

The London School of Economics and Political Science

Image, Information and Changing Work Practices

The case of the BBC's Digital Media Initiative

José-Carlos Mariátegui

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Declaration

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I confirm that chapters 5 and 7 of this thesis incorporated parts of the work "Video as Digital Object: Production and Distribution of Video Content in the Internet Media Ecosystem" (2011) published in *The Information Society* 27(4): 281-294, which was jointly co-authored with Professor Jannis Kallinikos; I contributed 50 percent of this work.

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I confirm that chapter 3 incorporates a selection from “Deconstructing Digital Video: The Ontological and Technical Complexities of a Medium” presented at the 27th EGOS Colloquium “Reassembling Organizations” in Gothenburg, Sweden, July 7–9, 2011, which I completed while studying at the LSE.

I confirm that chapters 4 and 7 incorporate a selection from the work “From Electronic Text to Media-Data Space: An Empirical Case of Organizational Change through Digitalization in the Media Industry” presented at the 3rd Latin American and European Meeting on Organizational Studies (LAEMOS) Colloquium in Buenos Aires, Argentina, April 7–10, 2010, which I completed while studying at the LSE.

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Abstract

The media industry is undergoing a comprehensive change due to media convergence and the diffusion of the internet. However, there is a lack of research in the field of Information Systems on how these technological phenomena impact work practices in broadcasting and media organizations.

Using the BBC's Digital Media Initiative (DMI) as a case study, I provide a detailed description and analysis of the implementation of DMI in news and long-form productions. The empirical evidence was gathered from BBC Northern Ireland (BBC NI), where a large-scale digital video production infrastructure based on DMI was implemented.

My point of departure is the study and impact of digitalization in work practices associated to the production of video as an image-based artefact, which complements previous studies that focus on information tokens such as electronic text. I seek to assess how work practices at BBC NI were affected by the use of digital video throughout the DMI workflow. In this context, my case study analyzes: 1) DMI's technical infrastructure and its impact on work practices for the purpose of searching and organizing video content, and how this affected news and long-form productions distinctively; and 2) the domain of video craft editing brought about by the digitization of the video production process.

My contribution demonstrates the importance of a semiotic approach to the study of the digitalized image-based artefact, particularly when analyzing the construction of a video narrative. Video narratives are based on work practices that originate not only from particular occupational cultures, but also from the technological characteristics of digital video information. I address the importance of the semiotic character of digital video, in both syntactic and semantic dimensions, and acknowledge its role as a constitutive element for understanding the impact of digitalization and work in the information age.

To the memory of my mother
To the memory of my father

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The following thesis summarizes the last twenty years of my academic work since I began my undergraduate studies in 1993. I had an atypical academic journey that started with biology and then mathematics, while being involved in culture and media arts. I simultaneously worked as a professional in the technology, media, and marketing industries. In the last eight years my varied interests led me to my research on technology and media organizations. There was always one theme that remained constant throughout my journey: technology and its impact on culture and society.

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List of Abbreviations

I incorporate several commonly used acronyms as the primary denomination throughout the dissertation.¹ I generally avoid acronyms when mentioning the word or phrase for the first time or when it would otherwise complicate or disrupt the flow of the argument.

API	Application Programming Interface
BBC	British Broadcasting Corporation
BBC HQ	BBC headquarters (Broadcasting Centre, White City, London)
BBC NI	BBC Northern Ireland (a division of the BBC based in Belfast)
BetaSP	Also known as Betacam SP or Betacam, is a family of professional digital recording video standards, introduced in 1982 by Sony
CCITT	International Telegraph and Telephone Consultative Committee (translated from French: Comité Consultatif International Téléphonique et Télégraphique)
CCETT	Center for the Study of Television Broadcasting and Telecommunication (translated from French: Centre commun d'études de télévision et télécommunications)
CEO	Chief Executive Officer
CIO	Chief Information Officer
CTO	Chief Technology Officer
D1	Professional digital recording video format, introduced in 1986 by Sony
D3	Professional digital recording video format, introduced in 1991 by Panasonic
DMI	Digital Media Initiative
DNI	Digital Northern Ireland (BBC NI's implementation of DMI)
DRM	Digital Rights Management
FCP	Final Cut Pro (Apple's video editing software package)
FM&T	BBC Future Media & Technology Division

¹ Refer to Appendix 11.4 for a glossary of terms on many of the technical acronyms mentioned here.

HD	High Definition (professional standard for TV resolution)
HTTP	Hypertext Transfer Protocol
I&A	Information & Archives Department (often referred to as BBC Information and Archives)
ICT	Information and Communication Technology
IS	Information Systems (a field of academic research)
ISO	International Organization of Standardization (based on the Greek word <i>isos</i> , meaning equal)
IP	Internet Protocol
IT	Information Technology
JISC	Joint Information Systems Committee
JPEG	Digital image standard (the acronym of: Joint Photographic Experts Group)
LSE	London School of Economics and Political Science
MPEG	Digital video standard (the acronym of: Moving Picture Experts Group)
MPEG-4	H.264/MPEG-4 video format specification
NHU	BBC Natural History Unit (a division of the BBC based in Bristol)
NLE	Non-Linear Video Editing Software (such as FCP or Avid)
NTSC	National Television System Committee
PDF	Portable Document Format
PGC	Professionally Generated Content
RSS	Rich Site Summary (originally RDF Site Summary, often dubbed Really Simple Syndication)
SD	Standard Definition (professional standard for TV resolution)
TOP	Technology and Operations division at BBC NI
TV	Television
UGC	User-Generated Content
URL	Unique Resource Locator
VHS	Video Home System (a popular videotape format)
VOD	Video on Demand
VTR/ VCR	Videotape Recorder / Videocassette Recorder
XML	eXtensible Markup Language
WWW	World Wide Web

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1. Introduction

Meaning is [...] an order with chaos on either side, but this order is essentially a division. [...] It follows that the future task of semiology is far less to establish lexicons of objects than to rediscover the articulations which men impose on reality.
–Roland Barthes, *Elements of Semiology* (1977)

It is impossible to imagine a world without images. The importance of the image and image making has been demonstrated throughout the history of humankind. From cave paintings to today's multiplicity of digital screens, societies have used images to access God, nature, truth, and science. In the last two hundred years, technical advances spurred the development of technical images, first through photographic devices and then through moving image devices in the form of film and later, video. Today, the moving image is one of the main technical artefacts driving the knowledge, media, and entertainment industries. However, to say that the moving image appeared only in the past few centuries neglects an important part of the history of human society. Media scholar Sean Cubitt has ventured to say that images of horses, fishes, and hunters scratched and painted onto the walls of caves during the Paleolithic Age were the first moving images: although the images themselves were not “moving”, the viewers would move in order to watch them as if they were a series of concatenated frames (Cubitt 2013). Whether Paleolithic or contemporary, the production of moving images has always been in equal parts artistic and technical accomplishments.

There are several reasons behind the explosion of image and moving image creation and consumption today: their migration to the digital realm and the digitalization of analogue information; the proliferation of cameras and mobile phones; and the impressive circulation of video. More than one-quarter of the expanding digital

universe consists of digital cameras and video recorders (Gantz and Reinsel 2011; Cisco 2012). The proliferation of devices for capturing, producing, and diffusing digital images alone does not sufficiently account for the phenomenon and its subtle implications, particularly in terms of the impact images have in media organizations. Today's contemporary image-making companies are clustered into powerful media conglomerates (e.g., NewsCorp, Time Warner, Viacom, the BBC, Bertelsmann) that manage not only what media content is being consumed, but also where and when. For decades the media industry was dedicated primarily to the creation and delivery of content. But when the digitalization of images and video began, an abrupt change in the media industry also occurred. As digital information grew, it required efficient forms of management. "Post-PC" conglomerates such as Facebook, Google, Apple, and Amazon became dominant players in the media industry, no longer by producing content, but mostly focusing their efforts on managing and aggregating digital information of all kinds.

The convergence of media and technology not only became a managerial or cultural pursuit; it had had significant implications for media industry employees' work practices. An analysis of the impact of digitalization on the media industry proves a fascinating paragon of the relation between images and technologies. Seen from a media perspective, the means of managing and manipulating video content produce engaging video narratives. Seen from a technology perspective, the manipulations of video are based on the abstract organization and aggregation of symbolic data tokens. Therefore, it is of great importance, now more than ever, to study how technology in the form of digital video, constituted as an image-based information token, impacts media organizations.

Marshall McLuhan (1964) mentions in his classic work *Understanding Media* that "the medium is the message". Today, more than at any other point throughout the history of manufactured media, McLuhan's dictum rings true for the understanding and diffusion of digital images: The message and the social practices that produce it seem subordinate to the medium, or the technology, in which it is embedded.

1.1 Motivation of the Research

Digitalization has redefined media content and has altered the conditions under which the latter is produced and distributed. In my research, I examine the digital image and how technological information in the form of digital video is reconfiguring work practices in the domain of craft editing in the broadcasting industry.

My research is motivated by my general interest in studying the impact of technology on contemporary work practices. Work practices are based on interactions and communications that are embedded in occupational cultures. By occupational cultures I mean the distinctive and broad habits of thought and action shared by members of the same profession and showed in their language, beliefs, norms, career patterns, skills and traditions (Barley and Van Maanen 1984).² Broadly speaking, in the field of Information Systems (IS), the impact of technology on work practices has been studied from two perspectives. The first emphasizes the view of technology as consisting on structures based on rational decision-making; such determinist perspective of technology is designed to bring productivity and efficiency through organizational change (Perrow 1986; Jarvenpaa 1989). The second perspective is largely based on the study of local relations and interprets the impact of technology as the outcome of social structures or situated enactment (DeSanctis and Poole 1994; Orlikowski 2000). However, these approaches are somewhat distant of what happened in recent years as contemporary work environments are considerably shaped by the interaction with technological (or digital) artefacts. The study of such structured objects and the ways they are managed (in the form of text, images, video, or computer code) provides an angle to analyze the impact of a technology through the structural attributes or properties of digital artefacts (Yoo 2010; Kallinikos, Aaltonen

² It is important to make a clear distinction between the term occupational cultures or occupational communities from the term “communities of practice”. The former is based on “a group of people who consider themselves to be engaged in the same sort of work” and share common tasks, job training, career patterns, and elements that influence one’s social conduct and identity (Barley and Van Maanen 1984: 295). The latter is based on informal groups contained within organizations that evolve spontaneously through social interaction, shared interests and leisure activities among their members (Wenger 1998). Communities of practice reinforce individual experience in a process of learning through practice or ‘learning-in-working’ (Brown and Duguid 1991).

et al. 2013). As work is becoming more abstract, symbolic and increasingly focused on the interaction between communication and technological information, what is being managed are representations of that technological information. Therefore, since semiotics studies signs and their systems in search for meaning and signification, it can also be used to analyze how digital artefacts influence work practices.

However, though a semiotic approach might offer the required mechanisms to analyze digital artefacts in contemporary work environments, current literature do not address the specific properties of the image as a digital artefact. Images are highly ambiguous compared to other types of codified notations since their semiotic value is rooted in their contextual origins and perceptions.

Furthermore, there is a lack of literature on the technological processes behind image-based digital formats and standards, particularly within the domain of media organizations. Most of the media industry has been computerized within the last four decades, which has significantly impacted work practices and the way information is being managed on a daily basis. Faced with large expenditures, actors in the media industry prioritized convergence strategies as a way to reuse content in multiple platforms, which not only reduced costs but also created economies of scale. Media organizations tried to adapt to these developments by making more efficient production processes that centralized their operations and combined radio, TV, news, and online (web) operations into a unified workflow. In the broadcasting industry in particular, the challenge of digitalization and media convergence appeared to be twofold: efficiency (converting their legacy analogue production and distribution systems to digital processes) and availability (digitalization prompted media content to be available on any platform, at any time, and be easily findable). The new workflows implemented in the broadcasting industry were based on unified production infrastructures in which numerous processes were being shared. Through new digital workflows, the skills and actions executed in the form of physical work were transformed into digital information tokens and their tasks were rendered as software processes.

1.2 Empirical Study

My point of departure is the study and impact of digitalization in work practices associated to the production of video as an image-based artefact, which complements previous studies that focus on information tokens such as electronic text. The empirical study is broadly based on the impact of image-based technologies, in the form of digital video, on work practices in the domain of video craft editing. Furthermore, I seek to analyze the role of digital video as a key image-based technical and social artefact.

My research is based on an embedded single case study: the implementation of the BBC's Digital Media Initiative (DMI). The empirical evidence was gathered from BBC Northern Ireland (BBC NI), where a large-scale digital video production infrastructure project based on DMI was deployed. I seek to assess how work practices at BBC NI were affected by the use of digital video throughout the DMI workflow. In this context, I analyze: DMI's technical infrastructure and its impact on work practices for the purpose of searching and organizing video content, and how this affected news and long-form productions distinctively; and, the domain of video craft editing brought about by the digitization of the video production process. My contribution aims to demonstrate the importance of a semiotic approach to the study of the digital image, particularly by analyzing the construction of visual narratives in the digital age and by acknowledging the impact of digital video on work practices.

The decision to use a case study as part of my research strategy derives from three sets of considerations manifested at the research site which are based on the need to see closely how major actors in the media industry deal with the digitalization of the video image in terms of the techniques, technologies and practices they deploy: first, taking into consideration the dominant role of the BBC in Britain, there was little control over the events as they occur within real-life scenarios; second, the boundaries between a phenomenon and its context are not clearly defined when one is directly observing events; and third, the fact that BBC NI was advanced in the implementation

of DMI meant that interviewees involved in such an event cannot be manipulated (Yin 2003). Such a case study employs an embedded design that incorporates multiple levels of analysis within a single study and is characterized by its explorative nature, issue of comparison, and depth (Yin 2003).

My empirical study focuses on the implementation of DMI in two distinctive occupational cultures, news and long-form productions, in a single setting: BBC Northern Ireland.³ The objective of such an empirical study is to disclose and eventually compare the effects generated by news implementation to those of long-form implementation. While investigating the two forms of implementation I sought to unravel the effects brought about by the digitization of the video production process in the domain of craft editing.

The research strategy consisted of four main stages:⁴

1. The first stage (2006 – 2009) was mainly exploratory and consisted of extensive research. I conducted interviews at BBC headquarters (Broadcasting Centre, White City, London) to understand the DMI implementation process and review documentation on DMI. Complementary informal meetings with industry analysts and experts were also held. This stage familiarized me with DMI and its implications. It also helped me to conceptualize the theoretical propositions in order to guide the initial data collection and analysis.
2. The second stage was comprised of a first visit to the site, BBC NI (2009). Through intensive research, I gained extensive knowledge of BBC NI's local implementation of DMI, Digital Northern Ireland (DNI). I then gathered details of the news production environment in order to understand the operations and the forces that shaped it and how these impacted the work practices of BBC NI staff.
3. The third stage (2010 – 2011) was composed of expert interviews in complementary locations (i.e., the BBC's Natural History Unit, BBC Academy, and Cinegy GmbH), which allowed me to evaluate the validity of my initial results

³ Refer to Appendix 11.4 for a definition on long-form and news productions.

⁴ For detailed information on the *Stages in the research strategy* refer to chapter 6.

- and gain access to an extensive range of specialists' perspectives. It also increased my knowledge of how DMI was conceived.
4. The final stage of my research was based on additional fieldwork to BBC NI (2011), primarily devoted to examining the implementation of long-form productions. I complemented the meetings with the BBC staff who were in charge of DMI implementation with interviews with actual "users" of the system on both long-form and news productions (e.g., journalists, producers, craft editors, media managers, and broadcast and technology engineers).

1.3 Research Objectives

The transformation of tasks in the broadcasting industry has given rise to a tendency toward the sequentialization and automation of both manual and technical processes. Such sequentialization requires the use of large-scale systems to tie together a disparate ecology of processes in order to manage digital content. In my particular case, I focus on the digitalization, in the form of digital video images. Images, both moving and still, are highly ambiguous information tokens. In order to understand how digitalized images are interpreted, I compare work practices in different production contexts. To support my research on digital video, I outline the main characteristics of contemporary digital images and reference earlier writings on the theoretical study of the digital image and new media (Mitchell 1994; Manovich 2001; Brea 2010).

Moreover, the conjunctive elements that form video images are not separable and independently analyzable, as they are composed of a series of digital images whose meaning requires multiple visual scans. From a semiotic perspective, my study provides evidence of the importance of the symbolic nature of image-based digital artefacts. Based on the particular semiotic characteristics of video narratives, work practices are affected in distinctive ways.

My research contributes to the field of Information Systems in that it complements and expands upon prior theories on the impact of technology on work practices by focusing on the digitalization of video in the broadcasting industry: one of the most technologically-intensive industries, which has also been under-researched by the IS community. I do so by analyzing how digitalization of image-based artefacts impact differently in two occupational cultures, news and long-form productions. In addition, I extend the somewhat broad literature on semiotics within the IS field that largely center on the domain of information (as a conceptual entity) and electronic text (Zuboff 1988; Ramaprasad and Rai 1996; Raber and Budd 2003; Floridi 2005; Brier 2008; Kallinikos 2011; Mingers and Willcocks 2014) to the specific study of the digital image (i.e., digital video), and use them to shed light on a phenomenon that has not yet been analyzed in terms of work practices.

The dissertation accomplishes the following objectives:

1. It introduces the study of work practices in contemporary media organizations. Consequently, it compares the impact of digitalization in two distinctive occupational cultures (i.e., news and long-form productions) throughout the management of image-based technological artefacts (i.e., digital video).
2. It assesses how the digital image is a different type of information artefact, in contrast to text or computer code, by juxtaposing the semiotic constitution of video craft editing in news production work practices (based primarily on the linear and conjunctive nature of text) with long-form productions' work practices (based on the synchronic nature of the image).
3. It analyzes video craft editing within the broadcasting industry and how digitalization renders manual processes into tasks that are based on software processes. The dissertation also recognizes and examines how some manual processes within craft editing are crucial to the production of visual narratives and cannot be rendered into technical tasks.
4. It illustrates the importance of studying image-based artefacts (i.e., video). Hence, as I explain at length in chapters 8 and 9, the impact of digitalization in work practices on news and long-form productions is not only due to their distinctive

occupational cultures, but also to the ways video is managed as an image-based technological artefact.

1.4 Thesis Outline

The thesis is divided into twelve chapters, including an appendix and a bibliography. The present chapter introduces the reader to the background development, assumptions, and reasons that have led to my research on media organizations and digital video. It also provides a short outline of the empirical study and the research objectives that the dissertation aims to accomplish.

Chapter 2 briefly explains the research domain, offering an overview of the media industry and media convergence. It gives an introduction to the developments in the broadcasting industry and the challenges brought about by digitalization and the rise of the internet. It seeks to explain how broadcasting organizations envision their work practices when implementing multiplatform delivery in a new competitive media environment. Media convergence led to new work practices within the media industry; thus, I explore the impact on work practices related to newsroom convergence and the management of images and video in the media industry. I also problematize the lack of research on the technological aspects of the media industry within the field of media studies. To conclude the second chapter, I explain how the internet impacts the media industry's processes and artefacts.

Chapter 3 introduces video as an axiomatic presupposition of my study. I describe video and its evolution into a digital artefact. I provide a description of the historical origins of video starting with the discovery of printed photography. I address how quality and transmission techniques are the main characteristics of what it is known today as digital video. In order to frame the historical evolution of the image, I describe its three stages as proposed by Brea (2010): the *image-object*, the *moving image* and the *digital image*. Then, I examine a well-known digital video format, MPEG, in an effort to deconstruct the technical properties it is built upon. I then focus

my attention on the different types of metadata available in digital video in order to compile its ontology within the contemporary broadcasting industry.

Chapter 4 presents the main literature that is the basis of my research. First, I review the available media literature to bring out the lack of research on technology in media organizations and the study of digital images from an IS perspective. Second, I give an overview of literature on how technological information impacts work practices (Baxter and Lyytinen 2005; Vaast and Walsham 2005; Brynjolfsson 1993; DeSanctis and Poole 1994) in order to demonstrate the impact of occupational cultures and technological information on present work practices (Barley 1983; Ekbja and Evans 2009; Lanzara 2009). Third, I bring up some literature from the field of IS that helps in understanding the semiotic characteristics of technological information (Raber and Budd 2003; Floridi 2005; Mingers and Willcocks 2014). I use the work of Zuboff (1988) and Kallinikos (2006; 2011) to illustrate the semiotic character of technological information and how work practices are becoming abstract as these are codified into information artefacts. Then, I examine the image as a digital artefact, thereby addressing how the interpretations of image-based artefacts are cognitively different from other digital tokens, such as electronic text. I conclude the chapter by illustrating other lines of theoretical research that relate to work practices, video, and the media industry and how that research differs from mine.

Chapter 5 introduces the research site. I first describe the BBC as an organizational setting, taking into account the Digital Media Initiative (DMI), its key operations, and the organizational changes it implemented. To understand DMI, it is necessary to briefly study the history of information management at the BBC, namely, standards and metadata as well as the way in which the Natural History Unit (NHU) pioneered video classification at the BBC. I recount the history of Cinegy, a video editing software package that was central to the introduction of DMI at the BBC. After giving an overview of the BBC in general, I focus on the primary research site: BBC Northern Ireland (BBC NI) and its deployment of DMI, Digital Northern Ireland (DNI).

Chapter 6 describes the methodology applied to my case study. I first introduce the site selection and research strategy and the process that I underwent in order to make the decision for choosing an embedded single case study. My research design is organized into five components, as proposed by Robert K. Yin (2003): the study's question, its propositions, its units of analysis, the criteria for interpreting the findings, and the logic of linking the data to the propositions. I also explain the methods used to collect, validate, and analyze my data. I conclude by offering insight into the peculiarities of the BBC as a research setting by addressing its complex organizational structure and managerial politics.

In chapter 7, I explain the most relevant processes of digitalization and how DMI has redefined the production workflow at the BBC. I then introduce the six main DMI operations at BBC NI; I describe them in detail and provide several quotes from the interviewees at the research sites. I subsequently describe the four main organizational and work practices that have been affected by the implementation of DMI at BBC NI. I also give an account of certain aspects of the work practices involved in long-form and news production processes. I do so in order to compare the ways in which the manipulation of digital video differs based on the occupational cultures of each implementation.

Chapters 8 and 9 build on my findings. Chapter 8 introduces the analysis with a study of craft editing. First, I analyze how digitalization of video as a cultural artefact in DNI impacts differently in news and long-form productions, respectively. Then, I study image manipulation practices throughout the DNI workflow in the context of video craft editing from a semiotic perspective. Focusing on craft editing illustrates the structure of digital video in terms of its image-based semiotic composition and how it plays an important role in understanding changing work practices. I conclude this section by addressing the importance of both occupational cultures and technology as constitutive elements of work practices for the production of video narratives. Finally, I summarize the characteristics of news and long-form productions by comparing their semiotics dimensions, video narratives characteristics as well as their occupational cultures.

Chapter 9 complements the analysis by explaining the technical infrastructure of DNI as it is composed of standards and applications that require new work practices to support it. Then I analyze how DNI has affected the work practices of BBC staff by presenting three complementary perspectives on organizational change: mutual adjustment based on complex organizational arrangements such as the ones required for long-form productions; the distinctive ways digital video is manipulated by BBC professionals in news and long-form productions; and a comparison between news and long-form productions' usage patterns based on the volume of video content produced (rushes) and the final broadcasted video product. Finally, I summarize my findings by illustrating the importance of the semiotic characteristics of video and how it impacts news and long-form production work practices differently.

Chapter 10 presents the conclusions of the thesis. First, I present a summary of the main findings. I then provide both theoretical contributions and acknowledge possible limitations to the study, both methodological and resulting from my specific research. I then suggest future research that will expand upon and complement my research.

As part of a bigger picture, the case study establishes how the broadcasting industry adapts to the drastic changes brought about by digital video, the internet and multiplatform delivery, which modifies the way in which content is produced and distributed. As I seek to assess how work practices at BBC NI are affected by the use of digital video throughout the DMI workflow, there are two crucial points that I present in this study. First, how digitalization of image-based artefacts impacts differently in two occupational cultures, news and long-form productions and affects the way audiovisual narratives are produced. Second, the semiotic character of digital video, in both syntactic and semantic dimensions, elicits how certain work practices, such as craft editing, cannot be entirely automated or codified. After all, audiovisual narratives are created through work practices that originate from occupational cultures, but also carry the technological properties of digital video information. In these ways, my case contributes to the study of image-based digital objects and the impact of digitalization on work practices in the information age.

2. Research Domain: The Media Industry and Media Convergence

With the possible exception of the military there is probably no other industry that relies as much on technology as broadcasting does.

–Brent McGregor, *Making Television News in the Satellite Age* (2010)

In this chapter, I provide an overview of the media industry with a particular emphasis on the broadcasting industry and how media convergence produces organizational changes within media-related work practices. First, I present the developments that have occurred within the broadcasting industry over the past several decades. I begin with a brief explanation of how the traditional broadcasting industry, based in operational silos and legacy equipments, was transformed by digitalization. The digitalization and unification of the industry is explained through the concept of media convergence. Media convergence has been fundamental to understanding both changes affecting media consumption and how broadcasting organizations envision their work practices when implementing multiplatform delivery strategies in a new competitive media environment. Media convergence has also led to new work practices within the media industry. I explore specific aspects of media work by first reviewing the existing literature on newsroom convergence. I then review writings that address the management of images and video in the media industry. To conclude this chapter, I explain how the internet impacts the media industry's processes and artefacts.

The general objective of this chapter is to provide an overview of the contemporary media industry through the topics and issues associated with my research. Hence, it is my objective to address two aspects of the broadcasting industry that are absent from contemporary research on media organizations: First, there is a lack of studies that emphasize the digitalization and unification of operations, particularly within the

broadcasting industry. There is also a lack of attention on the impact that such operations have on work practices within the industry. Second, there is a noticeable absence of research on the management of long-form productions and other image-intensive practices within the broadcasting industry. Most of the literature on digitalization and processes of technological convergence is embedded within media management and media economics literature. The perspective that media convergence literature offers ignores technological aspects in order to prioritize the discussion on corporate contexts, managerial strategies, professional norms, bureaucratic routines, and socialization (Picard 1989; Cottle and Ashton 1999; Schudson 2000; Picard 2002; Küng 2008; Küng, Picard et al. 2008b). There are also traditional subdisciplines within the media industry literature, such as broadcasting (radio and television), print (newspapers, magazines, journals, and books), and motion picture and recordings (Küng 2008), but none of them highlight the points raised above.

In the context of digitalization and media convergence, it is no longer possible to confine my research exclusively to television broadcasting literature; it is necessary to incorporate research from other disciplines that focus on online media (i.e., websites, portals, information aggregators). Although online media research is a recent development, it offers more substantial insights into the technological aspects of digital media than traditional media studies.

2.1 The Broadcasting Industry: From Specialized Systems toward the Digitalization and Unification of Operations

The history of the media industry has always been related to the expansion of technologies: The use of electrical energy for communication in the early nineteenth century facilitated the first telegraphic systems. Electromagnetic transmission and electronic waves enabled the developments of radio and television. Hence, the media industry is fundamentally based on the use and evolution of technology (Küng, Leandros et al. 2008). For example, television has always involved technologies

related to the ephemeral act of seeing and of instantly connecting content with audiences in real time (Uricchio 2008). Conversely, current technological developments in the broadcasting industry are based on digital systems of codification, the convergence of centralized information, and communication technologies and unified digital systems of information transmission, processing and storage (Thompson 1999).

Unified digital systems are relatively new developments in the broadcasting industry. Until two decades ago, legacy machinery performed specialized functions for most broadcasting production processes. TV broadcasting production was divided into three basic operations: *content creation*, *programming*, and *delivery* (Figure 1) (Küng 2008). Each of these operations, being mostly based on analogue technology, had specialized machineries that were not interconnected, creating working and operating silos.

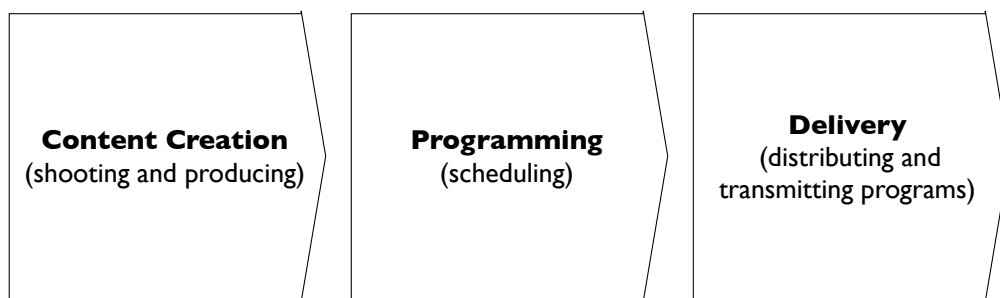


Figure 1: Traditional workflow for the television industry

(adapted from Küng 2008:54)

There are two main considerations to take into account in order to understand the working and operating silos within the broadcasting industry. First, throughout its history, there was a black-boxing of technologies enabled by industry manufacturers to established proprietary standards. For decades, the broadcasting industry was committed to buying hardware from a few manufacturers that were specialized in particular aspects of the media production process. Within specific operations of the media production process, black-boxing technologies was a habitual practice among manufacturers. It enabled the diffusion of proprietary standards and at the same time

prevented potential competitors from developing similar technologies as they were unable to use the proprietary standard that had already been diffused. Second, and as a consequence of the first consideration, being forced to use specialized machineries and proprietary standards for each of their three main operations (i.e., *content creation, programming, and delivery*), the media industry’s work practices became more divisional, aimed at specialized skills that could resolve specific tasks. Thus, many other new suboperations began to emerge from the three basic operations. Most of them required new equipments and additional specialization, which reinforced the notion of operational silos (Hanseth 2000). With regard to specific broadcasting industries (i.e., radio, television) new sub-operations emerged within the workflow (Figure 2). For example, in the television workflow, it was necessary to rearrange and bundle content from external sources to suit particular audiences, a suboperation described as *packaging/aggregating content*, which occurred in-between the *content creation* and *programming* operations. This is just one example of many suboperations that started to emerge in order to manage the evolving TV broadcasting production process. Moreover, as the internet permeated the broadcasting industry, suboperations such as *user interface design*, which involves the ways audiences access content through digital platforms (e.g., web, mobile, tablets, set-top boxes), had to be taken into account (Küng 2008).

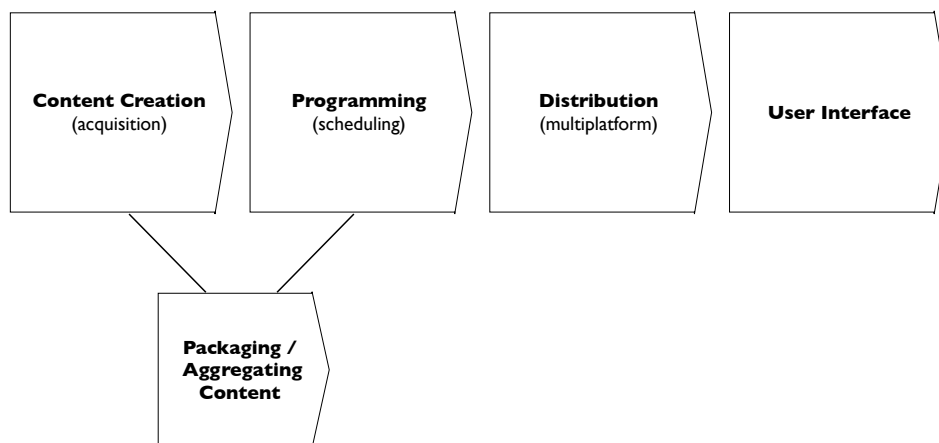


Figure 2: Emerging workflow for the television industry

(adapted from Küng 2008: 55)

The aforementioned working and operating silos generated highly specialized systems that halted the interconnection among the machineries that performed each specific operation. Thus, broadcasting industry professionals had an extensive knowledge of very particular technologies and systems, which led to some inefficient processes and little collaboration. Since time-sensitive capabilities are a foremost necessity in the broadcasting industry, the suboperations emphasized the use of specialized and expensive hardware as a way to make the production process more reliable and resilient.

As the new technologies and machineries demanded particular skills, it also meant that each operation, and some suboperations, demanded distinctive physical, practical and aesthetic capacities for their manipulation. Broadcasting professionals, namely broadcast engineers, became specialists in acting upon this specialized hardware. Although some technologies changed over time, the physical operations required remained very similar. The only standardized flow connecting the heterogeneous assortment of specialized equipments was the electronic impulses generated by video images, which were inscribed into videotapes. The videotape, as a physical entity, was used as a media token that connected all the operations in order to preserve the technical quality of video content. In that sense, videotape had a similar physical value to written paper in the era preceding the desktop computer. The complex setups of machineries set to manage the flow of video throughout the broadcasting operations constructed a sense of physicality that enabled a perception of confidence and control (Zuboff 1988). Incompatibilities among different types of hardware were perceived as irrelevant as long as the quality of the video image was preserved throughout the set of operations. Hence, a significant part of the broadcasting industry's hardware was designed to manage the technical quality of the video recordings, which reinforced the idea that specialized equipments were interdependent with each part of the media production workflow in order to obtain the highest image quality for the final video product.

Some media literature, mostly from the subdisciplines of media management and media economics, suggests that the technological advances currently driving the

media industry include digitalization, the internet, and streaming technologies (Küng 2008; Küng, Picard et al. 2008b). Though not far from the truth, digitalization and the emergence of the internet took place simultaneously; it is therefore difficult to interpret their impact independently of one another. However, it can be asserted that digitalization rendered a discrete set of legacy machinery and hardware infrastructure into software tasks and instructions. *Content creation, programming, and delivery*, the three basic operations within the traditional television industry workflow, were unbundled as a series of interconnected software processes that were also part of a larger unified computational system. Digitalization brought the unification of operations into a new systemic configuration (Zuboff 1988; Küng, Picard et al. 2008a). Whereas digital technologies brought the proliferation of both media content and platforms, the dynamics of the internet prompted the development of emergent business models for digital content distribution (Brown and Eisenhardt 1998; Küng 2008; Economist 2010; Kim 2012).

Digitalization is perhaps the most important and drastic change that has occurred in the television industry in recent decades. Digitalization demands the progressive dissolution of the physical artefact (the videotape) into digital tokens available as streams of data circulating smoothly through computer systems (Williams 2003; Uricchio 2011). The unification within a task space (computer) and task procedures (software) has reconstructed the secluded processes of legacy equipments into a new unified computational system. Video data files running through a database have replaced the videotape and VCR hardware. For the first time, all media content is centralized in a unified database. Computer programming encapsulates the broadcasting world according to its own logic (Manovich 2001). Media work has been, in part, reduced to managing the logic of data structures and computer algorithms, a sequence of operations that a computer can execute to accomplish a given task. Unification of broadcasting systems has introduced the possibility to access video content from any computer connected to a network (or the internet). Digital video assets are formatted to specific standards and stored on a database that involved two main requirements in order to be accessed. First, digital video must be searchable on a digital repository. Second, the integration of disentangled systems and

processes are a prerequisite for securing digital video passing through a unified digital workflow. Geert Lovink (2008) has suggested that since the digitalization of the media industry, viewers no longer watch films or TV, but watch databases. In that sense, the database has turned out to be the cognitive information path through which audiences are able to consume video content.

Digitalization has caused data to be organized in a particular way that enables efficient search and retrieval. The need for information that describes each digital video clip, commonly referred to as metadata (chapter 3), allows users with search skills to manipulate digital video (Liu 2004; Stiegler 2009; Uricchio 2011). Metadata, as Bernard Stiegler (2009) asserts, produces a *textualization of images*, a technological dimension to video production and consumption similar to searching Google or YouTube (Manovich 2001; Lovink 2008; Stiegler 2009; Uricchio 2011). I describe and analyze the *textualization* of image-based video content throughout my empirical work.

The digitalization of the media industry has not only increased the range of content accessible to media audiences but is also the main cause of the current fragmentation of the media environment. Philip M. Napoli (2011) argues that the fragmentation of the media environment can be broken down into two distinctive types: *inter-media fragmentation*, the increasing number of new technological devices and the ways in which content can be accessed; and *intra-media fragmentation*, which consists of processes that subdivide the choices within particular media technologies (i.e., broadband speed capacity, channel capacity) due primarily to the progressive digitalization of analogue media. *Intra-media fragmentation* also involves the phenomenon in which media content is disaggregated into discrete units and more granular bits and pieces (Kallinikos 2006; Napoli 2011). The disaggregated consumption of digital goods, particularly on the internet, in contrast to the traditional analogue media products (e.g., music tracks instead of music albums, book chapters instead of books, TV clips instead of TV series) brings new economies of scale and niche markets to the media environment (Anderson 2006; Benkler 2006; Lessig 2008; Anderson 2009). The homologation of a digital infrastructure and the consumption of

digital goods have contributed to media convergence, as I illustrate in the next section.

2.2 Media Convergence

Media convergence is an umbrella term indicating the disintegration of the boundaries that once separated traditions, practices, and actors in the mass media and entertainment industry (i.e., newspapers and printed media, TV and radio broadcasting, cinema and performance, video and games). Media convergence appears to answer the broadcasting industry's struggle to find a viable business model in the media environment as technological convergence offers new and fragmented modes of engagement (Smith 2009). It is also important to define what is meant by the term "media" in this context. The American media scholar Henry Jenkins, who is considered one of the initiators of the discussion around the concept of "media convergence", borrows his definition from media historian Lisa Gitelman. Gitelman explains that "*a medium [media] is a technology that enables communication; [...] a medium is a set of associated 'protocols' or social and cultural practices that have grown up around a technology*" (Jenkins 2006: 13). Jenkins emphasizes that what distinguishes media from simple delivery technologies media "*persist as layers within an ever more complicated information and entertainment system. A medium's content may shift, its audience may change and its social status may rise or fall, but once a medium establishes itself it continues to be part of the media ecosystem*" (Jenkins 2001: 93). Thus, in a media ecosystem, old form of media co-exists with new form of emerging media.

Jenkins (2001) describes five types of convergence that are redefining the current media ecosystem: *global, organic, economic, technological, and cultural*. *Global convergence* refers to the worldwide distribution of media content in all its forms and how media content influences other media content; *organic convergence* describes an

audience's ability to multitask by engaging with multiple messages at one time, which enables the user to become involved and participate in the media storytelling process; *economic convergence* involves the interest of media conglomerates to incorporate new divisions and companies in order to generate a multiplicity of content in all available media formats to constantly engage with their audiences (i.e., Time Warner, News Corp, Viacom, Disney); *technological convergence* describes the digitalization, interoperability, and unbundling of media content to facilitate its transmission across a diversity of platforms (e.g., TV, web, radio, print, mobile, games consoles); and, finally, *cultural convergence* involves the flow of stories, images, brands, and relationships across different media in which consumers actively participate (Forte Duhe, Mortimer et al. 2004; Jenkins 2006; Holt and Cameron 2010).

It is also important to note that *cultural convergence* is inextricably tied to *technological convergence* (Williams 2003; Jenkins 2006; Uricchio 2010, 2011). Jenkins underlines the importance of technological interoperability to accessing content with the case of the NTSC standard for analogue TV delivery.⁵ The United States and Japan shared the NTSC standard, which facilitated the exchange of content across national borders. The exchange of content made popular certain television genres, such as Japanese animation, which has had a significant cultural influence in the United States since the 1960s. Hence, *technological convergence* is fundamental to *cultural convergence* as different technologies, production systems, traditions, and practices overcome the seclusion of communication-based traditions of text, sound, and image to become integrated into the same platform.

As Figure 3 illustrates, previously unconnected industries (i.e., telecommunications, IT, broadcasting) that once depended on different technological standards evolved toward a single common standard, the Internet Protocol (IP). This model, commonly expressed as the *3-C model of convergence* (Negroponte 1996; Küng 2008), explains how the internet and digitalization have been instrumental to merging practices of

⁵ NTSC is an analogue television system used in Japan, the United States and parts of Latin America. There are other formats available, such as PAL (used mostly in Europe) and SECAM (used mostly in Russia).

audio, video, telecommunications, and data industries into a common technical platform (i.e., IP). The IP unites activities that were previously unconnected. Thus, it can be stated that while media convergence generates more information in standardized formats (*technological convergence*), it also fosters the distribution of content, which has deep repercussions socially and institutionally (*cultural convergence*).

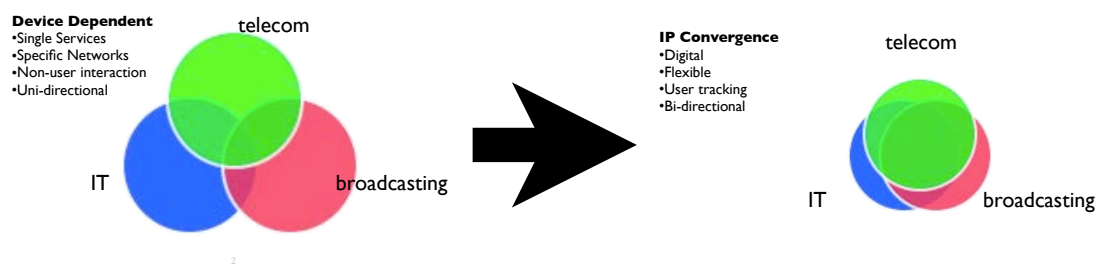


Figure 3: 3-C model of convergence: the merging and evolution of different industries into a common technical standard, the Internet Protocol (IP)

The influx between *technological* and *cultural convergence* fuels media groups' production of broad and complex content-based experiences in all type of media properties. The substantial consumption of content, from books to amusement park content, is described by Jenkins as follows:

[N]ew patterns of cross-media ownership that began to emerge in the mid-1980s during what we can now see as the first phase of a longer process of media concentration, were making it more desirable for companies to distribute content across those various channels rather than within a single media platform. Digitalization set the conditions for convergence; corporate conglomerates created its imperative. (Jenkins 2006: 11)

Digitalization has stimulated a shift in the former modes of production, distribution models, and delivery formats of cultural information. Such a shift implies a substantial redistribution of institutional actors' roles and benefits as well as bitter

struggles among the old and new media companies (i.e., the BBC vs. YouTube; Universal Music Group vs. Spotify; Barnes & Noble vs. Amazon). Hence, as Smith remarks “*convergence and divergence are complementary and not opposing forces. Dispersing content across a wide range of delivery channels (divergence) ensures multiple points of entry into a single media franchise (convergence). Similarly, dispersing narrative information across a wide range of channels (divergence) encourages consumers to pull together all the information and form a unified story (convergence)*” (Smith 2009: 12).

2.3 Media Work

In recent years, media scholar Mark Deuze has researched extensively the work practices of media professionals in the midst of media convergence. His work provides an account of how technologies, particularly the internet, have impacted their skills in a wide variety of disciplines. Deuze (2007) mentions that the introduction of new media technologies speeds up the creative process and contributes to a cultural phenomenon characterized by the desire to do and learn more in addition to existing competences, skills, and talent. However, technological convergence can be considered problematic for media practitioners who see themselves as “slaves” of the technologies and standardized processes that limit their range of creative options. At the same time, media convergence has enabled media workers to create and produce stories and films for a variety of platforms in order to engage the audience (Deuze 2007). Creating content for a variety of platforms and emerging technologies such as the internet requires media workers to constantly adapt their skills and roles.

Deuze (2007) lists some aspects that are unique to media work in comparison to the work practices in other industries, such as:

[T]he tendency of cultural companies to cluster in specific urban areas; the

risky and unpredictable nature of the media business; the complexity of controlling and collaborating with creative individuals in the context of project-based labour and commercial enterprise; and the pervasive nature of technology and information management in all aspects of the creative process. (Deuze 2007: 63)

Technology plays a crucial part in the creative practices and daily work environment in the media industry. The skills for manipulating technology in the media industry involve gathering, selecting, organizing, and communicating information (Deuze 2007). A significant concern regarding such skills lies in the use of standardized media formats. As media types (i.e., video, audio, images, text) become translated into the digital world through standardized formats, the repurposing of content also becomes easier to manage.

Existing academic literature offers an overview of how media work is affected by technological changes. I present a selection of the literature that is relevant to the work practices of both news and long-form productions. In order to connect the literature to my research, I have chosen writings on newsroom convergence. Since the literature on long-form productions is limited, I also provide an overview of the management of image-based content in the media industry. Though most of the literature available on image manipulation is also related to news production, it is possible to extrapolate it to most long-form productions; image manipulation is one of the most distinctive practices of long-form productions.

2.3.1 Newsroom Convergence

Argentinean media scholar Pablo Boczkowski states that media convergence should be seen “*as a contingent process in which actors may follow diverging paths as a result of various combinations of technological, local, and environmental factors*” (Boczkowski 2004: 210). The production and distribution of convergent news content has been proven and stressed in newsroom environments for nearly two decades

(Zoch and Collins 2003; Boczkowski 2004; Dupagne and Garrison 2006). In one major study, David Domingo (2007) revealed that 60 percent of Spanish media companies interviewed developed some form of newsroom convergence (although generally speaking, the ones with full multimedia newsroom integration were still a minority). In 2007 the manipulation of images and video within news production was still in its infancy, but the study also indicated that media companies' strategies centered on audiovisual and online media in order to make journalists more capable of managing multimedia content (Domingo 2007). Domingo (2007) also states that there was a lack of research on the dynamics and convergence in different media settings in which heavy technological developments had been implemented.

Some studies known for being successful convergence research cases (e.g. *Tampa News Center* as covered by *Tampa Tribune*, *WFLA-TV*, and *TBO.com*) have kept their business and management operations separate, with staff cooperating rather than working in a single converged organization (Dupagne and Garrison 2006). Such studies stress that the reasons for keeping business and management operations separate may involve elements such as language, cultural clashes and acceptance of models (Silcock and Keith 2006). Thus, most of the problems involve the different and isolated organizational practices developed by media workers for creating content as well as managing work processes, depending on the media delivery being used (i.e., newspaper, TV, radio, online).

Dupagne and Garrison (2006) also mention the lack of research on how convergent news operations affect news practice, roles, and culture. The main theme provided by their interviewees involved the ample sharing of available resources due to convergence and the interoperability of different information resources (Dupagne and Garrison 2006). Resource sharing requires a platform. The authors mention that in the case of the *Tampa News Center*, its information system, BudgetBank, caused journalists to perceive an increased number of shared story ideas and story tips among them. The argument may suggest that information repositories and digital libraries enable better cognitive perception with regard to information access and retrieval (Dupagne and Garrison 2006). Similar cases, such as the one in which journalists at

CNN reuse content through a digital database, reinforce the argument (Küng-Shankleman 2000).

In other strands of research, Juan Antonio Giner (2001) addresses the importance of the internet as a catalyst for multimedia integration in how it enables the convergence of the existing media (Giner 2001). Meanwhile, Bressers (2006) focuses on how innovation improves organizational strategy. His work is based on a survey that studied organizational and management issues, communications, sharing of resources, and workflow and content issues (Bressers 2006).

In general, there is managerial pressure to produce news material for multiple media that constrains the journalist's ability and creativity; they have to perform more tasks than before within the same short period of time usually required by the news environment (Cottle and Ashton 1999). Cottle and Ashton (1999) go further to discuss how multi-skilled journalists represent a threat to other specialized professionals, such as camera operators:

Video journalist cameras (VJ Cams) and digital video cameras (DVCs), have also been piloted by the BBC in Bristol (and other regional centres). These small lightweight cameras have proved to be one of the most controversial elements in the sweeping technological changes underway. Clearly they pose a threat to skilled camera operators' jobs and, according to their critics, can lead to a deterioration of picture and sound quality given the increased workload of single crew operators expected to produce simultaneously for different media. (Cottle and Ashton 1999: 31)

Due to changing technology, the journalist can perform additional roles that only specialized professionals were once capable of fulfilling. However, the quality of the work is then possibly jeopardized by the fact that a single person is undertaking multiple jobs within the same limited time frame afforded to news production.

From the different publications reviewed, I deduce that newsroom integration was

initially implemented because of *economic convergence*. In general, the news organizations within the media industry have followed a standardized process that is intrinsic to news organizations in general. In terms of media work, journalists started to perceive that there was an ample amount of information available in their digital library, which prompted the reuse of content. Finally, newsroom convergence stimulated the emergence of a new multi-skilled journalist capable of writing (scripting) and shooting images, and then editing their work on video desktop editors.

2.3.2 Image-based Content in the Media Industry

Current mass media communications are faster and use more visual elements than ever before, such as photographs, infographics, and video. The success of CNN, for example, lies in how these elements are associated with both a “dynamic” media culture as well as large and consistent strategic investments in developing news gathering infrastructures at an organizational and technological level (Küng-Shankleman 2000; McCargar 2004).

As previously mentioned, there is insufficient literature on long-form productions and the manipulation of image-based content (both still images and video) in the media industry. One reason for this lack might be that video repositories (digital libraries) are still not being deployed on a large scale, but it might also be due to the scarcity of research on broadcasting media in general (Erdal 2007). Hence, the following overview is composed of extracts from existing literature that mentions the management of digital images and video in media organizations, particularly within the case of news production.

Zoch and Collins (2003) use a survey of self-administered questionnaires to delve into issues related to multiple-media newsgathering. Their results show that almost 80 percent of respondents (i.e., journalists) stated that they were using audio and video to gather news on their websites, but only 40 percent stated they were able to do so efficiently. They also mention briefly that multiple-media stories are primarily

assigned to “tech-people” since they are more literate in terms of the management of technical equipment. Other literature also draws attention to the changing roles of the photographers, who, in many cases, are also shooting video while in the field. Videographers, as well are also carrying cameras for shooting still images. The expanding practices of videographers and photographers demonstrate the ways in which roles are shifting within the media industry (Stevens 2002; McCargar 2004; Dupagne and Garrison 2006).

Bossen, Davenport, and Randle (2006) examine photography’s transformation with the advent of digital news production and how it affects the creation and preservation of photographic records. Their research shows that fewer digital images are archived than images shot with analogue film cameras, though the net effect seems to be that digital photo archives are increasing in storage size due to higher resolution (Bossen, Davenport et al. 2006). Tasks that were originally performed in a darkroom, such as the selection and reviewing of photographs, are now completed by a team in the newsroom and in more collaborative fashion. Russial (2000) mentions that in convergent and digital newsrooms, the analogue photographic processes are not necessary (e.g., darkroom photo manipulation). Hence, a number of routine tasks (mostly required for analogue image reproduction) were eliminated, leaving the editorial department to complete the image selection process. Consequently, some photojournalists felt a loss of control with regard to the image selection process (Russial 2000).

Zavoina and Reichert (2000) explain how the convergence of *The Dallas Morning News* and *The Fort Worth Star Telegram* ascribed importance to media workers experienced in managing image-based content by implementing new roles, such as Visual Editor, Visual Journalist, and Web Director. The new positions clearly outline the changing skill set used on the job and the way in which visual media was managed. They were called on to conceive part of the news-gathering strategy and how information can serve in each media delivery, an activity closely connected with information repackaging. It can therefore be inferred that the visual jobs have become increasingly appreciated today.

