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VIDEOGRAPHY AS PRODUCTION NEXUS

DIGITAL FILM CAMERAS, MEDIA MANAGEMENT AND THE DISTRIBUTION OF CREATIVITY IN TV AND FILM PRODUCTION

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Abstract

This thesis is about new digital moving image recording technologies and how they augment the distribution of creativity and the flexibility in moving image production systems, but also impose constraints on how images flow through the production system.

The central concept developed in this thesis is ‘creative space’ which links quality and efficiency in moving image production to time for creative work, capacity of digital tools, user skills and the constitution of digital moving image material.

The empirical evidence of this thesis is primarily based on semi-structured interviews conducted with Swedish film and TV production representatives.

This thesis highlights the importance of pre-production technical planning and proposes a design management support tool (MI-FLOW) as a way to leverage functional workflows, which is a prerequisite for efficient and cost effective moving image production.

Dedication

All hard working film production students at Dalarna University and elsewhere. I am your biggest fan.

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Special thanks to my colleague and fellow doctoral student Thorbjörn Swenberg for valuable time spent on discussing moving image production as an intellectual endeavor. Without his professional attitude and support I would not have gotten this far with my studies.

Most of all, I am thankful to Charlotte – you know why.

List of Papers

This thesis is based on the following papers, which are referred to in the text by the following capital letters.

A Eriksson, P. E., Eriksson, Y., Swenberg, T., Sverrisson, Á. (2010) **New Design Processes in Moving Image Production. A Design Science Approach.** *Proceedings of the 11th International Design Conference - DESIGN 2010, Dubrovnik.*

B Eriksson, P. E., Swenberg, T. (2012) **Creative Space in Contemporary Swedish Moving Image Production.** *Journal of Integrated Design and Process Science.*

C Eriksson, P.E. (2012) **Convergence Cameras and the New Documentary Image.** *Digital Creativity*.

D Eriksson, P. E., Eriksson, Y., Swenberg, T. (2012) **Design Management Support for the Audiovisual Industry.** *Journal of Integrated Design and Process Science (SDPS, Berlin, June 2012).*

Contents

Definitions of Key Terms

A **Codec** is a specific way to organize the digital image information in a file. Usually a codec rationalizes this organization so that repetitions of information are reduced. This is called **Compression**. Every codec is unique and incompatible with others.

A **File Format** is a specific way to organize the digital information around sound and image data. The same file format may use different codecs, and the same codec may be employed by different file formats. Both file format and codec must be correct in order for computer software to read them properly, or at all.

Production has a dual connotation in this thesis. It refers either to an audiovisual object or to a process of creation.

Production Value is an aesthetic paradigm almost globally agreed upon among film and television production firms (Shamir 2007). Used as a concept, *Production Value* infers that those audiovisual objects with **High Production Value** look and sound exclusive, whereas others look and sound substandard or 'cheap', regardless of the innovative, or other, qualities.

Videographer is a term widely used in the US. The term connotes a professional who records video for a living. Indicates a lesser status than a cinematographer or DoP (Director of Photography). In this thesis I use the term videographer since most cinematographers of today record (digital) video.

1. Introduction

This thesis revolves around a kind of dilemma: how may the craft of videography remain a creative craft, while at the same time having to serve as a highly technical digital media management function? The answer to this question may be that if media management is to become simpler, the videographer will stand a chance to regain lost creative capital, and so will other designers of the production collective.

This was an important revelation of the *New Design Processes in the Audiovisual Industry* project that is the research framework for three of the papers included in this thesis (Papers A, B, and D). This project was a collaboration with fellow PhD candidate Thorbjörn Swenberg. One concrete outcome of this research project was the theoretical concept of *Creative Space.* Another tangible outcome was an agile design project that resulted in MI-FLOW[1], a Design Management Support tool in the form of an online checklist.

There are many more or less successful attempts at managing designers' creativity within the Swedish Moving Image Production Sector (Paper B). There is a consensus within this sector to take this challenge seriously since creative capital is at the core of this sector's business. If such creative capital is sacrificed through unwise management decisions that in effect shrink designers' *Creative Space,* there are ample reasons to believe that the 1,6 billion SKR (Fröberg 2011) that this sector generate per year will also begin to shrink.

This thesis describes how digital media and digital 'film cameras' condition creativity and shape professional digital moving image production (American Cinematographer 2011, Andersen 2010, Austerberry 2011, DeGeyter and Overmeire 2011, Hoffman 2012, Misek 2010, Monitor 2011, Swenberg 2012). These cameras shape moving image production primarily in two ways. Firstly, they impact communication by generating style signifiers that reside outside of the chosen production method; sometimes this happens unwittingly (Paper C). Secondly, digital film cameras affect the efficiency of workflows (Papers A, B and D). This

[1] MI-FLOW stands for 'Moving Image Flow'. Free trials and information (in Swedish) at: www.mi-flow.se

situation stands in stark contrast to the common situation of the past that remained surprisingly static (and stable) for almost a hundred years, as noted by the manager and owner of one of the biggest post-production companies in Stockholm:

> The big difference is that… before there were only 16mm. and 35 mm. If you were the producer the choice was simple, if you didn't have money you opted for 16, if you had the money you went for 35. Now there is an ocean of different possibilities. (Informant, Company A)

The central tenet of this thesis is that technological tools in organizational life have capacities for both oppression and emancipation (Miller 2012:245-246). The 'ocean of possibilities', i.e. new file/video formats and codec, constrain production systems and the distribution of creativity, but also augment flexibility and expressive constellations (cf. Swenberg 2012). The impact of the introductions of new recording technologies is never thus the sole concern of the videographer, although he or she is likely to have to take the blame if technological cruxes lessen later design options. In short, digital production modes put an emphasis on the networked and dispersed aspects of being creative with images. Therefore, as production duties and entities merge and overlap in the digital production milieu, and as designers' functions and roles merge, craft demarcations are to be considered with caution (Wikström, 2009). This is to say that when I discuss the videographer (or 'cinematographer') in this thesis, I do not approach him/her foremost as a visual storyteller and the director's visual implementer in accordance with the way this role traditionally has been defined.

So, then, how do I define the craft of videography? Admittedly, in this thesis, the questions of what videography is, and what a videographer does and why, will remain unsatisfactorily answered. Three nails in the coffin (as Latour once noted when failing to explain what A-N-T is). In part this is due to the precarious state of the contemporary videographer. Videography is in a state of flux. However, the rationale behind paying special attention to the videographer in this thesis is surprisingly simple (and possibly naïve): Videography is the *Production Nexus*, both in a technical and artistic sense. One might make a film without a director, producer, post-production specialist, sound recordist, script supervisor, gaffer and so on, but not without someone creating the medial object and passing it on. Regardless of how few recorded images there are to be found in contemporary moving image productions, if there is only one, the complete production chain must subordinate itself to the realism, irreversibility and materiality of this medial object. However, in contemporary professional moving image production this subordination is not only about compliance since, as philosopher Susan Sontag once noted, recorded images are inexhaustible invitations to "deduction, speculation and fantasy" (1979:23). In professional moving image production such invitations spur (mostly constructive) authorship struggles and take concrete forms

in redesigns. Hence, the act of capturing the raw material of the medial object is not only the *decisive moment* (to paraphrase Cartier-Bresson) in production, but also a prism through which intentions, constraints and choices of a complete production collective become crystalized. Any investigation into the impact of technological shifts that does not recognize this runs the risk of becoming tangential and inconsequential. Stating this, I hope that this thesis may contribute to the formulation of a new vocabulary and a critical perspective more fully responsive to the phenomenon of digital videography and the digital videographer.

The medial objects discussed in this thesis are industrially produced productions: features, TV-shows, commercials, 'infomercials' and documentaries. Such productions are viewed as *boundary objects*; common points of references and working arrangements that satisfy different concerns simultaneously (cf. Bowker, Star 1999). Thus, I consider such objects not only the materiality of something, but also the external and internal processes of producing the perception of that something (cf. Utterback et al. 2006). The internal processes of production are considered design processes in this thesis. External processes include budgeting, the management of technology, distribution of creativity and the use of visual conventions. It may be argued that the right mix of the right internal and external processes augments visual innovations (i.e. moving image product development). However, this thesis does not focus on visual innovations, but on technological innovations within the production context, since the effects of rapid technological shifts are more evident in the way media are produced, rather in their stylistic properties (Sverrisson 1998, 2002). Yet, it is assumed that there is a reciprocal relationship between technological innovations and visual innovations (cf. Bordwell et al. 1985, Salt 1983). This is similar to the recognition that the embodiment of new technologies in product innovations triggers customers' cognitive and emotional responses (Petkova, Rindova 2007).

As inferred from this, this thesis is a Design and Innovation thesis (and not a Media and Film studies thesis). As such, this thesis is part of the growing concern with the role of drivers, constraints considerations and environmental factors in innovative design organizations and collaborative innovation processes.

1.1 Background

For about a hundred years, industrial moving image production systems adhered to filmmaking practices in which all media were physical objects, mostly 35 mm celluloid film ('artefactual filmmaking'). In the 1990's this static situation began to change due to the introduction of tape based digital video formats and digital media technologies. Today some major features are still shot on celluloid. In fact, most of the Best Cinematography Oscar nominees of 2012 were shot on celluloid. Yet,

Kodak went bankrupt in 2012 and the digital industrialization process has accelerated in the present time and nowadays most productions depend on tapeless digital technologies (paper A). This has made the production apparatus and product development more flexible and dynamic, but also more complex (papers A and B). This complexity is primarily an issue of exchanging media (and the lack thereof). The Swedish Moving Image Production Industry has actively responded in numerous more or less inventive and successful ways to this (Paper B), one of which is the common DPX conforming strategy. Yet, the DPX alternative is not a 'silver bullet solution'.

It comes as no surprise that new internationally valid video format standards are under way to enable "interoperability of equipment" (Hoffman 2012:10). These standards, that have now been seven years in the making, are referred to as SMPTE (Society of Motion Picture and Television Engineers) standards on ACES (the Academy Color Encoding System) and marketed as a cure-all that will "play a significant role in creating and maintaining the assets in the entertainment and media industry." (Hoffman 2012:16). This becomes critical as large flat panels and high-resolution digital cinema will expose quality inferiorities more than ever before. However, this is not only a critical issue for business and content owners. Videographers are the first in line to enjoy the benefits of a new standard: ACES will presumably eliminate uncertainty between the on-set look management and downstream color correction, preserve the full range of colors/highlights/shadows on set for use throughout the production chain, preserve the ability to light 'by eye' without having to rely on video monitors, and remove the limitations of today's legacy workflows (Hoffman 2012:16). Many videographers surely hope these promises are not based on wild guesses.

In this thesis I argue that the role and function of the videographer are changing due to technological advances and accelerating industrialization processes. This transformation is intimately tied to two parallel developments that are interlinked. One has to do with the introductions of new types of cameras that now are widely used in moving image production (cf. Swenberg 2012, papers B, C and D). Although the difference between a traditional celluloid 'image assembly line' (here I have a digital intermediate production chain in mind) and a completely digital one is not great, the similarities are somewhat deceitful because the options for creative inputs in the critical recording phase and conforming stages differ because the digital one is programmable (cf. Manovich 2001). For instance, because a 'digital film camera' can output several different video formats, aspect ratios, resolutions and frame rates, its user must program (or configure) the camera. Thus, in the digital assembly line there are many choices in terms of what video formats and codec to chose from and to conform/transcode to (papers B and D). Since all stages are interconnected in a linear order (or in order of logic which tends to be rather linear), this makes the digital assembly line more prone to technologically related

constraints, most of which have their beginnings in the recording phase and the early conforming/transcoding phase (akin to a domino effect phenomenon). Thus, new recording technologies bring new demands and further stress the fact that a sound technical production system is only as sound as the videographer and his/her team allows.

The second development that I consider primary in the changing role and function of the videographer has to do with the distribution of creativity in contemporary production chains (cf. Swenberg 2012, paper A). In contemporary High End production the recording of images is becoming an act of capturing in which live-action footage is reduced to just another graphic or raw material for coloring and compositing (Misek 2010, Prince 2004:24-33, Manovich 2001:300, Swenberg 2012). Nevertheless, very few think that the videographer is no longer a critical creative. Yet, the role, function, skills and expressive capabilities of the videographer are changing, in some genres more and in some less. It may be argued that the videographer's role as a key creative now is restricted to types of films that are entirely made up of conventionally filmed scenes (Misek 2010:409). Perhaps needless to point out, such films are nowadays few and far between. Thus, the overall tendency is that from being revered as an artistic genius and a close ally of the director and his/her aesthetic vision (cf. Mascelli 1965, Alton 1949), the videographer is now primarily being viewed as a technical networking function that wins or loses his/her artistic capital in both silent and explicit negotiations with other designers and increasingly dynamic and sometimes hard to understand recording technologies (cf. Wheeler 2009, Barclay 2000). In brief, the videographer is constantly subject to adapting strategies that have become a natural state of affairs (cf. Bourdieu 1999:117).

In this thesis, the understanding of the changing face of videography is primarily based on empirical evidence gathered through interviews (see Method chapter). However, this understanding is also informed by my previous experiences as a video production teacher at Dalarna University and Southeastern Louisiana University, my own work with various video productions, and on my previous professional life as a videographer for KQED (San Francisco, California) and Southeastern Channel (Hammond, Louisiana).

1.2 Pre-understanding

In 2004 I was asked to become the lead videographer (as well as editor) for the history TV show Louisiana Parishes Chronicles. In it I was expected to combine live action DV-Cam footage with various other video and still format sources. This proved arduous and frustrating because several video formats were incompatible with one another. It took a lot of time and effort to figure out what settings in my camera and what settings in the editing software would result in the least rendering

time and allow a smooth viewing experience that did not exhibit aspect ratio crunching/stretching, noise and other odd distortions. I missed several deadlines because of this, I went over budget, I felt frustrated and, surprisingly enough I received a Telly Award (Cable TV Programming, History Series, 2005). The relation job satisfaction and quality or/and innovation is far from self-evident (cf. Zhou, George 2001).

Later, I encountered a similar situation as a teacher at Dalarna University. In an educational video production milieu it quickly became apparent that the reason why certain student videographers were more popular than others as crew members was not because they were smarter or otherwise more talented than the rest, but because they were able to mitigate the problems arising when facing new technologies (students are perhaps more than others forced to work with novel technical gear). This problem solving ability was not only regarded as a technical activity by the production collective, but more importantly an activity that provided space for other more creative activities. The rationale was that if technical gridlocks are solved quickly, there is more time to really work on your movie. However, the films (short fiction films) made this way were not necessarily the most innovative, but usually the most accomplished, judged by the criterion of quality or/and attained standards (i.e. *Production Value*). Obviously, there is a complex interplay of many creative forces in filmmaking. Yet the case for smooth workflows is hard to disregard since this appears to be necessary for a quality, on-budget and on-time delivery by non-frustrated crews.

The basic conclusion that may be drawn from my experiences as a videographer and teacher of video production is that the plethora of video formats and codec does not in and of itself constrain expression or/and creativity. On the contrary, new formats and codec are usually better than the ones they replace. Yet, if professionals (or students) disregard the fact that new technologies must at the very least assimilate perspectives that include the environment of use, the technology infrastructure and the business case (MacTavish 2009:124), the introduction of new formats and codec (hundreds of them) results in obstructed workflows, that in turn generate technical problem solving activities that from an organizational perspective may be regarded as time theft (Paper B). In other words, to an organization such introductions can be viewed as examples of non-value-added wastes.

1.3 Related Research

Film production research's true home is the professional and educational discourse that primarily discusses how to make films either look better or how to make them economically feasible (Herrman 2011:40). Constraints in this discourse are usually discussed as general advice on how not to do things in relation to the size of

budgets, impact of conventions, teamwork abilities and the expressive potential of technical tools (cf. Caldwell 2009, Herrman 2011). In brief, the consensus is that many elements influence what finally reaches the screen. For instance, cinematographer Steven Barclay draws attention to constraints that reside outside of the individual professional's realm, what he labels *logistics*:

> This salient and often underestimated factor cannot be regarded lightly when quality is to be attained or maintained, regardless of the medium." (2000:211).

