 or 7.1 formats* », (Mead, 2013).

Exhibitors are once again in the position of having to make decisions about sound formats—if or when to upgrade, and if so, which system to choose. The decision is not necessarily a technical one; there are non-technical factors to consider such as the power of brands, the availability of the titles supporting the formats, the cost of the equipment upgrades, and the competitiveness of the individual markets. "*For each exhibitor, a different combination of factors comes into play. Immersive sound, whether it is the Barco Auro 11.1 or Dolby Atmos format, is in its infancy, with less than 500 systems installed worldwide as of December 2013. But for exhibitors, now is the time to listen and learn more at this year's CineAsia convention, as cinema sound is poised to take its next big step forward* » (Mead, 2013).

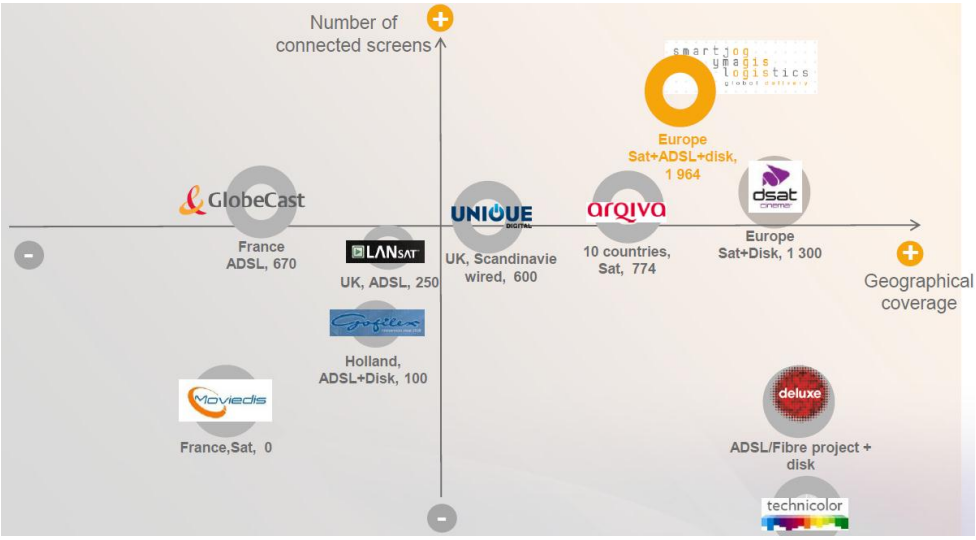
The Auro 11.1 is an innovative new audio system/cinema audio format powered by Barco. Barco is a European market leader in digital cinema projection and a global visualization technology company. Barco Auro 11.1 is intended to do for sound what 3D did for the picture by adding the ability for filmmakers to control a sound's direction and height within the auditorium.

Source: compiled by authors.

The worldwide growth of digital cinema screens has been impressive with a growth of about 30,000 screens over 2012-2013 (for the sound equipment see Box 21). 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: p.14) (see Figure 11 for the state of competition for film distribution). The penetration reached 93% that same year in the US (EAO, 2014: p.43) but reached 96% in China with 67% of them equipped for 3D projection (EAO, 2014:

p.51). South Korea is fully digitized since that same year (EAO, 2014: p.57), and India loomed around 95%[136] (EAO, 2014: p.55).

Figure 11: The competitive environment of digital film distribution in Europe



Source: Ymagis

Case study: Ymagis (France)[137]

The French start-up Ymagis has spotted a window of opportunity to develop fast in this area of digital film distribution to theatres. The firm introduces itself broadly as a "*specialist in digital technologies for the film industry*" (press release July 2014).

Ymagis assists cinema exhibitors 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).[138] 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, 61%, from their "toll" funding option, and only the remaining for 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 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 €47.3 million 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 Odyssée Venture) agreed to invest in the company. The company went public in 2013. In 2013, a joint venture was created with TDF, Smartjog, presented as the first service of integrated logistics for the cinema industry in Europe.

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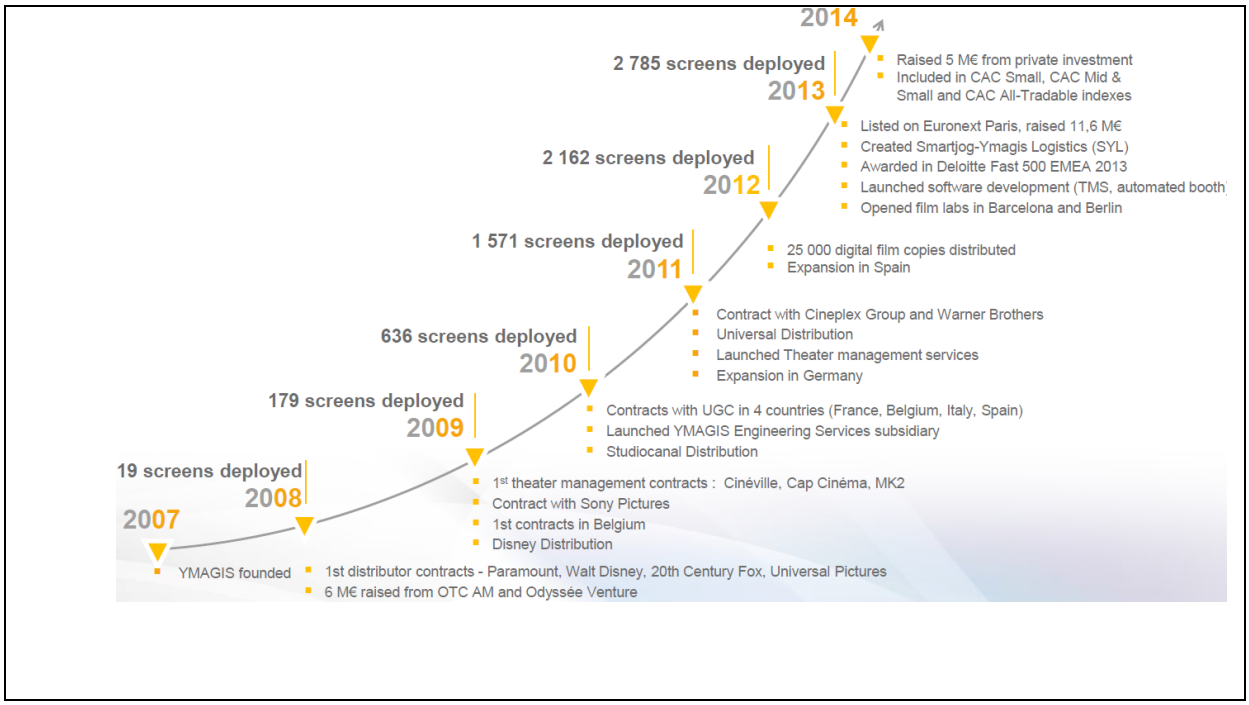
[136] EAO noted it was unclear how the figures were calculated.

[137] *Source*: company website 2014, annual reports.

[138] 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 the integration of software programs and operational services: technological expertise has strongly contributed to the success of the group in France as well as abroad.

Figure 12: Ymagis, a European leader in the sales of digital cinema equipment to cinema exhibitors.



Source: company website 2014

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.

The young firm has set a very ambitious objective:[139] 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

[139] Ymagis secured the top spot in Deloitte Touche Tohmatsu Limited (DTTL) Global Technology, Media & Telecommunications (TMT) industry group's 2013 Technology Fast 500TM EMEA (Europe, Middle East and Africa) rankings. Deloitte (2013a).

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. This acquisition will allow the company to become:

- the European leader in the sale of cinema equipment to cinema exhibitors and its installation, with an estimated European market share of 20%;
- the largest European network for the delivery of digital content, with more than 3,200 connected cinemas in 15 countries in Europe;
- the largest network of cinemas in Europe benefitting from NOC (Network Operating Centre) services and maintenance contracts, with almost 7,200 screens under contract in 21 countries in Europe.

Emerging channels of distribution: leapfrogging with Bollywood

"*Cinema in India is like brushing your teeth in the morning, you can't escape it.*" (Indian superstar Shahrukh Khan quoted by Singh, 2014). India is the largest producer of films (over 1,000 films per year) with annual ticket sales of nearly $2.8 billion, a box office of $1.53 billion (as of 2013, see Figure 7) and growth across international markets every year (Singh, 2014).

Lorenzen and Mudambi (2010) highlighted an interesting case of leapfrogging with technologies in the case of India with Bollywood. Bollywood produced approximately 250 annual feature films, in 2009; which represented 15% of India's film output, but accounted for 40% of India's film revenues, with a current annual growth rate fluctuating between 10% and 20% (Lorenzen and Mudambi , 2010: 6). The consultancy Deloitte notes: "*The industry is witnessing a shift from analogue medium to digital medium, and the trend is visible throughout the value chain—from content production to content consumption*" (Deloitte, 2014: 1).

Lorenzen and Mudambi show how Bollywood tried to catch-up in the competition with Hollywood, to go beyond the limitations of what they describe as a hugely fragmented home cinema market, a much disintegrated industry structure[140] with poor marketing and distribution capabilities, and of the limitations of the "masala" (mixed-genre) formula[141] (Lorenzen and Mudambi, 2010: 9): "*While Hollywood hesitated to take advantage of new distribution technologies, Bollywood decided to leverage the diaspora markets to introduce satellite TV and online film distribution. Such technological leapfrogging was necessary to capture value from the affluent diaspora which remains so geographically dispersed globally and across national territories that traditional cinema distribution is unviable*".

Eventually, to further move up toward higher value-added activities, Bollywood acquired shares of Hollywood: "*The 2009 acquisition by Bollywood's Reliance[142] Entertainment of US Dreamworks may signal a phase when Bollywood's global connectivity allows the cluster to co-produce Hollywood films, or even develop films that blend the styles of the world's two largest film entertainment industries to a new and truly global product*" (Lorenzen and Mudambi, 2010: 10).

[140] With hundreds of producers of feature films and related entertainment. Bollywood dates back to 1912, at roughly the same as Hollywood.

[141] Masala films of Indian cinema are those that mix genres in one work: action, comedy, romance, and drama or melodrama.

[142] An Indian conglomerate holding company headquartered in Mumbai, Maharashtra, India. The company operates in five major segments: exploration and production, refining and marketing, petrochemicals, retail and telecommunications. See Box 17.

Table 10: Bangalore and Bollywood's models of catch-up

	Bangalore Young ICT cluster (inception 1980s)	**Bollywood** Old entertainment cluster (inception 1910s)
Development potential	**Bangalore** Outward looking from inception - little investment in domestic market, - modest domestic spill-overs to suppliers of other industries.	**Bollywood** Inward-looking for almost a century - investments in domestic markets, - domestic spill-overs to suppliers and other industries.
Catch-up model	- Early and one-way global connectivity - inward investment impetus, outward market focus, -early but slow catch-up, steady exports, - initiative in value creation as well as value capture capabilities.	Late, but two-way global connectivity - inputs from Indian diaspora, outward investment, - late but rapid catch-up, booming exports, - leapfrogging in value capture activities.
Strategic challenges	Build two-way global connectivity through acquisitions, - in order to catch-up to bleeding edge in value creation and value capture.	Use existing two-way global connectivity, - in order to leverage existing value creation capabilities to create global products.

Source: Loren and Mundabi (2010: 14).

The two authors provide as well an interesting comparison between Bollywood, described as the main Indian content cluster, and Bangalore, the main IT cluster (Table 10) stressing the role of connectivity within global networks. One can note that the authors stress "domestic spill-overs to suppliers" which may point to some technology transmission or capitalization coming from the film as prototype which reminds the lab model evocated earlier. The catch-up model for Bollywood combines the new distribution technologies and the improvement of quality. UFO Moviez (Box 19) exemplifies the revitalization of the Indian film industry, being a pioneer in digitalization of distribution (Jaysinh, 2012).

Box 20: UFO Moviez: Technology-enabled business innovations.

UFO Moviez India Limited is an India based company that claims to be the world's largest satellite-based digital cinema network with 4000 digital screens across the globe.

UFO Moviez was founded by the Valuable Group in 2005, uses a MPEG-4 technology based Digital Cinema System, which allows films to get delivered to the theatres through satellite transmission. In 2005, the company became the first company in the world to deliver films via satellite for Digital Cinema Application using MPEG 4 technology. As of January 2008, UFO completed 1,000 installations across India. Its network grew to 2,500 screens in 2011.

The firm from Mumbai offers end to end digital cinema solutions and delivers films via satellite directly to theatres (3,513 digital cinema installations spread in over 1,350 cities across India[143]), ensuring 'first day, first show" for film distributors and exhibitors across India. On its website, the company insists on its focus on "*technology enabled business innovations*".

According to its COO, Jaysinh: "The entire industry has been revitalized by dropping various costs like operation costs, print costs, handling of the print costs, piracy leakages. So, UFO provides solution which solves the entire problem at one time". He claimed the Mumbai based company enabled the transition to 3D to meet the challenge of producers that initially were not willing to produce in 3D, as there were no 3D theatres.

Source: Jaysinh (2012).

[143] Including more than 100 3D screens.

Bollywood contributed to entertainment becoming India's second biggest growth sector, and India turning into an important global player in the global entertainment sector. The consultancy Deloitte reported, in its "Technology Fast50" on India, the growth of the media segment among other high tech sectors, noting that "*In the past, the winning companies from this segment were largely in the Mobile VAS*[144] *or Internet space but over the last two years, we have seen winners emerging from areas like music, video streaming and digital advertisement*" (Deloitte 2013b: 7).

Box 21: Piracy as a bottom up business model: the peculiar case of Nollywood.

The Nigerian film industry, known as Nollywood, presents a highly idiosyncratic model. According to Biola Alabi (Managing Director, MNet Africa , 2014), the Nigerian film industry is the second largest film producer in the world with an estimated value of US$500 million to 800 million annual revenue and the release of 2000 movies per year. Production budget is low, qualified by the EAO (2014: 61), "as no-budget guerilla production" ranging from US $2 000 to 200 000.

Its production models have been rooted in the informal economy, where these low-budget films are distributed in pirated formats through street markets in major cities (Flew, 2014: 13). In that kind of "commercial" circuit, a DVD sales around US $2 with an average sale of around 50,000 copies per movies. These specific Nollywood contents appeal to African all across the continent and the diaspora (UK, US, India): 1 million copies of "The Return of Jenifa" were sold.

The turning of pirate sites into legitimate operators, in 2012, led to an explosion of the African VOD space. The distribution circuit is, working upside down, with films being first distributed as VCR/DVD, then appearing on Pay-TV/DTT, and lastly aired on the Free-to-Air television. This is an interesting case of innovation through initially a short production/distribution circuit that eventually has enabled an alternative global network to emerge. The challenge, as noted by Flew (2014), is "to move beyond the low-cost, fly-by-night arrangements".

Source: compiled by authors.

Behind the screen: Towards on-line distribution for Internet-connected devices

New forms of distribution not only bring new streams of revenues (see Box 21 for the peculiar case of Nollywood), but opened up new opportunities for new entrants, in particular for innovative companies. Netflix provides an interesting case[145] 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, 2013: 1) "*the world's leading Internet television network with more than 44 million streaming members in over 40 countries enjoying more than one billion hours of TV shows and movies per month".*

The case of Netflix (USA)

Netflix has three operating segments: domestic streaming,[146] 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 was established[147] 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

[144] Value added services.

[145] See Annex B of the De Vinck, Lindmark cinema report (2012): 112-115. See as well for another case study, Grece (2014): 180-200.

[146] I.e. in that case the US market.

[147] By Reed Hastings (president and CEO) fellow software executive Marc Randolph, Incorporated in Delaware with offices in California.

on the Xbox 360, Blu-ray disc players, TV set-top boxes and the Apple Macintosh computer.[148] The company initiated its international expansion with 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" which cannot be treated as R&D expenditures as it covers "*payroll and related costs incurred in making improvements to our service offerings, including testing, maintaining and modifying our user interface, our recommendation, merchandising and content delivery technology, as well as our telecommunications systems and infrastructures "(*Annual Report, 2013: 25), and also costs associated with computer hardware and software. It does look broader than regular R&D but nevertheless the modification of the user interface is one of the dimensions held relevant by Bakhshi and Throsby (2010: 7) in their analysis of "hidden innovation", and may have involved some standard R&D. In any case, like Amazon, it provides a path to innovation stemming from the distribution segment and further relying on more and more complex technologies as illustrated in Figure 13.

The company interacts now with various players within a complex network of commercial relationships (Figure 13), a network they described as "*an ecosystem for Internet-connected devices*" (Annual Report: 1). 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*". In 2014 the company plans to substantially increase their investments in original content, representing less than 10% of their overall global content expense (Annual Report 2013: 28). As noted by an industry source "*Netflix is making a gamble in an attempt to beat out quality leader HBO*" (Experfy, 2014). Netflix market cap reaches US $24 billion v. US $56 for Warner the parent company of HBO. Indeed, Netflix subscribers now outnumber HBO subscribers, inspiring HBO (and other networks such as CBS's Showtime) to respond with a standalone streaming service, due to launch in 2015.

Netflix is available from €7.99 a month in France, Germany, Austria, Belgium and Luxembourg and from CHF 11.90 in Switzerland. In addition to the broad slate of international viewables, there are also many local and European titles available on Netflix across the new countries. Netflix is actively pursuing 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: 113). Netflix launched its 4K[149] stream early April 2014

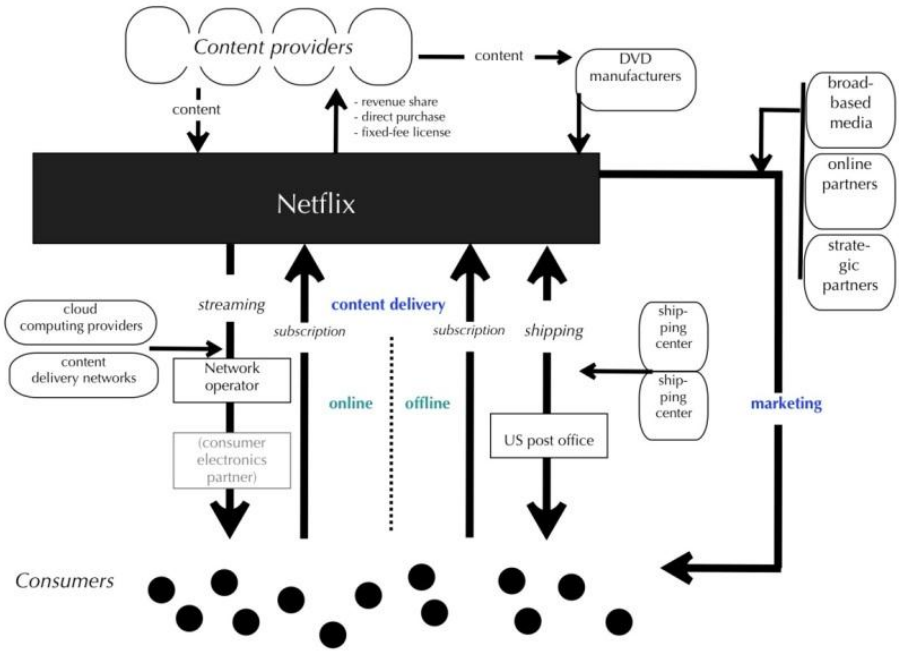
[148] See: https://pr.netflix.com/WebClient/loginPageSalesNetWorksAction.do?contentGroupId=10477&contentGroup=Company+Timeline

[149] 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

moving ahead of its competitors to display higher quality pictures (Technicolor White Paper, 2014: 6). 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: 8). 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 to set up a new balance between available brand contents and original contents.[150]

Figure 13: Netflix value network



Source: De Vinck and Lindmark (2012: 113)

Moving across the value chain through an innovative use of new technologies is a complex matter; some trials were less successful as illustrated by French and Canadian cases. In France, VideoFutur was initially a rental retail chain; it tried to expand into the on-line realm but the achievement has been far less impressive. Eventually, in 2013 VideoFutur was bought by Netgem,[151] an IPTV set top

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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.

