From electronic text to media-data space

An empirical case of organizational change through digitalization in the media industry

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Abstract
In this paper we examine the changing conditions of video production and distribution, consequent upon the deepening digitization and unification of computer systems in media organizations. In relation to media organizations, there is still little research on how their digital assets are being managed. Noticeably, in the media industry some of the most dramatic organizational changes are happening due to the ways in which the production of digital video is being managed. Throughout these processes, metadata becomes key as it is included and used extensively in the software platforms. In the typical broadcasting environment the retrieval of material was done through analogue systems and may have taken hours to find a specific content. These technical developments reconfigure and redefine internal operations in media organizations and change the cognitive skills of the users of technology into a media-data space. A new expertise and roles for the manipulation of digital media are emerging. Most of the new roles are related to the management of digital content from its creation all the way to delivery. The effect of this media convergence has increasingly been the reduction of all existing media to computational processes.

1. Introduction

The perpetually bright and controllable quality of cyberspace makes real things look poor and recalcitrant in comparison (Borgmann 1999).

In the last decade, due to the advance of the Internet and interactive media it has become seldom the interaction among users and how they are changing the way they watch and consume content. However, in relation to media organizations, there is still little research on how their digital assets are being managed. Digital video, which is today prominent in the Internet ecosystem, is also a central component in contemporary media production. Noticeably, in the media industry some of the most dramatic organizational changes are happening due to the ways in which the production of digital video is being deployed. However, there is even less literature in relation to the organizational and technological impact of those changes as most media organizations are still in the process of deploying fully-digital processes and systems (Deuze 2007).

Digital media objects require the production of tags (metadata) and other information about the content in order to make it findable and usable in a database. Therefore new expertise and roles for the access and manipulation of digital media are emerging within media organizations. Most of the studies had focused in changing patterns in consumers, however, historically few people has studied with considerable detail the practices in organizations. More over, informatization has two basic settings, the industrial one and the administrative; in terms of the media industry, which is a different industry it required a different treatment (Kallinikos 2005; Kallinikos 2009; Zuboff 1988).

In the subsequent section we build on some previous research and theories to analyze the basic elements of cognitive skills that are part of the informative

capacity of the electronic text in working practices as defined by (Kallinikos 1999; Zuboff 1988). Then we will make a brief analysis of the evolution of images taking into consideration how it detaches from its physical support from *image-object*, to moving image and towards a *data-object*. Accordingly we introduce the data-object as an important element in the unification and digitalization in the media industry. In order to study how this new image space performs in similar fashion to the electronic text prompted by (Zuboff 1988), we do an analysis of its constitutive cognitive form. In section 3 we explain briefly the research setting and its methodology, and in section 4 we conduct an extensive explanation of the work environment and its changing practices due to the digitalization and unification of technologies. The research setting is the BBC Northern Ireland, located in Belfast, where the first working application of the BBC's Digital Media Initiative (DMI) has been deployed. In section 5 we analyze our empirical research and connect it with some of the theoretical considerations discussed at the beginning of the article to understand some mayor cognitive skills that are being developed in the media industry working practices. Finally, we conclude with some broader issues that are connected to the research performed.

2. On the evolution of cognitive information in the media through computational operations

2.1 Screen's cognitive skills: from the electronic text to media tokens

Computer-based technology alters the constitution of work, tending to translate processes that initially were done through physical means into rendering electronic text onto a computer screen (Kallinikos 1999; Turkle 1996; Zuboff 1984). This has required two key cognitive skill faculties: first, the capacity to connect symbol tokens to the real and tangible world; and, second, the ability to think in abstract and procedural forms that permit associations and draw inferences from data. Data, information and knowledge are the tokens of this digital reality (Zuboff 1996).

As technologies become ubiquitous and interoperable, modern organizations face transformational challenges in order to take advantage of the informating and cognitive capacities of computer-based technologies. Cognitive skills assume that due to the specific constitution of a technology, physical reality is pushed from the places where human effort was exercised to be rendered as an information process (Kallinikos 1999). The object of sense has to be associated with a semantic reconstruction and comprehension of the relationships through a sign system (a word, a verbal or numerical statement, a code, or an image). Hence, the object of sense is the meaning of a sign system.

Each technological system in an organization has its very own use of sign systems. However, we have to take into account that since the initiation of the history of bureaucracy, the physical medium has always been important in order to build and comprehend relationships of a specific work setting. As (Zuboff 1988) illustrates, clerks wrote words on paper since paper was a concrete and credible medium, mainly because of its physicality and also

because writing itself is a physical activity. As computational processes penetrated working practices, workers developed abstract thinking in order to link physical entities with symbolic elements into the construction of reality itself (Hayles 2005; Hayles 2006; Kallinikos 2009).

Due to the expansion of the Internet, it is now prevalent that most technologies that operate on computer systems enable the manipulation of visual signs that are based on images or videos. An image is sent through the identification of semantic entities and the relationship by which it is composed or makes reference to. A digital image is further enhanced through the identification of those aspects from the real world that it is supposed to stand for. Running against the limitations of our own mental capacity in what Hayes (Hayles 2005) defines as the 'Regime of Computation', the Internet pervades the social and daily practices, generating a rather distinctive consumption of digital tokens in the form of digital images (photos, videos).