Along the same lines Cinema Philosopher Berys Gaut suggests that other things than a designer's intentions are decisive in the creation of a certain aesthetic and that not all meaningful properties of films are determined by artists' intentions. This is the claim that undermines intentionalism. (2010:155). Berys Gaut's rather pragmatic approach to filmmaking stands in stark contrast to the idealistic approach of Jean Pierre Geuens, author of *Film Production Theory*. In it Geuens applies disparate kinds of theories from the humanities discussing filmmaking as a kind of sacred art. According to Geuens, the moving image industry in itself is *the* key constraint. The theories addressed thus are not instrumental in regards to film production, but become answers to kinds of enigmas, such as how artists' creativity will flourish if they can avoid becoming sell-outs. To others the clash between pure art and commerce is considered to provide fertile soil for creativity and innovation. Swedish film industry researcher Margareta Herrman claims that disparate types of creativity that stand in opposition are necessary in moving image product development (2011:109).

Some scholars argue that systematic support systems are of no value in filmmaking ventures. Management researcher Marja Soila-Wadman defends film as an art venture and questions the notion that successful drama productions must adhere to a highly structured management philosophy (2005). Similarly, Laurent Lapierre claims that all artists stand above management and business aspects of production (2001). Thus, according to culture production theorist James Thornton Caldwell the timely research question of "what makes TV/film-production smarter" has yet to be asked by film researchers (2008:342-343). This thesis aims to partly remedy this.

One possible way of making filmmaking 'smarter' is to look at other design industries and learn from them. Because, as it turns out, the general situation described in this thesis is not exclusively a moving image production phenomenon. Similar issues are dealt with and have been dealt with in the conventional design industries as industrialization processes have accelerated. This has resulted in a wealth of research and studies in which there are some key discernable approaches present in regards to design processes and the role of drivers and constraints, and spaces of innovation activities. One common denominator in such research is *creativity*.

This is to say that the meta-theoretical framework that may be ready to tackle the many questions that arise in the ever-broadening value chains and distribution of creativity in industrial digital moving image production is not film theory (cf. Salt 2009, Eidsvik 2005, Philipsen 2009). This might be explained by film theorists' unwillingness to seriously deal with industrially produced films, as Film Theorist Bruce Isaacs notes:

> Each one of these films merits serious analytical attention, but accepted analytical strategies have rendered a great deal of writing on film insular, self-reflective, obtuse, and in its worst incarnation, elitist. (2006:13).

In summary, then, there is little related research to be found on professional film production in Film and Media studies since film scholars tend to disregard the industrial character of contemporary moving image production in which motion picture productions are put together by teams of designers according to assembly line design processes that are administered and managed in various types of networks (i.e. supply chains). As inferred from this, this thesis is an attempt to make 'old' film theory a little newer through infusing the film production discourse with Design Science, Actor-Network-Theory and contemporary Creativity research.

As it turns out, Design Science research has been instrumental in the formation of creativity research itself. Such research usually relates creativity to innovation, what prevents or drives innovation, and upholds the idea that if creativity is taken seriously and promoted, often through systematic enhancement, companies and people are more likely to increase quality output and become innovative because creativity is a necessary condition for innovation (Amabile et. al 1996).

One example of this is *Lean Production* scholar Jeffrey K. Liker, who states that unwarranted problem solving activities also result in "Unused employee creativity" (2004:29). The key assertion in Liker's *The Toyota Way* is that a lean production apparatus, in which employees' creativity is given ample room, is a pre-requisite for innovation, quality and prosperity. However, a lean production apparatus is not established in a matter of days and weeks, but is part of a long-term strategy (2004:51-64). Temporary ad-hoc solutions are simply not good enough. Neither may production remain lean if automation is prioritized at the expense of human intervention and human intelligence, as Swedish lean production researchers have suggested (Bjurström, Jackson 2012). From this it may be inferred that no quick fix such as the introduction of a revolutionary new codec will of itself make film production lean, and that any automation efforts must be combined with flexible "management by sight" (Bjurström, Jackson 2012:201).

1.3.1 Categorizing Creativity

There are many ways of approaching and categorizing creativity. The most common way is to categorize creativity according the level at which it emerges. The general focus is usually on individuals (micro level), but it could also be focused on cultures or systems (macro level). Some approaches are all-encompassing. For instance, organization scholar Udo Staber advocates an eco-systems approach that accounts for creativity and creative processes as involving three different domains (2012): *Dispositions* (talents, identities and motivations), *Relations* (social networks, epistemic community and competition/cooperation) and *Systems* (creative fields, clusters and institutions).

This thesis is rather unusual in the way that it deals with both the Relations and Systems aspects of creativity, specifically what *constrains* creativity within these domains. The idea of constraints is integral to the very concept of creativity (cf. Kaufman, Sternberg 2009). This is something that contemporary design process research efforts also attest to. For instance, in engineering design, constraints are commonly equated with uncertainties and risks. This does not encompass risks' effects on creativity per se, but is focused on the identifying of such risks in industrial design processes and managing them (risk management). Hence, constraints on creativity in Engineering Design are viewed in a *structuralist* way (cf. Sternberg 1999). This approach is common in research that focuses on the development of complex utilitarian physical objects that are made up of many different parts in which failure to mitigate constraints may have dire consequences. Aspects of complexity and coupling are here viewed as a severe constraint, posing great risk (Busby, McMahon 2005), as well as having a negative impact on quality (Huang, Inman 2010). The general agreement in such research is that uncertainties exist on different levels of abstraction and that risk forecasting and material properties are a critical concern (Engelhardt et al. 2010).

Another structuralist approach regards constraints on creativity as wastes or/and non-value adding activities that stand in the way of a lean production apparatus. According to the company that invented lean production (Toyota), there are seven types of waste. Lean production researcher Jeffrey K Liker considers "unused employee creativity" an eighth waste (2004:29). According to Liker one reason for unused employee creativity is breakdown of equipment causing "continuous process flow" to become obstructed (2004:87-103). This is in line with the idea that product development may be inhibited by "design evolution constraints" (such as the technological environment) as suggested by Burton et al. (2011) and that product development cannot become efficient via introducing new and better technologies alone (Beier, Maier 2010). In the same vein Liker warns that many expensive but complicated industrial technologies have failed to meet the

requirements of "supporting people, process and value" and have been abandoned in favor of simpler, manual systems (2004:160).

There is also other Design or/and Art related research that is less structuralist and more *situational* (cf. Sternberg 1999). Such research tangentially discusses the role of constraints in, for instance, collaborative design efforts and other more or less nondescript design activities within the realm of the arts such as art education, architectural design and graphic design (Casakin 2007, Henderson 1999, LeDantec 2010, Svihla 2010). In such research constraints are commonly viewed as external factors that are contextually dependent. Examples of such constraints include social factors (such as reputation), cultural conventions, management (including organizational matters), economics (such as systems of reciprocity) and technological shifts/innovations. Although sociologist Howard Becker is not a design researcher focusing on matters of creativity, his analytical concept of *Art Worlds* has a lot of bearing on this. Specifically to this thesis, Becker's *Art Worlds* offers ways to understand how art-makers and what Becker labels "integrated professionals" are constrained by changing technologies and how creativity is channeled through the constraints of (mostly visual) conventions (1984).

Within the Arts, Aesthetics and Information Technology discourses, creativity is dealt with in accordance with both the *inspirationalist* and the situationalist schools of thought (cf. Sternberg 1999). In these discourses the definition of creativity spans from the inexplicable and even spiritual to the concrete practices of actants that shape communicative expressions. In these fields there is an agreement that creative expressions can be supported by "creativity support tools" of various kinds, from the simplest sketching tool to advanced software (Schneidermann 2007:22).

The concept of *Creative Space* in this thesis is indebted to the way Ingar Brinck describes artistic creativity as a cognitive activity in the immediate context of the artist, and as such as a way to solve aesthetic problems with undecided ends (1999: 34). This notion runs counter to many (earlier) scholarly writings that have marveled at the inexplicitness of artistic creativity, claiming that the problem-solving model is rather unhelpful and vague (Hospers 1985). In spite of this, Brinck's practical problem-solving approach has indeed proven to be relevant in other practice-based studies on artistic creativity, as in studies on creativity in art education that conclude that artistic creativity has boundaries and that creativity has certain dimensions. In part, the assessment of these boundaries is what is taught (or should be taught) in art education (James 2004). Similarly, sociologist and design researcher Kathryn Henderson's study on CAD users, states that the restructuring and resistance caused by new tools are what circumscribe designers' creativity (1999).

However, within Design Science, exactly how to define the 'space' of solutions that designers explore in their design projects remains an unsettled question, as the development and practical implantation of the C-K Theory indicates (Hatchuel et al. 2004). This theory is based upon the space of concepts ('C') and the space of knowledge ('K'), and proposes an alternative non-problem-solving design theory that acknowledges the creative and serendipitous aspects of design, while accounting for inventive processes.

1.4 Problem Statement

I conclude that there is a lack of knowledge of how digital videography conditions communication and the distribution of creativity in production systems/workflows. Moreover, there is a lack of generally applicable design support models or/and tools that relate technological constraints and wastes to creativity and the management of workflows (paper A). In order to support design processes in the moving image production industry, and the teaching thereof, it is imperative to develop knowledge about the role of videography and how the videographer and other designers are constrained in digital production systems.
This is the main focus and the identified problem area of the research presented in this thesis.

1.5 Aim and Objective

Based on the problem statement, the aim of this thesis is to gain insights into what factors in digital filmmaking constrain videography in order to address the impact of these factors. The overall objective of this thesis is to identify factors that have a negative impact and, if there are any, to suggest ways to mitigate such negative effects.

1.6 Research Questions and Research Progression

To be able to meet the objective of this research a set of three research questions are posed:

1. **In what ways do new digital tools and new digital media impact the craft of videography?**

The first research question is posed to define how changing digital technologies affect videography, the videographer and his/her team.

2. **If there is an impact, what factors may be considered primary and why?**

Based on the result of RQ1, the second research question is posed to give evidence of the key factors of this impact and the rationale behind considering them significant/primary, i.e. how 'forceful' such an impact may be.

3. **If there are any negative aspects to this impact, how may this impact be mitigated?**

Based on the result of RQ2, the third research question is posed to figure out what kinds of support strategies may be used to mitigate possible negative effects of new digital tools and new digital media.

Table 1. Aim and Objective related to research questions and papers in the thesis.

Aim and Objective	Research Question	Paper
I. To gain insights into what factors in digital filmmaking constrain videography in order to address the impact of these factors.	1. In what ways do new digital tools and new digital media impact the craft of videography?	Paper A Paper B Paper C
I. To gain insights into what factors in digital filmmaking constrain videography in order to address the impact of these factors.	2. If there is an impact, what factors may be considered primary and why?	Paper B Paper C
II. To identify factors that have a negative impact and, if there are any, to suggest ways to mitigate such negative effects.	3. If there are any negative aspects to this impact, how may this impact be mitigated?	Paper B Paper C Paper D

Like most design research, this research is progressive and iterative in nature. This means that to a certain degree the research questions and objective of this thesis have been allowed to evolve organically, becoming more and more nuanced and refined, hopefully infusing the research journey as a whole with scientific stringency. Still, this research adheres to the DRM (Design Research Methodology) framework (Blessing, Chakrabarti 2009) and research stages (see Method Chapter).

One way of describing the logical progression of this research is to relate the research questions to the analytical progression of the papers that are the basis of this thesis; see Figure 1.

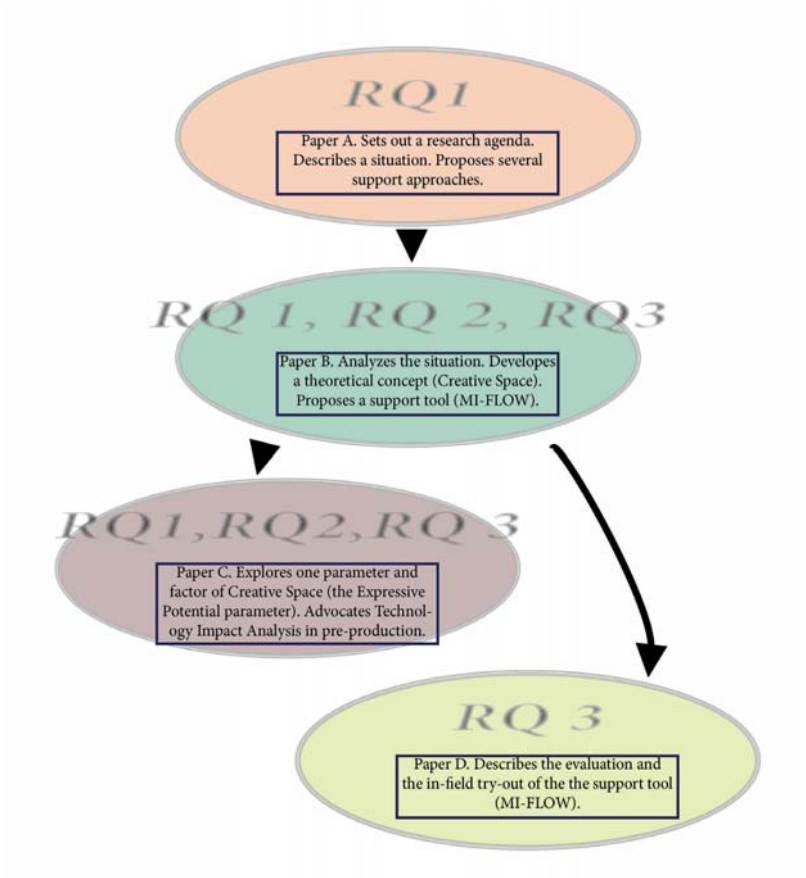


Figure 1. Figure showing what research questions pertain to what paper and how this relates to the analytical progression of this thesis.

As Figure 1 indicates, Paper C is a little different in its scope and focus than papers A, B and D as it was not part of the *New Design Processes in the Audiovisual Industry* project.

Yet another way to describe the research journey of this thesis is to describe the development of the support tool MI-FLOW in relation to the papers and the DRM stages; see Figure 2.

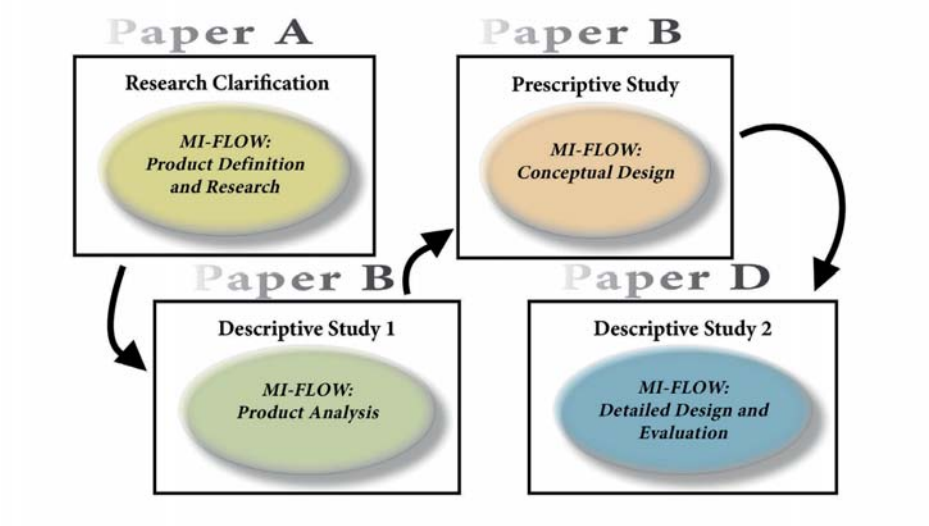


Figure 2. Figure showing how the development of the support tool (MI-FLOW) relates to the analytical progression of the research within the DRM framework and the papers of this thesis.