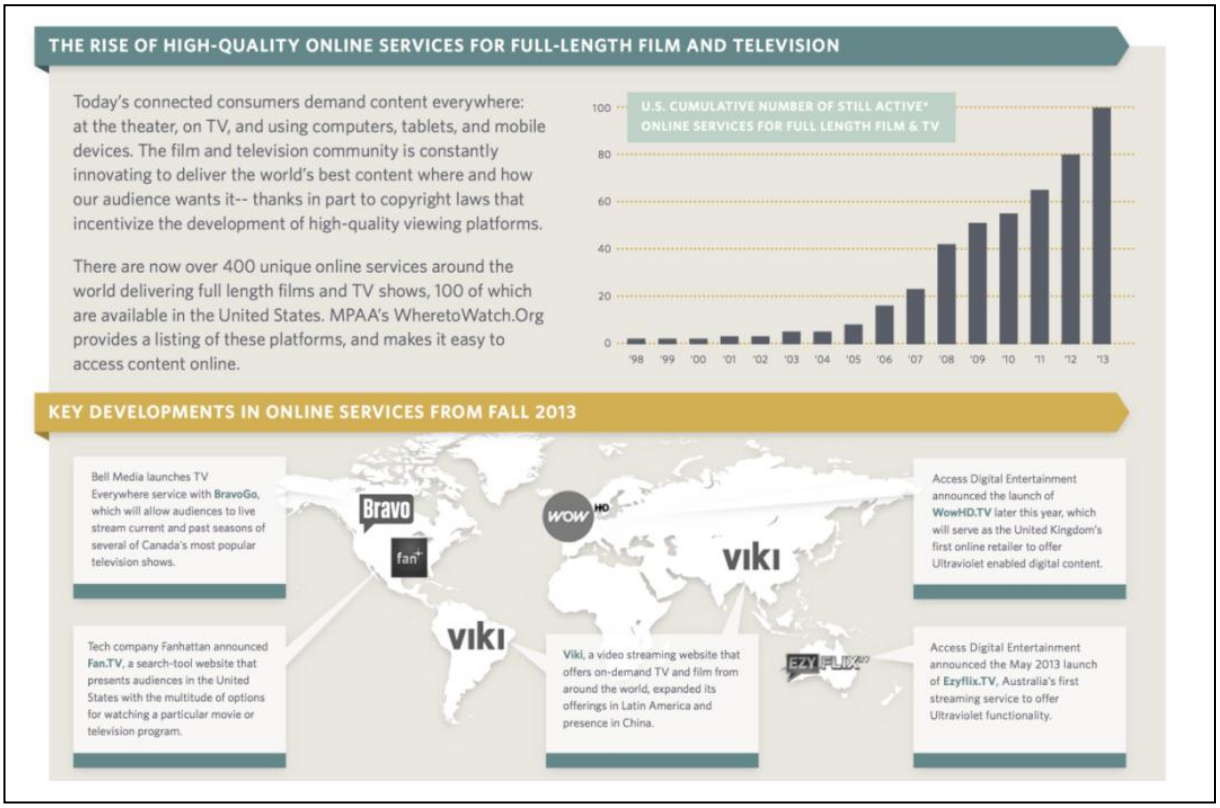
[150] According to Netflix's chief content officer, *House of Cards* was their most viewed content in February 2013 (Bain, 2013: 10). The new season of *Arrested Development* topped *Cards*' record, and the new series *Orange Is the New Black* recently beat this record again (Bain, 2013: 10).

[151] Netgem provides Connected Home Entertainment Solutions to Multiservice Operators. Source: www.netgem.com/about-netgem.php

box and middleware provider. In Canada, RipTicket was established in 2007 to help consumers discover videos from independent film makers. RipTicket allows users to stream, download or burn high definition, surround sound, feature-length films from the independent cinema library. The Vancouver, British Columbia-based RipTicket partnered with the US video Content Delivery Network (vCDN), Itiva Digital Media.[152] Itiva's vCDN supports both streaming and downloading of music, video, film and games. This Canadian attempt did not appear to become a major hit either.[153] This illustrates as well the role of the management of the "symbiotic" relationships. Netflix has been able to build its own "*ecosystem for Internet-connected devices"*, the other companies were not. Its model of innovation, not unlike Amazon's approach, concentrate on how to find the most accurate delivery modes for the content they buy and now start producing.

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 70s, with Pay TV/ Subscription TV in the 80s (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 to as to mobilize the resources needed, bringing together all the threads, first technical and then content creation.

Figure 14: Worldwide on-line distribution of film and television (2013)



Source: MPAA (2014) www.mpaa.org/technology-and-innovation/

From on-line to mobile: the way forward?

On-line distribution is now progressing faster with over 400 unique online services around the world (MPAA, 2014) as shown by Figure 14. In the United States alone, there are now more than 95 online services for streaming and downloading content that are available to consumers like Itunes, Netflix,

[152] The company founded in 2005 and headquartered in Palo Alto, California, claimed to be the first cost-effective video Content Delivery Network (vCDN). The company provides streaming solutions for the delivery of live and on-demand streaming media content to audiences. It offers live radio IP and IPTV video broadcasting solutions. Source: Bloomberg Business Week, June 2014.

[153] It seems that the company morphed into a mobile ticketing platform for events.

Hulu, Amazon Prime, HBO Go and Flixster (McCoskey, 2014b). This progression opens up new opportunities as illustrated in the previous section about Bollywood. Mobile entertainment is likely to grow next, with mobile applications building on the very fast spread of 3G/4G mobile and tablets.[154] Companies like Dolby are already investing to improve the sound quality of the devices (Dolby, 2014).

The content community (Fox, Paramount, Sony, Universal…) partnered with web-based companies (IBM, Microsoft), manufacturers (DEC, Nokia, Sony, Samsung), and Digital Rights Management (DRM) vendors in a consortium, the Digital Entertainment Content Ecosystem (DECE), to create "Ultraviolet",[155] an interoperable platform for consumers to build, access, and share content libraries across devices and services, both within and outside the home. "UltraViolet" operates in the United States (as of April 2014 the platform reached more than 17 million registered "UltraViolet" accounts (up 2 million from 15 million accounts at the end of 2013) (Gruenwendel, 2014) and nine other countries. UltraViolet launched its first title (Warner Bros.' *Horrible Bosses*) in October 2011. As of February 2014, the service carries 12,000 films and TV shows from all the major studios as well as other companies (DreamWorks Animation, Lionsgate, Relativity Media) and the BBC and HBO (Longwell, 2014). Disney did not join and launched its own rival cloud-based service early 2014.

De Vinck and Lindmark (2012) deem that the transition to digital DVDs is already completed in the home video market. DVDs have expanded the market and also offer easier and less costly adaptation (e.g. dubbing and sub-titling) of content. In recent years the DVD market has declined (both in the US and in Europe) (IVF, 2014: 10). The new high-definition format Blu-ray is growing rapidly but not sufficiently to compensate for the DVD decline. In 2013 Sony Pictures introduced 4K[156] Blu-ray discs and launched its Video Unlimited 4K/UHD catalogues (more than 140 titles, Technicolor White Paper, 2014: 7). In September 2014, Samsung inked a partnership with Fox's Innovation Lab to integrate Secure Content Storage Association technology (SCSA)[157] into its smart TVs and tablets, allowing for delivering 4K films as digital files on smart TVs (Tribey, 2014; Graser, 2014).

The next step for distribution may come from mobile as the mobile screen is gaining momentum. Mobile apps may represent the next phase of the content distribution revolution, creating an additional channel for providers to engage with their audience. According to the consultancy AppAnnie (2014: 5, see also KPMG 2014) video viewing on mobile devices increased 133% worldwide from Q1 2013 to Q1 2014, with Europe seeing more rapid growth than North America. As noted by M Gubbins, the distribution of films on devices such a mobile once seen with scepticism, "*is increasingly the place where young people in particular are choosing to watch film*" (M Gubbins, 2014: 75). Particularly for younger consumers, mobile devices are rapidly becoming the primary screen for video consumption.

3.4 Conclusion: The ever-shifting balance between technological innovation and artistic creation

The rhetoric of the outsider – the "deviant studio"- used by Coppola to promote his own endeavours highlights the reluctance of traditional industry to embrace new technologies and new forms of organization.

As stressed by F Filloux (2014b): "*In the media industry, historic players never developed a sense of urgency*". Obviously, the willingness to encompass changes cannot be taken for granted as it is

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[154] Just to give an example, in the UK, Ofcom's Communications Market Report 2013 (2013: 1) reveals that half of adults (51%) now owning these devices, almost double the proportion two years ago (27%).

[155] DECE proposes a "rights locker," or virtual library, which will ensure that users' content is accessible from and interoperable across all their devices.

[156] Next generation of High Definition (HD), see note 46.

[157] SCSA was first introduced in 2012 by Twentieth Century Fox Home Entertainment, Warner Bros. Home Entertainment, SanDisk Corp, CRI and Western Digital.

perceived as an element of disruption of existing patterns and value chains. As noted, 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.

New intermediaries bridge the streams like Ymagis bringing the content to digital theatres, Akamai to on-line distributors, UFO Movies, Netflix, etc. New mediations are emerging within each stream and beyond organizations, can morph sometimes in the very human and physical status of a Sup TD, a Supervising Technical Director, liaising between the core film team and the technical IT crews.

While technologies renew repeatedly and very often, changes requiring some time and innovations in the sector have been adopted over long-lasting period. In the particular case of digital technologies, it took more than three decades to introduce them in the three main streams: production, distribution, and exhibition. There is a generational effect observable in those chronologies, developing from the mid-80s together with the advent of the PC.

However, through the examples we reviewed, one can note that because of this fast changing technological environment, the balance between the two complementary visions of the industry – technological innovation and artistic creation - are evolving toward a more technology oriented vision, would it be in production as in distribution.

What might matter here is that both upstream and downstream stages are actively transforming rather than submitted to the unilateral dominance of one or the other. Second, this technology-oriented shift may offer an opportunity to move away from the doom of stranded investments in tailor-made but non-reusable technologies. The lab model (Dreamworks, Zoetrope) has shown some pioneering examples of such opportunity. At the same time, the conditions of creation of the work itself, the status of film as lab, as we have seen with various examples, are still much under the control of the directors. Coppola or Jackson as entrepreneurs, but also Cameron, Greenaway and Godard are good examples.

Within a complex value network and a capitalizing structure, some of the players are or will be able to achieve more commercial autonomy, extend their customer base to closer sectors such as the video games (Image Metrics) or broadcasting (Avid, Mc Guff, Massive, Weta) advertising (Buf, Ymagis), and also medical imagery (Image Metrics). These companies do stress the role of R&D even if its economic weight often remains difficult to assess.

The balance between the two dimensions is changing. In any case, what can be labelled as the "Avatar syndrome with 3D" shows that there is a possible virtuous path blending these dimensions: the coming of 3D brought market changes, allowed digital distribution to grow (UFO) and pushed theatres to get the necessary equipment, moving away from the catch 22 situation of both stages – the upstream and the downstream – expecting the other to invest first.

Finally, while customers are not all "techies" they are becoming more technology savvy, which is what the MPAA greeted while stating: "*If you love films, you love technology*". The future will show if on-line and mobile will fulfil their promises.

4. Entr'acte: A cross-comparison with the book publishing industry

In sharp contrast with the film industry, the book publishing sector provides a different example of the interactions with technology in the actual global transformation of an industry. It demonstrates the overall character of the ongoing transformations in the digital era and clearly illustrates how technological innovation and R & D take place simultaneously in several technical layers, following different paces.

A first phase of the research project on R&D in creative industries at the CRG, Ecole Polytechnique focused on the book publishing industry.[158] It is worth summing up these results as they enable to establish a challenging cross comparison with the situation of the cinema, examined in the previous chapter. One can now introduce some appraisal with the elements we went through.

4.1 A global transformation of the publishing industry

The book publishing industry has been always regarded as an essential element of the backbone of national/regional EU cultural identity. It is the oldest subsector of the media and content industries, and, in this context, is the only worldwide market where European companies are world leaders (Simon, de Prato, 2012). According to Lebert (2009), following the many changes that traditional publishing underwent since the 1970s, digital publishing became mainstream in 1997. New typesetting machines, desktop publishing and graphic art studios disrupted the traditional printing mechanism. Digital "on demand" printing and digitization also accelerated the publication process because publishers, designers and others could all work at the same time on the same book. Digital and traditional publishing became complementary.

The revolutionary aspects brought by the Internet and ICTs are impacting all the phases of the publishing value chain, notably changes in publication, distribution, sale and reading: the Internet, printing on demand and the e-book are the main drivers of change (see Table 11, for a view of the role of ICT). According to Hsieh et al. (2011: 206), the main e-book technology milestones can be identified as follows: content (information), composer (software necessary to create an e-book), container (the distribution medium and/or file format), storage, and access (the technology and software used to provide access to the content). With such various changes it is difficult to encompass all the characteristics of this revolution: some of them include the passage from physical to digital distribution, the zero marginal cost of producing an additional book, the emergence of new intermediaries, the many competitors entering this industry thanks to the digital technologies, and the problems linked to electronic security.

In this environment, publishers tend to take the role of content brokers and aggregators who cooperate with other actors (Jha et al., 2010). It changes the very notion of a book chain since the book is now an object resulting from new cooperation models of several actors (aggregators, distributors, technology providers…) with different professional specialisations. Moreover, with the emerging development of e-books and online distribution, printers, retailers and traditional distributors are in a weaker position. New aggregators and distributors are appearing. The e-book appeared as a simple file, downloadable on a computer like any PDF. From software supported by a shared infrastructure, its evolution led to a specific (proprietary) ecosystem. This independent mode of acquisition has been determined by the technological evolution of software as well as of hardware. In particular, the evolution of e-readers towards lighter and more compact models ushered in the creation of autonomous systems.

[158] It has been developed in the context of the French publishing sector, with the support of CNL (Centre National du Livre) and the French Ministry of Culture and Communications (Departement des Etudes, de la Prospective et de la Statistique), Paris: cf. Benghozi and Salvador (2013).

Table 11: The role of ICT in the publishing industry. The view from the FEP.

Authoring	Editorial	Production	Printing	Marketing	Distribution
Word Email	Word Virtual editing E-platforms and cooperative work tools Email Online iconographic archives Search engines	DTP XML Content management systems Digital archive mgmt ftp OCR Digitisation Ebooks Multimedia elements mgmt	Digital printing POD Professional printing Self-publishing	Websites Social media Blog Email Widget Search engine optimisation Podcast	Online bookstores Content aggregators Digital archive distribution Digital libraries Data mgmt and mining

Source: E Turrin, FEP (2014).

4.2 Conflicting pace of change

A first common factor should be emphasized in the dynamics of each sector. It follows from the paradoxical combination of swift repeated technological developments and very slow modes of implementation. According to the European Commission report (2005: 94), innovation in the publishing industry tends to be incremental (e.g. low-cost high-quality colour printing for books), rather than radical, such as the e-book or audio-book that aim to create entirely new markets. The Internet and ICTs have prompted publishers to develop and launch online products and services as the incentive is more and more intensified as ICTs are rapidly evolving. New initiatives like online platforms are fostering publishing industries to integrate into their offerings new content applications in the form of communication technologies and not only information or content technologies (European Commission, 2005).

In particular, formats and printing have been characterized by several technological revolutions in rapid succession (Cercone, 2009). While the relationship between printing and publishing houses has historically been very strong, publishers have become progressively autonomous in relation to printing and bookshop industries (Rouet, 2007). The publishing industry needs intangible investments, flexibility and customization, while the technical equipment required by graphic industries are always under the challenge of competition, modernisation and the need to work at full capacity. Publishers and printers are linked through a relationship of specialisation in terms of collections, formats, kinds of paper, and with the aim of reaching an optimum result of quality-costs-delays (Rouet, 2007; Gaymard, 2009). The digital revolution has had a later and less severe impact on the digital publishing sector compared to the music and cinema industries, where several changes happened in a brief time (Patino, 2008; Gaymard, 2009). Publishing has usually been a low growth business (Ronte, 2001), but in recent years the industry witnessed radical changes (OECD, 2012). Technology has had an unusual disruptive impact on publishing (Carreiro, 2010). But all these changes are happening under a slow revolution. The first attempts at introducing e-books failed because of their weight and cost (Patino, 2008). The main change happened when new materials were tested and implemented in new e-readers.

The book publishing sector has always been characterized by incremental innovations between large but competing publishers. The e-book introduction represented instead a radical innovation that fostered publishing houses to repel it in order to value the innovations they previously introduced. These innovations required huge investments and were meant to maintain the traditional value chain and its concentration of power, while the e-book seems to benefit more new

comers like Amazon, Apple and Google. A defensive strategy aimed therefore at gaining time for being able to optimally adapt to such a disruptive innovation like the e-book (Riot, 2013), focusing on cost reduction more than on product innovation. It is also necessary to compensate for the lack of competencies and technological expertise. Consequently, the deep weakness of the book sector might be that it has no immediate and obvious internal driver for change (EU, 2005).

4.3 The various loci of R&D

Economic changes in the e-book industry are clearly dominated by the technology: this not only improved performance and productivity, as it happens usually in manufacturing industries, but it redefined completely the market designs, the business models, the boundaries and the book industry components. The e-book diffusion fostered publishers to an increased attention towards appropriateness of R&D and technological innovation: the revolution in printing, formats, e-readers, tablets and PDAs, are at the origin of several changes in the publishers' strategy and new investments. As a consequence, publishers are defining and implementing technological strategies, focusing on some particular aspects. But all these strategies are depending on the new technologies' demand without a leading position of publishers. Thus, technological innovation and R&D in the book industry are constructed simultaneously at multiple levels of the value chain, mobilizing, specifically, various specialized players in the ecosystem.

