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ABSTRACT

Digital electronic technology systems are composed of hardware, software, thoughtware, and their context. The four elements of the model are in a context sensitive relationship where to alter one element is to change them all. Digital Cinema is a theoretical construct for understanding moving images produced and viewed in a digital context. Contemporary global culture is evolving from a mechanistic worldview into an emergent systems model in an age of information. Emergent systems are self-organizing, self-maintaining, self-renewing, and self-transcending. A digital production system for a digital cinema emerges from this theoretical context. The Digital Cinema production system is composed of video, computers, mass storage devices, telecommunications, and audio. Digital moving image productions are the result of a three phase technology restructuring process. In the first phase, new technology enhances existing tasks and processes. It makes them better, faster, cheaper or easier. Phase two is an integrative stage; a technological integration of multiple changed tasks into an integrated whole occurs. At the third phase, technological reconceptualization not only alters the tasks and the processes, but the rational and the outcomes of the process as well. Not only the "how," but the "what" is redefined. Digital Cinema is a phase three technological development. Moving images go through a four phase process regardless of medium format, or scale. The phases are: pre-production, production, post-production, and dissemination. All four phases are profoundly affected by digital restructuring. Digital storyboards point the way to a non-linear, emergent organizational approach to the four phase production process. Specific digital hardware and software applications are designed for each of the four phases to facilitate the digital restructuring process. (AEF)

Digital Cinema Principles and Techniques for Multi-Media Development

by Dr. Roger B. Wyatt

Abstract

Digital Cinema is a theoretical construct for understanding moving images produced and viewed in a digital context. The shift in perspective that emanates from the models' view leads to fundimental change in the production process of moving images. An introductory examination of thoses changes is the focus of this paper.

Paradigms and Models

The Songs of Steel is a work of Digital Cinema. It contains an original story that unfolds in the Fifth Century A.D., the time of the fall of the Roman Empire. The work is concerned with perceptions of paradiagmatic shift observed in the context of change. **The Songs of Steel** is linked to the continuity of motion picture development by the utilization of many film noir conventions. These include identiy shift, a romantic triangle, and betreyal among conspiritors. Perhaps **The Songs of Steel** is an example of a new film genre, Roman Noir.

Where the work diverges from the continuity of motion picture development is in its digital aspects. **The Songs of Steel** can be described as an abstract motion painting. While abstract conditions don't solely depend on a digital state, these specific images could only emerge from a digital context. With intensive utilization of computer visualization techniques that range from the exotic morphing to the mundane cut and paste, **The Songs of Steel** is highly abstract in appearance. Digital tools, processes, and a digital conceptual view are necessary conditions for development of this project.

Nineteen ninety five is an appropriate year to examine issues arising from the production of moving images. This year marks the centennial of the birth of film. On December 28, 1895, at a cafe in Paris, the Lumiaire Brothers organized the first public screening of a motion picture.Thus cinema has completed its first century and is now embarked upon its second.This second century appears to be a digital one.

Digital electronic technology systems are composed of a quartet of elements: hardware, software, thoughtware, and their context. In this model, hardware is seen as the physical appratus itself. As such, it is the most tangible element in the model. The software element of the model represents application programs, operating systems, and other programs. They are composed of thousands or perhaps millions of lines of coded instructions. When run, they transform hardware from an inert and purposless box crammed with electronics into useful and productive technology. Within software, hardware finds both purpose and identity. Thoughtware is the model component concerned with the techniques of technology. These are the combination of skills, views, values, and techniques that the user brings to bear when undertaking productivity tasks with digital technology. Context is the human surround or environment that enfolds all technology. Organizational values, emotions, history, desires, and fears all combine to create a dynamic interaction with both user and technology.

The four elements of the model are in a mutual casual relationship with eachother. A mutually causal relationship is a context sensitive relationship where to alter one element in the relationship is to change them all. For example, an advance in hardware capacity, such as a faster cpu (Central Processing Unit) opens new possibilities for software applications. Mutually causal.

Paradigms are the most fundimental thoughtware elements in the Digital Systems Technology Model. Thomas Kuhn, in his

book, **The Structure of Scientific Revolutions**, (Kuhn, 1962) reveals the crucial importance of conceptual frameworks within disciplines and the process of change that leads to the replacement of one paradigm by another. Contemporary society is undergoing a paradigm shift. Changes in worldview of this magnitude decenter everything, including moving image production.