Media workers have become more aesthetically reflexive and semiotically literate as they are increasingly aware of matching colors and texts and are also manipulating them through technology (Lash and Urry 1994). In the media industry some of the most dramatic and apparent organizational changes are happening because of the ways in which the production of digital images is being managed. However, there is little literature in relation to the organizational and technological impact of those changes as most media organizations were until recently still in the process of deploying fully-digital processes and systems (Deuze 2007).

2.4 The Internet and the Media Ecosystem: Processes and Objects

An important amount of digital content is provided through an increasing array of technologies and distribution platforms (Gantz 2007; Gantz, Chute et al. 2008; Gantz and Reinsel 2011). Within many of these distribution platforms, such as the internet, individual technologies continue to expand their capacity to deliver content, contributing to the disintegration of “mass” audiences and increasing the prominence of niche “long-tail” scenarios that in aggregate can exceed the reach of “mass” audiences (Anderson 2006). Furthermore, despite a proliferation of new set-top box products (e.g., Sky Go, AppleTV, TiVo, or YouView) today’s consumers feel that TV has not kept up with progresses brought by the internet. Consumers are used to recommendation and search engines (e.g., iTunes, Amazon, Google, YouTube) and the interoperability of their media assets to be used in a diversity of platforms.

The media ecosystem is based on an ensemble of the processes, systems, operations, and devices that make possible the production, mixing, and dissemination of digital content. The digital content spans across the semiotic traditions of text, image, sound, and the institutional compartmentalization of culture to a variety of genres such as films, photographs, comics and games, news and music, among others (Kittler 1999; Jenkins 2006).

In the information affluence underlying this ecosystem, findability and the interconnectivity of content are requirements that necessitate the technical compatibility of the varieties of systems and information. They also demand that the presentation of content in cultural and cognitive forms is appealing to the users. It is important in this respect to point out that the growth and social involvement of the internet have not only made possible new ways of communicating and exchanging information and culture, but have, in addition, shaped consumer expectations and user behavior (Shapiro 1999; Silverstone 2007; Shirky 2010a). The digital consumer is accustomed to the fact that information and information-based cultural artefacts are readily accessible and interoperable (Deuze 2007). Therefore, it comes as no surprise that packaging content in ways that allow it to be readily viewed, accessed, consumed, or acted upon by the viewers has acquired vital importance in media organizations (Aitamurto and Lewis 2013). Accordingly, the new generation of media producers is creating and enriching experiences through aggregating and mixing, as well as categorizing and finding content (Kallinikos and Mariátegui 2011).

The prospect of not catching up with the technological developments propelled by internet information aggregators (e.g., Google, Yahoo!, YouTube, Amazon, eBay, Facebook, Twitter) is threatening not only traditional broadcasting media (i.e., TV, radio, newspaper), but also the entire media industry (i.e., record labels, film producers). The last decade bore witness to the consolidation of several players in the media industry and the inclusion of internet companies and services inside their portfolio (e.g., MySpace, Last.fm, Hulu, YouView, BBC iPlayer), as well as the *de novo* emergence and rapid diffusion of internet information aggregators. Seen through this lens, some traditional media (such as TV) are understandably trying to embrace the new media. The common and assertive response to the problem is associated with multiplatform delivery of content. As economic consolidation has taken place over the last decade, many media organizations have sought to digitalize and merge their different operations to respond to the challenge of media convergence (Dupagne and Garrison 2006; Jenkins 2006; Lawson-Borders 2006).

As new technologies enter the market, new business models are being developed that

will also have an impact on the way we consume media. A recent example is Netflix, which started as a DVD rental company and after a few years shifted to a digital distribution model using the internet. Today, Netflix also produces TV series, such as the political drama based on the classic UK series *House of Cards* (Satell 2013). Netflix allows their customers to watch all 13 episodes of the series directly online. Hence, their way of distributing series is also challenging broadcasting's traditional programming schedule model. Schedules, budgets, methods, and practices are converging into a predominantly digital experience. As new convergent models appear in the market, television will have to converge with the dynamics of the internet.

Routines that for most of the media industry's history have been accomplished through manual processes are becoming automated into an encoded and structured data discourse (Liu 2004, 2008). The intention to automate the "non-creative" practices of media management as much as possible is perceived as a way of liberating and redirecting human creativity to the most important and innovative areas of media production and to ease the learning of new competencies and skills (Deuze 2007). However, as much as it liberates, the automation of these manual processes reinserts human effort into new and often complicated arrays of procedures and tasks. New combinations of procedures and tasks reconfigure the creation and production of media content in its entirety. These trends constitute a challenge for the media industry, which has been a relatively secluded organizational environment. For decades, the media industry's main focus was the production of content, rather than its findability and accessibility.

In this chapter, I reviewed the recent literature on the current state of the media industry and media convergence. Most studies of media organizations have not yet taken into consideration the technologies that are of due importance in the current transformation of work practices across media organizations, particularly with regard to the management of image-based media. Finally, I outlined the different processes and objects, such as findability, interoperability, and interconnectivity, that play a substantial part in the current media ecosystem as it is being impacted by the internet.

3. Deconstructing Digital Video and Metadata

We no longer watch films or TV;

we watch databases

– Geert Lovink, *The Art of Watching Databases* (2008)

The technical aspects of digital video are usually neglected when approached from the angle of media convergence or the history of the broadcasting industry. However, more than 50 percent of current internet data traffic is due to the use of digital video (Anderson and Wolff 2010). Recent studies suggest that the sum of all forms of digital video (TV, VOD, internet, and P2P) will continue to exceed 86 percent of global consumer data traffic by 2016. Internet video alone will account for 55 percent of all consumer internet traffic in 2016 (Cisco 2012). In spite of these projections, technical accounts of digital video only occasionally appear in the introductory pages of technical books on video compression or video production (Apple Computer 2000; Waggoner 2002; Richardson 2003; Taylor and Armbrust 2005).

As digital video is my main object of study, in this chapter I seek to analyze the historical and ontological aspects of video and its incarnation as a *technological construct*. I first examine the historical evolution of video, from its material or physical origins (e.g., printed image), which dates back to mid-nineteenth century photographic printing, to its non-material characteristics as a contemporary media object. Then, I describe three stages in the historical evolution of the image: the *image-object*, the *moving image* and the *digital image* (Brea, 2010). In order to address the crucial role that internet technologies associated with digital video currently have, I then analyze the case of a particular digital video playback standard, MPEG, which is the basis of most digital video available on the internet as well as in the broadcasting industry. MPEG has evolved, since its first public release date in 1993 (MPEG-1), becoming the most widely used method for playing digital video (Chiariglione and Magaudda 2012). My intention is to drive the discussion on how the

material perception of video has shifted in the digital landscape toward software-based functionalities. In addition, I outline the attributes of metadata, one of the most important technical layers in digital video that acts as the mediator between the video content and the search functionality. This chapter also lays the groundwork for my arguments regarding the technical and audiovisual layers of digital video, which are analyzed in chapter 9.

3.1 The Ontological and Technical Complexities of a Medium

Video is usually defined in terms of the consumption habits related to watching it, either through TV or, more recently, through emergent platforms such as the mobile phone, PC or tablet (Napoli 2003, 2011). However, digital video specifically should be seen as a technological artefact that has been able to dynamically adapt itself to a diversity of multimedia devices. Digital video's technical specifications are able to support forthcoming computational platforms as well new formats, operating systems, and software applications, which are part of the constantly changing media landscape (Chiariglione and Magaudda 2012; Deuze 2012).

While video is generally characterized as a *medium*, to understand video today it has to be envisaged as possessing a higher order of complexity. Video is a construct, not just feats of engineering. The elements from which video is composed define its technical characteristics and how it has been influenced by the internet and the media ecosystem. Convergence is an outcome of such reasoning, since the technological elements that comprise digital video are also shared with other media (Jenkins and Green 2012). If technological innovation is a process of the constant reassembling of old parts into new forms, then technologies are also containers of history, and the past accumulated in them is what composes their current state. Hence, the commonalities that video shares with other media require historical contextualization in order to analyze the different technologies that have come into play and what roles they fill.

3.2 Material Origins: From the Printed Image to Video

Video is not easy to define. Etymologically it derives from the Latin verb *videre* meaning “I see”, which connotes the direct relation of video with the realm of images. The development and evolution of the technical image has been systematically studied (Mitchell 1980; Benjamin 1986; Debray 1992; Mitchell 1994; Carroll 1996; Flusser 2011), but video stands distinctively on its own due to several particularities. Although video was initially composed of a sequence of images (frames) at a determinate number of images per second (frame rate), during the last century it also incorporated sound to become an audiovisual ensemble. Media philosopher Siegfried Zielinski, while studying the “archaeology of media”, rightly defines the assemblage of video and sound as *audiovision* (Zielinski 1999). For this reason, the study of video as a technical artefact does not conform to a single media definition. Rather, it consists of a complex set of layers of technologies that, when arranged together, define the technological object. As I discuss later, most of the history of video has been focused not only in terms of visual quality considerations, but also in terms of its transmission. Several attempts were made in the mid-twentieth century to improve the transmissibility of moving image formats. Such was the case of the 16 mm film gauge, which, by using acetate film stock, attempted to expand usage to include household. Thus, the presence of film in private homes also generated the development of new social spaces such as the “home cinema”. The subsequent introduction of 8 mm film also indicates the importance of transmissibility. The television itself epitomizes the importance of transmissibility: the TV set replaced most home cinemas of the early twentieth century in favor of instantaneous content. Since the beginning of the twenty-first century, the TV is now complemented by content in other apparatuses (e.g., phones, tablets, game consoles, VOD consoles) and technologies (e.g., Facebook, YouTube, iTunes) that also offer the convenience of video transmissibility.

3.2.1 Historical Considerations: The Genesis of Video

In *The Raster Screen and the Database Economy*, Sean Cubitt states that hardware is a response to software studies (Cubitt 2009). Thus, understanding the physical infrastructure has an increasing importance for the evolution of artefacts and the study of their characteristics in terms of digital objects. The genesis of video can be traced back to the nineteenth century, when William Henry Fox Talbot, a pioneer of photography, “made the earliest known surviving photographic negative using a camera: a small photogenic drawing of the latticed window in the south gallery of Lacock Abbey” (Olson, Brewer et al. 2012). “Continued experimentation by Talbot led to a breakthrough when he discovered that paper treated with a coating of silver iodide, exposed in camera, and developed in gallic acid mixed with silver nitrate and acetic acid would evoke a latent image” (Link 2012). The process used to create the image of the latticed window was used for what is known as a raster today, to separate a screen into a set of small cells (or small screens). The raster procedure enabled the making of photography as an industrial process that revolutionized the printing press into rotary presses (circa 1873). Therefore, to some extent, video has an early connection with photographic printing as both were founded upon the same technical principle.

Many decades after Talbot's photograph, in 1935, Bell Labs wirephoto applied the raster schema to the first commercial photo transmission system (also known as the telegraphic image transmitter), which was able to send an image over the wires to 25 US cities up to 3,000 miles away within one hour. The procedure required scanning an image with a rotary scanner that rendered the image cell by cell, from left to right. The image was then sent through electric impulses. In 1936, the German Post Office developed the world's first public video telephone service between Berlin and Leipzig, covering a distance of approximately 100 miles. A few decades later, TV's cathode ray tube also began to be based on a raster scan. The cathode ray tube directs beams in lines (scan lines) across a screen: the horizontal sweep controls the number of lines on the screen, while the vertical sweep controls how fast each screen is

displayed. Consequently, video incorporated information about both its image quality as well as how fast each frame had to change. As the Computer Desktop Encyclopedia references, computer monitors and TVs today “*use a similar method, whereby electrons are beamed (scanned) onto the phosphor coating on the screen one line at a time from left to right starting at the top-left corner*” (Freedman and Morrison 2011). It can be said that the cathode ray tube functions with a similar principle as print: illuminate or not illuminate (i.e., similar to the 0s and 1s of binary code). The concept of the computer pixel also derived from a manifestation of the TV raster. Hence, the evolution of images and moving images has a clearly traceable history in which new media clearly borrow from the technical aspects of the technology that preceded it.

3.3 Non-material Renaissance: From Digital Video to a Data Object

Initially, playing video on computers or other emerging devices was not an easy task as it demanded, in technical terms, specialized hardware (e.g., video cards, hardware accelerators), the software to play a collection of hundreds, or even thousands, of still frames at a defined rate per second and the synchronization of those images with sound. Furthermore, moving images and sound were based on different formats that had to be brought together in an embedded and unified digital package.

During the advent of digital video, there were other technical considerations that had to be taken into account, such as differences between the sampling rate of the images in a TV monitor and a PC monitor. In video, the sampling rate is the rate at which an image repeatedly appears on the screen. Initially these samples were a series of complete frames (called *progressive* sampling) but in analogue TV, this required a larger bandwidth. At the same time, requiring larger bandwidth meant that the entire production and broadcasting process of video (e.g., cameras, tape recorders, broadcast systems) became more expensive and complex. In order to reduce the signal bandwidth, video was sampled in a sequence of *interlaced* fields, in which half of the

information in a frame (one field) is sampled at each temporal sampling interval. Interlacing has been an important attribute and is still used today for most standard definition TVs.

Since digital video is free of many of the limitations analogue TV transmission formats faced, *progressive* sampling was reintroduced and used in new TV displays (i.e., LCD, plasma displays). As a result, *progressive* sampling provided the means to convey and present digital moving images regardless of variations in video standards.

A similar change occurred with the equipment used to display and record images, namely, the video players and recorders that were used in the media industry for decades. One of the main manufacturers, Sony, serves as an emblematic case: it developed several analogue formats that became standards in the broadcasting world, such as U-Matic (3/4 inches tape) and Betacam.⁶ These two standards have been used for the past four decades and millions of hours of material are recorded and archived in these two formats. However, physical standards have their drawbacks. In the case of both U-Matic and Betacam, both physical tapes were made available in two sizes (the smaller tape size was created for the introduction of portable record players used for field productions). Different tape sizes mean that the player deck requires a level of mechanical complexity in order to accept both sizes. The commercial ownership of both professional standards by a sole manufacturer (Sony) add a constraint. Sony's proprietary technologies dominated the professional broadcasting market for years and limited its evolution to new efficient formats. The expansion of information technology eventually promoted the replacement of analogue technology in favor of digital equipment. As many popular sources refer to, digital video was initially introduced "*in 1986 with the unveiling of the Sony D-1 tape format, which recorded an uncompressed standard definition component video signal in digital form*" (StudyMode.com 2008). However, as it was also a proprietary standard, D-1 was expensive and its use was restricted to large television networks.

⁶ See chapter 5 for more details on the evolution of Betacam in the media industry.

The perishability of tapes and the introduction of new consumer and “prosumer” (professional consumer) formats that were more efficient, portable, and of the same (or even better) quality made the limitations of proprietary technologies in the broadcasting industry apparent. Videotape systems were eventually replaced by cheaper software-based tapeless solutions, which did not depend on specialized hardware. Being based on software, the new tapeless solutions eventually became standardized and interoperable. Software redefined the notion of a “moving image” as a composite of multiple layers of digital video content embedded into a sole file format (Manovich 2011). Creating films and videos required the use of software that was based in the manipulation of digital video. Software for video manipulation unbundled digital video images in order to perform specialized tasks and processes. Software packages for digital video manipulation ranged from 2D and 3D animation to editing software that cut video into pieces to other software packages that were able to manipulate specific video characteristics, such as color or texture. Most software packages complemented each other to construct a final video narrative. As new software packages started to appear, media workers needed to understand the technologies available in each piece of software in order to decide if its use would achieve the desired visual outcome. As software packages became more sophisticated, more technical specifications embedded in their digital video technical layers were necessary in order to handle the greater number of requirements. As new technical opportunities became available for the manipulation of digital video it became necessary to incorporate new features such as higher image resolution or color space (Richardson 2003). Video could harbor different types of technologies within its technical layers; digital video was no longer arranged solely through its visual constitution, but also through its technical layers.

During the 1990s, as computer-based digital video editing become available, the first tapeless formats became available for commercial use. The content (video) was separated for the first time from a particular container type (videotape). Digital video was primarily stored on specialized hard disks, servers, and tape backups.⁷ The two

⁷ Without going into detail here, in comparison to consumer-grade data storage, broadcasting industry data storage requires a high degree of redundancy in order to be reliable in a large work environment.

most important aspects of tapeless video at this early stage was the relation between the image quality and the data storage size: the higher the image quality, the more data storage a digital video file required. As time passed, better image compression algorithms were developed, which enabled more efficient data storage. Initially, those image compression algorithms required specialized hardware in order to play digital video smoothly. This brought more specialized equipment to the broadcasting industry. In spite of their efficiency, hardware graphics cards that worked with proprietary algorithms also generated a variety of diverse and incompatible video formats in the market. Broadcasting companies had to limit their business to certain manufacturers if they wanted to reduce the complexity of their setups and at the same time have an efficient and streamlined system. In order to reduce such complexity, broadcasting companies started to use standard digital video formats, such as MPEG, as is described in the next section.

3.4 The Evolution of the Image: From the Image-Object to the Digital Image

As I have described, perceptions and understandings of what constitutes an image have evolved throughout the centuries. To understand the digital image, I consider three stages in the historical evolution of the image: first, the *image-object*; second, the *moving image*; and finally, the *digital image*, as it is depicted by media philosopher José Luis Brea (2010).

The earliest conception of the image as an *image-object* was inseparable from its technical regime, comparable to text and its paper support (Zuboff 1988). For centuries, the image's physical constituency and its content were both embedded into a single object (Brea 2010). Consequently, the technique was inseparable from the object. Production encrusted into materiality maintained a *form* and a *sense* of immutability (Latour 1986). The embeddedness of the image with its material

substrate meant that it was indissolubly tied to a particular support to conform to an *image-object*. To sustain and maintain the *image-object*, a regime of institutional settings such as museums and libraries emerged. These institutions took care of both the *image-object*'s materiality (i.e., preservation) as well as its access (i.e., communication, diffusion).

The second predominant approach to the image was characterized by the *moving image* (film and later, video). Lev Manovich states that moving images were initially seen as an extension of a better known technical artefact, photography:

When cinema in its modern form was born in the end of the nineteenth century, the new medium was understood as an extension of [an] already familiar one – that is, as a photographic image which was now moving. This understanding can be found in the press accounts of the day and also in at least one of the official names given to the new medium– “moving pictures”. (Manovich 2011: 159)

The *moving image* overcame the *image-object* regime, as it required an evident set of machinery as part of its support. The apparatuses used were specialized in particular operations. Machines were specifically conceived for shooting (i.e., cameras), developing film through a chemical process (i.e., film processing equipment), for editing the film strip to produce the final story (i.e., moviolas), and for viewing the film in a theater or at home (i.e., projectors). Nonetheless, the moving image was also embedded in some type of physical support, such as the filmstrip. This meant that the machinery that performed a particular set of operations was only compatible with a particular type of physical support (e.g., 35 mm filmstrips could only fit on 35 mm film projectors). Such a tight coupling of processes generated specific task-based equipments and specialization that resembles what occurred in other industries before the digitalization of their operations (Zuboff 1988; Kallinikos 2006).

As previously mentioned, due to tight schedules, preparation, and portability, the media industry required more efficient ways to record images that would reduce the

cost and speed up the film development process. In the late 1950s, magnetic videotape became popular in the media industry as it reduced the costs of film recording and live broadcasting. The use of videotape spread rapidly for pre-recorded broadcasts and news presentations on television. However, it was slowly introduced in long-form TV productions and commercials (TV ads) despite its advantages and cost-efficiency. One reason for its slow emergence was that the editing process significantly differed from film, and therefore required a new set of trained operators. As magnetic videotape began to replace film, the number of videotape formats exploded to several dozen. Each videotape format had better features than previous ones, but brought further complexity to the manipulation and maintenance of legacy machinery as its management required specialized equipment that worked on operational silos. As Clay Shirky recently surmised, “*the economics of video required for a long time that it had to be complex to be valuable*” (Shirky 2010b). Hence, most broadcast productions demanded the use of a complex ecology of disparate and specialized technologies.

The third evolution of the image was the switch from magnetic videotape and film-based media to tapeless solutions, like recording on hard disk drives, memory cartridges, optical discs, and other types of digital memory media. Digitalization, as I discuss further in subsequent chapters, has turned the *image-object* into a *data-object* that generated a set of cognitive skills similar to the ones required for electronic text manipulation (Manovich 2001; Weinberger 2007). The electronic image, however, not only requires mental abstraction, but new cognitive skills to navigate and manipulate visual codes inside a perceptively ubiquitous media ecosystem.

A new cognitive relation with electronic images emerged in media organizations, that was further expanded by the internet's image and video aggregators (e.g., Google, YouTube, Flickr) and the proliferation of video and image capturing and playing devices for consumer use (e.g., cameras, mobiles, game consoles, tablets). The change in electronic image consumption brought about by the internet also expanded the cognitive skills required by the organizations responsible for creating and broadcasting video productions in all forms and genres.

3.5 The Case of MPEG: The Deconstruction of Digital Video into Technical Layers

As previously mentioned, during the end of the 1980s and most of the 1990s, high quality digital video post-production was only possible by using sophisticated workstations with special hardware video cards installed. In 1988, the Moving Picture Experts Group (MPEG), a working group of experts, was formed to set up the standards for digital audio and video compression and transmission (Watkinson 2004; Chiariglione and Magaudda 2012). The standards developed by the MPEG were based on the compression technologies developed by the Joint Photographic Experts Group (creators of the JPEG still image compression, which is still widely used today) and the CCITT's Experts Group on Telephony (creators of H.261, a standard for video conferencing). Thus, the knowledge that created the first digital video standards came from experts in *image compression* (i.e., image quality) and *data transmission* (i.e., video conferencing). Both *image compression* and *data transmission* reinforce the idea that digital video was in essence an ensemble of image and transmission technologies. Curiously enough, the creation of digital video standards shares similarities with the history of TV, as it also deals with both image quality and real time transmission (Uricchio 2008).

The ambition of the MPEG was to develop standards for converging media, integrating the required technologies by using research results from multiple sources (acting as a bridge between academia and industry) and verifying the performance of the standard (Chiariglione and Magaudda 2012). Being a working group of the ISO (International Organization of Standardization), the MPEG was, and still is today, divided into ten subgroups: Requirements, Video, Audio, MDS, Test, Systems, ISG, Liaison, SHNC and Integration. Of these subgroups, Video is the only one that deals specifically with the video signal processing and it is of course the largest. Table 1 illustrates the activities of each subgroup.

Subgroup	Activity
Requirements	Collects the technical requirements that the new standard will satisfy, including new application domains that may need to be incorporated in the standard.
Video	Combines all technical experts that are concerned with video signal processing, meaning, the visual quality of the MPEG standard.
Audio	Gathers all aspects of audio coding and audio-signal processing. This group also specifies sub-standards such as MP3, the most popular audio format on the internet.
MDS – Multimedia Description Schemes	Responsible for the Description Tools (also known as Descriptors or Description Schemes), which include content management, content organization, content description, navigation and access, user interaction, data types, structures, and schema tools.
Test	Responsible for the testing and compliance of the standards.
Systems	Responsible for the combination and “packetizing” of audio, visual, and other ancillary data.
ISG – Implementation Study Group	A technical subgroup that gives advice on the algorithms used for the MPEG standard and analyzes the overall performance of each alternative available.
Liaison	Maintains communication between MPEG and other standards groups on topics of common interest (i.e., ITU-T, ITU-R, EBU, ATSC, SMPTE, ISO, CEN, DAVIC, JPEG, VRML, W3C, DVB, FIAPF, INTELSAT, AES).
SHNC – Synthetic Natural Hybrid Coding	Handles the visual data generated by the computer (synthetic visual data).
Integration	Supervises integration with other standards in order to work on common specifications and avoid overlapping.

Table 1: MPEG subgroups

(adapted from Diepold and Moeritz 2005)

After twenty meetings and four and a half years of development and testing, the first MPEG (H.261) standard was approved in 1993. The rationality for MPEG compression technology is considered asymmetric, which means that the encoder is more complex than the decoder. The encoder needs to process video information through algorithmic or adaptive procedures whereas the decoder is “dumb” and simply carries out fixed actions. This was one clear advantage for using MPEG in applications such as professional broadcasting where the number of expensive and complex encoders’ solutions is small (available to the broadcasting industry by means of specialized hardware and software) but the number of simple and inexpensive decoders is large (Richardson 2003; Watkinson 2004; Diepold and Moeritz 2005; Moeritz and Diepold 2012). For example, most PCs and mobile devices that are intended to use video content will be able to do so without issue. The advantage to standardizing the decoder is that over time, the process of encoding algorithms can improve while compliant decoders continue to be compatible with existing encoders (Watkinson 2004). The lack of encoder specification meant that MPEG-1 image quality could drastically vary depending on the encoder used. Having better image quality per bit fostered a competition among developers on better encoders.⁸ The MPEG’s breakthrough compression methodology also paved the way MPEG’s main achievement: packing digital media data more tightly than its predecessors. Higher compression significantly saves on cost and enables the flexibility to develop new applications for different platforms. The latest developments in internet applications, particularly in mobiles, have been a trigger for efficient compression (Diepold and Moeritz 2005).

One of the first additions to MPEG-1 video was the audio layer, which was necessary for the emission of sound during video playback. In 1991, the Musicam technique, as proposed by Philips (the Netherlands), CCETT (France), and Institut für Rundfunktechnik (Germany), was chosen for its simplicity and low computational power associated with the decoding of high quality compressed audio (Watkinson

⁸ Similar concepts on open encoding process are employed for other media standard formats such as JPEG.

2004). Audio, video, and system were then the three layers⁹ that comprised the MPEG-1 (Chiariglione and Magaudda 2012). However, the layers were flexible and open enough to be used independently. Some single package formats became very successful independently. Such was the case of two audio formats for MPEG-1, namely: MP3 and AAC, which became commercially popular through their use in media players (i.e., MP3 players, iPods, media players software applications for PCs and mobiles).

MPEG standards only defined syntax that could be applied to to any value (e.g., picture resolution, frame frequency, audio sampling, etc.) (Chiariglione and Magaudda 2012). The possibility for independent use of different layers offered MPEG the possibility to combine or “multiplex” audio data with video data in order to produce a single ensemble or data stream instead of two separate ones. Such was the case of MPEG-2, developed to support the transition to digital video services and digital video broadcasting (Diepold and Moeritz 2005). DVDs and most digital set-top boxes are based on the MPEG-2 format.

In 2003, the H.264/MPEG-4 specification became one of the most recent incarnations of the MPEG standard. The H.264/MPEG-4 was conceived to enable the diffusion of digital video in multiplatform devices (e.g., smartphones, tablets). H.264/MPEG-4 is the first truly multiplatform format, used in a wide range of applications, from DVD players to YouTube videos. Therefore, H.264/MPEG-4 enables its use in several operating systems, platforms, and devices, bridging the content provided by telecommunication, broadcasting, and computer industries into a single format. For the media industry, it is commercially convenient to produce content that is flexible enough to be used in (or recycled by) several platforms. As the number of portable devices exploded, the MPEG format was able to adapt to each specific distribution channel and display device. The H.264/MPEG-4 standard was conceived with functionalities clustered in three key areas: *content-based interactivity*, *compression*, and *universal access* (Diepold and Moeritz 2005). *Content-based interactivity* and

⁹ This refers to the particular format for both video and audio, called “codec”, which is based on a computer program capable of encoding and/or decoding a digital data stream or signal.

universal access were functionalities that required the development of new standards to supplement H.264, namely MPEG-21 (2001) and MPEG-7 (2002), which were both focused on incorporating technical layers of data and descriptions. In the following paragraphs I explain in detail the extended multimedia characteristics of MPEG-7 and MPEG-21 respectively.

MPEG-7 is formally called the Multimedia Content Description Interface as it is defined as a description coding standard. MPEG-7 associates text descriptions with video content itself to allow fast and efficient searching (Chiariglione and Magaudda 2012). Thus, this text layer of data is not a standard that deals with the encoding of digital video. MPEG-7 uses the text layer in the form of XML¹⁰ to store metadata that can be allocated to a defined video time code in order to tag particular events (e.g., tag a person in a video; synchronize lyrics to a song). One of the driving visions behind MPEG-7 was to make multimedia content searchable, just as we search for a video in YouTube or Google, but moreover, instead of only searching by keywords, the user would be able to search by images, colors, sounds, and melodies (query by humming). In this regard, the internet's searchability characteristics in the form of metadata and electronic text has influenced the multimedia requirements of MPEG (Diepold and Moeritz 2005; Kallinikos and Mariátegui 2011).

In the case of MPEG-21, its objective is to define a normative open framework that supports all digital delivery platforms. It seeks to provide access to an almost unlimited supply of media in a seamless, secure, and interoperable way by identifying the mechanisms and elements to support the multimedia delivery chain (Diepold and Moeritz 2005). MPEG-21 is based on two essential concepts: the definition of a "Digital Item" (a fundamental unit of distribution and transaction) and how users interact with those "Digital Items". "Digital Items" can be considered the universal token for operations within a multimedia framework (Chiariglione and Magaudda 2012). Therefore, the main objective of the MPEG-21 is to define the technologies needed to support users ability to exchange, access, consume, trade, or manipulate

¹⁰ XML (Extensible Markup Language) is a set of rules based on open standards for encoding and interchanging data, documents and web services over the internet.

“Digital Items” in an efficient way (Rao, Bojkovic et al. 2006).

As the previous paragraphs demonstrate, MPEG as a standard format no longer deals exclusively with audiovisual content in terms of its quality and transmission considerations. Instead, MPEG’s most recent incarnations (i.e., H.264/MPEG-4, MPEG-7, MPEG-21) emphasize the new composition of audiovisual content that complements its audiovisual content with data layers. Data enables digital video to be transported over networks to provide the appropriate interoperability for interaction with other audiovisual content.

Table 2 illustrates the evolution of multimedia standards. From the creation of the JPEG still image format in 1990 until MPEG-21 in 2004, digital video has evolved into a multimedia framework that is able to incorporate new emergent technologies as part of its characteristics (Moeritz and Diepold 2012).

1990	JPEG	Coding of still images
1992	MPEG-1	Coding of digital storage media
1994	MPEG-2	Coding for DVD and digital TV
1996	MPEG-4	Interactive multimedia and audiovisual objects
2001	MPEG-7	Interface for content description and metadata storage
2003	MPEG-4 AVC	Advanced video coding
2004	MPEG-21	Multimedia framework

*Table 2: The evolution of multimedia standards from still images to video frameworks
(extracted from Moeritz and Diepold 2012)*

Today, the internet has created a set of relations in which value and meaning lie in the interconnectedness of discrete data sets (Bowker and Star 1999; Dreyfus 2001). Interconnecting technical and descriptive layers, by way of algorithmic programming and interoperability interfaces, provides new meaningful modes of interpreting

information (Walsh and Ungson 1991). Figure 4 illustrates digital video's layers. There are two distinctive types of layers: the technical and descriptive layers and the audiovisual layers. The technical and descriptive layers can be interoperated with other video objects, as well as organized and indexed through their manipulation. When provided with the required data, they can be rendered in a similar fashion as mathematical models.

Conversely, audiovisual layers are largely based on content and thus, their quality relies on production values that cannot be measured through mathematical calculations. Therefore, digital video content requires the production of tags (metadata) that describe the most important and distinctive characteristics of a resource; it shares many similarities to the cataloguing that take place in libraries. Simple as the production of metadata may seem, it is nonetheless an unending process. As internet protocols and technologies are permanently changing, digital media must be steadily updated to these new formats in order to be readily accessed and findable. As digital video becomes part of this new media habitat, their organization will require more information. Images are highly context-dependent and may become ambiguous if decontextualized. Therefore, digital video constitutes a more complex artefact to categorize and a problematic entity to codify as digital information.

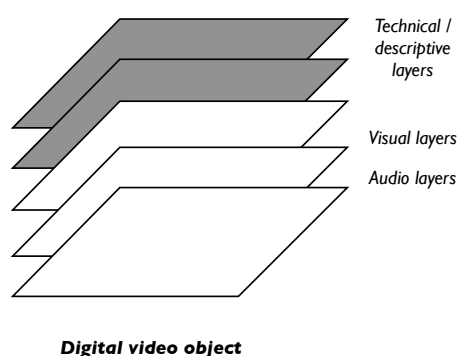


Figure 4: Layers of digital video objects

3.6 Metadata and the Management of Digital Video

In the previous sections, I explained the importance of the technical and descriptive layers of a video object to make it manipulable. One of the most significant ways in which digital video is manipulated is through the use of metadata. Content must be metadata tagged as it is digitalized in order to be ingested into any asset management system. The only way to trace digital content throughout the content life cycle of the workflow is through metadata (Cianci 2009).

Metadata provides codified instructions that allow a “blind” interchange of information, also known as “procedural instructions” (Piez 2001; Liu 2004). Therefore, interoperable information only generates value for an individual or an organization when it shares a set of common semantics or meanings. In order to interoperate two or more contents together, which may be technically possible, defining a shared meaning is also necessary (Cover 1998). Metadata is well-defined and agreed data, not interpreted data (Berners-Lee and Fischetti 2000; Halpin and Thompson 2006). Metadata is a language used for the analysis of object language, and is, therefore, a language *about* another language that enables the navigation through datasets (Dietrich 2000; Manovich 2001). The more data there is, the more metadata is needed to sort and search the internet successfully without getting lost in a data universe(Dietrich 2000).

In organizational contexts, the need for categorization will promote the use of metadata for all types of digital information (Baker and Bowker 2005). However, the language being used may restrict the flow of information from one domain to the other due to the limited number of standards that are agreed upon. As the data becomes better-defined, there may be also barriers to new inquiries, which may neglect innovation (Baker and Bowker 2005). In this sense, it can be said that data operating in databases in structured ways will always offer a limited depiction of reality. Conversely, this argument may not seem to be an issue for the current trend of information order on the internet. The most innovative technology companies are using classification procedures to repackage the information available to enable new

uses and encourage the production of User-Generated Content (UGC). In the subsequent paragraphs, I outline the three types of metadata available in digital video (descriptive, technical, and structural metadata) and explain their relevance.

Descriptive metadata is the most basic type of metadata. It is primarily comprised of the title, author, a (human-readable) description, subject or categorical information, genre and format, and relationships with other resources. Descriptive metadata contextualizes data within an information space of categories, classifications, keywords or tags in order for content to be findable. Thus conceived, descriptive metadata is assembled into recognizable cognitive entities, which are informative within a social context.

Technical metadata can be considered a special type of descriptive metadata that focuses on rule-based procedures in order to manage the life cycle of a digital video object. It is comprised of several types of information: technical metadata (core technical characteristics about the digital video object); digital provenance metadata (actions that have been performed on the object); rights metadata (information about access to digital rights management and use of the object as well as restrictions on the use of a resource, which may include machine-readable information based on DRM).¹¹ Technical metadata for video is not as developed as technical metadata for other types of media objects such as music or books (Guenther 2009).

Bits and bytes need to be processed into emulations of artefacts, which can be recognized as meaningful content according to computational instructions. *Structural metadata* instructs applications how to render artefacts, such as images, books or videos when these are divided into components. In particular, structural metadata describes the physical and/or logical structure of digital video objects; it is used to describe relationships between a video object's constituent parts or sequences.

Descriptive, technical and structural metadata are logical entities, which, when

¹¹ This is particularly relevant in video, as I illustrate during the empirical description.

combined, render digital video as an informative cognitive artefact. Metadata makes video content accessible, interoperable, and manipulable. However, if one part of its metadata is missing or corrupt, a video object turns into meaningless noise since it is either unreadable or unfindable. Thus, as mentioned in beginning of this chapter, a digital video object may well be rendered and accessed through a set of relations based on the value and meaning of discrete data sets. The audiovisual layers of digital video depend largely on the quality of its metadata, as it provides an entry-level signification of information. Although metadata provides access to video, it also has limitations; metadata may give a limited or simplified description of the meaning of a video content, which will hinder its findability. No matter how sophisticated metadata may be, it cannot capture the context constituted by experts on image production (e.g., craft editors) and its practice of gradually creating a coherent video narrative.

3.7 Toward an Ontology of Digital Video for the Broadcasting Industry

Thus far, I have explained in detail the evolution of video as an image-based artefact, from its initial material support (e.g., film, tape) to its current state as a digital artefact with non-material characteristics. Digital video is no longer based solely on its image quality and compression-transmission characteristics. Digital video prompts the construction of new technical layers that are fundamental for its manipulation that include metadata, procedures, data rules, and programs that are part of this new digital construct. It is, as Yvonne Spielman states, a medium that links to other mediums (Spielmann 2008). The formation of digital video must be understood through its electronic constituencies in which video shifted from being medium-specific to being “non-medium-specific”, whereby the new technical layers embedded within it contribute to its “non-medium-specificity” potential. As previously mentioned, it was common in the broadcasting industry to manipulate digital video through a series of processes that required different and specialized systems, each with different hardware and software capabilities. In any digital workflow that requires the use of many different software components, it is necessary to use interoperable exchange

formats that support the import and export of video files. Metadata provides video interoperability and consistency throughout the digital workflow. Metadata is also useful when controlling the different post-production and craft editing facilities from a central workstation (Richardson 2003; Watkinson 2004; Cianci 2009).

Some media scholars have lamented that digitalization results in the drop in quality and the degradation of features in video when compared to its legacy cinematic quality (i.e., size, color, sound) (Manovich 2001; Cubitt 2008; Wasson 2008). For example, when digitalized, the audio is flattened, resulting in a significant reduction of sound quality (e.g., the reduction of sound channels from stereo to mono or from four channels to two channels). The same occurs with digital images. When undergoing digitalization the compression scheme impacts the quality of the original raw video footage, decreasing not only its resolution, but also fine color adjustment executed during the shooting. After all, digital video is made from a conjunction of images (frames) and compression bitrate provides the quality in which the difference between one frame and another are digitally stored. The quality of digital video depends on its compression scheme, but is also contingent to the transmission of information in the particular device it is played on. The agonistic rationale of computation does have an impact in the aesthetics of what becomes digital video in the form of an audiovisual narrative.

From the perspective presented above, digital video does not only incorporate audiovisual characteristics from its cinematic legacy, but its data-filled layers are becoming increasingly crucial in order to confront the current need for information flow around different technologies and platforms. Digital video has evolved into a cultural artefact that contains different types of information. In an attempt to define digital video, Manovich states:

A “moving image” became a hybrid which can combine all different visual media invented so far – rather than holding only one kind of data such as camera recording, hand drawing, etc. Rather than being understood as a singular flat plane – the result of light focused by the lens and captured by

the recording surface – it is now understood as a stack of potentially infinite number of separate layers. And rather than “time-based,” it becomes “composition-based,” or “object oriented.” That of, instead of being treated as a sequence of frames arranged in time, a “moving image” is now understood as a two-dimensional composition that consists from a number of objects that can be manipulated independently. (Manovich 2001)

According to Manovich, digital video is increasingly permeated by data and as such, many of the conceptual arguments centered on its aesthetic value and image quality may not be of importance in the long run. W. J. T. Mitchell describes the internet as *“a metamedium, that incorporates all the possible mediums [...] Images continue to arise and circulate in these new media in a way, so rapidly that no conceivable archive could ever contain them all”* (Mitchell 2010). Therefore, the technical management of video is not founded on its material support, but its technical constituency. Technical constituency is based on software operations that are changing systematically, nowadays permeated by the logics of the internet.

In this chapter, I provided historical, ontological and technical explanations of the characteristics of digital video, understanding how it evolved from being based solely on its image quality and transmission characteristics to more technical and descriptive layers based on its metadata. In the next chapter, I introduce the theoretical framework of my research based on the study of the impact of technology on work practices and, more specifically, on how the particular characteristics of images and video as digital artefacts affect contemporary work practices.

4. Literature Review

I have a very hard time getting down to work on the screen because all I see there is a text in the form of an image which I have a hard time entering. With my typewriter, the text is at a distance; it is visible and I can work with it. With the screen, it's different; one has to be inside. It is possible to play with it but only if one is on the other side, and immerses oneself in it. That scares me a little, and cyberspace is not of great use to me personally.

–Jean Baudrillard, *Baudrillard on the New Technologies: An interview with Claude Thibaut (1996)*

In the previous chapter I gave a historical and ontological account on the evolution of the technical image and the main characteristics of digital video as a complex image-based technical object.

In this chapter, I present the main literature that is the basis of my research and delimits my perspective. The objective of this chapter is two-fold: First, study the literature on the impact of technology in work practices, and in particular, cases on similar technologies implemented in different organizational settings or occupational cultures. Second, demonstrate that digital images are complex cognitive and technical artefacts and that, in order to understand their technical characteristics and how these impact contemporary work practices, it is relevant to study them from a semiotic perspective.

First, I pick up where the discussion in chapter 2 left off. A review of available media literature bring out the lack of research on technology in media organizations. I then explore the reasons for the lack of inquiry on media organizations and the study of digital images from an IS perspective. Second, I give an overview of literature on how technological information impacts work practices (Baxter and Lyytinen 2005; Vaast and Walsham 2005; Brynjolfsson 1993; DeSanctis and Poole 1994(Orlikowski 2000))

and contribute to demonstrate the impact of occupational cultures and technological information on present work practices (Barley 1983; Ekbia and Evans 2009; Lanzara 2009). However, I also discuss some limitations of existing literature to study the impact of sophisticated technological information in modern organizations. Third, in order to understand the work implications in managing contemporary digitalized information, I extend the literature review to the study of semiotics and bring up some literature from the field of IS that helps in understanding the semiotic characteristics of technological information (Ramaprasad and Rai 1996; Raber and Budd 2003; Floridi 2005; Mingers and Willcocks 2014). I use, most notably, the work of Shoshana Zuboff (1988) and Jannis Kallinikos (2006; 2011). Both authors emphasize, through practical cases, the semiotic character of technological information and how work practices are becoming abstract as these are codified into information artefacts. Then, I examine the image as a digital artefact, thereby addressing how the interpretations of image-based artefacts are cognitively different from other digital tokens, such as electronic text. I conclude the chapter by illustrating other strands of theoretical research around work practices, video, and the media industry and how their approaches differ.

4.1 Exploring Media Organizations within the Field of Information Systems

As mentioned in chapter 2, there is a significant lack of research in media literature on the study of technology in media organizations (Boczkowski 2004, 2010; Chiariglione and Magaudda 2012). The technological processes behind digital formats and standards are particularly neglected, as they are usually taken for granted as forms of interaction and communication (Chiariglione and Magaudda 2012). Comprehensive studies around the technical evolution of artefacts in the media industry and their relation to the work and organizational practices in that industry are absent from scholarly writing. As Pablo Boczkowski states:

Media sociologies have lagged the technical evolution of the news workers' milieu, this is especially salient to make sense of contemporary management of media firms [...] Since the 1970s, newsrooms have been computerized to some extent. The variations in organizational structures, work practices and representation of the users are related to different ways in which newsroom workers adopt these technologies. (Boczkowski 2004: 198)

Boczkowski emphasizes that, in order to analyze the evolution of media companies over the past several decades, it is essential to study their evolution in terms of technologies and how they have affected media workers' work practices.

Brian McNair suggests that “*the form and content of journalism is crucially determined by the available technology of news' gathering, production and dissemination*” (McNair 1998). Although the development of multiplatform production and delivery technologies in newsrooms is accelerating, the technologies supporting it have not been analyzed in detail. Hence, earlier research on media organizations has not taken into consideration the evolution and characteristics of the digital technologies required for media convergence to occur (McNair 1998; Boczkowski 2004).

Although the study of new media theory and operations has received considerable attention for more than a decade (Manovich 2001; Hayles 2003; Galloway 2004), little research has been conducted into how technologies are being implemented and managed in media organizations. For example, several accounts on newsroom convergence fail to provide the technical aspects of how news are produced and delivered (McNair 1998; Boczkowski 2004). In the field of IS, the history of media and its constitutive technologies has often been overlooked (Chiariglione and Magaudda 2012). Some IS literature has explored the characteristics of media convergence from the perspective of digital artefacts, but few of them rely on empirical research that explores how digital artefacts are actually managed in media organizations (Tilson, Lyytinen et al. 2010; Yoo 2010; Kallinikos and Mariátegui

2011; Kallinikos, Aaltonen et al. 2013).

Furthermore, extensive studies of the technologies applied in the new media industry are likewise lacking. For example, the internet is a technical catalyst for the implementation and integration of media convergence strategies within the media industry, but most studies are based on the impact on sub-industries within the media industry (Deuze 2007, 2012) or make general assumptions based on media economics models (Küng, Leandros et al. 2008). However, as I will review in the next subsections, IS research on the implementation of information technology and its impact on work practices should be relevant to understand both the importance of occupational cultures within organizations, and the particular characteristics of digitalized information in its different forms (i.e., text, images, video).

4.2 The Study of the Impact of Technology on Work Practices

Since computer technology and knowledge workers have become preeminent in organizations, there has been an important shift in the nature of work. In the last three decades, growing importance is attached to studies on the impact of computer technology in changing work practices in factories (Zuboff 1988; Kallinikos 1999), office-based settings (Barley 1986; Zuboff 1988; Orlikowski 1992, 2000; Lanzara 2009), and, most recently, in contemporary life (Runde, Jones et al. 2009; Kallinikos, Aaltonen et al. 2010; Yoo 2010). Several studies have researched the impact of technology and work practices to understand in more detail how changes in technology use and work practices interact in complex organizational settings (Baxter and Lyytinen 2005) as well as the relationships between action, cognition and social representation (Vaast and Walsham 2005).

From one side, the literature rooted in the positivist tradition emphasizes the view of technology as consisting on structures based on data and rational decision-making models. Such a reductionist perspective of technology is designed to supposedly

overcome human weakness and bring productivity and efficiency through organizational change (Perrow 1986; Jarvenpaa 1989; DeSanctis and Poole 1994). Although it is true that technological properties impact work practices, their study is hampered by the difficulty to make a clear-cut difference between patterns that occur due to the characteristics of such technologies, and those which are contextual to particular organizational settings or based on distinctive occupational cultures. I will return to the limitations and possibilities of such view of technology in the next section.

On the other side, there is the social constructivist position which criticizes the determinist view of technology and gives a perspective running in the opposite direction: technology does not determine behavior; rather people socially construct technology, and interpret and use it in wide institutional contexts (Orlikowski and Robey 1991; Orlikowski 1992; Orlikowski and Barley 2001). This view encompasses several strands of thought ranging from the analysis of context and use (Mumford 2003), the social construction of technology (Bijker, Hughes et al. 1987), social action and cognition (Orlikowski and Gash 1994) or adaptive structuration theories (DeSanctis and Poole 1994), mostly based on the interpretation of structures, rules and resources provided by technologies and organizations (DeSanctis and Poole 1994; Orlikowski 2000). However, the main problem of such views is that, depending on the different disciplines and intellectual schools of thought applied, the way in which human actions are interpreted differ and, in some cases, may even contradict each other.

Within this vast literature, some researchers have studied the impact of the implementation of a similar technology (or technological information) in different social groups or organizational settings (Barley 1986; Robey and Sahay 1996). Such literature elucidates why similar technologies may trigger different perceptions on work practices. This is a useful research approach, since it helps to understand the persistent characteristics of a technology beyond the particularities of the context in which it has been deployed.

In a well know case, Barley (1986) conducted an extensive ethnographic study of an identical technological implementation (a new CT scanner) that affected the institutional patterns and social organization of two radiology departments in different ways. The effect of the technology on the work practices is explained to a certain degree by the interaction between radiologists and technicians while performing scan procedures. In order to find models and relations that explain how technology influenced the organizational setting, Barley refers to interactional patterns based on the institutional dominance of radiologists over the technicians. The interactional patterns studied by Barley favored verbal communication that conveys instructions, countermands, negotiations, and social relations. Even more so, the way in which radiologists and technicians operated the scan and diagnostic procedures required mastering the CT scanner's new features and procedures, some of them based on the analysis of visual signs, such as image resolution. However, the technical characteristics of the CT scanner, including its image-related properties, were barely mentioned as propitiatory of the change in work practices, even if some of the interactional and interpretative patterns were contingent upon the new technical characteristics of the equipment, diminishing the value and impact that certain technological characteristics might have on changing work practices. Furthermore, by studying only the interactional patterns and not the characteristics of the technology being used, such a case focuses on agency and an understanding how information technology, organizations and practices shape each other (Barley 1986; Suchman 1987; Brown and Duguid 1991), but limiting its applicability in other contexts that use the same equipment. This is problematic since a technology may be applied in a way that does not evince or takes into consideration the complexities of a particular implementation.

In general, the limitations of such perspective is that the term "work practices" seems a broader or general term subject to several, widely varying connotations. Even more so, its connotation in theory may be very different than in practice (Schultze and Boland Jr 2000). Additionally, such cases seem somewhat distant from what actually happens in contemporary organizations for three main reasons. First, IS implementations currently cannot adopt a long-term perspective (i.e., potential

technological changes to projects) since current implementations are less custom-made to specific groups of users and increasingly resort to off-the-shelf packages. Second, the use of interoperable technologies and off-the-shelf solutions brings with it the constant incorporation of new and sophisticated software able to communicate or integrate with existing packages, increasing the complexity of the study of how people interact with a particular technology. Third, contemporary organizations (not only in the media industry, but in general in service-based economies) extensively use and attach great relevance to digital media tokens (i.e., text, images, video). However, as mentioned earlier, their impact has not yet been studied in sufficient depth.

As industries increasingly rely on technology standards and infrastructures that help organizations share, transact, and link with each other –as if in a technology-supported distributed network–, media cannot be reduced to its interpretation or enactment in situated activities. Thus, while it is true that daily practices affect social settings, their analysis does not suffice to understand organizations and the implications that technological information has on them.

Ekbja and Evans (2009) take a different approach and present a study of the factors that influence land management decision-making based on the different sources of information used by land managers. They found that economic value is not the only important variable for land management decision-making. Personal and social values are also essential. By examining what they call different *regimes of information*, Ekbja and Evans found out how the same information coming from different sources may have different meanings to a landowner. Different meanings can explain why a landowner may act differently in response to the same information, depending on the source of information. Ekbja and Evans (2009) hold that each *regime of information* is a complex process that deals with situated practices of daily life but also involves the creation and enactment of information. Thus, not all useful information is encoded or rationally optimized and effectively put to use. The concept is rooted in the idea of *constitutive practices*, developed by sociologist Harold Garfinkel in the early 1950s. Garfinkel argues that it is a mistake to focus on individual actions, projects, and perceptions; instead, the focus should be placed on rules or practices by and through

which perceptions are rendered as work practices. Garfinkel points out that there is no information without an order generated by actors oriented toward rules, or the *constitutive practices* that they use to produce that order. Thus, information is situated in work practices as long as it follows the rules upon which the irreducible character of data-experiences is based (Garfinkel 2008: 22). Therefore, the exercise of analyzing *constitutive practices* requires a comparison of how different actors deal with the same rules (i.e., technologies), as well as the contexts that the actors act within and what they share as common signs of belief (Garfinkel 2008; Rawls 2008).

