World Warrior

Dan Farruggia
WORLD WARRIOR

DAN FARRUGGIA

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF ALL THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF FINE ARTS IN VISUAL COMMUNICATION DESIGN

SCHOOL OF DESIGN
COLLEGE OF IMAGING ARTS AND SCIENCES

ROCHESTER INSTITUTE OF TECHNOLOGY
ROCHESTER, NY
APRIL 6, 2014
ACKNOWLEDGEMENTS

Without the support of the following people, none of this would have been possible.

COMMITTEE MEMBERS
Chris Jackson, Shaun Foster, and David Halbstein.

FAMILY AND FRIENDS
I could not have done this without the overwhelming support of my friends and family. They have shown so much support to me and my career over the years. One final acknowledgement to my mother and father, who have shown me the most support and faith more then words can express. Thank you!
COMMITTEE APPROVAL

Chief Thesis Adviser: Chris Jackson, Visual Communication Design

Signature of Chief Thesis Adviser     Date

Associate Thesis Adviser: Shaun Foster, Visual Communication Design

Signature of Associate Thesis Adviser    Date

Associate Thesis Adviser: David Halbstein, Visual Communication Design

Signature of Associate Thesis Adviser     Date
<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT—PAGE 4</td>
</tr>
<tr>
<td>INTRODUCTION—PAGE 5</td>
</tr>
<tr>
<td>REVIEW OF LITERATURE—PAGES 6–12</td>
</tr>
<tr>
<td>INSPIRATION—PAGE 13</td>
</tr>
<tr>
<td>SAMURAI DESIGN PROCESS—PAGES 14–20</td>
</tr>
<tr>
<td>MODELING THE SAMURAI—PAGES 21–31</td>
</tr>
<tr>
<td>KNIGHT DESIGN PROCESS—PAGES 32–37</td>
</tr>
<tr>
<td>MODELING THE KNIGHT—PAGES 38–42</td>
</tr>
<tr>
<td>VIKING DESIGN PROCESS—PAGES 43–47</td>
</tr>
<tr>
<td>MODELING THE VIKING—PAGES 48–51</td>
</tr>
<tr>
<td>REVISIONS—PAGES 52–55</td>
</tr>
<tr>
<td>MATERIALS AND LIGHTING—PAGES 56–59</td>
</tr>
<tr>
<td>CREATING THE TURN TABLE—PAGES 60–63</td>
</tr>
<tr>
<td>USABILITY TESTING RESULTS—PAGES 64–65</td>
</tr>
<tr>
<td>SUMMARY OF RESEARCH—PAGE 66</td>
</tr>
<tr>
<td>BIBLIOGRAPHY—PAGES 67–68</td>
</tr>
<tr>
<td>APPENDIX—PAGES 69–76</td>
</tr>
</tbody>
</table>
The purpose of this thesis project is to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own fictitious real-time computer game called World Warrior. Much like the command and conquer game *Age of Empires*, players will pick from a vast range of civilizations, construct their own civilization, build an army, and destroy their opponents. It will take place far into the future, and in a time period where great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings exist within an alternate reality. This project will not only be an exploration of game character design, but one that can be easily implemented in the evergrowing computer game industry, where there is still a strong market for command and conquer real-time strategy games such as Warcraft, Starcraft, and the Diablo series. I will be researching every component and part of each suit of armor, identifying the weaknesses of that armor, and redesigning the armor for a fantasy future strategy game. The scope of my research for my thesis is heavily within the areas of character design, concept art, and 3D modeling fields for the gaming industry.
INTRODUCTION

The question I propose is this: Can 3D modeling and character design reflect traditional and cultural design elements and still be futuristic? I researched, redesigned, and revamped three of the most recognizable armor types in world history. These redesigns have been implemented with both form and function in mind to create believable and robotic suits of armor. I have successfully preserved the traditional elements and design integrities of these three great armors from the past and have made them futuristic. They are applicable not only to the videogame industry, but to the entertainment industry in general. These character designs will target the videogame industry, movie industry and comic book industry as well. They could be used for a graphic novel, or function as villains in a third person action adventure game. From character thumbnail sketches, to finished drawings, to final 3D models is a workflow that I am used to, and this workflow can directly be used within a design pipeline on a character design team.
REVIEW OF LITERATURE

One of the goals of this project was to research the historical, functional, and cultural elements that made the Samurai, the Knight and the Viking suits of armor so unique in different ways. It was very interesting to see how these armors developed during ancient times from the beginning stages, and how each specific armor was designed in a unique and functional way that reflected cultural, traditonal, and technological elements from the places they originated from. The samurai represents Japan, the knight represents the Middle Ages, and the Vikings represent Scandinavia. You can see these cultural elements reflected in each suit of armor. When taking on this project, I wanted to preserve these integrities of these three places of origin, as I designed my own modernized versions. Each suit of armor was put together and hinged with different plate technologies of that time period that were specific to that culture. Although they were state of the art for their time, they were not without weaknesses. One of the other goals of this project was to research these weaknesses and eliminate them for my newly revamped armors. For example, it was a common misconception that vikings wore plate armor that was similar to both the knight and samurai, but in all actuality, they only wore a chain mail skirt. For my new version of the Viking, I decided to design a whole new futuristic carbon fiber mail skirt with plate armor attachments, which is an upgrade from a basic mail skirt. This new skirt offers titanium plate protection which the original viking skirt did not offer, as well as a carbon fiber which acts as an upgrade from the standard chainmail. I repeated this same kind of process for the samurai and knight, identifying the weaknesses of the armors, and eliminating them.
DESIGN

The Skillful Huntsman
by Khang Le, Mike Yamada, Felix Yoon, Scott Robertson
Design Studio Press Published 2005

This book provides a tale from the Brothers Grimm that is given to three students from the Art Center College of Design, where they are inspired to create original design solutions for the characters, vehicles, and environments within the story The Skillful Huntsman. This book gives a step by step documentation of the design process of the three students, with the guidance of art director Scott Robertson, that features full-color renderings and sketches of people, monsters, and cities. I have always had great admiration for this book, and I often use it for reference on different design processes from start to finish when it comes to character design. It is an outstanding portrayal of professional workflows used in the industry today. This will be helpful to my thesis as a character design reference.

The Art of Warhammer
by Marc Gascoigne and Nick Kyme
BL Publishing

This book is a compilation of all of the different illustrations and artwork seen in the tabletop war game called Warhammer. The book features warriors, weapons, beasts, goblins, ghouls, orcs, dragons, as well as other fantasy characters and elements. When I begin doing sketches and concepts for my own armor designs for my thesis, I will mainly look at the different armor styles on the different groups of knights and warriors within this book for inspiration.

Warrior in armor character design tutorial
by Xia Taptara
TheArtClasses.com
August 9, 2012

This step by step tutorial is a walkthrough on how to design and render warrior armor from start to finish. Xia goes through different design processes on how to draw in Photoshop, achieve a solid grayscale rendering in for your character, then use a series of different color techniques and overlays to achieve the final look. In the concept stage of my thesis, I will need to go through a process similar to this when I begin designing my own battle armor for my characters.
The Gnomon Workshop collection of DVD’s are an excellent resource of training for professional artists. I purchased this particular DVD to get started with working in Corel Painter about a few years ago. Ryan Church is a widely known Concept Artist who has worked on famous movie titles such as Star Wars Episode 2 and 3, as well as War of the Worlds. Although this is a more of a technical video, Ryan Church still goes into great detail about his character design process and professional workflows which he uses on a daily basis when working in a studio. I admire his work a great deal therefore watching this DVD again will help me as I go through the beginning stages of my character design process.

