Cross-disciplinary Integration of Musical Works and Visual Arts through Computer Technology

D.M.A. DOCUMENT

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Musical Arts in the Graduate School of The Ohio State University

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Abstract

Cross-disciplinary Integration of Musical Works and Visual Arts through Computer Technology is a document that explores a range of topics specific to the integration of musical works and visual arts, and the cross-disciplinarity that occurs when this integration is facilitated through advances in computer technology. It also describes processes and technical resources used in the production of cross-disciplinary works. The study of cross-disciplinary works in this document is specific to musical works and visual arts which have been combined through computer technology. It also provides insight into institutional models of cross-disciplinarity and provides selected examples for study.
Dedication

This document is dedicated to my mother Dr. Viola M. Newton.
Acknowledgments

First I would like to thank my advisor W. Theodore McDaniel, PhD for his support and helpful guidance. His knowledge and advice have helped me remain attentive to completion of this document. I also thank David Bruenger, D.M.A. for honing my research and organizational skills. In conjunction with Dr. McDaniel, he has helped me make my writing more focused and succinct. I am indebted to Professors James Hill and Shawn Wallace, my instructors of saxophone, for helping to make my learning an enjoyable and stimulating experience. Lastly I wish to thank my family, friends, and colleagues whose enthusiasm, interest, and support of this project have given me the motivation to realize this achievement.
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Fields of Study

Major Field:  Music
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Chapter 1: Introduction

The computer has revolutionized the world in which we live today. Its dramatic impact on our lives is so pervasive that it is easy to take for granted. The advancements in computer technology make possible the following: mobile smart phones capable of many functions, social media, iTunes and Skype; console games like Playstation and Nintendo; and writing papers and taking on-line courses. Computer technology allows us to conduct information processing and maintain huge data storage systems; space exploration, GPS, and other transportation systems; aids pharmacies and hospitals in keeping records; operation of sophisticated banking and accounting procedures; perform complex mathematical problems; and aids health scientists and researchers to find cures for diseases, just to cite a few examples of the use of computer technology. In short, the computer allows us to organize and manage our daily lives at home and at work.

Computer technology has also impacted the creative arts world. The purpose of this study is to show how cross-disciplinary integration of musical works and visual arts is facilitated through computer technology; new artistic works become possible with the cross-disciplinary integration that is made possible by computer technology. This study is limited to the integration of music and visual art. The focus of this study is on works that
have been created by manipulating sound and images in music and art, and the cross-disciplinarity that occurs when the integration is facilitated through computer technology.

As computer technology has evolved and become more sophisticated, musicians and other artists are using cross-disciplinary work to create new compositions and artistic manifestations. It is the hope of this writer that this study will demonstrate to music composers and visual artists the vast artistic possibilities brought about by cross-disciplinary integration. It is believed that this study will provide a foundation for further research into cross-disciplinary integration that allows for further exploration of ideas, perceptions and perspectives in music and the visual arts.

‘Cross-disciplinary’ and ‘Cross-disciplinarity’ in this document

For the purposes of this study, ‘cross-disciplinary’ and ‘cross-disciplinarity’ are specific to the integration demonstrated when activities, research, or creation of content involving two or more fields of study are combined through computer technology. This integration is dependent on several factors: 1) Exploration of concepts of creative works across art forms; 2) Implementation of artistic ideas from disparate historical art forms (i.e., musical works and visual arts); 3) Availability of sophisticated computer hardware and software; and 4) use of technical processes that facilitate combining various visual and aural artistic expressions. This specificity underscores specialized experiences which support the integration of ideas, content and processes from differing disciplines through application of computer hardware and software. It also facilitates combination of conventions learned in musical works and visual arts through advances in computer technology.
Other interpretations of ‘Cross-disciplinarity’

Outside of this document, cross-disciplinarity is expressed in a myriad of ways, using a number of terms, to describe a collection of practices, perspectives and transformative processes which have been applied to media content. In the book, *Team Effectiveness In Complex Organizations: Cross-Disciplinary Perspectives and Approaches*, the author states integrating ideas from differing disciplines, more than any other factor, influences development of cross-disciplinary content. In Bruce Davis’ text, *GIS: A Visual Approach*, cross-disciplinarity refers to a philosophy in which a mixture of disciplines retains methodologies from the fields of origin. Additionally, each discipline also retains its own identity within the [cross-disciplinary] relationship.1 In Allen F. Repko’s text, *Interdisciplinary Research: Process and Theory*, Repko identifies cross-disciplinarity as a means to introduce concepts, resolve issues and address needs which appear outside of scope (or too complex) for a singular discipline.2 Repko states that “although various disciplines have differing approaches…all research-including [cross-disciplinary] research-involves identifying problems, discovering source material, generating data, organizing and analyzing that information, and drawing conclusions sustained by it.” 3

This study’s importance to persons wishing to create cross-disciplinary works arises, in-part, because understanding of cross-disciplinarity is complicated by the ways in which the practice is approached. In academia, for example, arguments for cross-disciplinary training are used to address challenges found in a traditional school curriculum. In Case

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3 Ibid.
Studies of Multidisciplinary Approaches to Integrating Mathematics, Science and Technology Education, the authors believe traditional curriculum presents a segregated approach to instructional topics which do not adequately address the re-assemblage of topics into a coherent body of knowledge to be used by students. Additionally, this study supports the integration of ideas, content and processes from differing disciplines such as those in the humanities. As noted in Allen F. Repko’s text, Interdisciplinary Research: Process and Theory, [cross-disciplinary] study reflects anthropologist Clifford Geertz’s description of "blurring of the genres" (i.e., disciplinary knowledge domains). According to Repko “the four ‘posts’ that have transformed modern thought post-positivism, post-structuralism, post-modernism, and post-colonialism [in] the new humanities is reflected in the development of interdisciplinary identity fields and new specialties.”

There are several terms which are sometimes used to describe cross-disciplinarity. In Tony Feldman’s book, Multimedia, the term “multimedia” is defined as a “seamless integration of data, text, images of all kinds and sound with any single, digital information environment.” This definition, in some instances, could describe a cross-disciplinary experience. Yet Feldman himself provides several alternative interpretations of multimedia; some of these definitions “describe [items] which combine computer-

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6 Ibid.
generated text and graphics on the same screen,”⁸ or “hardware and software necessary to combine still and moving pictures - with sound, text, computer-generated data and computer programs.”⁹ These definitions, however, enable the term “multimedia” to have interpretation greater than the scope in which it may have been placed. Related terms, such as multidisciplinary and interdisciplinary, are often used interchangeably with cross-disciplinary and cross-disciplinarity. The meanings of these terms become dependent upon the context in which the terms are employed. Multidisciplinary and interdisciplinary then become defined as processes used to combat a segregated approach to instructional content.¹⁰ These processes present a perspective from which relationships between the disciplines are able to be presented, even though the terms themselves are not clearly defined.

**Scope: Summary of Content**

This study incorporates key terms, examples, technologies, production flow, and resources for integration of musical works and visual arts through computer technology. Similar studies, in which the roles of music in multimedia, visual arts and mass media, and visual arts and music in media are discussed, have been part of the discourse on cross-disciplinarity. As such, those studies focus attention to understanding how music and other sounds support communication and play a central part in our conception (and implementation) of communications technologies. This study, however, is specific to the integration of musical works and visual arts. The focus is placed upon works that have

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⁹ Ibid.
been created by manipulating sound and images in music and art, and the cross-disciplinarity which occurs when the integration is facilitated through computer technology.

The outline of the study follows:

**Chapter 1: Introduction** provides an overview of cross-disciplinarity.

**Chapter 2: Examples of Cross-disciplinary Works** provides exemplary models of cross-disciplinary works.

**Chapter 3: Overview of Computer Technologies an Art and Music** identifies computer technologies which facilitate cross-disciplinary integration of musical works and visual arts.

**Chapter 4: Cross-disciplinary Processes and Technical Resources** illustrates examples of cross-disciplinary processes and technical resources that facilitate cross-disciplinary integration of musical works and visual arts.