The concept of *constitutive practices* seeks to convey the importance of understanding the characteristics of technical information in great detail and understand what type of encoded information can be effectively put to use, which has helped to unravel the ways in which technological information transforms work practices. Lanzara (2009) researched the implementation of video recordings for viewing court evidence in judicial practice. A comparison between videotapes and traditional paper-based documentation (i.e., transcript documents, written formats) prompted different perspectives on how video had to be reviewed by judges. Since most judicial systems' work practices were based on the management of manuscripts, viewing videotapes demanded a new work practice that was not part of the judges' long established occupational cultures. Therefore, the particular nature of video required the adjustment of judges' routines and procedures since it added a new range of observable phenomena. In order to integrate the video narratives into their work practices, the judges had to develop a perceptual understanding of the relations between the courtroom action and its audiovisual replica. Furthermore, judges were then confronted with multiple versions of the same event. Each medium (i.e., video, text) selectively filtered and channeled attention to specific features of the same event while excluding others, thus revealing the growing importance of considering the specific semiotic constitution and particularities of the information tokens embedded in technologies (i.e., video, image, sound, text, code) and how each may differently impact contemporary work practices.

The empirical cases presented by Lanzara (2009) and Ekbia and Evans (2009) demonstrate that occupational cultures and context are important in identifying how identical information may lead to different consequences. In particular, Lanzara (2009) stresses how the distinctive semiotic characteristics of technological information –in the form of video– may have a different impact on work practices. The next section presents an overview of how a semiotic perspective gives a richer understanding of the characteristics of technological information.

4.3 The Codification of Work Practices: Technological Information seen from a Semiotic Perspective

As illustrated thus far, the impact of technology in work practices are comprised by the specificities of their occupational cultures, which in turn are impacted by the distinctive semiotic characteristics of technological information. Technology does not simply store and transmit information, but as work is becoming more abstract, symbolic and increasingly focused on the intricacies of communication, what is being managed are representations of that information. Analyzing the impact that information-based tokens may have on work practices is particularly relevant in order to understand how certain work practices are codified into processes and routines based on digital information.

A remark in the previous section held that since technological determinism literature is based on a reductionist perspective (i.e., things have to be objective and true), it is difficult to analyze the functional structures that impact work practices due to the impossibility of unbundling the technological properties from the social patterns that are particular to a context or within certain occupational cultures. However, contextual forms are based on the particularities of language and communication, thus, from a semiological perspective, on meaning and signification (Saussure 1974). Signification refers to both the process by which signs carry meaning as well as the information they convey. Therefore, since semiotics studies signs and their systems in

search for their meaning and signification, it can be employed to analyze how occupational cultures are influenced by a sign system that communicates information.

In semiotics, a sign is an event or a symbol that is able to communicate information. Saussure remarked that a sign is comprised of a form (signifier) and its meaning (signified) and that meaning arises from the differences between signifiers. These differences are founded on two types of dimensions: syntagmatic, based on the possibilities of logical combinations in the order of signs (for example, a concatenation of words that construct a sentence based on a grammatical structure); and, paradigmatic, in which a term may be substituted by another one (for example, a word that can be replaced by another one within a particular shared context with or without losing its meaning). As two types of relationships between signifiers that operate in our brains, syntagmatic and paradigmatic dimensions had been applied particularly as a model for text analysis and distribution patterns of words in the fields of computational linguistics (Rapp 2002; Sahlgren 2006). Thus, semiotics makes possible to analyze technological information from the rational perspective of decision-making and data, and allows a more meaningful study of the operative characteristics of the sign systems that communicate information.

The literature on semiotics in the IS field is somewhat broad. Some authors have approached semiotics to try to bring forward new ideas based on the concept of information (Ramaprasad and Rai 1996; Raber and Budd 2003; Floridi 2005; Brier 2008). Raber and Budd (2003) take the concept of value and signification into the realm of information through the study and use of text patterns and information retrieval processes (Raber and Budd 2003). Ramaprasad (1996) takes on a semiotic perspective to analyze how information becomes meaningful throughout a “semiotic cycle” translated into three levels of semiotic associations that are related to the production of information: the syntactic level, based on the stimuli related to rules that generate data (raw information); the semantic level, where meaning is attributed to the stimuli in order to generate information; and, the pragmatic level, in which meaning is interpreted in a particular context to generate so-called knowledge (Ramaprasad and Rai 1996). Mingers and Wilcocks (2014) make a comprehensive study of semiotics in

business and information technology and propose an integrative semiotic framework based on Peircian linguistics¹² in order to make more explicit the relationships that need to be studied in advanced information and communication technologies in which the organizations are based (Mingers and Willcocks 2014). Barley (1983) uses semiotics as a way of conceptualizing and analyzing occupational cultures. He finds out that taking a semiotic perspective helps to elucidate, through symbolic interpretations, the rules through which members of an organization unconsciously generate meaning (Barley 1983).

Two key writings by Zuboff (1988) and Kallinikos (2011) analyze the impact that sign systems that communicate information may have on work practices. Both authors emphasize –by using case studies– how work is becoming more abstract and symbolic, increasingly focused on the intricacies of instrumentation, and distanced from its physical reference.

In her seminal book *In the Age of the Smart Machine: The Future of Work and Power* Shoshana Zuboff (1988) describes how information technology affects work practices based on eight noteworthy cases. Her research compares distinctive industrial and post-industrial environments (i.e., two pulp mills, a paper and pulp mill, a telecommunications operator, a dental claims insurance operator, a stock and bond transfers office of a large financial corporation, a financial institution, and a large pharmaceutical company) and addresses how the technologies implemented to automate processes at those sites fundamentally altered the way employees worked.

In her study, Zuboff explains that there are two fundamental characteristics of computer-based information management in work environments. First, computer-based information systems embody rules for acting upon and processing information that were previously only an outcome of experiential knowledge. Second, computer-based information (in the form of electronic text) is based on certain semiotic

¹² Along with Saussure, Peirce also led another approach to semiotics. The main distinction between these two types of semiotic schools is that for Peirce a sign is based on signifier, signified and object, whether for Saussure it is based mostly on the relation between signifier and signified.

properties that differentiate them from earlier forms of occupational cultures that depended on paper-based work.

The most important part of Zuboff's research, and the one that is most relevant to my work, is in the chapter "Mastering the Electronic Text" where Zuboff describes how the skills that constitute work practices are transformed from action-centered to codified intellectual skills. Zuboff defines intellectual skills as the *informing capacity* that is the basis to develop knowledge and apply it to industrial production processes. Industrial production processes take knowledge out of the physical domain (e.g., body, machinery) and transfer them as information into the abstract domain of symbolic semiotic tokens, namely in the form of electronic text and other types of codified tasks and operations based on software packages. Thus, the codification of information in work environments requires workers to trust and acquire knowledge of events that they are not able to see directly, but only or mainly through their representation and the use of electronic text and other symbolic tokens.

For Zuboff, making sense of the world of work through electronic text involves three different types of intellectual skills: first, the development of abstract thinking, which is the ability to understand states and relationships that lack immediate reference to the world; second, the ability to combine, delete, mix, or supplement information and discern patterns in the data provided; and third, procedural reasoning, or the execution of abstract procedures to complete a particular task. Zuboff describes electronic text as a comprehensive and systemic database, a system of events that is revealed as a flow of information. The flow of information is a metaphor for the production process or operations that are embedded within and that epitomize the *routinization* and *automation* mandate of the post-industrial age (Weber 1978). The programmed logic, which entails both procedures as well as oral culture, is codified and built into the structure of software packages, thus increasing the depth and complexity of the electronic text as a sign system. Informing capacity ultimately reconfigures not only the nature of work, but also the management of cultural information. The challenge of managing electronic text is two-fold: first, trusting the information presented by machines; and second, understanding or inferring that the action represented on the

screen leads to tangible action in the real world. The development of extensive intellectual skills in recent years contrasts drastically with the bodily actions that were often required in the industrial age. Performing intellectual skills requires new cognitive capacities in order to be able to read information that is framed within a particular knowledge set.

Kallinikos complements Zuboff's empirical studies in his case of a dairy corporation in Sweden (Kallinikos 1999, 2011). The dairy plant underwent a significant process of computerization in the final three decades of the last century. Its dairy production process became fully automated and concatenated following a pre-programmed sequence of steps. A software package provided an elaborate cognitive map based on a bulb system (symbolic tokens) that captured the complexity of the physical machineries and the production processes (reference) (Kallinikos 2011). When the dairy plant became fully automated, several tasks and procedures were re-shuffled in terms of importance and emphasis. Most of the new work practices were transformed from physical work into intellectual skills in the form of planning, running, and monitoring the production and refinement process at a distance; the physical participation of workers was substantially reduced (Kallinikos 2011: 111). The lack of physical reference to the installations at the plant was seen as a severe limitation on the operator's capabilities¹³. Meanwhile, the technological information interacting with people and the organization made operators relate to the task of examining the structure of sign, codes and symbolic schemes; as Mingers and Willcocks (2014) mention: *"the software package did not represent a mirror image of the material and technological constitution of work processes, but produced a multi-layered fragmented system of signs and codes that saw little relationship between token and referent [...]"* (Mingers and Willcocks 2014: 65).

As mentioned previously, when work is codified, some tasks and procedures are re-shuffled in terms of importance while it may not be possible to codify others. This requires two important assumptions: first, as information is being codified, the

¹³ The shifting emphasis to intellectual rather than bodily skills is particularly relevant to my research, as discussed further in chapter 9.

signification of the tasks and procedures may be transformed and have an impact in the associated work practices; and second, physical work, in the form of bodily interaction (i.e., face-to-face collaboration) may still be fundamental to assigning meaning to information tokens due to strong or persistent occupational cultures.

These cases illustrate that the affordances and constraints in work practices not only depend on the expertise, organizational processes, procedures, and other social capacities within the organization's occupational cultures, but also on the characteristics of technological information based on data schemes (symbolic tokens) that act as a reference to physical, social and interactional items. Figure 5 (next page) illustrates that in order to understand the transformation of work practices, it is fundamental to take both technology and the occupational cultures into consideration. First, social meaning is formed by the occupational culture that is constantly interacting with work practices enacted in particular contexts. Second, technology impacts work practices in terms of its rule-based constituents (i.e., procedures, standards) that create the basis for information tokens. Depending on the type of information token, it may also be important to take into consideration the semiotic characteristics of such a sign. Thus, the idea is not to define those "logical and true" technological characteristics as given, but to analyze how these characteristics may interact, or react, with work practices that are embedded in particular occupational cultures.

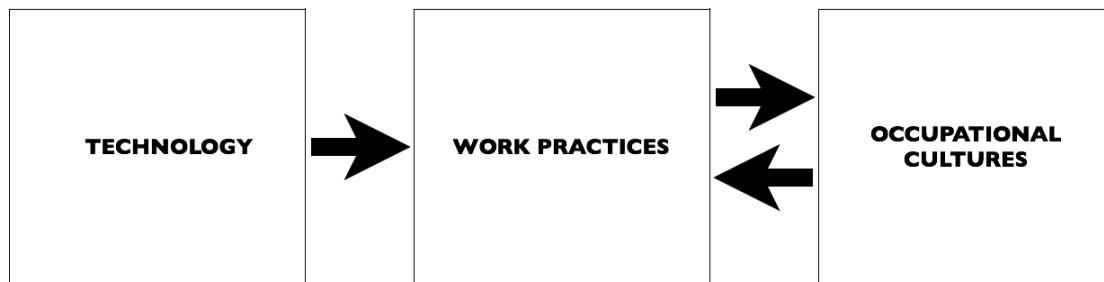


Figure 5: The impact of technology and occupational cultures on work practices¹⁴

4.4 Images as Digital Artefacts

In the preceding sections, I have illustrated the literature on how work practices are impacted by both technological information and the occupational cultures from which such work practices originate. The cases presented by Zuboff (1988) and Kallinikos (2011) go a step further in examining the characteristics of technological information by stating that the informing capacity of codified information also requires new cognitive capacities that should take into consideration the semiotic perspective, since such capacities are required in order to both interpret and give meaning to information tokens throughout work practices.

The cases brought forward are mostly related to sign systems in the form of text and although it is true that any object is part of a system of signs and significations, images carry characteristics that distance them from texts and other logical or combinatorial structures. In contrast to text, images do not consist of a combination of

¹⁴ I use a unidirectional arrow from technology to work practices because my research focuses on the analysis of how technology (in particular, image-based) impacts work practices. A bidirectional arrow could have been used if I were to mention, for example, that work practices affect the design of new technology and guide the implementation or application of a particular technology; however, this is not the topic of my research. On the other hand, the reason I use double-sided arrows between work practices and the occupational cultures is that, in general, occupational cultures are broader habits of thought and action shared by members of the same profession as evidenced in their language, beliefs, norms, skills and traditions and that constantly interact with and impact the way specific work practices are carried out. (See Section 1.1 for a more detailed definition of occupational cultures).

standardized marks or convey linearity, but spatial arrangements of differences expressed through, for instance, colors and shapes (Kallinikos 2002a). In that sense, digital video as an image-based artefact cannot simply be interpreted and managed through its technical layers for several reasons: first, the image is in itself highly ambiguous in comparison to other types of codified notations (e.g., text, sound, code) since its semiotic value is rooted in its contextual origins or individual perceptions on meaning and signification; second, the study of image-based information artefacts is a relatively recent area of study as the manipulation of these digital images in work settings has only been around for the last three decades. Although digital video is built from a series of technical layers that are codified in order to be read by software packages, it is not accurate to describe its impact on work practices in the same way it has been done with electronic text or other types of technological artefacts.

In a world that is more dependent on the management of images, the study of digital video and the way it impacts organizations is of utmost importance. There are no systematic studies on how the management of images impacts organizations and work practices. The study of digital images has largely been related to their cultural impact (Mitchell 1980; Debray 1992), or more recently, to how audiences react and produce them through UGC (Lessig 2008; Jenkins and Green 2012). The problem regarding the ambiguity of image representation is not new and has been central to theoretical studies of the image (Mitchell 1980, 1994). One way in which the level of ambiguity of image-based tokens can be reduced is by categorizing them or by establishing a meaning that is agreed upon by the interpreters of the image (Bowker and Star 1999; Kallinikos and Mariátegui 2011). However, the pictorial value of the image vanishes when its description, or the rules of the database that manage the description, is given priority. The sense of order is subverted and the value then rests on the particular arrangement and the relations it constructs, composed mostly of the metadata assigned to each digital object and by the codified instructions embedded in it. As digital images become a predominant part of the media habitat, they also require more metadata in order to become organized. However, beyond metadata's discrete value, images are highly context-specific and may also become ambiguous if recontextualized through metadata. Therefore, images are a complex and evasive

artefact to structure, evincing the problem of digitalizing them as information tokens.

It could be argued that since any kind of digital image has a material signifier, it expresses or represents a sign system. In image-intensive organizations, such as those belonging to the media industry (i.e., organizations in film, broadcasting, and publishing), work presupposes a cognitive capacity to understand and act upon process-oriented metaphors related to the production and manipulation of images and video. In most cases, the sign system largely depends on complex and elaborated codifications and descriptions as well as the technical constitutions that render the descriptions of images and videos as data tokens. When a digital image or video is technically manipulated, the constitutive layers of its syntactic information (i.e., *technical* and *descriptive* layers) are those being executed through the use of, or in, software packages. (See section 3.5).

However, the digital image cannot be rationalized only as a series of logical steps. A digital image is interpreted through the identification of elements from the real world that it is supposed to represent; hence, it is interpreted through the identification of its semiotic elements and the relationships it references (Kallinikos 1999). Images, being highly ambiguous, depend a great deal on their semiotic representation: as much as digitalization decontextualizes video images, video's recontextualization in a visual narrative is based on a complex combination of linguistic signs. Pictures depend on each individual's particular comprehension of what an image represents. In this sense, the description of an image embodies a rationalization and a common agreement on such representation. Most of the knowledge of the world has been constructed through references to cultural artefacts, which is also the way cultural information has been systematized into work practices. The systematization of video narratives into genres has created a world of professionals that are able to manage specific image-based tokens (i.e., still images, videos) upon an agreed semiotic representation.

It is possible to manipulate digital video throughout standardized production infrastructures that are based on resources and outcomes that can be optimized constantly. However, studying digital video from the perspective of such

standardized, decontextualized information and machine-enacted rules only offers a narrow definition of how digitalization impacts work practice. Technological information is founded on how it is perceived and acted upon (Ekbia and Evans 2009). Thus, the management of digital video is based on manipulating a complex and structured information artefact and semiotics offers a way of disclosing such structures, which significantly impacts how work practices are performed.

4.5 Remarks on other lines of theoretical research

Kathleen Eisenhardt acknowledges that by “*examining literature that conflicts with the emergent theory that one is proposing is important for two reasons. First, if researchers ignore conflicting literature, then readers' confidence in the findings is reduced; second, conflicting literature represents an opportunity to juxtapose the results and force the research to take a more creative route than originally intended*” (Eisenhardt 1989: 544). Avoiding conflicting or challenging works could result in narrow and idiosyncratic argumentation. This chapter concludes with a brief summary of other lines of research that also address the media industry in terms of their technologies, but that resort to other theories. Works by Emma Hemmingway and Josh Greenberg are summarized to then offer a general impression of their rationality.

Emma Hemmingway's *Into the Newsroom: Exploring the Digital Production of Regional Television News* is an extensive study of the BBC, primarily focused on its news operation (Hemmingway 2008). Hemmingway worked at the BBC for nearly twelve years and her research describes and analyzes the BBC newsroom's digital implementation in Nottingham.¹⁵ Hemmingway focuses her attention on understanding the perceptions of the BBC staff about the technologies that “construct” the media hub (ingestion hub) and the Personal Digital Production system. She recognizes the “*contingent, unpredictable, but crucial relationships*” between

¹⁵ This phase of digital implementation predates DMI and is therefore not related to my research by any means.

journalists and the technologies they use for news' production. Unfortunately, the account is situated in the fragments of very specific and narrow stories that do not offer much added value or fundamental conclusions to the narrative as a whole. Hemmingway uses Actor-Network-Theory (ANT) as a theoretical framework to analyze the journalists and their technological artefacts as "actors" that are dependent on each another (Latour 2005). She also defines an artefact as any apparatus that a journalist uses from a "camera" to a "truck". For Hemmingway, all actors have a role in the production of news content. Hence, she pays equal attention to the audiovisual technology and several other residual technologies that are not necessarily directly involved in the production of news content. In that sense, her analysis is more a chronicle of the relations between a wide range of artefacts and the journalists, but it falls short of discussing the impact of those "actors" on news production and the BBC as an organization.

Another work worth mentioning is Joshua Greenberg's *From Betamax to Blockbuster: Video Stores and the Invention of Movies on Video*. He approaches the history of the VCR and the videotape by centering his analysis on the perspective of the consumer and on what the author defines as industry intermediaries (retailers and film distributors) (Greenberg 2008). The book starts with a history of the use of the VCR (particularly Sony's Betamax), which resembles that of the microcomputer and the hobbyists around the technology and their communities. There are two key elements that Greenberg seeks to single out and highlight in *From Betamax to Blockbuster*: how the VCR was refashioned from a time-shifting device to a medium for movie distribution; and how this development was brought forward neither by manufacturers nor consumers, but by retailers and distributors. By using ANT, he describes these two groups of actors as being "in-between" consumers and manufacturers, and strives accordingly to stress the value of studying the "in-between" characteristics. Undoubtedly, the author's adoption of a social constructivist position produces some interesting insights. However, it seems that social factors were not alone in shaping the development of the home movie industry. This is evidenced by the current debacle of videotape's contingency on a technology that, with the advance of the internet, changed the way in which movies are distributed

(i.e., Netflix, VOD). It is not clear either whether Greenberg's analysis can account for the role the user played in these developments.

Some of the arguments presented by both Greenberg and Hemmingway fail to affirm why technology matters and must therefore be addressed in the study of the transformations they analyze. It is true that social agents and technology users may interpret technological characteristics differently, but as I argue throughout this chapter, situated enactments are only part of a bigger and more complex picture in which technology seems to matter in far more subtle and crucially modal ways that demand attention. Technology played a fundamental role in the evolution of video, both as the medium and as part of the development of an organization regime. The composition and structure of video as a technological artefact must be taken into account. The empirical chapter that follows describes how digital video impacted the work practices of the broadcasting industry, particularly in the case of the BBC's Digital Media Initiative.

5. Research Site and Context

Information is about to overflow and suffocate reality.

–Albert Borgmann, *Holding On to Reality* (1999)

In this chapter I explain the research site by outlining the BBC and its Digital Media Initiative (DMI). First, I summarize the DMI program and how it has contributed to a significant organizational change within the BBC. I then provide an introduction to the historical background of the development of standards and metadata at the BBC, as well as the genesis of Cinegy, one of the main software packages deployed for DMI. Finally, I provide a detailed description of the research site, BBC Northern Ireland (BBC NI), and the particular characteristics of DMI's deployment at this site. This chapter marks the beginning of my empirical study.

5.1 The BBC and the Digital Media Initiative (DMI)

The BBC, with more than 23,000 full-time staff, is one of the largest broadcasting companies in the world. It reaches millions of people each day through its 30 TV channels, 54 radio stations, 43 radio world services in foreign languages, 48 magazines, and several online initiatives. Roughly three-quarters of its budget is funded by the citizens of the United Kingdom through the TV Licensing fee.¹⁶ Therefore, the main purpose of the BBC is to act as a public service broadcaster.

In mid-2006, the BBC launched a major reorganization with the goal to make it easier for audiences to access its programs through multiple delivery platforms. Central to this initiative was the intention to offer media consumers the choice of deciding when,

¹⁶ More information on the TV Licensing fee is available at: <http://www.tvlicensing.co.uk/>

what, and on which platform they view content. As part of this new direction, the BBC streamlined its programs to show output across TV, radio, internet, mobile, and other emergent platforms (e.g., tablets, game consoles) that were considered equally relevant (Evans 2011). These concerns were given further momentum by the establishment of the New Media division, later renamed BBC Future Media and Technology (FM&T). The division assumed responsibility for the BBC's digital initiatives that focused on technology management and services concerning findability, navigation, metadata, VOD, mobility devices, and the Web, including the BBC-integrated VOD player¹⁷ (known as “iPlayer”) and emerging Web 2.0 initiatives, as well as the digital archive. Within this context, technology strategy became more centralized, with a single team of technologists and a separate technology budget. The reorganization also affected other departments, which are currently subsumed under *core media units* rather than *specific traditional practices*. Therefore, Sport and News were brought together in a new Journalism division; an Audio & Music division took charge of the BBC's sound content for all platforms, from radio and television to podcasts; and finally, the BBC Vision division subsumed the former BBC Television, Factual and Learning, Drama, Entertainment, and Children’s divisions. BBC Future Media and Technology Division (FM&T) now contains these three major divisions. Figure 6 illustrates (next page) the BBC’s current organizational model, which was presented in July 2006.

¹⁷ <http://www.bbc.co.uk/iplayer/>

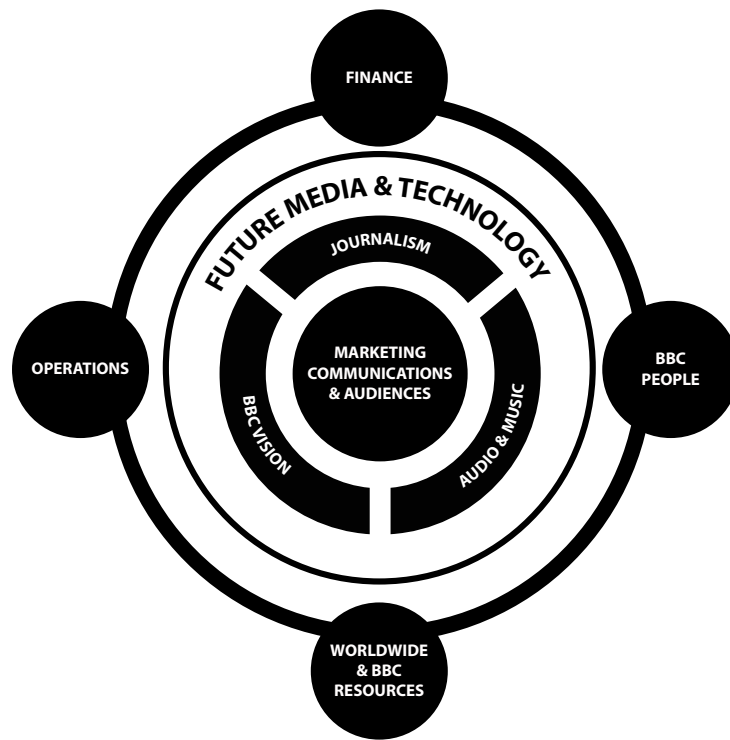


Figure 6: The BBC's organization model

The idea behind integrating *specific traditional practices and departments* into *three core media units* is closely linked to a convergence strategy that seeks to maximize the potential of each medium. In this case, the news productions (Journalism division), sound (Audio & Music division) and long-form video productions (BBC Vision division) are the targeted media in play. The BBC reorganization and its attempt to deal with overarching industry developments have been guided by the strategic vision summarized in a major company project, the Digital Media Initiative (DMI). DMI is known as a cutting-edge media convergence strategy that seeks to improve the way the BBC operates by providing greater efficiencies in terms of both time and costs as well as increasing the focus on multimedia content and creativity (BBC 2011).

To be efficient and competitive, DMI aspires for the BBC's core operations to rely entirely on information that is available in digital format. DMI aims to create an asset management culture in which information about the content is as valuable as the

content itself (Forrester, McClellan et al. 2011). Therefore, content-related information should be captured at the points where valuable knowledge *about* that content is being generated. In doing so, DMI facilitates the exploitation of content from a media convergence perspective; hence, content will potentially be readily available. As I demonstrate in the presentation of my empirical findings (chapter 7), DMI is driven by a series of technologies and services, concentrating largely on the creation (shooting, editing, post-production) and management (search, navigation, metadata, collaboration) of media assets. Upon the implementation of DMI, the BBC's core operations are to rely entirely on information available in digital format, mostly in the form of video and its underlying metadata. Particularly important here is the use of web technologies to enable the BBC to participate in the competitive digital universe among search engines and content aggregators, while maintaining the company's high-quality production values.

As an internal document mentions, for these aims to be accomplished, two groups of DMI-related changes must be implemented: *organizational transformation* and *technological integration* (BBC 2011).

First, in terms of *organizational transformation*, DMI is designed to allow BBC staff and third parties to develop, create, share, and manage digital video and audio content and TV programming on their desktop computers. DMI is therefore considered a project that involves technology, people, and production processes in a cost-effective manner and, at the same time, transform the way the BBC produces content in order to find new creative ways of interacting with its audiences (BBC 2011).

Second, in terms of *technological integration*, DMI aims to replace disparate legacy systems and create a unified digital production infrastructure that facilitates the manipulation of digital video content and access to the BBC's digital library. Hence, the unified computational system must integrate production (e.g., editing, post-producing, delivering) and archiving (e.g., indexing, retrieving, storage) processes in order to create programs in a more efficient way (BBC 2011).

For example, BBC Vision, the newly integrated broadcast and production group that emerged from the BBC's structural reorganization, brings together series, dramas, documentaries, and other long-form productions genres to prepare them for multi-platform commissioning on TV as well as web, mobile, and other emerging interactive technologies. Therefore, BBC Vision retains its responsibility for standard television and radio broadcasting, but also incorporates full accountability for new platforms, which was previously the responsibility of specialized functional technology teams inside the BBC.

DMI as a platform includes tapeless workflows and is intended to give BBC staff desktop computer access to the entire BBC digital archive.¹⁸ In 2011, it was estimated that DMI could save the BBC 2.5 percent in TV production costs per hour, totalling £100 million by the year 2015. The estimated cost of implementation and delivery of DMI was projected to be roughly £133.6 million and it was intended to conclude by the end of March 2017 (BBC 2011).

5.2 Standards and Technologies for Video Management at the BBC

Due to the BBC's large size, defining the right standards and choosing technologies for work to flow seamlessly throughout the whole organization has always been a daunting challenge. Hence, leading up to the initial implementation of DMI, it was not only a question of defining the right process and technology (i.e., an end-to-end unified computational system and a solution for managing digital video) but also providing common standards in terms of metadata and information organization that would work seamlessly in a unified workflow (BBC 2011).

¹⁸ As a side note, this objective is in itself wishful more than realistic thinking. As it was discussed during my meetings with BBC staff, it is technically impossible to digitalize the complete BBC archive as there are not enough VCRs in the world to playback and digitalize all the broadcasting formats in its archives. For example, the digitalization of legacy formats such as the defunct D3 (Panasonic) will require three times the D3 head drums that are available today. Also, D3 media only has a 20-year lifespan, so some of this media is no longer available.

In this section, I look at three relevant issues to help gain an understanding of the nature and complexity of implementing DMI at the BBC. First, I explain the evolution of standards and metadata at the BBC and their importance for supporting the implementation of DMI. Then, I present the historical origins and background of some of the technologies involved in deploying DMI, mostly focusing on Cinegy, which was selected as its main digital video integration platform. Finally, I briefly explore the landscape of the broadcasting industry before and after the implementation of Cinegy as part of DMI at the BBC.

5.2.1 Standards and Metadata

Dispersed throughout multiple sites in the UK, the BBC has a complex and diverse set of routines and procedures; therefore, technical standards have always been crucial for its success. Many special groups at the BBC are dedicated almost exclusively to defining standards for the electronic platforms. These groups ensure that the content offered by the BBC maintains the same tone and visual style, but above all, to assure the content is findable. For example, the BBC has a website detailing all standards and guidelines for developing and delivering products and services for the BBC online¹⁹ as well as a Global Experience Language (GEL)²⁰ site that is continuously being updated in order to help to create and design compelling multiplatform content.

Since the most common way to search for video at present is by text entry, the creation of metadata is a requirement. Metadata evolved from being used as a technology (for personalized tagging portals, CMS, and search engines), to a system that could be combined with other technologies (such as feeds and content aggregators), and is now also integrated as part of video production workflows (Rosenfeld 2006).

One of the first initiatives for classifying video at the BBC occurred three decades ago

¹⁹ <http://www.bbc.co.uk/guidelines/futuremedia/>

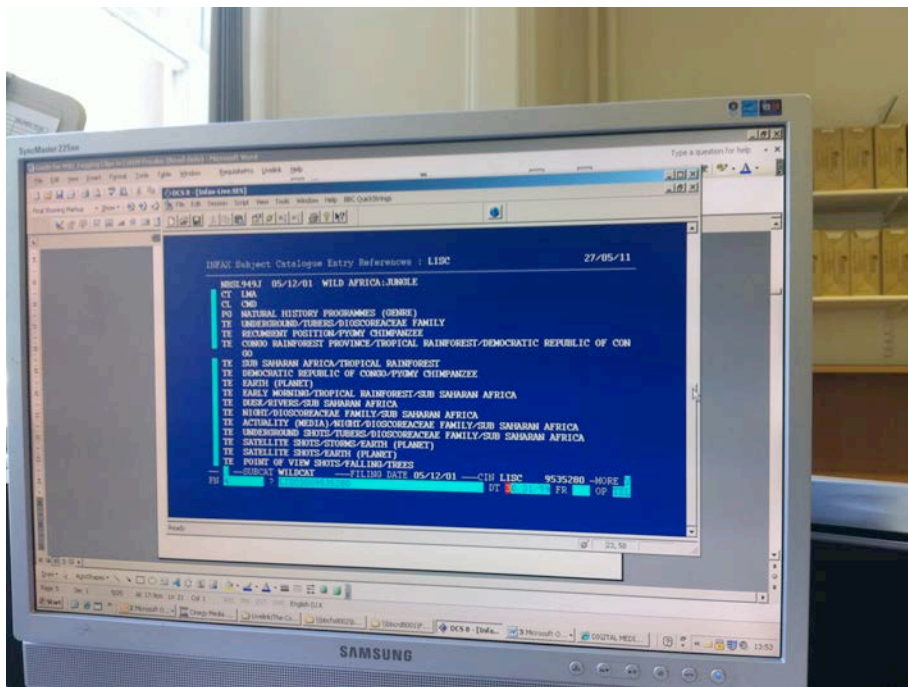
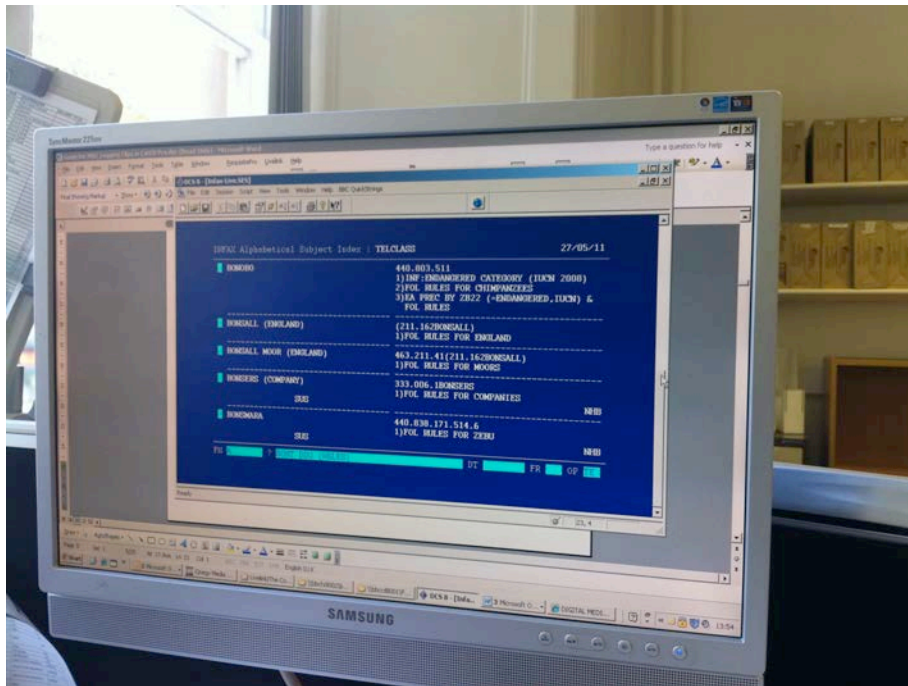
²⁰ <http://www.bbc.co.uk/gel/philosophy/design-philosophy>

in the Natural History Unit (NHU) based in Bristol. NHU is in charge of creating and producing the BBC's nature documentaries (e.g., *Animal Planet*, *Frozen Planet*). NHU not only provides world-class video content to BBC audiences, but also represents one of the most extensive efforts to produce adequate metadata about its video content which is even available online.²¹ This has created the possibility of producing new online archives such as *Wildlife Finder*²² (Evans 2011). Since the early 1980s, NHU deployed an internal database system to organize its archive. The system, InFax, was developed in MS-DOS (a precursor to the Windows operating system) and was one of the first relational databases that associated video content with formal text-written classifications. At that time, NHU had a scientific classification approach, as most of its researchers and producers were trained natural scientists. Their method of categorizing information on video content was based in biological classifications, such as genus or species. Biological classification has strong roots in the work of physician, botanist and zoologist Carolus Linnaeus (c. 1735), whose binomial nomenclature grouped species according to shared physical characteristics. InFax's use of this type of categorization also builds upon established classifications in the life sciences that exhibit considerable consistency (and therefore, predictability) through time. Even by today's standards, in which MS-DOS is quite a rudimentary platform (see Figure 7, next page), InFax is still considered throughout the BBC to be the best practice in metadata management software for classifying video content²³. Initially, NHU's use of InFax aimed specifically at the content that they worked on: they sought to be able to find the correct content and provide both technical and general descriptions about it. Another practice was the potential to reuse the contents' archive and thus reduce costs as it would not be necessary to shoot some content again. It is important to take in account that the content shot by NHU is in many cases unique due to the technical complexity that it demands (for an illustrative case refer to subsection 8.2.1). It may also not be possible to shoot the same material again since some species may have already disappeared or certain places may no longer exist.

²¹ <http://www.bbc.co.uk/nature/feedsanddata>

²² <http://www.bbc.co.uk/wildlifefinder>

²³ As part of DMI, InFax was to be replaced by a new search management system called Fabric.



more complex or sometimes impossible. For example, the field of journalism requires a particular kind of practice, language, and knowledge within media production. Journalism has developed systems and structures that facilitate and organize the work of its practitioners (e.g., journalists, editors, producers). However, journalistic practice is different from other genres, such as documentary, film, or fact-based productions. This means that different genres require ad-hoc systems and structures in order to facilitate and organize the work of its practitioners accordingly.

Around 2000, metadata creation and management at the BBC to a large extent reflected what was happening across the industry; it was mainly seen as a means for search engine optimization (SEO) in Google and in the BBC's local search engine. Hence, the organization had a rather fragmented approach to the development and application of metadata in the early years (Loasby 2006).

By 2004, the BBC began to invest in controlled vocabularies to cover all media content; content creators, mainly journalists, understandably protested against tagging their digital documents as it added work load and was considered as superfluous. The tagging of BBC content was quite uneven and unsuccessful, despite semi-automated classification tools that were presumed to lighten the journalists' work load (Loasby 2006). According to Rosenfeld there are two varieties of descriptive metadata²⁴, traditional vocabularies and folksonomies, which have never been mutually exclusive. Instead, traditional vocabularies and folksonomies can and should function as basic elements of what he defines as a "metadata ecology", where both serve important and often symbiotic roles (Rosenfeld 2006). As folksonomy became more widely disseminated at the BBC, BBC staff began using it as an alternative to traditional metadata (Morville 2005).

By 2006, the rise of digital video content on the internet generated more demand from audiences, prompting the BBC to devise an effective digital strategy where metadata became a necessity for both news and long-form productions (Loasby 2006). This

²⁴ For more information on descriptive metadata as well as other types of metadata refer to subsection 3.3.2.

increased the creation of data-driven prototypes that could demonstrate the innumerable possibilities metadata offered. During that time, the BBC developed several pilot projects and prototypes that were publicly available: Open Archive, an online digital video library, which made use of a rich collection of ready-made metadata from the internal BBC program catalogue (Loasby 2006); and, BBC Backstage,²⁵ which was envisaged as a more open and manipulable metadata ecology, interoperating information from massive and diverse databases by means of interfaces known as “mashups” (Mariátegui and Kallinikos 2007; Forrester, McClellan et al. 2011).

Matters such as findability, reuse, and access to a digital archive became organization-wide concerns and made the discussion about the role of metadata a significant topic within the BBC (Loasby 2006). The discussion sparked several questions based around the BBC’s former audiovisual workflow and the changes required to incorporate the metadata throughout the process. However, other issues related to the impact of the internet and the value of the metadata produced for the BBC’s audiences generated more questions than answers. The first inconsistencies in the way in which the BBC understood the metadata journey were evidenced by the different questions arising, which subsequently entailed different approaches to the way in which multiplatform delivery would be managed. Figure 8 (next page) schematically illustrates the rise of metadata as a primary concern at the BBC and addresses several questions expressed by staff at that time.

²⁵ <http://backstage.bbc.co.uk>

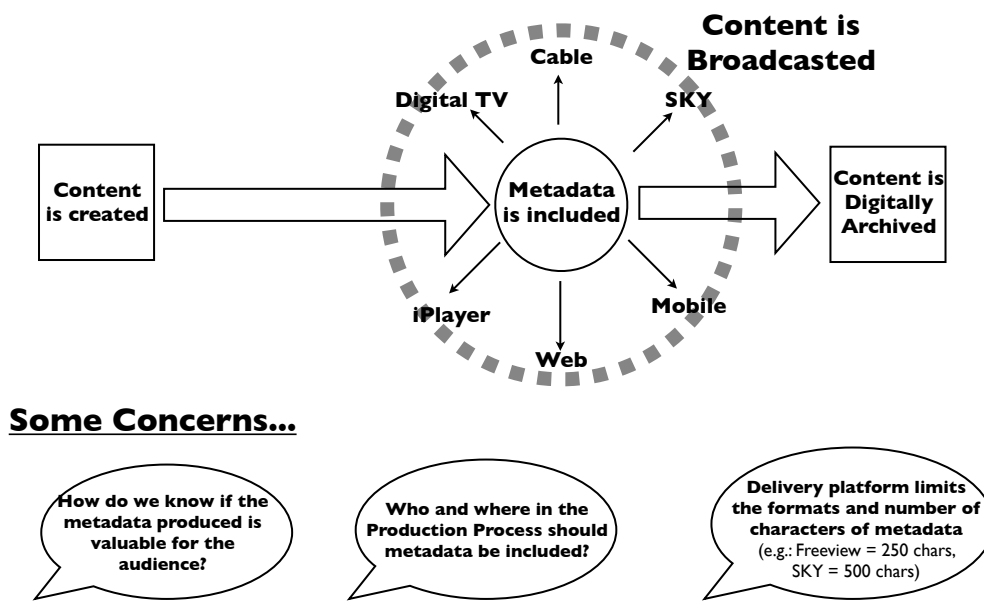


Figure 8: The metadata journey at the BBC

5.2.2 Historical Background of DMI: Cinegy

The aforementioned fragmented history of metadata's evolution at the BBC should be complemented with a description of the technologies that were devised to support DMI. Throughout this section, I describe the evolution of Cinegy, a video editing software that has a deep historical relation with the BBC and was later brought in as a central element to support the digital production infrastructure of DMI.

The story of Cinegy also begins at NHU in Bristol. While developing InFax, NHU envisioned the possibilities that could be brought about by management of video and metadata. One such possibility was to provide a tool that allowed people using the same video assets to work collaboratively, which was how NHU came up with the concept of “Collaborative Working”. The project that resulted from this idea was initially called Project Mercury and later renamed Project Colledia (an acronym for “Collaborative Media”). BBC Technology (the technological division of the BBC at the time) chose a German company, Aced, to develop the software based on BBC specifications (while the BBC retained the intellectual rights to it). One BBC

programme manager in charge of its implementation commented on the evolution from Project Colledia to today's DMI:

DMI really started in the late nineties in Bristol, as [Project] Colledia. It was customized for the use of the BBC since there was nothing like what they wanted.... Finally [BBC] London led the whole system initiative and called it DMI. They had a huge amount of requirements and they consulted people on what they needed.

(Programme Manager, BBC Academy, interview, January 19, 2011)

In 2004, BBC Technology was sold to Siemens, which defined itself as a services company and not a product company (BBC 2004). Consequently, Project Colledia was sold back to Aced, the German company that had originally developed it. It was then re-branded as Cinegy. As a product originally developed for the BBC, Cinegy was extensively customized to meet the BBC's specific requirements. It was initially used by NHU to produce *Planet Earth*, which was the first program to be managed using a fully digital workflow. *Planet Earth's* video shots were carefully metadata tagged and later put into a digital repository that enabled anyone at the BBC to reuse the content for other projects. With regard to its prospective reuse, the same programme manager involved since the beginning of Project Colledia mentioned:

[...A] chap spent over two years afterwards cataloguing all the rushes of Planet Earth. And a year ago they recon that 25 percent of the rushes had been reused by other programs of the BBC. So you then absolutely validate that the metadata has value and generate huge cost savings. A lot of the usage was for children's programs.

(Programme Manager, BBC Academy, interview, January 19, 2011)

However, the new fully digital workflow process did not run without complications. A considerable issue was the lack of interoperability between Cinegy and Avid, a turnkey editing suite widely used at the BBC. At the time, standardized video and audio formats were available, but no standard for interoperating metadata existed. In effect, metadata did not flow between Avid and Cinegy mostly because Avid had its

own competing standard. Since manufacturers were worried of opening the door to competitors, there were no industry-wide interoperable standards for metadata available at that time. Hence, the fully digital workflow process provided by Cinegy was in danger of effectively creating its own technological silo. Nevertheless, Cinegy was ultimately conceived on the basis of being flexible enough to integrate both open and proprietary standards into its system. The flexibility brought by Cinegy became an important feature that eventually established it as the main software package for managing video content within the BBC.

Cinegy was not only used for managing, collaborating, and sharing video content. As it relied strongly on tagging and metadata, it enabled archived video content to be easily findable and reusable. Due to *Planet Earth*'s initial success in efficiently managing metadata, the "NHU approach" of working with metadata became a "best practice" within the BBC. In early 2008, the BBC signed an agreement with Siemens for the provision of delivery of DMI. Siemens selected Cinegy as the main software solution to execute the implementation of a tapeless and multiplatform production infrastructure at the BBC (Broadcast-Engineering 2008; Chapman 2008). In the summer of 2009, after the delivery of DMI was delayed a number of times, the BBC and Siemens agreed that the BBC should carry out the implementation of DMI in-house, using internal staff, contractors, and a range of third party suppliers (BBC 2011). At the end of May 2013, the BBC announced the permanent closure of DMI as a large-scale initiative (Conlan 2013). However, Cinegy is still being used as a central part of DMI software solutions strategy today. Also, in the case of BBC NI's Digital Northern Ireland initiative, its implementation is considered by experts to be the most successful of the DMI programs and is still running.

Cinegy's open standards enables it to work on several parts of the digital workflow process at a glance: ingesting, archiving, editing (through desktop computer integration), finishing, and multiplatform delivering. Cinegy became the bridging platform that integrated craft editing suites (e.g., Avid, FCP), news platforms, desktop editing, local repositories, and centralized digital archives into a unified system. This has made Cinegy not only a key component of the digital workflow process, but also

one that unifies most of the other systems and processes (see Figure 9). A case study by Cinegy states that the DMI solution consists “of a suite of tools, applications, and open [frameworks that encompass] the complete broadcast production chain from ingest through playout modules” (Cinegy 2010). As my research focuses on DMI implementation at BBC Northern Ireland, it is useful to address the main components that installed at BBC NI: “Cinegy Ingest, for real-time, uncompressed HD-SDI encoding; Cinegy Archive, a server-based, centralized digital asset management system; Cinegy Convert for automated transcoding to enable integration with Avid and FCP; and the Cinegy Desktop NLE, deployed on client workstations for managing ingest, logging, browsing, and editing [digital video]” (Cinegy 2010).

Cinegy is not a turnkey solution in the way Avid was; it is not specialized in a particular function, but it became the key solution that unified a complex and diverse set of features.

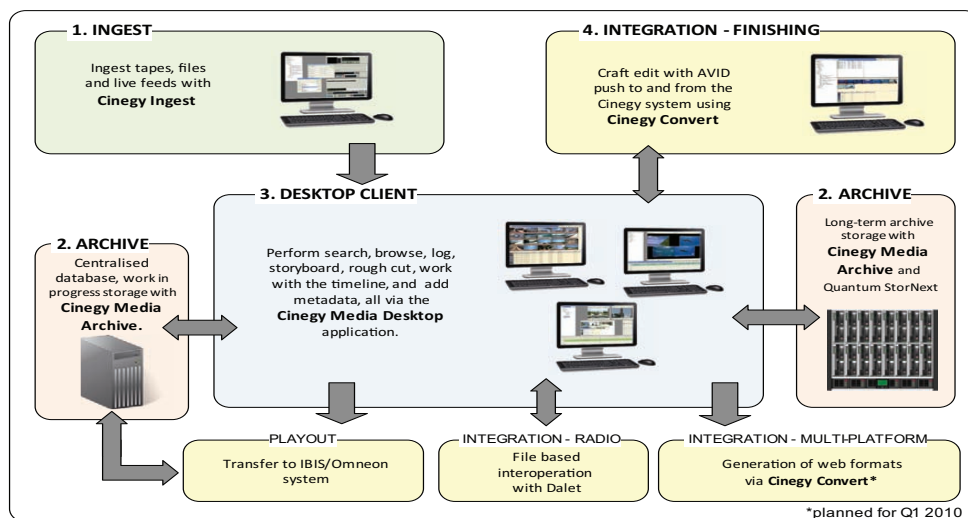


Figure 9: Cinegy capabilities and its interaction with other systems at the BBC

(extracted from Cinegy 2010)

5.2.3 The Introduction of Digital Video Production to the BBC

At this stage it is important to explain the evolution of the broadcasting industry with regard to digital video. As discussed in chapter 2, the broadcasting industry has been committed to buying hardware from a few manufacturers that were specialized in particular aspects of the production process. This generated a fragmented broadcasting ecosystem in which each manufacturer developed its own specialized technologies and equipment that were not interconnected with other manufacturers, most of which worked in silos. Broadcasting hardware manufacturers generated an economic model in which a few large players maintained their hardware tied to functional silos of expertise.

The dynamics of the industry allowed manufacturers to stop other competitors from developing similar technologies. For example, a common case has been the rivalry between videotape standards such as Sony and Panasonic. The consumer videotape market was dominated by Panasonic's VHS format in the 1980s. However, in professional broadcasting, Sony's Betacam and Digital Betacam were primarily the leading videotape standards for several decades (MacGregor 1999). The limited brand competition generated a broadcasting industry that relied on an assortment of secluded standards for specific functions. The assortment of standards also required the incorporation of a complex set of skills and experts specialized in particular brands, operations, and even in specific equipment. These issues caused the world of broadcasting to become cluttered of very specialized systems that were also very inefficient. Precluding possible interconnections between equipments also reduced the level of innovation in the media industry, which may have been among the reasons why, in terms of legacy equipment installed base, it is one of the industries that took the longest to execute an extensive digitalization of their business processes.

When digital video arrived in the media industry, manufacturers of video editing systems started following a model similar to that of legacy equipment manufacturers, as was the case of companies like Avid, a leader in video editing systems. By selling turnkey solutions, Avid offered their software and hardware (i.e., computers, video

cards, hard disks) as a bundled solution. As mentioned earlier, this model has several limitations. Manufacturers involved in a specific part of the process were not encouraged to innovate and broadcasting companies were restrained from incorporating new developments since the interoperability between different equipment was limited. The challenges became particularly notorious problems as the internet increasingly permeated the content generated by the media industry (i.e., music, video, news).

In contrast to most broadcasting industry players, Cinegy was a software company committed to a model which relied on open standards and without any proprietary hardware solution. Such a model distinguished Cinegy from the traditional commercial broadcasting solutions which mostly relied on proprietary hardware. As more players like Cinegy started to enter the professional broadcasting market (e.g., Apple, Adobe), providing competitive solutions, turnkey manufacturers were forced to adopt standards that enabled the digital interoperability between their systems.

Although Cinegy encouraged broadcasting companies to select the hardware vendors, they preferred to work with their software solution. Many media industry employees still preferred turnkey systems, which offered a bundled hardware and software solution. A bundled solution means that the manufacturer is responsible for any problem that may occur with the system; however, it also forces the use of proprietary hardware standards. As one Cinegy product manager stated:

The industry still prefers systems that can sell everything through one vendor, an integrated solution, like Avid.

(Product Manager, Cinegy GmbH, interview, January 26, 2011)

In contrast, if a system is not a turnkey solution is no support for all of its different physical parts. If a problem occurs, the first suspected culprit is the software; the user's first "thoughts" turn to Cinegy and blame it for the problem.

As previously addressed in this chapter, a key benefit of using Cinegy is the ability to

move away from legacy hardware. Once a video is logged (i.e., ingested into the system or digitalized), everyone in the organization has access to it. Its multi-user collaborative feature means that files are centrally managed. With its focus on software, Cinegy was able to react to market changes much faster and, seen from this standpoint, Cinegy became an “organization pusher”, driving a more decentralized, interoperable, and collaborative culture of digital video production at the BBC.