One of my favorite artists, Andy Park, is a Concept Artist who has worked in the entertainment industry for over 15 years. He has worked on a vast range of projects from comic book art to concept design for movies such as Ironman, Thor, Captain America, and The Avengers. I admire the work he has done particularly for the God of War video game series. The character design seen within the games are both exceptional and stylistically sound for the dark story behind the God of War series. For my thesis, I am going to particularly look at the armor designs for the variety of different warriors to get a good sense of how he executed a dark and realistic look that I would also like to have for my final character designs.

This course focuses on different modeling tools and techniques. Mastering topology is essential when making high-poly models and although I feel pretty confident with my modeling skills, mastering topology is something that I need to improve on. This will be a refresher course on different modeling workflows, but I want to make sure that I avoid certain potholes like creating bad geometry in my models.
Retopologizing Meshes in Maya
Digital-Tutors
Autodesk Authorized Publisher
http://www.digitaltutors.com/tutorial/186-Retopologizing-Meshes-in-Maya

The focus of this course is on retopologizing meshes in Maya. To achieve the highest resolution and detail in high-poly models, modifying topology must be integrated into all 3D modeling workflows. Since I am going to be using displacement maps textures for my characters, as well as achieve the highest amount of detail, the underlying topology needs to be accurate. This course will teach me how to do that, and will be beneficial once I start retopologizing my characters.

Introduction to mental ray in Maya
Digital-Tutors
Autodesk Authorized Publisher

These series of videos will be essential for me in developing my character designs in Maya. It gives me an in-depth look on how to use render passes to create a realistic look, as well as using global illumination and final gather for my final renders. It also includes a series of lighting technique videos to help achieve the most realistic look possible as well as rendering with displacement maps. Since I am going for high-poly models, I will need to make sure that I am making full use of the mental ray features. These videos will help me achieve that.

Introduction to Mudbox 2014
Digital-Tutors
Autodesk Authorized Publisher

As part of the challenge of my thesis project, I want to explore Mudbox 2014. Due to all of the sculpting capabilities that Mudbox has to offer, I know that I need to establish a workflow that will involve going back and forth between both Maya and Mudbox to achieve the look that I want for my characters. Although my thesis study is primarily on futuristic battle armor, which are highly geometric and hard edged shapes, I will still be using Mudbox to sculpt organic shapes within my armor designs. This course will take me through the process on how to get started in Mudbox, creating meshes, geometry, as well as importing my meshes into Maya.
Once I get comfortable with the interface of Mudbox, I want to begin sculpting. It is a much better software to use when it comes to sculpting them compared to Maya, and I hope to become efficient with the program. There are a wide range of sculpting tools available in Mudbox therefore this course will take me through all of the different sculpting tools, how to use them and when to use them. I can see this course as being very useful once I begin putting my finishing touches on my models by adding all of the fine details and intricacies.

**SUBJECT MATTER**

**The Function of Armor in Medieval and Renaissance Europe**
Dirk H. Breiding  
Department of Arms and Armor  
Heilbrunn Timeline of Art History  
The Metropolitan Museum of Art  
http://www.metmuseum.org/toah/hd/ufarm/hd_ufarm.htm

This article stresses the usage of “mail armor” and “plate armor” during the Renaissance era. Mail armor is a mesh of linked small metal rings, often called “chain mail”. Chain mail remained dominant over a long period of time, until the introduction of plate armor in the thirteenth and fourteenth centuries. This article also goes into some detail as to how heavy the plate armor was on each knight, as well as the process it took for a knight to equip himself in a full suit of armor. This article is helpful to me in the respect that it gives me some insight into the history of Renaissance armor as well as some visuals that could help me in terms of constructing my own knight armor.

**Medieval Armor**  
Medieval Spell  
http://www.medieval-spell.com/Medieval-Armor.html

This article dives into the history and evolution of Medieval armor. It explains how chain mail was used at the beginning stages of the era, as well as the construction behind it. Later on during the time period, the knights became unsatisfied with the chain mail armor and desired something much thicker and durable, the plate armor. Combinations of both chain mail and plate armor were then seen in the 14th century and they were outstanding combinations of color, form, and function. In order to make them successful, I need to make sure stylistically that each armor design stays within the confines of the ancient history look, but providing a futuristic spin.
Full Plate Armor
History of Armor
2011
http://www.history-of-armor.com/PlateArmor.html

This article provides a more in-depth look at the evolution of plate armor, which surprisingly did not originate in Medieval times. The first evidence of plate armor was discovered during the time of the Greeks and lasted well into the time of the Roman Empire and was revolutionized during the Renaissance. This article discussed the relevance of plate armor on the battlefield, its advantages, as well as its disadvantages. There is a common misconception that knights were not able to move during combat due to the weight of the armor, which weighed between 45-60lbs. They were able to do the exact opposite, such as sprint, mount their horses and swim if need be. This article was helpful in the respect that it gave me a different take on the history behind plate armor. With keeping this history in mind, it will help me to design better armor combinations now that I know that there were other cultural influences of plate armor from the Greek and Roman empires.

Viking Weapons and Warfare
Barry Ager
BBC History
March 29, 2011
http://www.bbc.co.uk/history/ancient/vikings/weapons_01.shtml

This article provides an excellent look at the history behind the Viking people, their weapons, and warfare. The article is well organized, clear, and concise in dividing the different parts of information. When it came to the defense armor that the Vikings wore, it elaborated on the shields, helmets and tunics that were worn into battle. For example, the shields were covered in primarily leather. Studies show that they could have painted different war patterns, symbols or mythological scenes. As far as the armor goes, reindeer hide was said to be used as armor, which proved to be more effective then chain mail and no signs of plate armor was used. Vikings did not have the funds or the resources to make lavish looking armor scene in both the Renaissance and Japanese civilizations, but they were still a force to be reckoned with. This article was extremely helpful to me because although I want to put a futuristic spin on the Viking armor, it would be very unique to still include different elements such as the painted war symbols and the reindeer hide to keep the integrity of the Viking look. I did not know these specific aspects about Viking armor, as well as others before I read this article. All of these facts will better help me design my final Viking armor.
The Story of the Samurai Armor  
Cranbrook Institute of Science  
Michigan’s Museum of Natural History  
http://science.cranbrook.edu/science-central/research/samurai

This article features an outstanding exhibit of ancient Samurai armors at the Cranbrook Institute of Science. It provides great descriptions of each samurai armor piece that was on display, including what it was used for, how it was assembled as well as how old it was. The article also goes into detail about the first Japanese Emperor and how his clan provided the building block for Japanese society. It also talks about the later clans which were divided, stating that the armor seen in the exhibit was manufactured from the Torii clan sometime in the 1600's. This article was helpful to me in that it gave me some insight as to how specific parts of Samurai armor were constructed, which I can apply to my final Samurai armor design.