The research attempted to reconstruct and map all the specific phases of the R&D value chain in the book publishing creative sector, allowing us to understand where the technological innovation actually takes place among the six main structural and technical layers of the industry (see Figure 20 for an illustration).[159] The method combines the value chain approach with the vertically integrated perspective usually used in the digital sectors. It gave us the possibility to portray a cartography of the value chain in the e-book publishing sector.

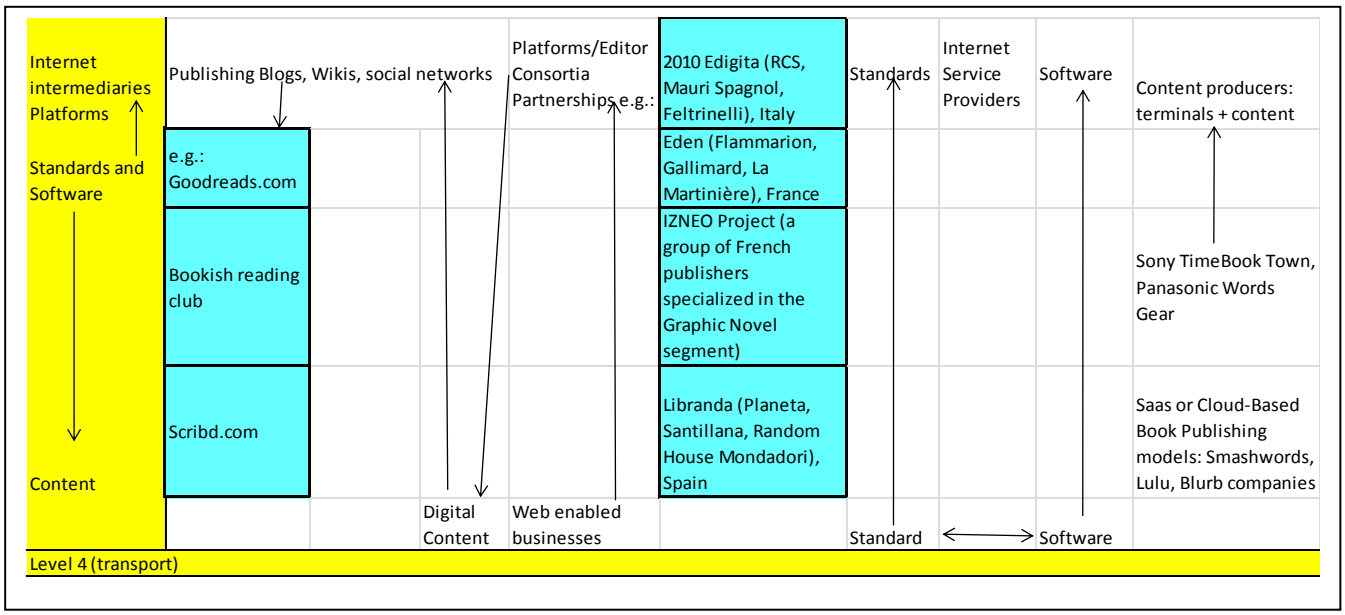
- Level 1 focused on the *operating systems standards*: the starting point is the introduction of e-ink technology and electronic paper displays (EPD) between the end of the 90s and the beginning of the 2000s.
- Level 2 focused on the *hardware and technology of terminals*: e-ink technology influenced digital printing and the emergence of the first tablets, e-book readers and personal digital assistants (PDAs). Several formats succeeded one after the other until their prominence at the international level of e-pub and pdf formats. Recent improvements are identifiable in the attempt at creating augmented books with additional properties like optical reader-embedded pen and audio-books.
- Level 3 focused on *standards and software*: blogs and social networks like Facebook and Twitter, and the diffusion of editors' platforms, consortia and partnerships are impacting and influencing the infrastructures and networks linked to the connection to consumers.
- *Architecture of infrastructures and networks* constituted level 4: print on demand (POD), digital aggregators, digital libraries, distribution platforms, are some key examples.
- Level 5 (*middleware*) focused on the tools structuring economic relations and exploitation rights like digital rights management (DRM) and digital object identifiers (DOI).
- Finally, Level 6 (user interfaces) identified the main work in progress like 3D e-books and environmental consequences of toxic substances for e-reader production.

More precisely, the description of the six layers enables to underline the following aspects. The e-ink's technology (Level 1) revolutionized the e-readers world. They became lighter, more compact, and easier to read with increased and/or more displayed screen sizes. They also improved the battery life and the capacity to hold more and more information with expandable memory (Level 2). In recent years the e-readers have succeeded one another without the dominance of one particular of them and are now competing with tablets and smartphones. Contrary to the music and film

[159] These six layers have been elaborated and adapted (Benghozi and Salvador, 2013: 14) from the classic Open Systems Interconnection (OSI) seven layers reference model (Zimmerman, 1980).

sectors, where supports have changed several times over the last decades, the book industry still cares for a secular reference model.

Figure 15: IT in the book sector – the example of standards and software.



Source: Benghozi and Salvador (2013)

In this context, publishers are investing on skills development for adapting their strategy to the e-book market needs: specific courses for acquiring competences are attended by internal staff. Furthermore, several platforms (Level 4) appeared on the market: these platforms are established in the form of a consortium among several publishers or they are managed by external actors playing the role of intermediaries.

Publishing houses are following the market needs without playing an effective role of leaders, merely using the several platforms and enterprises appeared on the market in recent years for distributing books through the Internet. They are also customers of companies that offer support in building standard formats like e-pub (Levels 2-3), they adopt tools like DRM or electronic watermark, but they are aware of the lack of strong support of tools structuring economic relations and exploitation rights and in particular those against piracy (Level 5). All this is happening through an imitation process among publishers rather than through an emulation process. This is also due to the heterogeneity of techniques and supply of e-readers, tablets and PDAs (Levels 2-3). As a consequence, publishers try to get the highest visibility for their brand and their books: they are looking for a link with social networks (Level 4), an application with I-Phone and I-Pad, a presence on all the main diffusion platforms. As a consequence, investments in R&D and innovation are not always linked to the creation of a real business model, but mostly to visibility. This means that the actual editorial strategy is focused more on maintaining the secular place and role of the publishers in the book value chain rather than really updating their role and functions to the new emerging, instable environment and changing cultural habits.

In order to maintain their place in the digital market, publishers focus on “trust” building in the relationship with distributors since they play a key role for the visibility of the catalogue on all the main important digital bookshops (Level 4). Several platforms specialised in technologies for digital publications are continuously appearing. This aspect is also linked to the growing importance of blogs and links with social networks like Facebook and Twitter (Level 4). It is interesting to highlight the emergence of a new strategy of building relationships with consumers-readers: the way of buying books is now personalised and readers are followed after having bought a book through their active involvement and interactions on the social networks. Books are now sold to buyers that are not anymore anonymous (Level 6). The evolution towards collaboration with social networks like

Facebook and Twitter is a means for knowing better readers' needs and habits and providing innovative reading experiences.

The relationship between publishers and Internet advertising for books (Level 5) is therefore another illustration of technological strategies. Publishers are well aware of the importance of the Internet in terms of promotion activities and marketing, but are hardly developing their own Internet website: they basically use it for providing information and communication and experimenting weak e-commerce initiatives.

Finally, some projects in progress focused on 3D e-books (Level 6), but they are so expensive and risky that it is difficult to find publishers willing to take this challenge. To that extent, as it was the case in the movie industry, the publishing sectors industry is more converging with the video game industry. In recent years, we observed – noticeably in comics of children books - the emergence of augmented and enhanced books supported by downloading files, book apps or streaming. Collaborations with game developers to create content that combines the strengths and appeal of the book various formats are on the way. And this evolution is a means for knowing better readers' needs and habits that are demanding ever more and more innovative reading experiences (OECD, 2012).

4.4 New competitors

The digital revolution of cultural industries is largely a revolution of the intermediation in its various components. 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 the technology is also the weight of intermediaries and economic actors supporting and supported by these technologies: Google, Amazon, Apple or other ISPs for example. Their importance is incommensurate with that of cultural actors and explains their ability to quickly build a place in the landscape of culture, using technological innovations to impose new economic models which strongly disturb the sectorial equilibria.

One of the main problems raised by the emerging role of actors like Amazon and other book platforms like Fnac in France (see Benghozi, Salvador, 2014b) is their capacity to collect large amounts of information to control consumers' relation and influence the readers' choice, thanks to automated prescription and recommendation substituting the experience of a physical bookseller. Moreover, according to Loebbecke et al. (2010: 55), Amazon introduced a radical innovation by changing its core design concept when it developed the Kindle reader (Benghozi, Salvador, 2014c). For the first time in the book market, hardware sales were being combined with content delivery: this business model has been proven to be successful in other major content markets such as music and software.

It raises a more general concern regarding publishers losing the control of their business to giants from outside the industry, like Amazon, Apple and Google (Guiry et al., 2012; Miller, 2013). While at the beginning publishers denied access to book files to actors like Amazon, eventually they were obliged to provide these files losing the power and the full control of the distribution channel. Moreover, the recent power struggle between Amazon and Hachette (for the amount of commissions paid on sales) shows that the centre of gravity of the industry is now clearly on the side of new digital platforms (see also Benghozi, Salvador, 2014b). Notwithstanding, the publishers' attitude towards these emerging giants is not proactive: a general lack of active initiatives and global programmes for counteracting these actors emerged from this sketchy landscape.

A lack of effective strategies?

Publishers conceive their strategy in order to adapt their content to the new digital demand and available devices rather than investing in the technological development and the design of the technology architecture (standards, devices, software). Moreover, the transformation process of a traditional publishing house into a digital one has not still been investigated in terms of evolution

and changes in the production chain and the editorial tools as well as the investment strategies adopted in the R&D (Benghozi and Salvador, 2013).

The research concludes that whatever the layer: "*Publishers are adapting their editorial strategy to the succeeding new digital demand needs, but they are not leading this evolving process with a convincing strategy*" (Benghozi and Salvador, 2013: 29), neither they are "*emerging as a pivotal factor*". In other words, despite the leading and continuing role of the publisher observed in the research, publishers do not appear to be in a command position to lead innovation. Especially as now these firms are confronted to huge IT companies that are innovation driven and organised accordingly.

To sum up, digital libraries, publishing-related community blogs, social media and social networking sites are emerging as key tools for attracting new clients and fostering the diffusion of e-books (Carreiro, 2010; Tian, Martin, 2010). Collaborative e-book distribution platforms created by a consortium of major publishers[160] and coproduction agreements among publishers and developers who specialized in the area of new technologies are other key tools (Mussinelli, 2010, 2011). In this context the effective role played by publishers and by their technological investments is not emerging as a pivotal factor. Publishers are adapting their editorial strategy to the succeeding new digital demand needs, but they are not leading this evolving process with a convincing strategy: a proof is that e-pub and pdf formats have not been a choice, but an imposition at the international level.

This raises questions about the durability of this fragile system and about who is taking the leadership role in the R&D developments and in the business model innovation process. Somehow, we observe a very similar phenomenon to the one we underlined for the movie industry, especially for the locus of innovation: a growing ecosystem of specialised technological companies (the new intermediaries providing e-readers, tables, ushering changes in format) emerges and supports publishers in the production of content.

[160] The European Commission is funding the Technology and Innovation for Smart Publishing (TISP) project to foster the meeting between publishing companies and ICT enterprises (see http://www.smartbook-tisp.eu/the-project). The TISP consortium will release recommendations by summer 2015.

5. Innovation policies for the digital age

The evolution of the creative industries development models and the changes brought by technology raise questions about how to (re)consider the role of public intervention in the area of culture. This chapter deals with policy issues triggered by these changes. Questions about the economic health and vitality of the European cinema industry, lead us to consider whether public intervention is justified. More broadly, are existing interventions at European or national level in line with the findings of this report? One may ask, in particular, whether support for creative projects - usual in the culture sector - should not give way to support for specialized technological suppliers - promoting the technological accumulation that is more common in industrial policies. It may be preferable to base policies for the creative industries on funding, tax credits, support to technology R & D, investments in infrastructure or support for the structuring of ecosystems, rather than supporting individual creative projects.

Another aspect of possible public action relates to the regulation of new forms of competition, particularly the issue of access as summed up by the notion of net neutrality. This question does not emerge directly from the dynamics of the cinema. However, it surfaces in the growing links between the creative industries and digital players (OTTs or ISPs). In fact, these growing links are accompanied by the prioritization of content and the particular recommendations that can be made by some platforms as part of their services[161] (e.g. SVOD) to their end customers. New relationships between new players and legacy players are enacted through three contradictory but also mutually reinforcing trends. The first is characterized by the dominance of new players in the distribution/exhibition stage (downstream domination). The second is related to the technological innovation generated by new forms of collaboration between the cinema industry and specialized technology providers at production stage, enacted by new intermediaries (upstream domination). The third is the shift of media consumption from push to pull creating a tension between the logic of prototype (a film) firmly rooted in this industry and the growing momentum for a logic of demand.

5.1 Issue 1: How to deal with powerful new intermediaries?

Some of the challenges these industries have been facing originate from the rise of powerful new intermediaries (see Box 22: the economic power of new distributors and Annex 6 for their market cap). The cultural industries' digital revolution is largely one of intermediation in its various forms. New players emerge and offer unprecedented solutions for aggregating and distributing content. They design original ways of marketing and transacting which are adapted to this new framework (free subscriptions, micro-payments). In the broader TMT perspective, technological intermediaries and economic actors, supporting and supported by technologies such as Google, Amazon, Apple or other ISPs, dominate. The economic importance of these companies is much greater than that of cultural actors and explains their ability to quickly build their space in the cultural landscape, using technological innovations that impose new economic models and upset the sectorial equilibrium. Also, these newcomers are more agile at identifying opportunities in a new environment which they themselves have largely created. This may mean that innovation is often left to these challengers, which radically disrupt the traditional industry. The study of the cinema industry sheds some light on this hypothesis.

[161] See Box 23 for more explanations.

Box 22: The economic power of new distributors

Sales of the new distributors (cf. Amazon, Apple) have exploded. Amazon has been one of the fastest growing IT companies since its foundation in 1995. Technology companies dominated the "Financial Times top 10 of global brands" in 2014 (www.ft.reports.com/reports, 2014) in the following order: Google n°1, Apple n°2, IBM n°3, Microsoft n°4); The highest-ranking content companies to appear in the Financial Times list are a Chinese video games company, Tencent (n°14), and Disney (n° 23). In 2014, Comcast was the highest-ranking content company to appear in the Forbes global ranking of companies (56th), Disney ranked 108th (Forbes 2014, www.forbes.com/pictures/mgl45fkfj/icbc-2/).

Amazon had net sales of US $74.45 billion in 2013, US $61 billion in 2012 (Annual Report 2013: p.16, up from 19 billion only in 2008) while publishers' total revenue from sales of books in the EU for 2012 was around €22 billion. In 2013, Apple had net sales of US $170.9 billion (Annual Report 2013: p.24, up from 37 billion in 2008). Apple ranks 15th in the Forbes Global 2000 list, but 1st for its market cap.[162] Universal Music Group's revenues for 2012 were €4.5 billion. These revenues include those of EMI Recorded Music, (consolidated since 28 September 2012 - Annual Report 2012) making it the largest music label. However, they are worth only the equivalent of the amount Apple invested in R&D: US $4.5 billion in 2013.

The valuation of their brands follows the same pattern: Apple's brand value is US $105 billion - more than the cost of the Apollo Space Program in today's dollars, followed by Google (US $68.6 billion) and Microsoft (US $62.8 billion).

Source: Companies Annual Reports, Forbes 2014 (www.forbes.com/global2000/list/), Brand Finance US 500 (www.brandfinance.com/news/press_releases/telecoms-brand-value-study-highlights-tussle-with-tech-firms)

Around the world, the balance of power has shifted downstream towards the distribution side, away from the upstream, or the "production" side of the media and content industries. In other words, there has been a collision between the economics of production of cultural goods and prototypes and the economics of distribution of digital goods and services. This move towards a greater control of the downstream is a feature of more mature markets, where marketing/distribution is taking backwards control of production (engineers, artists) (De Prato et al, 2014a). However, as the cinema case has shown, this does not stop the production segment from coming up with new options, to innovate in its own right and seize the opportunities brought by technology.

5.2 Issue 2: Competition issues and platforms

There has been heated debate about the power struggle between content providers and distributors, and about abuse by the latter of their dominant position. This debate resurfaced with the recent conflicts between Amazon and Disney,[163] and Amazon and Hachette. In the summer of 2014, the eCommerce giant halted pre-orders of titles (both books and films). In May 2014, a group of media companies,[164] the Open Internet Project (OIP) filed a competition complaint to the European Commission for it to assess and tackle new anti-competitive conduct by Google. The EC is already trying to curb some dominant positions (Google case, Microsoft earlier), but other policies may be needed to police competition and maintain transparency. "Net neutrality" was among the legislative instruments created to that end.

The development of the Internet made a range of alternative models possible through innovations and flexibility of ICT. The emergence - for the analogous offering of goods and services - of radically different business models disrupts the very conditions of competition. The consequences are a very fast pace of innovation and an intensely competitive environment (open technologies and low entry costs encourage entrepreneurs of all types and make it difficult to gain a competitive

[162] See the ranking of the largest markets caps in Annex 6.

[163] « *The latest to feel the Seattle retailer's sting is Walt Disney Co. Amazon isn't accepting pre-orders of forthcoming Disney DVD and Blu-ray titles including "Captain America: The Winter Soldier" and "Maleficent."* ». *Source*: http://online.wsj.com/articles/dispute-erupts-between-amazon-disney-1407714711

[164] Among which Lagardère, Bertelsman. See : www.openinternetproject.net/

advantage over time). On the content side, the hardware and software can be combined to design services of any kind and make content available almost instantly worldwide. From an economic perspective, these innovations call for the coupling between a high level of sunk costs and marginal costs close to zero, a common feature of all infrastructure networks.

Increasing demand for creativity, R&D and technological integration have to build on partnerships and industrial ecosystems, as we noted with the study of alliances (Chapter 2). Powerful actors are associated with these technological changes. The competition does not arise simply between peers, which differentiate themselves by their product/services and by mobilizing their strategic resources (innovation, quality and organization of production). It switches from competition between economic players to competition between geographical clusters or industrial consortia (IOS v. Android e.g.). Platforms therefore play a growing role in markets, and have a stronger effect on the costs and the pace of innovation. Innovations can emerge easily and quickly on an interoperable "open" framework, which facilitates initiatives from different origins (services, applications ...), while others (infrastructure) require cost, development time and greater investments.