Curiously, as we will see in the next section, Cinegy, which started as a project in video management, editing, and cataloguing at NHU, became commercially successful as a unified workflow solution for newsrooms across Europe. It was also for this reason that Cinegy was selected as a central component for the implementation of a tapeless environment at BBC Northern Ireland.

5.3 Research Site: BBC Northern Ireland

The main field research was conducted at BBC Northern Ireland (BBC NI), which is one of the BBC’s three regional broadcasters, along with BBC Scotland and BBC Wales. Headquartered in Belfast, BBC NI is the second 24-hour newsroom in the UK (a response to the need for coverage during “The Troubles”²⁶, a period of ethnic, religious, and political conflict in Northern Ireland.)

BBC NI operates two television stations, BBC One Northern Ireland and BBC Two Northern Ireland. BBC NI also produces some of its own news and long-form programs.

The news team at BBC NI is recognized for leading-edge journalism and producing original programmes. The main program is *BBC Newsline*, a regional news service (with the main half-hour bulletin at 18:30 and shorter airings at 13:30 and 22:25) that

²⁶ The duration of the “The Troubles” is dated back to the late 1960s and ended in 1998 with the Belfast “Good Friday” Agreement (<http://www.bbc.co.uk/history/recent/troubles/>)

also covers Northern Ireland politics in a separate segment. The newsroom space is shared by BBC NI radio. Both are responsible for providing material to the BBC's national radio and television newsrooms. Staff in the newsroom includes a general production journalist, a senior production journalist, head of programs, broadcast journalists and media managers (the latter were located at the central ingestion hub).

In the case of long-form productions, the BBC produces several regional political programs, notably: *Spotlight*, *Hearts and Minds*, *Inside Politics*, *Today at the Assembly*, *Let's Talk*, *Sunday Morning Live* and *Wanted Down Under*. Additionally, there are regional arts programs, weekend chat shows, special coverage of events, and one-off specials such as the *Titanic: A Commemoration in Music and Film*. The team involved in these types of long-form productions varies depending on the program, but often include a general producer, a senior producer, head of programs, and media managers (the latter were based in each production team and not in a central ingestion hub, as it was the case for news production).

In addition to programs intended purely for regional audiences, BBC NI also has a large production unit that generates content for the BBC's national channels across the UK (Kirkaldie and Kirk 2010). BBC NI is the Centre of Excellence for Current Affairs programming (*Panorama*, *This World*). The BBC Network Supply Review has decided that 3 percent of all BBC TV network production will come from Belfast by 2016.

In terms of organizational structure, BBC NI's Technology and Operations teams are also converging as the new and emerging production technologies, which include the management of Cinegy, blur former roles, enable smoother resource flow, and result in more efficient production. The newly converged Technology and Operations (TOP) team is run by six managers in the following positions (see Figure 10):

- *Fleet and Infrastructure Manager*: The Fleet and Infrastructure Manager manages legacy infrastructure and optimization of all facilities while developing innovative and cost-efficient plans for their maintenance and development.

- *TOP Support Manager*: The TOP Support Manager's main function is to refine, converge, and report on the support operation and optimization of all Technology, Distribution, and Archive workflows.
- *Business Delivery Manager*: The Business Delivery Manager is responsible for project delivery and development plans for the converged TOP unit.
- *Planning and Logistics Manager*: The Planning and Logistics Manager plays a key part in leading the implementation of a responsive planning and delivery model that is aligned with the commissioning and production community within BBC NI.
- *Media Technologies Manager*: The Media Technologies Manager is responsible for managing and supporting several technical areas across BBC NI's wide-ranging production workflows (Media Central, Post Production and Graphics functions).
- *Performance and Learning Manager*: The Performance and Learning Manager maintains strong working relationships with all departments throughout BBC NI to understand the evolving production solution delivery needs so as to identify and develop plans to support emerging talent both internally through BBC Academy and also externally through specialist experience via partnership opportunities.

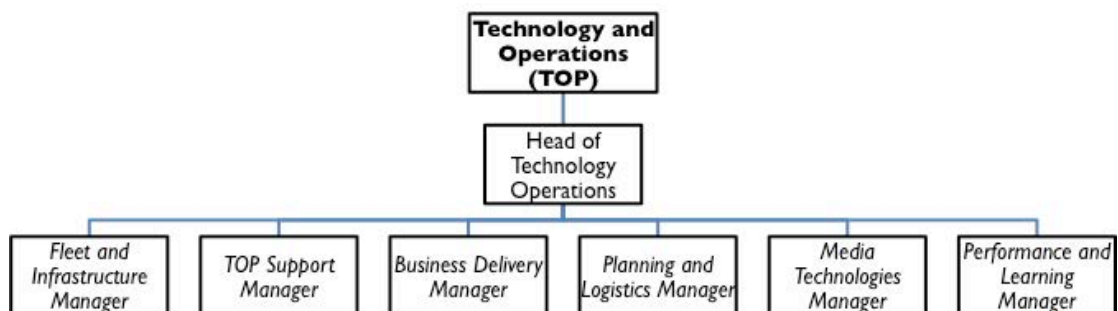


Figure 10: BBC's Technology and Operations organizational structure as of 2012

5.3.1. Digital Northern Ireland (DNI)

As described in the previous section, BBC NI is responsible for a significant number of local productions. However, it was very late in terms of technology investment; BBC NI was the last tape-based newsroom in the UK. The inability to search in a digital library often led to a redundancy of video shooting and research. Production bottlenecks were also frequent, particularly as producers and journalists competed for the craft editing suites available (Kirkaldie and Kirk 2010). In December 2007, the Technology Department of BBC NI submitted an Investment Proposal to pilot a new digital workflow, DNI (Digital Northern Ireland), which was approved in October 2008. It outlined the digitalization of both news and long-form productions. In April 2009, DNI's pilot project commenced with the news workflow and in December 2009 four pilot projects were implemented in the long-form productions workflow.

DNI was designed to transform business processes and technology within BBC NI. It sought to accomplish this through a series of change management executions, with an emphasis on what BBC NI defined as “Technology change drivers”. The following excerpt from an internal document indicates that these changes consisted of:

- Production transformation – need to align support model (e.g., DNI with file & IP-based methodology).
- Fragmented legacy systems replaced with new solutions based on common toolsets.
- Move towards common solutions enabling a design once, use many approach.
- Media asset management framework.
- Commoditisation of technology.
- Multiplatform production and content repurpose.

(Internal presentation, Technology Northern Ireland Reorganisation Detail, 2009)

BBC NI's legacy systems were largely based on videotape, which contributed to unnecessary maintenance costs. These costs included both the time needed by

broadcast engineers to fix the equipment but also the expenses in finding and replacing hardware and repairing legacy machineries, which did not add any real value to the business. Therefore, the pre-existing production workflow was becoming increasingly expensive and unsustainable. The absence of a centralized digital library also led to missing tapes, problems with legacy tape formats, inconsistencies in logging material, as well as media security issues (Cinegy 2010; Kirkaldie and Kirk 2010).

DNI was designed to accommodate a rapidly developing desktop production environment (both in-house and in the field), focused on the following characteristics:

- *Impact*: Result in improved resilience and increased staff proficiency in digital production techniques
- *Quality*: Produce improved technical quality and increase reliability
- *Value*: Deliver collaborative efficiencies

An important element of DNI's implementation was that Cinegy was an off-the-shelf software: It did not go through any in-house customization development or compliance, which meant that people would have to adapt themselves to the system rather than the other way round. In 2009, Cinegy was installed on more than 100 desktop computers. As one product manager in charge of Cinegy's implementation mentioned in relation to DNI:

DMI selected Cinegy as the software that was going to run everything. They were told that were not allowed to make any changes in the product, going live with very few problems (80 percent that we thought we could not live without). [...] A lot of the time broadcasters tend to overthink what their requirements are: Identify the core of what is your business need and then implement it, and then you will realize that there are a lot of initiatives that you will not necessarily need (and that you thought you might need). What happened is that at the end of the day Cinegy was designed [originally] by the BBC so it was what the BBC needed. (Product Manager, Cinegy GmbH, Interview, January 26, 2011)

The Cinegy solution was selected for its ability to support open standards and formats, which provided other benefits in terms of improved working processes. A Cinegy document showcasing the case study at BBC NI clearly summarizes its benefits:

- Flexibility and scalability allowing adaptation to productions of varying size, scope and delivery requirements.
- Improvement in production efficiency while reducing costs and without dictating a particular workflow.
- Integration with existing processes and technology thus easing migration while enabling the possibility for third-party components to be updated and replaced as time and budget allow.
- A pathway for future growth in terms of size and functionality, and to meet evolving content delivery needs.
- The ability to exchange material quickly and easily between Cinegy and other content production systems that changed the workflow for radio and online news as well. Previously in the tape-based world, radio and online news competed with TV for access to tapes as they came in from the field. Now with a digital workflow, radio and online news simply transfer the Cinegy files to their relevant systems for edit and playout/publication.

(BBC Belfast and Cinegy: News, Collaboration and Production for the Digital Northern Ireland Initiative, 2010) (Cinegy 2010).

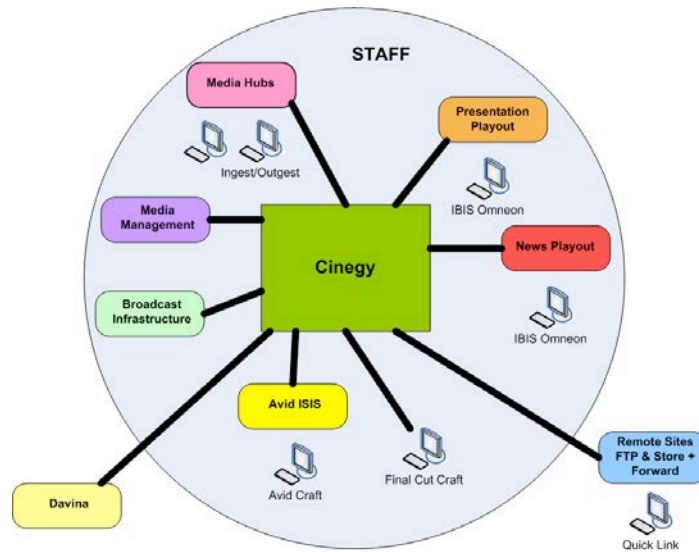
Implementing an off-the-shelf software solution also allowed BBC NI to stay focused on the change management plan by incorporating new roles and developing a consolidated and converged Broadcast Technology model, defined in a document as “Broadcast Technology Outputs”:

- Clear Broadcast Technology vision and roadmap.
- Optimised scheduling and utilisation.
- Proactive vs. reactive technology service delivery.
- Efficient administration and reporting.
- Reduced dilution of service delivery across hybrid requirements / interests.

- Centralised Broadcast Technology operation with converged programme support and consolidated technical knowledge.
- Increased ability for systems-based activity, fault diagnosis and remote fix.
- Business-realigned Broadcast Technology operation.

(Internal presentation, Technology NI Reorganisation Detail, 2009)

However, Cinegy was implemented at the BBC NI in a way that had never been done before. The implementation entailed the creation of three separate databases: two work-in-progress areas (for news and long-form productions, respectively) and one shared digital library (for permanent archive material). The databases provided client workstations with instantaneous access to ingested video content, meaning that changes made by one user could be viewed by other users simultaneously (Cinegy 2010; Kirkaldie and Kirk 2010). Cinegy also had to interact with two types of editing systems that were made available as part of DNI: the desktop editing suites (i.e., Cinegy and Adobe Premiere Pro) and the craft editing suites (i.e., Avid and FCP). All these interactions made Cinegy the central hub of DNI's digital workflow process. Figure 11 (next page) illustrates how Cinegy played and continues to play a key role in interoperation with other systems, such as video editing suites (Avid), the media archive, delivery, and news (extracted from an internal document: "Digital Northern Ireland Project").



*Figure 11: Cinegy and its interactions with other systems as part of DNI's digital workflow process
(extracted from Cinegy 2010)*

BBC NI focused on implementing new tasks that could be completed from users' desktop computers, including searching for and managing video content. According to one head of the Technology division at BBC NI:

DNI is a two-year project, but it is not a technological project. It is transformational (80 percent hearts and minds, 20 percent technology). It provides adaptability to change.

(Head of Technology, BBC NI, interview, October 19, 2009)

Implementation of DNI was generally recognized as enabling a transformation within BBC NI. The transition flowed better than expected with the journalists' teams. However, as I explain in the following chapters, long-form production teams did not embrace the new system as rapidly as anticipated. As my empirical findings later illustrate, the redefined workflow based on Cinegy has generated a distinctive change in the work practices for news and long-form productions, respectively.

In this chapter, I described the research site and context, first explaining the general

concept of the BBC's Digital Media Initiative (DMI), as well as its notions of standards and technologies for video management. By briefly introducing the history and evolution of NHU, I traced the first standards and metadata for video production produced at the BBC. I then described the historical background of Cinegy, the "out-of-the-box" software solution that was central to DMI's unified workflow. Finally I profiled the main research site, BBC Northern Ireland, and its particular implementation of DMI, defined as Digital Northern Ireland (DNI).

Chapter 6 provides both a methodology and a research perspective, which frame my approach to the research site. These are described extensively in the subsequent empirical findings and analysis (presented in chapters 7, 8, and 9).

6. Research Methodology and Design

Anyone who writes has to master the rules of spelling and grammar.

–Vilém Flusser, *Towards a Philosophy of Photography* (2000)

In this chapter, I describe the methodology I used to assess both the general implementation of DMI and its detailed process of deployment at BBC NI, the main research site. I first introduce the site selection and research strategy and the process that I underwent in order to make the decision for choosing an embedded case study. Then I describe my research design and the reference literature used, largely based in the work of Eisenhardt (1989), Sayer (2000), and Yin (2003). My research design is organized in five components as proposed by Yin (2003): the study's question, its propositions, its units of analysis, the criteria for interpreting the findings, and the logic of linking the data to the propositions. I also explain how the data was collected, as well as the methods used to validate and analyze it. Lastly, I explain the peculiarities of the BBC as an organizational setting and how my research differs from most of the research previously conducted on the BBC.

6.1 Site Selection and Research Strategy

The purpose of this section is to explicate the research strategy used. In order to do so, I first present the context of my research through a description of the site selection. Then I provide the main strengths of choosing a case study as a research strategy and outline the four stages of my research based on such strategy.

6.1.1 Site Selection

The case study was primarily based on information collected from BBC Northern Ireland (BBC NI) in Belfast, one of the national operations of the British Broadcasting Corporation (BBC). Supplementary interviews took place at the BBC headquarters (Broadcast Centre, White City, London) and in three additional settings: BBC Academy (Wood Norton, Worcestershire), NHU (Bristol), and Cinegy GmbH (by telephone).

BBC NI implemented Digital Northern Ireland (DNI) as part of the BBC's general Digital Media Initiative (DMI). As mentioned in the previous chapter, DMI is a massive UK-wide plan that sought to establish the BBC's core media operations' complete reliance on information available through a digital production infrastructure. BBC NI's Technology division is comprised of 77 employees who are directly responsible for implementing DNI. The on-site observation involved extensive visits to the main operation center (BBC NI) during the implementation stage, informal conversations, as well as observations that led to a technical understanding of the deployed solution. In addition, I was able to gain a better idea of the magnitude and complexity of the implementation while familiarizing myself with the contextual environment where I conducted research for more than two years. Visited areas included the newsroom facilities, teamwork production areas, the machine room, and craft editing suites as well as conventional office settings. The documentation analyzed include presentations on specific organizational and strategic aspects of the transformation as well as manuals and training reports. As DNI has mostly been based on a specific software solution, an off-the-shelf software package called Cinegy, an overview of this technology and a review of its supporting technical documentation were required to understand its ease-of-use. Since DMI's operations are assembled and distributed under six high-level functionality enablers,²⁷ understanding the specific implementations and processes of BBC NI's DNI required extensive in-depth knowledge of the DMI project.

²⁷ Refer to section 7.2 and Appendix 11.3.1 for more detail on DMI's six enablers.

From 2006 to 2009, preparative meetings and interviews were held at the BBC's headquarters with several stakeholders²⁸ involved in DMI from the FM&T division. The meetings complemented my knowledge of the site, bringing out important aspects to my attention, such as various stakeholders' views on the change management procedures, the technical challenges of the implementation, and its impact on work practices throughout the organization. The meetings also gave me a more holistic view of the media industry and its transformation, particularly with regard to the impact of media convergence and the internet.

It was important for me to understand previous “historical” technology implementations at the BBC that were similar to DMI as a means of obtaining a clearer image of the reasons behind DMI's deployment and its consequences. Therefore, as previously mentioned, in order to complement the research and acquire a more in-depth understanding of the implementation both in technical and historical terms, in 2011 I sought out additional interviewees at BBC Academy (Wood Norton, Worcestershire), NHU (Bristol), and conducted a two-hour phone interview with the product manager of Cinegy GmbH. The interviews at BBC Academy helped me to understand the implementation of DMI from the viewpoint of those who trained BBC NI staff. It also gave me access to professionals with extensive knowledge of all of the BBC's sites and decades of experience training BBC staff in different contexts, technologies, and moments in time. By congregating historical, comparative, and critical perspectives, a clear image emerged of the evolution of DMI at the BBC. Most of the staff I interviewed at BBC headquarters and BBC NI repeatedly mentioned NHU and its pioneering work in managing metadata and digital video. However, few could tell me exactly what and how they did it, which led me to conduct complementary interviews at NHU (Bristol) in order to gain first-hand accounts of what occurred. I supplemented these with a rich telephone interview with the product manager of Cinegy GmbH, who was also in charge of both NHU and BBC NI implementations (and was a former BBC employee).

²⁸ Refer to Appendix 11.2 for a detailed list of interviewees and their positions.

By visiting these sites and fostering an ongoing relationship with staff at the BBC, I developed an interactive knowledge that enabled me to understand the meaning of their communicative signs, conventions, and concepts. Therefore, I added to my research notes on unspoken and non-verbal dimensions of the context I studied (Sayer 1992). This context-driven approach allowed me to understand the social confluence of people and technology around the DNI workflow.

6.1.2 Research Strategy

As Robert K. Yin (2003) states in his acclaimed text on research methodology, *Case Study Research: Design and Methods*, case studies are the preferred strategy for an empirical inquiry into the origins of a particular phenomenon when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. Questions of “what”, “how” and “why” are emphasized in cases studies, as these focus on understanding the dynamics within particular contemporary settings (Eisenhardt 1989).

Hence, the decision to deploy case study derives from three sets of considerations that are manifested in my research site: first, the researcher has little control over the events as they occur within real-life contexts; second, the boundaries between a phenomenon and its context are not clearly defined when one is directly observing events; and third, the interviewees involved in such an event and their relevant behavior cannot be manipulated (Yin 2003). As Yin (1981) mentions, a case study can employ an embedded design that incorporates multiple levels of analysis within a single study and simultaneously combine data collection methods such as archives, interviews, questionnaires, and observations. Thus, a case study results in a process model that links multiple organizational levels over a period of time (Eisenhardt 1989).

In order to explain how a case study research strategy provided me with the

appropriate elements (i.e., explorative nature, issue of comparison, depth, penetration), I explain the process I undertook by dividing my research into four stages (see Figure 12):

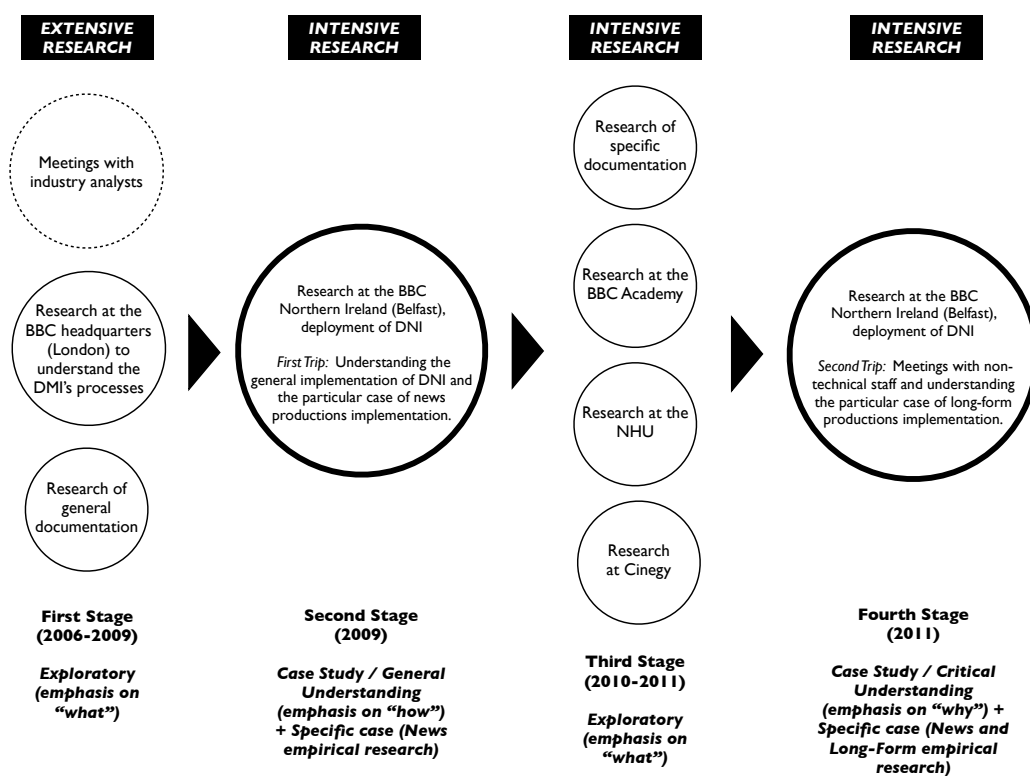


Figure 12: Stages in the research strategy

The nature of the first stage was mainly exploratory, as the boundaries between the phenomenon and the context that I wanted to study were not yet evident (Yin 2003). For this purpose, I met extensively with managers and consultants at BBC headquarters to understand DMI's processes. I also met informally with several industry analysts and experts as well as reviewed documentation (both public and internal) on DMI. Through this process I became familiar with DMI and learned its objectives and aims. I also acquired answers to questions regarding the "what" and identifying the "how" and "why", which I then added to my theoretical propositions in order to guide the initial data collection and analysis (Yin 2003).

The second stage was comprised of the first visit to BBC NI. During this visit I gained

an initial understanding of the DNI process (the “how” stage of my research) and then dug into the details of the news production environment in order to understand its operations and its context (the “why” questions). By the time I concluded the first visit to BBC NI, I had acquired extensive information through interviews, informal meetings, and internal DNI documents. While transcribing the interviews I came across many new questions.

The fieldwork at BBC NI prompted me to add extensive in-depth interviews from other settings to my case study (i.e., NHU, BBC Academy, and Cinegy). This third stage of my research was very useful as it allowed me to gain a broader range of perspectives on the implementation from a variety of people, not just BBC NI staff. It also elucidated and enriched some of the comments I received in the second stage and enabled me to gain both a broader and deeper knowledge of DNI. These visits also contributed to my recognition of the boundaries between a phenomenon and its context, which was not initially evident, as is suggested in the approach put forward by Yin (2003:13).

In the fourth and final stage of my research, with the experience and knowledge acquired from the previous three stages, I reviewed my fieldwork in order to develop sharper and more insightful questions that were specific to the site (Yin 2003). While the first visit to BBC NI focused on the implementation of DNI in the newsroom, the second visit was mostly devoted to meeting the staff in charge of the long-form implementation and production. I also had made a more careful and specific selection of the people I wanted to interview: I sought discussions not only with people from the Technology division, but also with actual “users” of DNI (i.e., journalists, producers, craft editors, media managers, and broadcast and technology engineers). Targeting certain groups enabled me to emphasize the “why” questions and pose them with better arguments about the site (in some cases I even had more knowledge than my interviewees, which also made the interviews richer and more exhaustive, and took no less than an hour of recording time).

After the final stage of my research, I decided to divide my case study into two sub-

types of implementations: the news (Journalism division) and the long-form productions (BBC Vision division). The intention behind analyzing these two divisions separately was simple: DNI was initially applied in the same way in each scenario but has worked differently. The complexity of the digital image is assimilated in different ways in news and long-form productions, yet DNI has been implemented in both due to the significant simplification of longstanding work practices. Therefore, it was important to identify how the work practices in each sub-case differ from each other and what that could contribute to the overall research. This approach enabled me to develop a more articulate understanding of the “how” and “why” questions. It also enabled me to depict the elements that have worked well throughout the implementation of DNI and those that have not worked as planned.

6.2 Research Design

As Robert K. Yin (2003) states research design is the logic that links collected data to the initial question of study. This linkage derives from theory about the study object and helps implement the case study design by making it more explicit (Yin 2003). In the following section, I present the research design in five components as proposed by Yin (2003): the study’s question, its propositions, its units of analysis, the criteria for interpreting the findings, and the logic of linking the data to the propositions. I describe each component by taking into consideration my specific case study, along with additional literature that elucidates the research design.

6.2.1 The Study’s Question

My research focuses on how organizational practices are affected by digitalization, and more specifically, the use of digital video, through the digital production infrastructure implemented in DNI. While studying the digitalization process and the constituencies required to manage digital video through a unified workflow, it was

important to bear in mind that certain elements that characterize digital video creation and management complement previous studies that focus on information tokens such as electronic text or computer code. Also, news and long-form productions are based on different work practices. Hence, this empirical study addresses the workflow and the sequentialization of work practices for the purpose of searching and organizing video content, and how this has affected news and long-form productions differently. Furthermore, I study the production of video narratives in terms of video's image-based constitution and its impact on organizational change.

My research is circumscribed to the comprehensive digital production infrastructure that comprises the DNI workflow. Hence, I do not concentrate on the processes that occur before ingesting a tape or after the delivery of the final broadcasted content (to TV or other media). It is important to mention that the shooting of video is described here as part of the DNI workflow, but I focus on it as an integral aspect of the video ingestion and digitalization process.²⁹

6.2.2 Propositions

As mentioned previously, my research complements other studies that examine changes to the work practices in office-based settings (Barley 1986; Zuboff 1988; Adler 1997; Zammuto, Griffith et al. 2007; Kallinikos 2011). It extends existing theories and makes two important contributions to the IS field. First, my research applies prior theories to an organizational transformation (through digitalization) in the media industry, one of the most dynamic and information-intensive industries. Second, my study complements previous work that largely centers on the domain of the electronic text (Zuboff 1988), by exploring the digital image as an information token. Therefore, I am not merely trying to complete an exercise of applying a theory to frame an empirical study. My work uses the theory as an analytical framework to analyze technology and organizations in an industry that has been under-researched by the IS community.

²⁹ For more detail on the BBC's DMI operations refer to chapter 7.

6.2.3 Units of Analysis

My unit of analysis is the BBC NI, which is the key entity that is being analyzed throughout the empirical research. In order to include in my research the characteristics of digital video management, I study the comprehensive digitalization process at BBC NI, the technological change, and work practices connected to the DNI workflow. The different organizational levels in which observations are being conducted are outlined as follows:

- *Operations*: DMI's main operations (six enablers) within the specific implementation of BBC NI's DNI.
- *Implementations*: Comparative descriptions of implementation in two settings: the Journalism division (news production) and the BBC Vision division (long-form production).
- *Organizational and work practices affected by DNI*: Descriptions of the changing work practices taking place within specific roles or positions that have been affected during the implementation of DNI.

The main purpose of dividing my empirical case into three different levels of observation within BBC NI is to gain an in-depth understanding of how an identical technology (DNI) impacts work practices in different organizational settings. I do so by analyzing the main operations that are part of DNI and its implementation in two different contexts and by examining how roles and work practices have been affected in news and long-form productions, respectively. In addition, I also depict the historical evolution of selected technological implementations at the BBC that resemble DNI in order to compare them with my findings.

6.2.4 Criteria for Interpreting the Findings

In this subsection I introduce some methods used in critical realism to apply them to the criteria for interpreting my findings. The basic argument of critical realism is that the world has an observer-independent existence. Thus, as an evidence of such

observer-independent character of the world, knowledge produced can be fallible. I mentioned in subsection 4.1.1 that in order to understand and compare the effect that technology has on work practices it is important to study the implementation of a similar or identical technology in different social groups or contexts. The objective of using critical realism as a methodological tool is to apply causal mechanisms to an identical technology (DNI), and demonstrate how the action of a particular technology in the same context generated different effects.

Causal Mechanisms in Empirical Research

The realist perspective seeks to identify both necessity and possibility or potential in the real world: in other words, how things coexist and the nature of their relation (Sayer 2000). One of the distinctive features of critical realism is the analysis of causation (Archer 1998; Archer, Sharp et al. 1999). For critical realists, social structures involve complex interrelations between the elements that constitute them and do not exist independently of the activities in which they occur. They exist because of their effect or occurrence. Social structures enable social activity and through those activities the former are reproduced or transformed. Therefore, social structures do not exist independently of the agent's conceptions of what these structures are doing (Mingers 2004). Events arise from functioning mechanisms that derive from the structure of objects (i.e., technologies, processes). Social scientists deal with open systems (the social world); thus, there is an absence of regular events or connections, such as the typical "cause and effect" concept used in the scientific hypothesis. Material change in society must be explained, but at the same time it should accept a broader conception of causation: objects are part of the structure, which relates to a set of internally relational elements. Explanations result from intensive research aimed at identifying the causal mechanism and how it works as well as triggering and discovering on-going circumstances (Sayer 2000).

Therefore, in open systems, causal power can produce different outcomes from the same structures. The causal mechanism is used as an important methodological tool

within my own case study: In my first visit to BBC NI, I planned to focus exclusively on DNI implementation in long-form productions, as this is an area where little research has been conducted and I thought I could produce a very innovative and novel piece of work. However, after the first site visit (the second stage of my research methodology practice, see Figure 12), it became clear that DNI's deployment in news production reveals important aspects of the organization-wide DNI implementation. These facets were crucial to my understanding of news production, and became an important point of comparison with the long-form productions' implementation. Furthermore, since the implementation of long-form productions has been executed in accordance with the previous model put in place for news production, to not research news implementation would have severely limited my understanding of the positive and negative aspects of long-form implementation. Figure 13, illustrates the initial causation of both implementations, referred to as an identical technology (DNI), and demonstrates how each particular context generated different effects.

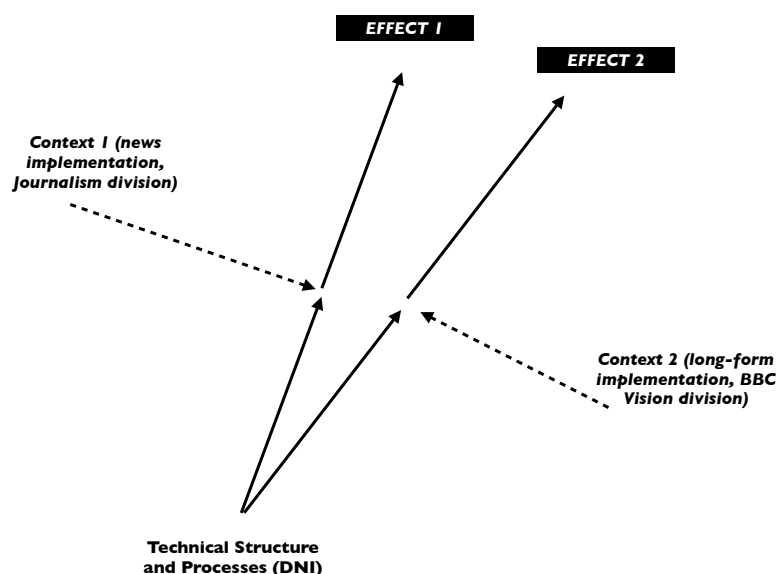


Figure 13: Critical realist view of causation applied to DNI

According to Eisenhardt (1989), a central component of research design is that researchers must constantly compare theory and data, formulating finally a theory

which closely fits the data. However, to build a good theory, it is also important to iterate data with data: in other words, to generate new insights from data that may yield an empirically valid theory. In my case study (Figure 13), the iterating and emergent process of analysis compares the effects generated in the news implementation (context 1) with that of the long-form implementation (context 2) in order to construct and define the validity of the research. Such qualitative data is useful for understanding why emerging relationships hold or fail. When a relation is supported, the qualitative data often provides a good understanding of the dynamics behind why it is happening (Eisenhardt 1989).

Extensive and intensive research design

Finally, as part of the research methodology, it is also important for research design to make us aware of the level of abstraction or depth required to analyze the data. Sayer (2000) discusses this issue when drawing a distinction between extensive and intensive research design. Extensive research looks for similarities among large or repeated observations to find significant relations. Defining a population by its taxonomy, shared attributes, or other traceable patterns is typical of extensive research. However, it does not directly address the causal mechanisms I mentioned earlier. On the other hand, the intensive approach starts with individuals and traces the main causal relationships. It is primarily concerned with the causes that allow one to describe the structures and mechanisms in social life that produce particular types of outcomes. In the following paragraphs, I describe how my research benefited from both extensive and intensive research design in complementary ways (see Figure 12).

The first stage in my research sought to explain the organizational changes within the BBC from an extensive research perspective. I required meetings with industry analysts and executives at BBC headquarters to gather preliminary research and understand DMI as a corporate-wide implementation. I also extracted and accrued information from formal documents in order to familiarize myself with the BBC's institutional history. With these resources I was able to establish key patterns in DMI's implementation that guided an in-depth research process.

Having a knowledge of the wider context, the second, third, and fourth stages adopted an intensive research approach that dealt with specific elements (i.e., technologies and processes within BBC NI that confronted staff and how the staff were affected). The views of the middle-rank and even some low-rank employees were also important to understand how they interpreted the problems they were facing. I adopted a particular focus on the operations that these individuals performed, how their work practices changed, and what those changes meant to them. Accomplishing this task required that I become knowledgeable of most of the equipment, brands specificities³⁰, and post-production equipment (i.e., Avid, FCP, Cinegy) among other traces. Some knowledge of the limitations of certain technologies and the reasons they failed to survive the tapeless environment was also necessary. In addition, new brands for digital video editing entered the market and each has been developing their own strategies aimed at digital broadcasting industry.

Intensive research also helped me to build relationships with the staff members occupying different positions within the BBC. Managers may have had a more holistic view of the problems, but a lesser understanding of how those problems influenced most of their workers' daily routines. Frequently, the managers were focused on the most stressful aspects or problems of the implementation and left smaller, more nuanced aspects out. It was interesting to observe how some problems dismissed by managers were regarded by middle and low-rank workers as major concerns. These concerns impinged upon each individual in a very different way. Intensive research was extremely useful in most of the journey, as it helped elucidate how employees were dealing with the implemented changes. It also offered a deeper understanding of the real operations on the ground, instead of descriptions written on paper or internal documents. While written documents may provide valuable information that enriches the research questions (Yin 1981), in some respects, these are very different from the personal experiences of staff members produced by their daily encounters.

³⁰ In the broadcasting industry some brands manufacture specific machines. Such is the case of Sony, which is the only manufacturer of the Betacam broadcasting tape standard.

6.2.5 Logic of Linking the Data to the Propositions

As I have illustrated, my research design analyzes the work practices affected by the implementation of a technical structure and how social contexts generate certain effects. To understand the changes underway, a deep and careful empirical understanding was required and not merely a “yes” or “no” survey-like questionnaire, which would have generated very narrow answers. Furthermore, the stories and reasons provided by the interviewees at the main empirical research site (BBC NI) had to be contrasted with comments and opinions from different stakeholders, which required several sessions to obtain a deeper view of the things under investigation.

During the data-collection process, the interviews, and my observations, I took into consideration existing research on the impact of technology on work practices in organizational settings developed by Zuboff (1988), Kallinikos (2011), Barley (1986), and more recently Ekbia and Evans (2009) and Lanzara (2009). I was also guided by an overall understanding of the main characteristics of media objects as illustrated in the literature (Benkler 2006; Zittrain 2008; Kallinikos, Aaltonen et al. 2010; Kallinikos and Mariátegui 2011; Kallinikos, Aaltonen et al. 2013). I reviewed additional literature to recognize the potential semiotic characteristics that media objects might have had for the production of media content (Goodman 1976; Barthes and Heath 1977; Kallinikos 1993; Bignell 2002; Kallinikos 2002b). Thus, the selection of the case study as the chosen research strategy helped me to devise and combine multiple data collection methods or procedures.

According to Eisenhardt (1989), during the process of data collection, an opportunity arises for a new line of thinking to emerge from the research. It is then logical to take advantage of this opportunity by altering data collection in a way that would likely provide greater support to validate the theory or to inspire new theoretical insights. In on-site analysis, tentative themes, concepts, and possible relationships start to emerge through the iterative process. This process “*systemically compares the emergent frame with the evidence from each case in order to assess how well or poorly it fits with the case data*” (Eisenhardt 1989). Studies that follow a similar methodology

(Walsham 1994, 1995; Peppard 2001) use theory as an initial guide for an iterative process to research design and data collection, which is particularly useful in semi-structured interviews.

Even though I had a fairly clear understanding of my initial research question and the research path I wanted to follow, many insights acquired during the empirical research process led to progressive adjustments to my initial question. For example, as mentioned earlier, comparing two implementations of an identical technology (in news and long-form productions) allowed me to search for answers to my initial research question from different standpoints (Yin 2003). If I had focused only on the long-form productions, I would have only understood part of the story and precluded a deeper analysis, as is presented in chapters 8 and 9. Although I was comparing the two practices, the unit of analysis focuses on implementation strategies using the same digital production infrastructure, which in each implementation led to dissimilar results. In that sense, it is important to recognize that the initial research construct can change during the research, resulting in a more concrete question that helps to carve a more coherent research path (Eisenhardt 1989).

6.3 Data Collection

Qualitative data was collected through participant observation, semi-structured interviews (both in-depth interviews and on-site visits), and secondary sources. The observations took place between January 2008 and June 2011. Interviews conducted at BBC headquarters in London (Broadcast Centre, White City) were mostly with executives and managers. At BBC Northern Ireland in Belfast, specific interviews on DNI took place. I conducted in-depth interviews with 10 people during a first two-day visit to the Belfast site (October 19 – 20, 2009) and 12 people on a follow-up two-day visit to the location in Belfast again (May 31 – June 1, 2011). During the first visit, the interviewees were mostly staff from the Technology division at BBC NI and were all involved in the deployment of the technology solution of DNI: support engineers,

broadcast engineers, and operations managers. I complemented the interviewee selection of Technology division staff during the second visit with participants who actually were the ones using the DNI on a daily basis as part of their work routines: journalists, editors, producers, production managers, and news directors from both the Journalism and BBC Vision divisions. It is worth mentioning that for the first visit, the selection of interviewees was made by my host, the head of Technology at BBC NI, after extensive discussions with me. During the second visit, having gained a greater knowledge of the site, and to acquire a richer perspective of the implementation, I personally selected for interviewing individuals who held certain positions.

The vast majority of interviews were held on the BBC NI premises. At BBC NI, I was given a private office in order to conduct interviews with complete privacy and comfort. Some of the interviewees possessed extensive knowledge of the organization as they had been working at the BBC for more than two decades and had therefore gone through several technological implementations during their careers. The interview questions sought to elicit information about how BBC staff understand the changes associated with DNI, both at the technical and organizational levels. By asking how workers did a specific job before and after the implementation of DNI, I was able to get an understanding of the ways in which certain changes took place. The interviews were loosely structured around a list of topics and questions composed by the researcher, as well as a research project fact sheet given to each of the participants. The main topics discussed in the interviews were related to the implementation of DNI, the specific changes to work practices at the news and long-form productions, as well as the key technologies used (i.e., metadata, digital archives, legacy systems, software packages, deployment of DNI). It was also important to preserve my position as an “outside observer” and make clear that I had no direct vested interest in the project so respondents would openly express their views (Sudweeks and Simoff 1999; Walsham 2001, 2006). The resulting data has been analyzed qualitatively by extracting a narrative from the data corpus based on the recurrence of topics and the identification of key motifs and theme.

To summarize, a total of 47 in-depth interviews, each lasting between forty-five minutes and two hours, were digitally recorded and transcribed in their entirety. A detailed summary of the interviewee information (date interviewed, name, position, and location) is available in Appendix 11.2. The interviews were reorganized with the purpose of identifying thematic units and yielded more than 60,000 words of field notes plus a gamut of photographs, videos, and sketches. While compiling the narrative, I sought to remain as close as possible to the transcribed interviews. The identification of major and recurring themes in the empirical material was possible due to the prior understanding of the main theoretical concerns for this research and extensive reading of similar research papers (Barley 1986; Zuboff 1988; Kallinikos 1999; Boczkowski 2004; Ekbia and Evans 2009; Kallinikos 2009; Lanzara 2009; Boczkowski 2010).

Prior to the interviews, the main research questions were prepared and discussed with the head of Technology at BBC NI. I requested initial feedback about the types of reactions I could expect from the interviewees. The research questions were then oriented and modified to better suit the respective roles of the different actors involved in the project. The open-ended interviews aimed at encouraging interviewees to elaborate on certain subjects so they would share their attitudes, beliefs, opinions, and feelings (Kendal and Kendall 1993). Additionally, a group comprised mainly of industry experts and academics was consulted in relation to broader issues around the topic as well as to outline possible business perspectives. Table 3 summarizes the number of interviewed informants and their location within the BBC.

Interviewees (location)	Number of interviewees
BBC Northern Ireland staff	22
Other BBC staff (i.e., BBC headquarters, BBC Academy, BBC Natural History Unit)	19
Industry Experts (non-BBC staff)	6
Total	47

Table 3: Interviewed informants

6.4 Validation and Data Analysis

In case study research, the tactics of using multiple sources of evidence, establishing the source or chain of evidence, and locating key informants to review drafts of the case study are all ways to construct validity (Yin 2003: 34). In this section, I explain how my research was validated by the corroboration of particular lines of arguments.

The interviewees' perspectives were mediated by the perception of the insider (the researcher, me), their views but also their feelings, emotions, and predispositions of the interviewees. The validity of most of the key arguments was established by triangulating the answers given in the second stage (first visit to BBC NI site) of my research design journey (Figure 12), with questions related to those matters that had been discussed with key managers at the end of the fourth stage (second visit to BBC NI site). This form of validation permitted only the most relevant aspects of the implementation to be taken into account in the analysis while smaller incidents and details were not considered.

Eliciting information from the interviewees was not the only way to validate my data analysis. During the exploratory visits (third stage), as I met with interviewees of varying ranks at different moments in time, I consistently proposed the same questions and obtained different responses which helped to validate the information received. The validation triangulation was exercised through the selection of the most recurrent topics in the discussions and continued to reappear during the process of writing the analysis. It was important for me to gauge the accuracy of my analysis, so the key findings were discussed with the head of Technology and other senior managers at BBC NI in order to obtain an *experienced validation perspective*.

As previously mentioned, during my meetings there were different groups present with diverging positions. Participant diversity was useful not only for understanding the various attitudes toward the implementation of DNI (and its surrounding technologies), but also for extracting from it aspects that were relevant to the research. Pin-pointing such aspects required excluding other considerations that might not be of

great importance or that could generate unnecessary noise and produce biased results. Also, the interviewees have had different levels of knowledge that affected the type of data received: Depending on their background, some interviewees used the technology better than others and some performed and understood certain processes more clearly. In general, people coming from the IT world seemed more convinced about the benefits and cost savings that new technologies, DNI in particular, brought to the organization. “Users”—mostly journalists and producers—had mixed feelings toward DNI implementation. Of those interviewed, the “users” felt the most affected by the technology and experienced its direct impact on their work.

Yin (2003) also mentions two more ways to assess the construct validity: first, selecting the specific types of changes that are to be studied; and second, demonstrating that the selected measures of these changes do indeed reflect the specific types of change that were chosen. In my case study these two aspects were addressed by comparing the news and the long-form implementations and by defining a common set of research questions in order to assess both implementations in similar ways (as illustrated in chapters 8 and 9). The comparison of similar implementations turned into one of the three different levels of observation of my study (Yin 2003).

6.5 Particularities of the BBC as a Research Setting

When I started working on my research at the BBC, I was interested in giving an account that emphasized its technological and organizational structure. From the very beginning of public service broadcasting in 1922, BBC engineers have been at the forefront of broadcasting developments, participating in important technological accomplishments (BBC 2012). The BBC’s major technological achievements were developed and implemented by its Research & Development department.³¹ The achievements include the conversion of the 405-line TV to 625 lines, the launch of color TV, film and video tape recording, telecine and caption generation, the transmission of television by radio links, transatlantic cable and satellite, teletext, and

³¹ <http://www.bbc.co.uk/rd/index.shtml>

the BBC Microcomputer, among others (BBC 2012).

In spite of its rich technological history, I was surprised not to find existing research about the BBC that studied the relation between its technological and organizational transition. As I mentioned in chapter 4, there are few studies of particular technologies that use perspectives such as Actor-Network Theory (ANT) to attribute an element of political influence on the organization to certain technologies (Greenberg 2008; Hemmingway 2008). It has become very common in recent accounts of the history of technology to draw on theoretical ideas that derive from what is commonly referred to as social constructivism. Yet, in such accounts the social component is usually overstated and the technological side significantly downplayed. The unfortunate outcome is that the subtle and slippery issues that revolve around the interaction between technical characteristics and institutional and social factors are overlooked (Mariátegui and Kallinikos 2008).

On the other hand, critical, academic, and essayistic literature about the BBC is mostly focused on aspects of its managerial politics. While I tried to conduct several interviews at the BBC, I became aware that due to its complexity, it is easy for any work about the BBC to rely on its institutional and political influence. It is worth mentioning in this respect the work of Georgina Born, who has written several studies on the BBC. Born has covered the transition of public service TV to the digital era in terms of media strategy and policy issues (Born 2003). Born also published a book based on extensive fieldwork at the BBC, which reflects on its history, the managerial figures of John Birt and Greg Dyke, the marketization of public service broadcasting, and how it developed its characteristic internal politics (Born 2004). Therefore, analysis of the technological aspect has not been exhausted since most accounts of the BBC are focused on its historical background and contribution as a cultural institution in the UK.

While I was reading some of the existing texts about the BBC, I encountered a void in considering the technologies that had been deployed there and the effects that they might have generated; these accounts failed to mention the significant effects of

certain technologies and how they impacted the BBC as an organization. As previously mentioned, the BBC deployed several technologies throughout its institutional life, so a history of these technologies and their influence on the way the BBC works and delivers its world-renowned content to its audience, two central parts of this organization, seemed to be missing. Although my research does not offer an extensive account of such technological endeavors, I contribute to the understanding of how certain technologies used by the BBC have changed the way people work. While doing the field work, research could easily become biased and centered around the BBC's internal politics as the issue is not only fascinating, but it is also part of the BBC's organizational culture. However, I was careful not to deal with those aspects in my research. Instead, I focused on identifying the problems that occurred, not as an assortment of political problems, but as aspects driven by the use of technology. As I mentioned in chapter 4, technology does matter and not everything that happens in an organization is socially constructed. Taking this reasoning into account, BBC NI was crucial to my research, as it was small and did not speak the political jargon that prevails at the BBC's White City premises, where decisions take longer to process and implement and it is indeed impregnated with a heavy corporate culture. BBC NI operation was smaller, which made it capable of making and implementing decisions more quickly than at BBC headquarters. This made it the perfect case for a researcher focusing on organizational change initiated by technological impact. Trying to do the same from BBC headquarters, as was my initial aim, proved to be impossible. The meetings at BBC headquarters with specialists on change management were usually too general and ambiguous and did not offer the deep insights I required. Apparently they seemed to be in charge of implementing solutions, but they adopted a macro perspective (from the entire BBC). In contrast, in Belfast I had access to people in a variety of positions, from senior managers to very low-level rank employees affected by the implementation. DNI implementation did not generate the complex problematic that usually has to be dealt with when trying to understand the BBC's work practices.

In this chapter, I described the research methodology. I first explained the site selection and discussed the research strategy, which supports my decision to conduct

a case study. Second, I illustrated the research design by dividing it into five components (its propositions, its units of analysis, the criteria for interpreting the findings, and the logic of linking the data to the propositions). Then I explained in detail how the data collection, validation, and data analysis were executed, taking into consideration the peculiarities of the research site and the methodological approach outlined by Yin (2003). I concluded by briefly mentioning the particularities of the BBC as an organizational setting, acknowledging related research and literature. In chapter 7, I apply the methodology throughout the core empirical research, which illustrates DMI's implementation in relation to operations and work practices at BBC NI.

7. DMI Implementation: Operations and Practices

*There's a lot of focus on the screens,
people aren't chasing tapes around.*

–Kieran Morgan, *Technology Portfolio Manager, BBC NI*

In the preceding chapters, I contextualized the implementation of DMI at both the BBC and the main research site, BBC Northern Ireland (BBC NI). I also explained the general organizational changes impacting the BBC due to the implementation of DMI; of particular importance is the vision of reorganization of the BBC's departments into three main divisions (or units) of media specialties (Journalism, Audio & Music, BBC Vision) with FM&T Division at its core. In the current highly competitive digital environment, the BBC has tried to gain a competitive advantage built upon its high-quality content and the use of technology.

In this chapter, I describe how DMI was implemented at the main research site, BBC NI. I explore how the BBC NI implementation of DMI, known as Digital Northern Ireland (DNI), has transformed the organization in terms of its work practices and technology. First, I introduce the general context of the tapeless workflow at BBC NI, giving a brief account of DNI's positive and negative impacts. I then discuss the main DMI operations by dividing them into six key “enabler” categories. Each enabler is defined in terms of the high-level functionality required to deliver a specific stage of the production process with regard to the management of video content throughout a digital production infrastructure. Consequently, each enabler as had a direct impact on the way content is commissioned, produced, and published at the BBC as well as how it will be managed and exploited in the future (BBC 2007). I also describe the most relevant characteristics that have supported the DMI operations, from the ingestion to the delivery of digital video, and provide first-hand accounts from the BBC staff I interviewed. Then, I address the organizational and work practices that have been affected by DNI's implementation by dividing them into four relevant aspects: first,

the management of the digital infrastructure; second, searching for and browsing content; third, remixing and reusing content; and fourth, the media management of video assets. Finally, an account is given of the management of digital video in the streamlined DNI workflow with regard to its impact on the Journalism and BBC Vision divisions, respectively. I first elaborate on each and then summarize the distinctive aspects of news and long-form workflows, and contrast their main technical and organizational differences. When describing the Journalism division, I refer to it frequently as “news” and in the case of the BBC Vision division, I refer to it as “long-form” productions (see Appendix 11.4 for an explanation of these terminologies). I use these terminologies in order to exemplify their distinctive formats as well as the dynamics and subtleties of the production processes that each demands.

7.1 The Tapeless Production Processes at the BBC: Toward a Simplified Digital Workflow

As mentioned in chapter 5, the BBC went through a profound restructuring in order to implement DMI, both in terms of technology and its organizational structure. One of the central features of DMI is its shift away from old legacy systems to a computer-based model serving a tapeless environment.