Historical Evolution of Samurai Arms and Armors Japan, 700 AD-1880 AD  
Korapat Lamsam, Cory Lauer, Paul Shepanski, Michal (Michelle) Talmor  
Degree of Bachelor of Science  
Worcester Polytechnic Institute  
The New York Times  
May 3, 2012  
http://www.wpi.edu/Pubs/E-project/Available/E-project-042612-111812/unrestricted/  
Samurai-Evolution-of-Arms-Armors.pdf

The Historical Evolution of Samurai Arms and Armor provides outstanding information of the evolution of the Samurai armor. Everything about the Samurai warrior class is included in this article from Samurai history, clan formation, tactics, armor, and weapon anatomy. It even dives into the psychology behind the Samurai. Prior to reading this article, I had no idea about the different codes, social structures and clans that were involved within the Samurai culture. All of this background information, aside from the armor, will allow me to design the armor by infusing specific personality traits of the warriors themselves.
INSPIRATION

When I first began the design process for World Warrior, I knew that I wanted to create a dark and futuristic world right from the beginning. I envisioned a grim and war-torn world where ancient civilizations and great empires were still very much in power, and all competing against one another for world domination. As stated before, I drew a great deal of inspiration from command and conquer computer games such as Age of Empires, Warcraft, and Starcraft, and there is still very much a market for these kind of games. One of my goals for the scope of this project was to design and modernize next generation armor for the civilizations within this game. When designing for the future, I wanted to take a different approach to the technologies that these civilizations would possess. I wanted to preserve the integrities of hand to hand combat and chose not to include futuristic laser gun weaponry. The next generation armor within World Warrior would protect the warriors against futuristic and modified melee-specific weapons such as swords, clubs, axes, and maces. Long ago these ancient civilizations fought one another by either means of hand to hand combat or weapon combat. I wanted to keep that style of warfare in tact for this game.

I wanted to begin the design process starting with the Samurai design. It was a suit of armor that I naturally gravitated to right from the start, due to the complex and intimidating look that it possessed. However, I wanted to take a different approach in regards to the design asthetic of the armor. I wanted to put a robotic and mechanical spin on the overall look.
Since I knew that I wanted to take a dark and robotic spin on all three of these armors, I began referencing *The Skillful Huntsman* book to begin drawing the right inspirations and techniques on how to design a successful character. The book went through a variety of different techniques, but one that I was particularly drawn to was the idea of creating interesting silhouettes. The idea of creating interesting silhouettes was that if you illustrated an interesting character shape, you could begin to work from the outside in, which is a quicker and more efficient way to design.

> “Whether it be a car, person, or building, your first impression of that object is its silhouette”
> Mike Yamada, The Skillful Huntsman, 16

If you take the opposite approach, which would be working from the inside out, you could get too caught up into the smaller details rather than the overall big picture. I placed a strong emphasis on first designing interesting silhouettes in the concepting stage (fig. 1).

Fig. 1. Dan Farruggia, *Samurai Silhouettes*, 2014.
Illustrator CS4, 11in x 17in.
Once I narrowed it down to one silhouette design that I was pleased with, I was then able to begin working from the inside out. I began researching the different parts of the traditional Samurai suit of armor. I needed to figure out how I was going to successfully incorporate all of these armor components and transform them into dark and futuristic versions, which was a challenge for me. As stated above, I wanted to preserve the integrities of the original armor, but modernize them to fit a whole new futuristic look. I wanted to start the design process with the helmet first. I believed that if I created a concrete helmet design from the beginning, it would set the tone for how the rest of the armor was going to look, as well as give it the right personality and character (fig. 2).

“The kabuto, or helmet, was easily one of the most striking parts of the traditional image of the samurai”
Paul Shepanski, Historical Evolution of Samurai Arms and Armors Japan, 700 AD-1880 AD, 50
After I solidified the helmet design, I then proceeded to design the rest of the armor. The traditional chest piece of the Samurai was based on lamellar plate construction, rectangular scales that were pierced through to be tied together into one single suit of armor. It was a relatively light armor to wear and it also covered vital areas and regions of the soldier while providing a great deal of flexibility. In addition, since there were many different types of Samurai armor, I wanted mine to represent that of the *yoroi* armor.

> “The yoroi armor was heavier and boxy, designed to provide a mounted samurai with great protection”
> Paul Shepanski, Historical Evolution of Samurai Arms and Armors Japan, 700 AD-1880 AD, 52

Since I wanted to preserve this lamellar quality, I came up with my own arrangement of lamellar scales to be draped over the chest piece. I designed the arrangement to cover the collarbone area and proceed down to cover the rib cage area. Underneath the scales is an additional steel covering for additional protection. I also wanted to incorporate steel shoulder armor as well, and since I drew all of these different attachments separately, I then combined them for the final design (fig. 3). Lastly, after the chest armor was completed, I added the final missing element, which was the helmet (fig. 4).
Fig. 4. Dan Farruggia, 
*Final Body Armor*, 2014. 
Pencil Medium, 8.5in x 11in.
As stated earlier, I wanted to research every aspect of each piece of the armor, ranging from how it was assembled, what materials were used, as well as the weaknesses. The Kote, for example, was the forearm protection worn by the Samurai. After doing extensive amount of reasearch on how it was designed, I realized that although it provided hand and forearm protection, it only featured protection up to a certain point due to its assemblance and the materials that were used. The materials were not durable or sturdy enough, therefore it acted more as a jacket sleeve with some added chainmail covering the sleeve. I identified these weaknesses and eliminated them. Instead of the jacket mail sleeve, I implemented a light titanium steel look which would offer more protection, as well as a flexible protective wrist guard attachment, which was not included in the original Samurai Kote. In addition, the original Kote featured a thumb guard, but it was not fully opposable. I wanted to add a fully opposable thumb guard to this new design (fig. 5). I repeated this same process for the Kusazauri (fig. 6) and the Suneate (fig. 7).

Fig. 5. Dan Farruggia, 
Kote, 2014. 
Pencil Medium, 8.5in x 11in.
Fig. 6. Dan Farruggia, *Kusazauri*, 2014.
Pencil Medium, 8.5in x 11in.

Fig. 7. Dan Farruggia, *Suncate*, 2014.
Pencil Medium, 8.5in x 11in.
After all of the different armor elements were finalized, I wanted to showcase the different parts that were accurately labeled in a spread. I chose the burnt parchment look to give it that ancient civilization feel. Although this new armor has been modernized for the future, the parchment paper is symbolic in the sense that it represents the civilizations of old, and how it successfully merges with the new, which is represented by the illustrations (fig. 8). I also took color palette choices into consideration early on within the design process. Although different Samurai armors were coated with an assortment of different colors, I chose to go with different shades of reds due to the amount of Japanese connotations associated with the color red. Within the Japanese culture, red is directly associated with protection against evil forces, important deities in the Shinto traditions, as well as strength. I chose to go with the red shade known as “karakurenai”, which is a crimson red.

Fig. 8. Dan Farruggia, *Samurai Spread*, 2014. Pencil Medium, 11in x 17in.
MODELING THE SAMURAI

Once the final Samurai design was solidified, I wanted to begin modeling. I was in the process of experimenting with a few different modeling workflows that would allow me to achieve quick and effective results. However, since I wanted to make my three armor models prepared to be used within a game environment, it would require them to have a relatively low polygon count (between 10,000 and 13,000 polygons).

In 3D computer graphics, polygonal modeling is an approach to modeling objects within 3D modeling softwares. This involves representing their surfaces using polygons since polygonal modeling is the preferred method for real-time computer graphics. Poly-count is the total number of polygons that exist within any 3D model. It is vital within the gaming industry to have low polygon counts due to how much the game engines of today can process and calculate in real-time. If you have models with outrageously high polygons, the game will not run as smoothly due to the amount of detail it has to calculate per model. Not only does it have to calculate the details of the models within a scene, but also the lighting, the textures for the objects, as well as the specular highlights of the objects. Game studios today use between 10,000 and 30,000 polygons for real-time games, however some lower end gaming systems can only process between 3,000 and 5,000 polygons. A low-polygon count for 3D game assets is essential in the gaming industry because they are easier to process and are optimal in real-time.