1.7 Delimitations

This research is centered on the *Swedish* moving image production industry: rental houses, post-production companies, technical producers and complete in-house production companies located in and around Stockholm (one out of the seven companies of this study is located in Borlänge). All but two companies are actively involved in the recording of images, i.e. the production phase. These companies are either mid-sized or small, reflecting the typical situation in Sweden. All of the interviewees are men; this is also reflective of the typical situation within this sector. These companies primarily produce content for traditional outlets of media including the Internet. So, computer games or other interactive media, virtual reality, Internet multimedia and user generated content (UGC) are not in the scope of this thesis (this does not exclude 'industrials' or Internet 'infomercials').

The discussions on *constraints* in this thesis concern factors that are as objectively quantifiable as possible within the parameters of a certain project (i.e. the *Boundary Object*). Obviously there are many other kinds of constraints in professional moving image production, such as certain types of knowledge, or/and the tasks and activities conducted in production that are dependent on professionals' exchanges of information. These exchanges are in turn dependent on socio-cultural and economic factors. Such socio-cultural meta-factors are not theorized or/and elaborated upon in this thesis but merely deemed intertwined with the production and the creativity dimensionalities that are part of this thesis.

Creativity in this thesis is viewed as a designerly, cognitive problem solving activity that embodies various constraints. This means that the psychological and the neuroscience-related definitions of creativity here are not of particular interest since productions are not the result of an isolated creative brain that resides within a singular person of a certain type, but the result of the distribution of creativity through technical systems. In agreement with sociologist Howard Becker, I think it is the interaction of all the involved parties that "produces a shared sense of the worth of what they collectively produce." (Becker 1984:39) Thus, the emphasis in this thesis is on the shared sense (i.e. a qualitative dimension) of creativity, not aspects of "originality" (Kaufman, Sternberg 2009). As a consequence, the kind of research that couples creativity to innovation in product development and industrial renewal research is approached selectively in this thesis, which I admit does not do justice to this great research field.

Production commonly refers to all the stages of professional moving image production, including pre-production and post-production. However, in this thesis the overall emphasis is on matters related to the stage that professionals commonly refer to as production or 'principal photography', which is the recording stage. Yet the interconnectivity aspects of contemporary moving image production require the study of causal relations of the production stage to consider all production stages (including pre-production and post-production).

1.8 Practical and Academic Contribution

There are two different contributions expected from this research: a scientific contribution to the research community and a practical industrial contribution to moving image production companies.

The expected scientific contribution of this research includes theoretical discussions in regards to the creativity of the videographer and what forces constrain creativity, for better and for worse. This is to enhance knowledge about role of the videographer and function of videography in contemporary, digital production milieus.

The expected industrial contribution is aimed at suggesting a support strategy that makes moving image production more streamlined and less sidetracked at the expense of design agents', including the videographer's, aesthetic problem-solving capacities.

2. Theories

In this chapter I will highlight and reflect upon relevant theoretical insights such as Ingar Brinck's notion of embodied craftsmanship that informed the theoretical concept of *Creative Space* (for a thorough explanation of *Creative Space* see Results chapter) and ANT (Actor Network Theory).

The kind of creativity that prevails in moving image production regards the shaping of communicative expressions (cf. Swenberg 2012). Viewed as such a shaper, the videographer composes and frames the shots, does the lighting, makes sure continuity is paid attention to, creates editing points and so on. This is to say that the videographer's know-how is what conditions his/her creative contributions. Francisco Varela, Evan Thompson and Eleanor Rosch explain context-dependent know-how as the essence of creative cognition (1991:148) and cognition as embodied action (1991:172-173).

Ingar Brinck develops this understanding (1999, 2007) when she applies creativity to aesthetic experience, for instance the ways such experience informs artistic creativity. She explains this as a cognitive activity in the immediate context of the artist, and as such, as ways to solve aesthetic problems with undecided ends (1999: 34). This is based on the Varela et al., notion that artistic creativity is "an embodied, experience-based craftsmanship." (2007: 422) According to Brinck this experience-based craftsmanship is characterized as distributed and context dependent (1999: 45).

This resembles sociologist Howard Becker's notion of *virtuosity* that essentially is a set of standards created and enforced from within the realm of the artist. However, Becker does not define this context very narrowly, as the notion of virtuosity depends on other people, for instance critics and patrons, who participate in setting those standards:

> But no one can tell whether an object or performance displays virtuosity without learning and accepting the standards of the workers responsible for the standards. (1978:888)

In this thesis such standards are *Production Value*. Production Value thus becomes part of the audiovisual map that the artist uses when navigating context, putting his/her cognition at use, i.e. being creative with tools. Consequently, as opposed to Brinck, I consider professionally made art products such as film and TV shows less as undecided and open ended and more as formulaic expressions. Production Value, or more precisely *High Production Value*, is the formula in question.

Brinck, whose primary interest is cognition and not social constructions such as aesthetic formulas and conventions, stresses that artistic creativity entails cognitive activities by agents in the world, where the immediate surroundings have a major importance (2007: 409-412). Here tools are considered key. In brief, Brinck's 'creative space' consists of constraining conditions that have implications on the practical work of the artist. This is the primary insight of Brinck that I have extrapolated into this thesis, and in particular into the development of *Creative Space.*

Creativity is enforced through technology's ability to mediate. In other words, in the best case scenario, tools become prosthetic and aid designers' *visual thinking* (cf. Arnheim 1969, Eriksson 2009) One way of describing this enforcing of creativity in film production networks in a detailed and precise way is to use Actor Network Theory. This approach is suggested by economy geography scholar Oli Mould as a way to avoid top-down, grand, determining metanarratives in film production research (2009). Let me here briefly contextualize and introduce a few key ANT terms to indicate their uses in this thesis.

In this thesis digital film cameras are not considered ineffectual and self-contained. According to ANT terminology these cameras are thus not *black boxed* as the case might be in regards to cables that only reveal their 'insides' (and thus require description) when they become dysfunctional. Sociologist Bruno Latour states that *mediators* enact power in an actor-network. Because cameras' "input is never a good predictor of their output; their specificity has to be taken into account every time." (Latour 2005:39) Cameras are thus mediators that possess the power to *enroll actants*. *Actants* is a collective term for either a human entity or a machine entity. The powers inherent in cameras are due to the fact that they need constant tinkering by someone or something that then becomes an *enrolled* actant. The enrolled human actant in this thesis is usually the videographer, the operator or the DIT (Digital Image Technician).

A commonly held notion (especially in academia) has it that digital cameras (i.e. an artist's tool) have no capacity to enroll actants; only human auteurs have that capacity. If this were the case, in accordance with the ANT terminology, this would make video cameras into *intermediaries* that, according to Mould, would "transport meaning without deformation." (2009:205) Viewed as such, a camera would then

require no description and in effect be dealt with as a *black box*. However, according to ANT, such a label would be suspect since the responsibility for any given action in a network (i.e. a production) can be found in both human and nonhuman actants since most *practice* (i.e. actions) in moving image production inevitably ends up in the practice of a non-human, which then requires ample description. In turn, such non-human actants need 'tinkering' by human actants in accordance with what could be likened to tinkering cycles (see Figure 3):

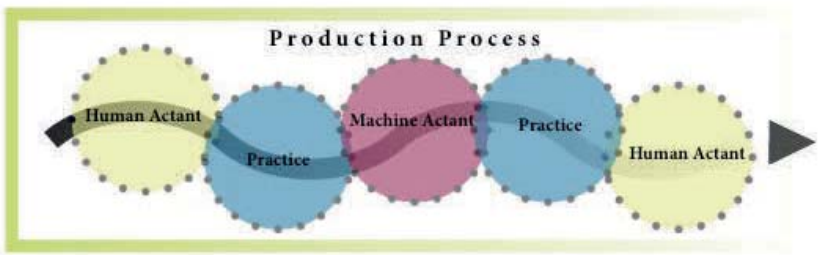


Figure 3. A stylized depiction of moving image production as tinkering cycles showing that the responsibility of any given practice can be found in both human and non-human actants.

Thus, media technologies such as cameras are not 'black boxed' but have the power to enroll actants. All kinds of filmmaking endeavors are result of the interaction between human actants and machine actants. Hence, the transformative powers of a camera are just as forceful as the wide range of professionals supplying it with various kinds of instructions (cf. Mould 2009:203). Consequently, in order to define how agency is enacted in networks, it is of utmost importance to figure out what digital video cameras afford, authorize, allow, influence, suggest, forbid, obstruct and so on (cf. Latour 2005:72).

Any delineation effort of the videographer's creativity must thus include the study of technological tools. Creativity is constantly filtered and modified through the capacities of technology, although, as sociologist and design scholar Kathryn Henderson reminds us, this is not primarily an issue of professionals' creativity being subdued to the forces of technologies, but a question of "creative resilience" (Henderson 1999:198). Nevertheless, if creativity is to be defined and evaluated, the role of technology in the shaping of communicative expressions must also be defined, and to do this ANT is helpful. Yet this is not an easy task. The impact technology has on films and TV programs (i.e. the aesthetics of film and TV), is usually not very straightforward. It is easy to disregard what might be considered mere subtleties of no apparent relevance. Two interesting historical footnotes indicate this: The Cinematograph Act of 1909 that stated that nitrate films could

only be shown at licensed theatres because nitrate film is a fire hazard established, almost by accident, the legal basis for censorship. The Hollywood continuity system, which is still the norm up to this day, did not become firmly established until the mid 1920's after the introduction of automated splicing machines (Enticknap 2005:13,19). Hence, some of the traces media technologies leave are more visible than we might think (a more clear-cut example would be early vignetting films from the 1910's or pixel vision art films from the 1980's).

Other traces are indeed very subtle, treacherously so. Such types of traces are in essence kinds of anonymous blank plates that function as manipulation spaces of different kinds (manipulation performed by other machines) in which the trace itself, for instance the many pixels that make up High Definition images, are invisible. Since most video cameras are High Definition, it could be argued that such cameras tend to deny their technical specificity; they appear to be steeped in sameness. Moreover, new technologies often aim and are designed to be transparent by emulating older technologies (the fake shutter sound of consumer type digital cameras reminds us of this). Hence, it seems unlikely that a new kind of video camera impacts communication differently than the one it replaces. This notion is what media scholar Henry Jenkins refers to as the Black Box Fallacy. It is not technology that establishes conformity, it is content: "What we are now seeing is the hardware diverging while the content converges." (2006: 15) Perhaps there are reasons to suspect that such a divergence is in part caused by professionals' desire to retain flexibility and, as Henderson suggests, protect the messy situated practices that "ensure that the work actually gets done". (1999:164) Considering that visual conventions are built into camera equipment (cf. Becker 1984), the implication is intriguing – what degree of technological 'messiness' catalyze the kinds of playful aesthetic explorations that become visual innovations?

3. Methods

In the method chapter I will address five different research methods that have been used in my research: interviews (and the coding thereof), reception study, questionnaires, visualization of causal relations (based on the codes) and the design method of MI-FLOW.

Interviews were primarily used in paper B. Reception Study and questionnaires were used in paper C. Visualization of causal relations was used in papers B and D and are part of the design method of MI-FLOW. Design method of MI-FLOW was initialized while writing Paper B and completed while writing paper D.

The different research methods were chosen in a systematic fashion and used progressively to clarify objectives and research questions and the answers to the research questions. This progression adhered to DRM (Design Research Methodology). DRM is not a method per se, but a rigorous, scientific, hands-on design research methodology that outlines the necessary steps in a design research project in order to make the research journey worthwhile and, ultimately, generate quality results.

The research journey of this thesis represents all of the four DRM research stages: Research Clarification, Descriptive Study, Prescriptive Study and Descriptive Study 2. The basic means of these four stages are: first a literature review and assessment of the situation, second an empirical data analysis, third, development of a support tool (based on empirical data), including an initial evaluation of the support, and fourth, an in-field try-out of the support. See Figure 4.

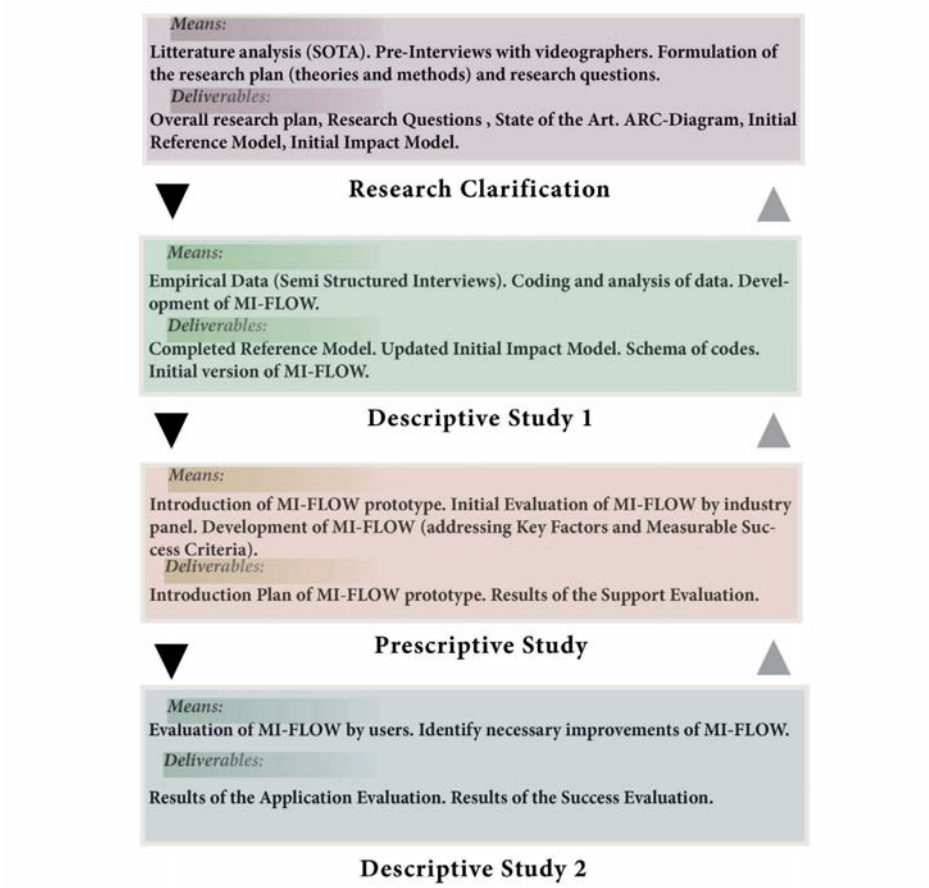


Figure 4. A schematic graph of the design research methodology used in this thesis. Adapted from Blessing and Chakrabarti (2009)

Although these four stages are separate, degrees of fluidity between the stages and parallel execution are allowed within the framework: "A methodology should be used in a flexible and opportunistic way to be able to adapt to the specifics of the research topic and any interesting avenues that may emerge." (Blessing, Chakrabarti 2009:14) Consequently, Figure 4 includes light gray arrows that represent iterations.

Please note that not all deliverables as shown in Figure 4 are included in this thesis, as this would require too lengthy explanations and descriptions.

3.1 Methods for Collecting Data

The Research Project *New Design Processes in the Audiovisual Industry* (Papers A, B and D) is a research-collaboration with fellow PhD candidate Thorbjörn Swenberg. As part of the Descriptive Study ('DRM stage 2') data were collected in two phases:

In order to get a better grasp of the problem in all of its practical dimensions as defined by the pre-understanding of this thesis, brief pre-interviews were conducted with a few stakeholders (2 videographers and 2 Post Production managers) of the moving image industry. The videographers interviewed are among the most prominent videographers in Sweden and their résumé's are all thoroughly indexed on IMDb (Internet Movie Database). They are freelancers, as most videographers nowadays are (very few are 'in house'). These brief unstructured interviews were not completely transcribed, but a few key statements were. Two brief non-structured interviews were also conducted with managers of two postproduction companies, one mid-sized firm in Stockholm and one small firm in the rural north of Sweden. The mid-sized firm in Stockholm has about twenty full time employees. The small one in rural north Sweden has three employees. Both of the managers own their respective company. These interviews were transcribed, and rendered a general comprehension of the situation that was deemed to turn into more distinct interview questions to be used in the next phase of interviews:

1. What are the consequences of the celluloid-digital technological shift in the production of films, commercials, information films and TV-shows?
2. If there are any problems related to this technological shift, could you please define them?
3. If these problems may be defined, what are the solutions to these problems?