However, industrial developments are hampered by the uncertain and risky nature of the technological innovations that may arise at different stages of the value chain. Indeed, music services can be developed by major labels, content retailers, radios and media, terminal manufacturers or portals aggregators. This technological structure directly affects the regulatory structuring of public action. In this perspective, the digital infrastructure is frequently described as being based on a multi-layered architecture: it requires the existence of well-defined boundaries between layers, and the possibility for each layer, for a fair and open competition between actors (see Benghozi et al, 1996). Many authors therefore argue that the Internet should be regulated "by layers", respecting the integrity of each technical layer. The basic idea behind this principle of layer neutrality – further suggesting "*net neutrality*" (see Box 23 for a brief history of the notion) - is to prevent cross domination between layers allowing the otherwise non-discriminatory treatment of content circulating on the lower layers.[165]

Vertical integration strategies and breakthrough innovations challenge this model that has traditionally been used as the basis for economic analysis.[166] They stimulate organization schemes and market initiatives that make the boundaries between technical layers increasingly porous and less separable. This is accompanied by deep changes in competition which can now take place from one layer to another: the VoD or TV offering proposed by an ISP such as Orange competes with those of OTT players like Netflix, or OEMs like Apple (iTunes), or those of producers like Universal, broadcasters like Canal+ and retailers like Fnac. Consequently, large companies rarely position themselves on one layer: they distribute value and investment on different layers. How can we determine whether Google's large investments in R&D are actually dedicated to storage infrastructure, the applications for users or the development of content sites like YouTube?

5.3 Issue 3: Net neutrality and investments strategies

The Open Internet Project claims that its main objective is to achieve neutrality on the Internet. The dynamic technological convergence challenges the traditional perspectives of the creative industries. Infrastructure is usually seen as more structured than content and as requiring more investment, while innovation in services and contents emerges from usages and users' experience.

[165] See Lessig (1999), in particular.
[166] Cf. Fransman, (2010).

Box 23: Background of the notion of Net Neutrality

It is usually acknowledged that "*net neutrality*" means different things to different people. As Marsden (2009: 24) puts it: " *'net neutrality' is a deceptively simple phrase hiding a multitude of meanings*".[167] This "*fuzzy*" notion originated in a US debate over the policies to be applied to broadband access networks, which are typically licensed and regulated at the national or even the state and local levels. This debate on how to regulate so as to keep the Internet "*open*" was triggered by the deregulation of broadband that was achieved with the FCC 5 August, 2005 decision on Broadband Internet Access Services (Simon, 2010). Some players feared that this landmark decision to deregulate may well jeopardize the future growth of the Internet and lobbied for some protective measures.

This subject was brought up in Wu (2003, 2007), and has since become a major academic discussion with significant policy impact. It is essentially an argument about the open Internet and the possibility for finely detailed charging for higher speed content—mainly video (Yoo, 2010). It has elements of intermediary liability, as the ISPs will have to inspect content more closely to decide whether it is permitted (Marsden 2009). From a technical viewpoint, more recently the wording "*managed services*" was used to deal with this issue. This covers the importance of network management (e.g.; specialized IP routing, packet differentiation, filtering, and content caching…) to prevent congestion and preserve quality of service. New technologies (e.g. cloud computing) will require new network-level traffic management techniques. It is usually agreed that differentiation is needed to better support heterogeneous applications (like voice, video and data for instance).

The Commission's position has been very cautious from the beginning. It takes the view that the EU 2009 regulatory framework was sufficient to prevent any abuse (no deregulation of broadband, strong non-discrimination principle) and that further legislation was not required.[168] EU regulators (BEREC) appeared to share this view, stressing that in the EU most problems encountered so far have been resolved by informal means, with the occasional intervention by the regulator.

However, the landscape in the EU changed after some initiatives from Member States that contributed to pushing the issue higher on the EC agenda. In June 2011, the Netherlands issued a law to protect the net neutrality principle and hence became the first market in Europe with a legal framework of this kind, raising the issue of the fragmentation of legislation across the EU. Later that same year, Finland introduced a constitutional right to Internet access, a right however that remains vague about the real obligations concerning net neutrality. In Norway, the regulator created non-binding principles on net neutrality (van Eijk 2011). In April 2014, the European Parliament voted in favour of net neutrality, adopting the "Connected Continent" telecoms Regulation proposed by the Commission in September 2013, following the conclusions of the 2013 Spring European Council. Arguing that there are no clear rules on net neutrality today at EU level, the Commission has shifted away from its historic, rather "hands off", position to introduce a guarantee of "net neutrality" in the proposed legislation. Kroes (2014) summed up the new position stating that: "*Net neutrality is non-discrimination online*", adding "*Open, fair and transparent. With strict safeguards and enforcement powers*". This may be understood as a way to address the more complex ecosystem we are facing.

Source: authors

Until now, the history of creative industries has mainly been about the ability of technology suppliers to step into the value chain: let us just think of Philips, Sony, RCA or Marconi. However, the technology suppliers left the value chain largely unchanged: they sought primarily to provide contents for the technologies they offered and created, thus, alternative content producers emerged (Sony Music or Polydor). The present situation, in a networked economy, is significantly different. New entrants are no longer simply looking for vertical integration; instead they try to design the entire industrial architecture supporting the production of goods and services, as illustrated paradigmatically by the Apple i-phone case. Controlling consumer access to content through digital

[167] Open Internet may be a better wording.

[168] EU 2009 regulatory framework (*Universal Service Directive*): "*NRAs will be allowed to set quality of service parameters on public communications network providers to prevent degradation of service or the slowing down of traffic across networks. In addition, consumers must be informed – before signing a contract – about the nature of the service to which they subscribe, including traffic management techniques and their impact on service quality, as well as any other limitations*".

platforms is at the heart of these firms' industrial strategies. The platforms create technical bottlenecks at the interface between legacy content industries and technological infrastructure and are the preferred means to dominate the market.

Such technological dynamics are potential levers of an explosion of the content market because they reconstitute the partitioning of distribution channels that recent technological convergence had helped integrate: it structures distinct integrated channels (from terminal to software) similar to those that can be found in the video game (consoles, mobile, PC). The radical nature of current innovation processes, from a global perspective, should lead to overcome old R&D perceptions, for example the gap between incremental innovations or rupture. Different types of innovation (which we assessed especially in the case of film) are not juxtaposed but are substitute in modular arrangements. This modularity and the centrality of innovation have an impact on investment strategies: the pace of technological change in networks and content requires massive investments to deploy the necessary infrastructure and appropriate content production.

Benghozi et al. (2009) argue that this is a new challenge for the public actors in charge of creative industries. The network economy and the content economy have different objectives and modes of regulation, with different economic features (see Chapter 1). Sometimes, the two are contradictory.[169] On the one hand, operators' incentives to invest in increasing network capacity are related to anticipated demand for services and content. On the other hand, content providers consider it necessary to increase capacity regardless of current demand as they believe available capacity will always find takers.[170] Therefore, the question arises: who takes the technology investment risk and how is it compensated? In other words, can the marketing of contents be an efficient revenue model to fund innovations in digital networks? However, regulation has always had a supply perspective: it focuses on how economic actors downstream can have access to resources made upstream. The issue of the sharing of risk investment in the value chain calls for a reversal of perspective in order to finance significant risks associated with technological breakthrough innovations.

5.4 Issue 4: Financing content: treating like as like?

The fact that dominance has shifted from production to distribution raises new issues, and brings new challenges not only for the legacy players but also for policy makers who have to review their existing policies to assess their effectiveness in a changed environment. Policy makers often end up being fired at from all sides. On the one hand, legacy players tend to argue that despite the changes, the policies (often designed to protect them or even fund them) remain valid as the basics of film production did not change that much. On the other hand, newcomers claim that changed circumstances require changed rules. Newcomers and legacy players are in dispute at present. The latter (be they legacy content providers or infrastructure providers) argue that the former (newcomers, now called OTTs) are not taking their fair share of the load, are benefiting from both content and infrastructure without making the contribution due, and are siphoning off audiences and revenues. The new players are certainly disrupting legacy business models and displacing revenues, bringing former cross-subsidy models to an end. However, the benefits that have been attributed to OTTs seem a bit more difficult to establish. Some experts remain sceptical: F Filloud stresses that most news web sites enjoy a boost in their traffic thanks to Google Search and Google News. His blog quotes an executive from Google who states: "*News media should not forget that we don't need them to thrive…*" (Filloud, 2014c).

French policy makers, for example, have continued to take the traditional approach – i.e. "the funding of creation" and have tried to extend the existing mechanisms to new channels – e.g. they have implemented a tax similar to the TSA on ISPs.[171] Some other EU Member States have

[169] Especially as there is often a discrepancy between competition on the one hand and protection of creation (technical or artistic) on the other, as illustrated by the economic debate about IPRs.

[170] C.f. the present development of next generation networks such as 4G or FTTH.

[171] 3% of the revenues derived from this channel of distribution.

mandated or plan to mandate financial contributions when these players distribute or 'package' audio-visual works (ISPs, mobile operators, etc.). The principle adopted in France was that 'each company making money from the use of work should contribute to the funding of the creation'. Other EU regulators agree with this principle[172]. The Media Forum set up by the EC in 2011 came up with some related principles to "*adapt financial support for audio-visual creation*" (solution 4) and "*to treat like as like*" (solution 5) mostly in the latter case for regulation and tax issues[173] [174] (Forum Executive Summary, 2012).

The Salmon report for the Forum d' Avignon came up with recommendations in line with these approaches to "*involve new players in financing creation*" (Salmon 2013: recommendation 3: 50), suggesting the usual approaches of both the introduction of a tax on connected equipment in the wake of the French Lescure report (Lescure, 2013), commissioned by the French government, and mandating obligations "*consistent with their influence*".

This principle sounds nice and (almost) fair, but it leaves open the much trickier question of how to implement it. This would require some robust evidence and a clear basis to quantify the contribution, to define the "influence" and even the "consistency", as most of the revenues derived from content are indirect revenues (advertising) and not from direct sales to customers. Indeed, the case is far more complex, as we are facing sophisticated multisided markets. Needless to add, these approaches distort the market and would need a thorough case by case analysis to prevent any unexpected consequences. The Salmon report acknowledged that "*current funding arrangements penalise the emergence of international structures"* (Salmon, 2012: 50). The report pleads rightly for more coordination at the EU level, but also for "*rebalancing power*" (Salmon, 2012: 51) which without the legal and regulatory teeth requested at the EU level, may amount to wishful thinking.

However, this approach may again miss the point in a digital environment. We stated earlier in this report that the situation of the French technical industries could be explained, at least partly, by a weak ecosystem for these technical industries, a missing linkage. The French "self" funding system actually includes technological backing to modernize theatres and limited support to post production technological companies: but – comparatively – this amounts to very little. The report for the centre National du Cinema (CNC) (Lepers and Portugal, 2013), blamed the "commoditization" of this subsector, which may be another way of blaming the lack of symbiosis within the French cinema ecosystem. In addition, the new digital environment is now jeopardizing the territorial basis of this funding system, based on the collection of the tax (TSA) by the national movie theatres, with the growth of alternative distribution channels and services provided by suppliers located outside the French territory or even outside the EU.

What is striking in the French cinema case, taking into account the gloomy situation in which its technical industries are now, beyond the few examples we spotted, is that the funding system developed over decades was often presented as a model, a "virtuous system" (Frodon, 2012). The system can be seen as obligatory savings monitored by the French administration through a public body, the Centre National du Cinema (CNC). This entity collects money from the box office through a tax (TSA) that is added to the price of the ticket, and then re-allocates the funds to production and also distribution, but to a lesser extent. Recently, there has been some controversy over the quasi-

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[172] For of review of the funding policies in some EU countries (Germany, France, Spain, Italy), of national and European film support, see Wutz & Perez (2014: 93-107).

[173] The EU Media Futures Forum was established in December 2011, it was composed of 28 individuals from newspaper and news media publishing to the audio-visual sector, technology companies and social networks.
http://ec.europa.eu/information_society/media_taskforce/doc/pluralism/forum/exec_sum.pdf

[174] Here "tax issues" relates to the different rates applied to physical object and digital ones, like VAT for instance. It does not deal with the issue of tax avoidance as stressed by policy makers or "tax optimization" as called by the industry.

rent the system allowed some leading actors to extract.[175] A well-known unintended consequence of this system is that it has driven an overproduction of films (Bonnell, 2011), or as Bonnell puts it more recently "*an excess of supply facing a lack of capacity of absorption from the demand side*" (Bonnell, 2014). The system was meant to fund supply, as the emphasis of public policies was to increase the level of financing (Frodon, 2012). Overproduction especially in the case of some nearly automatic funding is also a strategy to minimize risk in a prototype industry, trying to optimize the output, like portfolio management or the increasing dominance of sequels in the case of the US film industry.

Taking into account these tensions and the dilemma about the funding side, the new environment may benefit from going beyond the policy of "silo" financing (partitioning the financial support for each sub sector of creative industries) that has been dominant so far. Appropriate ways to finance risk should be sought from a more global viewpoint within the global ecosystem. However, despite the apparent conflicts between legacy players and the new intermediaries, one should recognize the positive role played by the latter. Setting barriers to their entry, thus hindering innovation, should be avoided, but at the same time a competitive environment should be maintained. As noted by Pew Internet report (2014), digital players have exploded onto the news scene, bringing technological knowhow and new money and luring top talents. The statement made by the president of Alibaba's digital entertainment business group - "*The influence of Internet innovation on the culture industry is no longer restricted to movie ticket sales, but has expanded to investment and content production*," (quoted by Frater, 2015) – comes as no surprise.

[175] See a summary in the 2013 Bonnell report: 182 and in Sthehlé, A. (2015). See also the critique coming from the French Government Body, Cour des Comptes (2014, 14), stressing "necessary changes", or Mesterlin (2015) claiming " *that while subsidies have massively increased—by 30 to 40 to more than 70 percent—since 2000, the attractiveness of French culture has been stagnant (cinema) or declining (TV) in France itself*" (p.23).

6. Conclusion: new relations within an extended ecosystem

This report investigates the way disruptive technologies are challenging the equilibrium and the business models of creative industries. Though the digitalisation of these industries has been the subject of a renewed interest in recent years, how they appropriate digital technologies remains understudied. This question is all the more important as in the digital age, most of the observed changes seem to be driven by actors outside the creative industries, while the traditional players of the industry are investing less in R&D and technology.

The evidence collected allows us to make several observations. Firstly, we describe the technological innovation models at work: who does what and how. Secondly, we show how the digital transformation may also be affecting the structure of the industry. Thirdly, we identify the main lines of tension that structure this transformation.

6.1 Main observations: innovation models and their impacts

Disruptive vs incremental innovation models: the role of IT companies

A cross comparison of several creative industries shows that young technological companies are strongly challenging legacy publishers with disruptive proposals – original products, online and mobile channels of distribution, experimental business models, social media, data analytics, etc. These young companies have real capacity to monetize these proposals by accessing a massive and global audience (Spotify, Rovio, Vice). They offer unprecedented solutions for aggregating and distributing content, designing original ways of marketing and new types of transactions (free subscriptions, micro-payments, premium services, etc.). In the broader TMT perspective, technological intermediaries and economic actors supporting and supported by technologies, such as Google, Amazon, Apple or other ISPs, dominate. This may mean that innovation is largely left to these challengers, who may radically disrupt the traditional industry.

The study of the cinema industry sheds some additional light. In addition to the disruptive changes at distribution level in most content industries, incremental technological innovation in the cinema industry has been facilitated by original models of innovation at production level. These are usually poorly documented in the literature but interesting to highlight. They are based on particular forms of collaboration, which are formalized through the decisive role of new intermediaries (firms or individuals). These new players, usually specialized technological suppliers (STS), are building their position by using their expertise to serve the creative dimension of cultural works. New mediations are emerging, which can even be made the explicit responsibility of a new role - a Supervising Technical Director, who liaises between the core film team and the technical IT crews.

Several case studies in our study show the growing role played by these specialized technology companies. The specific analysis of some companies and “iconic” clusters illustrates their place and role in the economy of the sector: the nature of the collaboration at different levels of the value chain (from the production stage to the exhibition stage in theatres), the strategy to capitalize on competitive resources from mastering technologies (equipment, patents and know-how), the investment economy (risk sharing and allocation of the created value), the convergence with nearby sectors, such as Videogames, thanks to multimedia developments and online distribution and the expansion towards other sectors of the economy such as the health sector.

These new specialized technological suppliers (STS) are medium-sized companies. They have mastered ICT skills overall but are active and specialized in only a small number of technical areas. Their growth model places particular emphasis on specific operations - rather unusual in the cinema industry – such as the management of assets, patenting, and the innovative technological spill-over to other industries.

The changing structure of the industry

Innovation models, brought in by these industrial technology intermediaries seem to offer an opportunity for change in the cinema sector's culture. The industry model is evolving from being "project-based" (concentrated on the production of the movie - its core model since the 40s), to being "business-based". In the latter model, R&D and technological accumulation takes place via technology companies, though these are mainly financed by the film production budget.

Also, technological innovation in the production stage in a "business-based model" rebalances internal relations within the sector. It redefines the competitive conditions, reorganizes value chains, and challenges the domination (mainly by large IT companies) of the distribution networks for the benefit of stakeholders in the production stage (the content producers). What may matter here is that both upstream and downstream stages are actively transforming themselves rather than being submitted to the unilateral dominance of one or the other. Second, this technology-oriented shift may offer a move away from stranded investments in tailor-made but non-reusable technologies.

Also, because of the fast-changing technological environment, the balance between the two complementary conceptions of the industry – technological innovation and artistic creation - are evolving toward a more technology-oriented vision, both in production and in distribution.

Tensions in the ecosystem between upstream, downstream and demand

The study highlights several tensions that structure the future organization of the industry.

On the one hand, ICT industry newcomers have brought a disruptive innovation model. They are introducing and mandating their own standards and business culture and in terms of film distribution, they are replacing the incumbents and imposing their rules on content producers. These IT companies are using technological resources in original ways - completely differently from the traditional content industries. Instead of merely enhancing the legacy content production process, user interfaces or distribution channels, they are building their strategy around their activities and ICT-enabled services.

On the other hand, an incremental innovation model has emerged. Specialized ICT industry suppliers are building mutually-beneficial collaborative relationships with the cinema industry at the production stage, promoting a relationship based on "Art meets Science". This could even shift the film industry from a project-based approach to a more stable business logic, as already discussed above.

The discrepancy between upstream and downstream is perhaps even more complex than it seems. In fact, new distributors are slipping gradually into the shoes of producers (e.g. Netflix, and Amazon most recently), and producers are succeeding in imposing innovative technology on the distributors (3D).

In addition, the relationship between production and distribution is challenged by the growing value given by the organization of demand and the structuring of consumer contributions. Indeed, these new configurations are also based on new technologies (recommendation algorithm, home studio) and new tools, which support crowd management (social networks, crowdsourcing process, crowdfunding). These tools interact with the three historical streams (production, distribution, exhibition)[176] of the cinema industry. In this new environment, demand is crucial and IT companies are better equipped to deal with it.