However, in regards to my thesis project, I realized that I would lose a great deal of detail due to such a low polygon count. There is still much to explore in terms of achieving high resolution detail with a low polygon model, therefore I decided to go with high polygon models for the sake of this project. I made the decision to create three high polygon models to achieve the amount of detail desired. After making this decision, I began modeling the Samurai, starting with the helmet.
I wanted to start with the helmet first because during the early development stages of the Samurai, I started with the helmet first as well. To achieve the look below (fig. 9), I used an extruding-based workflow. I was taught this specific workflow during my first Maya course during my first year of graduate school. Extruding is the primary and most common way to add geometry to your objects by pulling new faces or edges out of your mesh. It can be accessed by first switching to face mode, selecting any face of your choosing, then hitting the extrude key. The extruding workflow is a constant game of manipulating all three mesh modes: faces, edges, and vertices. You will know when you are in face mode when the edges of your mesh turn from green to blue (green is the specific color of object mode). Below is a screenshot of the differences between these two modes (fig. 10).

![Fig. 9. Dan Farruggia, Samurai Process Screenshot, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.](image)

![Fig. 10. Dan Farruggia, Extrude Screenshot, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.](image)
While modeling the helmet, I was constantly going back and forth between my own illustration of the helmet, as well as my Maya file, in order to ensure that my model was an exact visual duplicate of my helmet illustration. I wanted to make the entire Samurai armor as close to my illustration as possible. However, well into the modeling process, I began having issues with the symmetry of the overall helmet. When I was modeling the helmet, I didn't model one half and then mirror it to the other side, but rather manipulated and controlled each face on both the left and right sides. I felt that I had more control if I did it in this fashion, rather than putting so much effort into working on one side, mirroring it and not being satisfied with the result. I wanted to eliminate the risk on how Maya was going to mirror the other side if I chose to do so, whether it be a scaling issue or an attachment issue. Some people prefer to mirror because it saves time, but it is situational.

As I continued to add more and more levels of detail into the helmet mesh, I realized that the more faces I created, the harder my method of controlling each face on both sides was going to become. The more faces I created by smoothing my object, the more faces I was going to have to deal with. At one point during my modeling, I created too much geometry and too many faces, and at times when I thought I was grabbing the same faces on both sides, I would mistakenly grab the wrong ones and end up altering the symmetry of my helmet in a negative way. I then decided to change my workflow. At times, I was too quick to smooth the helmet and add levels of detail, thinking I could keep track of all the faces I was generating. It is easier to control faces with a low-poly model rather than a high-poly model. From that point forward, I was only going to work with low-poly models. If there were fewer faces, there was more control. After realizing this, I put the finishing touches on the Samurai helmet (fig. 11), and then moved on to the chest piece (fig. 12).

Fig. 11. Dan Farruggia, Helmet Screenshot, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
As I developed a comfortable modeling workflow, I moved on to other parts of the armor. However, although I was successfully modeling these separate pieces to look like my illustrations, I wasn’t putting them together like an action figure to form a human figure. When I attempted to do this, some of the pieces looked out of proportion to the main body, whether they were too big or too small in scale. I lost a good amount of time rescaling the meshes to their proper proportions. I got back on track, and found it enjoyable to build the separate pieces of the armor and put the pieces together like a puzzle (fig. 13).
After my model was completed, I needed to go through the process of cleaning up my geometry. Having proper and optimal edge-flow throughout your model is essential, and it is only achieved when you model with quadrangular geometry (geometry with four sides). If you do not model in this particular fashion, it will not smooth in the correct way. If your model has geometry with more than four sides, you will have something called “N-Gons”, which is not desirable when you finally smooth your mesh.

“An N-Gon has a variable number of sides, so the “N” in N-Gon stands for basically any number over four”
Justin, Mastering Topology in Maya, video

In order to clean up your geometry, make sure you are in the polygons mode in the top tab of your maya file, go to the mesh dropdown menu, then select the cleanup submenu (fig. 14).

![Fig. 14. Dan Farruggia, Cleanup Menu Screenshot, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.](image-url)
After selecting the cleanup submenu, select the “select matching polygons” option and then go underneath it to the “fix by tesselation” submenu. After that, select the “faces with more than 4 sides” (fig. 15).

By doing this, you have now isolated all the non-quad based geometry within your mesh. Each piece of non-quad based geometry should be highlighted a certain color, so that they will be very easy to spot and correct. To fix them, you need to use various combinations of the interactive split tool to manually divide your gemoetry into quads, which can be found within Object Mode. It can be a tedious process, but once you take the time and go through this process, you will have a more game-ready model!
Before I assembled the entire suit of armor with all the pieces, I decided to experiment with materials. I knew that I wanted to use the “mia” material right from the beginning. “Mia” stands for “mental images architectural”, and is known as the “physically correct” or “energy conserving” shader. It is not originally a Maya material, but a “mental ray” material. Mental ray is a stand-alone rendering application generated by solely mental images, and is originally a plug-in within Maya. The mia material balances both the reflections and diffuse in a physically accurate fashion. I was unfamiliar with the mia material at first and knew very little about how the shader actually operated, which is why I wanted to dive into my own experimentation. As far as color scheme goes, I knew right from the beginning I wanted to implement different golds and reds into the metallic look of the Samurai armor. I began to experiment with that as well (fig. 16, 17, 18, 19).
Fig. 18. Dan Farruggia,
*Mia Test 3*, 2014.
Autodesk screen shots reprinted with the permission of
Autodesk, Inc.

Fig. 19. Dan Farruggia,
*Mia Test 4*, 2014.
Autodesk screen shots reprinted with the permission of
Autodesk, Inc.
I presented these four samurai screenshots at a meeting with my advisors. I received a great deal of feedback from them. My advisors told me that my shaders were coming across looking like a very specular plastic rather than a metallic and polished steel. In addition, if I was designing my armor with both form and function in mind, there would be a big problem for my samurai soldier if he were to lift his arms over his head due to the spikes being present on his shoulder armor. The mobility would be very limited due to that safety hazard.

Realizing that safety hazard, I removed the spikes from the shoulder armor for the next meeting with my advisors, as well as having the entire model of my Samurai completed (fig. 20). I also realized that I was going to need some assistance from them to help me with both my shaders and the lighting for my models as well, but I wanted to get all the modeling done first before anything else.

Fig. 20. Dan Farruggia, *Mia Test 4*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Before moving on to designing the samurai, I wanted to optimize the final output settings with the samurai. I took a beauty shot of the samurai armor (fig. 21), as well as something called an ambient occlusion pass (fig. 22). In the world of computer graphics, an ambient occlusion pass is used to represent how each part of the scene or model is exposed to ambient lighting.
Afterwards, I took these two images and composited them in Photoshop. To add naturalistic shadows to my suit of armor, I put the ambient occlusion pass over top of the beauty pass, then set the ambient occlusion layer to “overlay” in Photoshop. This composite created my naturalistic shadows immediately. Even though the lighting and the texturing were not 100% solidified, I still wanted to do this test to visually see how the shadows would fall with the ambient occlusion pass for my final turntable animation (fig. 23).

Fig. 23. Dan Farruggia,
*Samurai Turntable Composite*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
KNIGHT DESIGN PROCESS

The knight is a very iconic warrior and is widely recognized for its importance in medieval history. It was a great opportunity for me to have the chance to redesign the armor from top to bottom to fit this futuristic world.

I once again referenced *The Skillful Huntsman* during the beginning of the design process, but I wanted to take a different approach for the silhouette design for the knight. Rather than creating solely black silhouettes, I wanted to work towards designing shapes within the silhouettes to improve my workflow (fig. 24).