In the second data collection phase, seven additional companies were addressed. In order to reach the people with the most thorough understanding of the interconnectivity aspects and causal relations of digital production; mainly personnel at the managerial level were interviewed. All of the managers are involved on a daily basis in actual hands-on production. In order to get as wide an overview as possible of the current situation in the Swedish moving image production industry, a variety of companies was included: small and mid-sized companies, very specialized firms, as well as production houses handling the full production chain (3 firms with 2-6 employees, 3 with 15-20 employees and 1 company with approximately 50 employees). The complete list of companies and interviewees is presented in Paper B. These interviews were semi-structured. All were videotaped, and completely transcribed and coded according to ethnographic research practice (Aspers 2007). This generated a schema of codes; see Table 2:

Table 2. Schema of codes of New Design Processes in the Audiovisual Industry as part of DS1.

Schema of Codes - New Design Processes in the Audiovisual Industry		
Code #	*Code*	Assignation of codes
3	***Theme***	
3.1	Production process	the sum of work with and negotiations around preproduction and/or manufacturing and/or postproduction of moving images
3.1.1	Workflow	a sequel of operations that are conducted within a production
3.1.1.1	Production method	ways to effectuate things that are connected to a certain production technology or technical tool or a certain general production organization
3.1.1.1.1	Technology shift	aspects on the transition from one production technology to another
3.1.1.1.2	Video file format	standard for the configuration of digital information for computer processing
3.1.2	Organization	allocation of (professional) competences as well as human and technical resources within a production
3.1.2.1	Work-role/s	demarcation of work tasks together with the competence that is expected from a person with a certain profession
3.1.2.2	Network	professional relations that are established between companies and/or individuals at different companies that cooperate within a production (or a project, if it includes several productions)
3.1.3	Creative decisions	decisions that are meant to affect the formal aspects of a moving image production
3.1.4	Production cultural attitudes	approaches to how things ought to be carried out in production
3.2	Economy	aspects of the monetary value of a production

After this initial coding, I went through the creative decisions code (#3.1.3.), production process code (#3.1), production method code (#3.1.1.1), workflow code (#3.1.1), video file format code (#3.1.1.1.2) technology shift code (#3.1.1.1.1) and work role code (#3.1.2.1) for issues and topics (i.e. statements) that specifically pertain to videography (the videographer, media management, cameras etc.). This additional scanning was performed in order to validate the assumed links and interdependencies between production constraints and videography/recording media. In this additional theme searching I excluded codes that were unlikely to have videography/recording media related statements (such as 3.1.4 theme code for instance).

3.1.1 The Reception Study

As for the Reception Study (paper C), completely different methods were used. Here an exploratory reception test (a qualitative method) was combined with a questionnaire (a quantitative method) in order to answer what philosopher David Davies refers to as the "ontological question" of how films are individuated (Davies, 2009:217). In this case, to indicate the indexical appeal of five short 'documentary-like' videos of two distinctly different appearances that are contingent on choice of digital camera (one *Convergence* Type and one *Conventional* Type). See paper C for more details.

75 audience members evaluated the videos. The majority of the respondents were aged 18-25. Each screening lasted about 3 minutes. All sequences were screened twice (the act of comparing requires some extra time). The videos were screened on various large and small screens. In conjunction with the screening the respondents were asked to fill out a simple questionnaire that included two questions pertaining to each video sequence (ten questions in total), as well as a comments field:

1. How truthful do you think this video is?
Answer: 1-10 (10 is maximum truthful)
2. Do you think this video could be used as evidence?
(Yes or No)

3.2 Methods for Analyzing Data

As for the interview data, categorization of statements was coded schematically, uniquely and non-contradictorily, in accordance with a structuring code hierarchy (Aspers 2007) in order to ease cross-readings and to find relational patterns between codes. The subject matter codes are presented in Paper B, Table 1. The coded statements were analyzed for over-lapping codes that indicate needs for closer examination (Aspers 2007:194). This was particularly the case with statements coded as *workflow*, *file format*, or *production method*, which were frequently overlapping, and therefore scrutinized in the analysis. Coherence of meaning between similarly coded statements from different informants was compared. The coding was assessed at this stage, and some statements were re-coded (see Paper B). A broad comparison of the relation of the statements with the most frequently occurring codes was made (Aspers 2007:192). The anticipated outcome of this analysis was a descriptive overview of the current production situation within the Swedish Moving Image Industry (see Paper B).

3.2.1 Causality Relations

Another way to establish relational patterns was made possible through organizing codes (and statements) in accordance with causality relations. This was done using a Reference

Model (Blessing and Chakrabarti 2009:46-59). In the model the effect of influences was visualized through linking certain relations to success factors, such as cost and quality. The anticipated outcome of this analysis was a shared view of the understanding of the research problem ('the existing situation').

The model shows a preliminary set of influencing factors thought to be relevant in my research. This is in other words a kind of constraints-of-videography model (which is why the model contains more negative than positive causal relations).

In the model the factor 'quality of production' is deemed a Success Factor and placed on top in the model. This factor could also have been labeled 'degree of Production Value'. Cost of Production' and 'Amount of Profit' are also considered Success Factors and also placed on top of the model. Influences are indicated with lines with arrows showing the direction of causal chains. Most of the lines have a plus or minus sign, indicating the effect of the influences. For instance, if the time for production increases (+), the cost of production also increases (+) and then in turn the amount of profit decreases (-). The number 0 indicates 'no effect' (or that it cannot be established). Some links are based on assumptions and are indicated with the letter A. Some links are based on empirical evidence ('Experience') and are indicated with the letter E; see Figure 5:

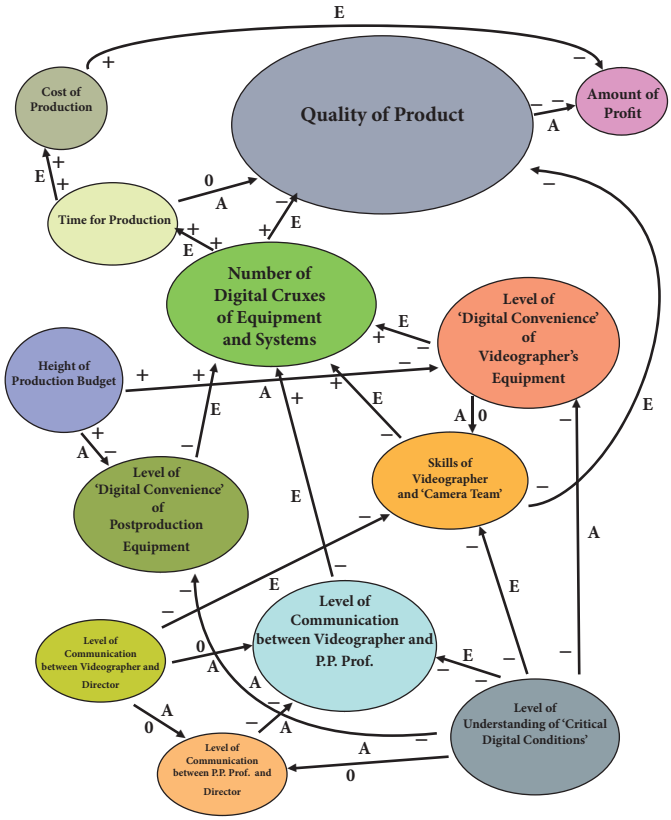


Figure 5. An initial constraints-of-videography model showing a preliminary set of influencing factors thought to be relevant (cf. Blessing and Chakrabarti 2009:46-59).

The schema of codes and the initial Reference Model resulted in a good understanding of the *existing* situation.

3.2.2 Design Method of the IS

In order to reach an understanding of the *desired* situation, I developed an initial Impact Model (Blessing and Chakrabarti 2009:46-59) showing the assumed impact of a support tool to mitigate digital cruxes. This model is resembles Swenberg's description of how digital cruxes relate to quality and costs in post-production (2012).

The initial Impact Model is another way categorizing the codes, linking some of the established causal relations of the initial Reference Model to an Intended Support (IS). The IS is what (later) turned into MI-FLOW.

In the model I placed the IS at the bottom (here referred to as Digital Moving Image Support Tool) as a way to highlight the assumed bottom up impact of the support in moving image production. In the model I have added the factor of 'likelihood of meeting deadlines' (instead of 'time for production'). This model is based on the assumption that existing support schemes are insufficient (see inserted partial Reference Model at top left). See Figure 6.

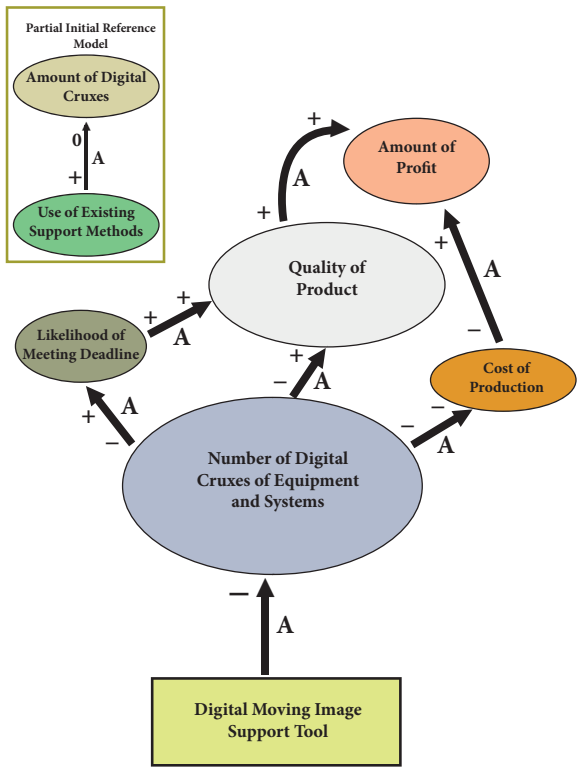


Figure 6. An initial Impact Model based on assumptions showing the desired situation in which a support tool is decreasing the amount of digital cruxes within digital moving image production (cf. Blessing and Chakrabarti 2009:46-59).

In order for the IS to perform in accordance with the initial Impact Model, the IS must include these core functionalities:

- It makes management foresee technical grid-locks (i.e. it *predicts*)
- It handles complex data (file formats, codex and image resolution)
- It simulates a workflow
- It functions at an overall project level (in the pre-production stage)

Table 3. Table showing what situations the IS aids in preventing, how it does it, and what the desirable outcomes are.

Existing Situation	File format clashes	File format jungle	Multiple workflow options	Ad hoc Design Support
Task	To identify needed conversions	To organize complex data	To simulate suggested workflow	To avoid technical bottle-necks
Result	Planned or avoided file conversions	Knowledge transfer	User specific, adapted workflow	Plan for workflow

Consequently, the IS must function as an early warning system that identifies file format conflicts and need for conversions at the overall project level before such conflicts may occur. The IS is thus a simulation approach that recognizes desirable patterns (cf. Lindemann et al., 2009). The early warning aspect implies the IS should be used in a pre-production meeting. The desirable patterns in question are in essence the technical make-up of the different production steps (or stages). In other words, the IS aims to remediate potentially dysfunctional workflows by highlighting technical clashes that obstruct smooth transitions and handover procedures between professionals of the respective production step such as the professionals of the recording phase (the videographer and his/her team). This is the general need the IS will fulfill: implement functional workflows (hence, 'degree of efficient workflow' could also have been considered a success factor of this model). On a more detailed level there are other more specific requirements the IS will address, as shown in the checklist model based on Roozenburg and Eekels (1995) below. See Table 4 (*D = demand, W = wish*).

Table 4. Partial Requirement List for MI-FLOW.

Partial Requirement List of MI-FLOW	
Problem Statement	Develop a Management Support Tool to help professionals in moving image production increase their *Creative Spaces*
Performance (D)	The IS should help assess the levels of clarity, simplicity and unity of technical workflow
Performance (D)	The IS should help asses the reliability of workflow
Performance (D)	The IS should be able to support creative activities within moving image production
Performance (D)	The IS should be able to use readily available information on valid formats and codex in order to be updated
Performance (W)	The assessment of workflows should be fast enough to be used regularly in pre-production meetings
Performance (W)	The assessment of workflows should be easy enough to be used regularly in pre-production meetings
Performance (W)	The IS should indicate possibilities of obsolete data and introductions of new equipment
Usability/Ergonomics (D)	The IS should be usable by 'management' in professional moving image production
Usability/Ergonomics (D)	The IS should be easy to use
Usability/Ergonomics (D)	The IS should be easy to introduce
Usability/Ergonomics (D)	The IS should be easy to maintain
Usability/Ergonomics (D)	The IS should be easy to learn
Introduction (D)	It should be possible to use the IS in conjunction with existing support models and strategies
Introduction (D)	No additional hardware or software will be necessary

Cost (D)	The IS should be free of charge to use
Cost (W)	The IS should not be costly to maintain
Life (W)	The IS should be have indefinite life with maintenance
Disposal (D)	The IS should have benign environmental impact

As implied by the initial Impact Model and the above partial requirement list, the clarification of what MI-FLOW should do (i.e. *Task Clarification*), and for whom, is now quite clear. Before venturing into a detailed conceptualization of the IS it is also worth pointing out that at this point it was quite clear that the IS cannot function as expected in the form of a non-interactive checklist such as a 'workbook' because a workbook is not as easily updatable, accessible and transferable. Therefore the option of a software-based checklist available through the Internet was deemed the most suitable.

Tools and names of tools are common knowledge within the production apparatus; codex and files are not (as the statements/codes of the interviews were evidence of). Expected type of imagery (special FX, Live Action material, 2-D animations, 3-D animations etc.) and type of resolution (1080i, 2K, 4K etcetera) are also common knowledge. Therefore, the IS should hide all difficult to grasp technical specifications in favor of image features and tools to choose from. The result, then, is a simulated workflow. Any conversion necessary is indicated with a warning. Every conflict of competing file formats or codex is also indicated with a warning. Seeing this in a pre-production meeting, managers, producers, directors and production planners can draw conclusions quite easily and act accordingly. See Figure 7.

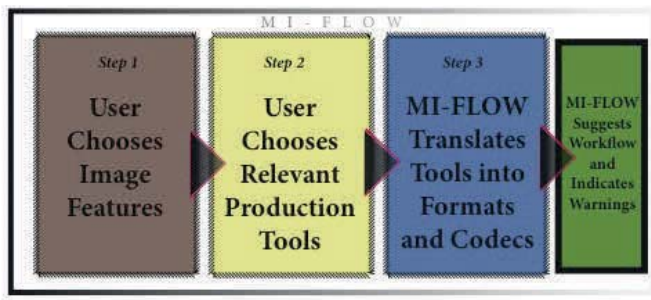


Figure 7. A basic sequence diagram of the IS.

After the basic functionalities and more detailed requirements of the IS had been defined, a more detailed sequence diagram was developed; see Figure 8.

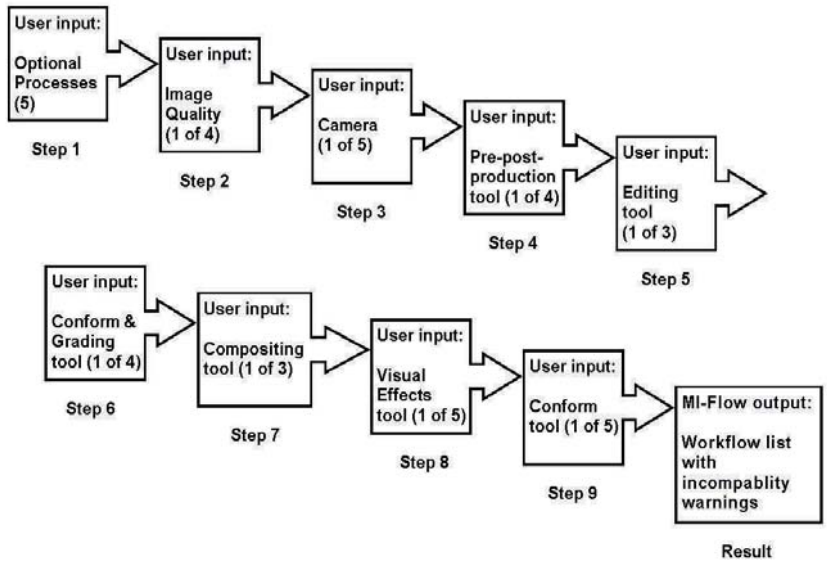


Figure 8. A complete sequence diagram of the design management support tool MI-FLOW.