Any kind of digital image has a material signifier, which expresses or represents a sign system. In some image-intensive organizations, such as the media industry (organizations working on film, broadcasting and publishing activities), the exercise of work presupposes a cognitive capacity to understand and act upon that processes oriented to the production of digital images through the use of communication technologies. In this case, the sign system depends mostly on the complex and elaborated codifications and technical constitutions that signify image objects. Let us now elaborate further on the cognitive constitution of the image by analyzing a brief history of its consumption, use and manipulation.

2.2 The evolution of the image

As it is in the case of the history of bureaucracy and the cognitive skills required for electronic text (Beniger 1986; Zuboff 1988), perception and

understanding of what an image constitutes has evolved throughout the centuries. To understand the digital image we should start by considering three main stages in the evolution of the image: first, the image-object, second, the film and finally, the digital image (Brea 2010).

In the first stage, the *image-object* was inseparable from its technical regime, in a similar fashion to the text and its paper support (Zuboff 1988). That meant that for a long time the image's physical constituency and its content was embedded as one sole object (Brea 2010). Consequently, the technique was unrecognizable from the object. Production incrusted into materiality maintained a form and a sense of immutability (Latour 1986). The embeddedness of the image with its material subject meant that it was indissolubly tied to a particular support to conform 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 (preservation) as well as its access.

The second stage is characterized by the moving image (film and, later, video). The moving image unwrapped the *image-object* regime, as it required an evident set of machinery as part of its support. Those machineries were specialized in particular operations. Some machines were specifically conceived for shooting (cameras), others for developing film through a chemical process, others for editing the film strip to produce the final story (moviolas) and further ones were made for viewing the film in a theater (projectors). Nonetheless, the moving image, was also embedded on some type of physical support, such as the filmstrip. This meant that the machinery that performed a particular set of operations were only compatible with a particular type of physical support.

The switch to magnetic tape happened since the media industry required more efficient ways to record images without the expensive and slow process of film development. In the late 1950's magnetic videotape became popular in

the media industry since it reduced the costs of film recording and live broadcasting (time schedules, preparation and portability were the key concerns). The use of videotape spread rapidly for pre-recorded broadcast and news applications. It was slow, however, in program production and the shooting of commercials, despite its advantages and economies. One reason for this was the editing process, which was significantly different from the one of film, and therefore required a different set of skills. As magnetic videotape started to replace film the number of videotape formats exploited to several dozens. Each videotape format had better features but brought further complexity to the manipulation and maintenance of legacy machinery and its media.

Furthermore, sets of machinery brought specializations thought-out the media industry; moving-image production was noticeably divided into three main operations: shooting, editing and delivery. Therefore, we can assert that with each *dispositif* new affordances, processes and skills were brought in distinctive ways (Agamben 2009; Uricchio 2009).

The third evolution of the image was the switch from magnetic videotape and film-based supports to tapeless solutions, like recording in hard disk drives, optical discs and other types of digital memory. Digitalization, as we will discuss further, turned the *image-object* into a *data-object* that generated a set of cognitive skills, similar to the ones required to perform actions with electronic text. The electronic image, however, not only meant the need for mental abstraction but also for new skills to navigate and manipulate visual codes inside a perceptively ubiquitous media-data space.

As a new cognitive constitution of electronic images becomes instituted in media organizations, the Internet multiplied the effect through image and video aggregators such as Google, YouTube and Flickr and the proliferation of image recording and playing devices (cameras, mobiles, game consoles). The change in consumption of electronic images, also extrapolates to the

cognitive skills required in organizations responsible for creating media stories. We should consider the Internet and other electronic platforms as spaces and processes of socialization and subjectivization for the proliferation of new symbolic and cultural formations of the image (Debray 1992).

2.3 Unification and Digitalization in the media industry

The history of the media industry has always been connected to the expansion of technologies, since the use of electrical energy for communication in the early nineteenth century that enabled the first telegraphs systems, the use of electromagnetic transmission in the 1870s and the first experiments on electronic waves that enabled at the turn of the twentieth century the developments of radio and then television. The media industry at its core is based on the use and evolution of technology (Küng et al. 2008a). The current developments of new forms of computation are based on the digital systems of codification and convergence of centralized information and communication technologies on unified digital systems of transmission, processing and storage (Thompson 1999). We will analyze in the next paragraphs, with some detail, the development of the media industry towards the digitalization and unification of its operations.

2.3.1 A fragmented broadcasting ecosystem

As we mentioned earlier, the machinery used in the media industry performed specialized functions; moving-image production was divided into three basic operations: shooting, editing and delivery. Each of these operations had specialized technologies and machineries that were not interconnected, creating working and operating silos.