Fig. 24. Dan Farruggia,
*Knight Silhouettes*, 2014.
Pencil Medium, 8.5in x 11in.
Although I wanted to create a very dark and futuristic look for all three of the suits of armor, I wanted to infuse more of a fantasy look into the knight. There are a great deal of fantasy stories involving knights, goblins, ghouls, and beasts that have been written in the past, and I began referencing the book *The Art of Warhammer*, which is a compilation of all of the different illustrations and artwork seen in the tabletop war game called Warhammer. The illustrations of the knights in this game possess a very traditional look but also have a very fantasy feel. Once I finished these silhouettes, I began picking different elements from each silhouette design that I favored the most. Just like the Samurai, I began the sketching process with the helmet first.

The helmets of the 11th century did not offer face protection, and were known as “nasal” helmets due to just offering nose protection only, and the helmets of the 12th century did offer visors for the face, but they were not fully opposable. Naturally, as time progressed, different helmet technologies evolved. Finally during the 14th century, medieval helmets featured fully opposable visors. I then began to sketch my own iterations of the 14th century helmet, but with a fantasy spin (fig. 25).

![Helmet Sketches](image.png)

*Fig. 25. Dan Farruggia, Helmet Sketches, 2014. Pencil Medium, 8.5in x 11in.*
Once I finalized the helmet design, it was time to move on to the body armor. Like the helmet technologies that evolved over time, the same went for the body armor as well. Although I modeled the helmet design off of 14th century influences, I wanted to model the body armor off of 15th century influences. The 15th century steel plate armor had a fine sense of both design and function, and also embraced a gothic style design aesthetic.

“In the 15th century, the master armourers began to appreciate the intrinsic beauty of the steel, and graceful lines were introduced in the construction of plate armor. This artistic tendency is best exemplified by the “Gothic” style of armor. Appearing about the year 1440, it is a very distinct style, and the pieces executed during this period combine picturesque outlines with graceful fan or shell-like ridgings.”


I wanted to replicate this kind of style as much as I could in my own design (fig. 26).

Fig. 26. Dan Farruggia, 
Pencil Medium, 8.5in x 11in.
Another common historical design element that I wanted to incorporate within the breastplate design was the Fleur-de-Lis. The Fleur-de-Lis is a stylized decorative lily which possessed a great deal of religious, political, artistic, and dynastic meaning within the French Monarchy. During my research of old style gothic armors, it appeared virtually everywhere on countless European coats of arms and flags. It has also appeared in the arms of the King of Spain as well as the Grand Duke of Luxembourg. Even in today’s world, it continues to appear on French postage stamps. It is an iconic symbol that has maintained its importance throughout the years, therefore I wanted to implement this symbol into my new design (fig. 27), as well as a modified version implemented within the shoulder armor (fig. 28).

Fig. 27. Dan Farruggia,
Fleur-de-lis Breastplate, 2014.
Pencil Medium, 1.26in x 1.48in
Another component that I wanted to redesign from the ground up was to allow this new armor design even more mobility and control for the soldier who wore it. Although the knight armor was made up of multiple parts and the soldiers who wore it were able to do things such as sprint, mount their horses and swim if need be, there was room for improvement. I wanted to base the new design back to the nature of the human figure, as well as create the armor to be more form fitting. Since knights also wore chainmail underneath their plate armor, I wanted to eliminate that aspect and create a protective carbon fiber suit in substitute of the chainmail armor. It would allow for more comfort, as well as protection. Additionally, to eliminate the clunkiness and bulkiness of the overall armor, I designed the plates to be attached to the carbon fiber mesh itself, so when the soldier put on the carbon fiber suit, he would put on the plate armor at the same time. In doing this, it would make the suiting up for battle process, that much easier and quicker.
Much like the Samurai armor, I desired to showcase all of the different parts of the knight armor, within a spread almost identical to the Samurai layout. For design consistency, just like the Samurai layout, I placed the large fullscale armor on the right side, with all of the separate components of the armor on the left (fig. 29).

Fig. 29. Dan Farruggia, *Knight Spread*, 2014. Pencil Medium, 11in x 17in.
MODELING THE KNIGHT

Once the final knight design was finalized, it was time to begin modeling. Since I decided that I wanted to do two high-poly models with one low poly model for my final thesis deliverables, I took the same kind of approach and workflow that I used to model the Samurai and applied it to the knight. As I stated before, I wanted to get the models first completed, then finalize the shader look later on. Since I learned from the shortcomings I experienced earlier while modeling the Samurai, I was then able to limit those mistakes going forward with the knight. Like the Samurai modeling process, I started with the head first, with an extruding-based workflow (fig. 30).

One other thing about my modeling workflow is that while I am in the process of creating my models, I often make copies of that mesh and set them aside. If I make a mistake in one of my models, whether I tweak the model in an undesirable way, or simply don’t like the look, I can always refer back to earlier models and correct the problem. If you have so much time invested in one model and you end up making a mistake, you do not have any earlier duplicates to refer back to.
Below are some more screenshots of the modeling process (fig. 31, 32, 33, 34).

Fig. 31. Dan Farruggia,
Knight Breastplate Process Screenshot, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.

Fig. 32. Dan Farruggia,
Knight Breastplate Process Screenshot 2, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Fig. 33. Dan Farruggia,  
*Knight Vambrace Screenshot*, 2014.  
Autodesk screen shots reprinted with the permission of Autodesk, Inc.

Fig. 34. Dan Farruggia,  
*Knight Greave and Tassel Screenshot*, 2014.  
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
As far as the modular detail goes, within the majority of these screenshots, I sculpted the shapes individually and placed them within my main meshes. My goal was to add sculptural detail to my models by importing the meshes from Maya into Mudbox, an Autodesk sculpting software. However, due to time constraints, I was unable to really dive into the software like I had originally planned. I stayed within the comfort levels of Maya to achieve the final look. Although the shaders were not yet finalized, I wanted to play with the final output settings a bit, by compositing the ambient occlusion pass and the beauty pass, to observe what the final model could look like (fig. 35).
As part of my final deliverables, my plan was to feature both my final illustration spreads, as well as my animating turntables in a 2-3 minute long motion graphics piece created in After Effects. The main idea was to feature my illustrations being drawn in by using different effects within After Effects. As soon as they were finished drawing themselves in, they would disappear and my turntable would then appear in its place. The turntable would then rotate in a 360 degree fashion that would take about 30 seconds, showcasing everything I have done. Just to do some experimenting with some early prototyping, I wanted to get a good sense of how these models would look while being placed in front of my illustrations (fig. 36).

![Knight Turntable Prototype](image)

Fig. 36. Dan Farruggia, *Knight Turntable Prototype*, 2014. Maya and Photoshop composite, 11in x 17in.

After completing these early stage prototyping concepts, I went back into my Maya file and cleaned up my geometry, just like I did for the Samurai. I tried to make this process routine after every time I finished a suit of armor. After I was satisfied with the knight, it was time to move on to the final stage of my World Warrior which was designing and modelling the final asset to my thesis: the Viking.
After already designing and modeling two suits of armor, I felt pretty comfortable in terms of getting ready to take on the final suit of armor: the Viking. I felt that I had developed a comfortable workflow for both designing and modeling and that I could transfer these workflows over to the final stages of my thesis. However, once I started doing some research on different aspects of the Viking warrior, I was very surprised at the facts I came across.

Through the course of my research on the Viking armor, I came to the conclusion that the Vikings really didn’t wear much armor at all. Unlike the knights and the Samurai, they did not wear any plate armor due to how costly it was in ancient times. The only records of the Vikings wearing any armor at all were something called “byrnies”.