New relationships between new players and legacy players are enacted through these different trends, which are contradictory but also mutually reinforcing. Firstly, new forms of dominance have been brought in by the new players at the distribution/exhibition stage (downstream domination). Secondly, technological innovation has been generated by new forms of collaboration between the cinema industry and specialized technology providers at the production stage, (upstream

[176] See Section 3.1.

domination). Thirdly, there has been a shift in media consumption from push to pull, which creates a tension between the logic of prototype (a film) firmly rooted in this industry and the growing momentum for a logic of demand.

These tensions have led us to redefine the opening question of the analysis. We no longer simply question the technological strategy or R&D in creative industries, we now focus on debating the effectiveness and consistency of technological policies or approaches implemented by economic players active in the cinema sector.

6.2 Three trumps in the game

The growing role of R&D and technology

From the beginning, this report has raised the question of the role of R&D – or rather its absence – in technological innovation in the cinema industry and across most creative industries.

The investigation shows that R&D expenditures are highly unevenly distributed within the TMT ecosystem: R&D is done primarily by equipment and service providers and IT companies, technology providers being the most R&D intensive players. In sharp contrast, the level of expenditures of the content sector, at least of the large firms that can be traced, remains very low.

The report shows as well that being a prototype industry, films are project-driven, implying the cooperation of the different players of the value chain within a "rather large village". Being a project-driven prototype industry also means that the focus is on creation during a single, non-reproducible experience, tilted toward the "artistic" dimension and therefore quite different from an R&D based innovation model. However, with digitization, combined with the growing related role of software and computer science during pre-production ("previs"), production (comprehensive computer based film editing systems) and post-production ("VFX"), these relationships may also evolve in a more profound qualitative way. No wonder that Livingstone and Hope (2011: 18) forecast that the growth will be lead in the UK by the video games and visual effects industries, "where creativity meets high-tech" as they put it, or as DreamWorks sums it up: "where arts meet technology".

These "encounters of the Third Kind" create new spaces of cooperation and coordination in the film production stream, with new intermediaries, like the "Supervisory Technical Director" who works within the company, and liaises with the core film team.[177] In other words, the development of "proprietary" software tools is conducted in constant collaboration and under artistic guidance. At the same time, this symbiosis seems to show ways to move beyond one of the weaknesses of film as a prototype – i.e. not being able to capitalize on some of the technical achievements of the film. As just stressed, there is a tension between two visions of cinema, the technical one and the "artistic" one: new technologies may contribute to reconciling the two or to further widening the gulf. Obviously, strong cooperation happened before, on technical or on aesthetic matters. For the former, Kubrick's "2001: A Space Odyssey" would be an obvious example as it employed a director and visual effects supervisor (Douglas Trumbull). However, without going into the details of the making of this iconic science-fiction film, the commitments required from the technical party, however demanding, were not on the same level as those to be found now.[178] The former model of aesthetic cooperation between, for instance, film-makers and set-designers is well known in the literature devoted to cinema.[179] At the time, it more or less boiled down to an "encounter" between two artists - simply a craftsmen's arrangement. It was not some kind of industrial project management between several entities, some of them running R&D departments of their own, filing patents (Akamai, Avid, Image Metrics, Trumbull Com.) in several areas linked to computing.

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[177] E.g.: In the cooperation between director Cameron, computer-scientist Debevec, and visual effects firm Weta, some sort of symbiosis took place.

[178] E.g.: Jackson, co-founder of Weta, needed to animate armies of hundreds of thousands of soldiers.

[179] E.g.: Orson Welles for "The trial" and Fritz Lang's "Metropolis".

Nowadays, these highly specialized high-tech firms undertake product development and product innovation on behalf of clients, as described by Green & al (2007: 48), which is more like formalized R&D. The growing importance of R&D may bring the cinema industry closer to more standard forms of innovation, built on the accumulation of R&D and the ability to re-use/reproduce the same innovation for other projects. This leads companies, as just explained, to file patents in ever more distant fields: e.g. optical imagery for Image Metrics, attraction park devices for Trumbull Com.

Digitization has enabled the technical sub-segment of the cinema industry, previously seen as the weak link in the value chain, to flourish anew in the UK and New Zealand, and new start-ups have proliferated due to the declining cost of complex production tools (special effects). It became the research branch of the film industry, guided by the artistic brief but going beyond the part it used to play in the project management of a film, and beyond the film as a single but ephemeral lab. This involves significant R&D expenditures, as can be seen from the data gathered. This pivotal role was anticipated in the 70s by pioneers like Trumbull who founded their own companies, Entertainment Effects Group and Future General Corporation, with the financial support of large studios like Paramount and MGM. American Zoetrope created its own enabling ecosystem, just like Netflix did around its connected device.

The case of the French cinema industry tells a different story. The lack of symbiosis between filmmakers and technical industries may offer an explanation for the difficulties the sub-sector is facing, with leading firms on the verge of bankruptcy. This may turn out to be a horizontal linkage weakness, as investing in a new technology for a film without monitoring the potential technology spin-off or by-products may create stranded assets. The leading firms from the UK or New Zealand appear to have been able to overcome this hindrance. The re-birth of this segment in Britain is especially interesting since British cinema almost disappeared in the 50s, when the leading film company, Rank, decided to exit the film business and enter the IT business (at that time, largely concerned with copying machines) to become Rank Xerox. Digitization is bringing this industry back to life, and the cases we have reviewed seem to show growth that is based on a market approach rather than on public subsidies or public management of the funds, like in the French case.

The reconfiguration of the business ecosystem

In the creative industries, legacy players seem reluctant to embrace the changes, a reaction often linked to the weight of their legacy business models even though their revenues are declining (newspapers). As seen in the cases of book publishing, cinema, the music industry and the newspaper industry described in this report, legacy players often held conservative views. They believed that the Internet should be used to develop their existing business models rather than to radically change them. Despite the fact that historically each new technology did bring new streams or revenues (broadcasting, cable, pay TV, DVD…), they failed to understand the opportunities that were opening up. Because of the initial conservative stance taken by mainstream industry, it is logical that innovation should come from challengers, mavericks and marginals.[180] This almost "catch 22" situation has been described as highly uncomfortable "Tarzan economics"[181] for incumbents.

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[180] Beauvialla and Coppola seem keen at adopting such attitude to stress their originality. In its website, Zoetrope carefully selects language like "deviant", "defied industry standards", "unconventional filmmaking techniques", "alternative and exceptional filmmaking strategies", stressing by contrast the conservatism of the mainstream film industry. Of course, one stays aware of such rhetoric of self-promotion. However it does point at the role of these challengers vis-à-vis the sectorial majors, even if they do have working relationships within the ecosystem. Indeed, it seems hard to treat the director of the "Godfather" or Peter Jackson, the director of "The Lord of the Rings" trilogy as "indies". See Chapter 4.

[181] Jeremy Silver (2013: 60) described the notion of Tarzan economics: '*My business model is hanging from this tree and I'm hanging onto it like mad but I've got to get through this jungle. In order to get through this jungle I'm going to have to move to another economic model, which apparently is one of those lianas over there that's hanging from one of those trees. I don't know which one it is so I'm going to hang onto the one I'm hanging onto for as long as possible until I can make sure that the one over there is actually*

Meanwhile, as this report shows, the industry is witnessing the emergence of a new digital ecosystem and a new allocation of tasks, centered around the important role played by the computing and software activities of the new intermediaries. Smaller or independent sector players seize the opportunity to achieve more competitive positions in the value network. They develop new forms of cooperation. Such specific industrial partnerships may be conceived not in the traditional sense, but rather as a set of industrial relations of "networked collaborators" within an ecosystem (see Figure 4: the new media value chain).[182] As emphasized by Benghozi and Salvador (2014: 3) "*a new vision of partnerships and innovative forms of contract need to be applied for supplying a process involving research-based firms, with specific characteristics and needs, and where partners emerge usually ex-post.*" This is the case nowadays in the various sectors of the creative industries. As a consequence, technological strategic partnerships cannot simply be as relations with identified industrial partners, they must also be conceived through the re-arrangement of the business ecosystem. This reshuffling of roles has historical antecedents in the 30s when new technologies allowed challengers to enter (Warner Bros. and Fox with sound systems).

The successful cases of Akamai, Avid, Weta, Double Negative, UFO Moviez, together with Ymagis, Rovio and YouTube have also been characterized by their global approach since their inception. Likewise, the comparison between India's two clusters, Bollywood and Bangalore, highlights the role of connectivity within global networks, and has been confirmed by other studies (De Prato and Nepelski, 2013, 2014; De Prato and Simon, 2014). Globalization is not new to the cinema industry that has served a global market since its inception. At the turn of the 19th century, the leading cinema companies were French (Gaumont, Lumière), before Hollywood took over. Now India is the world largest film producer with innovative ICT companies (Prime Focus, UFO Moviez). Digitization is modifying the scope and pace of the globalization process.

Developing movies is a structured and managed activity, bringing different kinds of resources together and working under some project management approach. There are specific opportunities to innovate but these are difficult to capitalize due to the lack of financial resources and continuity of an industrial process that only bigger companies can monitor.[183] The CIRAC report (2003: 29) emphasized the tension in creative industries between a "project team" model and an "enterprise" model, and showed optimism about the development of a "creative enterprise" model, blending the two. Today's intermediaries indicate some potential routes to that end that may make it possible to mix short-term projects and long-term sustainability.

As emphasized again with the case of book publishing, adapting to the digital age may require legacy players to develop more proactive investment strategies to deal with the challenge from their new powerful competitors. Going beyond the former limitations of the "film as lab" model brings benefits, and allows third parties to add their experience and technical achievements. But the other side of the coin is that the newcomers- the new intermediaries (including the new distributors) - are less susceptible to the "command and control" once exerted by the production segment. The investments required to produce media products need a growing part of investments in software solutions and in qualified staff for the digital age.

The right symbiosis between players, which fosters innovation while monitoring dominance, has yet to be found. The new configurations require new strategies and new ways to build competitive positions. As noted by Doyle (2013), economic success in the media industry is "*naturally dependent on the ability to adjust to and capitalize on technological advances.*"

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not going to come away in my hand. If I reach out for the one that's over there and it comes away in my hand I'm going to fall to the jungle floor and get devoured by insects. If I don't hold onto that one and hold onto this one I'm not going to make any progress because guess what? This one's really fraying quite badly too".

[182] As suggested by Steiner (2004) in his reflections on the adoption of new technologies and cluster development.

[183] We noted it was not always the case, at least as mirrored by R&D expenditures.

About the growing role of demand

In addition to the power struggle between downstream players and the entry of new intermediaries in the upstream production stage, another issue stemming from digitization has been documented in this report: a tension between the logic of prototype firmly rooted in this industry and the logic of demand that is gaining considerable momentum. Media consumption is shifting from push to pull. An increased number of distribution channels combined with the potential of directly addressing the public reinforced the need to pay attention to audience reach/demand/distribution. As noted by De Vinck and Lindmark (2012: 103), in this new environment "*demand is crucial*".

According to M. Gubbins, « *demand has become much more demanding* » (2014: 10) while at the same time the "*film industry remains wedded to a "push" model*" (2014: .34). Or as emphasized by T. Ilott, the film industry is still following an "*analogue model*" (Ilott, 2014) not taking into account the changes first from a rental model to an ownership model, and then to a direct consumption model. M. Gubbins concludes his report with a harsher comment: "*If this report can be reduced to a single point, it is that progress depends on audiences, and the current value chain and industry practices create a barrier, where it should provide a gate*" (2014:123).

Again, IT companies are better equipped to deal with this demand. They can meet the needs of consumers by creating more options for audiences to view content. In other fields, like fashion, some players like Zara or Celio have shown it is possible to create new innovative business models to face these challenges (Paris, 2010: 132). These companies do not anticipate, or impose their vision but react as quickly as possible to the trends they have noticed, in order to be able to supply the items they sell in time. Accordingly, IT companies use technological resources in original ways, completely different from those used by most creative industries. Instead of merely enhancing the legacy production process of contents, user interfaces or distribution channels, they build their strategy around their activities and ICT-enabled services.[184]

Publishers (in a broad sense) were used to managing this kind of relationship, especially when the firms were integrated vertically. Again, digitization has shifted the process and new distribution channels delineate new spaces. As we have shown in this report, distributors like Amazon[185] are best placed to reap the benefits of new forms of relationships between edited contents and consumers.

6.3 Public intervention: direct support or ecosystem enabling policies?

The EU cinema industry landscape described in this report is built on a case studies basis which obviously comes with some limits to any generalisation especially as most often it dealt with mainstream productions rather than middle tier productions. Nevertheless, it reveals a rather "mixed bag" with some clear success stories (UK VFXs, Quantic Dream, Rovio, Ymagis…), some less clear (Buf), and also some even less successful ones (Aaton, Thomson/ Technicolor…). De Vinck and Lindmark[186] noted the slow adoption of digital opportunities in the film industry and the lack of a "digital mindset" by European players. Nevertheless, they concluded their report on a rather

[184] HBO managed to involve the fans of its much noticed series "Game of Thrones", building its strategy around their activities (live-tweeting, fanvideo, fanarts, Tumblr …) (Quinton, 2014). We stressed that both Amazon and Netflix use data-mining systems to compile viewers' recommendations based on their choices of previously viewed media (Nissenbaum, 2009). Based on data, Netflix reinvented the video rental business. Pandora introduced automating radio creation and programming using data as well. Zynga uses data to intimately link game design and business models (Atelier Paribas, 2013: 81).

[185] Amazon introduced his Kindle e-reader dealing directly with customers. YouTube started exploiting "amateurs" video, a move that left initially legacy players sceptical, but not Google who bought the company fast enough, one year only after the site was launched. The company anticipated new forms of demand, a new blend of supply and demand brought by UGC.

[186] See their comprehensive overview of the strengths and weaknesses of the EU film industry and their SWOT analysis: see Table 4.2 in De Vinck and Lindmark (2012): Digital opportunities and challenges of the European film sector in different stages in the value network and Chapter 5, pp. 101-110.

optimistic note: "*many of the digital opportunities form a good fit with the European film sector*" (2012: IX). However, they add that vigilance is required and that "*the European institutions find themselves to be the logical partner for the development of a digital policy approach*" (2012: X).[187]

More proactive policies could strengthen Europe's assets. As we have seen, the EU's cinema industry centres are now competing with Bangalore-Mumbai and Los Angeles. There is also competition from emerging centres like Wellington (New Zealand), and others will probably appear sooner or later in South Asia. Other case studies have taken us to these already well known places:[188] Los Angeles, London and Montreal and beyond to the emerging Asia-Pacific scene (a scene that includes Singapore as well).

In this fundamentally global context, the legacy media industries in the EU, whatever their relative strengths, are fragmented and not in a position to make the best of their own strengths. They are followers, not trend setters. EU policies could contribute to bringing all the pieces of the puzzle together, by enabling further cooperation and coordination across Member States.

To take into account the new parameters of the digital environment, policy makers need to move forward and beyond simply supporting supply (a logic of production). A departure from "silo thinking" is required: e.g. away from partitioning industrial policies and from any "automatic funding" mechanism. At the same time, the new parameters make it more difficult to identify at what level appropriate policy should be implemented. Should public intervention target the layer level within the ecosystem? Or should direct support be given to the sector level or a blend of sectors, to economic players or to specific players (i.e. SMEs, start-ups, middle-range film production, independent producers)?

In the report, several policy issues are discussed as those where public intervention might be justified in a context of digital shift:

- How to deal with the powerful new intermediaries?
- Competition issues and platform
- Net neutrality
- Financing creation.

Of course, supporting the industry in the longer term also means bringing together all the necessary expertise through enabling policies in education, science and technologies.[189] Again, to achieve this, existing policies may have to be strengthened both at Member State and at European level. As a final note, a simple lesson can be drawn from the case studies: the field is now really swarming with companies - specialised technology suppliers - that are likely to have escaped any "policy" radar. Therefore the real question is: is there a need for policy or not? In any case, sticking to a vertical approach, "per industry", is bound to miss the point: these specialised technology suppliers are providing services across the layers of the ecosystem, and across the boundaries of well-established industries.

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[187] For the book publishing industry, the TIPS project is a good example of a willingness to bring together different partners and expertise so as to create "*room for a debate about innovation, where supply and demand can match to support the creation of innovative products and services as well as new technological solutions useful for the professionals of the book value chain*".

[188] See JRC-IPTS reports on Videogames and on European ICT Poles of Excellence

[189] A significant concern regarding skills and education was already raised in the UK Facilities Sector report in 2009 commissioned by UK Screen Association in partnership with the UK Film Council and Ascent Media and again in the NEXT GEN report published in 2011 and commissioned by Nesta. The authors, Livingstone and Hope (CEO of the VFX company « Double Negative") suggested to the UK government some policies along these lines in their 2011 Nesta report: "a set of 20 recommendations for government, educators and industry to transform the UK how the UK can be transformed "into the world's leading talent hub for video games and visual effects".

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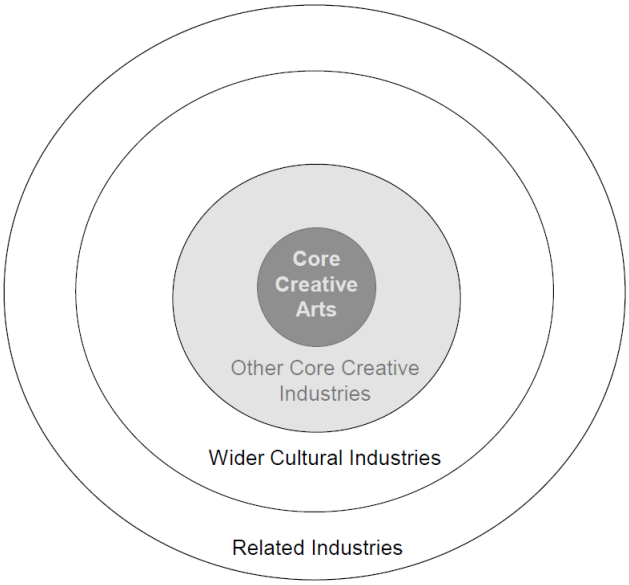
www.zoetrope.com/index.cgi

Annex 1: Creative industries - a questionable concept

In 2013, the US Bureau of Economic Analysis (BEA) introduced a satellite account (Art and Cultural Production Satellite Account: ACPSA), (Kern, 2014) based on the concentric models of cultural industries proposed by Throsby (2010) but using 2002 data. Figure 2 (Chapter 1) shows that most of the value added is coming from the production side and not from art support, design services or performing arts:

- Core creative arts: literature, music, performing arts, visual arts,
- Other core creative industries: films, museums/galleries, photography,
- Wider cultural industries: publishing and print media, television and radio recording,
- Related industries: advertising, architecture, design and fashion.

Figure 16: The concentric model of cultural industries.



Source: BEA (2014: 6)

In a statement, released in December 2013 with the US National Endowment for the Arts (NEA), BEA gives the following figures: Arts and Cultural Production account for 3.2% (US $504 Billion) of Gross Domestic Product in 2011. The statement added: "*in 2011, six industries accounted for 45% of ACP value added: motion picture and video industries, advertising services (creative content only[190]), cable television production, TV and radio broadcasting, newspaper and magazine publishing, and the performing arts and independent artists*" (BEA/NEA, 2013).