**Chapter 5: Institutional Models of Cross-disciplinarity** provides select examples of models, curricula, and philosophies employed by several institutions.

**Chapter 6: Conclusion** contains summaries of this document’s findings, theoretical implications, policy implications, and possibilities for future research.
Chapter 2: Examples of Cross-disciplinary Works

The integration of musical works and visual arts through computer technology is a prominent way in which cross-disciplinary works in the arts are visualized. This statement is supported by Conjecture Corporation’s *What Does an Interdisciplinary Artist Do?*. In this article cross-disciplinary works are defined by technological tools used to make enhancements to recorded sounds in poetry recitations, comedic routines, songs and storytelling. In fact, application of technology often serves as a means for the creation of cross-disciplinary works. At Hogeschool Vor de Kunsten Utrecht in the Netherlands, for example, content for cross-disciplinary works often have to be designed through technology. Ensuring the appropriate design and production processes and allowing for the context for which the content is being created and performed is essential. In this manner cross-disciplinary integration is conducted through a “suitable application of technology, [cross-disciplinary] collaboration and research…these aspects - and not only the quality of playing, composition or interpretation - influence the final musical product.”

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13 Ibid.
Application of technology is also of importance in cross-disciplinary studies at George Mason University. In its Master of Arts in Interdisciplinary Studies, for example, coursework includes traditional videography, videoconferencing, web design, multimedia, and digital editing. 14 On its website it is stated that “as high quality equipment becomes more affordable, more organizations (profit and nonprofit) are investing in in-house production studios and staff.” 15 There is a need for cross-disciplinary expertise including “multimedia tools and design, digital and electronic art, animation, and virtual reality.” 16

_Cross-disciplinary Works: Selected Examples_

The following cross-disciplinary works are selected examples which exemplify integration of music and art through implementation of various technologies. The examples show this particular type of cross-disciplinary integration is being explored globally - in that a central location (or locations) for such work is challenging to identify. That said, here are several examples of cross-disciplinary work conducted in ‘centers of expertise’ in the United States and the United Kingdom.

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14 George Mason University. Film and Video Studies concentration in the MAIS in Interdisciplinary Studies. George Mason University. http://mais.gmu.edu/programs/la-mais-isin-favs/requirements/
15 Ibid.
16 Ibid.
SPRAWL (Melissa Grey), a one-night performance event at the Stone in the Lower East Side of Manhattan, NY (USA), features new and recent musical and audiovisual projects by Melissa Grey and collaborators.\(^{17}\)

ESTUARY is a multimedia arts installation at the Museum of the Chemical Heritage Foundation in Philadelphia, PA (USA) and appeared in subsequent exhibitions. The project incorporates original videography and photography of the industrial docklands of the Delaware River and examines how forces of climate change, such as tidal floods, alter senses of place.\(^{18}\)

Rope and Chasm is an evening-length original composition for mezzo soprano and video animation, and a work for video and electronic sound. The work was created by the Department of Music Studies (Composition) in the Boyer College of Music and Dance at Temple University (USA).\(^{19}\)

And You Were In It is a collaboration between Theatre Studio West and the “Wellcome” Trust in London (UK). Participants are guided and challenged to explore dreams through their own dream diaries and active research alongside creative sessions to dramatize their


\(^{19}\) Ibid.
ideas and findings. The findings culminate in a multimedia exhibition and performance consisting of movement, monologues, films, posters and music.  

Major Cross-disciplinary Works

The following three examples are models of cross-disciplinary works that demonstrate integration of music and art through various technologies:

Example One - Art Installation: Ear Cinema

*Ear Cinema* is a collaborative cross-disciplinary installation/performance piece incorporating animation and film footage, sound diffusion techniques (namely ambisonics) and live performance. In early 2013, *Ear Cinema* had active installations and performances ongoing in ICA Gallery, London, Arnolfini Gallery, Bristol, Salisbury Arts Centre, Salisbury, Shunt, London, and Colchester Arts Centre, Colchester to name a few locations.

Ear Cinema: Philosophy

*Ear Cinema* features what it calls the ‘Expanded Cinema’ movement, a film and video practice which activates the live context of watching, transforming cinema’s historical and cultural ‘architectures of reception’ into sites of immersive experience that are heterogeneous, performative and non-determined. The personnel of the *Ear Cinema*

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23 Ibid.
project contend it is part of “cutting edge technology to combine with contemporary practices within sound art and live-performance to deliver a story in an entirely new way.” 24

_Ear Cinema: Visual Description_

_Ear Cinema_ states “The architectural overview involves four large canvas screens placed to make an eight (8) meter cube. Four projectors simultaneously run a combination of animation and film work and two (2) performers act out various characters in front of the screens in real-time accentuating the narrative. Eight (8) speakers are placed within the performance space to create a 3D sound environment using ambisonic technology allowing for precise spatial control of sound and music within the cube. Audiences are invited to stand between the four screens to experience the piece.” 25

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24 Ibid.
25 Ibid.
Figure 1: An Example of an *Ear Cinema* Installation

Video Examples of an *Ear Cinema* installation can be found online at the following web address. [http://www.youtube.com/watch?v=ATDD6SPKflQ](http://www.youtube.com/watch?v=ATDD6SPKflQ).

*Ear Cinema*: Personnel

Performers and technicians from a wide variety of artistic backgrounds and disciplines participate to create a cohesive aesthetic for each project. The following list of performers and technicians who participate in the *Ear Cinema* project illustrates the

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26 Ibid.
significant diversity in skills and specialties required to create this cross-disciplinary work.

- Wajid Yaseen – experimental music composer and artistic director
- Lizzie Oxbby – filmmaker
- Krystian Godlewski – performer
- John Taylor - visual effects supervisor
- Liv Camden – live action assistant
- Adrian Newman – lighting
- Robin Harvey – costume design
- Natalie O’ Conner – make-up
- Randa Ghazal – general assistance and all round excellence
- Yara Pascale Fuessel – general assistance and all round excellence
- Dagmara Bilon - dance
- Alice Tatge – dance
- Agnieszka Kapuscinska – live art performance
- Dave Hunt – ambisonics
- Gadi Sassoon – sound design
- Wajid Yaseen – music
- Alison Blunt - musician (violin)
- Greg Duggan - musician (cello)
- Jimmy Rogers – narration/voice over
- Jesse Darling – narration/voice over
- Alice Kemp – narration/voice over
Example Two - Live Music and Video Animation: FAV

FAV (Flute and Video) is a series of visual concerts involving the animation of Amber Boardman and live solo flute performances by Sonic Generator's Jessica Peek Sherwood. The artists aim to redefine both the traditional concert experience and public art performance by combining music, video, and electronics in unusual settings. According to Flux Projects (the art organization producing FAV in collaboration with Boardman and Sherwood), FAV’s “[cross-disciplinary] approach to presenting the arts brings a new way of seeing and hearing music to an unsuspecting public who might not normally seek out this kind of music or experience.” 27 Because the musical compositions for the animations are all written with a backing track to accompany the flute line, the visuals sync perfectly with the live performer, which can create an interesting interplay between live performance and pre-constructed video. 28

FAV: Personnel - Amber Boardman

Amber Boardman received her BFA from Georgia State University in 2003 and her MFA from the School of Visual Arts in New York in 2009. She has had solo exhibitions at The Shirey in Brooklyn, NY and Barbara Archer Gallery in Atlanta, GA. 29 Boardman's two-dimensional and video works exploit a wide range of mediums including video and digital and handmade animation; antique photographic and motion-picture technologies; oil, watercolor and hand sewn quilting. Boardman has worked as an animator for

28 Ibid.
broadcast television series appearing on the Cartoon Network and Comedy Central. She has taught a video art workshop at Rutgers University in New Brunswick, New Jersey.\(^{30}\)

*FAV*: Personnel - Jessica Peak Sherwood

Jessica Peek Sherwood, the flutist in *FAV*, has been an advocate of new music since attending college at the University of Michigan. Sherwood has worked with video artists in the creation of visual enhancements to accompany live performance. *FAV* (flute and video), a collaborative performance with visual artist Amber Boardman, was presented in Atlanta by Flux Projects. An active free-lance musician, she has performed with the Atlanta, Alabama, and Charleston Symphony Orchestras, as well as the Atlanta Opera and Atlanta Ballet Orchestras. \(^{31}\) Solo appearances include *Art on the BeltLine* (sponsored by the City of Atlanta), *FLUX / 2010* in Castlebury Hill, New Music Detroit’s *strange beautiful music II marathon* (including the premiere of a work by Steve Everett for flute and live electronics), as well as the *JacobTV Festival* at the University of Tennessee in Knoxville. \(^{32}\)

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\(^{30}\) Ibid.