“The sagas also mention ‘byrnies’ - long tunics of mail armour reaching below the waist - but surviving examples are rare. The mail consisted of interlocking rings with overlapping ends, formed by coiling an iron wire around a rod and then snipping it along the length of the rod. It took many hours to produce a mail shirt, making it very expensive, so they were probably worn mainly by the leaders.”

Viking Weapons and Warfare, Website

The byrnie was also known as a “hauberk”, which is another word for chainmail skirt. It was essential that they wore thick padding underneath the hauberk to absorb different sword blows and arrow strikes, but no such additional plate armor was worn. There were even some records showing that reindeer hide was worn as well, which was even more effective and offered more protection than the hauberk. However, if they wore any plate or scale armor, it was often obtained from the east through purchase or trade. Before beginning this research project, I was under the impression that the Vikings wore plate armor, but due to this discovery alone, I had to approach the design process of the Viking armor in a completely different way than the Samurai and the knights.
Instead of designing individual pieces of plate armor, I had to design my own hauberk. Just like a regular form fitting skirt, I wanted my design to possess that same look. As far as the type of materials that this skirt would be made from, I researched a couple of different modern day body armors. Similar to the carbon fiber mesh I designed for the knight armor, I wanted to design something similar, but infuse a titanium alloy fabric. However, I wanted my own version of the hauberk to have built-in plate protection, something that the previous hauberk did not possess (fig. 37).

Fig. 37. Dan Farruggia, *Hauberk Concepts*, 2014. Pencil Medium, 8.5in x 11in.
I then took different qualities from each hauberk concept and combined them into one final drawing. As I stated before, I wanted to incorporate plate armor protection for the forearms, arms, chest, rib cage, shoulders and back areas that were previously not protected with the original hauberk (fig. 38).

Fig. 38. Dan Farruggia, *Hauberk Final*, 2014.
_Pencil Medium, 8.5in x 11in._
Another interesting fact that I found was that not every Viking soldier wore a helmet into battle. Helmets were often worn by the most privileged soldiers, often leaders or generals, and they required incredible amounts of skill to produce. The most common helmet worn by the Viking soldier was known as the Gjermundbu.

“[The] [Gjermundbu] has a spectacles-like visor, an iron dome consisting of four sections with a spike on the crown, and possibly a mail neck-guard.”

Viking Weapons and Warfare, Website

The Gjermundbu possessed a very distinct look that I wanted to be able maintain when I redesigned the helmet for my own Viking armor. Since Viking helmets were relatively expensive to create, I wanted to make my new Viking helmet both cost effective and protective. This would therefore enable every Viking soldier within World Warrior to wear one. Below are some concepts for my own iterations of the Gjermundbu (fig. 39).

Fig. 39. Dan Farruggia,
Pencil Medium, 8.5in x 11in.
I then combined the final hauberk, helmet, as well as final sketches into one final spread (fig. 40). After I finished putting this layout together, it was time to proceed to the beginning stages of the Viking modeling process.
MODELING THE VIKING

The viking modeling process was going to be very similar to both the knight and samurai process. Like the other two suits of armor before the viking, I started modeling the helmet first. I took my final concept of the viking helmet, and imported my illustration into Maya so that I could constantly be referencing both my model and my illustration side by side (fig. 41).

Fig. 41. Dan Farruggia, Viking Helmet Screenshot, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.
As you can see in (fig. 41), I made a couple of earlier copies of my Viking helmet so that if I happened to make a mistake, I could always back track into one of my earlier models to correct the problem, much like I did during the modeling process of the Samurai and knight. I repeated this similar workflow for every piece of the armor. Since I am taking a low poly count approach to the Viking, here is a shaded wireframe of the helmet, to show that I am working within the confines of a low poly count (fig. 42).

Fig. 42. Dan Farruggia, *Viking Helmet Wireframe Shaded*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Afterwards, I moved on to other parts of the armor, constantly referencing both my model and my illustration to achieve the right look (fig. 43, 44).

**Fig. 43.** Dan Farruggia, *Breastplate Wireframe Shaded*, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.

**Fig. 44.** Dan Farruggia, *Viking Armor Wireframe Shaded*, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Once the model was completed, I went ahead and composited the ambient occlusion pass and the beauty pass of the Viking armor, with some basic light setup (fig. 45).

Fig. 45. Dan Farruggia, *Viking Composite*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
REVISIONS

After I had rendered and composited the three armors with their ambient occlusion and beauty passes separately, there was one thing that I had not visually tested, and that was how all three armors looked when arranged side by side. I wanted to see how the armors would look side by side with one another in terms of design aesthetic, color palette, material use, modular detail, as well as other design elements. I wanted to observe if I maintained a successful level of stylistic consistency within each design and also evaluate what particular areas were successful, as well as which areas needed improvement (fig. 46).

Fig. 46. Dan Farruggia, *Armor Layout*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.

My next phase was to present these images at another meeting with my advisors. They approved of the overall design quality and consistency between all three armors, as well as the color palette for each. However, since I had two armor designs that look very much robotic (the Samurai and knight) and one that was more form fitting (the Viking) there was a disconnect between the armor sets. My advisors then suggested that I not take the robotic approach and make them more functioning armor sets, that humans could actually wear and operate in. In other words, they wanted to see a character body within each suit. My advisor also gave me an Autodesk link where I could download free and already rigged character meshes. All I had to do was download the files, import them into Maya, and I had free reign to move and pose the characters since they were already rigged for me. Once I imported them into Maya, however, I had to go through the process of rescaling each armor model to fit the human form.
I went on the Autodesk link and searched through a handful of different character meshes and found one to my liking (fig. 47). I, then, imported it into Maya, created a carbonfiber shader for the mesh, and modeled it to fit within my armor, starting with the Samurai (fig. 48).

![Fig. 47. Dan Farruggia, Autodesk Maya Character Mesh, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.](image1)

![Fig. 48. Dan Farruggia, New Samurai Armor Screenshot, 2014. Autodesk screen shots reprinted with the permission of Autodesk, Inc.](image2)
Afterwards, I rendered out the final result for each suit of armor and repeated the same process of compositing both the beauty passes and the ambient occlusion passes for all three armors (fig. 49, 50).
I wanted to see how the new Viking armor would look on top of my armor design spread, just to get a good sense of how the final movie file would look. I rendered out a 100 frame turntable animation of the Viking rotating 360 degrees within Maya, and subsequently took that file into After Effects and placed the design spread behind the model itself. I rendered out the entire animation. The image below is a screenshot of the MOV file (fig. 51).

Fig. 51. Dan Farruggia, *Viking MOV screenshot*, 2014. 
After Effects, 1920 x 1080.
MATERIALS AND LIGHTING

After I successfully scaled down the armors to fit my character meshes, I showed the three characters to my professors. I, then, tweaked the poses to finalize them. I also revisited an earlier issue that I had not yet addressed, being the implementation of both lighting and materials to my models.

Earlier on during my design process, I was experimenting with the qualities and presets of the mia material. However, after meeting with one of my advisors, we both discussed that due to my unfamiliarity with the mia material, it was just best to stick with a material that I felt most comfortable with: the blinn material. We discussed that the physically correct attributes of the mia material can be achieved manually using a blinn material, which would be more sufficient for my purposes. We also talked about mapping reflections to each of my shaders and use an HDRI (High Dynamic Range Image) for image based lighting. In terms of controlling the reflectivity of my shader, I also had to create a ramp within my shader to effectively control something called the “fresnel” effect. The fresnel effect is the degree of reflectivity on any specular surface which is dependent on the angle at which it is viewed.