Contemporary global culture is evolving from a mechanistic worldview of an age of industry into an emergent systems model of an age of information. Fundamental values and assumptions are starting to shift. The new framework emerges from new understandings derived from systems theory and biology (Capra, 1983, Kelly, 1995). Emergent systems are self-organizing, self-maintaining, self-renewing, self-transcending.

A digital production system for a digital cinema emerges from this theoretical context. Such a system is emergent and not fixed. A digital production reflects a shift from a positivist, logical, and sequential world of crisp logic to an indeterminant, nonlinear, and world of fuzzy logic. These values inform, shape, and surround the production process of digital cinema.

The Digital Cinema production system is located within a Technology Quintet composed of video, computers, mass storage devices, telecommunications, and audio. These technology groups develop in two ways. First there is the linear developmet of technologies within the group. The development of 286, 386, 486, Pentium in the Intel CPU series serves as an example. This form of development is usually sequential and progressive, though on occasion these evolutions are punctuated by revolutions. The second form of development that occurs is the merged interactions among technology groups to form hybrid technologies. An online database requires both telecommunications and computing technology in order to to be implemented. Merged technology development often occurs as the result of non-linear, suprising jumps. Wireless email or a video dialtone are the results of this non-linear form of development. Desktop video technology is the result of the fusing of computer and video hardware.

Three Phases of Change

Digital moving image production systems are the result of a three phase technology restructuring process. In the first phase new technology enhances existing tasks and processes. It makes them better, faster, cheaper, or easier. At this stage what these terms actually mean is unclear.

The author's own attraction to computing serves as an example of a phase one situtation. At the end of the seventies, the author had been an active filmmaker for ten years. In an independent film production context of that period, the most trying stage of the process was the production of titles. Producing white text on a black background was a time consuming task demanding precise execution of many component subtasks. Failure at any stage would doom the entire effort, necessitating starting over from the beginning. High contrast Kodalith film demands precise exposure or the image will contain muddy whites and grayish blacks. Slightly soft focus is unacceptable when presenting text. In a pre-spell check environment a misspelled word renders a credit screen unuseable regardless of correctness of exposure or rightness of focus. Title production created an environment of demanding complexity.

However, change was at hand. The author's first exposure to a microcomputer came when leafing through a magazine in Polks Models, a hobbyist store in New York City. The magazine contained an advertisement for a microcomputer. Unaware of computing, the author was attracted by the display of electronic text on a computer screen. The author realized that titles composed of electronic text could be filmed off the monitor. A new technology would facilitate title production in a mode that was better, faster, and cheaper than

working with 16mm Kodalith film. This insight was a phase one realization focusing on improvement of an existing sequence of tasks in the context of the existing process.

Phase two is an integrative stage. In an integrative stage of the model, processes are still viewed in the context of the old, but are starting to shift in new directions. At this point, a technological integration of multiple changed tasks into an integrated whole occurs. Individual tasks are redefined as sequential hierarchies of process are flattened and joined. As a result of new technology innovation, the task of creating a white text on a black background title screen became a trivial one. The multiple tasks of insuring that Letraset paste-on letters are properly aligned, title card making, card alignment, card lighting, exposure, focus, and film development, all crucial to the earlier film process, are either eliminated or compressed. Title production is now done in one place by one person at one time on the computer desktop. Individuals and small groups are empowered.

At the third phase, technological reconceptialization not only alters the tasks and the processes, but the rational and the outcomes of the process as well. Not only how, but why is redefined. Both traditional goals as well as problems encountered while achieving them become irrelevant.

The third phase of technological restructuring is informed by the nature of problems.There are three classes of problems: problems solved, problems not solved, and problems that go away. In the third phase of technological restructuring, many process problems are rendered irrelivant. Whether anyone, let alone the author, can position Letraset letters in straight and parallel lines no longer matters because changes in both the technique and technology of text production within moving images has been reconceptualized. In a computer context, a new digital conception of text which spins, flips, and tumbles has emerged. The DVE (digital video effect) notion of text that moves occupies a far different conceptual space from that occupied by Letraset white text on a black background title card. The problems of whether text is alligned in a straight line or not become irrelevant in the new context. A problem that goes away is the result.