\(^{31}\) Ibid.

Figure 2: Flute and Video (FAV) Performance

An example of Amber Boardman and Jessica Peek Sherwood’s FAV (Flute and Video) may be found at this web address:

http://www.youtube.com/watch?feature=player_embedded&v=Unrc_gM8U-Y

Additional collaborations by Boardman and Sherwood

Additional collaborations by Boardman and Sherwood include Concerto for Piccolo and Game Boy, 2011 (Animation/Performance for Piccolo and Video), The Garden of Love,
Example Three - Performing Art: Omnifenix

The version of *Omnifenix* performed and produced by Keith Newton at The Ohio State University School of Music is a collaborative cross-disciplinary performance piece that incorporates animation of still images and film footage, a recording of the orchestra (without the lead solo piece), and live performance. The final film tells the story of the immortal phoenix, the mythical firebird born in flame with a colorful plumage and the ability to be reborn from its own ashes. The work has the full orchestral backing (recorded on disc) and hundreds of images of fire, desert, flame, and the firebird animated along with the musical score. The solo concerto part Newton plays on the saxophone is improvised live with the recording.

The original symphonic piece *Omnifenix* is the work of John Psathas (born 1966), a composer from New Zealand, son of Greek immigrant parents. He produces works in the repertoire of such high profile musicians as Evelyn Glennie, Michael Houstoun, Michael Brecker and the *New Juilliard Ensemble*, and he is one of New Zealand's most frequently performed composers. He established an international profile and has received regular commissions from organizations all over the world. It was the performance in 2000 (in Bologna, Italy) of the Saxophone Concerto, however, which first

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33 Ibid.
35 Ibid.
37 Ibid.
drew Psathas’ name to international attention. In its successful combination of these two disparate elements, the concerto wowed the 8000-strong audience and paved the way for further international performances of Psathas’ larger concert works.

Commenting on his work, John Psathas offers: “Ultimately though, the composer says he’s not overly precious about the way his work is interpreted. Because he considers the master version of Omnifenix is on the 2002 View of Olympus album, he doesn’t mind it being messed with.”

“[Omnifenix is a] piece made for improvisers…It really does leave 80 or 90 per cent of the solo part to be improvised,” he considers. “It’s within a really strong structure, and that drives very powerfully to the end.”

Although Omnifenix is primarily a classical work, jazz experience is required in order to interpret the concerto (most of the saxophone part is improvised). To this end Newton (having jazz background) emailed the composer, John Psathas, about the piece. Both artists (Newton and Psathas) began a conversation, and Psathas notified Newton about an mp3 recording available; it was the same recording used in 2006 when he recorded the piece with the New Zealand Symphony Orchestra and saxophonist Joshua Redman. Other saxophonists previously had inquired about Omnifenix, and Mr. Psathas emailed

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38 New Zealand School of Music “Professor John Psathas.” http://www.nzsm.ac.nz/about-us/our-people/staff-profile?staff=122901
39 Ibid.
41 Ibid.
42 Ibid.
the track and allowed them to perform the work using that recording including the freely available downloadable saxophone score and afforded Newton the same opportunity. After Newton began rehearsing the work for a public performance, he became dissatisfied with the prospect of standing alone on stage for 15 minutes with a ‘boom-box’ or ‘karaoke’ machine to perform what he considered to be a major work. Additionally, Newton worried about performing to an audience, who, while politely waiting for the end, would sit bored out of their minds watching one guy on stage for 15 minutes. Then he remembered – both the 2000 and the 2006 recordings of *Omnifenix* are featured on YouTube. The 2006 version, with Joshua Redman and the New Zealand Symphony Orchestra, is a high quality studio recording with video of the orchestra, Joshua Redman, John Psathas, and behind-the-scenes clips which were also used for a commercial DVD of the project. The ‘karaoke’ mp3 sent to Newton previously is also created from the same session. Newton’s solution was simple; acquire the video, remove the audio of Joshua Redman performing the piece, resync the video to the ‘karaoke’ mp3, and finally, then perform the entire concerto with the new video track on two gigantic screens. Newton emailed the composer and shared his idea. Psathas loved it, but he had one concern. Mr. Psathas had no agreement with Joshua Redman to use the video in this manner. In order to do the performance, Newton had to promise the following:

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44 Ibid.
1. No images of Joshua Redman would appear on screen during the performance.

2. Any images of Joshua Redman would be removed from the video.

3. Audio of Joshua Redman performing *Omnifenix* would also be removed.45

*Omnifenix* Production Process Summary

Newton’s performance of *Omnifenix* provides a proficient example of the production processes implemented in cross-disciplinary works. The process used to create this version of *Omnifenix* involved using computer technology for the organization of assets (images of the phoenix, desert, planets, and others still images used to create the animations), non-linear software for video editing, video compositing, special effects, animation and audio video synchronization, and personal computers which were used to project the final video on large screens. It required a significant amount of planning, acquiring and organizing hundreds of assets (mostly photos), and hours of production and post-production development rendering images, creating animations, syncing and re-syncing audio and video files, and encoding final versions for performance. The entire process was roughly between 320 and 360 production hours (this does not include practice time on the completed work). The process is outlined below:

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45 Ibid.
Pre-production

1. Organized assets (audio, video, still images).
   a. Karaoke Recording (orchestra without lead saxophone)
   b. Joshua Redman Performance (video)
   c. Images (phoenix, planets, etc.)

2. Compiled tools and resources required to complete the project.
   a. Software
      i. Final Cut Pro (video editing and compositing)
      ii. Apple Motion (visual effects)
      iii. Adobe Photoshop (image editing)
      iv. Steinberg Cubase (audio editing)
      v. NCH WavePad (audio editing)
   b. Reference Recordings
      i. Brecker Performance (research)
      ii. Musical Scores (research for animatic)

3. Created Storyboard (using PowerPoint)

4. Created Animatic (using Final Cut Pro)

Production

1. Resampled Audio recording from 48khz to 44khz (using WavePad and Cubase)

2. Synced Karaoke recording with Joshua Redman recording (using Cubase).
3. Covered all images of Joshua Redman in video (using blank black screen created in Final Cut Pro).

4. Composited video from the Joshua Redman recording (now without Redman) with images collected for the project (using Final Cut Pro).

5. Created ‘rough cut’ of video with timings set for all images and audio resynchronization completed (using Final Cut Pro).

Post-Production

1. Added visual effects (camera shakes, lighting, animation of stills (using Final Cut Pro and Apple Motion).

2. Produced final audio mix (using Cubase).

3. Rendered final video in digital formats (QuickTime and WMV (Using Final Cut Pro)).

Omnifenix Live Performance

In live performance, additional computer hardware and software hardware were used both for performer and for the audience. The media (finished video with audio) is played on one computer (using Quicktime or Windows Media software). The computer sends audio to the theatre’s audio speakers and video to the video projectors.