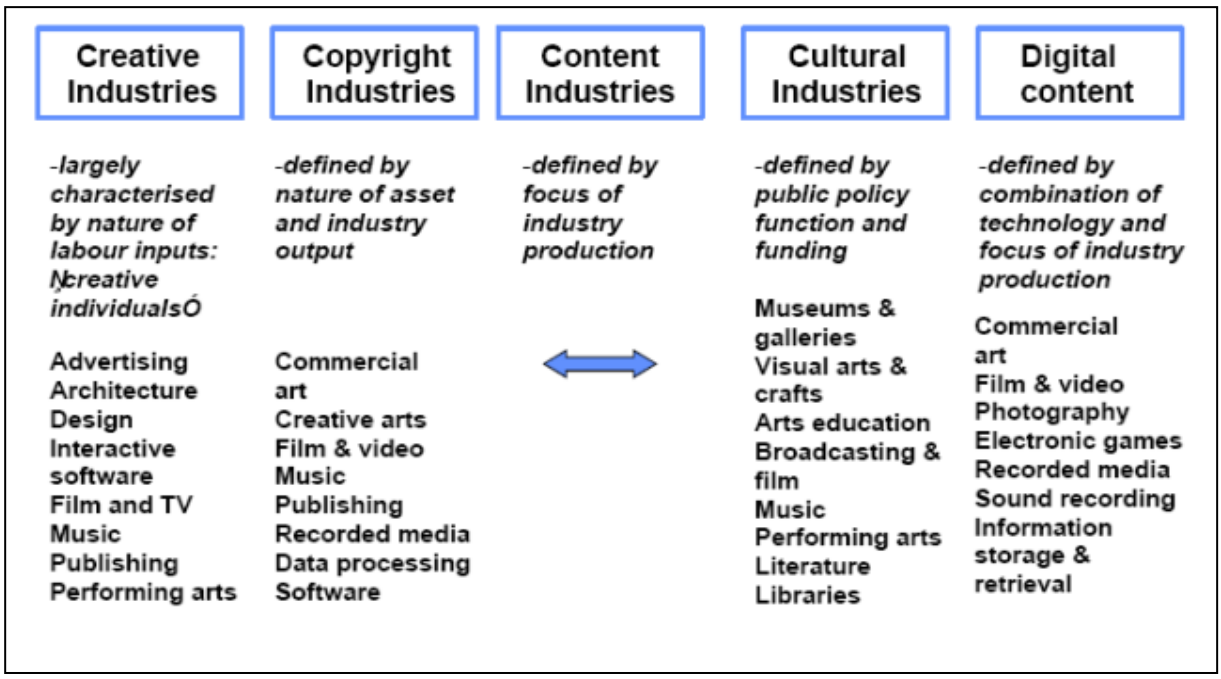
The various components of "economic" industries

As stressed by the CIRAC report (2003: 8), "*In practice, there is a significant overlap between the industry activities grouped under the various labels for this sector*". The report illustrates this confusion of categories within Figure 17. This figure shows that different categories differ along the criteria adopted for its definition, for instance 'creative industries" defined by the nature of the labour inputs vs. copyright industry defined by the type of asset and industry output. Focusing on one criterion is not without having some consequences about the kind of innovation one can consider. By overstressing the "creation" aspect, we are likely to come across the second

[190] They exclude public relations work, distribution of ads (e.g. flyers), sign painting and media buyers.

"*entrenched prejudices*" spotted by Bakhshi et al (2010), and ending up with a "*conception of creativity that mystifies too much of its work*".

Figure 17: The category confusion within content industries

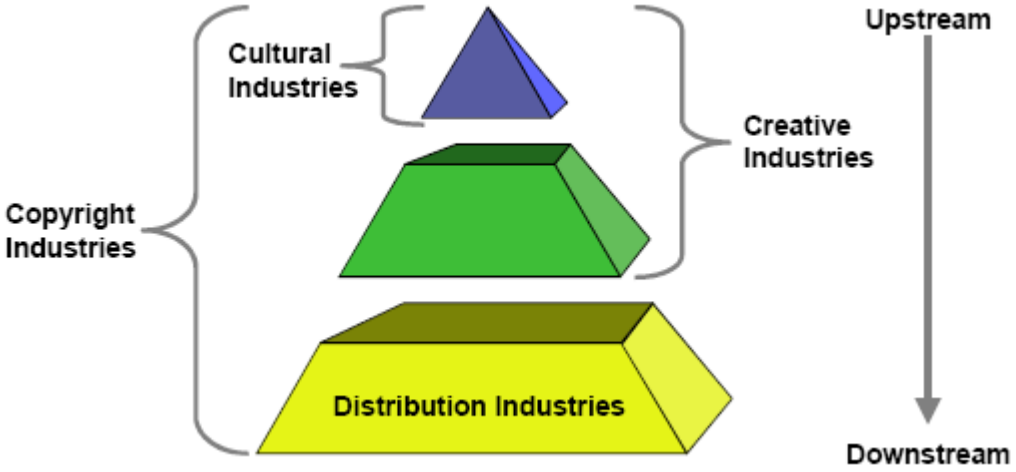


Source: CIRAC, (2003: 7)

Whatever the definition and the agenda, despite of a lack of consensus on the real meaning of the notion "creative industries", there is some agreement about the locus of the economic power, about where the added value comes from. Therefore, it seems logical to concentrate on these industries often labelled as well media and content industries (production industries in Figure 2). These industries have been heavily impacted by the digital shift (Simon, 2012) which brings some authors to consider them as "enabling industries" (Potts, 2009: 141). The case for "arts and crafts" seems much weaker from that angle; yet it does not mean there is no innovation. This field has been studied by Bakhshi and Throsby (2010). They do show "*that arts and cultural organisations innovate in audience reach, push out artistic frontiers and create economic and cultural value*" (2010: 1), but there is less room to apprehend the interaction of ICT technologies and the potential role of R&D. Besides, these areas are less complex in terms of interactions, less likely to yield many models of innovation because of less developed value networks.

The CIRAC report complemented Figure 17 with another one (Figure 18) that is in-line with our approach so far, following the relationships along the value chain. Figure 5 offers another heuristic value to illustrate the relationships between the segments as it shows the prevalence of distribution. Digitization increased this domination and shifted more and more toward downstream domination. The cards are being reshuffled but the trump is on the downstream side. The report shows examples of this impact and how it may offer some models of innovation based on distribution channels, for instance in the case of cinema (e.g. Netflix or the Indian company UFO Moviez).

Figure 18: The value chain of content industries



Source: CIRAC, (2003: 7) from Singapore Ministry of Trade and Industry, 2003

This group of diversified industries can allow tracking how innovation occurs at each level of the value chain and implies players from each segment. Following, Den Hertog (2002), Green et al. (2007: 8) distinguished four 'dimensions' of service innovation:

Service concept: innovation can involve an idea for a service development that is a new service, a 'new value proposition". Many service innovations involve fairly intangible characteristics of the service, for example an information service with new content. Others involve new ways of organizing solutions to problems.

The client interface: refers to innovation in the interface between the service provider and its customers. Clients are often highly involved in service production. Changes in how customers' roles and relationship to suppliers are configured can be major innovations for many services.

The service delivery system: this often overlaps with dimension 2, but there are also internal organizational arrangements that relate to delivery which need not necessarily involve (or even be visible to) clients. While much innovation concerns the electronic delivery of services, transport and packaging innovations can be just as important (e.g. pizza delivery involves a variety of vehicles, packaging and payment systems, ordering systems, etc.).

Technological options: the process innovations familiar in manufacturing sectors, and many innovations in manufactured products, most obviously exploit this dimension. New IT is especially important in underpinning the technological options available to most services, since it allows for greater efficiency and effectiveness in the information-processing elements.

Following the classification of innovation in the art and cultural sector proposed by Bakhshi and Throsby (2010: 16), four forms of innovation are specified:

- Innovation in audience reach: broadening, deepening, and diversifying,
- Innovation in value creation: economic and cultural,
- Innovation in art-form development,
- Innovation in business management and governance: new consumption spaces, production means and business models.

Their analysis also reveals than now each form of innovation is impacted. For instance, with audience reach, any new media technology had two basic effects: first, to enable to do more of the same, and two, to do new things. Applied to video media, this translates into two dimensions of use:

a broadening/ widening (expansion of regular TV, more at different time), and a deepening: the extent of signals to sensory receptors, to eyes, ears, nose/skin/mouth, toward the entertainment of total immersion with the user participation. For the first time content/ media will be based on an individualistic experience as opposed to the times where such experience has to be shared (theatre, music). Examples of the new content models are: immersive films/ games (like "*Pirates of the Caribbean 2*"[191]), immersive sports, marketing test drive cars, travelogue.

Table 12: Media and content industries facing innovation technology: an overlook of the different contexts

	Integration of the value chain	Investments in creation	Legacy technology	Digital technology
Book publishing	=	–	stable	emergent
Video game	+	= / +	not relevant	+ ++
Film	+	+ +	stable	+
Music	–	=	evolving	++
Newspaper	-	-	stable	+

[191] A 2006 American fantasy swashbuckler film.

Annex 2: The ESSnet Culture Framework

The ESSnet-Culture framework rests on three key concepts: cultural domain, function, and dimension.

The **cultural domain** consists of a set of practices, activities or cultural products centred around a group of expressions recognized as artistic ones. The cultural domains are common to each dimension studied (economic, social etc.).

Ten cultural domains are proposed: Heritage, Archives, Libraries Book & Press, Visuals Arts, Performing Arts, Audio-visual & Multimedia, Architecture, Advertising, Art crafts.

The **functions** used for the general ESSnet-Culture framework for cultural statistics are the main functions considered for mapping cultural activities and identifiable with existing economic and statistical classifications. The functions are sequenced functions (from creation to dissemination, along with training or support functions) but, as already said before, they do not aim at representing the whole economic cycle. They follow an economic approach and a practical one simultaneously, with the final objective being the production of sound cultural data. Functions are connected with domains so as to define cultural activities.

Six functions are proposed:

Creation: the function of creation concerns the activities related to the elaboration of artistic ideas, contents and original cultural products. In certain cases such as heritage, the creative function is less evident, being more commonly manifested through dissemination. For instance scenography, the art of designing and organizing space for exhibitions or performance, aims at disseminating heritage and arts but is based on creation (the art of matching together volume, objects, colours, light with technical and artistic skills).[192]

Production/Publishing: the production of cultural goods and services relates to activities, which help turn an original work into an available work. Production and publishing are connected to the same stage of the cycle, but production is linked to non-reproducible products when publishing is linked to reproducible ones. Production and publishing involve different formats and methods: the paper edition of a book is a publishing matter; so is the production of electronic books.

> Sometimes the production function exists in economic statistics but is not considered as a cultural matter, as for example in architecture, a domain in which production is tantamount to the non-cultural activity of construction; the printing activities are also part of the cycle but they are not considered as core cultural activities. Sometimes, the production function is made up of services activities, like the activities necessary for setting up a collection (museums or libraries science).

Dissemination/Trade: the dissemination function corresponds to making created and produced work available; dissemination includes the acts of communicating and broadcasting content so as to make cultural goods and services available to consumers (exhibitions, galleries). It does not operate in the same way as trade activities in which the commercial side is put forward. Cultural trade activities are those, which involve buying cultural products from a third party in order to sell them with no (or very little) transformation. The cultural trade activities are sometimes only partly cultural statistical classes (e.g. the sale of newspapers linked with stationery), sometimes entirely considered as cultural (e.g. the sale of books). Distribution networks are undergoing huge transformations with the advent of electronic trading and on-line trade is included within the concept of cultural activities.

[192] The activities of scenography are included into class NACE Rev.2 - 90.02 'Support activities to performing arts'.

These first three key functions, along with technologically related changes, are not necessarily separate. Thus, the creation and dissemination of a cultural product (music, for example) can be done simultaneously by the same person (whether professional or amateur) and with the same media, the internet being an example in which this action is quite simple.

Preservation: preservation includes all activities that conserve, protect, restore and maintain cultural heritage. Digitization is considered mainly as part of preserving activities, even if it also has a function of dissemination.

Education: education is understood as formal and non-formal education in the field of culture. It allows the development and transfer of skills within recognized cultural activities, as well as an awareness-raising function within cultural domains. Cultural education therefore includes all cultural activities, which can bring together professionals, practicing amateurs and participative citizens/consumers. Formal education in cultural fields can be identified only in statistics on education coming from administrative data sources using the International Standard Classification of Education (ISCED). Unfortunately, it is not possible to distinguish cultural educational activities within formal education in economic statistical classifications as NACE.

Management/Regulation: the management function relates to activities carried out by institutional, public or private organizations whose mission is to offer the means and a favourable environment for cultural activities, operators and spaces. This includes administrative activities and technical support activities to support culture. Regulation is necessary to both encourage cultural activities and to define and confer copyrights.

The **dimensions**: other approaches of culture such as the demand side of the cultural cycle or the social functions are called dimensions (they are analysed in specific Task Forces, *see following chapters*). A dimension refers to a specific approach on culture: economy, employment, consumption, financing, practices and social participation. These dimensions bring into play different tools and have different objectives, and therefore deserve special treatment.

Other specific terms or concepts are introduced into European framework for cultural statistics.

Cultural activities are understood as all types of activities based on cultural values and/or artistic expressions. Cultural activities include market- or non-market-orientated activities, with or without a commercial meaning and carried out by any type of producers and structure (individuals, organizations, businesses, groups, amateurs or professionals). Cultural activities represent the general conceptual framework, one cultural activity is carried out within a cultural domain and according to the function necessary for its achievement. For the production of data and measurement, cultural activities are described theoretically and then put into correspondence with statistical classifications, mainly economic classifications NACE Rev.2 (2008).

Cultural activities described in the framework according to the NACE codes, represent the **cultural sector**. The cultural sector is therefore made of cultural economic activities. In national accounts, a differentiation exists between **market** and **non-market** sectors. Market producers are producers that sell their output at economically significant prices. Nonmarket producers are producers that provide most of their output to others for free or at prices that are economically insignificant. Moreover, the European System of Accounts (ESA95) provides additional rules for the distinction between market and non-market producers, and the criterion to calculate if sales cover more than 50 % of production costs.[193]

It is not always possible to distinguish market activities from non-market ones in European sources. Structural Business Statistics (SBS) are supposed to cover only market-oriented enterprises but some evaluation should be done on the implementation of this concept in each EU Member State. In the EU-LFS, there is no possibility to distinguish between the private and the public sector of employment. Moreover, the status of units in national sources may be handled in different ways

[193] See Eurostat : http://circa.europa.eu/irc/dsis/nfaccount/info/data/esa95/en/een00126.htm

(for instance, national museums or national theatres may be public institutions with profits for sources of income).

Distinction and comparisons are therefore uneasy. Nonetheless the differentiation between market and non-market remains essential as it is used in business registers and systems of accounts and as it covers different structures and types of economic models.

The concept of Creative and Cultural Industries (CCIs) is often used by different stakeholders, especially by policy makers (in different fields of economic or social policy) and, in particular when economic data on CCIs are presented. The concept is used in various documents and it is not standardized. It also extends to different realities (creative industries, creative goods, creative economy, creative cities, creative regions, creative class etc.) and covers different cultural sectors in academic documents or national strategies. Starting from a core set of relatively basic cultural fields (heritage and fine arts in general) and broadening it to wider activities (publishing, audiovisual, design, architecture) and peripheral fields (software, telecommunications, ICT), the CCIs notion often seems generic and broad and does not merely include cultural/artistic creation. Not only the notion of 'creativity' cannot be statistically measured but also the notion of 'industries' has different meanings, ESSnet-Culture strongly recommends when speaking about creative and cultural industries, to clearly mention the sectors that are covered.

Source: ESSnet Culture Final Report, pp. 55 – 58.

Annex 3: R&D in the creative industries – some insights

Creative industries show little R&D activities. Two main views try to explain this fact. As presented in Chapter 1, the creative industries are seen as "*under-represented in innovation and R&D surveys*" (Green et al (2007: 58). Second, the overlap (or confusion) between innovation and creation seems to overshadow the importance of R&D and technological activities in these industries.

The first section of this annex reviews briefly some anecdotal examples showing that R&D may in a way disappear under the "creative" aspect. The second section introduces to some data and shows that the definitional confusions about the creative industries also complicate the observations, inducing over and under representation of the industries, pending the perspective.

Some observable R&D activities in the creative industries

Some anecdotal evidence about R&D can be gathered in various media industries, for instance in the case of broadcasting. In the US, the David Sarnoff[194] Research Center (Princeton), so called RCA Labs,[195] founded in 1941, played a central role for the development of broadcasting technologies (cameras and computers visions, LCDs, microwaves…), (Magoun, 2003: 7). Cable Television Laboratories Inc. (CableLabs) was created in 1988 by cable television operating companies. The labs from Denver contributed to the specification authorship of the DOCSIS.[196]

In France, a specific department was in charge of research and production within the French Public Broadcasting Service (Service de la Recherche de l'ORTF). Under the leadership of avant-garde musician Pierre Schaeffer the emphasis was on experimental art (including music). When the French Public Broadcasting Service was re-organised in 1975, the R&D department was transferred to the entity in charge of the television archives, the Institut National de l'Audiovisuel (INA), although the emphasis was more on the "traditional" creative aspect.[197]

The National Film Board of Canada, created in 1939, is also a well-known example of some R&D being implemented, although, again, much more on the "creative" side. Its mandate (renewed in 2000) stated that its mission is to "*explore the creative potential of the audio-visual media*". The animation department eventually gained distinction, particularly with the pioneering experimental work of Norman McLaren who headed the department.[198]

In the cinema industries, one could have expected the technical industries[199]to play a major role for R&D.[200] The result is a mixed bag, as yet argued earlier. On the one hand, these industries have

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[194] David Sarnoff was a pioneer of American radio and television; he led the Radio Corporation of America (RCA).

[195] Now a fully owned subsidiary of SRI International (SRI), founded as Stanford Research Institute. The Institute was involved in Arpanet.

[196] Data Over Cable Service Interface Specification (DOCSIS) an international telecommunications standard that permits the addition of high-speed data transfer to an existing cable TV system.

[197] The "service de la recherche" was known mostly for having produced a very popular nonsensical cartoon: "Les Shadoks" which, according to Wikipedia, "*caused a sensation in France when it was first broadcast in 1968-1974*". The "Shadoks" were bird-like in appearance (anticipating "Angry Birds"), characterised by ruthlessness and stupidity and inhabited a two dimensional planet. See: https://www.youtube.com/watch?v=6XlMTHVGhRA

[198] In 2014 for the anniversary of his birthday, the NFB released an app for the Ipad, with videos of his short films: www.mclaren2014.com

[199] The segment covers: shooting (manufacturers equipment and film, shooting rentals, shooting studios/set, mobile production unit), post-production (labs photochemical/digital/video, image and sound post—production, dubbing and subtitling), diffusion (screening and broadcasting, duplications (prints/KDM), DVD), archiving, storage, and restoration. In 2012, all these activities reached €1.1 billion in France according to the French Trade association FICAM (2014) for a panel of 109 companies: post-production accounted for 17%, immediately followed by dubbing/ subtitling and mobile production unit with 15%, then shooting studios and shooting rentals with 13% each.