DMI, being a corporate-wide initiative, aimed to place the BBC at the vanguard of media organizations. The BBC attempted to do this in a challenging context in which audiences had begun to consume content through a growing variety of digital platforms and devices. DMI intended to place BBC at the vanguard by developing four basic capabilities within the organization (BBC 2007):

Collaborative multiplatform program capability: DMI was to enable collaboration among BBC staff, encouraging them to work as teams through the use of a unified computational system.

A streamlined and agile production process: While managing digital video production, DMI aimed to reduce the time spent handling videotapes (work of low perceived value). No longer handling tapes would purportedly allow more time for creative and editorial tasks (work of high perceived value).

High quality information about assets: DMI was to generate an “asset management culture” in which metadata would be incorporated throughout the production process. Incorporating metadata would facilitate the effective findability and reuse of content.

Flexible infrastructure capable of supporting future services: DMI’s tapeless environment was conceived as a flexible and open platform capable of accommodating new and evolving technologies and audience services.

DMI emphasized the digitalization of video content as the first step toward a more efficient and streamlined convergent production environment. For BBC staff the most palpable change that accompanied DMI's implementation was the physical disappearance of videotapes and VCR decks from the producers’ and editors’ desks. That change actually meant a profound simplification of the production process. Figures 14 and 15 illustrate the differences between the tape-based and tapeless workflows: Figure 14 shows the original tape-based process (the videotape stages are highlighted in orange) and Figure 15 shows the streamlined process without the videotape.

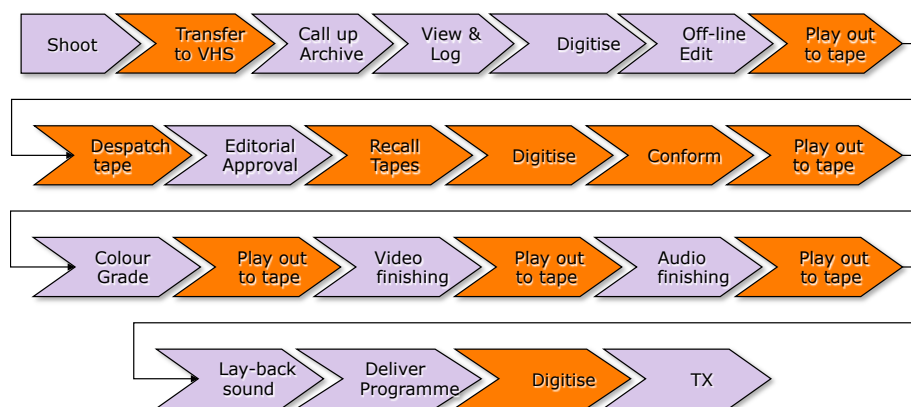


Figure 14: Former tape-based workflow at the BBC

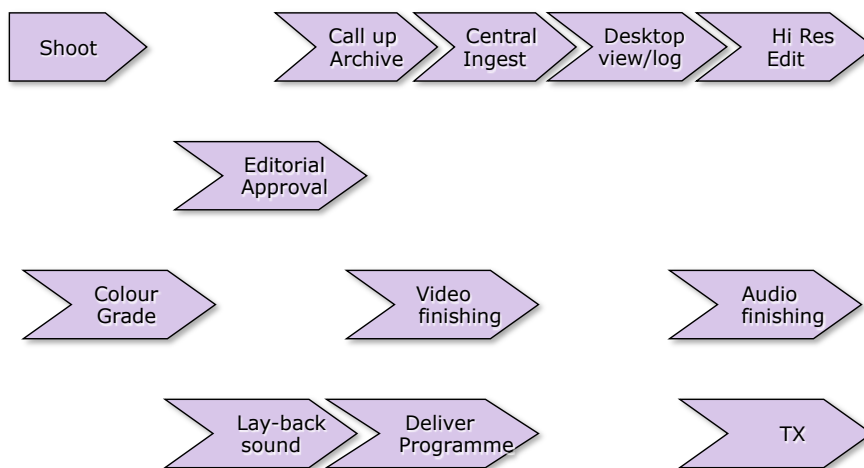


Figure 15: Current DMI tapeless workflow at the BBC

Digitalization simplifies the process of video production by eliminating the physical artefact (videotape and VCR) from the unified workflow. A tape-based work flow required the physical manipulation of the videotape; a producer typically had to first find the videotape, then play and review it on a VCR deck, pressing rewind or fast-forward to locate a particular shot. The implementation of DMI eliminated numerous manual and time-consuming processes that were of low-perceived value.

The simplification of the production process brought about by digitalization was expected to achieve a tapeless workflow that was as reliable as the tape-based workflow it replaced. However, when researching the implementation of DMI at BBC NI (DNI), I learned that the new tapeless environment initially received mixed reactions from its users. On the positive side, there were several advantages to using DNI that can be organized by four distinct characteristics:

Convergent content: The material is permanently shared, which means it is available to everyone at BBC NI at all times. Since BBC NI generates multiplatform content (e.g., TV, mobile, web streaming) its strategy for content management means that the video content would be shared across the DNI workflow; for instance, someone could

be cutting a piece for the *Ten O'clock News* while simultaneously another employee could edit the same source material for radio or a website.

Metadata: Metadata seeks to enhance content findability both for the viewing and potential reuse of BBC NI's video content, comparable with a video search on the internet. When the material is logged in DNI's digital archive, the BBC staff are able to search for videos through keywords. Hence, provided that the metadata has been placed correctly, anyone would be able to find the video content more easily, enabling organization-wide exploitation and reuse of BBC NI's video assets.

Collaboration and mobility: DNI encourages the deployment of an agile infrastructure that is more efficient for teamwork and approval processes. For example, if an editor is working in Belfast on a production that needs approval from an executive producer in London, this could be done remotely over the internet; in the same way, different parts of a video story could be edited in different locations simultaneously.

Immediacy: Finally, a tapeless environment offers the convenience of having the material on hand constantly; one can go directly to a specific section of a video asset, without rewinding or fast-forwarding it in order to find a particular shot.

Conversely, DNI's implementation also had several adverse effects. DNI demanded the development of new technical skills from the staff at BBC NI, which led to three unanticipated problems:

Planning and budget: The economics of shooting, reviewing, and storing digital video differ from the previous tape-based environment; although it is more efficient, some costs, such as data storage, are much higher. Planning a digital video production requires not only an understanding of the production's budget constraints but also new technical aspects such as tracking storage limitations during the shooting, editing, and post-production phases.

Complexity in dealing with team collaborations: Tapeless video editing is suitable and convenient for small groups; however, when a project requires the involvement of several people, it becomes harder to manage. Several interviewees at BBC NI mentioned that organizing and balancing the skills of more than five individuals was already difficult. Since those involved had varying degrees of knowledge about DNI's processes, managing interaction among them has become more complex. If the production demands teams of a more substantial size, for example, fifty people (which is the case for some long-form productions), it is extremely difficult to deal with the participants if they are not “tech savvy”.

Reliability of the networks: Legacy and digital video differ in the challenges they face when it comes to reliability. The legacy systems were characterized by interviewees as being specialized in a limited set of functions. Therefore, broadcast engineers had to make sure that each single specialized piece of equipment was reliable. In contrast, digital video's reliability does not depend on single artefacts but on the ways all artefacts come together as a unified computational system. For example, if there are simultaneously too many users connected to the system or working with the same media assets, there could be limitations to the digital library server's performance, particularly when using high bandwidth formats such as HD. As one media consultant stated:

If one studio was recording in HD [higher resolution standard] and another studio tried to view the same material, it was a bit jerky. Then we turned to SD [lower resolution] and it was fine, and later, when the recording in the other studio finished, it was absolutely fine. So yes, we can have a bottleneck.

(Media Consultant, BBC Academy, interview, January 19, 2011)

All these positive and negative aspects of implementation are included in the next section, which provides a detailed account of the DMI operations through DNI.

7.2 DMI Operations in DNI

The DMI operations consist of a set of procedures through which video content is assembled and distributed, constructing a workflow. These are subsumed under six high-level functionality enablers (Figure 16, also illustrated in Appendix 11.3.1).

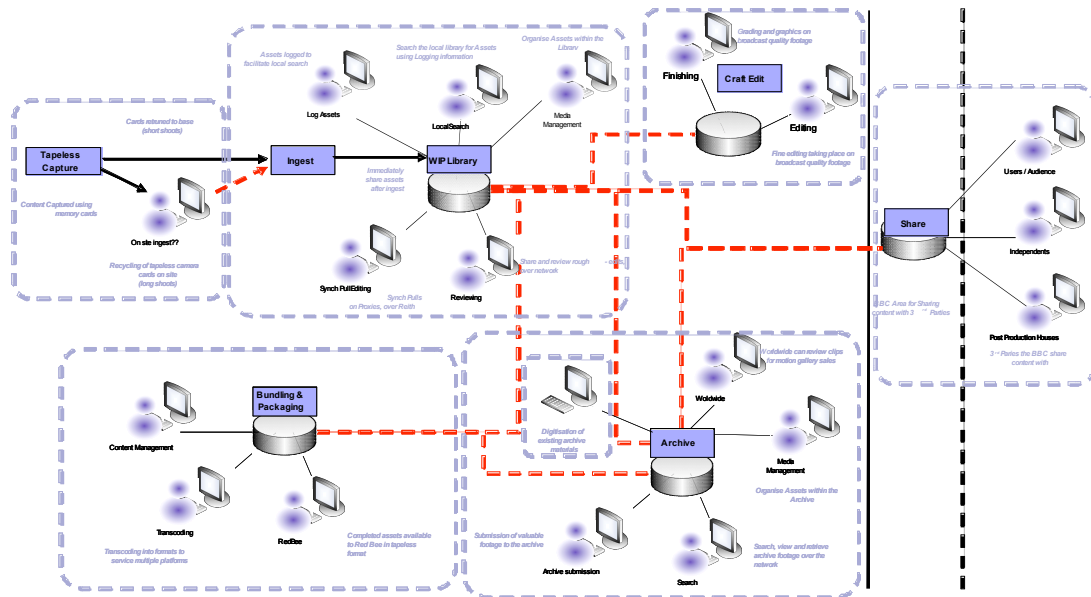


Figure 16: Enabler overview

(for a larger image refer to Appendix 11.3.1)

An enabler can be understood as a set of capabilities (people, processes, and technology solutions) required at BBC NI to implement DNI. These enablers include the tasks involved for any production based on digital content. In Table 4, I describe each of the six enablers and the task sequence that drives them.³²

³² Enabler 6 - Share is only mentioned briefly as it was not fully implemented during my fieldwork and it was not the main focus of my research.

Cognitive Category	Enabler name and description	Task Sequence
Content Creation and Crafting	Shoot: Allows physical tape to be removed from the shooting process, reduces time spent ingesting footage, and provides the opportunity to record metadata during the shooting process.	<ul style="list-style-type: none"> • New footage • Metadata point of entry • Automated metadata
Content Creation and Crafting	Work in Progress: Enables smarter decisions early in the production process (planning), gives multiple users access to content, and adds agility to a multiplatform production process.	<ul style="list-style-type: none"> • Content inspection and reuse • Ingestion • Indexing • Media management • Reviewing • Multiplatform production
Content Creation and Crafting	Craft: Enables most of the editing to be completed on lower cost desktop-based packages.	<ul style="list-style-type: none"> • Editing • Post Production / Finishing
Content Delivery and Distribution	Share: Facilitates local and external parties (independent producers, post-production houses) to access content adding increased agility to the production process, provides functionalities to share video content with audiences.	<ul style="list-style-type: none"> • Sharing locally (within the BBC) • Sharing with externals • Sharing with the audience
Content Delivery and Distribution	Bundle and Package: Provides the ability to seamlessly convert content to finished form for various platforms.	<ul style="list-style-type: none"> • Asset conversion • Scheduling and availability
Content Management	Archive: Allows content that is “born digital” to “stay digital”, richly tagged to enable the content to be exploited for both audiences and commercial use.	<ul style="list-style-type: none"> • Storing • Moving within and across repositories • Managing asset life cycle • Archiving

Table 4: Major cognitive categories and enablers of DMI

(adapted from BBC 2007)

It is important to note that the enablers do not work in a strict linear progression. Some may overlap and others may work simultaneously. Figure 17 shows a diagram of the DNI workflow divided into six enablers. It starts with the Shoot enabler and finishes with the Bundle and Package and Share enablers (the latter facilitates multiplatform video delivery to audiences through on-air, VOD, web, and mobile platforms).

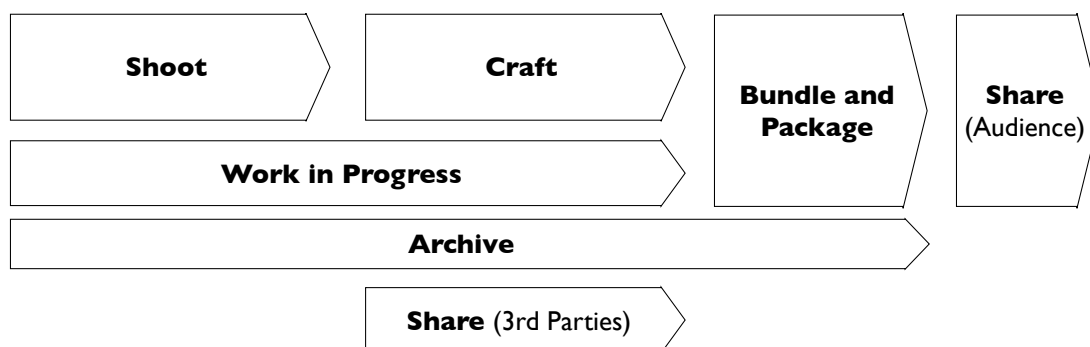


Figure 17: DNI workflow and its six enablers

DNI operations underlying the production and distribution of news as well as the operations for long-form video productions are both managed and delivered by the same digital workflow and platform. Such a workflow has been tested and assessed in newsroom environments for more than a decade (as explored in chapter 2). Long-form productions had until recently been deployed using analogue or hybrid (digital and analogue) workflows which in most cases were customized, depending on the facility conditions or production requirements.

In the subsequent section, I explain in detail how each of the six enablers works in practice. I also incorporate some of the views from BBC staff on how these operations were perceived as part of the implementation of DNI.

7.2.1 Shoot

Video content creation at BBC NI begins with the commissioning of a program. A

script and a shooting plan is developed, followed by shooting. Shooting is the first stage of the audiovisual process; it is the moment in which images are captured, mostly with tapeless cameras, although some analogue (tape-based) cameras may still be used. Each shot is converted into bits of data, which are then recorded onto a media storage drive (e.g., hard disks, memory cartridges). For decades, experienced cameramen and cinematographers made these shots; at the time of this research, long-form producers and journalists were also acting as photographers and videographers since the equipment had become much easier to operate.

Digital shooting is also the point of departure for creating metadata that makes video content identifiable and accessible. The metadata fields to be filled-in are relatively simple (i.e., date, title, feature, cameramen name, film director, and basic description). Many interviewees confirmed that the shooting process was the most convenient moment to add basic metadata about each shot; cameramen knew precisely what they were looking for while shooting and could describe it more clearly while still in the field.

The input of metadata during shooting also depends on the type of commission. If a commission is planned in advance, some of its metadata might be pre-loaded. Other commissions might be unexpected or lack a clear shooting plan (i.e., breaking news, factual commissions); in these cases, metadata might have to be incorporated later. If the production consists of a small crew (i.e., cameramen, producer, and film director), the team will usually inform the media manager about the production characteristics. The media manager will then pre-load the appropriate metadata and check its validity afterward. As one interviewee mentioned:

The key to good metadata is to input it at source. One of the tasks for the digital media operation team [media manager] is to do the ingestion and to ensure the quality of the metadata. [...] Involving the media managers with the production people helps them with the metadata creation.

(Programme Manager, BBC Academy, interview, January 19 2011)

However, inputting metadata during shooting is not efficient in both technical and practical terms. At the time of my interviews, most of the cameras still lacked the necessary technical functionalities required to input metadata directly. Instead of using a keyboard (which seems to be the most convenient method) input is accomplished through a separate interface (i.e., tablet, smartphone, external Bluetooth keyboard), which makes the process more complex. Ideally, camera manufacturers automate the process of inputting metadata during shooting. As one technology development manager (responsible for all technology development within BBC NI) stated:

[C]ameras have the capability to take [metadata] from a PDA or handheld Bluetooth device directly to the camera. The workflow will be that from the newsroom you assign a story to a journalist. Then he types in an little bit of XML script and delivers it from his handheld device, through a Bluetooth connection, to the camera, so that he can have the story log stored in the camera with the appropriate metadata.

(Technology Development Manager, BBC NI, interview, June 1, 2011)

From this account, it is clear that the BBC technology engineers know what is required in order to automate the shooting process. The quote also illustrates their desire for automated functions expected to become available in forthcoming generations of digital cameras and that the new cameras already offer some automated (auto-generated) metadata such as date and GPS location. In an internet-driven environment, the general consensus seems to be that the more metadata gathered about digital content, the better. Automated metadata not only improves the findability of a digital object, but also facilitates the construction of new applications and prototypes to organize information. The same interviewee also discussed the use of GPS location and its potential when interoperated with other data sources available on the internet:

I built a prototype that captures digital GPS and digital compass data and mixes it with Google maps. The benefit is that we can create a website where you have shots of a particular geographic location and descriptions with regard to the

location in which the shot was made.

(Technology Development Manager, BBC NI, interview, June 1 2011)

The Virtual Value of Shooting

As mentioned in the previous section, today's cameras are less expensive and more standardized which lowers entry-level barriers and makes it easier for laymen to manage their basic operations. Thus, assistant producers or junior staff at BBC NI, with little shooting experience, are being sent for commissions. Problems emerge related to both the lower quality and the large quantity of the material shot.³³ The complexities of managing large amounts of video increase the costs of storing it on BBC NI's "Work in Progress" digital library as well as the time spent editing it. As one programme manager mentioned:

One issue that the IT world starts struggling with is that if you have a camera crew, and that crew works 200 days per year, and if you have three camera crews, and you start doing the math of how much data is being produced, then we sum up and it was 1 petabyte a year; how much does it cost? If you buy a hard disk it might be quite cheap, but the drive fails or you don't get the backbone speed [...].If you are looking for a professional enterprise solution, you are looking between £1–2 million, which is a lot of money just for storage, and even assuming that you deleted 90 percent of your rushes.

(Programme Manager, BBC Academy, interview, January 19, 2011)

The expressed concern about the cost of digital video storage indicates that some BBC staff compare DMI with former legacy equipments. In addition, BBC staff not only questioned the cost but also digital media's life expectancy and reliability. In the videotape world one could keep the media "forever", but the cost and scarcity of digital media cartridges prompted the necessity to reuse them. Thus, BBC staff must store the data from their media cartridges as quickly as possible and copy it onto external hard disks or laptops, which could put the content at risk. As one technology

³³ In video production, the relation between the hours of video rushes shot and the final output duration is called the "shooting ratio".

development manager summarized:

The first problem is that they [cameramen, producers] are shooting on compact flash cards. Problem number one: it is consumer media, it may be expensive consumer media [...] which means it's not a tape, you have to reuse that media, which means you have to copy that media off that card onto another device. You are copying that onto either a laptop hard drive or an external hard drive connected to a laptop. And these [hard drives] are the most unreliable pieces of hardware.

(Technology Development Manager, BBC NI, interview, October 20, 2011)

The perceived unreliability of digital media storage (e.g., hard disks, memory cartridges) is due to the fact that they do not have the same physicality of videotape. When video content from memory cartridges was ingested into DNI's digital library to be viewed and edited on desktop computers, the sense of physicality has been lost completely. This frustrates some senior producers accustomed to reviewing material on videotape and have not adapted well to viewing it on computers. In contrast, the former videotape process allowed videotape manipulation at one's discretion. A media manager mentioned the advantages and difficulties of manipulating digital media in the following way:

The tape was cheaper and more robust, and also you have this fear: If you have producers that have always had the tape, since it is also physical, they can put it on their shelf. And now the cameramen give this little memory chip, and when it gets to the producers they don't understand what is going on and what to do with it, as they don't understand computers. For the younger people it will not be an issue, but you give that to someone of 50-years old, and they don't have any idea, they don't know how it works.

(Programme Manager, BBC Academy, interview, January 19, 2011)

To summarize, DNI requires that key metadata is ingested at the source, ideally during the shooting process. This is a new process for cameramen and several technical and practical limitations persist, challenging this initiative's ability to be

executed in an efficient and reliable way. Shooting is no longer solely associated with capturing video, but also requires the input of metadata for each shot. BBC staff also has had to adjust to the elimination of analogue procedures and adapt to reusing memory cartridges and taking the time to transfer the video from those memory cartridges to computers and centralized digital servers. In this sense, the ephemeral nature of digital media (e.g., hard disks, memory cartridges) was seen by interviewees as unreliable when compared to the physical stability of videotapes. Furthermore, tapeless shooting, though perhaps more efficient, has prompted unspecialized staff to be commissioned to shoot, generating a higher shooting ratio and unnecessary rushes that has made the process of storing the media in the digital library – as well as editing it – more complex and expensive.

7.2.2 Work in Progress

The “Work in Progress” enabler is one of the processes that best illustrates the new series of tasks required to manage digital video throughout the DNI workflow. Once digital video is shot and captured on a media storage drive, the journalists or producers return to the newsroom (or production workspace, in the case of long-form productions). They first have to hand over their video rushes and the metadata contained on them to the ingestion hub operator or media manager.³⁴ He or she then transfers the data from the external media storage drive to DNI’s digital library. The transfer might also occur by digitalizing analogue media (i.e., tape-based media formats such as VHS, Hi8, or DV) to the ingestion hub. The ingestion hub is connected to the entire technological infrastructure of DNI and collects the digitalized content in the “Work in Progress” servers, which consist of a digital library. Video content is then available to everyone at the BBC simultaneously for reviewing and editing.

However, since several interoperable systems are working at once, the transfer of data

³⁴ In this initial stage of the process, the metadata did not necessarily need to be in digital format, it could be submitted as a handwritten document.

is not necessarily a seamless process. For the “Work in Progress” enabler, BBC staff must consider several new aspects of both the digital video asset itself as well as the unified computational system through which it is managed. In the analogue broadcasting workflow, BBC staff would take a videotape and simply insert it into a VCR deck. In the tapeless environment, they need to understand the diversity of available digital formats in order to play them smoothly on a computer. In some cases, incompatibilities with the digital formats prevents video from being played. The format’s incompatibilities result in frustration and generate praise for the old videotape environment. As one programme manager stated:

I used to work in DigiBeta [videotape format], I put it in my deck and it plays.

Now I have something that I put in the computer and won’t play.

(Programme Manager, BBC Academy, interview, January 19, 2011)

Attempting to access and view metadata and finding it impossible to do so frustrated BBC staff in DNI. Worse still, the troubleshooting process could lead to different explanations. This makes some staff particularly reminiscent of the tape-based workflow because problems that arose with videotape were much simpler to solve. With digital, the range of potential causes makes it more difficult to identify the correct solution. One BBC NI technology manager elaborated on the contrast between troubleshooting with analogue and digital media:

So rather than playing a[n analogue video]tape into the system to be ingested, you are simply transferring files of cards. [This] brings a new set of problems. It can be very fast, sometimes it is not. Tape technology is very mature – tape technology has been around for decades – so you are pretty sure that when you put a tape into a machine and press play it’s going to play, and you are going to get pictures and you are going to hear something. With the file in the card [if the video cannot be viewed], is it the problem with the file? With the card? Is it a problem with the computer? Why can’t I see it, why can’t I hear it?

(Technology Portfolio Manager, BBC NI, interview, May 31, 2011)

The technology manager characterized video as being straightforward and “mature”

and expressed dismay over the complicated troubleshooting process when confronted with a problem with the digital media. In general, compatibility issues often arise with digital media because each camera manufacturer has its own digital video standard (i.e., type of compression, codecs and wrappers) and certain software cannot play particular video formats. Also, incompatibility issues can only be identified after the ingestion of video assets has been completed. This is often a challenge faced by BBC NI staff. Of all the ambiguous technical processes that BBC staff has had to deal with during the DNI workflow, this is the most complex to solve.

As in the case of the Shooting operation, BBC NI staff perceived digital video as less reliable than physical tape-based analogue media. Digital media, like memory cartridges for example, might be technically more stable and durable than tapes, but they are perceived to be the opposite. The analogue videotape as a physical element embeds the magnetic tape and the enclosure as a self-contained artefact. In contrast, digital video as an artefact is made of two separated entities: one is the physical enclosure (e.g., hard drives, services, and memory cartridges); and the other is the content, which is translated into a digital video format and accessed through software packages. The sense of unreliability occurs when digital video is ingested into the DNI workflow, departing from a physically “stable” enclosure and vanishing into software processes.

There are some positive aspects of tapeless media that has made the individual working process of content production more efficient and convenient. With regard to the benefits of the new process in terms of time-efficiency, one editor mentioned:

[I]f I had a one hour videotape of material to get into my laptop, I had to wait one hour. Now with the tapeless camera, I can just slide the card into my laptop and there it is [...]. You will actually think, well, instead of waiting for that one hour of material to load, you might be finishing one hour earlier.

(Dedicated Shoot Editor, Sports, BBC NI, interview, June 1, 2011)

Digital media management benefits people who are well versed in technological

matters, such as craft editors who used to manage digital video on editing suites and understood that the new process would save them time. As previously mentioned, this is not the case with other professionals used to managing analogue media, such as broadcast engineers or producers.

From Digital Indexing to Metadata

Indexing and tagging digital video content is a relatively new process at BBC NI. In the tape-based era, labeling was based on writing a general description about the content on a physical label. The videotape box was then ruled on the side and finally it was shelved.

As I mentioned in chapter 5, during the 1980s, digital indexing at the BBC was done using software-based systems such as InFax. The centralized I&A department took the metadata from the description printed on the videotape label and typed it into the InFax system. Digital indexing allowed anyone at the BBC to search for a term and the results would indicate a shelf where the videotape was located, in a similar fashion to traditional library catalogues. However, the process was time consuming, as it entailed not only searching for and retrieving the tape from a shelf but also locating a VCR to play the tape on. This was not always easy as some VCR machines could be in use; in other cases the tapes required the use of legacy equipment that may have been out of order. Therefore, looking up archived material was not efficient for time-sensitive day-to-day production.

In contrast, using the DNI workflow, BBC staff are able to search for or edit the video content metadata efficiently. In order to make video readily findable and reusable, Cinegy software streamlines the process to make it easy to tag the right metadata to video content. In the DNI workflow, a news story would have an ID, which would subsequently be sequenced within the Cinegy interface. A digital structure would be generated, in which the user was able to view three elements: the video content, a folder (bin) to put the video content into, and a timeline to organize the video elements into a story. In contrast to the management of physical videotapes, the I&A

department manages the digital video's metadata as a backroom process, by conforming it to DMI standards and ensuring that everyone at BBC NI would share the same knowledge by using the correct terminology to tag or search for video content. These search, organization, and storage mechanisms exemplify the core process of what today is defined as multiplatform channel content distribution and convergent production. The complex set of technological processes prompted BBC staff to develop and utilize multidisciplinary skills and extensive knowledge about the DNI workflow. Provided that metadata is indexed properly, everyone can search for video content. Easy access to metadata would then increase staff efficiency.

7.2.3 Craft

Craft entails the process of editing segments of video footage, adding special effects, color correction, and grading as well as voice and sound recordings (i.e., sound editing, design, and mixing). Finishing and post-production are also catchall terms that describe the entire family of these activities including digital manipulation, transformation, and remixing video content through the use of software packages (for more information on these terms see Appendix 11.4).

Video editing is defined mainly as the selection and order of scenes from rushes that create a video story. Craft editors organize video scenes into a coherent narrative. In the analogue broadcasting world, a craft editor worked throughout the editing process in collaboration with a producer and a cinematographer (or a film director) among other professionals. Interaction and collaboration were crucial since much of the story's structure originated from group discussions while reviewing several hours of footage. From the empirical study, I recognized that the interaction between producers and editors is absolutely fundamental in order to assemble the desired shots into a coherent video narrative. Hence, video as a final product results from the negotiations that occur between different actors. Craft editors maximize the impact of the elements at hand (i.e., the idea, the script, and the shots) by getting the most out of technical tools (editing suite, special effects, post production techniques) through their broad

experience. Editing is after all a highly creative process, particularly with long-form productions or complex news stories, as the storyline demands a vast number of decisions.

Craft editors interviewed at BBC NI had difficulty articulating the precise nature of their work since the way they manage and mix moving images has always had a level of ambiguity. Craft editing is not a concrete process; it depends on the shots, the script, the discussion among team members, and the available technology.

The craft editing process can be regarded as one of the most rudimentary practices of the DNI workflow since its artistic essence has not changed with digitalization. In projects using preliminary versions of Cinegy (pre-DMI workflow), such as *Planet Earth*, the crafting process was regarded as a key thoughtful and creative moment that facilitated the selection of the most appropriate shots. As one programme manager stated:

In Planet Earth, they were using Cinegy [...] to do the shoot-selection, so that editors can do rough storytelling; they had a bin called “best bits”, and every Friday they had a meeting to allocate where those “best bits” could be used.

(Programme Manager, BBC Academy, interview, January 19, 2011)

Craft was considered a central part of DMI's process as it involved systematic meetings and discussions about the formation of new projects. The DNI workflow has brought an automated and streamlined selection and editorial process; face-to-face interaction is reduced in order to increase operational efficiencies. Craft editors now work based on a script that has been written in the initial stage of the content creation process, a process in which editors usually did not participate. The new DNI workflow reduces the level of group interaction that had been fundamental to the analogue broadcasting environment.

During the discussions at the research site, the new craft process was mentioned as an example of how technology obstructs the *techno-aesthetic* value of the final video

product. The term *techno-aesthetic* refers to the confluence of technical features being used (the *technology*), the appropriate level of expertise required in using those technologies (the *craft*), and the desired outcome generated from the process (the *art*). Defining the resolution format (SD or HD) for video production serves as a useful example of how *techno-aesthetic* value is understood. In HD, the color field differs from SD and the depth of field is a major issue. Lighting then becomes very important in both the shooting and the editing process. In addition, knowledge of color-correction software is crucial for editing in HD. In practical terms, all team members (i.e., cameramen, producers, and craft editors) have to understand the technical difficulties of focusing in low light with an HD camera in order to solve depth of field issues that might arise. One programme manager mentioned the practical importance of understanding the technical details of using HD with the following example:

What people have actually found out [with HD is] that you have to pay more attention to detail. [...] So for example, the makeup, more than to be exaggerated, [it has to present a] natural look. I think that most people realize that there was a lot of theory behind HD that in practice never came to happen.

(Programme Manager, BBC Academy, interview, January 19, 2011)

Hence, shooting in HD not only requires technical skills, but also knowledge of production values (such as makeup) that have to be taken into account in advance (while shooting in this case) in order to obtain the desired visual quality. Most HD processes are defined in the field and cannot be followed by theoretical or technical parameters. They require constant practice, which creates a stream of knowledge about both the technology and the craft.

The craft process is one of the most important creative moments in the DNI workflow. Certain aspects of the craft process changed since DNI's implementation, while others remained the same. In terms of the fundamentality of teamwork, the craft process is one of the few operations in DNI that still resembles the former analogue broadcasting process. However, DNI reduces face-to-face interaction in order to increase operational efficiencies. As part of the DNI workflow, the craft process not

only establishes a narrative, but also addresses technical aspects of video production that have to be considered during the shooting and planning phases (some are subsumed as *techno-aesthetic* values). Finally, a new skill the craft editor has had to acquire in DNI is the ability to search for video content through its metadata, a topic I discuss in greater detail when describing the work practices affected by DNI (subsection 7.3.2).

7.2.4 Share

The “Share” operation articulates the delivery and transfer of digital video content throughout DNI. It provides the functionalities to make content available to both BBC NI users (i.e., staff and third parties) as well as their audiences. As these two types of publics are quite distinct, the Share operation is designed to cope with them in different ways. I divide the description of the Share operation into two parts: first, a description of the internal and external users; and second, a description of the final audiences.

Internal and external users

The Share operation offers three functional ways of sharing content, depending on the type of users: BBC NI users, BBC-wide users, and external parties.

The first functionality is available to the local BBC NI staff and is based in the ability to co-create remotely and simultaneously, enabling group productivity. All the desktop computers at BBC NI are connected to the same digital library server. Therefore, if someone ingests or produces new video content, it will be available to everyone instantaneously.

A second functionality of the Share process is its large-scale use at the BBC. A DMI server hosts and captures video content that is available for BBC staff at any of their

locations. Such access would offer the BBC's best shots for potential reuse in other productions. At the time of my fieldwork, the second Share functionality was not yet available on a large-scale throughout the BBC; special infrastructure and bandwidth had to be put in place to cope with the potential requests to service thousands of users simultaneously. However, some pilot projects for reusable video content had been successfully implemented throughout the BBC using content from NHU's *Animal Planet* and *Frozen Planet*.

A third functionality shares media assets with external parties (independent production companies and post-production houses, usually called "indies"). As many commissions are not made in-house but externally, it is crucial for the BBC to enable some sharing functionalities for third parties. The transfer of assets and asset information enables some limited content management functionalities.

Audiences

As I previously stated, the study of audiences is not part of this research. However, as Share is an operation that connects the delivery of video content to different parties, it is relevant at least to mention briefly the particular Share functionality related to final audiences. The Share process includes the deliveries of the final productions through an expanded array of media platforms (e.g., air digital transmission, mobile, iPlayer, and other emergent platforms). Also, by giving audiences the final audiovisual products as well as additional video content to be used and manipulated, there is a potential for User-Generated Content (UGC). There have been several projects at the BBC that employ UGC, such as BBC Backstage and the BBC Creative Archive.

Share is a major new operation in the video broadcasting environment brought about by the DNI workflow. It involves new processes that may be similar to the delivery of video content, but are focused in making content available instantaneously and simultaneously to both external parties as well as to the BBC at large. Also, the Share functionalities open up the possibility for online content to be remixed and edited, creating the potential for UGC by the BBC's audience.

7.2.5 Bundle and Package

Once digitalized, organized, edited, and indexed, video content is ready for delivery. The Bundle and Package operation enables video assets to become available for several types of devices both online and offline. It provides the means of knowing how content is finally being consumed. As I mentioned earlier, in the Work in Progress and Craft operations, video content is manageable, flexible, and interoperable within the bounds of the systems that made it possible. Conversely, in the Bundle and Package operation, video must take on a specific format in order to be broadcast (such as mobile, iPlayer, or air digital transmission). Therefore, one of the most important tasks in the Bundle and Package operation is the asset conversion that transforms it into the appropriate delivery formats. The internet does not have a specific format for video (it depends on the device as well as data speed). This makes the compression of the same media asset into several new versions necessary in order to accommodate the different platforms and internet bandwidths. Compressing video assets usually results in the reduction of the original quality of these assets. For this reason, compressed video is only useful for broadcasting and delivery but not for archival purposes. A high-quality version of the video content, usually without compression, is rendered back to the digital library.

There are two additional functionalities that integrate the final digital video story into the media ecosystem. The first functionality relates to the schedule for the video asset's delivery to a target system or users (i.e., audience). Though the internet is by and large an interactive medium in which the standard broadcast scheduling is no longer relevant, scheduling organizes and plans how long the asset will be available and where and when it will be put online. The second functionality schedules metadata that conveys the video content information, (i.e., title, date, duration, description, etc.) and makes it findable and available both online, in digital set-top boxes, and on VOD consoles. There is an assortment of set-top boxes and VOD players (i.e., Tivo, Sky, Virgin) that have different technical standards for delivering video and its corresponding metadata. Therefore, during the Bundle and Package

process, DNI has to match its delivery output to the receiver's platform. In order to exploit additional functionalities, such as reviewing and search capabilities, video content has to be adjusted to the standards of each platform.

To summarize, Bundle and Package uses some concepts from the broadcast era scheduling, namely the organization of video content into blocks of time for on-air delivery. However, this procedure is now automated and it not only brings video content, but also the correct metadata, to the available platforms, set-top boxes, and VOD players.

7.2.6 Archive

At BBC NI, digital video content is archived in a large machine room. Nearly 90 percent of the room contains old legacy videotape equipment, while only two vertical cabinet racks of video servers store all BBC NI's digital video content. The digital archive is the backbone for most of DNI's processes of searching, retrieving, and storing its video assets. In the analogue broadcasting workflow, the archive was a place where information was stored that was no longer used on a day-to-day basis and that, as time passed, became part of the BBC's audiovisual heritage. Quite conversely, in a digital world, the archive's content is permanently available and its information management represents the essence of its "continuous life".

DNI's Archive (or digital library) is comprised of a series of manual and automated routines. In such a routine, each media asset is assigned to a correct file structure and tagged with the appropriate metadata. The Archive operation also has well defined functionalities for the use of its video content, such as reviewing, searching, storing, and collaborating with the members of the production crew. Cinegy software is used for searching through metadata and is a way of retrieving audiovisual content. Hence, it is crucial that video assets are correctly tagged in order to make them findable throughout the DNI workflow. The digital library is establishing a new relationship to video in the way BBC staff manipulate content. A digital media operations manager

discussed the ways in which people searched for video asset tags in the digital library:

One of the things that has changed is the way people are searching for the content. They are searching for how the things are tagged. [...] As the amount of image-based content is exploding, the value of content rests on its findability.

(Digital Media Operations Manager, BBC NI, interview, October 19, 2009)

Metadata describes the shot and its technical characteristics and is the only way in which video content can be retrieved. In contrast, the former analogue process required the BBC staff to review most of the tape by rewinding or fast-forwarding it in order to find a particular shot. Though the former process was regarded as time consuming, it allowed a closer look at the image content. The Archive's search functionality means that BBC staff now look up video content through text-based input queries (metadata), therefore by terms that they might think are connected to video assets with specific visual characteristics.

Managing metadata's life cycle in a video asset

One of the most interesting aspects of archived video content is that for it to live in the digital space, its life cycle has to be managed through its metadata. The first metadata model developed by the BBC's I&A department was excessively extensive consisting of more than 22,000 identifiable types of entries. Hence, the BBC tended to put as much metadata as possible into every video asset. Cinegy's approach is different. It is based on reducing the amount of metadata to that which is most commonly used and valued by broadcasting professionals. Cinegy demonstrates that only 20 to 40 different types of entries are necessary to sustain the lifecycle of a video asset. Throughout BBC NI, the I&A department has taken Cinegy's approach into consideration and has been tagging metadata accordingly.

The way in which metadata is defined depends on the type of production requirements. For example, video content for news comprises at least six basic fields of metadata. However, in the case of long-form productions, media managers decide

ad-hoc which fields are the most relevant for use. In long-form productions, the metadata description has to be meaningful for the different team members (i.e., producers, editors, media managers, third parties). For example, only a few metadata fields may be necessary to edit a documentary based on recently shot rushes. However, producing a documentary based on historical footage from the digital library requires different metadata in order to find the desired scenes.

Metadata could potentially generate other sophisticated uses for the content and its data. Managing video content life cycles through its metadata facilitates the automation and unification of the DNI processes. Through specialized software packages the unified workflow automates certain production processes. One former executive producer mentioned the benefits metadata offered regarding copyright information management:

[I]n the metadata [of a video] you can put all the rights information: copyrights, music, etc. So if you've got a piece of material which you want to use but you haven't got the permissions yet, you can put it in, but it is gets tagged with a red cross. So you can see it, but it would not be played out [broadcast delivery] until you got the rights.

(Freelance Producer, former Executive Producer, BBC Birmingham, interview, January 19, 2011)

Through metadata, copyright permission could be viewed in the content itself. Other BBC staff mentioned that new tools also enable video content to relate to its text script. By pulling both together, the tool automatically populates the video with the script's text. In this case, the craft editor can search for the words in the script and reach the divider location in the video timeline. Metadata can also be used for review approvals, a process by which a video story awaits editorial comments and broadcast delivery permissions. Cinegy also includes a dashboard with the different versions and stages that each video asset has passed through, which facilitates the monitoring and evaluation against the initial scripts, storyboards, or rough-cut edits.

Searching for video content

In traditional libraries it is still common to find librarians that know exactly where to find a specific book. They know a book by its color, binding, or spine. Information explosion in digital form renders it very difficult, virtually impossible, to detect those special traces or characteristics within content. Therefore, an important process carried out by the Archive, as in the case of hard-copy libraries, is the cataloguing process. Cataloguing video entails the inclusion of metadata for retrieval, searching, and reviewing purposes. Rather than being simply a repository, the Archive becomes a strategic and collaborative resource for retrieving and sharing information. Concurrently, retrieving information by searching metadata has made people aware of the importance of tagging metadata correctly within each piece of video content. In the words of a technical lead:

It is wonderful to search, but usually people are reluctant to organize their material. So people are realizing that if they [in]put the metadata they will have more. [...] At the end of the day it means that the I&A people define what should be saved or not, based on the information generated [...].

(Technical Lead, BBC NI, interview, October 19, 2009)

Correct tagging is a crucial task for metadata retrieval. Also, the digital library not only mediates new digital assets but also analogue archives originally based on legacy formats (e.g., videotape or film) that are being transferred to digital format. Digitalizing legacy media assets can be driven by editorial priorities (i.e. material that will need to be converted to digital format first due to commissioning) or by preservation priorities (i.e. old film and videotapes in bad condition or VCR and film decks that are becoming discontinued or out-of-order).

The Archive has changed dramatically from its former incarnation as a library of physical videotapes. It has gravitated toward digital video content on servers, which is constantly available and updated, mainly through the management of its metadata. The Archive's main functionalities are based on searching, reviewing, and storing

video content, all through text-based information interaction in a similar fashion as YouTube and other search query based information aggregators.

Thus far, I have presented in some detail the six distinctive DMI operations. I have explained their main characteristics along with relevant comments about how BBC staff perceived them and how each of them contributed to the unified computational system that composes the DNI workflow. In the next section, I give an account of the organizational and work practices affected by DNI at BBC NI in four relevant aspects: first, the management of the digital infrastructure; second, searching and browsing content; third, editing, remixing and reusing content; and fourth, the media management of video assets.

7.3 Organizational and Work Practices Affected by DNI

Since the legacy technology available at BBC NI was formerly divided in silos or “technological islands”, the work practices of the staff involved in the daily broadcasting operations were also divided. During my meetings with BBC staff, senior managers regularly mentioned that DNI was not seen as a technology project but a transformation. Therefore, one of the most important tasks during the implementation was to incorporate distinctive new capacities into employees’ work practices in order to make the most out of the new tapeless environment. However, the skills required for the DNI workflow have challenged the way BBC staff worked for decades in the analogue broadcasting workflow.

In this section, I present the main work practices affected by the digitalization and management of digital video assets in the DNI workflow. This section is divided into the four distinctive organizational and work practices. First, I introduce the *skills required for managing the digital infrastructure*, a section in which I describe how digital video replaced the functional silos (“silos of expertise”) that were embedded in the analogue broadcasting process for decades. The second practice is content

management (one form of the manipulation of video content). Content management centers on the *search skills* required to manage digital video, particularly in terms of how craft editors have replaced the visual imaginary of capturing video with the routine of searching the BBC's digital library. The third addresses the capacities of *editing, reusing, and remixing content*, and the particular ways in which journalists and long-form producers incorporate these skills into the new production environment by extracting material from a database instead of creating original material. The fourth and final subsection identifies the *media management of video assets*, which is one of the most novel practices and a prerequisite for *searching, editing, reusing, or remixing* content in a successful way.

I already mentioned that for the successful deployment of DNI, several positions associated with work practices had changed or were created. The positions that experienced the greatest change were the broadcast engineers, technology engineers, journalists, long-form producers, craft editors, and media managers. I mention some of these roles throughout this section and incorporate related information about the former role of each position (whenever it existed previously to DNI). I then expand on how the new tapeless environment requirements demanded new skills. Interviewee comments are included to offer first-hand insight into experiences and understandings of these new skills.

7.3.1 Managing the Digital Infrastructure

Since the origin of the TV broadcasting industry, broadcast engineers' main role was to take care of hardware, mostly in the form of analogue video and audio equipment. As previously mentioned, the broadcasting industry was accustomed to expensive turnkey solutions that offered technical reliability. Therefore, during those times, there was a need for broadcast engineers to develop specialized skills within functional silos.

Before analogue began the transition to digital, there was a need for broadcast

engineers to master specific skill sets. Sometimes it was even necessary to have redundant hardware ready in order to preserve the reliance on the system. The following commentary by a programme manager describes the complexity of executing a technical adjustment required for shooting (a camera line-up):

If we go back to 28 years ago [...] you had to do camera line-up and it was an hour long process of line-up: pointing at a chart and making sure that the greys in the chart appeared as greys in the camera. This was because the technology was old and it would drift colors. [...] In a studio of the mid-80s [you had] four cameras, and the first week [you would have no] more than three cameras working [simultaneously]. [...] If you wanted a camera to work, you had to have an engineer because it was so unreliable, you had to develop those skills. There would had been three broadcast engineers out of the back making sure technically that a studio would work. If you look at a modern studio setup, we don't do camera line-up, we don't do studio line-up. We walk in, we switch it on and it works! [...] As the equipment was getting more reliable you needed fewer engineers.

(Programme Manager, BBC Academy, interview, January 19, 2011)

The programme manager's insight illustrates both the high degree of specialization required and the unreliability of the technical equipment during the pre-digital age. Hence, broadcast engineers were very much involved in the technicalities of the machines; they had to understand not only their functionalities in detail but also their potential shortcomings. As part of their daily routines, broadcast engineers had to solve diverse issues that emerged unexpectedly and prevented the specialized hardware from working properly.

In contrast to the analogue broadcasting days, hardware in the digital age has become largely commoditized. As a consequence, digital hardware is not often worth fixing; replacing the item is frequently seen as the better option. This culture of replacement did not fit within the existing work ethos of broadcast engineers. One technology support manager stated:

In the broadcast world there was the sense of taking over the hardware and fixing it, but in the software-based computer systems, it is all about monitoring. There is not a way to know perfectly well how the software works; they need to have a much more systemic view of the whole process. Traditional engineers are not comfortable with that, they would like to get into the “resistor” and solve the problem.

(Technology Support Manager, BBC NI, interview, October 19, 2009)

Clearly the shift was not only an issue of ethos with regard to broadcast engineers’ culture when compared to computer engineers. It had also to do with certain technical issues that were taken for granted in the broadcasting world that did not translate to the IT world.

At BBC NI, as digital technology replaces old legacy equipment, broadcast engineers with IT skills have become of great importance. Management of the technical infrastructure is no longer concerned with legacy pieces of specialized hardware, but with digital technology infrastructures in the form of centralized servers, media storage drives, networks, and above all, software. Software is a central aspect of work practices as it involves interoperating standards that sustain a digital production infrastructure for shooting, editing, post-producing and digital video archiving.

The openness of DNI also assumes that the unified computational system has to be constantly enhanced with heterogeneous combinations of new software packages. This means that technology engineers cannot be “specialists” in a particular type of software, as it was in the old days of specialized broadcasting hardware. As new software services are continuously built on top of the DNI workflow, technology engineers have to identify how one piece of software interacts with another. For example, technology engineers must take into consideration open standards that will enable most systems and formats to interoperate properly. Overall, it seems that technology engineers are immersed in monitoring and managing the digital infrastructure, rather than occupied with “fixing” particular systems. The management of digital infrastructure is not concerned with particular equipment, but with a

network of interoperable software services; in order to stay competitive in the evolving media ecosystem DNI's tapeless environment has continuously acquired new features and services. Therefore, DNI requires constant monitoring in order to sustain the flawless operation of its digital infrastructure.

When managing a digital infrastructure like DNI, it is more important to know how to envision heterogeneous scenarios of use and their potential problems. For example, a technology engineer working for the production facilities at BBC NI discussed the scenario of use for a new camera technology. He envisioned how it would interact flawlessly when implemented as part of the DNI workflow:

The new card cameras that are coming with a new format called XD-CAM (HD-50, from Sony), which now we are going to move natively from the cameras to Cinegy or Avid, without any transcoding involved; this is the codec rather than the discs, which seems to be acceptable for HD productions. So that means we will deal natively from the camera right through to the final edit, so it doesn't get transcoded along the line.

(Productions Facilities Manager, BBC NI, interview, May 31, 2011)

As illustrated by this technical description, much of the work of technology engineers is based on the analysis and conceptual reasoning of anticipated problems as well as the possible solutions available to maintain the uninterrupted operations of the DNI workflow. Thus, BBC staff has to understand new technologies and how these could interact with the overall DNI workflow. Such knowledge seeks to ensure that the system is as flexible as possible while it remains reliable and stable. Hence, technology engineers are required to be capable of monitoring and maintaining the stable articulation of rules and procedures embedded in the software and the unified computational system that comprises the DNI workflow.

7.3.2 Searching and Browsing for Content

Searching and browsing for content in DNI's digital library became one of the most drastic changes to the way news journalists and long-form producers experience video retrieval. In the traditional broadcasting era, they had to view video content in a linear manner by playing it on a videotape deck (i.e., rewinding and fast-forwarding until the content was found). After the implementation of DNI, news journalists and long-form producers browse content from a database comprised of digital videos that are only searchable through their metadata. Prior to this new process, searching for audiovisual content entailed asking co-workers who had participated in the shooting about relevant footage or by watching video content repeatedly for several hours until the right scene was found. After the implementation of DNI, footage is described through metadata fields, which also means that if the descriptions of video content are not detailed enough or are unsuitable, the content can be lost forever in the digital library. As a head of Technology at BBC NI mentioned, searching for video through their metadata has changed the way BBC staff looks up content:

One of the things that has changed is the way people are searching for the content. They are searching for how the things are tagged. [...] As the amount of image-based content is exploding, the value of content rests on its findability.

(Head of Technology, BBC NI, interview, October 19, 2009)

To some extent, browsing and searching BBC NI's digital library was no different from the everyday practices of searching YouTube or Google. However, there are ways in which the users of DNI are required to have a particular awareness of the process in order to find the desired content. In particular, the way metadata was inputted during the ingestion process is important knowledge to have. The way in which metadata was tagged in long-form productions causes searching for content to become particularly complex. As previously addressed, there are customized methods of tagging long-form productions depending on production type; in order to search video content, a somewhat extensive knowledge of the way video content had been tagged within a particular type of production genre is required.

In the case of news production, the process is somewhat different from that of long-form productions, and more successful. Two years after the implementation of Cinegy in the newsroom workflow at BBC NI, journalists understood how important it is to have accurate metadata input into the system for searchability. In response to a question about the perceived value of metadata, a technology portfolio manager stated with great satisfaction the change in the way people searched for digital video content:

Yes, the value of metadata has become much more apparent for them, more appreciated, as a token. The system has been in operation for two years, so they can search for material, they can see at their fingertips if they put in a search term, all the material that is coming out. So the discipline of how the material is named and the amount of detail that is being used for the metadata is really apparent, because the better that it is the better your search is, and they don't have to depend so much on the media manager. Rather than go to a media manager and say, "Can you get me all the material we have on X?" they can just search for "X", and over the past two years whatever we got will come up in thumbnails.