The performer (saxophonist) uses a video monitor (in this case, a secondary screen on stage), as well as headphones (with audio from the computer providing playback), to stay in sync with the video playback. Additionally, the performer uses a mixing board to control the audio levels (for playback and live performance) in the headphones.
Added equipment

a. Video Projectors
b. Audio Speakers
c. Computer
d. Monitor Speakers, Mixing Boards and headphones
e. Microphones
f. Set lighting

Figure 3: Omnifenix Performance- Keith Newton
Summary

This chapter showed the application of technology as means for the creation of cross-disciplinary works. Select examples of cross-disciplinary works illustrated some of the differing concepts, technologies, and implementations of cross-disciplinarity. Three major (in-depth) examples were used: *Ear Cinema, FAV, and Omnifenix*. They provide exemplary models of cross-disciplinary integration as well as some of the processes involved in the conception and creation of these works. The next chapter will identify computer technologies which facilitate cross-disciplinary integration of musical works and visual arts.
Chapter 3: Overview of Computer Technologies in Art and Music

Computer technology, as it relates to cross-disciplinary integration of musical works and visual arts, is part of a diverse and wide spread use of computer hardware and software. The role a specific technology serves in creation of cross-disciplinary works provides insight into the applications, methods, and practices of cross-disciplinarity. Because ‘technology,’ as a term, can possess a number of connotations, the discussion that follows is specific to computer technology which facilitates cross-disciplinary integration of musical works and visual arts. The discussion also identifies hardware and software which shape tenets of aforementioned technologies.

Computer Technology and Music in the 21st Century

Music ‘technology,’ in part, refers to technical advancements which facilitate changes in teaching, learning, and performance of music. In the 21st century computer technology in music exists as a sub-set of information technology. In V. Rajaraman’s text, Introduction to Information Technology, the term “information technology” is defined as “technology which is used to acquire, store, organize, and process data in a form which can be used in specialized applications, and disseminate the processed data.” 46 In this document, computer technology in music makes this definition specific to the

information (or data) used by computer hardware and software implemented in the creation (and dissemination) of musical works.

In the 21st century, technology in music is often created to fulfill a specific purpose, for example, to securely convert, store, protect, process, transmit, input, output, and retrieve information (or data) associated with musical works. This may include technologies for live performance of a musical work, audio production, music notation, or miscellaneous functions associated with music creation, performance or dissemination. These technologies also provide several methods for performing such tasks as cut, copy, and paste; in music technology these functions provide means to transfer, modify, add, or reduce large sections of data. These processes create efficiencies for completion of repetitive tasks. Efficiencies can also be leveraged in a creative manner by allowing sections of works to be manipulated (such as moved or modified) to test creative ideas or to rearrange the form of a musical work.

Technological innovations in music have repeatedly influenced the ways in which music is created. In TechnoPop: The Secret History of Technology and Pop Music, the author, Rick Karr, states that as performing musicians and producers alike are using bundles of virtual synthesizers, drum machines, and other music technology to create and distribute musical works, new technology continues to influence the music industry.47

47 Ibid.
Selected Innovators and Pioneers of Computer Technology in Musical Works

The presence of technology in musical works is significant, in part, due to the persons providing major innovations of computer technology in music. In the 20th century many of those innovations originated from Jazz guitarist Les Paul. Paul first started experimenting with building guitars in the 1930s. According to Brent Hurtig and J. D. Sharp, authors of Multi-Track Recording for Musicians, computer hardware and software, especially those used in the creation of musical works, included concepts and techniques garnered from Les Paul’s innovations. 48

According to the article The History of MIDI about another innovator, Dr. Robert Moog (designer of the Moog synthesizer - a prominent device in the commercial manufacture of modular voltage-controlled analog synthesizer systems), the Moog was used successfully in live performances and in notable recordings including Switched-On Bach (an electronic realization of J.S. Bach’s work), as well as the audio soundtrack for the 1971 Stanley Kubrick film adaptation of A Clockwork Orange, and other Moog versions of classical pieces by Beethoven and Rossini. 49 Synthesizers and electronic keyboards gained prominence with the implementation of MIDI (an acronym for ‘musical instrument digital interface’) in the 1980s. This ‘universal’ digital communication system with a ‘common (digital) language’ 50 enabled numerous computers hardware and software applications to be integrated into music-making processes. Since 1983 the MIDI protocol has grown to encompass additional concepts as standardized MIDI (aka

50 Ibid.
General MIDI) song files, new connection mechanisms such as USB, FireWire, and wi-fi, new markets such as mobile phones and video games, and hosts of ‘alternative' and ‘performance' based MIDI products. The History of MIDI suggests that music production continually shifts recording techniques away from hardware manipulation exclusively, and moves towards a combination of hardware and software based music production. The History of MIDI also suggests that consumers form and support new practices (using electronic stereos, iPods, smart phones, computers, and other media devices) in acquiring musical works.

Functional Uses of Computer Technology in Musical Works

Connections between cross-disciplinary implementation of musical works and visual arts through computer technology exist in part because it is rare that a specific piece of technology, especially computer technology in music, is exclusive to itself. Since some technology may be implemented outside of the scope for which it was created, computer technology in music may often fulfill dual, if not multiple, purposes. For example, music software intended to be utilized in studio recording may also be implemented to support live performance of a musical work. Software intended primarily to create music notation may also be utilized in formal analysis of chords, melodies, rhythms, and other structures in a musical composition. The following paragraphs present an overview of computer technology as it is typically utilized within, or in support of, musical works.

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51 Ibid.
52 Ibid.
53 Ibid.
Computer Technology for Live Musical Performance

*Computer Technology for Live Musical Performance* includes computer technology which facilitates synchronization of audio and MIDI files with real-time performances. This technology is commonly used by performers of musical works as a way to deal with economic adjustments of live venues or artistically to reproduce the sound of a studio recording in a live concert setting. Artists like Justin Timberlake, Alicia Keys, Beyonce Knowles, Jay-Z and Kanye West all use music technology in live performance to synchronize audio files and samples through music software (like Albeton Live and *Fruity Loops*) with the real-time performances of singers, musicians, and dancers. These programs provide nonlinear, intuitive flow, alongside powerful real-time editing and flexible performance options. The manufacturers of Albeton Live, for example, list features of the software which include groove engine, revamped warping, live looping, new effects, crossfades in the Arrangement View and a MIDI editor.\(^{54}\) This technology also includes software programs such as *Venue Magic* and *Nicolaudie* which facilitate multi-track mixing of video, audio clips and lighting effects to create synchronized video, audio, and lighting for live shows and events.\(^{55}\)

Computer Technology for Audio Production

*Computer Technology for Audio Production* includes computer technology in music implemented primarily for recording, editing, and producing audio files. The technology is used primarily to disseminate musical works as commercial recordings, to synchronize


musical works to video for film and television, or re-sample musical works for other purposes. This technology is often implemented in music hardware (such as compressors, EQ units, and amplifiers) and also packaged alongside software sequencers (i.e. Cubase, ProTools, Vegas Audio) in a virtual interface. The resulting combination, known as the Digital Audio Workstation (aka DAW), is in use by musicians in smaller project studios and in full production recording facilities.

Cubase is an example of a suite of software applications created for audio engineering and production of musical works. The software is implemented as part of a Digital Audio Workstation (DAW) and also serves as a shell (or host) for smaller audio applications or ‘plug-ins.’ This may include drum machines, vocal editing and (real-time) pitch correction, MIDI and VST (virtual studio technologies) expression tools, automation, VST instruments, and a number of mastering and editing tools.

Audacity is another example of software (open source audio editor and recorder for Windows, Mac OS X, GNU/Linux) created for audio engineering and production of musical works. According to its makers Audacity may be used to record live audio, convert cassettes, digital recordings or CDs, edit digital audio sound files, cut, copy, splice or mix sounds together and change the speed or pitch of an audio file.56

Computer Technology for Music Notation and Composition

Computer Technology for Music Notation and Composition provides creators and performers of musical works the tools to create written representations of musical works.