There are two main causes that reinforced these working and operating silos. First, through the history of the media industry, there was a black-boxing of

technologies, enabled by industry manufacturers, in order to lead standards. Black-boxing technologies enabled proprietary standards that allowed manufacturers to halt competitors to develop similar technologies for specific operations. Second, as the broadcasting world was forced to specialized machineries for each of the three main operations this made the working practices more divisional, aimed at specialized skills. These two issues not only generated that the world of broadcasting became very specialized, but it also generated an extremely fragmented ecosystem. This brought to a stand still any possible interconnection among machineries that perform different operations. In the media industry, this ended up in having several standards for specific functions.

People working in the broadcasting industry knew about very specific technologies and systems, which led to extremely inefficient processes. This brought that the operations in the media industry were extremely specialized, mostly focused on hardware and their real-time capabilities (which as we have seen is a critical element in broadcasting).

As those technologies and machineries required particular cognitive skills, it also meant that each operation, and some sub-operations, demanded rather distinctive cognitive settings from the people that were in charge of operating them. These people became specialists in acting upon specialized technologies and machineries. Even though some technologies changed through time, the physical operations to be performed remained very similar. The only standard flow connecting all these equipments was the electronic impulses that generated video images, which were inscribed in videotapes. The videotape, as a physical entity, was used to connect all the operations in order to preserve a technical quality. We can think of the physical value of videotape in the same way (Zuboff 1988) defined the use of written paper in bureaucracy. The videotape and the machineries used to control its functions became standardized enabling a sense of domination and a sense of physicality that enabled a perception of confidence (Zuboff 1984). As long as

the quality of the story was preserved throughout the set of operations, incompatibilities between machines and silos were unimportant. Even more, as the quality was preserved, this reinforced the idea that specialized equipments in each part of the process were necessary in order to sustain the highest quality.

2.3.2 Digitalization and unification of operations in the broadcasting ecosystem

Some literature suggests that the technological advances that are currently driving the media industry include digitalization, the Internet and streaming technologies (Küng et al. 2008b). Digitalization and the Internet took place simultaneously, therefore it is difficult to interpret their impact independently one from the other. However, what can be asserted is that digitalization rendered a discrete set of legacy machinery and hardware infrastructure into software instructions. Shooting, editing and delivery –the three basic operations within the media industry- were unified into a series of interconnected software processes. Digitalization brought the unification of operations into a new systemic configuration (Küng et al. 2008c; Zuboff 1984).

Digitalization demanded the progressive dissolution of the physical object (the videotape) into digital tokens available as data files in a computer system, witnessing one the most drastic changes in media organizations up until now. Video data files running through a database, replaced the videotape and for the first time all the media become centralized in a database space. The database in that sense becomes the place where to access the content. Having the video file in digital format and stored on a database generates two key settings: the first is that the media objects requires to be findable on the digital space; the second, is that a unification of the systems is required in order to streamline the digital workflow. Hence, unification brought up the possibility to access the material from any computer connected to the network. The unification of a task space (computer) and task procedures

(software) reconstructed the tasks and procedures from legacy equipment into a unified digital arrangement.

Computer programming encapsulates the world according to its own logic (Manovich 2001). The world becomes reduced to the logic of data structures and computer algorithms, a sequence of simple operations that a computer can execute to accomplish a given task. Geert Lovink (Lovink 2008) has suggested recently that we no longer watch films or TV; but we watch databases. Data is organized in a particular way for efficient search and retrieval. The need for information describing digital objects, commonly referred as metadata (Liu 2004) enabled not only a new constitution of digital objects, but also new receivers and consumers of metadata (Stiegler 2009). This brings, as Stiegler clearly asserts, a "textualization of images".

Both unification and digitalization of the main operations in the media industry to conform to a "media-data space", generated that broadcasting and technological operations in the media industry concur into one common cognitive space. Taking into consideration the studies on working practices and cognitive skills faculties required for informative computer renditions (Kallinikos 1999; Zuboff 1984) and the new cognitive space derived from the digital image (Brea 2004; Manovich 2001; Mitchell 1994), we will now try to bridge this two key points into what we define as a new cognitive constitution of the image on a media-data space.

2.3.3 The media-data space as a new cognitive form

The media-data space implies going away from the physical object that has traditionally conditioned the media industry and make tasks and operations informatized through software, reconstructing some of the foundations of the work and modern bureaucracy (Kallinikos 2009). Let us elaborate on this concept.

The computerization of culture involves the projection of the fundamental parts of computer software onto the cultural sphere (Manovich 2001). Cultural narratives are built by the concatenation of sequences; today this concatenation is done on a computer, and through a media-data space of media objects available in a database. In contrast to a narrative, a database represents as a list of items that has unlimited possibilities to be arranged and that represent a cause-and-effect trajectory (Manovich 2001). Creating a story using media objects can be understood as the construction of an interface to a database (Manovich 2001). Traditionally, media objects available in the database could be related by units that share commonalities, or as it is defined in semiology, a paradigmatic dimension (Barthes 1977); going back to the cultural narrative this is a combination of signs, which has space as a support, that are related in context and are represented in reality to what is called the sintagmatic dimension (Barthes 1977). (Manovich 2001) mentions that new media reverses this semiotic relationship: the database is given material existence and pervades our reality of the world through the manipulations of digital tokens rendered in computer screens, or as we have defined, in a media-data space. The media-data space brings a new constitution of reality, in which discrete data tokens pervade the cognitive skills. The cultural narrative constitutes a set of links to elements stored in a database.