The effectiveness and efficiency of the IS depend on the nature of the interaction of the stakeholders at the pre-production meeting. If this interaction results in a situation in which actants allow for different interpretations of the use and output of the IS, it will be difficult to ensure that the IS will be effective and efficient (despite of the IS' intended simple and non-ambiguous design). In order to arrive at a design of the IS that ensures that its users know how it should be used and not used, it must be preceded by a basic evaluation that verifies/checks that the IS fulfills the requirements.

As part of the Prescriptive Study ('DRM stage 3'), an initial Support Evaluation was undertaken. This was checked during the initial Support Evaluation:

- The Consistency of MI-FLOW
- The Completeness of MI-FLOW

The professionals that were part of this initial evaluation consisted of three professionals of three Swedish Moving Image Production firms. These evaluations

were based on a PDF version of the IS, hence it was not interactive at the time of the evaluation; see PDF page 1 of the IS (in Swedish); Figure 9.

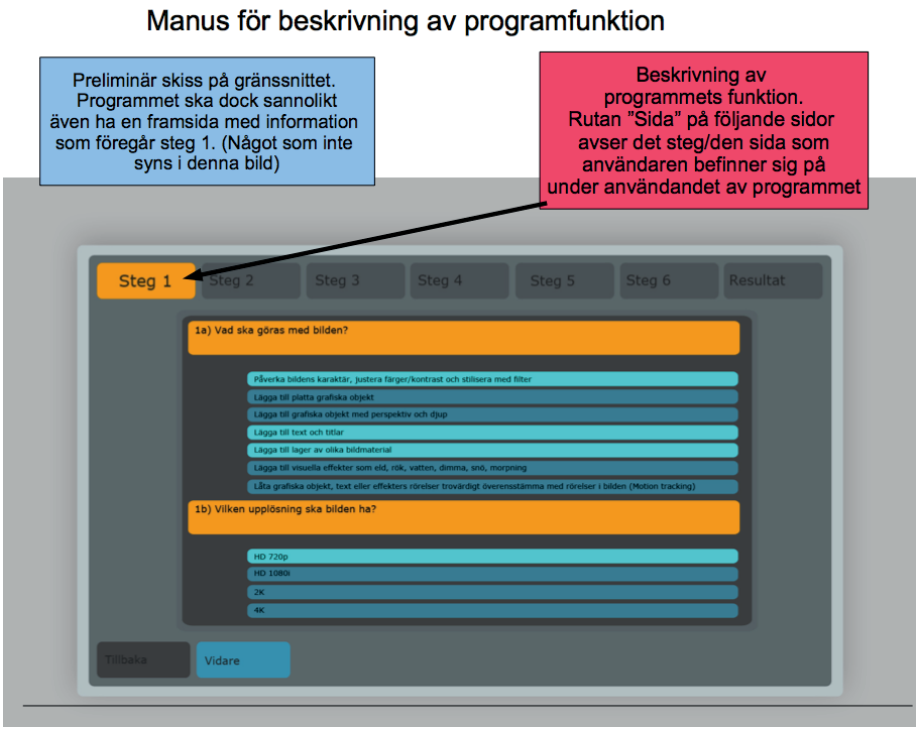


Figure 9. Image showing step 1 (page 1) of MI-FLOW as PDF version (in Swedish).

The purpose of Descriptive Study 2 is to identify whether the *Actual Support* (AS) can be used for the task intended and has the expected effects on the Key Factors. In DS2 it is also necessary to identify whether the Support indeed contributes to success, as represented by the Impact Model.

As argued by Blessing and Chakrabarti, it is wise to evaluate the design support when it is introduced. This is due in part to the fact that the introduction creates a new situation that did not exist beforehand, "many unexpected effects may occur." (2009:182) The 'old' reference model is no longer valid, because some effects may have been unforeseen. This is both negative and positive.

The introduction of any support system is a great challenge. It is not enough that the AS is actually functioning (as proved in the PS stage). It is also important that:

1. The description of the existing situation is (still) valid.
2. The description of the existing situation proves to be detailed enough.
3. The actual success-related effects may be defined.

The above requirement list emphasizes the 'tricky' issue of timely introduction. The context into which the AS is implemented is not the same as the IS was conceptualized to deal with. Obviously this is not a situation that only pertains to MI-FLOW, but a conundrum in the development of any kind of support, (unless the situation that the AS is to deal with is static, which must be a rare occurrence since this counters the very idea of how problems come to the surface in design process systems). The problem of changing context may result in different but related problems. One problem has to do with the issue of how to pinpoint positive (and negative) effects. It is possible that some unforeseen negative side effects obscure the positive ones. It is also possible that there are positive side effects that may be paid great attention while the overall effect is negative. For instance, the very implementation of MI-FLOW could result in various production team members paying special attention to issues that pertain to file format related cruxes to a certain problem at hand. This in of itself is a positive effect. Yet, this is not a guarantee that this awareness or new work routine has permeated the complete organization over time. If it has not, this may result in different routines - or worse opposing routines - gradually beginning to hold sway in the organization. The end result being is that the organization finds itself yet again at 'square one' (the ad-hoc solutions stage). In summary, the good practice of evaluation is every bit as difficult as conceptualizing a functional and relevant Support (cf. Chakrabarti, Blessing 2009: 182-214).

The *actual* Support Evaluation consisted of two phases. It includes two related but slightly different evaluation methods. In the first phase, we introduced the MI-FLOW concept as a 'dummy' (interactive, but incorrect output) to five industry members in a group interview setting. The group interview was held at a moving image production company's meeting room (in Stockholm). The group interview was centered on a 'show and tell' of MI-FLOW in which the interviewees were encouraged to interrupt the presenter (myself) at any time. The 'show and tell' was based on a mock production chain that involved some of the tools that the Prototype included. The presenter then asked follow-up questions based on the issues that the interviewees mentioned and discussed (among themselves usually). The interview was recorded (both audio and video). See image of result page of 'dummy' the way it appeared to the interviewees; Figure 10.

Figure 10. Image showing last step (Result Page) of 'dummy-version' of MI-FLOW. Note warning in light red.

The professionals that took part in the group interview were not part of the interviewees of the previous DRM stages. After the group interview, it was transcribed and coded. All coded statements were analyzed for over-lapping codes (multi-coded data) that indicate that the relation between codes must be studied closer (Aspers, 2007). Similarly coded statements were then related to the different informants for identification of meaning coherence. Concepts that emerged from this analysis were then introduced into our analysis as first or second order constructions (Aspers, 2007).

In the second phase of the MI-FLOW evaluation process, we (I and Thorbjörn Swenberg) let three industry members (two producers and one operations manager) try the AS (Actual Support) in their respective industrial setting. MI-FLOW is at this stage still a Prototype (does not contain optimal amount of input/output options) but fully responsive and functional. See Figure 11 for an example of part of the result page:

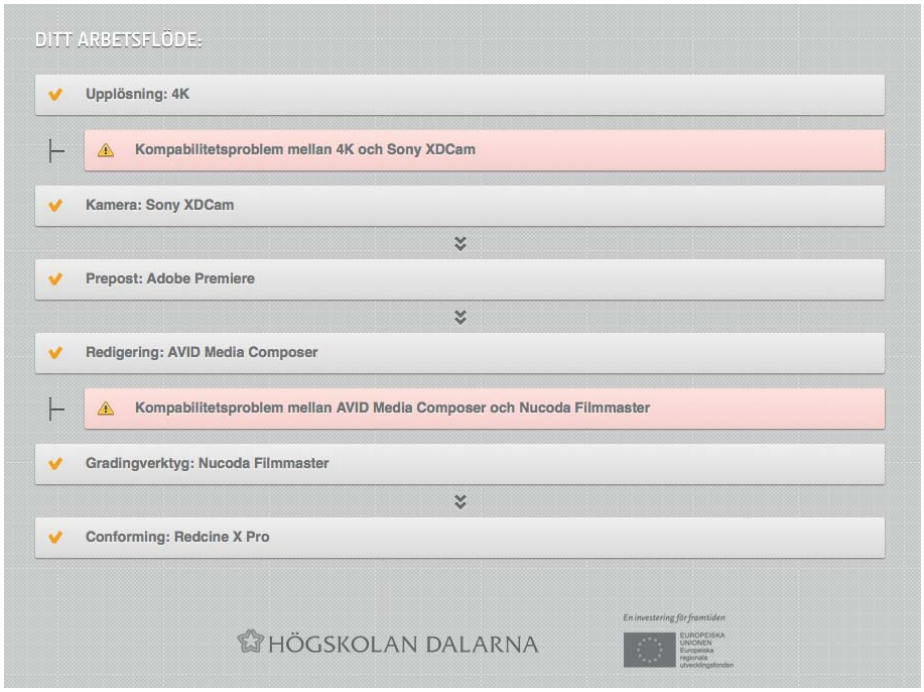


Figure 11. Screen shot from www.mi-flow.se showing an example of last step (Result Page) of Prototype of MI-FLOW the way it appeared after a specific inquiry.

The informants of the second evaluation phase were all men, aged 35-40 – representing the situation in this industry. We stated that they used the AS at least twice in a situation/production context of their own choosing. They were then asked to answer a qualitative questionnaire based on our research questions. The answers were then crosschecked with the previous coded statement categories in order to be able to hone in on discrepancies and commonalities (and explain them).

3.3 Methodological Reflections

In the project *New Design Processes in the Audiovisual Industry* we interviewed mostly managers in a variety of moving image production companies in Sweden. However, it is the below-the-line workers (Caldwell, 2008: 27) who experience the actual impact of the technological shift in their everyday work and thus can talk

about it. Hence, the risk associated with the manager approach is that the perspectives that are already studied by previous research or/and that the managers' viewpoints are emphasized, instead of being broadened and problematized. Nevertheless, in the pursuit of studying "controlling processes" we acknowledged the anthropological approach of "studying up" (Nader 1997: 711-737). In Bourdieuian terms this means to study the commerce aligned dominant fraction of the knowledge class (1993). However, to 'study up' in the moving image production context is also to "study sideways" (Ortner 2009:182-187) since both the managers of this study and myself essentially are 'framers' that strive to get a better overview of the totality of design work within the firms addressed, as well as production processes in the industry at large. This is also to infer that alternative uses and synergy effects of the IS (MI-FLOW) within the realm of below-the-line-workers may never be identified, which could be considered a pity.

The main weakness of the Reception study (in combination with the questionnaire) is its limited scope and, hence, the resulting empirical data's incompleteness. This study does not in itself render any conclusive answers to what the communicative challenges are in producing the new documentary image, due to the fact that it is very difficult to pinpoint exactly what stimuli have the right of way, what stimuli may be regarded as primary or/and secondary. It could be that, for instance, the choice of frame rate or choice of aspect ratio should be considered primary, i.e. that the delimitations of the study could be misconstrued. Another difficulty involves the framing and phrasing of the questionnaire questions. Perhaps visual evidence and visual truthfulness are really too vague concepts for young viewers? It is also possible that questions on realism would have been better understood. No doubt audiences are of different sophistications. Some respondents commented on the questions' vagueness and, therefore, wanted them contextualized. However, I think this lack of context is justifiable in the sense that imagery more often than not 'hits' audiences out of context.

However, in summary, if completely conclusive data are to be generated by studies such as this one, this (combination) method must be further refined and increased in scope.

4. Summary of Papers

This thesis originates from four papers that were the outcome of two empirical studies. Paper A, B and D came out of the same empirical study. The first paper (paper A) is a research clarification that motivates the use of Design Research Methodology in the study of the field of moving image production within the Swedish context. The second paper (paper B) presents the descriptive study made in that field, with the overall objective to suggest design management improvements. The fourth paper (paper D), that is also part of the research project *New Design Processes in the Audiovisual Industry*, deals with the evaluation of the support tool (MI-FLOW).

The third paper (paper C) is a second empirical study, the only paper of this thesis that is not part of the *New Design Processes in the Audiovisual Industry* project. This is a reception analysis of what I call the *New Documentary Image* that is the visual outcome of the use of 'convergence cameras' in documentary production. This study was made in order to reach a deeper understanding of the expressive potential parameter of *Creative Space*, specifically the communication dimension of this factor.

Papers B, C and D are journal papers; paper A is a conference paper. Papers A, B and D were co-authored with Thorbjörn Swenberg. I am the sole author of paper C.

Paper A: In the conference paper **New Design Processes in Moving Image Production: A Design Science Approach,** we scan the film production discourse as well as make pre-interviews with a few stakeholders to see whether and how the shift in recording technology, from chemical to digital, might affect the industry. That shift might seem convenient and offer ways to augment flexibility in production (and possibly it is more economical), yet this appears to come at the price of workflow cruxes that obstruct the distribution of creativity. The paper represents a State-of-the-Art and forms a theoretical base for continued research in the field. The paper is based on the first stage of the DRM – the Research Clarification stage.

The relevance of the DRM approach, we explain, is to be found in the ever more

industrial circumstances within film production, as well as in recognizing that the creative activities taking place there are collaborative design activities and organized in a distributed fashion. This is akin to other conventional design industries. The concept of High Production Value as a quality-measuring device is introduced in the paper.

Our suggestion is to develop a distributed creativity workflow model for the Moving Image Industry. It is proposed to leverage the design process and make the successful execution of contemporary digital film and TV productions possible to a greater extent by the means of avoiding technical bottlenecks and thus reaching smooth workflows. The outcome of the use of such a model is suggested to be less time wasted and more time to spend on creativity within the process.

Paper B: The journal paper **Creative Spaces in Contemporary Swedish Moving Image Production** describes how the distribution of creativity has changed since recordings turned digital, specifically within film production in Sweden. It is a descriptive study, focusing on the material conditions for creative work in order to reveal how the shift to digital recordings has affected design processes. Mainly managers at High End production companies are interviewed. These firms are of different kinds, covering all production related matters, from equipment rentals to technical distribution. Mostly small but also mid-sized companies are addressed. Data are coded and analyzed according to ethnographic standards where re-occurring and overlapping phenomena are sought.

The data illuminate a chain of related phenomena at play when recordings turn digital. Economy impels choice of recording technology and specific equipment. Equipment, in turn, constrains production methods by deciding digital codes, which in turn is decisive for the rest of the workflow. The right digital code is critical for tools to function well, and also in order to allow for adequate design processing of sounds and images. Thus, digital code affects what options there are for aesthetic processing, and is a decisive factor for the 'Creative Space' of each audiovisual designer. The concept of *Creative Space* is thus the theoretical contribution of this paper.

We suggest that it seems a better practice if workflows are decided upon first and recording equipment is chosen accordingly (with the right settings), depending on what measures are planned for at the postproduction phase. Altering the workflow later, if the wrong choices are made, increases workloads at several other instances later in the production, as noted by the Producer and Technical Supervisor of the one man firm: "If there is a small movement at the axis end of a window wiper, it causes a much larger movement effect at the other end." (Informant Company F).

The outcome of this part of the study is a rough outline of a comprehensive web-

based checklist that could be used to technically fool-proof digital productions in order to avoid later lock-ups and reversals of the production process. Thus, production managers may save time and money, safeguard quality (at least technical quality) and spend resources on designers' creative contributions instead of digital problem solving.

Paper C. The journal paper ***Convergence Cameras and the New Documentary Image*** describes how new digital recording technologies pose new creative dilemmas for documentary videographers. New types of high-resolution video cameras with 35 mm sized sensors and mounts for real film lenses generate a type of imagery that does not look typically 'observational'. By testing this imagery's capacity as the guarantor of documentary authenticity and interrelating this with visualization theories, this paper aims to explain the ontology of the new digital documentary image, its lure for the documentary filmmaker and its ramifications for reception in order to leverage technological production awareness of the documentary videographer and production members.
The empirical data presented in this paper are based on an explorative reception study in which five different types of moving image sequences were tested on an audience in order to be able to define the level of indexical appeal in shallow depth of field, high resolution, High Production Value documentary moving images.
The result of the reception study indicates that the discrepancy between production method and production tool may have a negative impact on the indexical appeal of observational documentaries, but that convergence cameras fuel creativity.