According to Coda Music, makers of *Finale* (a music notation computer program), more than 2.5 million professional and aspiring musicians, composers, engravers, arrangers, and educators use [these types] of notation products.\(^{57}\) Content may be entered using a MIDI sequencer, by using a mouse, or from scanning scores of musical works. Both Coda Music’s *Finale* and Avid Technologies’ *Sibelius* (another music notation computer program), for example, include tools for selection, multiple page editing, and cut-copy-paste options already familiar to users of word processing or visual editing software applications. Files may be saved as standard MIDI and may be imported into software running on Digital Audio Workstations. Additionally, the files may be manipulated using other production and sequencing programs to help creators of musical works prepare musical scores for final production.\(^{58}\)

Miscellaneous Computer Technologies in Music

Miscellaneous computer technologies in music help to contribute to cross-disciplinary work because they provide opportunity for diverse use. *Plug-ins* are software applications which operate within larger ‘host’ programs, for example – a software compressor (such as IK Multimedia’s *T-Racks* operating within (or ‘plugged-in’ to) *Cubase*). Plug-ins’ functions include virtual instruments, equalizers, secondary audio editors and mastering/finishing tools.

\(^{57}\) Coda Music Technology. "*Finale Music.*" [http://www.codamusic.com](http://www.codamusic.com)

\(^{58}\) Ibid.
Personal Computers and computer-like devices are technologies which include workstations, smartphones, tablet computers, and other hardware capable of running music software as ‘apps’ and are owned by millions of people.

Research Tools may include databases which compile information about music and musicians, analog and digital recordings, wikis, video archives, user groups and forums on the web.

A Primer on Technology in Visual Arts

In visual arts, ‘technology,’ in part, refers to technical advancements that facilitate changes in teaching, learning and performance of art forms that are primarily visual in nature. This may include “two and three dimensional creative expressions such as painting, drawing, graphic arts, printmaking, product design and commercial art, textile, and fiber arts.” 59

Computer Technology and Visual Arts in the 21st Century

In the 21st century computer technology in visual arts is utilized heavily in photography, video, and filmmaking. These applied arts utilize technology in a manner specific to the information (or data) used by computer hardware and software which is implemented in the creation (or performance) of visual works of art.

The influence of computer technology in the visual arts is recognized by institutions such as the College of Arts and Sciences at the University of Washington. As noted in a 2003 article Where Art Meets Technology, “With recent advances in technology, visual artists

are able to create works that once lived only in their imaginations. Some advances allow greater precision. Others enable artists to complete a project in hours rather than days. And some have led to entirely new art forms.” 60

Significant Historical Developments in Computer Technology and Visual Arts

Computer technology in visual arts is prominent in the entertainment and advertising industries. According to an article written by Daisy Duru for Yahoo Voices, computer programs like Adobe Photoshop and Corel Painter, and also 3D programs like Maya and 3ds Max, have become mainstays of development in commercial production of visual arts. Companies can use these programs to quickly produce a finished art piece in less than a week, in a way that is cost effective and efficient without the challenges presented by traditional media. 61 Additionally, the article shows advanced artists go further than basic production by using both 2-D and 3-D graphics programs to create surrealistic images to create work that would not be possible without aid from computer technology. 62 Duru then shifts the focus of the article to the video game industry – an area in which “artists and designers of software companies and in-house studios use these programs to quickly produce a finished art piece in less than a week…a necessity since many gaming companies have time as a factor when releasing games.” 63

One of the most dramatic changes in the visual arts is the implementation of computer software for digital manipulation of images. Professor Paul Berger, chair of the

60 Ibid.
62 Ibid.
63 Ibid.
Photography Program at the University of Washington notes advantages of technology in digital photography in a 2003 article about technology in the [visual] arts. Berger states that “Some students use digital simply to create a great ‘straight’ print; others use it to change the way we describe the world.” 64 Berger also places significant importance on understanding the advantages of computer technology and digital imagery. He states “[technology] can do color manipulations that are extremely sophisticated” 65 to make corrections, like sharpening an image or make room-size displays, which were previously limited by the size of chemical processors. Berger says his own work, which involves assembling photographic images into “big weavings of imagery,” would be virtually impossible to create without digital technology. 66 “Even if you start using digital technology just to make better prints…it soon leads off into new directions.” 67 Berger also concludes that photos can also be altered or combined to create images that no longer simply record reality but challenge it and to “do some extremely invasive things that alter ‘photographic’ description of reality.” 68

**Functional Uses of Computer Technology in Visual Arts**

Connections between cross-disciplinary implementation of musical works and visual arts through computer technology exist in part because it is rare that a specific piece of technology, especially computer technology in the visual arts, is exclusive to itself. Since some technology may be implemented outside of the scope for which it was

65 Ibid.
66 Ibid.
67 Ibid.
68 Ibid.
created, computer technology in visual arts may often fulfill dual, if not multiple, purposes. The following is a general understanding of the purposes for which computer technology in visual arts is implemented:

Computer Technology for Image Editing

*Computer Technology for Image Editing* includes computer hardware and software used to create, alter or manipulate still images and illustrations digitally. The processes may include photo retouching, airbrushing, editing, and tools to render two dimensional (2D) or three dimensional (3D) images from scratch. Visual artists use image editing software as a way to manipulate the appearance of digital imagery in a way that supports the image’s ‘authenticity’ or prepares the image for fantasy interpretation. Programs such as Adobe *InDesign*, *GIMP*, and *Paintshop Pro* exist along what may be the most well-known of these programs - Adobe *Photoshop*. These programs provide nonlinear, compositing and editing features alongside flexible performance options.

Computer Technology for Non-Linear Editing and Production of Film and Video

*Computer Technology for Non-Linear Editing and Production of Film and Video* includes computer technology in the visual arts implemented primarily for recording, editing, and producing video and film. These files may be disseminated as commercial product, synchronized to music for film and television, or re-sampled for other purposes. These technologies can be found in video capture hardware (such as digital input/output (or I/O) devices). The technologies are also found in video software (i.e., *Final Cut Pro*,...
Avid DV, Vegas Video) in a virtual interface. The resulting combination of hardware and software is referred to as a Post-production Workstation (a combination of hardware and software specifically for the recording, editing, and rendering of video and film) and is found operating in smaller project studios or in full-production editing suites.

Adobe Premiere and Apple’s Final Cut Pro are examples of software application created for video editing, engineering and production. The software is often implemented as part of a Post-production Studio Workstation. In addition, software also serves as a shell (or host) for smaller audio and video applications and include options for stabilizing footage, dynamic timeline trimming, expanded multicam (multiple camera) editing, adjustment layers, real-time visual effects, expression tools, and automation. Additionally, these programs often include host plug-ins as well as VST (virtual studio technology) instruments, and a number of mastering tools.

Computer Technology for Compositing and Visual Effects

Computer Technology for Compositing and Visual Effects provides tools which allow for creation of cinematic visual effects and motion graphics to video and film. Software in this category may be implemented in the production of film and video content in order to integrate animated 3D objects with 2D video footage, to key, mask, rotoscope, and paint composites, or to add or extract material from video content. Two industry standard programs, Adobe AfterEffects and Apple Motion, provide access to this type of production. Both technologies are able to create titles sequences for film and television,

composite 2D and 3D footage, and provide precise control of the timing and position of visual elements. Additionally, the technologies also provide support for audio editing and synchronization of audio elements with video, and prepare media content for final rendering to film and video.

Miscellaneous Computer Technology and Visual Arts

Miscellaneous computer technology in visual arts helps to contribute to cross-disciplinary work because opportunity for diverse use is provided. Technologies for video playback, personal computers, and computer-like devices include workstations, smartphones, and other hardware capable of running video software as ‘apps.’ These devices are also able to operate other software.

Summary

The technologies which facilitate cross-disciplinary integration of musical works and visual arts have enabled new practices in media creation. This chapter presented an overview of technologies (in both musical works and visual arts) which have significance, in part, due to the major innovations, functions, and the efficiencies provided by computer technology. In the next chapter, it will be shown how these technologies combine knowledge and skills from an established tradition with specific computer hardware and software for the creation of cross-disciplinary works.