(Technology Portfolio Manager, BBC NI, interview, May 31, 2011)

Journalists developed an understanding of the value of metadata in order to delve into the vast amount of organized, available shots to create their news stories. Hence, part of the journalist's creative process entails searching for video content. Results from search queries then structures the news story accordingly. Searching also ensures that the work done by journalists is being done almost independently, and does not require the participation of any other professional to work with him during the process.

In the case of news production, the reuse of existing footage from the digital library makes the search functionality fundamental to the creation of news stories. In contrast, the process of searching for video in the digital library for long-form productions is limited since most of the footage for long-form productions is created

from scratch and for specific genres.³⁵ However, the search functionality raises the possibility to reuse content (as is demonstrated later), particularly in the case of shots that are difficult or expensive to produce. This occurs within long-form productions at NHU, which produces some of the most costly shots. After shots are tagged, they are available in the digital library for reuse by other TV programs, bringing economies of scale to the BBC.

Long-form productions' craft editors have been exposed quite recently to the new practice of searching for and browsing video content in a digital library. Pictures and moving images have always been fundamental to defining a storyline and craft editors are experts in the manipulation of moving images to create a narrative. Craft editors used to work very closely with long-form producers in order to engage in outlining both the content narrative and aesthetics. The initial ideas that established a good or exciting story were an important driver for craft editors, who took the bits and pieces of video rushes and transformed them into a final story. However, as the DNI workflow was conceived, long-form producers edit video content (of late, they are usually pre-editing). This means that if a pre-edit results in a poor selection of shots, it limits the creative possibilities for craft editors to produce a good story. Hence, due to the DNI workflow, most of the editors are not familiar the material beforehand. Editors also do not have a chance to interact with the producer who performed the pre-editing. The separation between the pre-editing of video assets and its craft editing generates several problems with the quality of the final content. Craft editors must examine the material extensively to find the most acceptable shots. However, as they are not familiarized with the material in advance, they have to perform "blind-search" or "blind-browsing" through the pre-selected scenes to judge their suitability and possibly request their replacement. During the interviews, I was told several times that an important aspect that was lost in the new DNI workflow was the possibility for the craft editor to view the shot material while it was being ingested into Cinegy. The process of reviewing and digitalizing every shot is also an important process since it allows the craft editor to do a first mental pre-selection of the best shots. One

³⁵ There are some long-form genres that intensively reuse content, such as Documentary or Factual, but for most cases, long-form productions are based on content that is built from scratch.

productions facilities manager stated:

In the old days, when a producer came to a suite, they came with tapes and the editor would have ingested those tapes, so the editor saw all the material. And they knew, and they organized their material into what they call “bins”, just like folder structures, as they were ingesting. So once that system has stopped, the editors don't have sight of any of the material in advance. They just have access to the data about those shots. So in their mind they don't know where the shots are.

(Production Facilities Manager, BBC NI, interview, May 31, 2011)

From this account it is clear that the reviewing process involves two important characteristics: First, interaction and teamwork among producers and craft editors is considered part of a creative process necessary for craft editing; Second, and consequently, the shot selection facilitates the categorization of the material into Cinegy in a particular order. The organization of video content is an important cognitive support for craft editors to organize the structure and plan the video narrative. The search functionality has eliminated these two processes from the craft editing phase.

Summing up, the search skill has ushered in new creative possibilities as well as efficiencies to the DNI workflow. However, the benefits are mostly related to efficient and streamlined ways of managing video content for news production. Conversely, in the case of long-form productions, craft editing previously entailed the reviewing of the video content, a process that was removed in DNI. Using a streamlined editing process in long-form productions limits the craft editors' pre-editing and reviewing process of video material, which is fundamental to their ability to prepare content for the craft editing process. Thus, the search skill affected long-form and news productions in distinct ways.

7.3.3 Editing, reusing and remixing content

The editing, reusing, and remixing of content from different audiovisual sources is closely affiliated with the search capability. For decades editing has been comprised of several capabilities such as cuts, dissolves, fades, superimposes, long-shots, close shots, etc. These capabilities are translated to the technical features available in digital video software editing packages, such as Cinegy.

Before the transition to DNI, journalists and long-form producers filmed commissions with a crew comprised of a cameraman and at least one technical assistant. The crew handed the raw video footage to the craft editor. The work of journalists and long-form producers thus focused on constructing the story conceptually and working with their crew and other specialists throughout the craft processes in order to assemble the final story.

One of the main practices that the new desktop environment introduced was the capacity for long-form producers and journalists to edit, reuse, and remix video content on their own. The use of Cinegy has enabled journalists and long-form producers to work in a more efficient way, without any need to chase a particular tape. They are able to concentrate more on the craft and the technical abilities required to manipulate video content. Furthermore, the materials available at the digital library (supposedly) provide journalists and long-form producers with ample creative possibilities. In order to manipulate content using a video editing software package, such as Cinegy, journalists and long-form producers require new cognitive skills. The new cognitive skills also has prompted these professionals to be more creative and craft-oriented.

One of the most drastic changes that has accompanied the new DNI workflow is that each journalist or long-form producer now has access to a Cinegy video editing tool; technically they are able to manage most DNI processes from their desktop computers. In contrast, a trained cameraman from the tape-based era often knew what

the editors required and would edit along while shooting. Quite the opposite happens when the material is shot by a producer or an assistant producer and not by craft cameramen. The producers seem to shoot everything in case they missed something. However, the overzealous approach to shooting puts tremendous pressure on the end of the workflow, which is actually the part of the process that continuously has been cut in terms of time and cost.

Some producers rely heavily on their craft editors to create a program; however when the rushes to build a program are poor, it is difficult and more time consuming for a craft editor to build the video narrative. This is why it is fundamental to have experienced editors who can give the story the desired intention.

Furthermore, since DNI depends on a limited storage space for each project, there is additional pressure to delete unnecessary media from the media servers in the shortest possible time. In comparison to the tape-based workflow, the digital shooting ratio is much higher. One technology portfolio manager contrasted generalist producers with skilled specialists such as cameramen, stating:

If it is a trained, skilled cameraman, he will tend to have a quite low shooting ratio, whether he is using tapes or cards, [it] doesn't matter, because he is trained that way, and will have a focus. He doesn't just record pointlessly, whereas production people who tend to be less trained with cameras want a safety blanket, and will record, over and over again, whatever it is. The down side is, at the next point in the process you have now 300 hours of material to look [over] in just 30 hours.

(Technology Portfolio Manager, BBC NI, interview, May 31, 2011)

As the interviewee acknowledged, shooting by general producers often results in the acquisition of too much unnecessary or imprecise material that clogs the DNI workflow. Long-form producers in particular have had to become more hands on with Cinegy and develop the ability to pre-select their media shots before the edit. Otherwise, they risk accumulating a large quantity of material that offers little in

terms of quality. Long-form producers' work has had to emphasize the structure of the story so that when it reaches the craft editor, the latter can concentrate on the craft process rather than reediting irregularly shot and incoherent material. In most cases, a small number of good shots is preferred to many bad shots.

In order to stay true to a coherent story, it is important for any cameraman to shoot for quality rather than quantity. If a craft editor is provided with excessive video content, he could have too many options to deal with and might end up conveying an interpretation that strays from the original; an uneven pre-selection of shoots does not give a clear direction for the final story to follow. Also, as mentioned earlier, in many cases, the producers no longer sit next to the craft editors during the editing process, leaving the editors without the possibility of face-to-face teamwork or assistance. In the analogue era, editors were able to log and select the video material in collaboration with a producer. In the DNI workflow, editors pick up the content that was logged into the system and pre-edited in advance; craft editors no longer actively participate in the selection of shoots that become digitalized and sometimes the material logged might not be good enough. For a good edit, craft editors have to know the material they are working with very well. There are also some important technical details that affect the final video narrative. For example, the "in" and "out" points of each shooting is fundamental to a good edit. If the rushes are collected without sufficient space at the start and at the end of each shot, the editor will not have enough useable content to contribute to the final product.

Remixing and editing content also requires the technical capacity to understand the "hidden processes" embedded in computer systems, such as rendering times. The media industry's legacy machinery was based on electro-mechanical machines that enabled BBC engineers to actually "see the process" while it was running (what is known as "real time" in computational terms). In contrast, most digital technologies require computational processing (commonly known as rendering) for special effects or high-resolution output (HD) broadcast delivery. At times, when the system was busy rendering, BBC staff identified it as if "the system was not working" or as if "the network was slow". This has proved to be a particularly common reaction in the

newsroom: journalists find it difficult to understand the abstract language of rendering processes when each minute counts in their effort to finish a news story. The perception of rendering as a “computer error” increases significantly when a news story is ready for on-air delivery. Before it is actually sent for broadcast, the news item has to go through a high-resolution rendering process. For news journalists, it has not been easy to get used to waiting for the final high-quality version of the news story. Journalists expect the processes to be immediate, but when presented with evidence contrary to that perception, they can become impatient.

The capacity to edit, reuse, and remix content has had distinctive effects in the DNI workflow. News journalists have quickly adapted to Cinegy; they understood immediately the benefits of being able to browse and select the desired content while simultaneously editing from their desktop computer. However, for long-form productions was difficult to reuse content in most cases. Additionally, the work has been divided into operational steps whereby producers do most of the logging material into the system and craft editors are left to pick up the content that has been logged. Since craft editors do not participate actively in the digitalization process, problems are likely to arise since they might not be able to obtain content necessary to produce a final story.

7.3.4 Media management of video assets

One of the central processes DNI requires is the management of digital video in the digital library. As was the case in the era of videotapes, in which all media was labeled and systematized, the digital library is accessed through text-based queries. Therefore, it is crucial to input (or label) quality metadata about the video content that has been ingested into the system. In order for this to occur, the role of the media manager came into existence. A digital media operations manager defined the role of media managers in the following way:

Media managers for me are librarians, because it is a very skilled task that yes it

can be taught, but essentially is what we've been doing forever. [...] It is essentially a library skill. Our work may have changes, we are working using servers, [but in essence] we are still are adding information to a database so it can be retrieved.

(Digital Media Operations Manager, BBC NI, interview, June 1, 2011)

Though the media manager's role might be reminiscent of the librarian's, their work is grounded in the ingestion and cataloguing (tagging) of video content to be used as the main source for DNI's news and long-form production workflows. Being part of the new organizational model based around DNI operations, media managers provide video content management services within each production team or at the newsroom's ingestion hub. Hence, the media management operation is physically based within each production team.

The major problem with any kind of file-based system, such as DNI, is that once it is in the database, it vanishes if it is not well labeled. Media managers are then responsible for ensuring that the metadata's quality enabled its content to be searchable from the digital library and useable to BBC staff. Being a text-based format, metadata enables media managers to propose diverse possibilities for the types of tags and descriptions for each piece of video content. In long-form productions, the production teams and media managers at BBC NI have developed specific sets of metadata fields depending on the level of functionality or even the stage of the production. Hence, apart from the basic metadata descriptions for digital video content, each video can also include temporal descriptions, or text-based scripts that can increase its chances for findability.

The possibilities for inscribing metadata onto a video asset could become endless; however, all digital video had to be tagged with both technical and descriptive metadata. There are several types of descriptive metadata (which makes the process of organizing long-form productions more complex). A media consultant described the types of metadata that characterized productions in DNI in the following way:

You have the technical metadata, that of course is not very helpful, and then you've got descriptions. If you want to describe shot by shot, you might want to do something called "temporal logging", which is that in one layer of metadata [it refers to] what is happening (description), in another layer you will actually want the script (what he is saying) and in another layer it might have rights clearance.

(Media Consultant, BBC Academy, interview, January 19, 2011)

Most productions contain different types of metadata, depending on the genre or the specific requirements of the program. One of the main reasons to include media managers in the production teams is because they defined the type of metadata that each particular production required. Hence, the type of metadata for news and long-form productions differ substantially, as the Manager of Digital Media Operations explained:

The media manager I have in the newsroom is different from the one I have in production. They look at things much differently, their workflow is different. The workflow in news is fast turnaround, much more standardized. It is very easy to get into that process, the workflow does not change. Whereas, if you work for a long-form production, fortunately Cinegy has a very fluid folder structure, so one production might want to see their folder structure in one way and the next one might be completely different, so even going to the folder structure, the tree looks completely different from one production to the next. Working with the long-form productions, there is definitively much more creative license going on there [...]. You need to ask more questions, you need to have a very good communication stream going on there because things can change rapidly. It's a much more difficult environment. It's a challenge for media managers to keep up on what is going on.

(Digital Media Operations Manager, BBC NI, interview, June 1, 2011)

Since media managers are allocated to particular production teams, they participate in the creative articulation of each production as well. Their role is very much inside the process, creating and documenting the type of descriptive metadata to be added to the video content. Media managers also make sure that video was loaded into the system

correctly so that the media will be available for editing as well as helping to plan the migration of content to the craft editors. As media managers were assigned to a specific production environment and participated in the projects since their conception, the long-form teams generally value their participation and what they offer in terms of understanding particularities of managing the video content for each genre or specific production. The media manager's position has turned into a more strategic role and their coordinative capacity around the use of the material is central.

Another important function associated with the media management of digital video is the process of data cleansing. Data cleansing is the process of discerning which video footage should be kept in the digital library and which is not worth keeping. In the digital world, in contrast to the physical one, the restrictions to storing media are completely different. In the physical world, one has to take into consideration conservation and the possibility that tape-based media might deteriorate or be damaged. In the digital world, as it is easier to keep everything, media cleansing prevents duplication and inefficient management of video available in the digital library. At the same time, as there is a scarcity of digital storage space available at BBC NI, media cleansing prevents servers from acquiring too much unnecessary material. The storage limitations differ from the internet economy, in which there is a perception of infinite (and mostly free) storage space available.

I now turn my attention to how the operations and work practices described above are being used in two distinctive production environments: the news (Journalism division) and long-form production (BBC Vision division).

7.4 The Management of Digital Video: A Streamlined Workflow

In April 2009, BBC NI started the first pilot project for the implementation of DNI in the newsroom. Less than six months after it began, DNI was successfully deployed. More than 250 staff members in the Journalism division were able to use the new

digital workflow without major difficulties. In December 2009, several months after the newsroom implementation, DNI was deployed in four pilot projects for long-form productions. However, as of May 2011, the long-form production workflow was not yet fully implemented.

In this section, I elaborate on DNI's implementation within both news and long-form production environments. First, I describe the Journalism division by discussing the particular dynamics of the newsroom production workflow that emerged after the implementation of DNI. Then, I assess DNI's impact on the operations carried out within the long-form productions at the BBC Vision division. Long-form's diversity of genres help to illustrate the particular complexities of these heterogeneous and less standardized types of audiovisual projects and how they shaped the DNI implementation in this division. Finally, I illustrate several differences between the news and long-form workflows and how they are tied to the particularities that surround both implementations.

7.4.1 Newsroom Workflow (Journalism division)

In less than six months, DNI was successfully implemented at BBC NI's newsroom. The new DNI workflow for digital video was carried out 100 percent using Cinegy while 92 percent of news stories were produced directly by the news journalists themselves on their desktop computers. The news journalists realized the benefits of the DNI workflow immediately and the rollout plan was completed in only four weeks, two weeks ahead of schedule. Many interviewees highlighted this fast adoption of DNI. A digital media operations manager mentioned how surprised they were with the fast deployment of the system within the news environment:

It was fantastic going into the newsroom first, as we have their buy-in very quickly. Journalists could see the advantages immediately. [...] They are used to working in a particular type of environment and it was impressive how fast they

changed their work habits. [...] It was incredible, we didn't expect that.

(Digital Media Operations Manager, BBC NI, interview, June 1, 2011)

The Journalism division's quick adaptation to the DNI workflow surprised BBC NI's senior managers; they had expected that such a drastic organizational transformation would require a lengthier period for the implementation and the demonstration of palpable results. One of the main reasons for the fast adoption was the use of Cinegy for desktop computer editing. Being based on a Windows environment, an interface that the journalists were accustomed to, also contributed to the fast adoption. When looked at in detail, the organizational change prompted new ways that journalists relate to the news stories. The management of video was now accomplished through categories and descriptions in the form of metadata, which enabled a simpler method of searching for video content. DNI's streamlined workflow offered more editorial control by making BBC journalists aware of the entire process. Thus, journalists became more accountable for the management of the video assets they used to produce news stories.

DNI brought about an important change with regard to the way television news stories are conceived at BBC NI. Before the implementation of DNI, news stories were produced in teams comprised of several professionals (i.e., cameramen, craft editors, journalists, and senior news editors). Each professional carried out a particular task that contributed to the final news story. Conversely, in the new DNI workflow, journalists mostly work by themselves through the entire process shooting, browsing, and searching for content, video editing, and preparing the news story for delivery. Cinegy identifies and alerts the editor if a shot has been used previously, preventing the occasional repetition of shots by journalists who edited multiple news stories. Hence, the processes of the new automated workflow enables journalists to cope with the fast production of news stories, which is a central aspect of the dynamic world of news. The search and edit functionalities, provided by Cinegy, also simplify the process of news creation; numerous manual and time-consuming processes required to prepare a news story, such as looking or asking for a tape in order to find a specific shot, became unnecessary. Since all shots required for news story creation became

available in a single digital library for everyone to use, the search and edit functionalities enable an efficient workflow by reducing dependence on others. With the complete implementation of DNI, journalists are able to conduct most of the tasks individually from their desktop computers.

In comparison to the previous analogue news operations, the DNI workflow is extensively systematized and organized in sequences of automated tasks that streamline work practices into a series of steps and scenarios. Figure 18 illustrates the general process for Tapeless Camera Deployment, which is an excerpt from a detailed 30-page Briefing Document. This document describes the different scenarios and use cases that might occur during the camera selection, shooting, ingestion, and archiving of the produced media assets (see Appendix 8 for the news workflow's use cases). The briefing outlines the precise process and what to do in different scenarios.

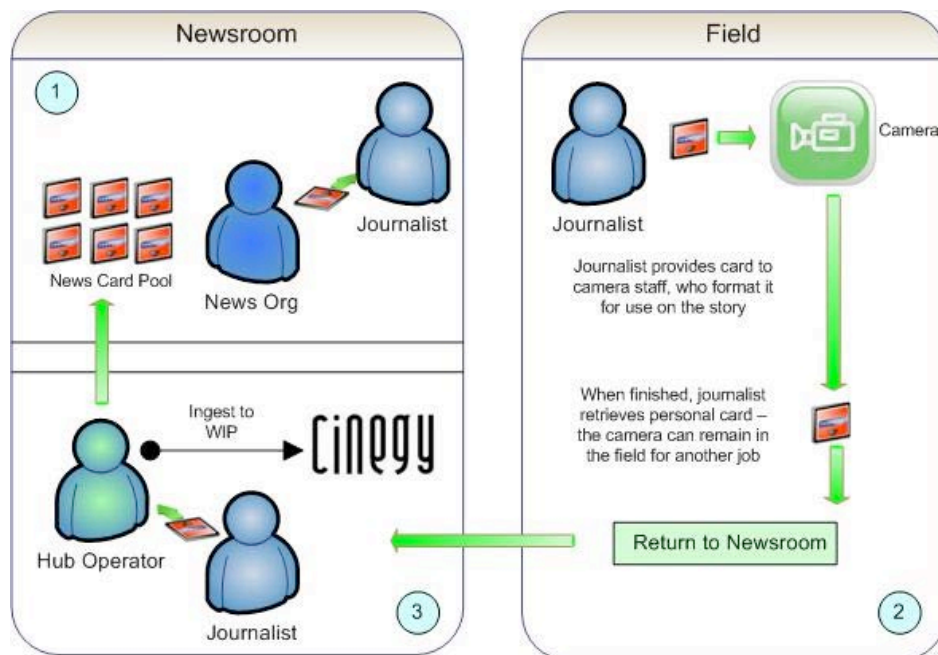


Figure 18: General process for tapeless camera deployment

(extracted from Cinegy 2010)

To summarize, the DNI workflow was adopted in a short period of time by the BBC NI newsroom team, seemingly due to the journalistic culture's familiarity with tight schedules and a concatenated sequence of processes for the fast-turnaround production of news stories. DNI has translated most manual and time-consuming processes into automated procedures and routines, which also has eliminated most of the former physical interaction. Hence, the introduction of the new DNI workflow transformed journalists' work practices by giving them the opportunity to handle much of the work on their own.

7.4.2 Long-form Workflow (BBC Vision Division)

When DNI was introduced to the BBC Vision division, long-form production processes initially relied on applying the same systematized workflows that had previously been successful in news production. However, in the case of long-form productions, due to their nature, time span, and complexity (i.e., diverse types of content and genres), the workflow was confronted with several unexpected complications. Therefore, the DNI workflow for long-form productions' rollout plan was delayed several times while the IT team responsible for the implementation tried to adjust its deployment in a small number of pilot projects.

Figure 19 (next page) illustrates the general process long-form productions undergo as part of the DNI workflow. The diagram provides a complete description of the initial DNI processes and details the technological, procedural, and documentary requirements. In contrast to news stories, long-form productions consist of a diversity of outputs, from fast turnarounds and live shows to "weekly's" and documentaries that can take over a year to complete.

Producing your Film

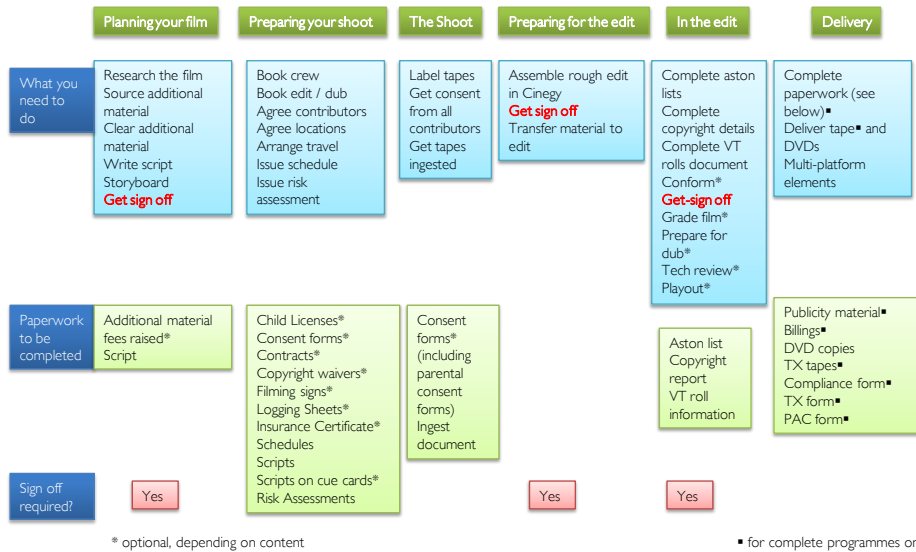


Figure 19: General process for long-form productions with respect to DNI workflow (extracted from BBC 2011)

Long-form productions are generally planned several months or years in advance. Also, it is not possible to rely on a single person for most long-form productions, as is the case with news. Meetings and face-to-face interaction, depending on the type of production, are often an important part of the workflow. Each professional participating in the meetings may have different approaches to the video story, which makes the definition process much longer and more complex. When DNI was initially implemented, its rollout did not necessarily take into account the existing characteristics specific to long-form production.

Modeled on the news production process, the DNI workflow at the time of initial implementation was generally perceived to be oversimplified and restrictive for long-form producers. One of the central pieces of DNI, Cinegy, was seen as an elementary editing software package in comparison to the sophisticated tools for craft editing that producers and editors were accustomed to operating (i.e., Avid or FCP). Producers felt limited by Cinegy’s features in contrast to the powerful and creative tools they worked with before. Furthermore, long-form production teams were used to

incorporating heterogeneous modes of production into the design and post-production processes to enrich the aesthetic value of the final product. Many interviewees expressed frustration with the restrictions imposed throughout the DNI workflow. Long-form production teams were restricted from using other software packages that did not comply with DNI. This prompted a reaction to the DNI workflow as a whole. As the Producer for Factual Programmes stated:

I guess there are very nitty gritty technical things with regard to Cinegy. One example would be that a lot of the time we like to rough cut something and burn a DVD so I can give it to my boss to watch on his laptop. [...] You can't do that. All you can do is edit something together and then send it to Avid. So in a world where we are now moving to file-based media and everyone has iPhones there is no way to get your material out of [the Cinegy software used in] your computer.

(Producer for Factual Programmes, BBC NI, interview, May 31, 2011)

In recent years, there is an increasing number of technologies and services available that are able to connect to the internet. Therefore, there is a greater need for flexible solutions in which video content is able to interact with new technology services available on the internet. In order to do so, it has become vital to incorporate technology engineers into the production planning and execution processes. In this respect, the Producer for Factual Programmes mentioned:

I am making a new series in October. Usually I have a meeting with my cameramen and editor to plan it. Now we are going to have a technologist in that meeting as well. It can help us to make the production easier, smarter, give viewers more.

(Producer for Factual Programmes, BBC NI, interview, May 31, 2011)

The routinized DNI workflow sought compartmentalized processes and “one-size-fits-all” solutions. Incorporating the particularities for each long-form production into the DNI workflow required the reorganization of the automated workflow for each particular case. As I mentioned earlier, the long-form production crews’ expertise and capabilities were central to the creative and *techno-aesthetic* aspects of manipulating

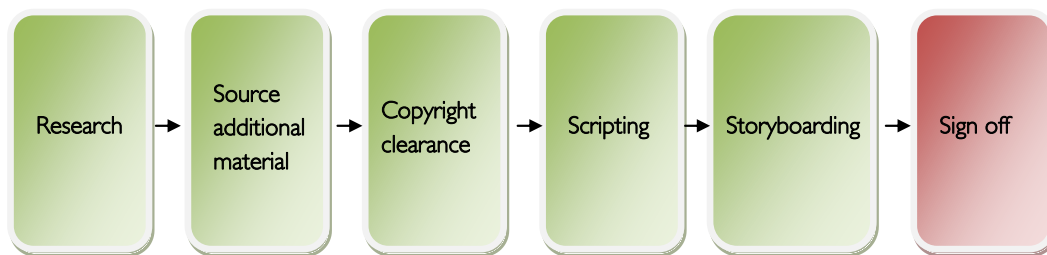
video content. Each DNI workflow should then be customized for each particular production requirement. As a production manager for Television Current Affairs elaborates:

The model for Spotlight just doesn't lend itself to the model of working [with DNI] at all, because basically it is a 30-minute current affairs film but it has a fairly limited budget. In theory we have a shooting week, but the shooting happens over a longer period, and quite often they are shooting while part of the team is editing.

(Television Current Affairs, Production Manager, BBC NI, interview, June 1, 2011)

From this account it seems clear that each production genre has particular production requirements, which needed to be taken into account accordingly. There was not a single model that could be used for all long-form productions, as such. Figure 20 shows the new planning stages for content creation and highlights the most creative phases in the construction of a long-form production. The problem lies in the existence of a standard workflow for both news and long-form productions; some crucial stages of the tape-based long-form process were eliminated in DNI.

Planning your content



The process to follow in planning a strong film

Figure 20: Planning stages for content creation

(extracted from BBC 2011)

The increased length of time required to create long-form productions in various genres made the standardized DNI workflow unsuitable for most types of long-form

productions. Moreover, these productions required team dynamics that were not implicit in the concatenated DNI workflow that was based on the newsroom structure. As a result, some processes, such as crafting, were unsuitable for the new workflow. Instead of creating a centralized media management hub, as had been the case in the newsroom, media managers were incorporated into each long-form production team, illustrating one of the ways in which DNI was altered in order to respond to the differences between long-form and news production processes.

7.4.3 Distinctive Aspects of News and Long-form Workflows

In the previous sections, I describe several specific aspects of the implementation of the DNI workflow in news and long-form productions, respectively. In this section, I briefly summarize both processes in order to explain the limitations of DNI.

First, it is important to recognize that the work completed by a journalist in near-total isolation in the newsroom contrasts to the teamwork required in the case of most long-form productions. Second, in the attempt to simplify and maximize DNI workflow efficiency, especially for the benefit of the newsroom environment, some important steps in the process were oversimplified when applied to the long-form production process. The role of the craft editor in the initial stages of the process was removed or overlooked, limiting his or her ability to review or search for pre-edited content. Third, news productions employ a concatenated sequence of unvarying processes as well as automated procedures that work for most news stories. In contrast, long-form productions require the customization of the DNI workflow for each particular type of production or genre as their heterogeneity demands flexibility. Fourth, the particularities among the different genres within the long-form production environment also require that media managers and technology engineers be available at the inception of each project, both in terms of organizing the assets based on customized metadata structures as well as planning technical considerations regarding the use, storage, and maintenance of the video content.

There are additional differences between news and long-form production in terms of the ingestion and media management of video. In the newsroom, ingestion is centralized in an ingestion hub and with standardized video shots. The stage-driven approach of news production contrasts with the heterogeneous organizational assemblages of long-form productions. Long-form productions require highly coordinated teams and face-to-face collaboration, hence, it is more difficult to categorize and standardize in terms of organizational dynamics.

In this chapter, I presented the core of the empirical work, describing the operations and practices of DMI implementation, dividing it into three significant parts. The first outlines the six DMI operations at the DNI (Shoot, Work in Progress, Craft, Share, Bundle and Package, and Archive). Second, I provided an empirical description of the main practices affected by digitalization subsumed into four distinctive organizational and work practices. I concluded by giving an account of the management of the digitalization in the streamlined DNI workflow that was applied to news and long-form productions, and contrasted their technical and organizational differences.

In the subsequent chapters (8 and 9), I present an analysis of my empirical research, which revolves around the question of how BBC NI's practices were affected by the new DNI workflow as a streamlined digital production process.

8. Analysis: The Digital Image and Changing Work Practices

*“The new electronic interdependence recreates
the world in the image of a global village.”*

–Marshall McLuhan, *The Gutenberg Galaxy* (1962)

In this chapter and the one that follows, I build on my findings in an attempt to answer the main questions posed in the introduction. I seek to analyze the impact of digitalization in work practices associated to the production of video as an image-based artefact in the domain of craft editing in the distinctive occupational cultures of news and long form productions.

I divide my analysis in two paths of inquiry: First, I analyze how digitalization of video as a cultural artefact in DNI impacts differently in news and long-form productions, respectively. Second, I study image manipulation practices throughout the DNI workflow in the context of video craft editing from a semiotic perspective. My aim is to analyze how work practices are affected by the structure of video as a digital image-based token and use semiotics to disclose such structures. As mentioned in chapter 4, the use of the same technological information may influence the work practices of different occupational cultures in different ways (Barley 1986, 1996; Ekbia and Evans 2009; Lanzara 2009). However, studying video production only through the lens of its situated practices may omit any relevant aspects that elucidate how digital video as a technological artefact impacts on those work practices. After all, news and audiovisual narratives are based on work practices that originate not only from their respective occupational cultures, but also from what constitutes the semiotic character of digital video as a technological artefact.

Section 8.1 explores how DNI has been implemented through the management of cultural artefacts, namely, digital video content. I study the work practices based on

operations and information management, in particular, the work done by journalists and long-form producers regarding the use and management of video content. I analyze how the DNI workflow has promoted the sequentialization of tasks, and how this affected the work practices in both news and long-form productions. Then, I study in detail the distinctive ways of searching and classifying video content in news and long-form productions. Bowker and Star state that any classification system faces certain limitations, so I examine the specific limitations of classifying video content in DNI (Bowker and Star 1999: 107).

In section 8.2 I assess how digital image-based tokens have particular characteristics to be taken into account when analyzing work practices. I do so by exploring the manipulation of video through the operation of craft editing. Craft editing is an extremely significant operation within DNI because it begins with the reviewing of the video shots captured at the initial stage of the production process and terminates with the final video story intended for broadcast. Thus, the editing process demands the work practices of a diverse group of professionals. I analyze craft editing work practices from a semiotic perspective and examine how the digital image differs from the manipulation of other types of media tokens (i.e., text, code).

To conclude this chapter, section 8.3 summarizes the characteristics of news and long-form productions by comparing their semiotics dimensions, video narratives characteristics as well as their occupational cultures.

8.1 DNI Workflow and the Sequentialization of Work Practices

In order to manage video content, most BBC staff (i.e., journalists, producers, craft editors, media managers) use Cinegy, an off-the-shelf software package. Video content recognition is difficult due to the distributed, mutating, and shifting nature of digitalized video content (Kallinikos and Mariátegui 2011). Cinegy has enabled the identification and management of video content through metadata. In this section, I

analyze the work practices of the BBC staff, namely journalists and long-form producers and their interactions with video content through DNI, and how video content has been transformed into news narratives (for news productions) and audiovisual narratives (for long-form productions), respectively. I first start by analyzing at a macro level the DNI workflow and the sequentialization of tasks.

A sequentialization process in general is based on interdependent operations that are embedded as part of a system. Sequentialization sought to render the DNI workflow predictable and controllable (Kallinikos and Mariátegui 2011). The processes that digital video content undergoes as part of DNI are not as visible as in the case of the tape-based processes of the analogue broadcasting era. Hence, journalists and long-form producers who participate in most phases of DNI's operations (from Shooting to Delivery) are required to develop a new array of intellectual skills (Zuboff 1988) in order to understand the digital workflow while at the same time being able to compose and edit video content into narrative structures.

Composing and editing are basic operations that organize digital video content in a *montage* of concatenated images (Manovich 2001; Treske 2013). Consequently, most editing systems for desktop computers, such as Cinegy, organize video content on a timeline structure. The horizontal operation of a timeline structure is based on the conventions of traditional film editing as shots are assembled one after another (Treske 2013). Before video shots are organized on a timeline, they are available as tracks in a folder. These tracks are organized as a running list so that calculations such as the total length of each video shot (duration) can be executed easily before they are mixed into the timeline. The outcome of the different video shots assembled in the timeline is a final news or audiovisual narrative that is ready for delivery.

Cinegy is similar to other off-the-shelf software packages that accomplish pre-determined and automated standardized tasks based on algorithmic and data management processes (Manovich 2001; Gillespie 2014). However, before Cinegy was introduced, many tasks related to the management of video relied on manual processes. One such operation was video editing, which could not be organized by

means of an automated system. In large systems such as DNI, the sequentialization of video content is not based on processing it, but on organizing its information as a linear or sequentialized structure. Sequentialization is largely based on managing tasks and organizing them accordingly. For example, craft editing, which involves the selection of video shots to produce a final audiovisual narrative, mostly involves using one screen at a time. Thus, it is impossible for many people to edit the same video project within multiple timelines simultaneously (in different machines) as it will not help to organize information and could eventually generate confusion. Video is, after all, a narrative that follows the same linearity of a film. It is true however, that many people might participate in different moments of the craft editing process in order to incorporate their expertise. For example, while the craft editor is editing video content into a sequence, special effects experts could be working on particular effects to be added to video sequences when brought back into the final timeline. When projects are complex or long, two editors or more might edit specific portions or sections of the timeline. However, the final video narrative has to be completed in a linear organized fashion. While this option helps to reduce editing times, the main risk might be a lack of coherence due to editors' differing opinions that go unmediated in the absence of a central supervisor (Murch 2001).

Cinegy is a simple to use editing software package and does not have the advanced features offered by most professional software such as Avid or FCP. Therefore, Cinegy only conveys selective aspects of the fundamental processes that take place within the DNI workflow. These selective aspects depicted a process similar to the procedures journalists had followed for decades in the analogue world, in which rules were also based on sequentialized processes and structured tasks (Boczkowski 2004; Dupagne and Garrison 2006; Boczkowski 2010).

After the implementation of DNI in the BBC NI's newsroom, it was agreed that the tasks and procedures used for the newsroom should also be applied to long-form productions. Since the news deployment of DNI was very successful, the IT team was confident that it should also work in the same way for long-form productions. However, it soon became evident that the DNI workflow as applied to the

management of news was not appropriate to the management of long-form productions. The latter requires processes based in a less sequentialized and codifiable structure and varies significantly depending on the particular type of genre or commission, as I discuss in the following paragraphs.

Long-form production teams were accustomed to managing diverse and less sequentialized tasks since, in most cases, a portion of their work depended on unanticipated production decisions. They relied on flexible problem solving, which by definition is based on unstructured tasks. Then long-form production process involves an intuitive expertise that relied on face-to-face interaction and group collaboration, such as planning or reviewing rushes and preliminary versions of the audiovisual narrative. For example, the editing operation brings together a number of specialists for a range of activities as dissimilar as scripting, shooting, or composing (Kallinikos and Mariátegui 2011).

A large-scale solution, such as the DNI workflow, alters work practices by requiring that common skills are rendered as technical tasks. Hence, the complex texture and dynamics of long-form productions is simplified or overlooked in the implementation of DNI. Furthermore, as I discuss in the subsequent sections, the management and organization of video content through a sequentialized computational system, such as DNI, also influences the way in which audiovisual narratives are constructed.

During my empirical research, I observed that the BBC NI engineers on the IT team seek to optimize processes and automate manual tasks as much as possible. However, tacit knowledge and high uncertainty with regard to the complex interaction dynamics among people working in long-form productions have made it difficult to encode the relevant tasks as a sequentialized and uniform procedure and automate them (Galbraith 1973; Winograd and Flores 1986; Nonaka 1994; Dreyfus and Dreyfus 2000). Let me discuss this further.

Organization-wide information systems like DNI go a step farther to shape human

agency than stand-alone or independent packages. Cinegy,³⁶ being an off-the-shelf software package, has brought uniformity to DNI by helping overcome a disparate ecology of application and management techniques that populated the organization. As Kallinikos (2011) claims, the syntax of large-scale solutions, such as DNI, tend to dissolve the various tasks and the information they generate upon one another into a sequence of interdependent technical tasks or series of tasks. By doing so, large-scale solutions simplify organizational assemblies of functions and processes and require of human agency to enact work tasks by relying on routines and procedures embedded in software packages (Kallinikos 2004, 2011). DNI is a digital infrastructure in which key operations are fixed (at least temporarily) to withstand any deliberate manipulation. DNI includes the combination of data items, transactional steps, and rules in its workflow which standardizes the input and output of its data throughout its operations, meaning that some intellectual capacities —the planning, running, and monitoring of the DNI workflow— are emphasized, while others —the face-to-face interaction, informal communication, and group collaboration— are left out (Zuboff 1988; Kallinikos 2011). Consequently, DNI’s standardized, predictable, and controllable linear assemblages of tasks have blocked, or at the very least impeded, the exploration of any innovative solution that is not considered part of the workflow. I devote the subsequent paragraphs to the analysis of the BBC staff’s interaction —in both news and long-form productions— with the DNI workflow and examine how it affected their work practices.

8.1.1 News and Long-form Productions: Distinctive Ways of Searching and Organizing Video Content

The varieties of technological information that digital video content generates through the DNI workflow construct an expansive electronic text in the form of metadata.

³⁶ In the particular case of Cinegy, it is also important to bear in mind that although it is an off-the-shelf package, it is embedded with several specifications and workflows developed at the BBC; it was initially an in-house project, as is explained in chapter 5.

There are two main processes undertaken by journalists and long-form producers in order to search and organize video content and how the use of symbolic tokens affects the work practices of journalists and long-form producers.

Finding videos in DNI is accomplished through text-based search queries in the digital library. In the case of the BBC journalists, their “multitasking” skills made them more capable of searching for content as well as metadata tagging new content, skills that were non-existent in the BBC NI newsroom environments before DNI. Searching for video in the digital library through the use of metadata requires that the news environment share a set of common definitions about the video content, which facilitates its findability. The *informating capacity* of digital video, in the form of metadata, takes center stage in news production. Searching for video also stimulates a new capacity in journalists: the skills to create new material from pieces of existing ones (e.g., reusing, remixing). In order to do that, journalists “read” video content through their metadata descriptions. Such a manner of “reading” video content might be efficient in order to find the video pieces necessary for news stories but lacks the coherence for more complex or longer video narratives.

As already mentioned, a key characteristic of Cinegy is its linear process for constructing either a news or an audiovisual narrative. This is particularly relevant to BBC NI’s convergent newsroom in which multi-skilled journalists create, edit, and deliver their news stories. DNI reinforced the cognitive transformation to its workflow with the creation of each journalistic story as it incorporated several news production tasks into its sequentialized processes. As already addressed in chapter 2, such a structured workflow has underlain newsroom environments for nearly two decades (Zoch and Collins 2003; Boczkowski 2004; Dupagne and Garrison 2006). Furthermore, since news stories are composed of small “bits” of videos (many with a duration of only a few seconds), it is relatively easy to join several pieces together into a small concatenated structure (totaling between 2.5 to 3 minutes for each news narrative.)³⁷ Thus, the standardized process on which DNI is based resembles most of

³⁷ Refer to subsection 9.2.3 for a more detailed discussion on the comparison between news and long-form productions’ usage patterns.

the processes of typical news environments (Treske 2013).

During the post-production process, creating video for news at BBC NI begins with the arrangement of the content (video, images, text, sound) into news bulletins. Through this arrangement, the content is listed in a running order, within a structure that would appeal or be relevant to the audience (i.e., top story at the beginning, a lighter story at the end). Scripting, correcting spelling, editing video, writing headlines (that grab the audience's attention), or preparing a running order are all work practices that belong to standard journalistic production (Bignell 2002; Williams 2003). Though their work practices have not changed dramatically since the advent of DNI, BBC NI journalists are required to learn to search and organize moving images through an editing software package (i.e., Cinegy). This demands a new cognitive capacity; journalists must master the management of audiovisual information and incorporate new skills, such as searching for video clips, in order to find the appropriate scenes and compose their news stories.

Furthermore, journalism at BBC NI also requires a work environment in which every task has to be completed quickly. Although speed characterized journalistic production in the tape-based era as well, it became facilitated and reinforced by the highly sequentialized and routinized tasks embedded in DNI. News homogeneity (i.e., similarity among the structures of most news content) also contributes to making the production processes more effective and is a result of the volume and frequency of stories that the news industry demands (Boczkowski 2010).

However, since DNI's news production operations were subsequently transferred to long-form productions, the results have been mixed. In contrast to DNI's news implementation, which was successfully integrated and automated ahead of schedule, problems have arisen during long-form productions implementation because long-form productions differ significantly from each other. In addition, rationalizing each long-form production genre's creative process into a series of logical tasks has proved to be problematic.

As previously mentioned, one particular challenge for long-form productions with the advent of DNI is the search for video footage in the DNI digital library. For decades, BBC NI's long-form production system had been based on the manipulation and management of visual signs in the form of video content; there was no need to search for visual elements through text-based queries. In general, each type of audiovisual genre had its own rules that had to be organized as a structured event. In most long-form productions, video content is difficult to codify in terms of metadata. The *techno-aesthetic* considerations of the televisual content demand a set of particular rules (Hall 1980). For example, depending on the type of content, different rules are followed in order to structure long-form productions' work practices. The following description of a scene from *Planet Earth's Making Shallow Seas* evinces the complex nature of visual information as well as the *techno-aesthetic* considerations required for a particular type of long-form shooting process:

A one-ton grey shark captured in ultra-slow motion. In real time it will last only a second. It took a high-tech camera designed to analyse car crashes along with split-second timing to capture an amazing glimpse of a predator in action. (Planet-Earth 2013)

A one-second video segment from the *Making Shallow Seas* example requires profound knowledge in order to search through metadata for its specific attributes. Thus, a long-form production, which uses hundreds if not thousands of images such as this one, makes the search for keywords difficult and demanding.

The format of television itself has always relied on a codified structure for iconic signs that look like objects in the real world or that reproduce its conditions (Hall 1980; Bignell 2002). It can be said of certain video scenes that their encoding is much closer to the realm of painting because technical detail is required to analyze each image separately (frame by frame) in order to see how a conjunctive set of images contributes to the video narrative (Flusser 2002). The DNI workflow rationalizes the moving image, rendering video content from a "natural sign" (i.e., extracting or shooting video images from reality) into an "analytical sign" (i.e., codified video

images as information tokens) based on rules and procedures. “Analytical signs” are based on interdependent cognitive operations that reinforce one another (Kallinikos 2010; Farocki 2013b).

I mentioned earlier that video content’s *techno-aesthetic* elements are required for certain fine-grained operations, such as those that comprise most long-form productions. Hence, in contrast to the serialized structure and fast pace of news production, DNI’s long-form productions’ performative patterns are largely based on conjunctive complexes of symbols that require space for interpretation. Even in productions that rely on reused video content found through a metadata search in digital libraries (i.e., historical documentaries), the main performative pattern that contributes to the final story is based on the input provided by the craft editor’s creative considerations and the outcome of the interaction he or she has with other professionals involved in the project. As previously mentioned, long-form producers and craft editors find it difficult to use the search functionality as a means to locate video images and initially did not had any alternative. Through DNI, a craft editor’s relation to the video content over-emphasizes the skills of searching and browsing, limiting the *techno-aesthetic* characteristics of video content that are fundamental to the final output quality in long-form productions.

The changing text-image relationship explains how the management of video content in news and long-form productions demands a distinctive profile of competencies that depend upon an understanding of both genre’s occupational cultures. It also demands technical skills for efficiently navigating the structured and organized processes brought about by DNI.

8.1.2. Limitations in classifying video content in DNI

The work practices in DNI are also dependent on the characteristics of electronic text and digitalized video. Both electronic text and digitalized video are bound to a system

of classification. In *Sorting Things Out: Classification and Its Consequences*, Bowker and Star (1999) explore how systems of classification “build an information environment” and analyze their social and technological aspects. They investigate a diversity of classification systems and organizations, including the International Classification of Diseases (ICD). They mention three limitations in any classification system (Bowker and Star 1999: 107) that I summarize and associate to the work practices performed under DNI:

Data entry as work: No matter how good the classification scheme is, its scope is limited to the fact that data entry is never an easy task and there will always be mistakes or cultural variations (Bowker and Star 1999). In the case of DNI, the metadata entry is limited to the understanding of the person who input it, which might be tainted with omissions or mistakes. Moreover, an individual’s *techno-aesthetic* perceptions or cultural background also play an important part in their understanding of the video content, and therefore, in the way it is classified.

Convergence between medium and message: There are a limited number of technologies for storing information and each faces its own restrictions (Bowker and Star 1999). As is the case with digital video, information is stored using the most current technology (e.g., format, codec). Therefore, as new technical characteristics are introduced and become relevant to the BBC, legacy video content becomes incompatible or at least lack the same characteristics as video content that is acquired with new technology. Earlier content then becomes difficult to identify and reuse due to technological discontinuities, which generates greater dependency on creating new content that complies with the new technical characteristics.

Infrastructural routines as conceptual problems: No knowledge system exists in a vacuum; it must be compatible with other systems. When one develops a standardized system there is a need to create a uniform set of data-gathering and encoding practices (Bowker and Star 1999). DNI is a large-scale system within a larger digital production infrastructure (DMI). Hence, DNI has to connect and relate with other BBC locales and systems. It also must comply with certain large-scale standards that operate under

generalized information and do not take into consideration any local adaptation.

The three aforementioned limitations represent aspects that pertain to DNI, as they do to most other information infrastructures. These characteristics impact the work practices that have emerged in DNI with regard to searching and organizing video content, both in news and long-form productions, respectively. However, the management of a digital video information infrastructure such as DNI also demands understanding the particular characteristics of the digital image-based tokens it carries. I do so in the next section by exploring the manipulation of video through the operation of craft editing.

8.2 Manipulating Digital Video through Craft Editing: A Semiotic Perspective

As previously mentioned, a craft editor has the ability to improve or enhance the *techno-aesthetic* value in an audiovisual narrative and enrich the visual characteristics linked to it. In this section, I use the craft editor's work practices before and after DNI in order to understand the semiotic characteristics of digital video tokens. The following contributions are based on my empirical work, but are also supported by the literature on film and video editing (Murch 2001; Ondaatje 2009; Chang 2011; Goodridge and Grierson 2011; van Oosterhout, van Rossem et al. 2012; Farocki 2013a).

In analogue craft editing (previous to DNI), all audiovisual narratives are composed of different pieces of video (mostly in the form of video shots). The craft editor analyzes the video material available in order to create an intelligible sequence that prefigures the narrative possibilities of the final story (Laurier, Strelbel et al. 2008). This is done through the appropriate use of video editing software packages (i.e., Cinegy, Avid, FCP), but also via a series of work practices. In terms of work practices, participation and collaboration is performed mostly during the planning and

editorial stages. The process of collaboration retains strong elements of craftsmanship performed in the times of ancient workshops, when teamwork began to emerge as a social practice (Sennett 2012). Before and during craft editing, there are certain aspects that enable the development of the video scenes into a narrative, such as screenings, discussions, repeated rewinding of tapes, meetings, and note-taking (Murch 2001). The craft editor is one of the few people working on the production of an audiovisual narrative that does not know the conditions under which the material was shot. However, craft editors have a fundamental influence on the final story. Craft editors can be seen as a hinge or an interface between the shot material (based on the initial idea or script) and the final story that is delivered to the audience.

One of the initial tasks craft editors perform is the reviewing of the material (in the form of video rushes or shots) in order to learn more about it. At BBC NI, several interviewees indicated that shot reviewing was one of the most creative moments of the editing process, as it helped craft editors familiarize themselves with the material (Murch 2001; Ondaatje 2009). Generally speaking, shot reviewing is a central moment in which “*an array of preceding and subsequent editing practices*” are performed in a repetitive way (i.e., the capturing of clips, logging, rewinding, playing, stopping, forwarding, repeated previews of the same shot) (Laurier, Strebel et al. 2008; Farocki 2013b). The reviewing process is also the moment for alternative interpretations of the original script to emerge; it could be even considered as an “exit strategy” for editors to deviate from the initial idea and seek a different route. The Oscar-winning film editor Walter Murch addresses this cognitively enabled creative process, stating:

You are learning something new about the material as you search for what you think you want. You are actually doing creative work and you may find what you really want rather than what you thought you wanted. [...] You familiarize yourself with the material, but it becomes particularly valuable in the recutting, where your original notes—heavily influenced by the script—become less and less useful as the film finds its own voice. (Murch 2001: 47)

As a contrast, in DNI, the reviewing stage is no longer based on rewinding or fast-forwarding the video material, as this process has generally been replaced by the search functionality. Search as a function means looking up something that one thinks one is looking for, or rather, looking for what one thinks one needs (Murch 2001). The mediator between the video content and the search functionality is codified text of a particular type: metadata that describes the shot and its technical characteristics (Laurier, Strebel et al. 2008). Metadata is produced by media managers through computer-based systems or by algorithmic and automated procedures, and is thereby prone to possessing one literal meaning.

However, during DNI's craft editing, the shot reviewing process is performed by editors in a fairly random fashion; there is no sequence in the way editors search for a selection of shots. It is important to consider two issues related to the shot reviewing process: First, the image as a cultural artefact (in both news and audiovisual narratives) is different from codified text. Browsing for a video image is a complex act that differs from searching for a video through metadata. Video images are a conjunction of inseparable elements that "reach the human eye" (Goodman 1976). The conjunctive character of video images means that its elements are not decomposable and independently analyzable, as it is made of a series of images whose meaning requires multiple visual scans. In semiotic terms, one could claim that the image as an entity has a paradigmatic organization (images are selected and compared not necessarily consciously) but not a syntagmatic one (images are not necessarily organized as a sequence) (Saussure 1974; Bignell 2002). Second, audiovisual craft editing is never a linear process; it is accomplished through a series of unpredictable tasks. Streamlining any kind of unpredictable task into concatenated procedures, such as DNI, or selecting video content through its metadata would destroy the art and craft of editing practice.