Lastly, I needed to go through the process of gamma correcting my shaders within Maya. Gamma correction deals with the ability of electronic media (monitors specifically) to accurately display both colors and values. Some imagery in the world of computer graphics are auto-corrected, while others are not. If you are going to render “out of the box”, you need to make sure that everything is properly corrected. However, if you are going to do your color correction in post (or a different software), you need to make sure that the auto-correction is removed. Shaders within Maya are already gamma corrected when you assign them to your materials, so I needed to go through the process of ungamma correcting all them. I knew I was going to color correct in After Effects, but in order to do it correctly, all of these principals of ungamma correcting my shaders needed to be applied in order to achieve the look I desired.
Below is a screenshot from my Maya file of a shader that showcases a mapped environment reflection, a ramp that effects the reflectivity of the shader as well as the gamma correction node (fig. 52).

Fig. 52. Dan Farruggia, *Shader Screenshot*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Subsequently, I went through the process of creating my shading network for each suit of armor in this same fashion. In order to add diversity, I mapped a different reflection map to each shader within each suit of armor. Each of the shaders on the Samurai armor feature the image of the Japanese dragon statue. The knight shaders feature an industrial looking image, and the Viking shaders feature an image of a dreary mountain landscape. I wanted each image to reflect different settings where the armors could in fact exist.

After I was finally starting to achieve the metallic look within my shaders, it was time to focus on creating an accurate light setup. After speaking to one of my advisors in regards to lighting, he stressed the emphasis of creating a three point light system. It is a standard method used throughout visual media such as video, film, as well as computer-generated imagery. A three point lighting system involves using three lights: a key light, a fill light, as well as a back light. The key light provides the main source of light and shines directly upon the subject. The fill light is positioned at a relative side angle to the key, also shining on the subject. This light shines on areas of the subject with a softer tone than the key light, as well as areas that the keylight does not illuminate. Lastly, the back light is usually placed behind the subject and illuminates the object from behind, providing what is also called a “rim” light, separating the subject from the background (fig. 53).

Fig. 53. Dan Farruggia, *Samurai New Light Setup*, 2014.
Autodesk screen shots reprinted with the permission of Autodesk, Inc.
Lighting, by far, was one of the biggest hurdles I had to overcome. I have very little lighting experience to begin with, and it is a difficult thing to master. I was struggling with using and varying adjustments of each light, trying to find the proper light ratio and illumination that was going to properly showcase my models without completely blowing out the contrast and highlights. Lights in Maya can be adjusted in a handful of different ways, whether it's the cone angles, falloff or intensity. It was just a balancing act to find the proper look. After varying test renders and light tests, I was making progress (fig. 54).

In this image, you can see that I used the key light to illuminate the right side of the model with a reddish light. The fill light is illuminating the left side of the model with a soft blue, and the rim light is illuminating the back side of the armor with a light blue light. Enabling cast shadows in your lights is also essential, but in order to not create visual confusion, you only enable cast shadows in one of your lights, in this case, the key light.
Creating the Turn Table

It was now time to put together the animation. Once the lighting setup was working properly, it was time to create the turntable. Within Maya, there are a handful of steps you have to complete to setup the turntable. First, you must go into the render settings and set up the number of frames you want to render out. In my earlier prototype turntable of the Viking, I rendered out that particular video to be one hundred frames long. One hundred frames only generated three seconds worth of final animation, which was simply not long enough. For my three turntables, I decided to render out 300 frames of a 360 degree animation.

Secondly, you do not render out the actual movie file in Maya. Instead, you render the animation out as something called an image sequence. Image sequences are a series of still images produced from something called a “batch render” in Maya. This can also be enabled within the render settings of Maya. The batch render produces an image for each frame of the animation, which then needs to be imported and composited together in After Effects, as well as rendered out in After Effects as a movie file.

Thirdly, you must setup a camera to view from within Maya (make sure that that specific camera is selected within the render settings). Lastly, you must keyframe the animation to have the object rotate 360 degrees. If you have the object in one place, go to frame one of the animation, set a key by using the S key, then go to frame 300 and rotate the object 360 degrees. Afterwards, set another key. Once you play the animation, the object should rotate 360 degrees in a smooth fashion.

It took a great deal of time to render out the three image sequences in Maya, but once it was completed, it was time to import the files into After Effects. However, although the image sequences were taken care of, I still needed to figure out how I was going to animate my illustrations within After Effects.
I discussed the concept with my chief advisor, and we came up with an idea that these drawings would be able to animate themselves being illustrated on the parchment paper with the assistance of a movie file. We had this idea of a very organic and expressive animation, one that would be similar to that of an ink drop on paper. When an ink gets dropped on paper, it is spread across in a very unpredictable and interesting fashion. My advisor gave me a black and white ink drop movie file that he had, and here are a few screenshots showing the sequence of the movie itself from start to finish (fig. 55, 56, 57).

Fig. 55. Dan Farruggia,
_Ink Drop Screenshot 1_, 2014.
Mov file, 1024 x 768.

Fig. 56. Dan Farruggia,
_Ink Drop Screenshot 2_, 2014.
Mov file, 1024 x 768.
In these three screenshots you can see the gradual transition of how the ink drop effect progresses within the movie. The movie itself is approximately 54 seconds long. I really liked the overall feel of the movie and how naturalistic it looked in comparison to a real ink drop animation. It was now time to put it all together.

In order to combine both my illustrations and my turntable sequences generated from Maya, I needed to import them into After Effects as the same size dimensions to avoid any disproportion or scaling issues. I was also advised to import my entire illustration PSD file into After Effects, with each drawing and design element on its own separate layer, named properly so that I knew which layer contained which design element. If each drawing were on its own individual layer, it would be easier to animate in conjunction with the ink drop movie file.

Afterwards I set the proper dimensions for the composition, imported the PSD file, retained the layer sizes, and then imported the ink drop movie as well. I dragged every aspect down to the work area, and in order for the drawings to animate with the movie file, they all had to be placed underneath the movie file. Within the layer properties in After Effects, I combined the layers containing the drawings into their own composition, and set that layer property to something called “luma key”. What this means is that the layers were now going to retain the animation qualities of the movie file above it. I, then, set the movie file to not be visible. With the composition containing the drawings set to luma key, the drawings animated in looking exactly like the movie file, once I hit the play button with that growing ink drop effect. However, since the original movie file is 54 seconds long, I had to cut that duration down immensely to about 6 seconds long, which can be done in After Effects.
In regards to gamma correcting my Maya turntables, I placed an “exposure” effect layer on each image sequence. Additionally, I enabled all channels to be seen within the exposure effect, and had full range to control both the reds, the greens, and the blues for each image sequence. Had I not ungamma-corrected all of the shaders beforehand, the exposure layer would have given me an undesired effect once I started manipulating the red, green and blue channels. Below is a screenshot of what my After Effects file looks like, with the exposure effect on the left, with all of the necessary working layers below (fig. 58).

Furthermore, I had to work out the timing between the ink drop animation for my illustrations, as well as what periods in the movie my turntables were going to animate in, as well. I wanted to feature the Samurai first, the knight second, and the Viking third. I sequenced them in that order since the armors were also designed in that order, during the design process for World Warrior. Once I rendered the final movie file, I was very pleased with the final result.
USABILITY TESTING RESULTS

Once Imagine RIT arrived, I was only able to showcase one of my turntable animations in a movie file due to the other two suits of armor being rendered at home. Each turntable took about four days to render, therefore, due to how render expensive the animations were, I was only able to have one ready for the show. I designed a questionnaire for viewers to fill out after watching my turntable animation, in regards to which areas of my design were successful, as well as which areas needed improvement. I wanted user feedback on the pacing of my animation, the color palette of my suit of armor, the lighting of the model, as well as, overall visual style.