What are the implications of these processes and models for Digital Cinema? Taken as a whole they reveal the dynamics of change and its structure. They are signposts that remind us that change changes. Innovation restructures not only process but outcomes as well. Digital processes will seek out and enhance digital attributes. Yes, McLuhan is right, we navigate forward looking through the rear view mirror. But at a certain point one gets the mirror out of the way and starts looking through the windshield. With the new gaze the third phase begins.

Digital Cinema is a phase three technological development. By seeking out and enhancing digital attributes, digital cinema acknowledges a century or more of abstract art and an age of information. **The Songs Of Steel** is not photorealistic at all. To take a photograph, shoot film. To work digitally, digitize.

Moving Image Production Phases

Moving images from the imagemakers point of view, go through a four phase process regardless of medium, format, or scale. The four phases are: pre-production, production, post-production, and dissemination. These processes apply whether the production is film, video, or digital in format. These processes are engaged equally regardless of production status. Wether a project is amateur or professional is irrelevant.

Pre-production is concerned with answering the fundimental questions: what am I going to do and how am I going to do it? Scenario development and visualization of it are primary activities of this stage. To think of going over to Walmart and buying videotape to record a baseball game is just as much a pre-production activity as

storyboarding an action sequence for a Hollywood epic. Logistical and financial planning are other scalable activities of a pre-production process. Deciding to get in the car and when to drive over to the field for the game while remembering to bring some cash for gas is just as much a part of logistical and financial pre-production as is how to put together and pay for **Waterworld** at the other end of the continuum.

Production is concerned with element creation. Quite often it is the shortest, but often the most intense phase of a project. Images and sounds are constructed, recorded on tape, on film, or disk. They are the raw materials of a project. Production, like pre-production, is a scalable process applying equally to projects of all formats and sizes.

Post-production, the third phase of the process, compises the tasks of image editing and soundtrack construction. The creation of meaningful sequences out of production elements is the result of these tasks.

The dissemination phase connects a project with its audience. The scale of complexity of this stage can range from bringing a tape to show to a group of friends to the global distribution of a first run motion picture..

All four phases are profoundly affected by digital restructuring. New digital tools available at all price levels will reorganize moving image production into a very different form with very different dynamics, values, and purposes. The new tools are here and the process is underway. Here are some examples.

Dramatica, a scenario development software package, alters the pre-production process. Dramatica is an AI (Artificial Intelligence) application. An expert system is built into it. This does not mean that one can put in a collection of names, dates, places, and information, shake and bake the elements, returning a few hours later ready to recieve a finished script as output. What actually occurs is an implentation of the self-organizing aspects of the the emergent systems paradigm. By means of AI, Dramatica acts as an advisor to the scenario writer. The program poses questions regarding various elements of the emergent work including clarity of story structure or character development. The program poses increasingly numerous and subtle questions. Dramatica extends the statement, "I read the script..." to include "and the script reads me." Clearly something new has emerged.

The pre-production process of pre-visualization is also transformed by digital technology. Storyboard Artist, a pre-production visualization application, solves a problem with storyboards. Traditionaly storyboards are similar to comic books in that they are a sequence of drawings representing an action sequence. As they are a sequence of still silent images, they do not accuratly reflet the dynamics of time within the production. As Cinema is a time art, traditional storyboards are limited in this respect. Storyboard Artist utilizes Quicktime, a cross-platform standard developed by Apple to support dynamic data. Accordingly, a Storyboard Artist project always presents a consistant unfolding of time.

Digital storyboards point the way to a non-linear, emergent organizational approach to the four phase production process. It is possible to start editing, a post-production activity, during pre-production before any sequence is recorded. Sequencing, timing, camera position, and more can be worked out in pre-production. Storyboard Artist becomes a Digital Cinema simulator. By working out sequences in advance, problems can be anticipated. The simulation process feeds insights forward into the actual production.