Paper D. The journal paper **Workflow Management: Design Management Support in Professional Audiovisual Production** deals with the need for design management support within the Audiovisual Industry due to the increasing variety of video file formats and codecs available to professionals. The amount of video file formats and codecs are referred to as 'the file format jungle' by moving image professionals and needs to be navigated by managerial staff who are not electronic engineers or technicians, but responsible for audio-visual design work within film and TV production.
In this paper we evaluate a prototype for a design management support tool (MI-FLOW) that compares and matches file formats and codecs for different production tools. The core principals of the support tool prototype are found to cohere with the needs for design management support within film and TV production, and the tool is therefore an option for commercial development.

5. Results

In this chapter I will present the results of the papers, including the main outcomes of the complete research journey of this thesis: MI-FLOW and *Creative Space*. In addition I will present the Completed Reference Model and the updated Impact Model that are not paper specific but are a concrete outcome of the development of MI-FLOW within the DRM framework (specifically the Research Clarification and Descriptive Study stages). Comments and explanations for the respective links of the models are elaborated upon in the Conclusion and Discussion chapter.

5.1 Paper A

An initial review of literature in conjunction with pre-interviews with industry representatives indicate that there are constraints in many productions due to the diversity and multitude of file formats and codecs for digital video. This is hard to grasp and to get an overview of (for most professionals). This results in 'cruxes' in production processes. A workflow model for the Moving Image Industry, based on the concept of distributed creativity, is suggested as a possible way to alleviate the problem. The workflow model could be developed successfully within the framework of Design Research Methodology. The anticipated outcome of the use of such a model will be less time wasted and more time for creativity.

5.2 Paper B

Efficiency, frictionless workflows, and quick turn-around are sought within the moving image production industry. These properties are to be attainted when companies' technological resources and creative resources are maximized. However, this can only be achieved if/when knowledge about certain media's technical parameters are known to management and most designers. Digital image files of faulty video formats (or with improper codec) constrain moving image production actants' creativity in several ways: either the files do not work at all in the production system and thus need to be converted. This becomes a time theft. In

addition, this holds expensive production equipment 'hostage'. Or, they do not contain the optimal amount of information that is needed for the image processing; see Table 5.

Table 5. Table showing the selection of type of data and data levels as functional or dysfunctional outcomes.

	Dysfunctional Outcome	Functional Outcome
Amount of Data	Too much data to handle effectively in production systems ('Data glut'). Too little data to ensure quality images or to be evaluated.	Just right amount of data to be handled by production systems, enough data to ensure required image quality.
Type of Data	Non-compatible file formats and codec require lots of time and expertise to conform and transcode.	Compatible formats and codec allow for smooth workflow that in turn is a prerequisite for creativity.

Many of the contemporary constraints associated with digital videography are thus kinds of predicaments related to the recording media, i.e. the very materiality of digital media and how it is configured, which varies, as indicated by the owner and manager of one of the biggest post-production firms in Stockholm:

> It was easier in the beginning when there only was the RED-camera, but now, after RED, it just continuous. And all the different manufacturers, they cannot agree upon what is the standard file format, codec, or compression algorithms, and so on. It is a jungle." (Informant, Company A)

Issues that pertain to transferring, backup and archiving are also related to the problem that professional digital videography generates too much data. In artefactual filmmaking this was rarely considered an issue. Some remember this time with great fondness (informant 1, Company B). Digital tapeless filmmaking, on the other hand, is sensitive to data overload. Thereby it is wise to know what is a black-boxed storage solution and what is not. For instance, a hard drive storing the videographer's media (i.e. the 'film' or the 'clips') is only black-boxed as long as it not handled carelessly. Some blame delivery services and low quality external hard drives for lost media (informant Company A).

However, a crashed hard drive might not be the end of it, as long as proper back-ups have been made in the recording phase by the DIT (Digital Image Technician, the digital videographer's right hand). The usefulness of the DIT should not be underestimated. However, occasionally the DIT is looked upon as an unnecessary expense and media management as something that is not budgeted for:

> Some are pretty skeptical about the usefulness of the DIT; why pay someone who just sits there seemingly idle next to the videographer? (Informant 2, Company B).

The problems associated with live screening and on the set evaluation are similar to the issues of transferring, conforming, making backups and archiving, but are more contingent on the *type* of data. The wrong type of media does not play properly or/and is too low in quality to be properly evaluated:

> After the first day of shooting the videographer came up to me and told me 'I have no idea what I am doing'. He was very nervous. (Informant 2, Company B).

However, not everybody recognizes this precarious situation. Especially "above the line" creatives (Caldwell 2009) still think that live screening will take care of itself (at no extra cost) as was the case in tape-based filmmaking. Some claim that HD was great since "It was more like what you see is what you get" (Informant 1, Company B)

Digital filmmaking not only introduces constraints, but also leverages certain production principles and empowers the videographer and his team (the DIT – Digital Image Technician –plays an important role here) since digital files on hard drives are 'developed' on a computer and can be screened and copied any time at any place (if the required hard drive and software is available, that is). In addition they can be pre-graded for evaluation on the set in a matter of only minutes: "They make the final look on the set. Then that look is kept throughout post-production." (Informant 2, Company B) This makes the digital 'lab' extremely mobile and less dependent on and constrained by, for instance, the willingness and assumed professionalism of people developing films at a film lab: "Now you have film quality on the set." (Informant 1, Company B)

Different cameras and video formats constitute a range of options in terms of system configurations. However, there is no fixed formula that will reassure the videographer or 'specialist' what camera will work with what post-production gear, and what camera and settings will result in the most smoothest workflow: "You won't find out until you have used it." (Informant Company G) Similar concerns

are also expressed by other informants, such as the owner and manager of the small video production firm in Borlänge: “You don’t just run to the store and buy a camera, and get disappointed later, no, we put it into our editing system first and noticed there were some issues.” (Informant Company E)

Several solutions to cruxes are identified in the data. Here I summarize these solutions as three categories - depending on type of crux addressed and core principle of the solution - as follows:

1.) Workflows

Reaching the best workflow for each production is a critical matter, since there is a need for time efficiency and reduced loss of image quality throughout the production chain. As suggested by most of the informants, spending planning time on scheduling workflows is considered mandatory for any moving image project. Only the company working with ‘plug and play’ technical solutions from the same manufacturer does not consider this an issue. However, estimating time for each design process beforehand is a most challenging endeavor. In summary, the primary solution to ‘production chaos’ spells *workflow planning* regardless of how difficult it may be. The issue that most informants agree on is that all image processing must be decided on first, before *workflows* are fixed. The aim is the smoothest file transferring between the tools in use in postproduction. File formats and codex should be determined at this stage to avoid file conversions; that is to avoid time waste and image quality losses, since the codec in use is decisive for whether a tool will be able to process the image or not. First thereafter should the choice of cameras be made. Then production can start. This way postproduction sets the conditions for the videography team.

The image quality evaluation issue (how to evaluate undeveloped and ‘raw’ images) in High End recordings is also dealt with through altering workflows, so that the first grading of an image takes place soon after the recording. Either it is done on the set, where the recordings take place, or via broadband at a postproduction studio.

2.) Production Methods

In order to achieve an affordable workflow that sufficiently meets the aesthetic requirements regarding the images, production methods are arranged according to different principles. In the analysis of the interviews we identified four such principles:

The first principle is to keep the option of multiple parallel workflows open. This may be accomplished through a variety of ways, combining new and old equipment. Optimal distribution copies are hard to achieve this way.

The second principle is to let the quality demanded in distribution decide what quality to use throughout production in accordance with the image design processing needed. Image compression is then used at an economically motivated level. A disadvantage of this principle is that alternative forms of distribution that might be demanded after the first distribution, then require re-processing of the images in several steps, with additional tools, which in turn consumes a large part of the potential profit of more distribution.

The third principle is to keep the production open to all kinds of distribution by investing in high computing capacity (fast hard drives or servers) and using uncompressed images and powerful tools all from recording until distribution. All sorts of distribution will then still be possible.

The fourth principle is to use relatively inexpensive production systems ('plug-and-play' solutions) where the same manufacturer makes all the equipment. Then the conversion between file formats is guaranteed by the manufacturers to work easily and without loss. This is only possible with production systems up to a certain production level as High End equipment manufacturers tend to focus on making only one or a few types of products, such as cameras or certain software. High End production systems thus have to be arranged by combining equipment from different manufacturers and cannot use this principle.

As a general principle, several informants stress the importance of standard procedures for the respective tools in use, for each specific design process that an image may go through. This could apply to any production method, regardless of the current workflow in use.

3.) Competences and Work-roles

What is also made explicit in many statements made by our informants is that the shift in technology from chemical to digital requires a whole set of new knowledge within this industry. New cameras and digital tools come with new capacities, but need to be mastered, by both technicians and designers. Planning a production means planning for the transfer of digital material through a production chain with several tools involved. Avoiding conflicts between the digital material and the tools that are scheduled to process it means being well aware of the digital capacity of each tool, as well as what are the optimal file formats and codex to use. There must be a person assigned the specific task of keeping control of those issues in order for a production to function. At one firm it is a Visual Effects Supervisor who is in charge of this. At another firm it is a Digital Supervisor. At yet another firm it is a technician with the special interest in file formats and codex.

Since many of the digital parameters that have to be set in the camera belong within the scope of the digital world, not many cinematographers master this job; hence a technician is needed. Digital Image Technician (DIT) is a new work-role being established. The DIT has responsibility for the camera settings, takes care of the image files after recordings, makes the backup copies, and transfers the files to wherever they are to be distributed. Also preliminary grading, for image quality evaluation, may be taken care of by the DIT.

4.) Management Deficiency

As an overarching requirement, several informants express that production processes should be effective, smooth and fast, with enough creative space for individual designers. This is meant to be achieved through work routines, process control, arrangements for collaboration and flexible workflows. Technical capacity, professional competence and knowledge about technical parameters are mentioned as keys to success.

The wish for a 'smoother' production apparatus, as described above, indicate that most cruxes relate to insufficient knowledge about what the digital technology requires from the production organization. There are several stories told about documentary films, TV productions and commercials productions that start out with cheap cameras, for instance DSLRs, because of producers wanting to lower costs. However, no managing staff or camera operator knows what file formats or codex to choose in relation to the up-coming postproduction. That is considered something for the postproduction firms to simply 'solve'. This, then, turns out to cost a lot more than what was saved by the choice of camera.

This is a managerial issue. Directors and producers who are used to working with the chemical technology, are not yet aware enough of some of the technical dispositions that digital technology inhabits, and the cruxes that follow. Nor do they sufficiently know how to handle situations brought to the surface by those cruxes.

Several informants express the need for producers, directors and other managerial staff to get educated on those matters. They ought to understand the principles that digital moving image production is subjected to at the core level of codex, to be aware of how productions must be planned. Production should be planned according to the postproduction workflow needed, and production management should establish as a standard procedure to have a preproduction meeting with the postproduction firms, in order to save time and promote creativity.

5.3 Creative Space

In summary, the above results indicate that the end product governs production methods and that three main factors are at play in shaping the efficiency of workflows in digital audiovisual projects, factors that in turn appear to condition audiovisual communication and artistic practice: Time for Project, Amount of Digital Information and Skills. Here, some alternative terms could also be used, for instance, 'digital convenience' or 'digital affordances' would also be viable terms for the Digital Information factor. Regardless, the key assumption here is that designers' creativity in an audiovisual project, such as the videographer's creativity, depends on his/her skills at handling digital equipment and cameras, time to work on a project and the constitution of digital information production technologies available; see Figure 12:

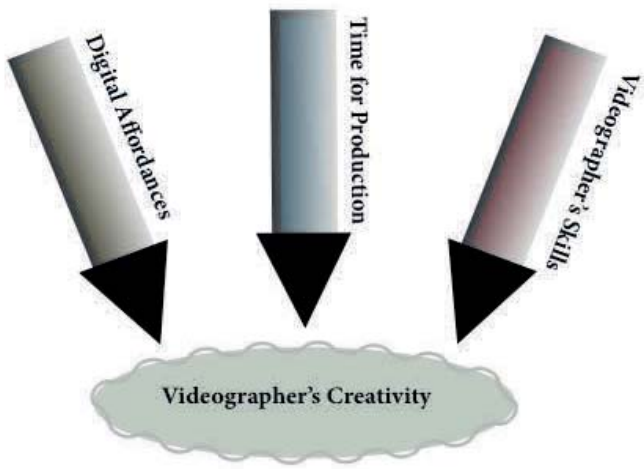


Figure 12. Figure showing three constraining factors of the videographer's creativity.

The above figure is a rudimentary outline of what was developed into an *optimization* concept that serves to support rationale choices of tools and digital media in order to 'liberate' creativity in contemporary moving image production: *Creative Space.* This is not a videography-specific concept, but is generally applicable to any digital moving image production designer's craft-related practices.

Specifically, *Creative Space* pertains to a designer's space of creativity within the boundaries of a specific digital moving image production (i.e. a commercial, fiction film, TV-Show documentary etcetera). In other words, Creative Space is based on the premise that the *production* ('film') is the *boundary object*, i.e. the production is what is used as a means of coordination and alignment and is what bridges various professions' capacities and practices (cf. Fisher and Reaves 1995, Star and Griesemer 1989).

In this concept's later refined versions, the 'skills factor' was referred to as 'expressive potential' since this factor really is a combination factor that is combined of an actant's skills and a tool's capacities (paper C). See Figure 13.

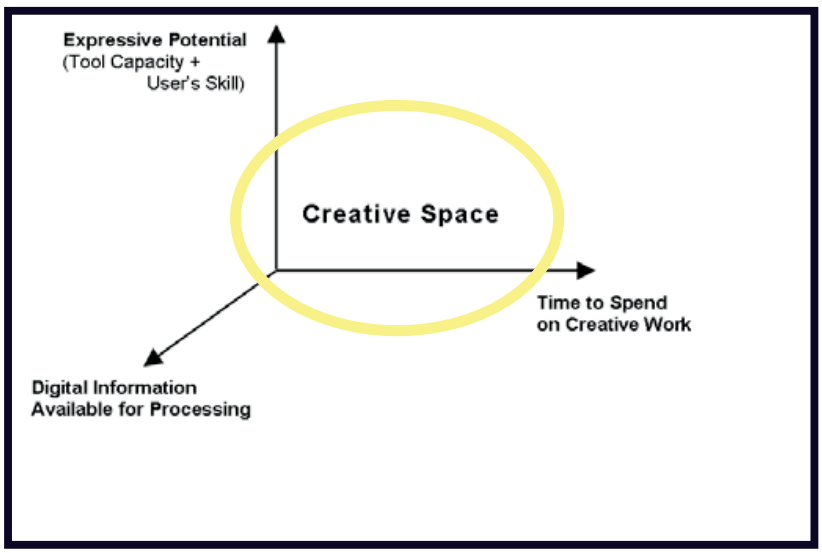


Figure 13. Dimensions of a videographer's creative space in moving image production.

The implicit assertion of this concept is that if a designer (such as a videographer) can spend less time and effort on technological problem solving, there is more room for creativity. If the three factors that enclose the designer's *Creative Space* are at optimal levels, a designer's creative capital may be fully utilized. Hence, avoiding any cruxes and problems that extenuate this space is to safeguard designers' creativity and, hopefully, safeguard the quality of the production.

This space is not infinite. The dimensions that enclose this space may increase or decrease, but will not disappear, nor expand infinitely. It is finite. A project requires a certain amount of creative work, and deadlines must be met. In every project there is a definite amount of digital information to be processed, and every project employs designers and tools of various kinds and capacities.