Therefore, the constitution of a media-data space is the result of two important characteristics. First, the perception of images in our cognitive understanding of reality and how through the use of digital tokens we perceive them as ubiquitous. And, second, some central characteristics of electronic text that are also present in the digital image, such as the necessity of a palpable physical medium that enabled to build and comprehend relationships of a specific work setting (Zuboff 1988).

Computer screens through which reality is mediated by means of data always hides, discloses, distorts, magnifies or conceals operations (Kallinikos 2009). The black-boxing of machinery and artifacts, both in software or hardware prevent the intervention on the process by which the end product is produced. Computation, differs from industrial automation in the sense that it is significantly more vertically stratified and functionally interdependent (Kallinikos 2009). In the case of the media industry, that means that with hardware and broadcasting machineries, we were still able to understand with more precision the process of each specific operation. Each specific operation brought with it a stratification of skills, which did not enabled unification of tasks. Digitalization and unification enables the common work among several software operations, but the processes and algorithms become hidden. For this the technological character of the search processes for the moving image, similar to when we look for something in Google or You tube (Lovink 2008; Manovich 2001).

As we will see in the case that follows, there are still several attitudes towards technology and physicality of the object that prevail, even if the organizational setting has been used to deal with technology. When the processes that were used to find their means through physicality becomes automated, it looses the cognitive and personal memory, We rely that automation will make things better and more organized than humans; as well as an automatic system is given, they stop to remember the functions and rely on the system. Thought many of the rules that were mapped initially from human work were translated into the system, those rules as working practices banish with the use of the automated system.

A system could automate or informate (Zuboff 1984). The issue is that some processes may seem so simple that they become automated and the people will latter vanish them from their minds, and they become invisible processes. On the other side, when people work on a process that informates, they will turn to understand what they have to frame in the process; as the system

becomes more sophisticated, it is made up of hidden layers of technological apparatuses and its social construction is limited (Kittler 1997).

3. Research Setting and Data Collection

The case study was based at BBC Northern Ireland, one of the operations of the British Broadcasting Corporation (BBC). BBC Northern Ireland (BBC NI) deployed Digital Northern Ireland (DNI) as part of the Digital Media Initiative (DMI). (DMI) is a massive UK-wide plan that aspires to have BBC's core operations relying entirely on information available on digital format. BBC NI operations include 77 people in the technology department. Qualitative data were collected through participant observations, interviews (both in-depth interviews and on-site visits) and documentary sources. The researcher conducted in-depth interviews with 10 people during a two-day visit to the setting in Belfast. The people interviewed were all involved in the deployment of the technology. The on-site observation included an extensive visit to the main centers of operations of the implementation, informal conversations and understanding of some of the technologies deployed. This also helped to gain a better illustration of the magnitude of the implementation as well as to acquire familiarity with the contextual environment. The areas visited included the machine room, the newsroom and the editing suites. The documentation included specific organizational and strategic aspects of the transformation as well as training reports. As the initiative was mostly based in a particular software solution, an off-the-shelf software package called Cinegy, an overview of the system and technical documentation about it in order to understand its ease-of-use was required. The interviews constructed the bases of the analysis. As the DMI operations are assembled and distributed under six high-level functionality enablers, therefore extensive knowledge about the DMI project was required in order to have a general understanding of several processes at BBC NI's DNI. The interviews were transcribed and re-organized with the purpose of identifying thematic units. The identification of major and recurrent themes in the empirical material was enabled due a prior understanding of the main theoretical concerns that this research had prompted and extensive reading of similar research papers (Kallinikos 1999; Kallinikos 2009; Lanzara 2009; Zuboff 1988). The presiding section is a

condensed version of the findings that are connected to the theoretical analysis delineated in section 2.

4. Case Study

4.1 BBC DNI: Overview and Context

BBC NI in Belfast is the second 24-hour newsroom in the UK (due to its adverse political situation). However, it was very late in terms of technology investment; it was the last tape-based newsroom in the UK. Their legacy systems were mostly based on tape, generating unnecessary costs to maintain. This costs not only include the difficulty to find replacement pieces of hardware that were not longer manufactured, but also the time of employees, dedicated in fixing and repairing old equipments, which was not adding real value to the organization.

DNI has been the first real implementation of DMI in the UK that used commodity software and hardware. The approval for the investment was given on October 2008. The off-the-shelf software selected for this implementation was called Cinegy. Cinegy was originally developed at BBC Technology Ltd., which was later sold to Siemens, which at the same time sold it to a private company based in Germany. Cinegy as a product originally developed by BBC Technology was extensively customized to meet BBC's specific requirements. When Cinegy was brought to BBC NI as an off-the-shelf software solution, it did not go through any type of customization process. However, the use of Cinegy at the BBC NI was done in a way it was never used before, creating three different databases: two Work-in-progress Areas (both for news and long-form productions) and one shared library (the permanent archive for material that was worth keeping).