Software packages such as Cinegy are made to "*classify, order, process, store, retrieve transfer, and control data and information*" (Kallinikos 1999: 263); however, they cannot organize the shot reviewing process of video content in the same way

craft editors do. The work of craft editors is based on the arrangement of an inseparable complex of image tokens. Craft editing entails both paradigmatic analysis (comparing selected video images, not necessarily consciously, to alternative shots) and syntagmatic analysis (comparing video images with preceding and following shots) (Saussure 1974; Barthes 1977; Farocki 2013b). In semiotic terms, one could claim that digital images are composed of both syntagmatic and paradigmatic structures: as much as syntagmatic structures redefine and organize the sequence of work, paradigmatic structures reinforce the need to work collaboratively and resist the linear definition of order.

Video editing systems achieve most of their speed and automation from the ability to retrieve the requested material instantaneously, either by selecting (browsing) or searching for it. In DNI, this task is seen as one that would allow craft editors to work effortlessly. Instant access depends on knowing exactly what target one is looking for, which originates from metadata. However, many craft editors do not possess the verbal skills to describe an image through text. Their explicit awareness comes from visual patterns found through the extensive reviewing of video shots (Farocki 2013b). In many cases, limiting the reviewing process to the use of the search functionality may not exercise or demonstrate the creative talent and visual imagination that craft editors possess. Reviewing is based on discovering what one needs, without previous knowledge of what that might be. By contrast, searching is only useful when one knows what one is looking for. Hence, the reviewing and searching processes depend on how the craft editor's cognitive patterns relate text with images since the cognitive processes of reading images is quite different from reading text.

Linear viewing presupposes that video be reviewed through rewinding or fast-forwarding, which is a more natural process in terms of image inspection than searching for video in the digital library. The development of an audiovisual narrative requires an exhaustive review of the shots available in order to use the material to the fullest extent. Therefore, for long-form productions, DNI's craft editing process became difficult to automate, speed up, or streamline. Good craft editors need to review rushes several times in order to get an adequate and evolving perception of the

video material (Murch 2001; Ondaatje 2009; Chang 2011; Goodridge and Grierson 2011; Farocki 2013b).

Issues related specifically to the DNI workflow have also limited the work practice of creative craft editing. DNI divides the craft editing process into a sequence of concatenated tasks, which has prompted two major problems. First, the audiovisual narrative has been understood as a final phase of a process that depends heavily on a script and a pre-defined structure of the content centered around the producers' initial shot selection and pre-editing as well as in an automated and sequentialized process. This might not have been the best way to ensure the quality of the final story since the craft editors make important contributions in the very process of reviewing the shot material. The DNI workflow does not reflect the grammar of complex interactive exchanges that occur during the production of news or audiovisual narratives. In addition, by streamlining the workflow, DNI reduces the number of opportunities for teamwork, discussion, and collaboration, which are the most creative instances that occur during the production of an audiovisual narrative. DNI attempts to reduce the craft editing process into a sequence of codified tasks. However, being a compound of multiple and varied genres, the long-form is virtually impossible to confine within a "one-size-fits-all" streamlined workflow.

Furthermore, craft editors create an audiovisual narrative by taking into account the language of the particular genre. This is done in order to elicit an audience response (Barthes and Heath 1977). In film, and particularly in the DNI's long-form productions, one shot could offer different readings depending on the sequence of shots surrounding it. Filmic syntagms are not confined to the sequencing of shots, but include other specific semiotic aspects that also contribute to the audiovisual narrative (such as cut, fade, dissolve, and wipe). It is during the editing process that each of the scenes and the structure of the audiovisual narrative as a whole are defined and described. BBC NI craft editors write the description for each scene that would then be used in a logbook. The logbook can be interpreted as a personalized tagging system specifically tailored for each audiovisual narrative. Each scene's description is then part of a particular intimate knowledge of the video content, since much of the

editing process requires fitting together different scenes in order to construct a narrative. Thus, craft editors do not deal with moving images through rule-based systems or searchable syntagmatic routines like the ones deployed in DNI. Their way to analyze, use, and manipulate video content is not analytic or rational, but based on experience and intuition.

8.2.1 Understanding Digital Video Objects as Cultural Artefacts

In the previous paragraphs, I presented a description of how the semiotic character of the image (both the paradigmatic and syntagmatic dimensions) constructs a video narrative. However, semiotic tokens are not the sole influence on video narratives. As mentioned in section 8.1, situated practices within each genre or type of production are also fundamental to the development of a cultural artefact in the form of a video narrative. Those work practices are based on interactions and communications that are embedded in occupational cultures. Occupational cultures influence the way in which video narratives are built, regardless of the impact of the DNI workflow. The occupational cultures of both news and long-form productions, though quite distinctive, are profoundly institutionalized and have well-established values, skills, vocabularies and identities (Barley and Van Maanen 1984). The video narratives constructed for both news and long-form productions depend not only on the semiotic elements, but also on the non-semiotic occupational cultures within each particular genre.

Figure 21 illustrates how the semiotic characteristics of a digital video object (both its paradigmatic and syntagmatic dimensions) influence the video narratives that result from long-form and news production work practices. The figure also indicates a profound interaction between the actual construction of video narratives and the occupational cultures within each particular televisual genre that shapes the final news or audiovisual narrative. Thus, news and audiovisual narratives are complex constructions developed through distinctive work practices that carry strong

occupational cultures (e.g., news, film, documentary) and are impacted by the semiotic constitution of image-based technological artefacts in particular ways.

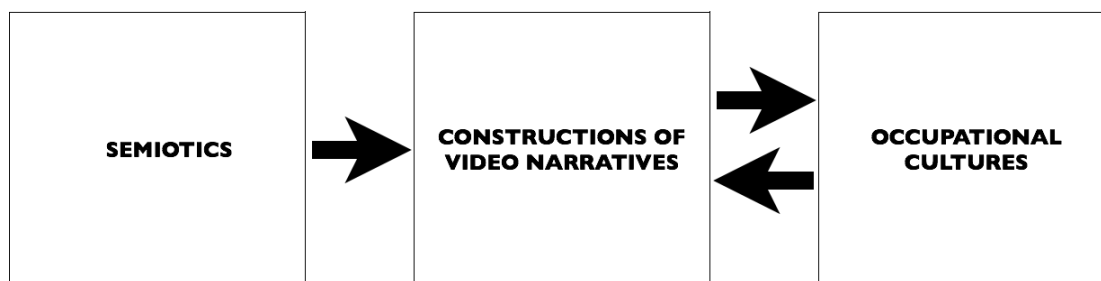


Figure 21: The influence of semiotics and occupational in the shaping video narratives

In the following paragraphs, I analyze the particular syntactic and semantic aspects of the digital video object in detail and describe how its manipulation throughout the DNI workflow constitutes it as a bipartite semiotic artefact (Goodman 1976; Kallinikos 1993). By separating the syntactic and semantic units of digital video objects, my intention is to define the object in terms of a non-ambiguous grammar of shared entities and rules structured by its visual signification.

DNI's technical infrastructure provides rules, formats, and standards that enable the interoperability of digital video. Additionally, digital videos' metadata is based on syntactic units that are often disjointed, enabling the interoperation of video content through literal meaning. In order to be interoperable, digital video objects' technical and descriptive layers are based on data structures that are compatible with other digital video objects.

Conversely, visual narratives' layers of digital video are based on a semantic organization (both of a paradigmatic and syntagmatic nature) that cannot be disjointed as they are embedded in order to produce a particular meaning. The BBC owes its video content quality to its *techno-aesthetic* attributes that are a central part of the final video narrative. In contrast to metadata or other rule-based tokens founded on information management and technical infrastructure layers, visual narratives cannot

be recombined or interoperated without losing the specific meaning they convey. Visual narratives are not based on standard or syntactic tokens, but are based on conjunctive structures that are the outcome of particular video shots and the decisions provided within a specific occupational culture.

Furthermore, genres exist within the realm of occupational cultures that are by no means static. Therefore, as cultures of productions evolve, the metadata assigned to delineate certain genres might well lose its significance in the future (Bowker and Star 1999). In his seminal work *Television: Technology and Cultural Form*, Raymond Williams (2003) states that the combinations of genres (i.e., news, argument and discussion, education, drama, films, variety, sports, advertising, documentaries) constantly create new hybrid genres and subgenres.

Figure 22 (next page) illustrates how digital video is manipulated through its referential status (its technical and descriptive layers); it also expands some of the concepts presented in chapter 3 (Figure 4) in relation to the types of layers of digital video objects (i.e., technical and descriptive layers, visual layers). Digital video objects, when interoperated or manipulated through syntactic processes, are rendered as machine-enacted rules, which may elude some of the most notable and valuable aspects: the signification of their visual layers. Therefore, conceptualizing digital video objects demands a definition of their particular structure based on their semiotic attributions and visual signification. When delving into digital video as an information object, it is important to consider not only its syntactic organization based on descriptive and technical layers, but most profoundly, the characteristics of its visual layers, which are based on paradigmatic, synchronic, and conjunctive attributes that are not interoperable through syntactic processes (Saussure 1974; Goodman 1976).

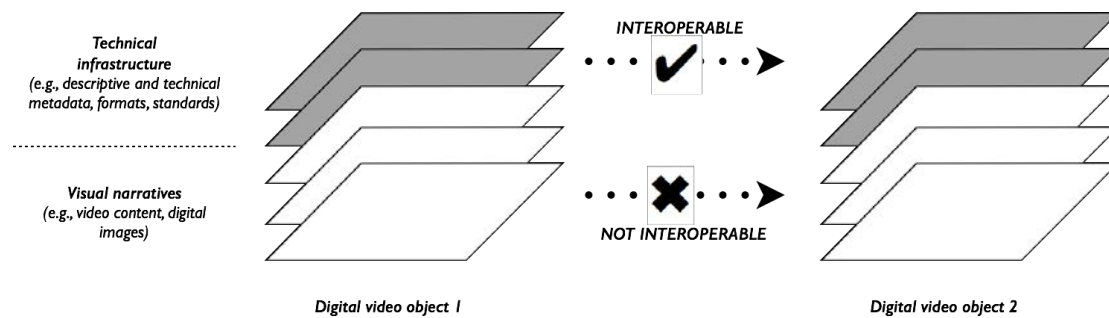


Figure 22: The interoperable and non-interoperable layers of digital video objects

The digital video objects used for news production at BBC NI have a systematized structure. As mentioned earlier in this chapter, the world of broadcast journalism is extensively standardized and the structures of news stories are based on syntactic characteristics that are relatively homogeneous. The ability to search, edit, reuse, and remix short clips from different sources in a digital library is dependent upon high-quality metadata that describes the archived digital assets. Selecting video content for reuse is a work practice that has been well documented over the past two decades as being common in broadcasting newsrooms (Küng-Shankleman 2000). In the news tradition, time constraints required a production process that streamlines the relation between news scripts and associated video pieces in order to compose a final news story. The success of news-oriented broadcasters is also contingent upon abundant reuse of these visual elements. As in the case of many news providers (e.g., CNN, Reuters, AP, AFP), DNI offers journalists an increasing range of reusable visual elements in the form of photographs, infographics, or video content.

In the realm of semiotics, the difference between verbal and visual media is the difference between a symbol (an arbitrary conventional sign) and iconic sign (which signifies the sensuous resemblance of what it stands for) (Jappy 2013). In that sense news and printed media follow a similar structure based predominantly on the symbolic nature of written text rather than on the realm of the visual. In the case of TV news stories, those written scripts (texts' structures) are then associated to visual images (verbal signs, read as arbitrary symbols composed by literal meaning). When one hears and sees a TV news story, the voiceover, which describes the news

narrative, relies on a written script that, in turn, organizes the way images are arranged. Sports news is quite the opposite: the voiceovers are based on what the images are showing. Thus, iconic signs are scanned immediately after an occurrence at that very particular moment to be translated into text-based representations. However, in both situations the resemblance to the world is based on literal (i.e., text-based) meaning (Mitchell 2010).

Long-form video content, as I discussed earlier, does not come from a culture of searching or reusing content. In the long-form production world, a large amount of data translates into a vast number of hours of video content that has to be logged, indexed with the appropriate metadata, and reviewed repetitively. The interoperable character of digital video in long-form productions only generates value for a production team when it shares common visual significations. For example, a documentary in which a team of producers searches historical footage in the digital library has a very different value and culture of production than a complex endeavor like *Animal Planet*, which was five years in the making and required that different teams dedicate months to traveling across the globe. Thus, in long-form productions, work practices have been intimately related to the strong occupational cultures from which each particular production emerged.

Forms of signification based on digital video content in long-form productions cannot accommodate DNI's demand to organize image-based information through syntactic processes enabled by metadata. Metadata may not always bear an intrinsic relationship to what it signifies; it primarily provides the means to describe and organize information in a standardized way. Therefore, the long-form video content is far from the neat world of routinized processes that DNI originally intended. In long-form productions, digital video becomes a meaningful audiovisual narrative through the new knowledge that emerges from the semantic contextualization (paradigmatic and syntagmatic) of the reviewing process, face-to-face interaction, collaboration, and other communicative processes that cannot be automated through the DNI workflow.

8.3 Digital Video Narratives: Confluence and Tension Between Semiotics and Occupational Cultures

Thus far, I have analyzed the semiotics of digital video in order to provide an understanding of how its image-based properties are fundamental to the complex operations of the DNI workflow. Table 5 (page 214) summarizes in detail what I have described in terms of the characteristics of both news and audiovisual narratives (long-form) respectively, and how these are produced through the interaction of both their semiotic and occupational cultures.

Video narratives are based on a complex combination of linguistic signs and are represented both by their syntagmatic and paradigmatic dimensions (Barthes 1977) along with the occupational cultures embedded in news and long-form productions, respectively. The DNI workflow has introduced the possibility of arranging video items in a digital library through a list of video items that can be organized in an unlimited number of ways and are represented through a cause-and-effect trajectory. As Manovich (2001) states, new media reverses the semiotic relationship of cultural audiovisual narratives: the database is given a material existence and pervades our reality through the manipulation of digital tokens rendered in computer screens, or as I have argued, in a media ecosystem.

New media's reversal of the semiotic relationship of cultural audiovisual narratives in DNI is partially true if the nature of browsing or reviewing new media artefacts is based solely on their metadata and the use of the digital library. However, during the craft editing process, digital video objects are manipulated in a timeline that forms an audiovisual narrative marked by strong conjunctive elements. Hence, the meaning through which a video shot is indexed *a priori* (i.e., metadata, computational aggregation, or interface to a database) is diminished as the paradigmatic and syntagmatic dimensions are exercised throughout the complex interactions during video editing. Such a work practice occurs in both news and long-form productions, even if each will produce different types of video narratives. As paradoxical a phenomenon as it might seem, the same work practice can be extended to the way most internet users search for online video content (i.e., YouTube, Vimeo) and remix

digital video to form new hybrids based on paradigmatic, synchronic and conjunctive dimensions.

Type of Production	Semiotics	Video Narratives	Occupational Cultures
News productions	<ul style="list-style-type: none"> - Tagging and describing images as metadata. - Video browsing and searching in the digital library through metadata. - News semiotic homogeneity: standard structure for most journalistic production. 	<p>News Narratives</p> <ul style="list-style-type: none"> - Images follow mostly verbal descriptions. - Intensive reuse/remix of video content. - Similarity brought about by high volume and frequency of news production. - Composed of small video fragments. - Highly sequentialized and routinized. 	<ul style="list-style-type: none"> - Division of labor is simple and structured. - Delivers short news narratives (in terms of duration). - Work environment promotes instantaneity: the fast culture of televised journalism. - Multi-skilled journalists.
Long-form productions	<ul style="list-style-type: none"> - Difficult to browse or search through keywords in order to find a particular video scene. - Complex combination of linguistic signs. - Linear and extensive reviewing of shots (paradigmatic and syntagmatic dimensions) 	<p>Audiovisual narratives (long-form)</p> <ul style="list-style-type: none"> - Complexity of editing (many people collaborating). - Impossible to organize each genre's creative process into tasks. - Complexity in defining technical and aesthetic aspects (<i>techno-aesthetic</i>). - Conjunction of symbols creates a space for interpretation. - Highly sophisticated technical detail in every image. 	<ul style="list-style-type: none"> - Distinctive cultures of production for each long-form genre. - Specific equipment and productions techniques required for each production. - Unanticipated and contingent production decision-making. - Intuitive expertise and tacit knowledge. - Group collaboration and face-to-face interaction and communication. - Focus on creative and artistic considerations (e.g., the work of craft editors).

Table 5: Characteristics of both news and long-form productions in terms of semiotics, video narratives, and occupational cultures

9. The management of Digital Video as a Cultural Artefact

McLuhan declared that the “electric media” of the twentieth century—telephone, radio, movies, television—were breaking the tyranny of text over our thoughts and senses. Our isolated, fragmented selves, locked for centuries in the private reading of printed pages, were becoming whole again, merging into the global equivalent of a tribal village.

—Nicholas Carr, *The Shadows* (2010)

In this chapter I seek to analyze the paths by which digitalization affects work practices at BBC NI by the use of digital video through the digital production infrastructure of DNI. To answer this question I divide this part of the analysis in two paths of inquiry: First, I explain the technical infrastructure of DNI as it is built upon standards and applications, and address the new work practices required to support it; Second, I discuss the impact of DNI in BBC NI by analyzing three perspectives on organizational change.

In section 9.1, I begin by analyzing the shift in the broadcasting industry’s infrastructure from a set of loosely coupled electro-mechanical equipments toward a unified computational system implemented through DNI. I discuss how the management of video participates in the evolving infrastructure based on the convergence of developments in technology and media industries. I use the generative model proposed by Jonathan Zittrain (2008) to make sense of and analyze the digital infrastructure of DNI; the lower layers of the generative model are the foundation of this part of the analysis. The main objective of this section is to illustrate the components that are required for the implementation of DNI’s technical infrastructure as well as to differentiate infrastructure-based artefacts from culture-based artefacts. Furthermore, I illustrate how DNI’s technical infrastructure also has impacted work

practices at BBC NI.

Section 9.2 analyzes how DNI has affected the work practices of BBC staff by presenting three complementary perspectives on organizational change. I first delve into the importance of intuitive expertise and mutual adjustment (Mintzberg 1983), particularly in the case of long-form productions. Second, I analyze the distinctive modes of interaction between professionals and digital video content in both news and long-form productions, respectively. Third, I make a comparison between news and long-form productions' usage patterns.

Section 9.3 summarizes my findings from chapters 8 and 9 by illustrating the importance of the semiotic characteristics of video and how it impacts news and long-form production work practices differently. The impact on work practices in the way video is managed as an image-based information artefact throughout the DNI workflow is due to both occupational cultures and technology (semiotics) as constitutive elements for the construction of video narratives.

9.1 DNI's Digital Infrastructure: From a Legacy to a Generative Model

For more than a century, the broadcasting industry was accustomed to expensive turnkey solutions that were highly specialized and compartmentalized, as I mentioned in chapter 2. Hence, the management of these artefacts required experienced broadcasters with certain skill sets and training. Experts such as broadcast engineers were capable of recognizing a broad range of problems with the hardware they used as part of their daily routines, which required a hands-on approach to the management or repair of hardware (Zuboff 1988; Dreyfus and Dreyfus 2000). Traditional broadcast engineers were accustomed to working with a few specialized systems and most of these types of equipment were based on electro-mechanical components that depended on replaceable parts. Broadcast engineers at BBC NI employed what Zuboff

calls “action-centered” skills that resulted from direct engagement and physical activity (Zuboff 1988).

Action-centered skills are learned through practice and the acquired knowledge leaves no physical trace once a task is completed. The experience broadcast engineers acquired was developed over years of specialized training and empirical knowledge about an artefact (or sometimes, even with a particular brand of an artefact). They developed a deep and insightful knowledge about the artefact they operated, based on a persistent problem-solving experience that required little abstraction (Mintzberg 1979; Dreyfus and Dreyfus 2000). In the traditional broadcasting world, some broadcast engineers developed a close or even empathetic relation with “their” particular machines, which was reinforced by the oral culture of informal conversations about the mechanical constituencies and particularities of each artefact. Empirical knowledge about one artefact or brand of artefacts resulted in the ability to improvise, which enabled broadcast engineers to resolve specific issues in an efficient manner. The ability of a specialist to identify certain problems with electro-mechanical solid machines (and detect possible solutions for them) is articulated by filmmaker Walter Lenertz. He states, *“I recognize immediately if they [the cameras] are feeling well or if something is not right. Small noises sounding a little different, maybe all that is needed is a bit of nose grease, the main means of running them”* (Lenertz 2011). Like a filmmaker with a long history of working with a camera, broadcast engineers could also detect the ailments afflicting their tape-based equipment.

The history of video production in the media industry evolved from a compound of electro-mechanical technologies that worked effectively in silos toward an integrated digital production infrastructure. Analogue broadcasting equipment was being phased out for years as the result of several consecutive technical developments, but its definitive obsolescence was manifested in BBC NI when DNI was first deployed. Broadcast engineers soon realized that most of their specialized skills were superfluous. The DNI digital infrastructure is mostly abstract and invisible as it is dominated by software packages grounded in the management of information. In the

following paragraphs, I discuss DNI in terms of its digital infrastructure and how it impacts the work practices of broadcast engineers and technologists at BBC NI.

DNI was intended to be a flexible technical infrastructure capable of supporting future media services; hence, it is to be managed accordingly, taking into consideration the complex compound of both digital video content as well as its surrounding and interoperating software-based processes. Problems that might arise in the software-based digital infrastructure cannot be dealt with in the same way as in the former analogue broadcasting environment. There is not necessarily a straightforward way to locate the problem's source, especially due to the fact that DNI is based on several pieces of software services running simultaneously in complex infrastructural formations (Star and Ruhleder 1996). Hence, working in a tapeless environment like DNI requires a systemic view of the whole digital infrastructure process. The broadcasting skills required for DNI are based on support, planning, and monitoring as well as on the management of information (Kallinikos 2011). Also, the tasks in DNI are automated on a large scale. They are chained together in routines and sequences for acting-upon information in order to accomplish a desired outcome (Zuboff 1988; Kallinikos 2010). In DNI, detecting and servicing problems requires approaching the entire interconnected system, which differs greatly from problem-solving methods for singular electro-mechanical machines in the previous analogue environment.

The process of phasing out analogue broadcasting platforms in favor of a digital infrastructure has rendered human work into a series of sequentialized tasks that attempt to resemble the skills of broadcast engineers. During the process, some forms of work are removed in favor of new ones that are necessary to manage the new technological infrastructure (Barley 1996). Unified computational systems resemble the evolution of the computer industry as it is illustrated in the generative internet model proposed by Jonathan Zittrain (2008). The generative model is preceded by the early IBM service model of selling mainframe systems as a bundle of hardware, software, and maintenance services (Zittrain 2008: 12). The legacy analogue broadcasting technologies resemble the bundled computer technologies (software,

hardware, and services) that offer a limited range of technical capabilities because they fulfill very narrow or specialized purposes. However, as made evident in the case of the IBM service model, *appliancized* solutions are inflexible and limited to solving specific problems in industries in which processes were clearly defined, limiting external innovation (Tilson, Lyytinen et al. 2010). In contrast, Zittrain argues that the openness of the personal computer and its separation of hardware, operating system, and application layers fostered flexibility and a community of third-party developers who generated constant innovations (Yoo, Henfridsson et al. 2010). Zittrain uses the generative model to explain the evolution of the internet ecosystem, which is based on a modular and open platform of technological standards. I apply Zittrain's model of the generative internet to describe how bundled computer technologies bear similarities to broadcast environments and to explain the evolution from *appliancized* solutions to digital infrastructures. The DNI workflow was established as a complex digital production infrastructure composed of layers of co-existing and evolving standardized technologies.

Similar to the service-based "IBM business model", the broadcasting industry depended on a limited group of specialized vendors that offered turnkey solutions by bundling hardware, software, and maintenance (e.g., Avid, Sony, Panasonic, etc.). By having turnkey and proprietary solutions that were not interoperable, broadcasters were slow and limited in their ability to incorporate new technologies; indeed, their vendors prevented it. However, as the internet expanded, convergent digital platforms began to emerge, enabling the production and consumption of media via multiple platforms and various forms (Jenkins 2006). The internet forced turnkey manufacturers to work with open standards by unbundling their services and using interoperable technologies. Concurrently, the new digital environment prompted the growth of small third party developers who created software packages based on open standards that did not depend on the specific hardware sold by turnkey manufacturers, as is the case of Cinegy. Software and open standards assembled the layers of a constantly expanding and evolving ecosystem of media technologies. The DNI workflow was conceived as a unified computational system flexible enough to allow the integration of new software and hardware developments, as long as they were

based on DNI’s standards that enabled interoperability.

Figure 23 illustrates an interpretation of Zittrain’s generative internet model as applied to DNI. The bottom rung contains the “standards layer”, which is based on the video codecs, formats, and other technical standards that are necessary, at an elementary level, for any digital video asset to be ingested and managed in DNI. The subsequent level contains the “application layer”, which consists of the video management software as well as the hardware such as PCs, hard drives, servers, and camera manufacturers. The application layer is based on open standards that enable the interoperability of both hardware and software systems. Software packages are an essential addition to the application layer because they led the broadcasting world from bodily and action-centered skills based on hardware to the management of abstract and cognitive processes based on software (Zuboff 1988; Kallinikos 2010).

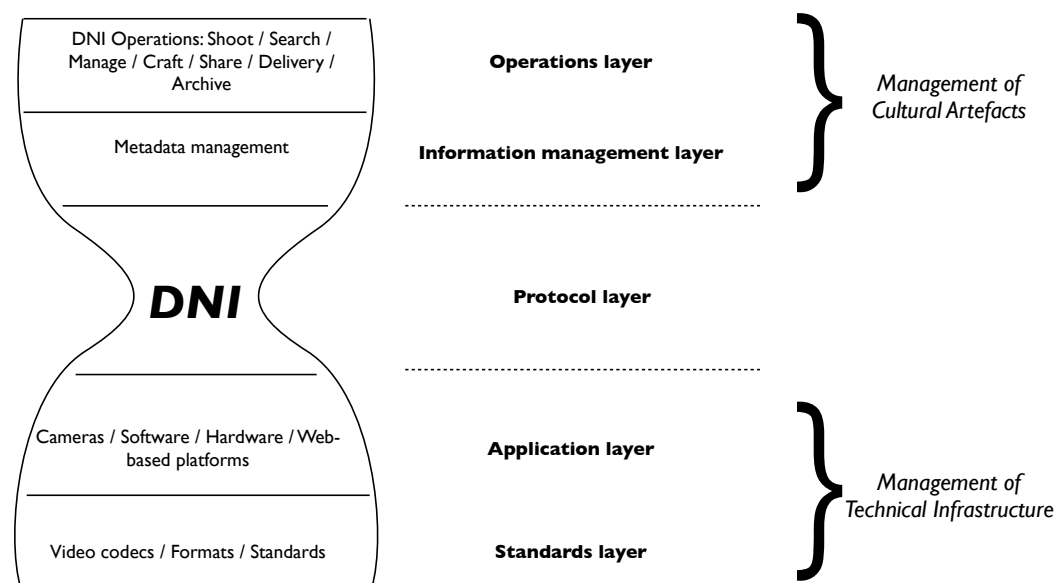


Figure 23: Hourglass architecture: DNI’s generative model

(based on Zittrain 2008)

The bottom layers of DNI's generative model illustrate that the management of DNI's digital infrastructure required a new set of skills from the BBC staff working with this complex assemblage of software, hardware, and services. It is also fundamental to note that in any open model, such as DNI, enabling more flexibility (i.e., interoperability) comes with the cost of reduced stability. Hence, new skills were required for monitoring and analyzing the technical processes (i.e., standards, applications) that supported the flow of digital video content throughout DNI. The technologists' primary role was developed to create and maintain the infrastructure that enabled the upper layers of DNI to work technically seamlessly (Barley 1996). These skills required conceptual reasoning from BBC staff with regard to the potential problems that might occur and the possible solutions. Since it was no longer sufficient to have knowledge of a specific type of hardware or software, managing DNI's infrastructure required a systemic view and an understanding of how the different components of DNI might interact as part of the unified workflow. The digital infrastructure remained the domain of technologists, not ordinary users. Therefore, the structured tasks of monitoring and analysis sharpened the *"awareness of the effect that one's actions may have on others and indirectly on oneself"* (Kallinikos 2004: 9). The aforementioned skills required for the use and management of DNI's technical infrastructure helps to illustrate why new roles were introduced in several stages of the unified workflow. Technologists (i.e., technology engineers) based their newly established roles on extensive planning and an understanding of the complexity involved in customizing the DNI infrastructure for particular types of video productions.

In Zittrain's model, the top two layers ("information management" and "operations") are responsible for managing cultural artefacts in the form of video content. When the amount of image-based content exploded, the value of video content came to rely on its findability. The "information management" layer consists of the ways BBC staff were able to input, search, or manage digital video content in the form of metadata. Metadata enabled the large-scale deployment of DNI, bringing uniformity to the disparate ecology of application and management techniques that populated BBC NI (Kallinikos 2004; Kallinikos and Mariátegui 2011). Finally, the "operations layer"

represents the tasks and operations that BBC staff could actually perform by way of off-the-shelf software packages, such as Cinegy. These two top layers of DNI's generative model (information management and operations, respectively) include most of the new skills and work practices that are now required for the use and management of digital video, as described in chapter 7.

9.2 The Impact of DNI in BBC NI: Three Perspectives on Organizational Change

The use and manipulation of digital video content (e.g., reviewing, editing, scheduling, etc.) presupposes a streamlined and smooth workflow provided by DNI's technological infrastructure. In order to understand how work practices have been affected by DNI's workflow, I study three complementary ways on organizational change. The first describes how video productions require coordination mechanisms supported by mutual adjustment. Second, I describe DNI workflow in terms of the modes of interaction between professionals and digital video content. Finally, I compare news and long-form productions' usage patterns.

9.2.1 Intuitive Expertise and Mutual Adjustment in News and Long-form Productions

Throughout the empirical description, I discussed the importance of intuitive expertise in relation to the work performed in long-form productions. Dreyfus and Dreyfus's (2000) description of expert systems versus intuitive expertise offers an interesting case for comparison with the work practices in news and long-form productions:

We have found that in domains where a person can function without calling upon the full range of his natural language understanding, common sense, know-how, and ability to adjust to unanticipated changes, expert systems can competently perform tasks that would normally be

described as requiring judgment and wisdom. (Dreyfus and Dreyfus, 2000: 117)

Taking this perspective into consideration, in DNI news production, the standardization of skills indirectly has brought about the standardization of working processes that journalists are able to control and coordinate with ease. On the other hand, long-form production processes require a different approach. Instead of starting with standardization, it must first be determined whether the skills of the long-form production team can be streamlined or standardized into tasks or not. In most cases, long-form editors and producers work intuitively, understanding and deciding based on their past experiences (occupational culture) of what did and did not work (Dreyfus and Dreyfus 2000). In my research on long-form productions, I found that different professionals that participate in the conception and production of a video story interact with each other in such a way that cannot be standardized into tasks. Complex social interactions like the ones involved in long-form productions fulfill duties that reflect a variety of experiences and skills, which are assembled into what constitutes the work practices particular occupational cultures induce (March and Olsen 1989; Kallinikos 2006).

In complex organizational settings, where outputs cannot be standardized, the process of organizing must “*favor the simplest yet most adaptable coordinating mechanism: mutual adjustment*” (Mintzberg 1979, 1983). Henry Mintzberg (1983) defines *mutual adjustment* as a particular mode of coordination occurring when it is not possible to organize work practices according to a linear sequence. The process of organizing long-form craft editing work practices fall under the category of *mutual adjustment* since the professionals involved must coordinate work through face-to-face interaction and informal communication. Mintzberg outlines the complex nature of *mutual adjustment*, stating:

Control of the work rests in the hands of the doers. [...] But at the outset, no one can be sure exactly what needs to be done. That knowledge develops as the work unfolds. So in the final analysis, despite the use of other

coordination mechanisms, the success of the undertaking depends primarily on the ability of the specialists to adapt to each other along their uncharted route. (Mintzberg 1983: 4)

Mutual adjustment comes naturally to DNI since craft editors and long-form producers generally like to work side-by-side with others (i.e., technical assistants, cinematographers, special effects specialists), collaborating in small groups. Working side-by-side and adapting informally to one another is part of their work practice. The work practices based on planning or editing phases, such as giving opinions on the quality of a shot or the sharing of responsibility, usually involves work with a higher level of uncertainty that is impossible to preplan or divide into predictable tasks. Since the predictability of the task is a basic conditioning variable in the choice of organizational forms, Galbraith (1973) mentions that uncertainty ought to be seen as “*the relative amount of information that must be acquired during task performance. It is relative to the amount of information required and the amount already possessed by the organization*” (Galbraith 1973: 5).

Therefore, to reduce uncertainty (the relative amount of information that must be acquired during task performance) requires pre-planning or introducing a sequentialized order or workflow. Such is the case of news production, where there is less uncertainty since journalists’ work practices promote a sequentialized arrangement between tasks and standardized procedures. A sequentialized arrangement between tasks is defined as a *mechanistic model*, where the functional tasks compose a linear workflow. As part of their work practice, multi-skilled journalists work largely on their own to create, edit, and deliver a news story in a fairly standardized way. They do not require coordination with others. When the task is very similar and there is no need for coordination with other people or departments, the level of information processing is reduced; therefore it also reduces the level of uncertainty surrounding the task.

In conclusion, certain work practices can only be automated and standardized when a video narrative is homogeneous and can be reproduced in a similar way, as is the case

with news production. Thus, the news production process in DNI is based on standardized procedures that are organized around the work practices of a multi-skilled journalist who is able to handle most of the news story creation on his own. Conversely, long-form productions' work practices rely on complex interactions based on side-by-side collaboration and adapting informally to one another's opinions and contributions. Long-form productions' particular mode of coordination cannot be organized according to a linear sequence; thus, *mutual adjustment* is required in order to coordinate the work practices through face-to-face and informal communication.

9.2.2 Modes of Interaction between Professionals and Digital Video

Content

Barley (1996) mentions that since technology, work, and organization coevolve, it is difficult to untangle the cause and effect that a particular technology might have on work practices. A way of analyzing the impact of technology will require the understanding of how different actors deal with the same technologies and what those actors share as common signs of belief (Garfinkel 2008; Rawls 2008). In this section, I analyze the different ways digital video is manipulated in both news and long-form productions respectively. I do so by illustrating the interaction between media professionals (users) and the technology (digital video object) they manipulate.

Figure 24 (next page) illustrates the context surrounding news and long-form production interactions between the digital video object and the users that participate throughout the DNI workflow. The news production interaction with the digital video object is largely based on an individual and direct interaction. Quite the opposite occurs in long-form productions in which several professionals take part.

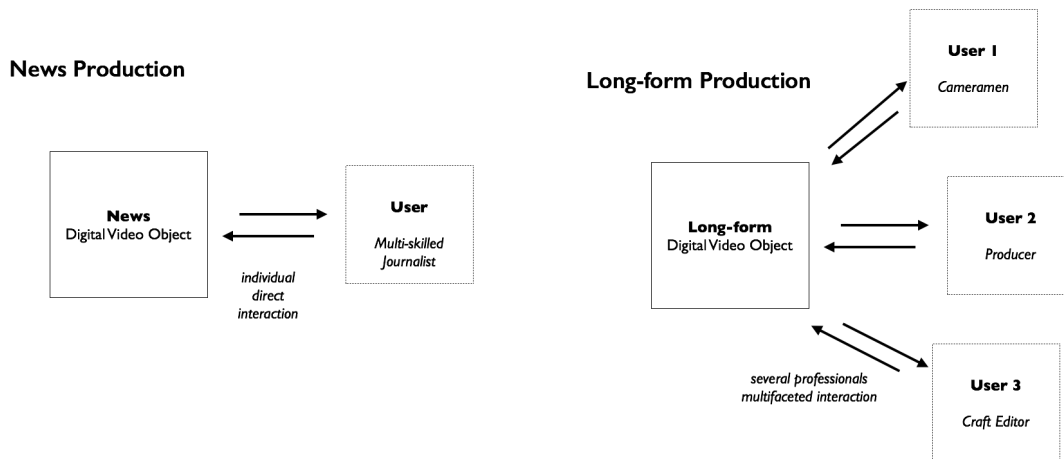


Figure 24: News and long-form productions in the context of the interaction between the digital video object and its user(s) throughout the DNI workflow

The different nature of the interactions that a digital video object might have depends of the type of production of which it is a part. In the case of news production, the work is largely performed on an individual level by the multi-skilled journalist. Therefore, the complexity involved in managing and interpreting (inferring) the digital object is substantially reduced. By contrast, long-form video manipulation requires *mutual adjustment* among the diversity of participating users so that they may need to adapt to one another on a social level (Mintzberg 1983). Mintzberg (1983) claims that “*sophisticated problem solvers facing extremely complicated situations must communicate informally if they are to accomplish their work*” (Mintzberg 1983: 7). In the tape-based environment, long-form productions professionals (e.g., craft editors, producers) relied on work practices that encouraged face-to-face interaction and communication, which contributed to the management of the complex nature of video manipulation. In addition, depending on the genre, a heterogeneous array of professionals would collaborate side-by-side on a given long-form production and provide their expertise throughout the DNI workflow. For example, as I described in chapter 7, when a producer shoots or pre-edits a digital video object, he or she interprets its content in his or her own way. When the digital video object is subsequently ingested in the DNI workflow in order to be edited by a professional craft editor, there is a possibility that the shots or the pre-edits might not be what the craft editor expected to receive. This is because in most cases, the producer selects the

pre-edits individually, with no participation from the craft editor. Previously, the process of reviewing and ingesting the material was done by the producer and the craft editor. In order for the participating professionals to negotiate meaning, face-to-face interaction and communication are of utmost importance.

The type of interaction among users in both news and long-form productions can help to clarify the complex nature of the DNI workflow and how it relates to past and emerging work practices. In news production, the interaction of a single user with the digital video object (through its metadata) reduces the number of people involved in the decision-making process to a minimum and thus contributes to the uniformity of the news workflow. However, in long-form productions, the several users participating in the management of a single digital video object interpret the digital video object's metadata and visual content in different ways. Thus, in long-form productions, the establishment of a common set of explanatory categories that reduce the variety of interpretations available for a digital video object is only possible through face-to-face interaction and group collaboration.

In conclusion, long-form productions involved the participation of numerous professionals for manipulating the same digital video object. The process required close interactions (face-to-face communication) as to establish a digital video object's characteristics and meanings. Thus, as is generally the case with long-form productions, as more users are involved in the management of a digital video object, the interaction with the digital video object becomes more complex. Conversely, in news productions usually a single user interacts with the digital video object; therefore, there is no need for collaboration with other professionals about the characteristics and meanings of the digital video object. It is important therefore to uphold that DNI may have automated several tasks, but has been unable to accommodate the lessons of certain longstanding collaborative work practices.

9.2.3 Comparison Between News and Long-form Productions' Usage Patterns

I conclude section 9.2 by extracting from the empirical research another analytical study related to the differences between news and long-form productions. The subsequent paragraphs address the volume of video content that news and long-form productions used in different genres. The volume of video content is defined in terms of hours of rushes, the time it takes to be produced³⁸ (i.e., digitalized, tagged, edited, post-produced), and the final duration of the broadcasted video product.

Depending on the genre, the time it takes to produce a final video significantly varies. News-related content often must be created and broadcast within a short time frame. The length of the production process depends upon whether the video content is already available in the digital library (for reusing or remixing) or is to be created from newly shot footage. Nevertheless, news stories usually require a volume of video rushes that ranges between one to three hours to produce a two to three minute news story. Conversely, programs like NHU's *Planet Earth*, which utilized 1,500 hours of footage, took two to three years to edit, metadata tag, and deliver.

Table 6 (next page) provides a comparison of several usage patterns and how these differ as the result of the final output duration.³⁹ Production times also depended on how compartmentalized the production groups were. To return to the example, *Planet Earth* was largely split into teams that took on a percentage of the shot reviewing workload for long periods of time (i.e., around 200 hours per group, working for two to three years each).⁴⁰ The time it takes to produce a video story (from any genre) is contingent upon the volume of video rushes available and its final output duration.

³⁸ In this case, the production time calculated does not include the time consumed for the shooting and the pre-production of the video content.

³⁹ The selection presented in the table should not be seen as exhaustive but as illustrative of the point I would like to emphasize.

⁴⁰ This means that NHU staff gained extensive knowledge of the material they worked on, which reinforces the argument that prolonged reviewing of video content increases craft editors' detailed knowledge of specific video productions.

Macro type of production (news / long-form)	Micro type of production (genre)	Volume of content (video rushes used)	Production time	Final output duration
News	News story	Short (1 – 3 hours)	Short (less than 1 day)	2.5 to 3 min.
News	Sports	Short (2 – 3 hours)	Short (less than 1 day)	2.5 to 5 min.
Long-form	Weekly <i>Panorama</i>	Medium (10 – 20 hours)	Short (1 week for research)	30 min.
Long-form	Event (e.g., <i>Wedding of Prince William</i>)	Medium (20 – 30 hours)	Middle (1-2 weeks)	30 – 45 min.
Long-form	<i>Planet Earth</i>	Very Large (1,500 hours)	Very Long (2 – 3 years)	550 min. / 11 episodes (50 min. each)

Table 6: Comparison between genres and final output duration taking into consideration the volume of content and production time required

Table 6 demonstrates that the time required to produce video content is closely associated with the immediacy of work practices involved in each genre: some required hours (e.g., news stories), others a few days (e.g., factual, events), and some required several months or years of preparation (i.e., image pristine documentaries such as *Planet Earth*).

Since DNI's processes were streamlined for news production, they have been efficient in performing the tasks and supporting the work practices required to produce the best news story in the shortest possible time. However, a long-form program that takes months to produce requires different processes than one that took only few days or even hours to produce. This comparison illustrates two points: First, producing a news story in a short period of time requires a number of resources and, therefore, different processes and work practices from the ones required to create a long-form production. Second, the time to produce a program is bound to the occupational cultures of each

particular genre.

DNI as a unified computational system has brought standardization and uniformity to the work practices of both news and long-form productions at BBC NI. However, the transformation of tasks instigated by the DNI workflow has prompted, to some extent, a tendency toward sequentialization in order to tie together a disparate ecology of work practices and tasks (Kallinikos 2011). I illustrated the contrast between different genres in both long-form and news production, which are based on distinctive occupational cultures with different institutional histories. Though the DNI workflow was based on an identical technology, its implementation in long-form and news productions has led to different organizational implications. Thus, not all work practices, particularly the ones that require face-to-face interaction and collaboration, are possible to sequentialize into tasks and routines. Some of those work practices are based on decades of expertise and training closely related to the particular characteristics of the moving image, production values and occupational cultures of each genre.

9.3 Final Remarks

The main objective of chapters 8 and 9 was to expand the discussion to disclose the semiotic nature of digital images and how the work practices in news and long-form production are affected by visual signification of digital video as an image-based information artefact. I intended to show, with the support of the empirical evidence, that the production of news and audiovisual narratives do not rely solely on occupational cultures embedded in particular types of production (i.e., news, long-form). The semiotic character of the digital image also impacts in the production of news and audiovisual narratives.

The case of the news narrative shows it to be composed of a conjunction of visual signs that are mostly defined by a written or verbal structure. In most TV journalistic

practices, the way in which news stories are constructed follows the path of a text or *script* and the images describe explicitly or literally what the text says. There is no complex visual decodification for the human mind since most of the images rely on the literal meaning of the narration that accompanies the image. Browsing and searching for images makes sense in terms of work practices as metadata links the text script with images that are based on literal meaning. The use of Cinegy, particularly in terms of its metadata management, augments the capacity of multi-skilled journalists to convert their *scripts* into video news narratives. In terms of media semiotics, it must be said that news-related visual compositions are relatively homogeneous and structured, and in many cases, repeat the same images in different news stories (Bignell 2002). A news narrative's richness and value lie in the discretionary composition of clips.

With regard to long-form productions, these processes are more complex and difficult to define. Each genre requires a particular set of production values. Those production values are deeply embedded in each particular team's work practices as these accommodate and are accommodated by the compositional nature and visual signification of a digital image. For example, as the empirical work in chapter 7 evinced, in order to understand the methods for organizing information as metadata, the media manager is required to learn the particularities of a genre. Genre familiarity enables the media manager to create the appropriate metadata during the planning and production of a video narrative that are then perceived as having value. The occupational cultures of each genre as well as the shared sign systems contextualize the way producers and craft editors work and create an audiovisual narrative. In long-form productions it is not only a syntagmatic sequence of images defined by a subsequent verbal description; the paradigmatic dimension of audiovisual narratives depends on the visual signification it is composed of (both syntactic and semantic structures) as well as the work practices that lead to its creation.

As mentioned in chapter 4, most studies on technology and work practices focus on the social by and large, and do not analyze in detail how people interact with the different semiotic dimensions that constitute the digital object, in particular this

becomes more acute with regard to digital images. Technology embeds basic notational distinctions (i.e., *score*, *script*, *sketch*), which are based on semiotic characteristics that are managed differently depending on the particular occupational cultures they relate to. In my case, I illustrated how DNI (identical technology) is being applied in two different types of production, news and long-form. However, as I have shown, technology cannot be reduced to the interpretation based on how people socially construct it, neither it can be defined based on a reductionist perspective. The semiotic characteristics of technological information, in this case digital video as an image-based artefact also have to be kept in mind. Though the use of an identical technology may differ depending on its context, semiotic characteristics encourage more conclusive arguments about how work practices may be enacted in different contexts. Furthermore, the discussion about the digital image cannot take into consideration only the syntactic characteristics of digital artefact, but also must acknowledge their deeper and richer semantic dimensions that are contingent on its visual constitution. Seen from this perspective, both the semiotic characteristics of technology as well as the occupational cultures are constitutive elements to enacting the understanding of how video narratives are produced.

In the world of images, not all useful information can be encoded in digital form in ways that can be interoperated or mixed with other information sources (Ekbja and Evans 2009; Ekbja 2010). In order to maintain the creative process that allows for the conception of audiovisual narratives, different coordinative mechanisms are required inside an organization. What makes the DNI case so relevant is how digital information in the form of video content is determined by its semiotic characteristics and impacts work practices. Such is the case of the broadcasting industry, which is based on the manipulation of image-based information tokens. Therefore, I would like to argue that, analyzing the digital image in terms of its semiotic characteristics is a major asset to the study of the impact of technology in work practices in image-intensive contemporary organizations.

10. Conclusion

Information is the cognitive currency of the age.

–Jannis Kallinikos, *Governing through technology* (2011)

In chapters 8 and 9, I sought to demonstrate the impact of digitalization in the work practices at BBC NI after the implementation of DNI. I did so by analyzing the particularities of digital video as an image-based technological object taking into consideration a semiotic approach. In connection with this, I compared the different impact that digital video has in two occupational cultures within the BBC NI, news and long-form productions, respectively. Thus, DNI as a software-based infrastructure allowed for only a single way of managing digital video in both news and long-form productions. However, the impact in work practices originated by this implementation should not be seen only from situated modes of interaction based on the particular occupational cultures within news and long-form productions, but also from understanding what constitutes the semiotic character video as an image-based digital artefact.

In this final chapter, I summarize my findings and consolidate several theoretical contributions to the specific study of image-based digital artefacts and their impact on work practices in the media industry. I then address the methodological and research limitations of the thesis. To conclude, I highlight prospective areas for further research.

10.1 Thesis Summary

In the preceding chapters, I addressed how video production in the broadcasting industry evolved from a compound of specialized systems that worked effectively in

silos into an integrated digital production infrastructure, in which one action affects another. The structured tasks brought by DNI elicit the path by which digitalization affect work practices in terms of the distinctive occupational from news and long form productions, but also throughout determinant aspects in the way digital video is being interpreted (i.e., search) and produced (i.e., craft editing).

DNI as a digital production infrastructure is based on standardized systems that codify work practices into automated tasks. These new automated tasks brought by the digitalization of video are not only confined to monitoring and analyzing software-based processes through which video content passes, but most notably had an effect on the way video narratives are created. The work practices for video creation depend on domain-specific attributes related to the way in which video in news and long-form productions are being managed. Thus, the management of video content in news and long-form productions at BBC NI rely on distinctive competencies that are deeply rooted in the occupational cultures of each genre of production and that cannot be treated through compartmentalized processes and “one-size-fits-all” solutions. DNI reinforces the cognitive transformation of its workflow by rendering skills into tasks as sequentialized processes. Such a structured workflow has been the basis of news production environments for nearly two decades, mainly by managing content in the form of electronic text. Thus, the standardized process on which DNI was based resembles most of the processes typical of news environments. However, the sequentialized processes of DNI do not resemble the complex tasks conducted during craft editing audiovisual narratives such as long-form productions. The management of video content in long-form productions demands a distinctive profile of competencies and technical skills for efficiently navigating the structured and organized processes brought about by DNI.

As illustrated in chapter 7, digitalization provides instant access to video material only by browsing or searching for content in the DNI digital library. While searching for video content became a common practice due to the diversity of video assets available in DNI’s digital library, the BBC NI case suggests that archives also raise temporal, cultural, and technical problems. Finding archived assets is an act of choice guided by

relevant keywords. However, text descriptions used to archive an asset may not be compatible with, let alone available in, a digital format. As new assets are created digitally *de novo*, they acquire new constituencies that previously archived media assets may lack (such as a new field required for a particular delivery platform). Creating and searching metadata is coupled with giving meaning to a sign system that communicates information. This makes metadata time-bound and subject to the depreciation of its relevance if it is not regularly updated and maintained; what is relevant to some groups or audiences one day may become irrelevant the next. Digitalization also brought a quick rate of metadata obsolescence at BBC NI, producing technological discontinuities since legacy video content became incompatible with the new technology. Technological discontinuity generated a “semantic gap” as the material was unavailable throughout the system, paving the way for dependency on creating new content that complied with DNI’s technical characteristics. Reusing existing content became contingent upon the search capacity to match archived metadata with metadata about new content. Thus, it became necessary that news and long-form productions required customized metadata tagging which also demanded BBC NI to establish the new position of a media manager for each type of production. The media manager was required to understand the particularities of each audiovisual genre in order to input the correct metadata.