Chapter 4: Cross-disciplinary Processes and Technical Resources for Production

A cross-disciplinary approach to integration of musical works and visual arts involves acquiring resources used in a variety of fields, and leveraging practices and processes from numerous disciplines. The approach may also utilize concepts from a variety of media; this may include but not be limited to film/video, music, animation, computer programming, sculpture, photography, and crafts. In the arts, this approach becomes manifest through research, development, creation, production and presentation of original works. Some cross-disciplinary works explore the theoretical and practical connections between a wide range of creative disciplines, providing skills and knowledge more varied than those skills obtained in the study of a single discipline. Other cross-disciplinary works may create a performance or activity for intellectual advancement of the performer, or to expand the educational experience of an audience. In either case, these works may develop new practices in media creation, hybrid forms of media and performance, and facilitate inclusion of artistic practice from multiple disciplines. The practices often combine knowledge and skills from an established tradition with computer hardware and software available for the creation of cross-disciplinary works.
Preproduction, Production, and Post Production Phases

The processes used in pre-production, production and post-production of media content are essential components of cross-disciplinary work. Each process supports the cross-disciplinary nature of media creation. Herbert Zettl, professor emeritus of the Broadcast and Electronic Communication Arts Department at San Francisco State University (SFSU), discusses the processes in the *Television Production Handbook*. Zettl’s description of pre-production includes all the preparation and activities used to transform a basic idea into a workable project (i.e. proposals, synopsis, scripting, and equipment).  

In Zettl’s production phase all of the audio and visual content is recorded or fashioned into tangible materials for future use in post-production. In post-production, Zettl states that content is edited, organized, and encoded into the content’s final format.

More information about the pre-production phase

During pre-production, all of the assets needed for a particular cross-disciplinary work are identified. Steps in this phase may involve creating the script, organizing production art, and recording the voice over to be used in the final product. In contemporary music production, for a single or an album release for example, pre-production is used to create and refine the most promising ideas. An example pre-production process is described in Jean Wright’s book, *Animation Writing and Development: From Script Development to Pitch*. In the book Wright’s process begins with the script or story outline. Next will be audio recording; a voice director will record the cast and also work with a composer for

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73 Ibid.
74 Ibid.
Storyboarding is the next portion of the preproduction process; all of the scenes will be organized into the first visual outline of the story. The storyboard may also be sequenced and synced to the audio to create an animatic – a visual guide in which the final timings of the storyboard’s images are set, with audio, on film or video.

More information about the production phase

In the production phase, recording of media takes place. Media recording may include, for example, audio and video recording, re-slugging (preparing timings of all the elements of animation), and background image painting. Color and production art rendering and compositing (the combination of individual parts into a single work) will also be conducted. Audio recording is usually completed digitally in a program like Cubase or ProTools which is able to “record multiple takes of an audio track, then assemble the best bits from each take into a final, composite track.”

More information about the post-production phase

Post-production refers to all phases of development occurring after the actual end of filming or and/or recording the completed work. This can include sound design, foley (production/addition of sound effects in film), additional re-recording or mixing. In Animation Writing and Development: From Script Development to Pitch, Wright describes the process as the following: “Editors mix the voice tracks with ADR (audio

76 Ibid.
77 Ibid.
78 Ibid.
and dialogue re-recording), sound effects and music tracks. The tracks are then blended. The [video] is combined with the sound…The completed project is now ready for delivery.”

Table 1: An example of pre-production, production, and post-production phases in animation

<table>
<thead>
<tr>
<th>Phase of Development</th>
<th>Steps and Processes</th>
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<tbody>
<tr>
<td><strong>Pre-production</strong></td>
<td>• Record Script</td>
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<tr>
<td></td>
<td>• Record audio</td>
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<td></td>
<td>• Produce Storyboard and Animatic</td>
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<tr>
<td><strong>Production</strong></td>
<td>• Create Animation and Backgrounds</td>
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<td></td>
<td>o Place assets</td>
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<td></td>
<td>o Set timings</td>
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<tr>
<td><strong>Post-production</strong></td>
<td>• Edit and Composite files</td>
</tr>
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<td></td>
<td>• Finalize and Render</td>
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</table>

*Technical Resources for creation of cross-disciplinary works*

There are technical resources which are essential for the production of cross-disciplinary works.

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81 Ibid.
Resource #1: Personal Computer

The personal computer is a resource on which cross-disciplinary concepts can be gathered, organized and developed. The non-destructive nature of the personal computer makes it a resource in which works may be constructed, deconstructed, and constructed again. The personal computer also serves as a ‘host’ machine for virtual environments in which performances of cross-disciplinary works may be tested and evaluated. In a live performance, a personal computer can also facilitate playback of audio tracks, video compositions, or serve as a monitoring device for other equipment implemented in creation of a cross-disciplinary work.

It is recommended that technologies utilized for cross-disciplinary integration of musical works, visual arts, and computer technology are developed as powerful, robust machines with a significant amount of processing power, memory, and available space for data. A computer with minimal amounts of memory, processing power and space is less able to function when conducting multiple processes (or ‘multitasking’). Typically, these computers encounter challenges with audio and video synchronization. Files can be corrupted, playback at incorrect sample rates, drop frames, or ‘stagger’ during playback. Additionally, computers without a significant amount of processing power, memory, and available space for data may be more likely to lock (or ‘freeze’) and cease functioning. This ‘freeze’ can be crippling in development of audiovisual content for cross-disciplinary works, or when synchronizing audio and video playback in real-time.
Apple’s requirements for its video editing software *Final Cut Pro*, for example, indicate minimum requirements for performance of its software. These requirements include the following:

- Mac computer with an Intel Core 2 Duo processor or better.
- 2GB of RAM (4GB of RAM recommended).
- OpenCL-capable graphics card or Intel HD Graphics 3000 or later.
- 256MB of VRAM (512MB of VRAM recommended).  

Digidesign, the maker of *ProTools* states that “for optimal performance and reliability,” be sure that your computer or laptop meets the following minimum system requirements:

*ProTools Core Specifications: MAC*  

- Computer: Avid-qualified Apple computer
- System Software (32 or 64-bit) Mac OS X Lion 10.7.1/10.7.2 or Mac OS X Snow Leopard 10.6.7/10.6.8
- Total System RAM: 2GB minimum, 4GB (or more) recommended

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ProTools Core Specifications: WINDOWS 84

- Computer: Avid-qualified Windows-based computer
- System Software (32 or 64-bit) Windows 7 Home Premium, Professional, or Ultimate edition with Windows 7 Service Pack 1
- Total System RAM: 2GB minimum, 4GB (or more) recommended

Additional Sample Requirements (for MAC and PC) 85

- Avid Audio Interfaces and Peripherals
- Audio Drive Requirements: One or More Hard Disk Drives Dedicated for Audio Record and Playback
- System Hard Drive: Minimum 15GB free space on startup drive required for Pro
- Graphics Card: Dedicated Graphics Card highly recommended 86

Creation of cross-disciplinary works also requires that personal computers have available connections (or ports) for peripheral devices. These devices may include a USB or Firewire audio interface, analog or digital video monitors, speakers and microphones, monitoring equipment, or other devices depending on the need of the performer -- production or performance notwithstanding.

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84 Ibid.
85 Ibid.
86 Ibid.
The following recommendations are hardware specifications for the computer by the writer of this study:

Core Technical Specs: Recommended (MAC or PC)

- Core Processor: 2.2GHz or 2.4GHz quad-core Intel Core i7 or AMD processor
- Hard Drive Space: 500 - 750GB 7200-rpm hard drive
- Display Resolution: 1440 by 900 (native), 1280 by 800, 1152 by 720, at 16:10 aspect ratio; 1024 by 768
- Memory: 4GB (32bit OS) 8GB – 16GB (64bit OS) \(^{87}\)

Secondary Technical Specs: Recommended (Mac or PC)

- Four (4) USB 2.0 Ports
- Three (3) Button Optical Mouse
- Video Card with 128MB Video Memory
- Two (2) Firewire ports
- 1/8” Audio Out
- 1/8” Audio In \(^{88}\)

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\(^{87}\) Recommendations of the writer.
\(^{88}\) Ibid.
**Resource #2: Computer Software**

Computer software, the collection of computer programs and related data which perform functions or provide instructions to computer hardware, is also important for creation of cross-disciplinary works. The software chosen will most likely be based upon the functions or the roles the software may fulfill in the development of content for cross-disciplinary works.