In the words of Mervyn Middleby, Head of Technology of BBC Northern Ireland "*DNI it's a 2-year project, but it is not a technological project it is a transformational (80% hearts and minds, 20% technology). It's adaptability to change".*

As the implementation of DNI is recognized to enable a transformation within the organization, our research is focused in analyzing how it redefined the workflow and how this workflow at the same time generated a change in the cognitive skills enabling a new space of possibilities facilitated by the informating capacities of computer-based technology.

4.2 Changing Practices: how digitalization redefined the workflow.

4.2.1 Tape-Based Operations carried at BBC NI

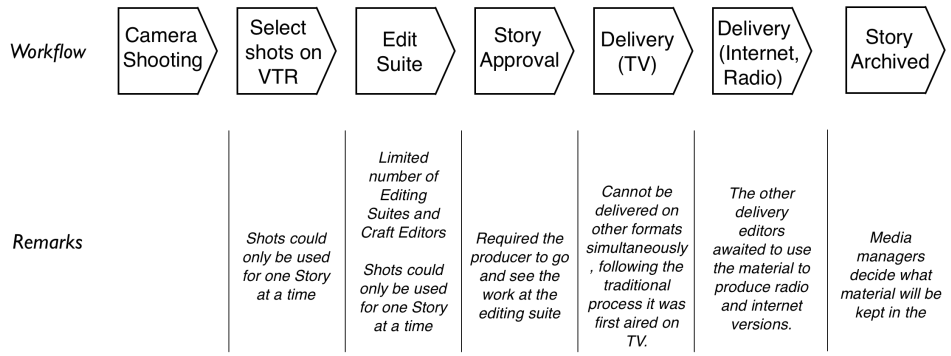
One of the central aspects of DNI was the shift from old legacy equipment to a computer-based model serving digitalized media assets. BBC NI was based on old legacy machinery that generated a fragmentation of technologies operating in silos, a sort of "technological islands". BBC NI operational workflow followed the classic tape-based world process (Fig. 1) that consists of the subsequent steps[1]:

1. Shooting gets recorded to tape.
2. Tape gets labeled with the information that was shot.
3. The journalist has to book an editing suite in order to get its story edited, as it was done in expensive editing suites and tape based legacy equipment, which were scarce and on high demand during certain peak hours.
4. The editing of the story requires at least the participation of a journalist plus an editor.
5. The final story has to be reviewed by the producer, who approved the story.
6. The approved story on tape is available for on-air delivery (TV broadcast).

[1] For practical reasons and as an illustrative case, this description follows the process that is followed in news production. Though the BBC DNI has been also deployed for long-form productions (documentaries, series and drama) at the moment of field research it was not fully deployed. Therefore, further field research is required in order to map long-form productions processes.

7. After the tape is used for on-air delivery it is accessible for the other media deliveries (Internet, radio)
8. Some selected material will be available in the archive in physical tape format.

Fig. 1 Original (Analogue) Process



One of the most problematic issues of this model was that it depended on a physical media, the videotape. If more than one journalist required the videotape as it had shots that were also necessary to produce other stories it would have to wait for the first story to finish the editing process (step 5 on the workflow). Another problematic issue occurred due to the scarcity of editing suites, as there were only a limited number and each of them requirement of a permanent editor, which made them extremely expensive in terms of man-hours. Beyond the organizational processes, as mentioned earlier, legacy systems were expensive to maintain and difficult to manage. Even more serious, was that this model was not working smoothly, since depending on machinery generated a patchy fragmentation of legacy equipment that worked unevenly.

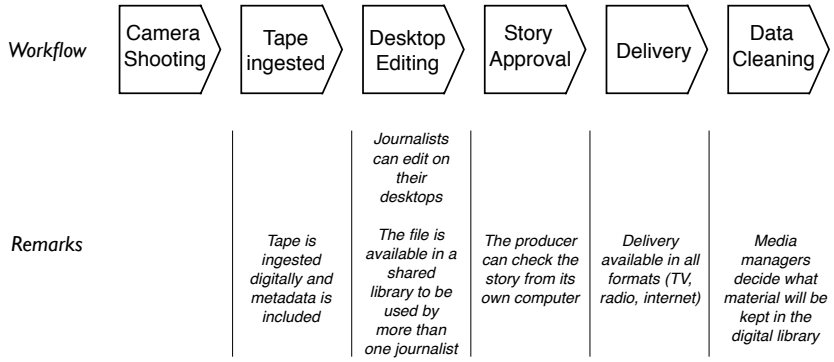
Finally, the videotapes as a physical medium had to be stored and preserved. As we learned in section 2, videotape has been evolving through several formats, which means it required maintenance, and had a limited life based on its use (worn out after several playbacks).