In contrast to the media manager whose work relies on assigning text-based metadata to video content, the work of long-form craft editors was based on visual patterns that required extensive reviewing of video shots. Reviewing is based on discovering what one needs, without previous knowledge of what that might be, which contrasts with searching which is only useful when one knows what one is looking for. Craft editing is never a linear process and is accomplished through a series of unpredictable tasks; it depends on the shots, the script, the discussion among team members, and the available technology. The craft editing process can be regarded as one of the most rudimentary practices of the DNI workflow since its artistic essence did not change with digitalization. Craft editing is a complex series of actions that significantly differ from searching for a video through metadata and is dependent on the *techno-aesthetic* characteristics of digital video (referring to the practice as an assemblage of

technology, craft and art). To understand how work practices are influenced by digital images, it is necessary to identify how its semiotic relationships based on paradigmatic and syntagmatic dimensions enable a particular mode of organization. Thus, as much as syntagmatic tokens redefine and organize the sequence of work, the paradigmatic tokens in which audiovisual narratives are based on an intricate interplay between artistic aspirations, skillful craftsmanship and collaborative practices, all of which resist the linear definition of order.

In addition, the different types of interactions that craft editors have with digital video as a sign system in both news and long-form productions is important for understanding the complex nature of the DNI workflow and how it relates to past and evolving occupational cultures. In news production, a single user's interaction with the digital video object (through its metadata) reduces the number of people involved in the decision-making process to a minimum (i.e., a sole individual) and thus contributes to the uniformity of the news workflow. However, in long-form productions, the multiple users participating in the management of a single digital video object may interpret the digital video object's metadata and visual content in different ways. Thus, in long-form productions, the establishment of a common set of explanatory categories that reduce the variety of interpretations available for a single digital video object is only possible through face-to-face interaction and group collaboration.

I have illustrated how digital video is based on a complex set of layers. Some layers, such as the technical and descriptive layers, can be interoperated with other video objects, as well as organized and indexed through their manipulation. Conversely, a digital image cannot be rationalized only as series of rational procedures since its visual layers are largely based on content and thus, their quality relies on production values that cannot be measured through calculations but through the identification of its semiotic elements and the relationships it references.

10.2. Theoretical Contributions

In the following section, I consider possible theoretical contributions that my work could add to enrich particular areas of study: the study of technology in media organizations, the study of the technological artefact through semiotics, and, in general terms, the research's contribution as part of the new discipline of software studies.

Studies of technology in media organizations: Though media organizations and the broadcasting industry in particular use new media technology intensively, there is still little research on the study of work practices and the impact of technology on such settings. As I mentioned in chapter 4, there are three areas of study that focus on technology in media organizations that contribute to the IS discipline: studies of image-based systems; explanations of extensive implementations in the media industry, and; the impact of the internet and media convergence on organizations. Within these areas, studying the technical artefacts' characteristics, software processes and work practices provides a better understanding of the impact of technology on the media industry.

A semiotic perspective to the study of the technological artefact: To a certain degree, the general explicit semiotic attributes of information have been studied and analyzed (Barley 1983; Zuboff 1988; Ramaprasad and Rai 1996; Raber and Budd 2003; Kallinikos 2011; Mingers and Willcocks 2014). However, in the BBC NI case, the signification of digital video as an image token requires taking into consideration the ambiguity of image representation and the particularities of image-based information artefacts. I tried to depict video as a technological artefact and describe how it “performs” in a determined environment in order to study how particular types of image-based technologies define the options for navigating, editing, and searching a digital document by taking on a semiotic perspective. For the study of image-intensive organizations, such as the media industry, given the complexity of their work practices, it is important to take into consideration its media semiotics in order to understand how technology affects the work practices and thus, the output

produced (e.g., video narratives). The research of digital images and their impact on work practices complement the literature on semiotics in the IS field.

Software studies: My work in general contributes to the emerging discipline that some scholars have defined as “software studies” (Fuller 2008; Manovich 2011). Software studies does not mean that one needs to understand the “raw code” or a computer language in order to analyze the software being used. Software studies is much closer to the implementation and use of software in fields such as cyberculture, internet studies, new media studies, and digital culture. My research contributes to software studies in that it is specifically based on the technological and social impact of digital video as a cultural artefact in media and broadcasting organizations. In general, my research also contributes to the study of the characteristics of contemporary image-based artefacts.

10.3 Limitations of the Study

Throughout my initial research and after reading comparable literature, I have made note of the limitations of the study. In the following sections, I outline the most significant restrictions of this thesis, which are divided into methodological and conceptual limitations.

10.3.1 Methodological Limitations

1. People generally do not reflect on what they are doing on a daily basis. Therefore, interviewing different stakeholders in order to conceptualize a technology may be a difficult way, even for knowledgeable professionals, to understand and reflect on what they are doing in their work environment. Usually their conceptualizations about the use of a particular technology were not well explained and were fairly inarticulate. Thus, there is a tendency to become biased toward a particular perspective that is well-articulated, even if it might be wrong

or is not sustained by other empirical data. On the other hand, not to become preoccupied with aspects that are poorly explained and that do not seem to be important in the first place might represent only a partial interpretation of the facts. It is therefore important to take into consideration such typical biases when conducting case studies through unstructured interviews. Taking into consideration the dominant role of the BBC in Britain, there was little control over the events as they occur within real-life scenarios. Therefore, to reduce the chance of committing inaccuracies, I did two things: first, I validated most of the selected commentary and key arguments with a group of experienced professionals in the field (e.g., consultants, managers, training specialists) who were not directly involved in the implementation. I also conducted exploratory research questions in complimentary settings with experts and consultants who provided impartial opinions and had different perspectives about the implementation. Second, I visited the main research site (BBC Northern Ireland) twice to further validate my arguments. On the second visit, I elaborated on questions with the same interviewees to see if I would obtain similar answers to the ones collected during my first visit to the site.

2. It is difficult to discern when an implementation (or part of it) is successful or unsuccessful. Though DNI was cancelled as a project (Conlan 2013), many of its processes and technological implementations are up and running at BBC NI and there have been important changes in the way the technology is being used that address some of the problems discussed in this thesis. People do criticize implementations, even when most of the processes are in full swing, since there are always issues to resolve, especially when these issues have a direct impact on their work practices.
3. The BBC NI case study shows only one particular implementation of DMI, so it may be difficult to extrapolate it to any other setting. From a methodological perspective, the case study design inevitably leads to limitations with respect to the generalizability of the findings, and therefore claims to provide an analytical generalization as proposed by Yin (2003). That said, most of the processes

throughout the broadcasting industry are standardized (particularly in the newsroom) and they use similar (or identical) technologies, therefore some logical extrapolations and assumptions could be made in similar settings.

10.3.2 Research Scope Limitations

1. From a conceptual perspective, the dissertation focuses on the study of broadcasting organizations while leaving out other media organizations and their work practices that relate to the management of images. It also does not study the impact those work practices have on competing media aggregators (i.e., YouTube, Google, Flickr). In addition, the dissertation does not focus on the related domain of User-Generated Content, although it is mentioned peripherally. Therefore, I do not study the importance of the audience in the changing media landscape, audience evolution, or the transformation of media consumption.
2. As I stated in chapter 6, there is a lack of literature available on the analysis of the technological aspects of the BBC. Most of the writings and accounts of the BBC are focused on its historical background or aspects of its managerial politics (Born 2003). As with any attempt to venture into an area that has been underexplored or that lacks competing literature, this thesis risks the limitation of not being able to relate or compare its findings with similar research.

10.4 Future Research

My PhD is part of The Information Growth and Internet Research (TIGAIR) project, recently renamed The Information Habitat Research Network (InfoHab, www.infohab.org). InfoHab is a research program that studies the social and institutional implications of information growth and the expansion of a networked information environment, which is referred to as the digital or information habitat. The program seeks to understand the information habitat's far-reaching significance in

contemporary institutional life. After working for nearly seven years on the same case study, I plan to continue to be part of the InfoHab team after completing the PhD program. I have developed new areas of interest around digital artefacts and the social and organizational impact that these have on contemporary work practices. Some topics I have an interest in pursuing in the future include: comparative studies on memory and broadcasting institutions, image studies in organizational settings that are image-intensive, and legacy systems in the media industry.

Comparative studies on memory and broadcasting institutions: I plan to examine the intricate relationship between information and data by focusing on the role metadata plays in the institutional practices in the BBC's NHU, one of the largest and most valuable video archives of the world's natural heritage, and Europeana, a project on unifying the digitalization initiatives of European libraries, archives and museums. In these particular cases, on which I am collaborating with my colleague Dr. Attila Marton, we analyze digital metadata objects as the result of the homogenization of semiotic logics qua binary codification that afford the computational construction of information. We argue that NHU and Europeana are engaged with the datafication of novelty (information) and persistency (archiving). The two cases address the tension between homogenized data and contextualized information through their respective metadata schemes, which are employed for both the management of information (novelty) and the maintenance of digital archives (persistency).

Organizational studies from an image-based perspective: The media industry is one of the most intensive organizations in terms of their use of technologies. It manages a plethora of media tokens, particularly image-based digital objects. As I mentioned throughout this research, seen from an IS perspective, there is a lack of studies about the organizational changes within the media industry. Therefore, the study of how digital images are managed in organizations is in itself new in terms of research within the IS field and may well expand the discussion about information artefacts.

Legacy systems in the media industry: As mentioned in chapters 5 and 8, the media industry was one of the industries that took the longest to implement the digitalization

of their business processes. The legacy systems in the media industry were mostly based on closed systems, which added unnecessary maintenance costs. The media industry's attachment to analogue technology bears a resemblance with the history of fragmented legacy systems which were replaced by unified computational platforms (i.e., ERPs). I plan to continue studying the change towards decentralized, interoperable, and collaborative culture of digital video production in the media industry.

11. Appendixes

11.1 Research Project

In this section, I present three documents that I provided to interviewees prior to each interview. All interviewees and participants received the *Introduction Sheet for the Informants*, which contains information about the research. There are two types of *Introduction Sheets*: the first contains general information and was distributed during the first visit to BBC headquarters and BBC NI; the second *Introduction Sheet* contains more specific information about what I wanted to achieve during the second visit to BBC NI. The second document provided was the *Communicative Validation (Interview Topic Guide)*, which contains the general questions that were asked during the interviews. The third document is LSE's *Research Ethics Review Checklist*, which provides the ethical research guidelines applied to my research.

11.1.1 Introduction Sheet for the Informants

Sheet for the Informants (First Visit, BBC NI)

About the Information Growth Research Project

The Information Growth and Internet Research (TIGAIR) is a project based at the Information Systems and Innovation Group of the Department of Management, London School of Economics. TIGAIR's main research focus is the managerial, organizational, and technological consequences of the accelerating information growth that has been taking place over the last two decades.

As information is expanding from traditional to digital media, particularly on the internet, it confronts users with a variety of delivery formats (i.e.: VOD, RSS feeds, blogs, wikis) that must be manipulated and mastered. Furthermore, the management of information itself becomes a key issue for most organizations. It consumes organizational resources at the same time as the forms by which it is managed frames what is relevant and shapes the perception of threats and opportunities. Recent studies

suggest that organizations, major producers and containers of information, have classified less than 10 percent of their information. Since the estimated six-fold increase of digital information in 2010, from which 25 percent will come from image-based media, the tools to manage diverse types of information become crucial. The studies available today offer quantitative information about the use of storage capacity or software packages and the like. However, research on how work practices and organizations are adapting to the growth of information and the conditions it tends to establish is scarce. Very little is currently known with respect to 1) the patterns and dynamics of information growth and 2) the implications of that growth in terms of new working and managerial practices. The TIGAIR project aims to investigate and identify these new kinds of patterns through multiple case study research. For more information visit: www.tigair.info.

BBC and Information Growth Research

The new generation of media producers and consumers are transforming and enriching experiences through aggregating and mixing, as well as categorizing and finding content. These conditions are closely tied to content innovation that generates value for both users and the web services they consume. Findability and accessibility are therefore key prerequisites for operating and competing in today's multiplatform digital marketplace. The main purpose of the research we plan to undertake at the BBC is to analyze the organizational changes and managerial practices generated by the implementation of the Digital Media Initiative (DMI) which are defined in the following two main thematic domains:

1. Emergence of new practices and roles, both as formal functions as well as how people understand, perform, and interact in those functions within DMI.
2. The strategic role of metadata in DMI as a driver both of innovation (through characteristics such as findability or User-Generated Content) and as a way to clearly define processes and roles within the BBC. In this sense we want to analyze how metadata is implemented both at an organizational level and as a business strategy.

Value for Money

Our project is part of a multi-industry research focused on information-intensive practices in organizations. Therefore, in broad terms, the BBC as a participant in the research will benefit from some of the general conclusions that will arise out of this study and that have an impact in the new environment of media production and delivery. In specific terms, the BBC will also benefit from feedback on the current status and future trends of the industry by a team comprised of academic researchers that have extensive knowledge of media convergence, organizational studies, and web services innovation.

Methodology

The work methodology will be to meet with several participants of the identified project. The research will involve a series of individual interviews and small-group discussions with people whose work has been directly or indirectly involved with the use of the technology and the study of official documents or other archived material. We seek to gather views of managers and employees as well as relevant technical experts if required. Gathering these perspectives should be done in different moments of the implementation. In this way we would be able to track how DMI has been deployed over time and how it has been changing the way people deal with it. As it is explicitly stated in the NDA signed by the LSE and the BBC, all information will be treated with utter sensitivity and our reports will be available for reading or scrutiny by interviewees and the BBC. If needed, anonymity and confidentiality will be granted. The project will conform to the LSE ethical research guidelines and the ESRC research ethics framework. It is important to remark that we will not evaluate or assess any part of our findings at the BBC. We will seek to use the BBC's experience as an opportunity for learning and academic research.

Sheet for the Informants (Second Visit, BBC NI)

For this second visit to BBC Northern Ireland, we envisage to complement the information that was obtained in the first fieldwork (September 2009), as the change

management of the “Digital Northern Ireland Project” was expected to finish during the first semester of 2010.

There are three key areas we want to cover:

1. Understand the main changes that had occurred from September 2009 to date regarding the change management of the BBC NI project, both in terms of technology and organization. How is the organization managing the vast amounts of media that are being logged into the systems? Are there any new work practices attained from the experience?
2. Complement our understanding of the change management in the newsroom by meeting with one or two journalists (or news operations managers) that were deeply involved in the change management process.
3. Extend our research to include the change management that occurred in the long-form production process and the specific difficulties that this stage of the project possessed. In this part of the research, as it was in the case of the newsroom production, we are not only interested in the deployment of the technology but also in the complexities that these technologies brought (positive and negative aspects) and how these processes (and the technologies/platforms involved) are perceived by users (internal clients).

11.1.2 Communicative Validation – Interview Topic Guide

1. Introduction

What is your current position/role in the organization? What is your job about?

What are you currently working on? For how long are you working in the BBC?

2. About DNI

How would you describe DNI? Why is a project like DNI necessary at the BBC (or at BBC NI)? What is your experience with the system? Do you work much more efficiently?

What do you think are the differences and similarities between DNI and the former traditional work practices?

How would you characterize the differences between DNI as it was envisioned and how it is implemented today?

What do you think is expected from DNI and what do you need right now to make it happen?

3. About the Organization

What are the most important challenges the implementation of DNI faces in both long-form and news production? Which were the most important and critical aspects of its deployment?

Which roles have shifted dramatically after the implementation of DNI?

4. Technical Aspects

Does the BBC staff enter the metadata on the respective video footage?

Are they getting used to search and tag video assets?

Can you explain the media managers' role with regard to their use of metadata?

In the news or long-forms environments, has the notion of metadata permeated the teams?

11.1.3 Research Ethics Review Checklist (LSE)

	Yes	No	Not Certain
Consent			
Does the study involve participants who are in any way vulnerable or may have any difficulty giving consent?		X	
Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in public places)		X	
Research Design/Methodology			
Does the research methodology use deception?		X	
Are there any significant concerns regarding the design of the research project? a) If the proposed research relates to the provision of social or human services is it feasible and/or appropriate that service users or service user representatives should be in some way involved in or consulted upon the development of the project? b) Does the project involve the handling of any sensitive information?		X	

Financial Incentives/Sponsorship

Will the independence of the research be affected by the source of the funding?		X	
Are there payments to researchers/participants that may		X	

have an impact on the objectivity of the research?			
Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?		X	

Research Subjects

Is pain or more than mild discomfort likely to result from the study?		X	
Could the study induce unacceptable psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life? Will the study involve prolonged or repetitive testing?		X	
Are drugs, placebos or other substances to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?		X	

Risk to Researchers

Do you have any doubts or concerns regarding your (or your colleagues') physical or psychological wellbeing during the research period?		X	
---	--	---	--

Confidentiality

Do you or your supervisor have any concerns regarding confidentiality, privacy or data protection?		X	
--	--	---	--

Dissemination

Are there any particular groups who are likely to be harmed by dissemination of the results of this project?		X	
--	--	---	--

11.2 List of BBC Staff Interviewees' Information and Dates of the Interviews

Date	Person Code	Position	Location
14 th of December 2006	DMI-001	Development Producer, BBC	Broadcasting Centre, White City, London
15 th of February 2007	DMI-002	Head of Innovation, BBC New Media & Technology	Broadcasting Centre, White City, London
8 th of April 2007	DMI-001 ⁴¹	Senior Research Producer, BBC	Broadcasting Centre, White City, London
8 th of April 2007	DMI-003	Senior Producer, BBC R&D	Broadcasting Centre, White City, London
21 st of April 2008	DMI-004	CIO, BBC	Broadcasting Centre, White City, London
4 th of July 2008	DMI-005	Digital Media Technology Controller - Journalism (Sport) & Programme Manager, DMI	Broadcasting Centre, White City, London
26 th of February 2009	DMI-005	Digital Media Technology Controller - Journalism (Sport) & Programme Manager, DMI	Broadcasting Centre, White City, London

⁴¹ DMI-001's position changed from Development Producer (2006) to Senior Research Producer (2007).

23 rd of February 2009	DMI-005	Digital Media Technology Controller - Journalism (Sport) & Programme Manager, DMI	Broadcasting Centre, White City, London
23 rd of February 2009	DMI-006	Organisational Development & Change Consultant, BBC	Broadcasting Centre, White City, London
23 rd of February 2009	DMI-007	Senior Business Lead, Digital Media Initiative, BBC Future Media & Technology	Broadcasting Centre, White City, London
13 th of September 2007	DMI-008	Controller, BBC Vision	Broadcasting Centre, White City, London
3 rd of April 2008	DMI-008	Controller, BBC Vision	Broadcasting Centre, White City, London
14 th of September 2007	DMI-009	Head of the Internet Research & Future Services Team, BBC R&D	Broadcasting Centre, White City, London
19 th of October 2009	DMI-010	Head of Technology, BBC NI	BBC Northern Ireland, Belfast
19 th of October 2009	DMI-011	Senior Technologist, BBC NI	BBC Northern Ireland, Belfast

19 th of October 2009	DMI-012	Broadcast Executive, BBC NI	BBC Northern Ireland, Belfast
19 th of October 2009	DMI-013	Technical Lead, BBC NI	BBC Northern Ireland, Belfast
19 th of October 2009	DMI-014	Technology Support Manager, BBC NI	BBC Northern Ireland, Belfast
20 th of October 2009	DMI-015	Technology Development Manager, BBC NI	BBC Northern Ireland, Belfast
20 th of October 2009	DMI-016	Digital Media Operations Manager, BBC NI	BBC Northern Ireland, Belfast
20 th of October 2009	DMI-017	PMO, BBC NI	BBC Northern Ireland, Belfast
20 th of October 2009	DMI-018	Technical Engineer, BBC NI	BBC Northern Ireland, Belfast
20 th of October 2009	DMI-019	Technology Portfolio Manager, BBC NI	BBC Northern Ireland, Belfast
19 th of January 2011	DMI-020	Programme Manager, BBC Academy	BBC Academy, Wood Norton, Worcestershire
19 th of January 2011	DMI-021	Freelance producer (former executive producer, BBC	BBC Academy, Wood Norton, Worcestershire

		Birmingham)	
19 th of January 2011	DMI-022	Freelance Media Consultant, DMI	BBC Academy, Wood Norton, Worcestershire
26 th of January 2011	DMI-023	Product Manager, Cinegy GmbH	Bristol
27 th of May 2011	DMI-024	Archive Services Manager, Information & Archives BBC Technology Division I&A Bristol, Natural History Unit	NHU, Bristol
31 st of May 2011	DMI-025	Broadcast Continuity Communications Technology Manager, BBC NI	BBC Northern Ireland, Belfast
31 st of May 2011	DMI-019	Technology Portfolio Manager, BBC NI	BBC Northern Ireland, Belfast
31 st of May 2011	DMI-026	Producer for Factual Programmes, BBC NI	BBC Northern Ireland, Belfast
31 st of May 2011	DMI-027	Assistant News Editor, BBC NI	BBC Northern Ireland, Belfast
31 st of May 2011	DMI-028	Productions Facilities Manager, BBC NI	BBC Northern Ireland, Belfast

1 st of June 2011	DMI-015	Technology Development Manager, BBC NI	BBC Northern Ireland, Belfast
1 st of June 2011	DMI-016	Digital Media Operations Manager, BBC NI	BBC Northern Ireland, Belfast
1 st of June 2011	DMI-029	Television Current Affairs, Production Manager, BBC NI	BBC Northern Ireland, Belfast
1 st of June 2011	DMI-030	Senior News Director	BBC Northern Ireland, Belfast
1 st of June 2011	DMI-031	Dedicated Shoot Editor, Sports, BBC NI	BBC Northern Ireland, Belfast
1 st of June 2011	DMI-010	Head of Technology, BBC NI	BBC Northern Ireland, Belfast

11.3 BBC Documents

In this section, I include basic documentation on DMI that illustrates some of its technical requirements: *DMI Enablers*, *DMI's Metadata Model*, and *Four Use Cases for News Workflows Card Lifecycles*.

11.3.1 DMI Enablers

The various elements that DMI delivers as part of the BBC's production workflow are described through a set of enablers.⁴² An enabler can be defined as a set of capabilities that the business will have following the implementation of DMI, and consists of the combination of people, processes, and technology solutions.

DMI consists of six enablers defined as follows:⁴³

- *Enabler 1 – Work in Progress*: Enables smarter decisions early in the production process, multiple users accessing content, and added agility in the multiplatform production process.
- *Enabler 2 – Archive*: Allows content that is “born digital” to “stay” digital, richly tagged to enable the content to be exploited for both audiences and commercial use.
- *Enabler 3 – Bundle and Package*: Provides the ability to seamlessly convert content from finished form for various platforms.

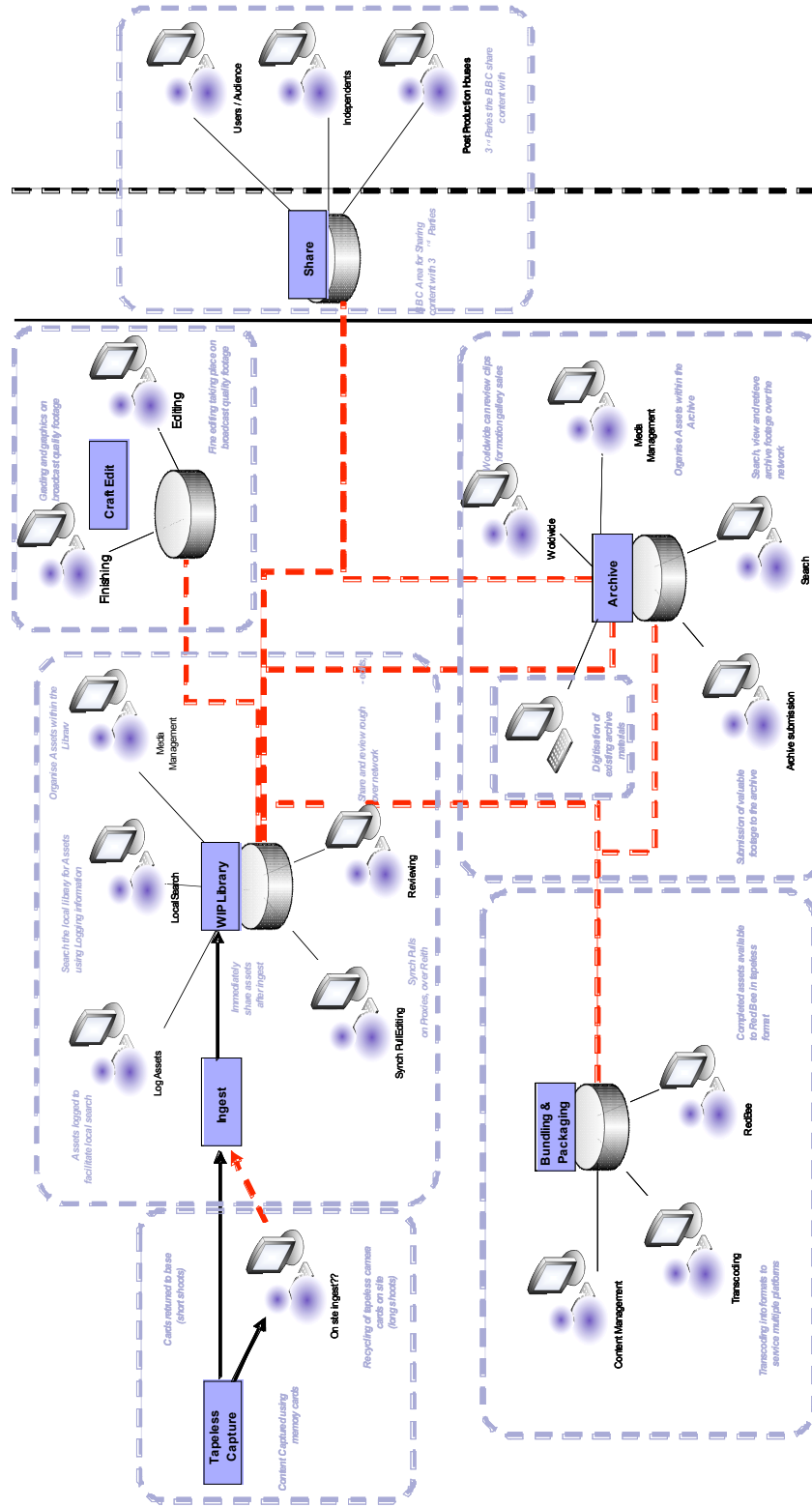
⁴² Please refer to chapter 7 for the empirical description of each of these enablers.

⁴³ The numbered order of the enablers is the one mentioned in the BBC documents; however, for my research purposes in chapter 7, I reorganized them in order to make it more understandable and follow a sequential process from ingestion to delivery.

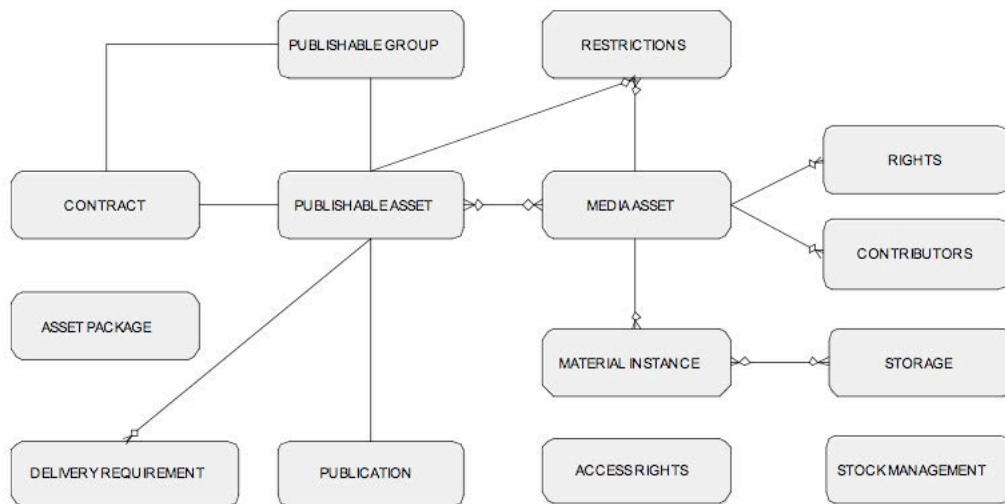
- *Enabler 4 – Shoot:* Allows tape to be removed from the shooting process, reduces time spent ingesting footage, and provides the opportunity to record metadata during the shooting process.
- *Enabler 5 – Craft:* Enables complex editing to be completed on lower cost desktop based packages.
- *Enabler 6 – Share:* Facilitates multiple users including third parties to access content adding increased agility to the production process.

Figure 26 provides an overview of DMI's six high-level functionality enablers through which video content is assembled and distributed, constructing a workflow.

Figure 25 Enabler overview



11.3.2 Metadata Model



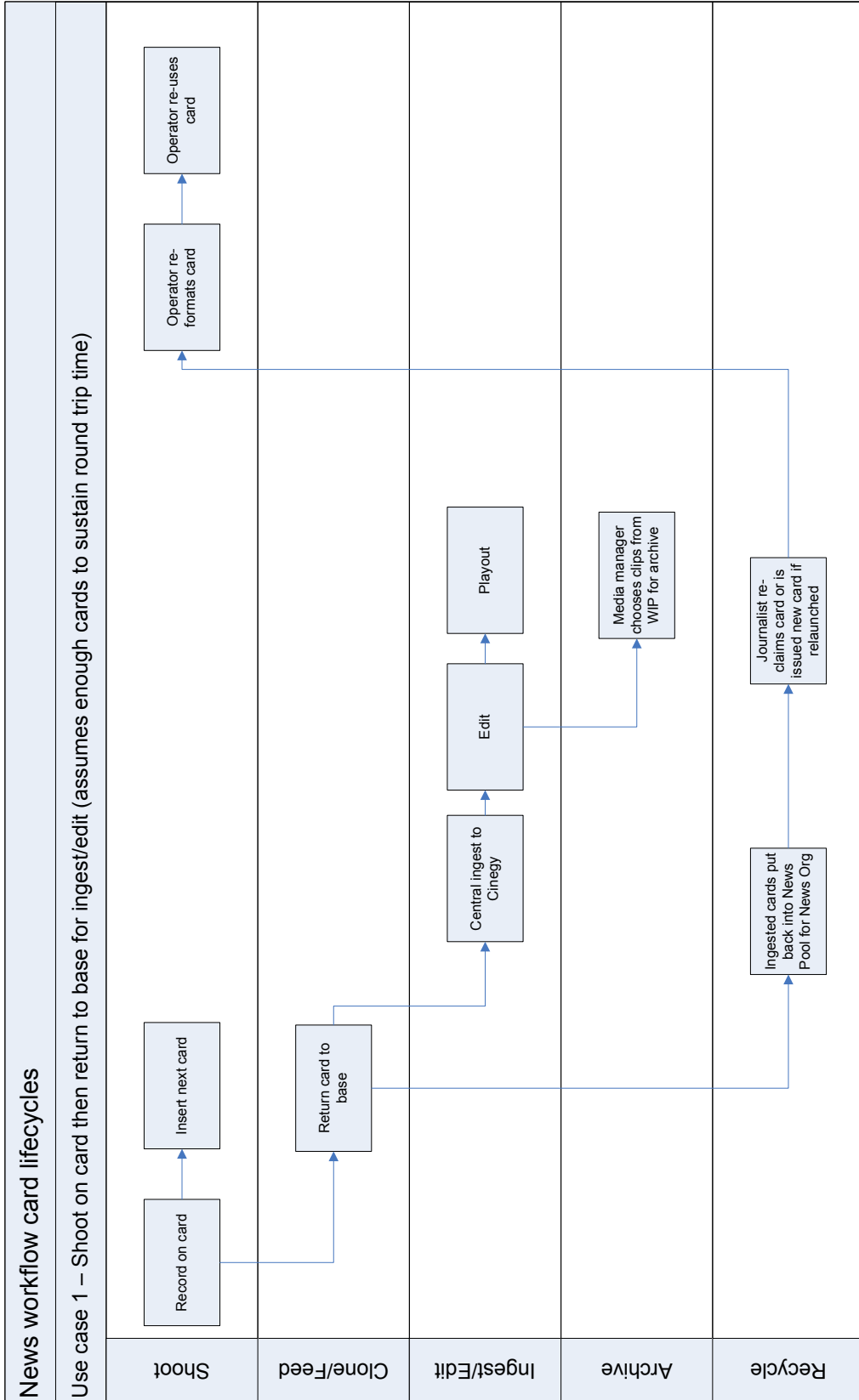
Definitions:

Asset Package	A bundle of assets (Publishable Assets and Media Assets) intended for export/outgest from the DMI system.
Access Rights	Control of users' access to folders and assets.
Contract	The contract between Commissioning and Production that details which Publishable Assets the Production Team should deliver and any terms and conditions related to the Publishable Asset, such as the number of transmissions bought.
Delivery Requirement	Defines the delivery requirements for a specific Publishable Asset Version. For

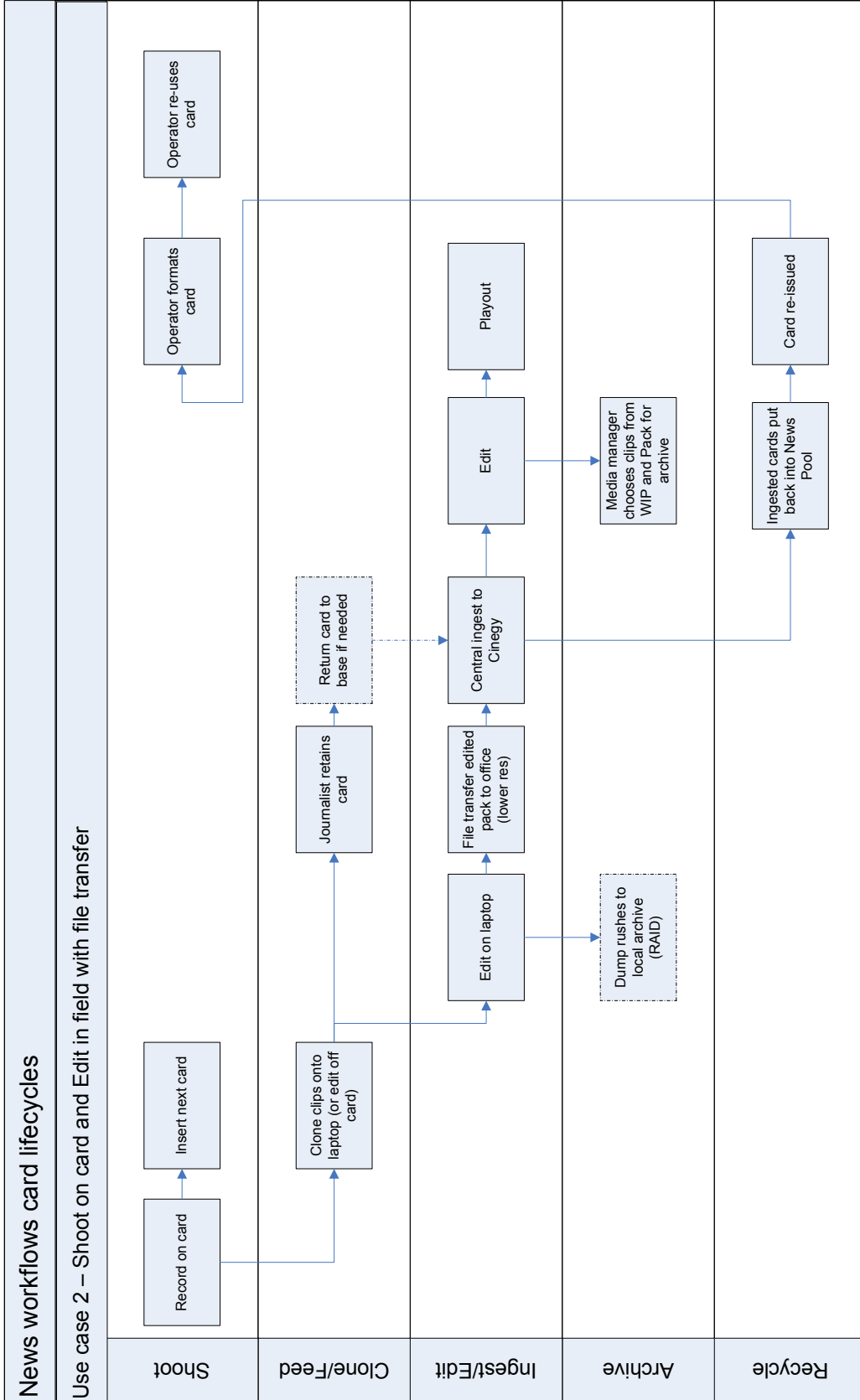
	example, BBC1 required Walking With Dinosaurs to be delivered on 1 x 625 line PAL Digital Betacam videocassette. It may also define any reports, e.g. a “PasC type” report that must be delivered.
Publishable Group	Any grouping of a Publishable Asset such as Brand, Campaign, Series, Website, etc.
Publishable Asset	The usage of an asset, e.g. television programs, radio programs, webpages, interactive streams, interstitials, etc.
Publication	The publishing of a Publishable Asset, which includes linear television, radio and web.
Material Instance	The instantiation of a Media Asset. A Media Asset may have several instantiations, e.g. with different compression types (JPEG, MPEG, etc). An asset produced by Production could include any audio, video, stills, data, etc.
Media Asset	A Media Asset may be used as a Publishable Asset, but other Media Assets, such as rushes, may not be used as a Publishable Asset.
Rights	The Media Asset will have associated metadata, including details of the rights. Any rights information (copyright information and other rights) associated with the Media Asset.
Stock Management	Represents data required for Stock Management for the library.

Storage	The storage unit (e.g. the specific tape or file) for the specified instance of the media asset.
Talent	Contributors to the asset, e.g. presenter, actor, cameraman, etc.
Usage Restrictions	Any restrictions related to the usage of an Asset. Examples include Legal/Litigation and Editorial restrictions.

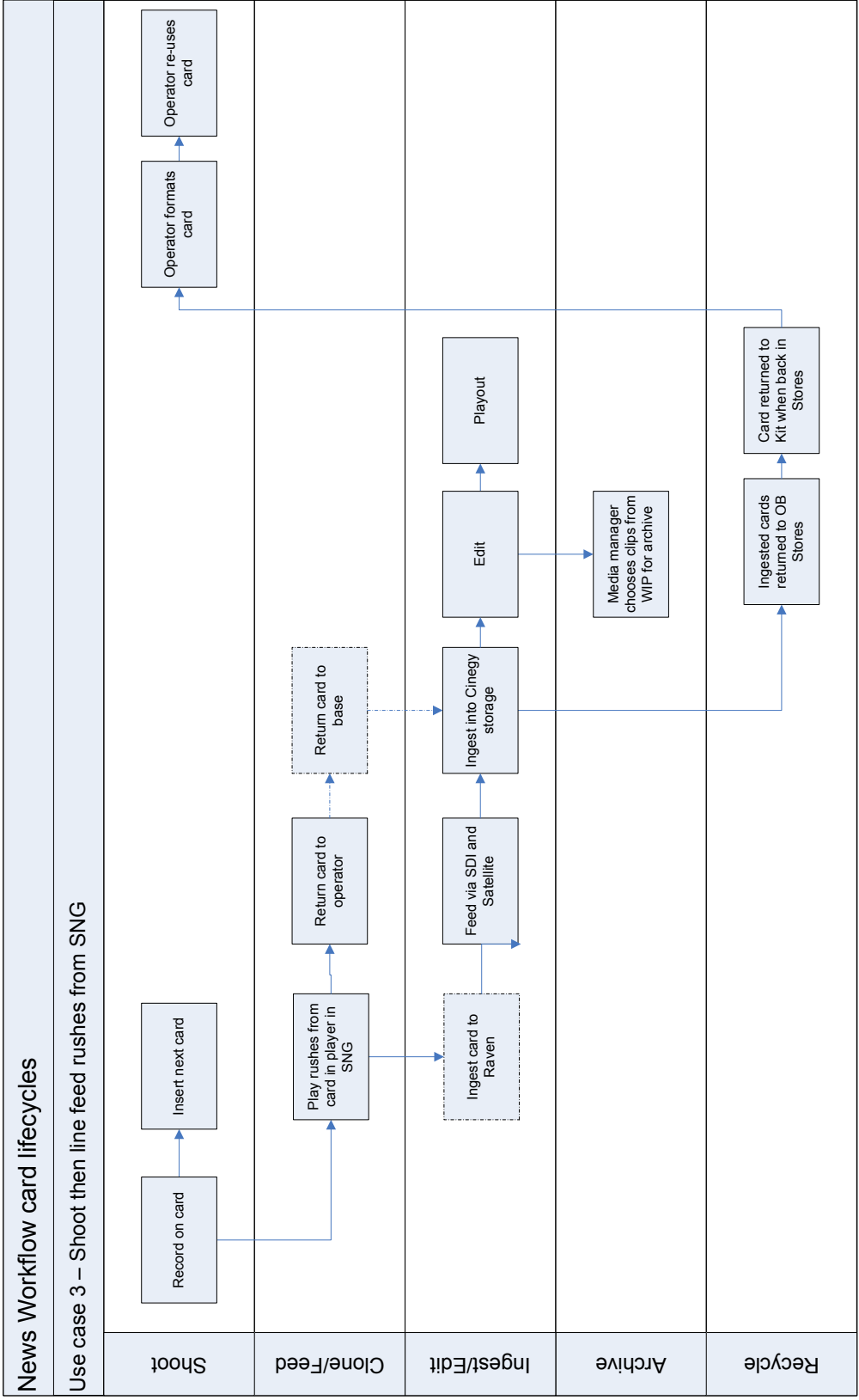
11.3.3 Four Use Cases for News Workflows Card Lifecycles



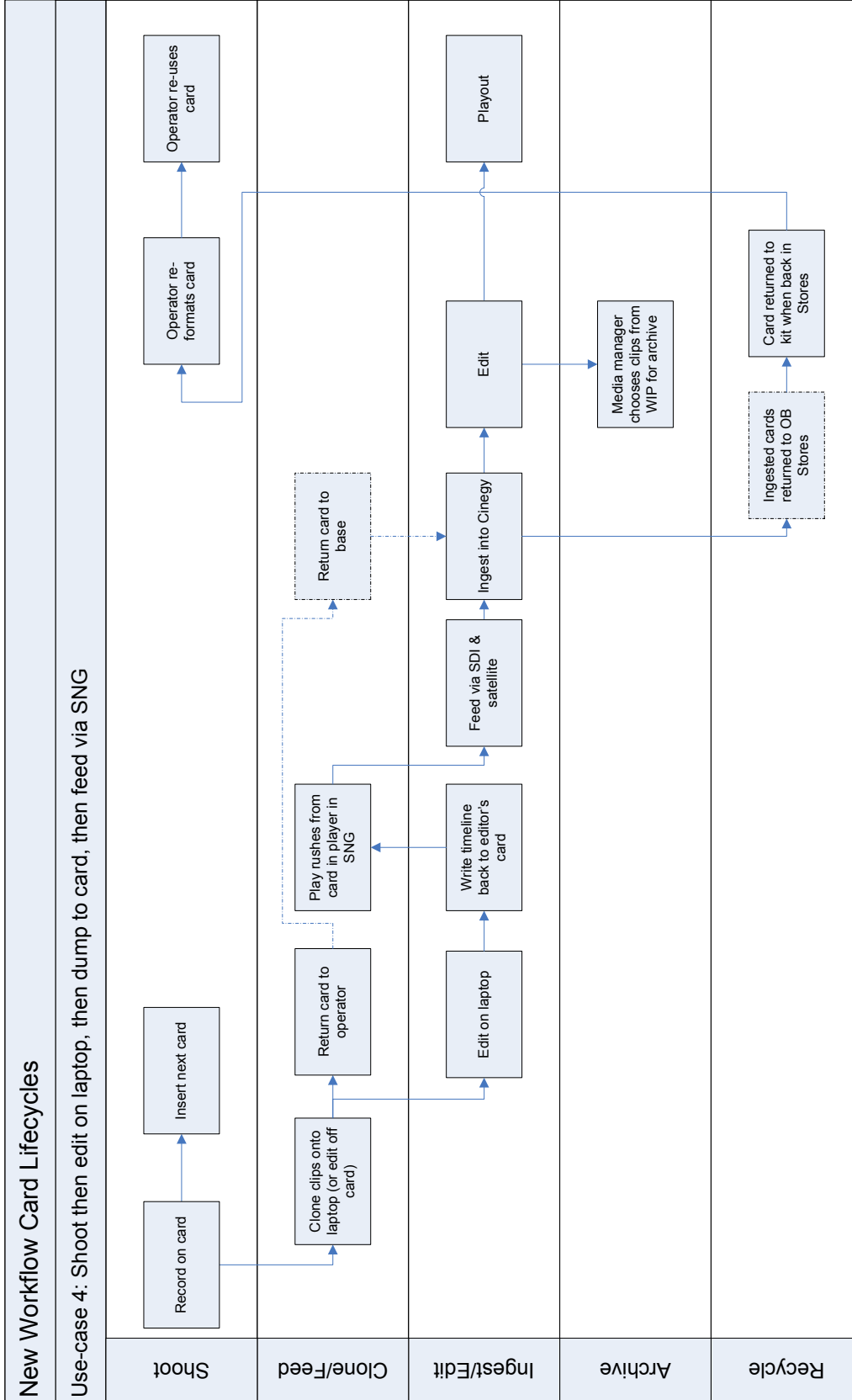
Notes: Cards identified by barcode.



Note: File transfer at lower resolution most likely to be done with Quicklink Store and Forward



Note: Player will initially be a PMW-500 body – RAVEN box will replace this as long as UDF cards at 50Mbps can be read. If being used in a Press Conference format, enough cards must be available to meet demand of repeated short clips needing to be sent via SNG.



Issues:
 Need to confirm what NLE's can write back to cards
 Returning card to base is optional – if important rushes would bring back and ingest

11.4 Glossary of Terms

In this section, I provide an explanation of the technical terms used throughout the thesis within the specific context of my research.

Assembly: The editor's first pass and selection of shots during the process of cutting a video or a film.

Avid: The manufacturer of several digital video editing systems. Avid products are widely used in the television and video industry. Media Composer is one of Avid's main professional software-based video editing systems.

Cinegy: A video editing software package initially created at the BBC and then sold to Siemens. As it is stated on its website: "*Cinegy Workflow is the software platform which combines digital asset management, video ingest, and software based encoding, broadcast automation and playout, production tools, archive storage, and retrieval, all integrated into one seamless database-driven production workflow*" (Cinegy 2013).

Capture (Ingestion): Digitalization of videotapes to be translated into digital video.

Compression (Data Compression): The reduction of a video file's size while maintaining a high-quality picture based on a delivery format. There are several types of compressions for various purposes. For example, DVDs or web movies are compressed in formats that can make files 15 to 30 times smaller than professional broadcasting files' sizes.

Crafting (Craft Editing): The crafting of a project is an extremely important task as it involves the manipulation (post-production) of the material shot. It is a process that goes through several phases, most of them aesthetic and narrative (story-telling). There are many people involved in this process. Crafting includes fine video editing,

transitions and special effects (animations, titles, or compositions). It is usually done in specialized video editing software or specialized post-production workstations. When the content is approved, other phases of crafting processes will include final edits for titles, sound production, and final adjustments to audio and video levels.

Codec: Shorthand for “coder-decoder”. It is the software (or computer algorithms) that takes a raw digital video file and turns it into a compressed video file. Different codecs translate media files in different ways depending on the platform. For example, video codecs compress the size of a video file while maintaining its quality based on the platform it is going to be delivered on.

D1: A type of high-quality video equipment produced by Sony and considered the first digital videotape commercially available. It was initially introduced in 1986 and recorded as an uncompressed standard definition (SD) component video signal in digital form. As it was a proprietary standard, D1 was expensive and its use was confined to large television networks.

Digital Filmmaking: Moviemaking technologies that, like traditional film, capture an image. Unlike traditional film emulsion, digital offers a more uniform image and lacks grain and randomness of color or light.

Digital Item: Can be considered as the universal token for operations within the MPEG-21 multimedia framework. Digital Items are defined by the technologies needed to support users to exchange, access, consume, trade, or manipulate MPEG-21 in an efficient way.

DVD (Digital Video Disk): A disk that records and plays data using a technology similar that of a CD. It generally uses the MPEG-2 video compression scheme.

Final Cut Pro (FCP): A type of professional digital video editing system manufactured by Apple, Inc.

Handheld Camera: A portable camera used by a camera operator. These cameras are usually inexpensive and very simple to manipulate in comparison to much bigger cameras that are based on TV studios.

HTML: HyperText Markup Language (HTML) is the main language for creating web content on the internet to be used in several platforms.

iPlayer (BBC iPlayer): A VOD television and radio service and software/web application, developed by the BBC to stream its media content over the internet.

Movie file: A file that contains a digital video data file structure that could be used with any media management software (e.g., video editing, post-production, etc.)

MPEG: An ISO standard partly based on the Quicktime file format (MPEG-4) that defines most multimedia file and compression standards for the media industry.

Long-Form productions: Long-form productions are defined as video products of long running times (usually no less than 30 minutes) that take the form of a drama, series, TV show, documentary, or film. Long-form productions take several days, months or even years to produce and require long hours of shooting, editing, and post-production. These attributes and conditions distinguish long-form productions from other types of media products such as news items or TV commercials.

Non-linear editing system: A preferred terminology for naming video craft editing suites. It is sometimes regarded as the audiovisual equivalent of word processing. It is non-linear in contrast to analogue editing methods which were based on recordings on reels or tapes in which editing had to be done sequentially. Thus, non-linear editing means that the system is able to modify the order of digital video clips at any moment on a timeline sequence.

Metadata: "Data about data". It is a language used for the analysis of object language, therefore, a language about another language that enables navigation

through datasets. There are different types of metadata, such as technical, structural, or descriptive metadata. Their main objective in the media industry is to make content accessible through search queries.

News Productions: In contrast to long-form productions, news productions take the form of news stories, sports coverage, and other brief journalistic style content. News productions take only several hours to produce. Their content is made out of shot footage as well as archived material.

Post-production: Post-production is a term used to explain the manipulation of video in terms of changing aspects of editing, composition, and visual effects (for example, an effect that changes the color of a video shot). Post-production is also related to CGI (Computer-Generated Imaginary), which includes all the animations in 2D, 3D, and other special effects. An important part of post-production that has been developed substantially in recent years is the composition, which is the use of layers (in a similar manner to a program such as Adobe Photoshop) but with moving images.

QuickTime movie: A video file format developed by Apple that contains sound, video, animation, or a combination of data types or layers.

Resolution (Display Resolution): The quality of the image in terms of numbers of lines in the TV monitor or display. It is usually quoted as width \times height, with the units in pixels. There are two common standards: SD (standard quality, 720 \times 486 pixels) and HD (high-definition, now the common standard for commercial TV Networks, which ranges from 1280 \times 720 to 1920 \times 1080 pixels). New higher resolutions are constantly being developed such as Ultra-high-definition television and Cinema Projection.

Rough Cut: A draft version of a film or story. It allows the director and executive producer to get a sense of the film's overall flow before the final cut.

Shot list: A list of all shots necessary for a particular sequence or for the full film or

story.

Storyboard: A schema that gives a structure to how the image (or series of images) has to be shot and arranged in the script. Directors, producers and editors use storyboards to illustrate their ideas before shooting.

VOD (Video on Demand): Systems which allow audiences to select and watch/listen to content (usually TV or film programs) instantly. Services such as TiVo, Netflix or BBC iPlayer are often regarded as VOD.

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