Non-linear structure reorganizes the sequence and order in which creative participants contribute to the development of a project. For example, in the industrial linear analog context, musicians rarely become involved until post-production editing. Their music must be timed to actual edited sequences. As a result, while their musical contributions greatly enhance any

project, because of the late stage that they enter a project, the scope of their contribution has definite limitations. In a non-linear feedforward reconceptualization of pre-production that Storyboard Artist represents, virtual footage can be made. Now musicians can participate in the beginning of a project rather than waiting until the third stage pre-production process begins. They can contribute more as a result. A virtual rendition of the work, animated and drawn, emerges from a new fully digital conception of pre-production. As the project moves into production, digital storyboard sequences can be replaced with more fully realized footage as it is produced.

At the production phase, the digital restructuring continues. Cameras that record digital rather than analog imagery are becomming operational at all levels of production. One of the most innovative is the Ricoh RDC-1 digital camera. It weighs nine ounces and can record up to 492 still images, 100 minutes of sound, or four full motion five second JPEG video sequences, with sync sound at 30 fps onto an eight meg PCMCIA. This card has the dimensions of a credit card. The RDC-1 is the first phase of what is to come. Record five second secquences now, record hours in the near future. By recording digital in the first place there is no need to undertake the cumbersome and time consuming task of digitizing analog video or film into a digital format. This is a phase two technological process that consolidates or eliminates separate tasks in a production sequence.

At the post-production stage, Scene Stealer, an ISA hardware card with accompaning applications software, continues the process of making certain problems irrelevant. The process of logging footage is a time consuming task. This tedious yet necessary task is the process of cataloging the mountain of footage that any production generates. It involves identifying footage content, recording the time code location for the start and stop of each shot, describing wether each shot is a long, medium, or close-up, and a great deal more. To do this well requires spending six hours of logging for every hour of tape recorded. The Scene Stealer software contains an AI element. The application is sensitive to difference. It can differentiate between pans, zooms, and camera movement on one hand, and actual camera starts and stops. This capability means Scene Stealer can identify the starting and stoping points of a shot. If it senses a 100% change in the arrangement of pixels in an image, it knows that there is a 99% probability that the shot has ended. A new shot will have a new arrangement of pixels. With a vcr on playback, the program can be set to grab and digitize a user specified amount of frames, perhaps one frame out of every thirty. As it identifies and records, the software automatically notes the time code location for the start and stop of every shot on the tape. Scene Stealer also records the audio track. A comprehensive abstract and catalog of a sequence of moving images has been created automatically. Once again new technology has restructured a production process.

Premiere 4.2 is a non-linear editing software application.The program reflects the digital restructuring of post-production. Priemere makes irrelevant the problem of video tape or film footage shuttling. **The Songs of Steel** production process yeilded approximatly 22 hours of footage. It took a year, at the rate of one day a week, to edit that mountain of footage down to one hour and 52 minutes. It is probable that up to one third of that time was consumed waiting for videotape to rewind or to fast forward. In analog video editing, there appears to be a perverse law at work. It states that whatever shot the editor is working with, the next one the editor wishes to work with is located at the other end of the tape. Premiere brings cut and paste into the editing process. Under digital conditions the editor grabs an image and brings it into a time line. When compaired

to the analog processes of analog film and video editing, digital word processing for moving image sequences is a very different way to edit moving images. It represents both a process but more importantly, a conceptual shift in not only how but what is done in the post-production process.

Dissemination, the fourth stage of the moving image production process is also reorganized under digital conditions. The World Wide Web is in the beginning stages of developing the capacity to process moving images. When that is accomplished, the drive-in will be transformed into the surf-in. Because the web is key word searachable, both Digital Cinema producers and viewers can search out the other. A highly disperrsed audience on a global scale can form together to become a virtual audience for a virtual movie. This is only possible as a result of digital restructuring of the process.

The moving image production system that we end with is far different than the one it replaces. It is the result of the interaction of a new paradigmatic framework mutually interacting and informing a new array of digital tools. The new view reveals emergent systems are self-organizing, self-maintaining, self-renewing, self-transcending. As we have seen, Digital Cinema works organically grow. Self-organizing. Digital technology flattens chains of process sequences. Self-renewing. New opportunities revealed by the new pardigmatic lens and operationalized by new digital technologies creates feedforward and feedback loops of creativity and innovation. Self-trancending.

Emerging from digital pluses, wrought of silicon and vision, a Digital Cinema reveals images of beauty and awe.

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