4.2.2 DNI Operations carried at BBC NI

When DNI was deployed, the central technical aspect of the process was to use a system that was based on digital video files. That meant that IT infrastructure that serviced this deployment had to be interoperable. At the same time, digital assets required a unified technological space in order to be transferred among the different parts of the process. It would not be proper here to talk about centralization, as there are many systems in place; it is a unification of standards based on a common computational infrastructure in order to facilitate the interoperability. DNI consistent on a new workflow model (Fig. 2) that followed the subsequent steps:

1. Shooting gets recorded to tape.
2. Tape gets ingested and digitalized through an ingestion hub.
3. The media object (video file) is digitally labeled (metadata).
4. The media object is available for everyone, to be used for any story at any moment.
5. The journalists on their desktop computers do the editing.
6. Craft editors only participate in very specific, mostly aesthetic-related instances, where their crafting talent is valued.
7. The producer from its computer could review/approve the final story on the fly.
8. The final product is available for delivery at the same time for all media platforms (TV, internet, radio). It is believed (and it makes sense) that the Internet will be the first to put it on air.
9. Hold all the rushes and then the media library managers will have to make decisions in order to see what to delete and what to keep (media cleansing).
10. The material is permanently available at the digital library for further re-use in other stories.

Fig. 2 Current (Digital) Process



An infrastructure based on quite a detailed and extensive list of requirements, storage, network storage, restrictions for using material, formats, has to be defined in order for users to access the material. As in many IT implementations, this one might have had the misfortune of not working in the way it was planned. However, it worked much better than expected. Currently, the management of media is done 100% software-based, 92% of the news stories are produced directly by journalist on their computers, which is a true transformation. One of the reasons for the success of this initiative, was that BBC NI, as mentioned earlier, were very late in terms of technology investment, therefore, the investment was valued by all members of the organization. As the journalists realized the benefits immediately, the rule out plan was completed 2 weeks before the plan (6 week plan vs. 4 weeks).

One of the central aspects, which changed with digitalization, was the use of metadata as a key element to find digital video on the database. The major problem with any kind of file-based system is that once it is in the database it banishes if it is not well labeled. Most proprietary storage technologies systems allocate a number but not a logical name. One of the tasks of the digital media operation team was to do the ingestion and they ensure of the quality of the metadata. Embedding the media managers with the production people, in order to help them with the metadata creation. Always focusing to

be at source. Technically not yet the cameras have systems for metadata ingestion.

All these organizational changes within BBC NI affected the cognitive skills of the people that had to work the most with these technologies, namely the journalists, as well as the editors and the broadcast and technology engineers. In the next sub-section we will try to analyze some of those changes in the cognitive skills of some of the positions that evidenced the most drastic changes in their working practices.

4.3 Changing Working Practices

As we mentioned previously, as technological machinery was divided in silos or "technological islands", so did the practices of the different people involved on their daily operations and routines. The new DNI workflow not only enabled the use of digital material through a standardized computational system but it also produced some changes in the working practices. We will analyze four positions that from our fieldwork denote the most drastic changes on their working practices after the deployment of DNI. These positions are: news journalists, craft editors, media managers and broadcast engineers. We will first describe the role of each position and then expand on how the role has changed.

4.3.1 News Journalists

The role of news journalist is one of the most diverse inside the newsroom. The news journalist participates in the shooting of the story, reporting as well as preparing the final version of the story that will be broadcasted.

The role of the news journalist is the one that suffered the most evident change. While working on videotape machineries, they require the support of an editor in order to instruct them on what they expect from the editing of their

final story. With DNI the editing job has turned to them, who are now able to edit their stories by using a simplified video-editing tool available on their personal computers. As one technical project manager mentioned:

> *When you go down to the newsroom it used to be a loud environment, but since this is rolled out to journalists they are very focused on their desktops editing their own pieces, and they are quiet and concentrated. Before they were always trying to get the same piece of material from some big event, and perhaps there was just a couple of tapes with that stuff and there were 5 or 6 people wanting them. But now they all can have them at their fingertips, so they can sit and concentrate on them and produce. Before they were waiting on a slot for an Avid suite and they might be hanging for 2 hours before they could do anything. Now they can sit and actually finish up and go home early. Plus they produce better material cause they have wide range to choose from.*

The use of the video-editing tool also connects their possibility to browse the digital archive, which offers most of the digital footage from the BBC NI. News journalists were able to search the digital archive in a similar fashion to searching on YouTube or Google. Therefore, there is a perceptual sense that the materials available at the digital archive provide them with ample creative possibilities. This perception contrasts with the sensation generated by the limited time possibilities to view videotape material. Browsing the digital archive links also to the change in the way news journalists experience media content: before people were viewing media content in a very linear or narrative way; today they are browsing, which makes it easier for search. Because news journalists have been working with a video-editing tool they understand now how important it is to have metadata inputted into the system in order to find material.