[200] Cf. Figure 16 for an overview of the players within the cinema technical industries.

even been described in the French case, "*as a stagnating link in an expanding value chain, tech industries*" (Imaginove, 2014: 9). This seems to underestimate the dire situation as leading players such as Laboratoires Éclair, Technicolor (formerly Thomson) or innovative camera manufacturer Aaton were on the verge of bankruptcy. Part of the reason has to do with the fact that this sub segment is treated more as a plain supplier rather than a leading technical partner. A report for the French Centre National du Cinéma (CNC), (Lepers and Portugal, 2013), mandated to assess the economic strengths and weaknesses of this sub-sector, stressed that this technical part of the cinema industry is perceived as a "commodity" and not as the core value of the industry. The authors emphasized the negative aspects of this bias (Lepers and Portugal, 2013: 25) and suggested some rebalancing and an improved consideration of R&D. Besides, the report underlined that this segment also suffered from serious economic challenges.

On the other hand, some national technical industries are faring better than others (see Chapter 4: UK post-production). The entry of emerging new players may signal a change in the legacy relationships with these suppliers, between "creation" and technical provision of services, brought by digitization, pervasive computing and new distribution channels. Even in the case of the French industries, some start-ups managed to emerge recently. For instance, Ymagis, founded by executives from the world of cinema and high technologies, in 2007 showed an amazing growth curve. The French firm covers activities of the technical industries (production, post-production, storage) but focuses on digital distribution of digital copies (company website, 2014). They claim to be an innovation company with half of its workforce being engineers and technicians, devoting in 2013 11% to R&D in their labs (Paris, Barcelona, Berlin), (Ymagis, 2014).

Some observable R&D data in the creative industries

In their empirical study of creative industries and innovation in Austria, Müller et al (2009: 155) came up with some interesting ratio for R&D within the firms they studied[201] (see Table1): "*31% of the creative enterprises in Austria conduct in-house R&D*" but they add that this "*is driven by two sectors, engineering and software*". The ratio is much lower among the other industries covered in their study: "*only a fifth to a fourth engages in R&D activities*". Then, they compare the figures with those from the Community Innovation Survey (CIS, 2005: 156) and find that "*creative enterprises turn out to be significantly more innovative than enterprises from other knowledge intensive sectors. Among the creative enterprises with 10 or more employees, 86% have introduced product or process innovations within a three-year time period, compared to 56% among enterprises from knowledge-intensive sectors*". They also found that these industries supported innovation as lead users of new technologies, thereby acting in a way as « enabling industries » as stressed by Potts (2009: 141, quoting Hartley, 2009): "*general enabling social technology"*.

A report for the Australian National Office for the Information Economy shares partly these findings, emphasizing that "*the economic multipliers arising from the creative industries are significant*" and that they are "*becoming important enablers as intermediate inputs*" (CIRAC, 2003: 11). This does not seem to match other data and other researches where legacy players seem not to be in the driving seat as noted with the book publishing industry (Benghozi, Salvador, 2013, 2014 a, b). These optimistic conclusions may come from the integration of engineering and software, the

[201] Based on the activities listed by DCMS to which they add engineering and consulting:
- Content: film, (computer) games, journalism, authors, music, performing arts, photography, sound studios; accounting for 5% of all creative enterprises,
- Design: arts and crafts, design and fashion, graphic design, engineering design, web design; accounting for 9%,
- Software: programming and computer services (excluding web design and computer games);
- Architecture: architecture including landscaping and urban planning; 19%;
- Advertising: planning, creating and putting in place advertising campaigns, public relations management, market research, advertising services;
- Publishing: publishing of books, newspapers and other printed matter, including printing services

The last four sectors account for 13-16%.

acknowledged engine of all these industries, an aspect they stress in their final conclusion adding in contrast that "*the Architecture and Content sectors have rather few links to the innovation activities of their customers* » (CIRAC, 2003:167). Besides, the distribution of firms of 10 and more employees is likely to differ greatly from knowledge intensive sectors such as computer services or the chemical industries. Larger firms although innovating with products and processes may be more dominated by some industrial routine than creative SMEs. This may be a bias in the approach. Muller et al (2009) do note though that just 16% of their sample employ 10 or more people.

Mouline (2010) attempted to follow alliances for R&D in the "multimedia industries" (multimedia equipment, multimedia software, multimedia services, multimedia chips, games and contents), starting from the assumption that under fast changing technological conditions, firms needed to form new alliances, thereby modifying the frontiers of the firm in a set of complex arrangements. Although he focused on the strategic drivers of the alliances, he drew his conclusions from a sample of 188 firms retrieved from the French data base DIAM.[202] His findings are consistent with the reference literature on R&D alliances in economics. The multimedia equipment sector accounts for 43.5% of the total of alliances (Mouline, 2010: 79), followed by software and multimedia software, leaving a much weaker ratio to "traditional" content industries. He found that the data indicate a convergence between equipment, networks and services that is dominated by US firms: he quoted that at the time of his research, in 2007, these US firms were leading as well in terms of R&D investments/ revenues ratio (2007): Broadcom 23%, Electronic Arts 20%, Xilinx 18%, Adobe system, Tellabs and Qualcomm 18%.

The section above shows that some R&D expenditures may be overshadowed by the more "attractive" creative side of the media and content industries. However, the data gathered in the report, as expected and noted in Chapter 1, shows that most of the expenditures are driven by two sub-sectors, engineering and software under a (too) broad definition of creative industries.

[202] « Données sur les Industries et les Alliances dans le Multimédia », operated by the Observatoire des Stratégies Industrielles. Database composed of 223 R&D alliances between 1995 and 2005.

Annex 4: R&D expenditures from a converged telecom media technology perspective

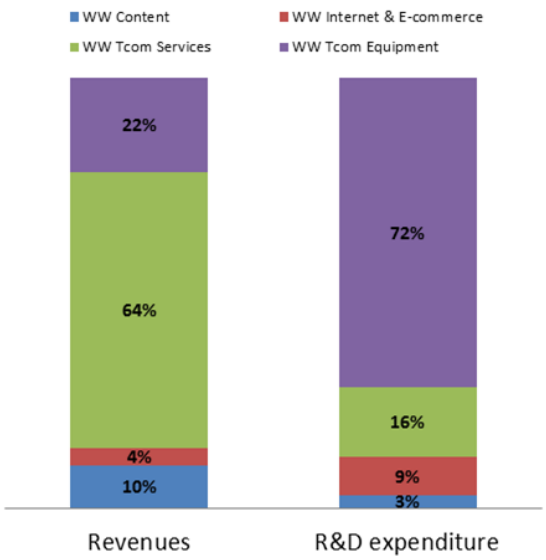
This annex presents the R&D component within the wider *Telecom Media Technology ecosystem*: such ecosystem is constructed on the assumption, strongly supported by evidence, that the growing convergence and overlap of activities of the IT, Telecom and creative content sectors affects those sectors to the point of creating a new environment described under the notion of "the new ICT ecosystem" (Arlandis et al., 2010, BCG 2011, Fransman, 2010, 2014) or "Telecom Media Technology (TMT)" according to other consultancies (AT. Kearney, Booz&co,[203] 2011; Mc Kinsey 2010; PwC 2014).

It stresses the new "symbiotic" (Fransman, 2014: 6, 11) relationships between industrial players from sectors that one could consider as separate. The section gives a cross-comparison between the sub-sectors of the ecosystem focusing on R&D expenditures. It demonstrates that within a context of very high investments and rapid – often disruptive - change, the creative industries represent a rather small player, at risk of being dominated by industries and companies of other "converging" sectors.

The fate of the cultural industries, and that of public intervention, need therefore to be thought within such broader perspective. A cross comparison within sectors of the "telecom and media ecosystem"

This first approach of the role of R&D within the media industries points to some bridges with other IT players within the broader ecosystem. If one takes a look at the level of R&D expenditures, Internet players such as Microsoft or Google, are indeed or are becoming major investors in R&D as illustrated by Figure 20 (Simon, 2011) and Table 3, allocating around 10% of their sales revenues to R&D (Figure 19). R&D expenditures, as noted by Fransman (2010), are highly unevenly distributed between the four layers he distinguished within the ICT ecosystem (layer 1: equipment providers, layer 2: network operators, layer 3: content and app providers, layer 4: final consumer) with R&D done primarily by equipment providers (72% of the total), and IT companies (16%), leaving 12% to the players of the other layers of the ecosystem (a mere 3% to content players) (Figure 19).

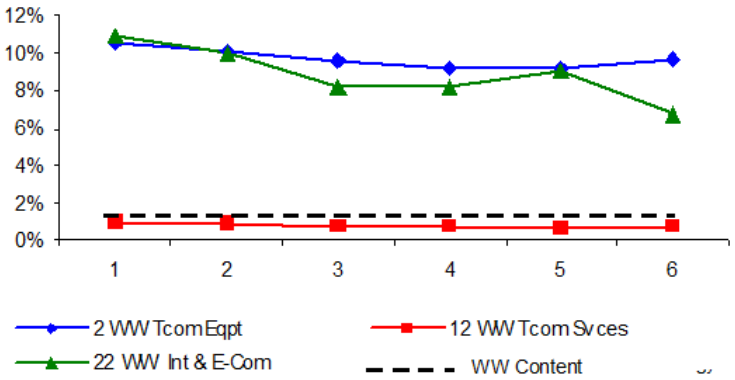
Figure 19: Revenues and R&D investments World Wide (WW), (2007).



Source: Reuters and annual report of the companies

[203] Global Telecom, Media and Technology (TMT) ecosystem.

Figure 20: R&D to sales ratio across the four layers (2002-2007) Worldwide.



Source: Reuters and annual report of the companies

IT companies are major investors in R&D as shown by the Predict reports (2011, 2012, 2013). In 2008, Microsoft ranked n° 1 among the top 20 R&D-investing ICT companies (see Table 13 below), and n° 3 among the top 50 companies (The 2013 EU Industrial R&D Investment Scoreboard 2013: 27). Not only Microsoft ranked 1, but Nepelski and Stancik (2011) showed that Google is riding far ahead in a group they characterized "*with R&D growth rate above 16% and sales growth rate above 14%*" (Nepelski and Stancik, 2011: 24).

Table 13: The top 20 R&D investing companies (2008)

#	Company	NACE sub-sector	4 digit ICB sub-sector	Country	R&D 2008 (€ m)	R&D growth 2005-2008 (€ m)	CAGR 2005-2008 (%)
1	Microsoft	Computer Services and Software	Software	USA	6482	1745	11.0%
2	Nokia	Telecom Equipment	Telecommunications equipment	Finland	5321	1692	13.6%
3	Matsushita Electric (now Panasonic)	Multimedia Equipment	Leisure goods	Japan	4401	-484	-3.4%
4	IBM	Computer Services and Software	Computer services	USA	4327	458	3.8%
5	Sony	Multimedia Equipment	Leisure goods	Japan	4132	147	1.2%
6	Intel	IT Components	Semiconductors	USA	4117	415	3.6%
7	Cisco Systems	Telecom Equipment	Telecommunications equipment	USA	3707	1317	15.8%
8	Samsung Electronics	IT Components	Electronic equipment	South Korea	3469	669	7.4%
9	Hitachi	IT Equipment	Computer hardware	Japan	3398	314	3.3%
10	Alcatel-Lucent	Telecom Equipment	Telecommunications equipment	France	3167	1375	20.9%
11	Ericsson	Telecom Equipment	Telecommunications equipment	Sweden	2975	644	8.5%
12	Canon	IT Components	Electronic equipment	Japan	2969	695	9.3%
13	Motorola	Telecom Equipment	Telecommunications equipment	USA	2956	309	3.7%
14	NEC	IT Equipment	Computer hardware	Japan	2795	610	8.6%
15	Hewlett-Packard	IT Equipment	Computer hardware	USA	2549	38	0.5%
16	NTT	Telecom Services	Fixed line telecommunications	Japan	2151	-373	-5.2%
17	Fujitsu	Computer Services and Software	Computer services	Japan	2053	147	2.5%
18	Google	Computer Services and Software	Internet	USA	2010	1578	67.0%
19	Oracle	Computer Services and Software	Software	USA	1991	644	13.9%
20	Qualcomm	Telecom Equipment	Telecommunications equipment	USA	1641	914	31.2%

Source: Nepelski and Stancik (2011), based on a sample of 428 companies of the *ICT Scoreboard*

However, telecom services companies remained the engine of investments accounting for 67% of the total of investments over the period (2004-2008) as shown in Table 14, the R&D being outsourced to the equipment providers (Simon, 2011) that represented 84% of the total over the same period. Over the following period (2008-2012), the distribution of investments remained rather stable with telecom companies still accounting for 61% of the total investment (Table 15)

Table 14: The distribution of revenues, investments and R&D expenditures (2004-2008) (Billion US dollars).

	Revenues			Investments		R&D		Ebitda margin	EV to Ebitda
	Bn$	%	CAGR 4/08	Capex/revenues	%	R&D/revenues	%		
Content players	236	8%	6%	5,9%	5%	1,7%	3%	21%	6,6
Internet players	84	3%	26%	6,5%	2%	9,2%	6%	23%	10,2
Network operators	1 200	40%	10%	16,3%	67%	0,8%	7%	35,6%	4,9
Equipment & IT Services	1 460	49%	6%	5,3%	26%	7,4%	84%	14,5%	6,8
Total	2 990	100%	8%	-	100%	-	100%	-	-

Source: Reuters and annual report of the companies. EBITDA: earnings before interest, taxes, depreciation, and amortization. EBITDA Margin refers to EBITDA/total revenue. EV: enterprise value

Table 15: The distribution of revenues, investments and R&D expenditures (2008-2012) (Billion Euros).

	Revenues			Investments		Ebitda margin	Entreprise Value	
	€ Mds	%	CAGR 2008-2012	Capex/Revenues	%		€ Mds	EV/Ebitda
Hardware & Electronics	1 729	43%	3%	6,0%	27%	14%	1 544	6,2
Software & IT services	495	12%	2%	3,8%	5%	23%	944	8,4
Network Operators	1 346	33%	4%	17,2%	61%	33%	2 175	4,9
Intermediation	149	4%	24%	7,0%	3%	22%	424	12,7
Media	334	8%	2%	4,4%	4%	22%	507	7,0
Total	4 053	100%	4%	9,4%	100%	23%	5 595	6,1

Source[204]: Reuters and annual report of the companies. R&D data not available for that period. CAPEX: capital expenditures

It should be noted that each layer is characterised by a specific economic model as follows:

- prototype industries with mostly high fixed costs for the content layers,
- network externalities for internet players,
- sunk costs (network infrastructure) for ISPs and network providers
- sunk costs (to a lesser extent) for technology suppliers and manufacturers of equipment and hardware.

These economic features bring constraints and opportunities for related models of innovation:

Industries like the media and content industries built on prototypes are most likely to allocate more resources on team building, to bring together different kinds of expertise, technical and artistic and less on R&D.

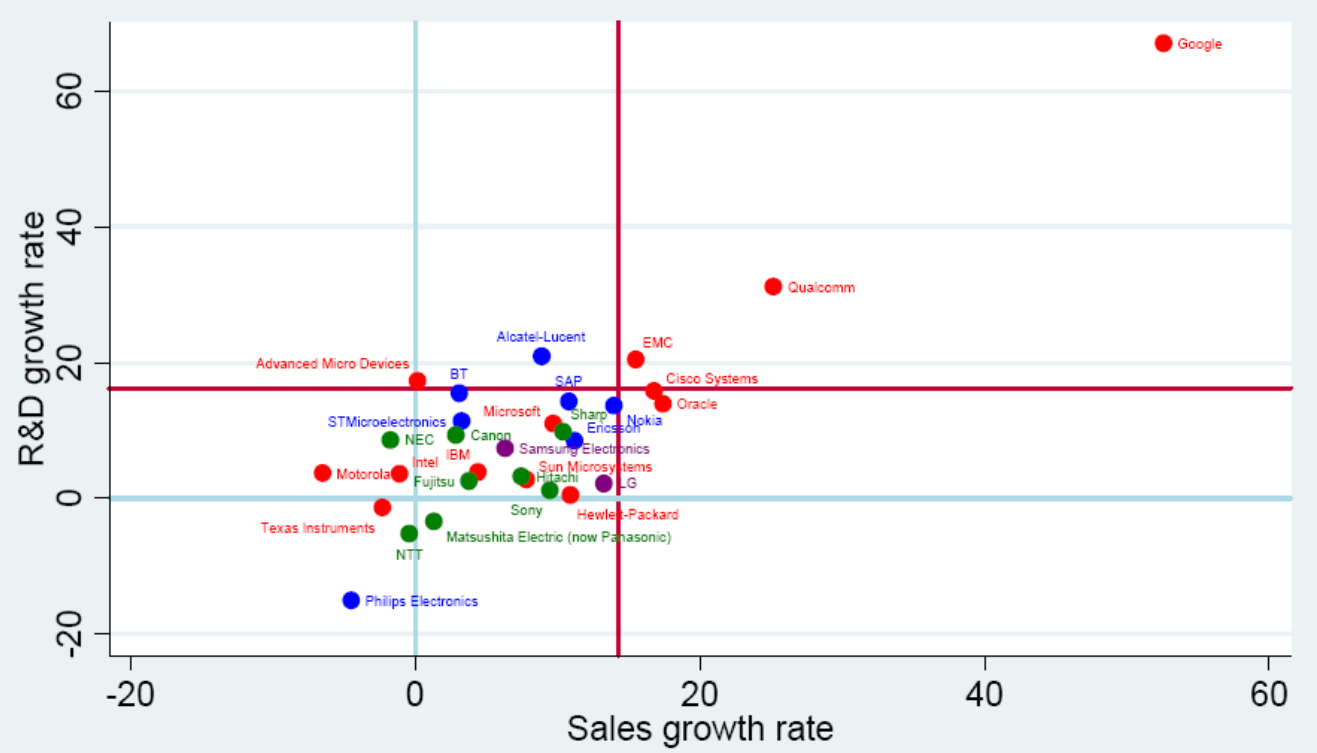
A sunk cost industry must program its long term investments as illustrated by the network operators.

Network externalities allow marginal and incremental innovation to flourish as illustrated by the dramatic growth of the "app" economy: within five years (July 2008-October 2013) the number of apps available for download in the Apple platform has grown from 500 to more than 1,000,000 with 60 billion downloads in total (Appnation, 2013).

[204] Note that the classification differs from Table 15 to 16. Table 15 aggregates hardware and software under "equipment services".