Software for business, pre-production and organization of assets

Office suites, collections of software applications including word processing, project planning, spreadsheet, and presentation software may be implemented pre-production in video, for example, to write a script, to plan a scene, or to plan specific events throughout the work. Spreadsheet software or database tracking may be implemented to track the media assets included in a new work. *Final Draft*, the industry standard “scriptwriting program for screenwriters, TV writers, playwrights, and writers of new media”\(^89\), or the open source alternative *Celtx*, which according to its creators “combines what it calls 'full-feature scriptwriting with media rich pre-production support'…designed for creating and organizing media projects like screenplays, films, videos, [and] stage plays,” \(^90\) are examples of software implemented in creation of cross-disciplinary works.

Because activities around business, pre-production, and asset organization are diverse and quite varied, choices about software are dependent on the task(s) for which the software is required.


Software for Image Editing

Image editing software becomes especially important when creating media assets such as still images, posters, or composited images (stagnant) to be used in audiovisual media. These assets may appear in storyboards, production art, graphics creation, animatics, special effects, or promotional materials and be utilized at any point in the production process. Adobe Photoshop and its open source counterparts (like GIMP) are expected to deliver state-of-the-art editing, compositing, and graphic design capabilities for 3D design and motion editing in industry standard formatting. The Durian group, makers of the open source movie Sintel, is an example of a company which used free/open source software for their entire creation pipeline in the studio including GIMP and Inscape for the images.91

Software for Audio Editing

Audio editing software, the main software component of a digital audio workstation, is essential for the recording, editing, and mastering of audio files. An audio editor, for example Cubase or ProTools, will let users of the software non-destructively record and edit audio and store recordings as digital audio files, fade, filter and compress multiple audio tracks, convert digital audio files between different audio file formats, and perform additional audio processing. By providing so many features Cubase seeks to be “go-to software for recording, editing, mixing and producing music in all its creative forms [with] sumptuous effects, inspiring instruments and stunning editing tools [in an] easy-to-

91 Durian Movie Project. “About the Film: Sintel” http://www.sintel.org/about/.
use interface that puts creativity first.” Advanced features of audio editing software provide tools for expansion, flanging, reverb, equalization, and crossfading of audio files, in addition to access to virtual instruments, audio samples, and time coding (in order to work with video in post-production workflows).

Software for Video Editing, Compositing and Special Effects

Integrating musical works and visual arts through computer technology requires specialized video compositing and special effects software. Software should provide general purpose non-linear editing functions (cutting, filtering, and encoding) and offer flexibility in creation of media for video compositing and effects. Adobe Premiere and Apple’s Final Cut Pro are among industry standard non-linear editors for video editing and compositing, and also provide features for cropping, panning, filtering, dissolves, fades and other video effects.

For advanced compositing including but not limited to “sophisticated motion graphics and cinematic visual effects,” Adobe After Effects and Apple’s Motion are recommended. Adobe After Effects, in particular, contains a number of features which can be utilized in creation of visual effects. This includes the ability to incorporate [3D software] scenes in as layers, the ability to separate complicated elements from

93 Ibid.
backgrounds, and tools to stabilize specific objects within a scene.\textsuperscript{95} Adobe Premiere has customized its interface to allow for customizing preferences and workflows as well as integrating with other Adobe production applications (such as \textit{Photoshop} and \textit{After Effects}) to support advanced production of media elements.\textsuperscript{96}

Software for Playback of Audiovisual Media

\textit{Windows Media Player, QuickTime Player, VLC Media Player}, and others are among media players available for use on personal computers to play audiovisual content. When creating cross-disciplinary media, software which has “built-in support for many popular audio and video formats—including 3GP, AAC, AVCHD, MPEG-4, WMV, and WMA”\textsuperscript{97} (and ability to play additional audiovisual formats) is essential. Functions including but not limited to fast forward, reverse, file markers and variable playback speed should be supported. In addition, media management, cataloguing and search of metadata (including title, date recorded, and authors) should be included.

Playback of audiovisual media may be enhanced by employing various plug-ins or add-ons with differing media players. \textit{Windows Media Player}, for example, can use both plug-ins or add-ons which add functionality including audio effects or enhanced DVD capabilities.\textsuperscript{98} The \textit{QuickTime Player}, maintained by Apple Corporation, has a host of

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plug-ins available which also extend the software’s functionality to include enhancements for playback (such as close captioning and audio equalization) and advancements in audio encoding.

Software for Encoding of Audiovisual Media

Encoding is the process of preparing audio and video files in the proper formats and specifications for playback. When preparing media content for encoding, it is important to be attentive to the original source and capture methods, the current encoding of the media, and the intended output format for playback (including but not limited to MPEG-1 MPEG-2 (MPG), MPEG-3 (MP3), QuickTime (QT), Windows Media (WMV), H.264 (MP4) FlashVideo (FLV)).

Miro Video Converter is one example of encoding software which will “convert almost any video [(and audio)]to MP4, WebM (vp8), Ogg Theora, or for Android, [and] iPhone [with] presets that will convert video to the correct sizes and formats for popular phones, iPods, and other media players.” 99

Apple’s QuickTime Player is another example of software which can be used for audio encoding. The player does this through the application of plug-ins or add-ons. According to Apple, open architecture allows third-party developers to create components, or plug-ins to QuickTime which expand the program’s functionality.100

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Third-party developers have created varied plug-ins which allow for encoding of popular video formats such as H.264, OggVorbis, or Windows Media.

*Production Flow: Traditional 2D (and 3D) Animation*

In cross-disciplinary production, such as in television or film, the production flow often determines the combination of hardware and software used for creation of the final product. A commonly accepted format follows:

**Pre-Production**

- Scripting (word processing software)
- Voice Recording (audio recording (ProTools or Cubase))
- Storyboarding (Adobe Premiere, Microsoft PowerPoint))
- Animatic (Adobe Premiere)

**Production**

- Animation (Toon Boom Studio)
- Basic Compositing (Adobe Premiere/Final Cut Pro, After Effects/Motion)

**Post-Production**

- Audio re-record (audio recording (ProTools or Cubase))
- Advanced Compositing and Special Effects (After Effects/Motion)
- Final Rendering (Adobe Premiere/Final Cut Pro)
Production Flow Example: DreamWorks Animation

In a large studio, such as DreamWorks Animation, the production process may be much more refined and include additional steps. As is the case with cross-disciplinary work such as animation, a significant amount of personnel with various skills are required to complete a singular work. For example, production processes may include the following:

- Scripting
- Storyboards
- Visual Development (creation of drawings, paintings, blueprints, sculptures and physical (or virtual) models
- Casting
- Modeling, Rigging, and Character Animation
- Visual Effects and Lighting
- Sound FX
- Audio Mixing

Summary

This chapter identified some of the practices and processes which may be leveraged during development of cross-disciplinary works. Pre-production, production, and post-production of media content were shown as essential components of cross-disciplinarity. Resources and recommendations of tools to be used in the creation of media for inclusion into cross-disciplinary works were cited. In the next chapter, specific examples of

101 DreamWorks Animation. “Production Process”
http://www.dreamworksanimation.com/insidedwa/productionprocess
institutional initiatives (organizations and institutions supporting cross-disciplinarity) will be identified.
Chapter 5: Institutional Models of Cross-disciplinarity

Cross-disciplinary performing arts programs achieve specific aims through funding, presentation, creation, and education of cross-disciplinary work. As arts organizations seek to engage, inspire, and entertain audiences through cross-disciplinary performing arts, models of cross-disciplinarity are being explored by a number of institutions.

Grant funding institutions and cross-disciplinarity

Chocolate Factory

The attention to cross-disciplinary integration of musical works and visual arts is presented in the work of the Off-Broadway Theater Awards awarding-winning Chocolate Factory. It is an organization that values the process of creation and the spirit of experimentation but emphasizes collaboration combining movement, music, video, and text to devise a means of storytelling that is immediate, collage-like, and highly visual, in addition to being dependent on new technologies. When successful, “the work is not easily categorized as theater, dance, new music, or video art and is rather a thorough intermingling of these disciplines.”