Finally, another issue that changed significantly is their perception of when the story is ready to be delivered on air. Before, it was immediately once the story was finished to be edited; now it takes some minutes to upload to the

system the high-quality version of the videos in order to put it available for delivery. The news journalists do not easily understand why they have to wait to have their final copy available, mostly because they do not see the hidden process that takes on the computer system. As one support engineer mentioned:

> *Originally what we thought is that the system will manage it transparently, so the actual delay is irrelevant. But they have to understand that moving from the tape to final export requires few minutes to move some information from tape to disks. The technology should be invisible for the user.*

4.3.2 Craft Editors

The craft editor is the specialist in charge of editing audiovisual content, usually in specialized editing suites. The craft editor works closely with the news journalist in order to edit their story in editing suites. The success of DNI was something that was not anticipated by the craft editors, which abruptly were no longer required by news journalist to edit their stories, as news journalist had their own desktop video-editing tool. In words of a support engineer:

> *That worried the editors in two ways: either their role will be diminished, since the journalists had a [software] package to put the news together; or, possibly, the journalists were going to prepare a mess and then ask the craft editors to rectify it.*

Consequently, one of the most problematic groups of people were craft editors, that do a very skill full job but that no longer had to dedicate long hours to work with news journalist in editing stories. However, after DNI was implemented, it was evidenced that the desktop video-editing tool provided to news journalists is quite simple and cannot compete with an advanced editing suite. Therefore, craft editors, who had a more deep technical expertise, still are necessary to work on stories that required advanced post-production

effects or even small clips that required some kind of effect within stories edited by news journalists.

4.3.3 Media Managers

Media managers are in charge of the management of both the physical videotape-based as well as the digital libraries. As the digital library is accessed through text-based queries, it is key to input good quality metadata in the video files available there. The media managers position is therefore no longer at the library itself but at the ingestion hub, where media is digitalized. Good quality metadata is inputted at the point of shooting or at the ingestion hub. This position has become strategic as the archive is continuously in use.

Another important function of the media managers is the process of data cleansing. Data cleansing is the process of selecting what footage should be kept in the digital library and what is not worth keeping.

4.3.4 Broadcast Engineers

Broadcast engineers had been managing hardware, mostly video and audio equipment. Broadcast engineers have a very different ethos compared to computer engineers. As one support engineer mentioned:

> *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 system view of the whole process. Traditional engineers are not comfortable with that, they would like to get into the "resistor" and solve the problem.*

Broadcast engineers for decades had been used to managing and manipulating tape-based equipment and other legacy systems. Broadcast engineering is quite a specific industry in which certain issues that are taken for granted, in IT systems simply work or do not have a translation. Broadcast

engineers were accustomed in working with tape machines and other machineries that worked on real time.

As the broadcasting machineries are turning into computer systems that are more complex from a configuration point of view, support issues become a completely different, as this systems are unified. However, the viewpoint is that though the broadcasting industry is turning to computerized systems, there is a need to understand the broadcast industry and how it works. The new roles of a broadcasting engineer are a blend between the management of large computer-based network and the ways that this systems input and output information to and from the real world.

5. Discussion: Conceptual and perceptual issues

Taking into consideration the empirical research, we have extrapolated some of the core arguments to serve as evident characteristics to support our theoretical framework (section 2). In this way, we propose five aspects taking place in the media industry that generate new cognitive skills due to the capacity of connecting symbolic tokens to the real and tangible world, mostly related to the processes of digitalization and unification.

5.1 Hidden Processes

Each society corresponds to a particular kind of machine (Deleuze 1995). Therefore, every knowledge system has its corresponding medium of transmission that emerges as what (Kittler 1990) calls a 'discourse network', namely a "network of technologies and institutions that allow a given culture to select, store and process relevant data". In the current media industry, underlying the layer of information manipulation, there is a set hidden processes based on algorithms that a computer executes to accomplish a given task (Manovich 2001). In turn, through the history of media industry there has always been hidden processes, initially in silos of expertise promoted by legacy machineries, and today through digitalized and unified computational systems.

(Kittler 1997) mentions that everything could be discretionalized to binary symbols, therefore a computer program stands as an intermediate entity or a series of layers; writing is also part of these intermediate layers. Kittler also makes a similar analysis considering the interoperations with other layers that a program requires to interact in order to deliver a result.

Technical infrastructures are managed according to specified plans and workflows, however we have to see them also as an heterogeneous collection

of technical components, humans and institutions, embedding a representation of the functions of the organization (Ciborra 2002). Technically speaking, for the system to work therefore it required several pieces connected with each other.

Therefore, in terms of the users there may be several processes that become invisible. However, in terms of the managers and IT specialists, some of those processes are not hidden; nevertheless, it becomes inevitably more complex to deal with them. Beyond the apparent simplicity of the computer system, the relationships are always abstract cognitive entities that describe highly selective aspects of the world (Kallinikos 2009). Most of the journalists do not understand many of the processes that are linked and connected in the new technological infrastructure deployed; accordingly, they question why does it take time to render some processes that are invisible. At the same time support teams do not only need to teach and explain the hidden processes, but also they have to be more holistic as there are several processes that they themselves also do not see.

5.2 Liberating creativity through computational processes

One aspect that continuously was brought to the attention during the field-work and is also present in the literature available on media work is the consideration of how technology enables and facilitates a more creative environment (Deuze 2007). In other words, how can the machine help and support exercising automated tasks or speeding up the creative process. This in itself is a very relative issue and it is connected directly to the possible computationally capacities available for a particular set of skills.

For example, in the case of journalists the editing suite available on their desktop machines is extremely elementary in comparison to a professional editing suite. However, this functional simplification of their interface

(Kallinikos 2006) lets them explore expanded possibilities that were not available before. Therefore the technical restrictions in some platforms may not be relevant as far as they speed up practices that previously took longer time to do.