Sunk costs call for traditional R&D developments in order to support the renewing of infrastructure and productivity gains

Figure 21: Top 30 R&D-investing ICT companies divided by R&D and sales growth rates (2005-2008).



Source: Nepelski and Stancik, (2011)

Another consequence of these various economic features, is that although the level of investments of Internet companies (Google, Yahoo!, Amazon, eBay,...) is in progression, it remains modest in terms of overall investments ICT sector contribution, 2% of the total (2004-2008) versus 67% for networks operators as shown in Table 15, and 3% for the period 2008-2012 (Table 16). However, their level of R&D expenditures is now comparable to the level of expenditures of network operators, respectively $7.72 and 9.6 million. Besides, it has to be stressed that these Internet players have the highest growth (26% CAGR 2004-2008, 24% 2008-2012) and value (Enterprise Value to Ebitda: 10.2%, 2004-2008, 12.7%, 2008-2012), the latter reflecting the market capitalisation of these new companies (see Annex 6 for the market caps). "Technologies providers in Layer 1 are the most R&D intensive players" (Arlandis and Ciriani, 2010: 18).

Annex 5: Entr'acte[205] – professional and amateurs: the rise of user-generated contents (UGC)

The dramatic fall of the costs audio-visual production tools (see Box 12: Avid) contributes to the blurring of the border between professional and amateurs as stressed by Flichy (2010). For instance, Image Metrics, a leading provider of facial animation technology (see Box 9), allows self-representation and personalized content through its proprietary algorithms that make the recognition and real time animation of nuanced expressions and emotion possible with nothing more than a camera on a laptop, tablet or smartphone. "*Everyone can now use professional tools - Protools, Ableton Live or simply desktop tools - to create their own music*", notes Salmon (2013: 14), adding: " *Self production remains trickier in the cinema sector, despite the rise of digital cameras for achieving quality films*" (Salmon 2013: 14). Salmon quotes an ADAMI[206] study that reveals that 60% of the artists in their association made at least one recording via self-production between 2008 and 2010 (Salmon 2013: 15). Amazon is providing would-be musicians and writers with tools and even some funds to self-produce.

These evolutions lead to the consumption on the same device or in the same room of a new blend of various types of contents: truly "edited" contents, user generated contents (UGC) ranging from almost professional production to contents provided by "friends", transaction (utilitarian audio-visual like tele-shopping, tele-transaction, interactive advertising…), (Busson et al, 2011). The blend is likely to change over time but new entrants, especially social networks, are the engines of these changes toward multitasking, multi-screening behaviours.

Media consumption is gliding from push to pull. Not only users are posting pictures or circulating the pictures they took through their favourite social networks (Facebook) or specialised provider (Instagram), but they started circulating videos as well. Videos over the Internet stand for the majority of traffic on broadband mobile internet (Cisco, 2013), the traffic is exploding and this is likely to grow at least for the coming years.

Before the advent of digital technologies, the split between "amateurs" and professional films was clear cut even if "amateur" filmmaking was a very popular and widely spread hobby (Odin, 1995, 1999). YouTube, before being bought by Google, started with some amateurs' short videos; other sites like DailyMotion in the EU followed.

It does not mean that all the videos produced by users may become global hits, or even that the still to be perceived as amateurs are trying to become professional players. Most likely the vast majority of users producing contents will stick to some of the previous patterns of amateur film-making and just take the opportunity of the new channels of distribution to circulate their contents. The word "prosumer" was coined by the futurologist Alvin Toffler in 1980 anticipating this emerging phenomenon. However, just like in the case of music, where amateur musicians were also able to act as professionals or semi-professionals occasionally, as illustrated by various kinds of folk music (blues, country, flamenco…), this opens up a new space in between the realm of professionals and of amateurs, eventually allowing the scouting of new talents.

In the field of music, the DIY (Do it yourself) model (Bacache-Beauvallet et al, 2011; Byrne, 2012) adds another source of production, thereby increasing diversity, and offers some novel avenues for creativity: as David Byrne (singer of the US band "Talkin' Head") noted: "*The totally DIY model is certainly not for everyone – but that's the point. Now there's choice*".[207]

What happened with music to a certain extent with DIY, with pictures taken from mobile phone, may as well still grow with videos enabled by the introduction of more and more sophisticated cameras in mobile phones. The iPhones already allow for some kind of motion pictures; manufacturers are

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[205] A 1924 French short film directed by René Clair.

[206] A special interest group for the administration of the right of artists and musicians in France.

[207] From an article in Wired magazine 2007 quoted in Bacache et al (2011).

introducing new cameras that may not be different from the camera they produced for the professional sectors, at least for the lighter ones. Samsung just launched in April 2014 a "*zoom"-branded "camera specialised smartphone*".[208]

Voci (2013) spotted some interesting examples, in a fast growing mobile market such as China, of amateurs circulating short videos shot with their mobile cameras. According to Voci (2014): "*And thanks to portable and affordable digital technology, cinema today is also made up of a myriad of amateur videos that contribute creative and often dissonant perspectives on what China is*". Voci analysed what she called "*portable movies*" giving examples of Chinese amateurs' short films: "*Portable movies are generally freely circulating (i.e., shared rather than purchased) and almost exclusively targeting transient –online or on-phone– audiences. In particular, mobile-made and viewed movies often emphasize portability, playfulness, connectivity, and sharing as their main defining elements*" (Fowler and Voci, 2011). Voci considers it is an attempt to develop an aesthetic of brevity away from a more traditional approach (Voci, 2010: 77-78), an innovation in art-form development to use Bakhshi and Throsby classification (2010: 16).

The production of these videos can be triggered by an array of factors. For instance, the huge viral success of the South Korean rap artist, "Psy", "*Gangnam Style"* posted on YouTube in 2012, gave birth to a lot of parodies, some originating without any doubt from professionals (including some Angry Birds, Minecraft style), but other not. Parody on YouTube is a genre that is attracting amateurs and professional alike. YouTube offers a top ten of these musical parodies as well as parodies of films[209] produced by "*clever, creative YouTubers*" (Lazar, 2014).[210]

In the video games industry, several firms actually rely on communities of users in order to design new products and services. Internet technologies are thus used as forums and social networks for providing consumers with the possibility not only to share information but also to actively contribute to design new content and functionalities for improving their products and services (Parmentier and Gandia, 2013). The communities of users are considered as new sources of co-innovation (Parmentier and Mangematin, 2014). Indeed, in the case of the video games industry: actual gamers can simultaneously be not only users but also developers, but "*what is new is that the blurring of firm frontiers in digitized industries allows for fluid interactions between user communities and firms*" (Parmentier and Mangematin, 2014: 40). For instance, from a technological viewpoint, Image Metrics introduced in 2012 "Zombie Wars", an iPad exclusive free digital comic app that lets users insert their images into a tale of a zombie outbreak and become the main characters: a new platform for creating 3D customizable avatars from 2D facial photos. The fan culture for digital games is deeply embedded in shared practices and experiences among fan communities, and their active consumption contributes to the production: fan-programmers (generally known as "modders") play a role in the success of the PC digital game industry.

"Fanfiction" is booming with readers using well-known characters to produce their own stories with the endorsement of authors like J. K. Rowling and Stephenie Meyer (White Paper, Digital Book World, 2014: p.15).In the book publishing industry, publishers are using new forms of community of readers (away from book clubs). For instance, a 2013 study of publishers' use of online communities Bowker Market Research ((BM commissioned by Publishing Technology found that publishers' commitment to online communities was set to double by 2015. The survey revealed that two thirds of the publishers surveyed already hosted one or more online community (White paper).

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[208] It took the shape of the Android 4.4-powered Galaxy K Zoom. The device, which follows the Galaxy S4 Zoom's lead by having a digital camera-like rear body, is said to "*blend advanced digital camera technology*". *Source*: www.mobileworldlive.com/samsung-unveils-latest-camera-smartphone?utm_campaign=MWL-D-20140430&utm_medium=email&utm_source=Eloqua&elq=0a75892c53c7481c8ded4be162040d3f&elqCampaignId=1633

[209] See for instance http://azbigmedia.com/scottsdale-living-magazine/lists/top-5-movie-parodies-youtube

[210] www.huffingtonpost.com/shira-lazar/the-best-oscar-movie-paro_b_4855996.html

These productions appear to fall under three out of the four forms of innovation specified by Bakhshi and Throsby (2010: 16) stressed earlier: innovation in audience reach, innovation in art-form development (formal innovation without venturing into any value judgement), and innovation in business management and governance (new consumption spaces, production means and business models, the latter still being a question mark). The combination is therefore offering new opportunities. These forms of innovation are also complemented by innovative ways of using and sharing recommendations. Amazon built part of its marketing strategy on the strength of these recommendations. This suggests a shift that goes together with a move to downstream domination: from supply to a demand driven economy of content, as noted by Bain (2013: 10). IT players, beyond their power position, are intrinsically well placed to benefit from this shift, to make the most of new analytics (so-called "big data") and the cloud (Amazon is a leading provider of third party cloud computing services with AWS). This shift brings along some marketing innovation.

No wonder it has been hailed as a drastic transformation of knowledge production and sharing (Benkler, 2006, 2011, Cooper, 2006, 2008, Lessig, 2001, 2004). These authors stress that the new situation and its potential growth creates room for a second model: the community model, in which modules of media creation and play modules will be created by decentralized peers, collaborating loosely with each other. This involves another, less mainstream, form of creativity, "*but it's not likely to be the main way to create new content*" (Noam, 2010). A richer content also means a more expensive content. This is also a continuation of trends for Noam (2010). It requires creativity, many programmers, lots of alpha and beta testing, and many new versions. Such expensive content exhibits strong economies of scale on the content production side, and network externalities on the demand side. Both favour content providers with big budgets that can diversify risk, can distribute over other platforms, have a strong brand, and can coordinate the specialized inputs of the various segments involved. It may help to reach a critical mass as it was the case for radio in the 20s and Internet in the 80s (Noam, 2008), as Noam (2005) summed up: «*grassroots created the market then they are dismissed*». Wi (2009) offered similar views for video games.

The role of user generated contents (UGC) may be overstated as it will probably not become the main source for the provision of content at least in the case of cinema or other media with high fixed costs of production. As noted by Cameron and Bazelon (2010: 36): "*With a major film costing over $200 million on average, of which $39 million is spent just on marketing the film, it is hard to imagine that selling credits or garnering attention in social media sites will ever be able to cover the costs or inspire investors to back such a large undertaking*". Waterman (2011) noted that, between 1975 and 2010, the average production costs per movie went through a dramatic increase: from US $3.1 million in 1975 to US $82 million in 2010. This is acknowledged as well by the Bain Report (2013: 11), quoting crowd funding as "*a complement rather than as a substitute for the existing publisher toolkit, along with traditional approaches*". As stressed by Ramos (2014: 54) indeed "*very frequently projects presented on crowd funding platforms are low budget, and often financed by a large audience where each individual provides small amounts of money*". "*Crowd funding today represents less than 1% of the investments*" in the book, cinema, and video games industries (Salmon, 2013: 46).

Nevertheless, crowd funding allows the consumer to participate in the emergence of tomorrow's artists. Companies like Yahoo are using some form of crowdsourcing to fill the gap between edited content and amateur content. To track unmet demand, the search company commissioned amateurs to provide relevant contents then grant exclusive control for the rights of publishing on line.[211] User generated contents (UGC) play a major role for social networks (Ala-Mutka, 2008; Punie et al, 2009), and for sites like You Tube, they are a vital component of their business model to attract advertisers.

[211] Yahoo at the IIC Brussels 2012.

Annex 6:

Table 16: Internet companies with a market cap over US $1.5 billion

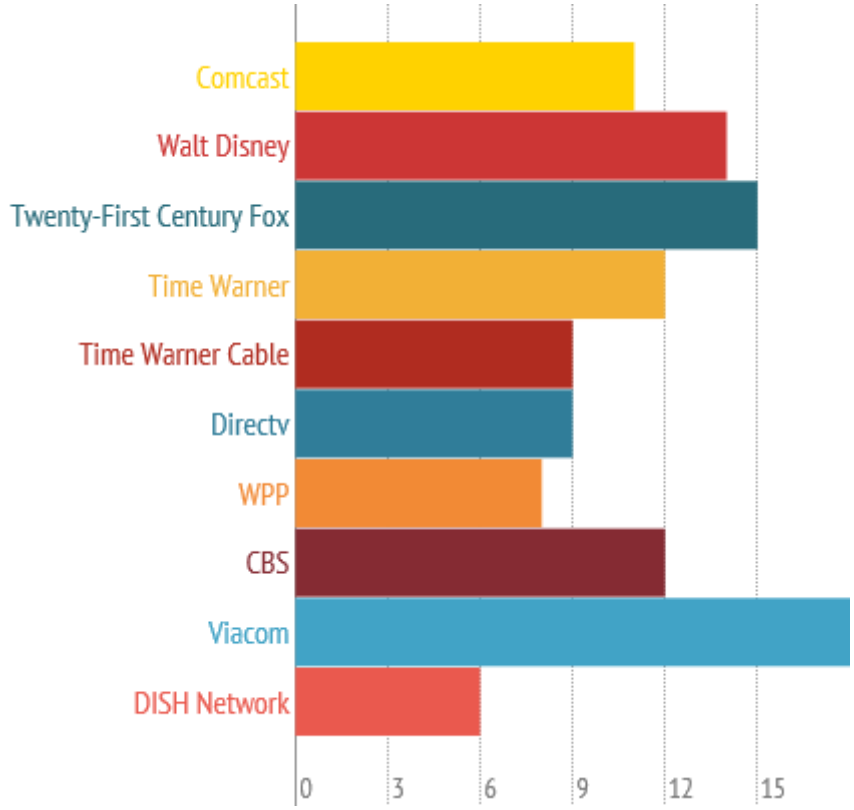
	Firme	Pays	Code Bourse	Capitalisation (déc 2012) Mds$	Chiffre d'affaires 2011, Mds$
1	Apple	États-Unis	AAPL	483	108,2
2	Google	États-Unis	GOOG	233	37,9
3	Michrosoft	États-Unis	MSFT	226	69,9
4	Amazon	États-Unis	AMZN	113	48,1
5	Tencent	Chine	NNNC.DE	73	4,5
6	eBay	États-Unis	EBAY	65	11,7
7	Facebook	États-Unis	FB	57	3,7
8	Softbank	Japon	SFTBF	42	
9	Baidu	Chine	BIDU	35	2,3
10	Priceline	États-Unis	PCLN	30	4,3
11	Salesforce.com	États-Unis	CRM	24	2,3
12	Yahoo	États-Unis	YHOO	23	5,0
13	Yahoo! Japan	Japon	TYO:4689, YAHOY	19	
14	Experian	UK	EXPN	16	4,5
15	360Buy	Chine	Private	13	
16	Symantec	États-Unis	SYMC	13	
17	Linkedin	États-Unis	LNKD	12	0,5
18	Rakuten	Japon	RKUNF	11	
19	Liberty Interactive	États-Unis	LINTA	10	11,6
20	NHN	Corée	035420.KS	10	
21	Otto Gruppe	Allemagne	Private	10	14,8
22	Rackspace Hosting	États-Unis	RAX	9,9	1,0
23	Equinix	États-Unis	EQIX	9,8	1,6
24	TD Ameritrade	États-Unis	AMTD	9,2	2,7
25	Twitter	États-Unis	Private	9,0	
26	Alibaba	Chine	1688.HK	8,7	1,0
27	Expedia	États-Unis	EXPE	7,8	3,4
28	Akamai	États-Unis	AKAM	7,3	1,2
29	Yandex	Russie	YNDX	7,2	0,6
30	Equifax	États-Unis	EFX	6,4	2,0
31	Trip Advisor	États-Unis	TRIP	6,0	0,6
32	Verisign	États-Unis	VRSN	5,9	0,8

	Firme	Pays	Code Bourse	Capitalisation (déc 2012) Mds$	Chiffre d'affaires 2011, Mds$
33	Netease (163.com)	Chine	NTES	5,5	1,2
34	Netflix	États-Unis	NFLX	5,0	3,2
35	United Internet AG	Allemagne	UTDI	4,2	2,5
36	InterActive Corp (ASK)	États-Unis	IACI	4,1	2,1
37	Wikimedia	États-Unis	Fondation	4,0	
38	Zalando	Allemagne	Private	3,8	0,7
39	Youkou Tudou	Chine	YOKU	3,6	
40	MercadoLibre	Argentine	MELI	3,5	0,3
41	Asos	UK	ASC	3,4	
42	Square	États-Unis	Private	3,3	
43	Groupon	États-Unis	GRPN	3,2	1,6
44	Sina	Chine	SINA	3,1	0,5
45	Qihoo 360	Chine	QIHU	3,1	
46	Livingsocial	États-Unis	Private	3,0	
47	Digital Sky Technologies	Russie	Private	3,0	
48	AOL	États-Unis	AOL	2,5	2,1
49	E*Trade Financial	États-Unis	ETFC	2,5	2,3
50	Dropbox	États-Unis	Private	2,5	0,2
51	Vente Privée	France	Private	2,5	1,4
52	Palantir	États-Unis	Private	2,5	
53	airbnb	États-Unis	Private	2,5	0,0
54	Shanda Interactive Entertainment	Chine	SNDA	2,2	0,7
55	VK	Russie	Private	2,0	
56	Hulu	États-Unis	Private	2,0	
57	Zynga	États-Unis	ZNGA	2,0	1,1
58	HomeAway	États-Unis	AWAY	1,8	
59	Sohu.com	Chine	SOHU	1,8	0,9
60	Pandora Media	États-Unis	P	1,8	
61	TiVO	États-Unis	TIVO	1,5	0,2
62	Kayak Software	États-Unis	KYAK	1,5	0,2
63	Pinterest	États-Unis	Private	1,5	
64	ValueClick	États-Unis	VCLK	1,5	0,6

Source: Gilles and Marchandise (2013: 73-74)

Annex 7: Ranking and profit margins of media companies (Forbes 2014 Global 2000 List.)

Figure 22: Media company ranking



Source: Forbes, 2014. Available at: http://infogr.am/the-worlds-ten-largest-media-company?src=web

Annex 8: List of participants at the validation workshop

"Models of innovation in the Creative and Content Industries: Inspiring insights from the Cinema industry". Seville, November 7, 2014.

Participants list:

- Pierre-Jean Benghozi, ARCEP, CRG Polytechnique (Paris).
- Terry Ilott, Principal, Bridge Media, (London)
- Juan Mateos-Garcia, NESTA, (London)
- Juan-Carlos Miguel, Universidad del Pais Vasco (Leioa)
- Valerie Mocker, NESTA, (London)
- Thomas Paris, researcher at CNRS (GREG HEC / CRG Ecole polytechnique), affiliate profesor, HEC (Paris)
- Elisa Salvador, researcher CRG Polytechnique (Paris).
- Jean Paul Simon, JPS Public Policy Consulting, (Seville).
- Harald Trettenbrein DG CNECT (Brussels)

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