The factors of *Creative Space* are interconnected and inter-dependent within the boundaries of a project. This means that the concept of *Creative Space* must be understood as relational. This explains why different creative spaces may be evaluated when compared with one another. This makes *Creative Space* a phenomenon possible to manage within various production systems and projects (paper B), since what constitutes its boundaries can be objectively (as objectively as possible) defined and compared, and therefore altered. It may be altered with the help of MI-FLOW.

Creative Space excludes non-objective/quantifiable criteria and/or non-project related criteria such as, for instance, 'knowledge', 'knack', 'brainstorming', 'experimenting' and so on. This makes this space into something that within the field of sociology could be labeled a *Reduced* Property Space (cf. Asplund 1968). This reduction is due to the fact that some - possibly important - factors cannot be satisfactorily related/interconnected to one another, and/or the digital information factor in particular.

After having developed *Creative Space*, the Reference Model and Impact Model were updated to include the factors of *Creative Space*. The result was a complete Reference Model that is reduced in scope and completely contingent on the theoretical concept of *Creative Space*. Hence *Creative Space* became the Key Factor. What remains is the Success Factor of Quality of Product. See Figure 14.

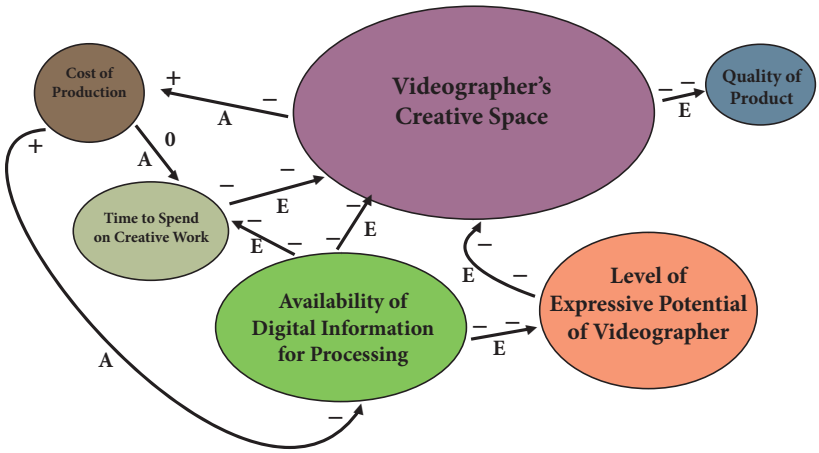


Figure 14. A complete Reference Model based on Creative Space.

From the complete Reference Model I conclude that I have reduced the number of links and factors to be investigated. In agreement with Blessing and Chakrabarti (2009) I think it is better in a detailed empirical study to have a deep understanding about a few factors than a shallow understanding of a large number. Nevertheless, the model still contains a few 'weak' relations. One such weak relation is the link between the Videographer's Creative Space and Cost of Production (this link – and others – will be addressed in the Discussion and Conclusion chapter).

Based on the completed Reference Model, the initial Impact Model can now be updated and further detailed. The support (MI-FLOW) aims to limit the impact of the factors that decrease the videographer's space. Therefore the Updated Impact Model will revolve around the dimensions of Creative Space. Note that no factors that cannot be influenced by MI-FLOW are part of the model. See Figure 15.

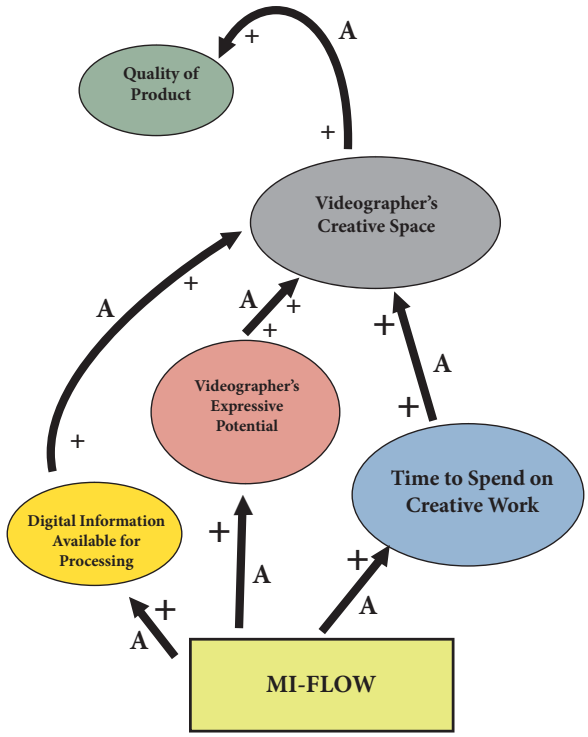


Figure 15. An updated Impact Model centered on the theoretical concept of Creative Space.

5.4 Paper C

'Convergence cameras' fuel creativity, but at a cost (potentially dysfunctional communication). Specifically, the results of the questionnaires indicate that the new documentary image (i.e. the convergence sequences) has less indexical appeal than the conventional documentary image. Overall, the conventional types scored higher than the convergence types and were more often regarded as valid audiovisual evidence. The 1:1 sequence achieved the highest average score. This is the sequence that was designed to look the most conventionally documentary; it is low-resolution, made to look handheld and has great depth of field. The 2:1 scored as high as 1:1, which means there is no difference in statistical terms. It contained all conventional style factors as in 1:1 except the handheld factor. Thus, whether the handheld element is part of the indexical appeal remains to be determined.

The *Fumbling Man Sequences* of the conventional kind (1:1 and 2:1) scored slightly higher than the conventional sequence 3:1. Perhaps the fabula aspects of the *Fumbling Man Sequences* correspond to a higher degree with the documentary truth claim than the *Angry Woman Sequences*. The *Angry Woman Sequence* of convergence type (3:2) received the lowest average score of all sequences. Yet (paradoxically) the *Angry Woman Sequence* of the conventional kind (3:1) was considered to be most evidential of all the sequences.

It is also worth noting, in this context, the overall low beliefs in the videos' value as evidence. The indexical appeal points are similarly not very high.

The results of the explorative reception study indicate that the production method - tool discrepancy has a communicative dimension. So has the lure of High Production Value. This is to say that the choice of tool and the resulting material imprints (to the image) have great meaning potential. This is in agreement with Becker: *Conventions* place strong constraints on the videographer (1982: 32). The often-hailed digital transparency claims are thus highly questionable since certain aesthetic conventions are built into the design of the convergence cameras.

5.5 Initial Evaluation of MI-FLOW

The results of the initial evaluation showed that the design of MI-FLOW appears to be consistent. That is, there are no steps/tasks that invite hesitation or confusion and sidetrack the user when trying the IS since all actions required by the user follow the same basic principles. The basic Support Evaluation also showed that as far as contemporary professional filmmaking within the Swedish context is concerned, the IS appears to be as complete as needed, at least as prototype. No major production step appeared to have been excluded. Yet, it might be the case that some productions involve other minor steps that are not covered by the IS. It is also possible that some production units do not refer to certain production steps the same way as the IS (for instance, it is possible that some do not differentiate between 'grading' and 'editing' since some use editing software to grade).

5.6 Paper D

Paper D deals with the in-field evaluation of MI-FLOW. This evaluation was undertaken within the final DRM stage: Descriptive Study 2.

In summary, these are the specific results of the Support Evaluation:

All Informants: ensured the logical functioning of IS (i.e. MI-FLOW), at least at the lowest level; grasped IS's core functionality; agreed with the intended use in pre-production; could maneuver the IS's menu.
Two informants: thought IS should "contextualize" compatibility problems and explain the underlying reasons; indicated that the IS would not replace current practice; ruled out that the IS could be used in customer negotiations.
One informant: thought the core functionality was too narrowly defined and desired one additional constraining factor (color mismatching between PC and Mac computers); thought IS's solution page was incomplete and wanted emphasis on "solution", not the problem (i.e. did not want to try several workflows until there were no warnings); desired more data (i.e. more choices); expressed concerns that IS would replace valuable social relations; deemed IS "educational" rather than "enabling"; appreciated IS's way of simplifying technical requirements; suggested the IS could be used as a file format database; indicated an alternative use for the IS during production.

6. Conclusion and Discussion

In this section I will relate the videographer's practices (and his/her team's practices) to the establishment of functional workflows and the leveraging of the distribution of optimal creative spaces throughout the production chain. I will also answer the research questions. Then I will further elaborate on the implications of the digital aspects of videography and explain exactly why *Creative Space* is supported by MI-FLOW, and why it may not be. Finally I will comment on and explain some of the links of the Reference Models and Impact Models of this thesis.

Videography as digital production nexus implies not only the connection between human actants' different artistic intentions, but also the connection between machine actants' different digital insides. To take the specific nature of digital machines and digital media into account in production - what they allow, afford, and in fact express – is to feed and foster creativity. In this sense, this nexus is key in establishing constructive interaction between tools and designers for the betterment of creativity in production and (hopefully) the medial object itself. However, the smooth functioning of the digital production network is not to be taken for granted. It takes strategies, systematic enhancement and recourses to support this smoothness in order to create space for creativity. Creativity in moving image production is not a matter of a simple straightforward process that is only contingent on a designer's expressive intentions or/and inherent gifts and talents. Such intentions are constantly subject to other factors that constrain the shaping of communicative expressions and obstruct the distribution of creativity in technical systems. Here the level of sophistication of tools, complexity of production systems and the collaborative nature of contemporary filmmaking are key. However, these aspects cannot be understood separately form the materiality of Digital Media, the machines that handle it, and the professionals who function as digital gatekeepers – the videography team.

This thesis has also shown that as new digital recording media and new cameras are being introduced into the production apparatus, the role of the videographer is

shifting. From being a key creative in his/her own right, the videographer is now being forced to cope with his/her new role as a networked gatekeeper to functional workflows, as well as having to cope with the new mediating powers of digital film cameras. If the videographer manages to do this coping successfully, he/she will regain lost creative capital and leverage the distribution of creativity. However, and this is the key insight of this thesis, the videographer cannot accomplish successful coping strategies alone: management must be involved. Any successful digital moving image production must submit to a rigorous technology impact analysis in the pre-production phase by a kind of broker who understands the requirements of the medial object (often through the specifications of a customer or/and a producer) and at the same time understands the various capacities of the complete production chain.

Constraints are not simply 'evil doers' but are integral to creative enterprises. Introductions of new recording technologies do not solely generate negative effects – if that were the case they would not have gotten introduced in the first place – but also become an opportunity to explore new expressive possibilities. Here the expressive potential parameter of *Creative Space* becomes an important factor to understand and control, since a successful exploration of new expressive possibilities hinges on how efficient the interaction between machine actants and human actants is. If such an interaction is efficient, *High Production Value* is obtainable. The expressive potential parameter may thus be evaluated by degrees of Production Value – a time tested criterion. But perhaps more importantly, if the distribution of creativity is not obstructed by dysfunctional workflows, there are ample reasons to believe that digital media may finally be able to return to us what has possibly been repressed: the potential of innovative audiovisual productions.

6.1 Answers to Research Questions

I conclude that the specific answers to the research questions of this thesis are:

> **RQ1** (In what ways do new digital tools and new digital media impact the craft of videography)?
>
> **Answer:** New digital tools and new digital media force the videographer to function as a gatekeeper to functional workflows. At the same time, new digital tools and new digital media augment expressive capacities.
>
> **RQ2** (If there is an impact, what factors may be considered primary and

why?)

Answer: The parameters of *Creative Space* are primary since they allow and constrain creativity. They do this because these parameters are not constants; they vary in degree, and they contract and expand. If they contract, or are misaligned, the designer's space for creativity decreases, and vice versa.

RQ3 (If there are any negative aspects to this impact, how may this impact be mitigated?)

Answer: The negative impact of these factors may be mitigated through using an on-line checklist (such as MI-FLOW). Digital configuration must be accomplished. Technology Impact Analysis in the preproduction phase may lessen miscommunication impact of the expressive potential parameter.

6.2 The Unboxing of Digital Machines

At the heart of the file format crux situation is the faulty notion that everything digital is black boxed, while in reality it is not. The unboxing of file formats and codec is not about machines breaking down (as it usually is in other conventional design industries). It is about the many nuances inside the 'black box'. These nuances make file formats and codec fit for certain technical configurations, but not for others. They remain the same, but do different things in accordance with the network they mediate within and what machines they are put into. It could be said then that file formats and codec can change the outcome of the product through the practices of the machine actant and the videographer (and other design actants). Stating this, it becomes obvious that the production network is not a network confined to the production team (although in this thesis I do not venture far beyond). Camera manufacturers, software engineers, investors and even corporate lawyers are in this sense part of the network. However, this list could be almost endless. This is why MI-FLOW is geared towards the part of the network that is most easily managed and closest at hand, the part that is the most susceptible to design process support and where the support proves to have the greatest impact. That part of the network is the men and women responsible for the recording of images.

6.3 Digital Malleability

One important recommendation to any videographer is to set the camera's settings correctly straight from the onset of the production. Correct settings in combination with correct conforming warrant a smooth production flow in which cooperation in between image crafting professionals is not obstructed. This highlights a key aspect of contemporary moving image production: In order for a smooth workflow to be established it needs to be technically organized (or 'synchronized'). The digital degree of 'malleability' needs to decrease at the instances where there is the most potential flexibility (see Figure 16.)

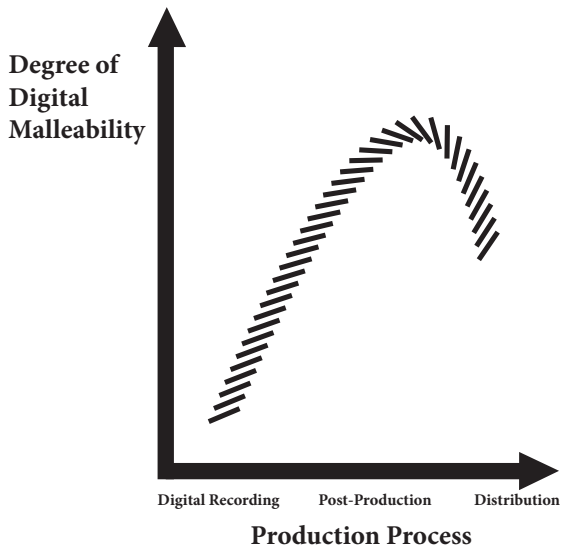


Figure 16. A stylized depiction of at what stages there are the most digital options, or digital malleability, in a digital moving image production process.

This explains the importance of the videographer (and his/her team) in creating functional workflows. Again, a mess-up in the recording phase will result in wastes of one sort or another down the line. Simply put, everything cannot be 'fixed in post', as the conventional wisdom has it, and when and if it can, it comes at a cost.

The right instance to decrease the amount of digital options is thus not at the stage where there are the most such options (primarily because this would result in loss of quality). Any containment schemes and streamlining efforts must be applied in advance. A digital assembly line only functions as well and smoothly as its first

stage/stages allows. This is to say that there are favorable responses to certain key critical conditions in the early stages of a digital moving image production process, and that these responses in effect are the organizing of digital technology in production. See Figure 17:

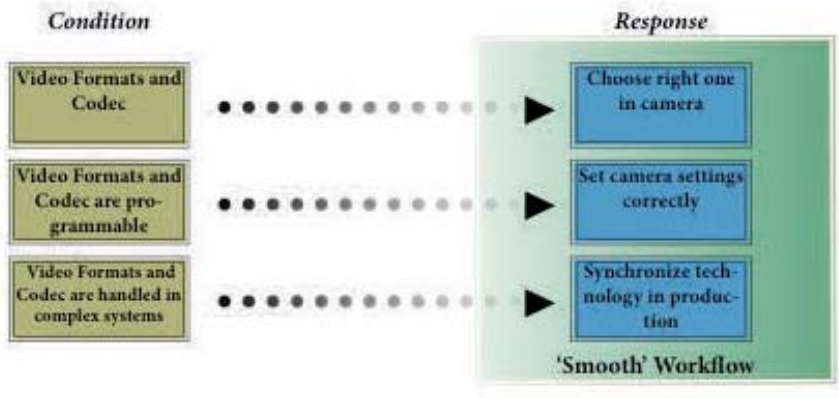


Figure 17. A summary and categorization of critical conditions and desired responses in the early stages of a contemporary digital moving image production process.