5.3 Sense of property, collaboration and individuality

Digitalization generated a shared space were digital footage was for the first time available to everyone in the BBC NI in order to use it for working on new stories. The sense of property is lost and at the same time the notion that all the material is available for everybody else becomes settled. Though most of the computer-based implementations that had been deployed for DNI promote the individualization of work, we must take into account that as long as there are shared resources (such as the shared digital library) the potentialities of collaboration will be brought as a possibility. The project, goal and plan should make sense to those called on to implement them (Ciborra 2002). Human beings do not like to be controlled, or if they are, they want to see that the technology makes sense to them and they are getting benefits, and a sense of hospitality, an interface that connects the technologies with their users (Ciborra 2002). DNI generated this sense of hospitality to its main beneficiaries. Finally it does not have an author, it can be used by anybody in the workspace or it results from impersonal and autonomous processes in some cases that offer that the digital object is less vulnerable of criticism, especially in the sense of the processes as well as the archived images.

5.4 Physical support of the image object towards a data-object

Technology through digitalization has integrated many tasks into processes that have been rendered in computers systems (Kallinikos 1999; Zuboff 1984). The informating capacity of technology produced a new medium of

electronic image that depended upon electronic text, findability and manipulation of the media-object. The constitution of innovativeness started with text, but has in the electronic image further constituency, which offers findable and re-mixable possibilities.

The electronic image as well with the electronic text exists independently from time and space (Zuboff 1984). When the object was confined to be physical it generated a pressure of centralization; in the case of the media industry, the process was go to the archive to get a tape and then find a machine in order to visualize it. The electronic image is the result of unification into a database of a computer system, and therefore its contents are standardized, and can inform the entire organization through a network of desktop computers. What desktop publishing brought was that we no longer required sophisticated equipment to diffuse print media; it is the same with desktop video, in which today, we no longer need the specialized hardware in order to edit or manipulate video.

5.5 The Database and the media-data space

Data repositories when being in digital format generate a sense of abundance of information. In contrast to the scarcity of using limited content shot at one or taking the time to search for additional material in a physical archive, digital libraries are able to have all these material available on a searchable database.

Computation let to establish and technologically embody the operational object with lower-level computational processes. Before computation few people understood the complex processes required to handle image production, but now thanks for computation, the operation and manipulation of video has come to each desktop, in a similar fashion to what is happening with consumer videos in YouTube. Simplifying the processes, or making

industrial or commercial processes to resemble similar processes to the ones available today on the Internet enables the users (in this case the journalists) to intervene the media directly.

The smooth operation of the computer system that runs on the organization is made possible through elaborate database solution and other computational resources that support the task and functions modules in which users interact. There is a forge between higher-level technological objects at the human interface and the lower-level function through which the functionality and computationally mechanics of the objects by which this process are sustained (Kallinikos 2009).

6. Concluding Remarks

We have to take into consideration that literature around media and the impact of the internet has been focused on strategic and organizational consequences more connected to the competiveness of the media industry and its relationship with the audience (Küng et al. 2008a; Küng-Shankleman 2000) and not on organizational issues that are key to understand the process of computation within the working environment as well as the cognitive skills and changes within working practices.

We have started describing how electronic text became reconstituted into cognitive skills in organizations. Then we analyzed the evolution of the image towards a digital *data-object*. The *data-object* enabled the digitalization and unification of processes in the media industry. The media industry turned from a fragmented media ecosystem into a media-data space. Capturing analogue information and putting it in digital format, recaptures the abundance as well as irrelevance available in analogue information, therefore richness and variety is perceived, as well as a significant order (Borgmann 1999).

As the moving image started to be manipulable, the materiality of its support also led to uncover its limitations. For example, to edit a film, it was a holistic act of action upon a group of sequential images that could not be manipulated in a discrete fashion (Brea 2010). As the viewing and manipulating machineries evolved, so did the ways in which this holistic process of acting upon images became more sophisticated.

For decades, and still to some extent today, the broadcasting industry has been operating in silos. However, we must say that those silos were not complex to connect since the main element they transported, the videotape, sustained the whole “production line”. In general the broadcasting industry never tried to connect those equipments together in order to streamline or automate the process. As mentioned earlier, perhaps there was no reason to

do this as the main element that was transported, video, was transported through electronic signals that due to the high-quality of the equipments never impacted over the final quality of the production. The equipment that was used, that can be defined in some was as legacy equipment, did not interoperate with others, most manufacturers in the broadcasting industry developed their own standards and as the players were few, the standards prevailed for many years. Since these manufacturers were few, the broadcasting companies defined to go to one standard or the other. However, during the years, as more of the production was done using computer equipment, from non-linear systems to special effects packages to digital cameras, it became more obvious that the broadcasting industry required to interoperate their operations through standard digital technology.

The effect of media convergence has increasingly been the reduction of all existing media to computational processes. Digital video is assembled by a variety of operations most of which are sustained by underlying numerical representations that render them programmable, manipulable and interoperable (Kallinikos 2009).

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