The Creative Capital Foundation (CCF)

The Creative Capital Foundation (CCF) is an organization that partners with other organizations (such as the Doris Duke Charitable Foundation) to provide funding support for cross-disciplinary works. Entities (persons or organizations) applying for grants should be significantly grounded in at least one of the Arts Program's three core disciplines of contemporary dance, jazz or theatre. Cross-disciplinary performing artists and artist collectives can apply for two types of grants administered by the Creative Capital Foundation:

- Creative Capital grants for individual artists, which include project funding and professional development support; and
- Multi-Arts Production Fund grants, which support innovative new works in the live performing arts.

Academic institutions and cross-disciplinarity

Georgia Tech

The emergence of cross-disciplinarity initiatives is beginning to be recognized in academia as part of an important shift of philosophy in arts employment. The School of Music at Georgia Tech, for example, is among the first of its kind to meet rising demand for cross-disciplinary music technology talent in academia and industry by accepting applications for the PhD degree in Music Technology. “Traditionally, music technology...”

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104 Ibid.
academicians have focused on technology for experts and high-art,” said Gil Weinberg, director of the Center for Music Technology. 105 “The new PhD program will position Georgia Tech at the forefront of fundamental shifts in the music industry, providing well-rounded doctorate-level graduates for a growing demand in music technology for novices; social and mobile media; education; and [sic] accessibility.” 106

University of Michigan

The University of Michigan has also recognized the desire and need for its graduates to have training across disciplines; the university offers several degrees at the undergraduate and graduate level in Performing Arts Technology for students “who possess demonstrated interest in producing art forms that integrate images, sound, and music using computer technology.” 107 Curriculum features are listed below.

University of Michigan: Bachelor of Fine Arts in Performing Arts Technology, Music Concentration (Curriculum B)

Entry into this program requires that students have experience in performance (both traditional and technologically enhanced), music theory, composition, mathematics, and computer programming.

106 Ibid.
The curriculum includes:

- Tonal music through ear-training and sight-singing, written work in construction and composition, and musical analysis
- Six hours of musicology exploring European and American music history, as well as the sounds and concepts of many world music traditions
- Two terms of elementary piano study
- Two terms of elementary music composition study
- Twenty-two credit hours of coursework in Performing Arts Technology including Introduction to Computer Music, Seminar in the Media Arts, Acoustics & Psychoacoustics, Computer Music Composition & Arranging, Sound Recording and Production, Digital Music Ensemble, and Electronic Chamber Music
- Five Performing Arts Technology electives selected from the courses in Performing Arts Technology
- Senior Thesis
- Non-music courses including Math 105 or proficiency; the University’s two semester English writing requirement; one course in Screen Arts and Culture: Aesthetics; two additional courses in Screen Arts and Culture, one course in Computer Programming; one course in Computer Aided Design, Modeling, or Animation; one course in Visual Arts & Culture; one course in Still Imagery & Technology; and a Dance elective
- Electives to complete a total of 120 credit hours

108 Ibid.
Steven’s Institute of Technology

Among the limited number of academic programs in higher education which attempt to provide students an experience of cross-disciplinarity, the program at Stevens Institute of Technology is worthy of notice. The program is run by Distinguished Industry Associate Professor Andy Brick from the College of Arts & Letters at Stevens Institute of Technology (located in Hudson, Hoboken NJ). A composer, orchestrator, and conductor of video game music, Professor Brick has brought an artful approach to dozens of game and film soundtracks, including such familiar titles as Sim City 4, Mafia II, the Halo series, Stranglehold, Civilization V, and many others. Professor Brick is also the music director and principal conductor of PLAY! - a series of multimedia-rich concerts. Performed by full orchestra and choir, the concert features award-winning music from a catalogue of blockbuster video game titles. ¹⁰⁹ To accompany the scores, crowd-pleasing screens throughout the concert space highlight memorable moments from the video games. ¹¹⁰

Philosophy

At the Stevens Institute of Technology, Brick teaches music theory, orchestration, and composition to students through the Music and Technology program, which, according to Brick, provides undergraduate students with a thorough and comprehensive understanding of the interrelationship between music and technology. ¹¹¹ Brick offers the

¹¹⁰ Ibid.
¹¹¹ Ibid.
following views about the Stevens Philosophy: "We view technology not merely as a tool that may foster the creative process but as a mirror reflecting the creative spirit of the individual…It is our mission to not merely provide the musicianship skills and technological aptitude necessary for any actively engaged musician, but cultivate an insight into the historically dependent nature of music and technology. With such insight, we can actively engage the necessary critical thinking to foster innovation in music production, composition and technological design." 112

Curriculum

Music and Technology students at Stevens Institute of Technology complete a "core" curriculum that provides the student with the fundamental skills necessary for further concentration within their specialization. 113 This includes courses in traditional music theory, history, production piano/performance proficiency, and technological tools. The approach is critical to note that without a demonstrated mastery of the current technological tools of the art, the conception of the art, no matter how well defined or conceived, may never be brought to fruition and that any discipline within the field can no longer rely only on that knowledge provided by traditional conservatory training. 114

112 Ibid.
114 Ibid.
Summary

This chapter examines specific funding and educational models of cross-disciplinary work in academic and funding institutions. The chapter reviewed curriculum from select institutions and initiatives from performing arts organizations to support development of cross-disciplinary works and to place organizations at the forefront of fundamental shifts in the level of interest in producing art forms that integrate images, sound, and music using computer technology. The next chapter will review this document’s findings, explore theoretical implications, and provide recommendations for further research.
Chapter 6: Conclusion

As mentioned at the beginning of this study, the computer has changed the world in which we live in the 21st century. Advancements in computer technology have not only impacted our everyday lives, but have had an increasing influence on the processes by which creative artists treat music production and music composition, and the resultant products of the process.

The purpose of this study was to show how cross-disciplinary integration of musical works and visual arts was facilitated through computer technology. Cross-disciplinarity in this study, which was limited to musical works and visual arts, is the integration demonstrated when activities, research, or creation of content involving two or more fields of study (musical works and visual arts) are combined or facilitated through computer technology. As a result of the cross-disciplinary integration, it was demonstrated that new artistic works became possible with the cross-disciplinary integration facilitated by computer technology. Works, which have been created by manipulating sound and images in music and art, and that allow for the application of technology to serve as a means for the creation of cross-disciplinarity, demonstrate to music composers and visual artists the vast artistic possibilities brought about by cross-disciplinary integration. These specialized experiences, the integration between musical
works and visual arts through computer technology, are supported by ideas, content, and processes from different disciplines.

Recommendations

The following are recommendations from this study:

1) While this study was limited to cross-disciplinary integration of musical works and visual arts, it is recommended that cross-disciplinary integration be more widely applied to examine creative possibilities with and between other disciplines;

2) Specialists, academics, and persons without formal academic training should promote collaborative, interdisciplinary, and cross-disciplinary study as other options in creative endeavors or explorations and advancement of knowledge;

3) Colleges and universities should broaden the curricula of the music major to include music technology and consider the influences and changes in music composition and music production that have been brought on by the advancements in computer technology;

4) While it is expected that traditional conservatory training would continue its core curriculum of courses in music theory, composition, history, performance and proficiency, it is recommended that the curriculum include courses in media production, sound recording and production, and other courses that reflect advancements in computer technology; and that
5) Academic institutions may benefit from funding opportunities and institutions that promote the presentation, creation, and education of cross-disciplinary work.

*Future research*

The emergence of cross-disciplinarity with the increased availability and access to high-performance and sophisticated technology, make it possible for the artist and practitioner to utilize the new technology in creative ways. It is the writer’s belief that ideas, perceptions, and perspectives in music and the visual arts will continue to benefit from the implementation of artistic ideas and methodologies acquired from various fields of knowledge, and that the experience of using sophisticated computer hardware and software to facilitate integration will provide even more substantive creative growth in music and visual arts. It is expected that future studies will focus on newer and more sophisticated engagements facilitated by increased collaborative, interdisciplinary, and cross-disciplinary integration in the music and art worlds.
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