6.3.1 Managing Digital Malleability

However, the Videography team should not decide what file format and codec to record. If they did, they would probably choose certain cameras and certain types of formats on the grounds of personal preferences. And there are many such conflicting preferences (paper C). He or she must choose what digital material to record on the basis of the needs of the post-production team. This is to promote the distribution of creativity. The professional capable of communicating such demands and needs is usually some sort of manager or technical supervisor involved in the preproduction phase. Still, the task of keeping track of what formats play with what machines, new and old ones, is daunting. This is what MI-FLOW keeps track of.

6.4 The Limitations of MI-FLOW

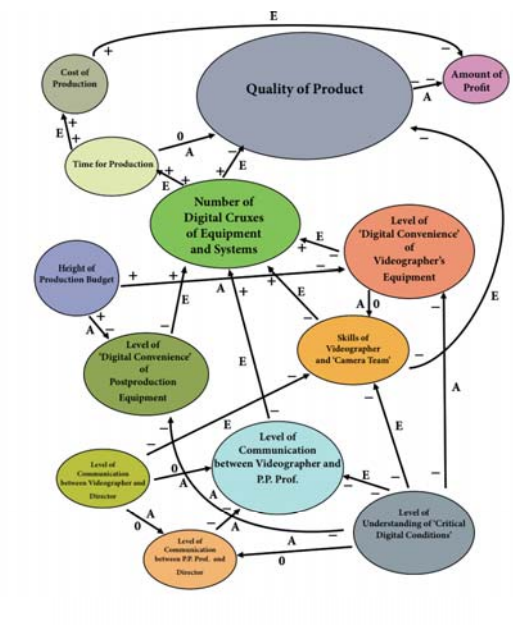
At this point it ought to be quite clear what MI-FLOW does: MI-FLOW black-boxes files and codec, although the general advice of this thesis is to unbox (yes, this is somewhat of a contradiction). However, what is perhaps still unclear is what MI-FLOW does not do.

First of all, it does not replace management or human interaction in the pre-

production phase. It is meant to function as a complement in preproduction meetings. What about the 'tricky' expressive potential parameter of *Creative Space*: does MI-FLOW augment this factor? On one hand, it certainly does. MI-FLOW has the potential to remove cruxes that detract designers from reaching their expressive potential. For instance, if the videographer knows straight from the get-go the technical parameters of the production, he/she may focus on being creative instead of focusing on technical problem solving. In the case of the videographer, MI-FLOW also indirectly supports the evaluation of images (by sight) through making sure media plays properly across viewing platforms. It may be argued, then, that MI-FLOW indirectly supports the videographer's cognition.

On the other hand, using MI-FLOW will not alleviate miscommunication outcomes of the sort discussed in paper C. It does not directly influence the choice of tools' mechanical capacities (lenses for instance), nor, quite obviously, does it shape communicative expressions the way human actants do. It does not overtly form, encourage or diminish aesthetic options. In short, the expressive potential parameter of *Creative Space* is far too complex a factor (and powerful) to be controlled/conditioned by a – rather simple – checklist.

6.5 The Reference and Impact Models



At this point I need to explain some of the assumed relations and influences of the Reference Models and the Impact Models in order to further motivate the relevance of *Creative Space* as a way to compare and optimize levels of creativity within digital moving image production.

As indicated in the initial Reference Model, a high budget does not correspond to a high level of digital convenience of digital equipment. On the contrary a high budget tends to decrease it, although this inconvenience is mitigated by the skills of various kinds of experts. This is because

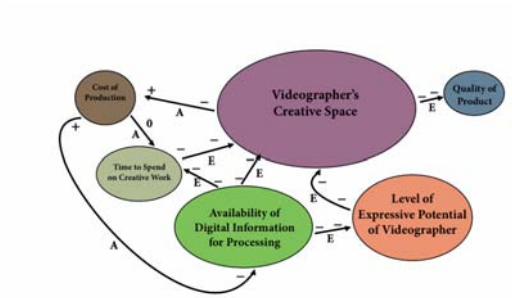
high budget filmmaking usually involves disparate kinds of expensive equipment (that is not mass-produced) that have unique features, settings and technical configurations. This is the opposite of relatively inexpensive mass produced 'plug and play' gear and software that are high in digital convenience.

Here it is also worth noting that it is assumed that the level of digital convenience of equipment has no effect (or that such an effect would be hard to establish) on the skills of the videographer and his/her team. On a personal level I can attest that my cheap Samsung HD camera that only has four buttons (one of which is an upload to YouTube button) and that is marketed as an ease of use camera does not aid the effectuating of my videographer skills (I can't even shoot sharp images with this thing since it lacks a focus ring). Yet, what is considered convenient/inconvenient varies from videographer to videographer. Perhaps lacking a focus ring could be considered a convenience, since that way the videographer does not have to bother shooting close-ups. Simply put: what is considered constraining factors of equipment varies according to who is the user, his/her preferences and his/her skills at handling a certain piece of equipment. Hence, there is no standard technical formula of equipment that can enhance the skills and abilities of a videographer. As a consequence, manufacturers define 'digital convenience' quite differently and do this in accordance with their own ideas and needs. Thus, a freelancing videographer oftentimes work with a lot of different kinds of cameras and other gear that all exhibit their specific take on 'digital convenience', which in of itself is an inconvenience, and some become really adept at handling this (usually young videographers). Furthermore, one aspect of a certain piece of equipment might be convenient under certain conditions in certain configurations, but not in others. Lastly, what is convenient in terms of ability to improve functional workflows is not the same as convenience in terms of ergonomics and usability. A technically inconvenient camera might still be great at supporting the cognition of the videographer.

It is also worth noting that it is assumed that the effect of time for production on the quality of the product cannot be (satisfactorily) established. This is not to say that time for production is irrelevant, but that some productions require more time and some less, and that as long as the deadline is met it seems reasonable to believe that no additional time would generate a higher quality product. This is also to suggest that merely adding time to an already set amount of production time in order to safeguard or/and promote quality output is useless.

As inferred from the Results Chapter, in the Completed Reference Model I make the assumption that if the videographer's creative space decreases, it is likely that the cost of production will increase. I make this assumption based on the premise

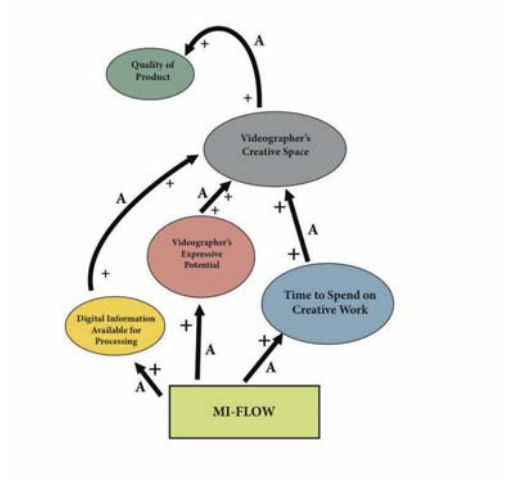
that the unused creative capital of the videographer will result in additional expenses when production companies somehow compensate for this lost creative capital (for instance, companies may have to add other designers to the payroll). This puts the finger on the value of the videographer. How big an asset is the videographer in Moving Image Production? In what ways can she/he be replaced?



Another link of this model based on assumptions is the relation between Cost of Production (+) and Availability of Digital Information (-). In part this is a weak link since the causal chain that Cost of Production is part of is entirely based on assumptions. In regards to the relation in question it seems possible that one consequence of cutting costs is that companies try to keep the amount of digital information available for processing at a minimum, since it is a cost-cutting strategy to avoid expensive storage and computer solutions that can handle rich digital media (such as so called RAW files or uncompressed media). Still, there is little evidence that this cost-cutting strategy is widely spread among mid-sized firms. (However, it is a strategy at the small firm located in Borlänge).

At this point it would also be appropriate to explain why I think there is no causal linkage between Cost of Production and Time to Spend on Creative Work. This might seem a little odd since one could assume that well-financed productions can afford to make sure that designers spend adequate time doing their work. Perhaps this is true, but this misses the point. The Time to Spend on Creative Work factor is not the same as a 'work time factor'. Work time factor in this context would be a misnomer. The time factor of this model is not contingent on aspects of financing and budgeting in the same way as work time is. Regardless of type of production – low budget or high budget – time spent on creative work remains a key factor of a functional production, and any production (low or high budget) will estimate how much time will be spent on certain creative tasks. Accordingly, a videographer can only spend a certain amount of time on creative work (unless deadlines are insignificant). The overall issue here, then, is to be able to define what time is creative and what is a time theft in order to make sure that videographers have enough creative time within any given project's limitations.

At this point I also need to explain and further motivate some of the assumed relations and influences of the updated Impact Model. It is assumed that the Intended Support (IS = MI-FLOW) will make more digital information available. However, this is not to say that the IS automatically will suggest any file format



and codec that adheres to the third principle production method, i.e. always assume maximum amount of digital information preference on the part of the user (see previous subchapter). Quite to the contrary, the IS helps define what type and amount of digital information is suitable in a certain production context (no productions are alike). The underlying assumption here is that incompatible, 'crux-prone' formats and codecs never provide the user with the optimal amount (and/or type) of information available. Crux-prone material always results in quality loss and by definition provides the user with less digital material to work with (low resolution material contains less information). This is an example of how a designer's creativity gets constrained by digital material; there are only so many creative choices that can be made with inferior material. Creative options multiply when type and amount of digital material are optimal (i.e. optimal in relation to other production constraints). In summary, the IS attempts to make management aware of this digital inferiority and therefore offer ways to avoid it before it is too late, or too costly to rectify.

7. Future Research

This thesis focuses on technical production constraints within the realm of the recording stage and how these impact how 'lean' the production apparatus is. It merely touches upon the communicative dimensions of certain production choices (paper C). However, this, I believe, is a worthwhile and intriguing research venue to explore further.

The fact that certain production methods and certain media tools affect the communicative outcome of audiovisual productions is often downplayed in film and media studies. Perhaps this neglectful stance is reflective of the absence of a fully developed 'production grammar' or/and that foregrounded modes are considered invisible and merely "naturally there" (Kress, Van Leuween 2001:54). In any case, it seems to me that to neglect the meaning potential of production is to claim that everything is pre-figured by designs (and to deny that production communicates directly). This is an extremely theoretical proposition not grounded in everyday reality that I have come to believe does nothing to alleviate constraints in the realization of designs, however perfect such designs may be.

A more practical approach, grounded in everyday reality, would give center stage to material qualities, media technologies and cognition. One possible direction of such a practical approach would be focused on educational films and other moving image productions that aim to 'instruct'. This would go to the heart of the *how* in designs, exploring *how* media technologies and their capabilities extend human vision and thinking and help us 'touch' and understand audiovisual productions (i.e. support cognition). This is not to say that such research would be entirely centered on production processes, it would also focus on the outcome of such processes – the medial object and its audience's use of such an object.

The rationale for looking at instructional, educational and informational productions instead of conventional TV and Film productions is twofold. I think such productions would provide more clear-cut evaluation criteria than, for instance, fiction films. As this thesis has shown, it is no easy and straightforward task to circumscribe the forces behind communication impact of tools and production methods in narrative films (paper C). Simply put, the failure or success of instruction due to certain production choices and methods is easier to discern in

productions that tend to be less creatively distributed, technically complex and usually aim to serve only one kind of audience. The other reason for focusing on non-narrative productions is that I think such research would serve a great purpose. Right now various kinds of protocols, production methods and 'production grammar' are developing as what was initially labeled UGC (User Generated Content), inexpensive digital media tools (such as inexpensive high resolution video cameras), audiovisual manuals, Internet distribution and very select audiences are becoming part of an ever more complex media consumption/user landscape. This is no longer a peripheral phenomenon, especially considering the ways "…digital media sharing has become everyday practice." (Engström 2012:46) What has long been argued in theory is already being implemented in practice. Computer interfaces make perception and reading more physical, material qualities that once were not regarded as materials now suggest a semiotic potential, classifications are being transformed and media is formed in socially new ways (cf. Kress and Van Leuween 2001).

Many audiovisual examples of what is hailed as 'better than text-only instructions' are very short lived and do not seem to be appreciated. YouTube and the Internet are full of audiovisual (and visual) instructions that no one pays attention to and seemingly are of no use. In short, the Internet has become a graveyard for failed instructions. However, there are also many great examples of effectively communicated instructions. The questions are, then, what make some audiovisual productions more effective than others, how do the new conditions affect the semiotic potential that resides in production, and how can we control this semiotic resource to serve our own ends for the sake of creating a comprehensive production grammar for audiovisual productions?

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Appendix I

Paper Abstracts and My Contributions

Paper A

New Design Processes in Moving Image Production. A Design Science Approach.

Industrial design processes have several common denominators regardless of the actual design. This is to say that the production of moving images is a kind of design process. Even though every single film- or TV-production is unique, the production processes as such are often similar. Therefore we suggest that a Distributed Creativity Workflow Model will be useful in film- and TV-production. This model will facilitate the design process and make the production of contemporary audio-visual material more cost effective. Hopefully more time can be spent on creativity within the process.

Keywords: distributed creativity, design models, audio-visual design, and film/TV-production.

Contribution: My contribution is data collection, analysis and writing.

Paper B

Creative Spaces in Contemporary Swedish Moving Image Production.

Production of moving images is turning completely digital. This leads to new possibilities and new constraints for creativity within film and TV production chains.

This paper describes professionals' current comprehension of the consequences of the shift from celluloid to digital technologies, within the Swedish Moving Image Industry. New technologies bring new workflows, new design processes and new constraints.

We aim to illuminate factors that affect design creativity in digital moving image production, by addressing questions about production related responses to the digital turn as well as the affects of such responses on creativity.

Inspired by Ingar Brinck's creativity theories (1999, 2007) we view aesthetic problem solving as a cognitive process and suggest *creative spaces* to be the critical phenomenon to manage. We also use organization theories, particularly the

work of Katherine Miller (2011) to explain why creativity ought to be a primary management concern.
The empirical material used is semi-structured interviews with management personnel in Swedish moving image production companies. Outcomes include that the variety of digital formats available today is hard for crafts people to overview. This has brought costly workflow constraints that largely limit creativity.
We suggest a pre-production file format check-list as a tool to support design management.

Keywords: technological shift, file formats, workflow, creativity and design management.

Contribution: My contribution is data collection, analysis, theoretical work and writing, equally shared with co-author Thorbjörn Swenberg.

Paper C

Convergence Cameras and the New Documentary Image

New digital recording technologies pose new creative dilemmas for documentary videographers. The new type high-resolution video camera with 35 mm sized sensors and mounts for real film lenses generate a type of imagery that does not look typically 'observational'. By testing this imagery's capacity as the guarantor of documentary authenticity and interrelating this with visualization theories, this paper aims to explain the ontology of the new digital documentary image, its lure on the documentary filmmaker and its ramifications on reception in order to leverage technological production awareness of the documentary videographer and production members.
The empirical data presented in this article is based on an explorative reception study in which five different types of moving image sequences were tested on an audience in order to be able to define the level of indexical appeal in shallow depth of field, high resolution, High Production Value, documentary moving images.

Keywords: documentary, camera, videographer, verisimilitude and reception.

Contribution: The complete article is my singular work, including the production of the audiovisual material.

Paper D

Workflow Management: Design Management Support in Professional Audiovisual Production

This paper deals with the need for design management support within the Audiovisual Industry, due to the increasing variety of video file formats and codecs available to professionals. The amount of video file formats and codecs are referred

to as ‘the file format jungle’ by moving image professionals, and needs to be navigated by managerial staff that are not electronic engineers or technicians, but responsible for audio-visual design work within film and TV production.
We have evaluated a prototype for a design management support tool that compares file formats and codecs for different production tools, with the help of Swedish moving image industry producers. The core principals of the support tool prototype are found to cohere with the needs for design management support within film and TV production, and the tool is therefore an option for commercial development.

Keywords: design management support, video formats, audiovisual design, creativity and creative space.

Contribution: My contribution is data collection, analysis and writing, equally shared with co-author Thorbjörn Swenberg.