I received a great deal of user feedback from all age groups at Imagine RIT. Since my target age demographic for World Warrior was ages 13 and up, I attracted a great deal of kids that were drawn to my animation. I also talked to a handful of my design colleagues about my turntable animation and they gave me valuable feedback as well. A few of them pointed out that the Samurai armor could be lit much better in regards to the three point lighting system, and that they also wanted to see a richer color palette. They appreciated the different types of red color values within the Samurai armor, but it was a little bit too monochromatic. They desired the reds to be just a little bit richer in value. They also pointed out that the armor reflections were just a little too prominent and recommended that they be toned down. The reflections were detracting from the overall look of the armor, due to how strong they were. Lastly, the arm length proportions of the character mesh for the knight armor were entirely too short. The arms needed to be lengthened so that it fit real life human proportions. After Imagine RIT, I took all of these suggestions and feedback into consideration and then proceeded to change the design in accordance to their feedback, for the better. I toned down the reflections, enhanced the contrast of the reds within the Samurai armor, as well as increased the intensity of the lighting.
Below are a few key examples of comments and suggestions that I received from my colleagues, which I really took into consideration and subsequently applied them to finalize the look of World Warrior. The rest of the full scanned feedback forms can be found in the Appendix Section of the documentation.

Fig. 59. Dan Farruggia, Feedback Screenshot 1, 2014.
InDesign Document, 8.5 x 11.

Fig. 60. Dan Farruggia, Feedback Screenshot 2, 2014.
InDesign Document, 8.5 x 11.

Fig. 61. Dan Farruggia, Feedback Screenshot 3, 2014.
InDesign Document, 8.5 x 11.
Throughout this whole thesis project, I can’t express how much I grew and learned as a designer and visual thinker. I set out very lofty goals when undertaking this project, and I feel that I have achieved them. One of the primary reasons I came to RIT was to learn how to bring my characters to life using 3D modeling softwares. I was very much interested in becoming familiar with 3D modeling, sculpting softwares, lighting techniques, as well ad texturing techniques. I was determined to explore all of these areas during my two years of graduate education. I gained a great deal of technical knowledge on a handful of 3D modeling softwares, but also improved my design skills as an illustrator. I set myself up to not only apply what I have learned, but also develop a workflow and pipeline to successfully showcase the design process of a character in the 3D industry from initial concepts, thumbnails, drawings, to final 3D output.

From a historical standpoint, my interest in historic design really propelled me to take on this kind of project. I also used my interest in game design as a launching pad for this project. I was inspired by a handful of fantasy and sci-fi oriented movies and videogames showcasing different types of unique armors through engaging storytelling. I wanted to delve into this area of design, and felt that World Warrior was a perfect opportunity for me to do so. I had the opportunity to learn about the history of the Samurai, knight and Viking armors, and was also able to combine my research and apply them to create new age futuristic versions of these armors using my illustration and 3D modeling skills.

Lastly, due to time constraints and lack of software knoweldge, in the future I would like to learn how to use industry standard sculpting softwares such as Mudbox and ZBrush, as well as sculpt high resolution details using these softwares for my characters. Outputting both normal maps and texture maps have also been two areas of interest, and I plan to explore these areas and incorprorate them into my workflow, as well. I still feel that I am not strong enough in the area of lighting and feel the need to make improvements in that area. Having a mastery in Mudbox, ZBrush, normal mapping and texture mapping, are all necessary to become a true 3D artist.
BIBLIOGRAPHY


Dan Farruggia

Thesis Work In Progress Evaluation Form: World Warrior

Summary of project: The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

2. Pacing of Animation/Timing
   - Appropriate
   - Effective
   - Well designed
   - Too fast/slow
   - Ineffective
   - Needs refinement

3. Lighting and Shading of Models
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

Overall Comments and Suggestions:

GREAT IDEA AND CONCEPT, CANT WAIT TO SEE
17 ALL TOGETHER!
Dan Farruggia

Thesis Work In Progress Evaluation Form: **World Warrior**

**Summary of project:** The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

<table>
<thead>
<tr>
<th>1. Visual Style (illustrations and models)</th>
<th>Creative</th>
<th>Common</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Needs refinement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ineffective</td>
</tr>
<tr>
<td></td>
<td>Appropriate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Effective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Well designed</td>
<td></td>
</tr>
</tbody>
</table>

| 2. Pacing of Animation/Timing              | Appropriate | Too fast/delay |
|------------------------------------------|             |                 |
|                                          | Effective |                 |
|                                          | Well designed |                 |

| 3. Lighting and Shading of Models         | Creative | Common |
|------------------------------------------|         |        |
|                                          |         | Average |
|                                          |         | Needs refinement |
|                                          |         | Ineffective |
|                                          | Appropriate | |
|                                          | Effective | |
|                                          | Well designed | |

**Overall Comments and Suggestions:**

Consider adding some form of grunge/battle damage - these are extremely clean renders for Warrior's armor.
Dan Farruggia

Thesis Work In Progress Evaluation Form: World Warrior

Summary of project: The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)  
   - Creative  
   - Appropriate  
   - Well designed  
   - Effective  
   - Common  
   - Average  
   - Needs refinement  
   - Ineffective

2. Pacing of Animation/Timing  
   - Appropriate  
   - Effective  
   - Well designed  
   - Too fast/slow  
   - Ineffective  
   - Needs refinement

3. Lighting and Shading of Models  
   - Creative  
   - Appropriate  
   - Well designed  
   - Effective  
   - Common  
   - Average  
   - Needs refinement  
   - Ineffective

Overall Comments and Suggestions:
Dan Farruggia

Thesis Work In Progress Evaluation Form: World Warrior

Summary of project: The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)
   - a little
     - monochromatic
     - would like some more color
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

2. Pacing of Animation/Timing
   - the sketching of the illustrations goes nicely with the background
   - Creative
   - Appropriate
   - Effective
   - Well designed
   - Common
   - Average
   - Needs refinement
   - Ineffective

3. Lighting and Shading of Models
   - better than I could ever do.
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

Overall Comments and Suggestions:
Dan Farruggia

Thesis Work In Progress Evaluation Form: World Warrior

Summary of project: The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)
   - Creative ✔
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

2. Pacing of Animation/Timing
   - Appropriate
   - Effective ✔
   - Well designed
   - Too fast/slow
   - Ineffective
   - Needs refinement

3. Lighting and Shading of Models
   - Creative
   - Appropriate
   - Well designed ✔
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

Overall Comments and Suggestions:

Really cool, hope your game is successful!
**Dan Farruggia**

**Thesis Work In Progress Evaluation Form: World Warrior**

**Summary of project:** The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. **Visual Style (illustrations and models)**
   - [✓] Creative
   - [✓] Appropriate
   - [✓] Well designed
   - [✓] Effective
   - [ ] Common
   - [ ] Average
   - [ ] Needs refinement
   - [ ] Ineffective

2. **Pacing of Animation/Timing**
   - [✓] Appropriate
   - [✓] Effective
   - [✓] Well designed
   - [ ] Too fast/slow
   - [ ] Ineffective
   - [ ] Needs refinement

3. **Lighting and Shading of Models**
   - [✓] Creative
   - [✓] Appropriate
   - [✓] Well designed
   - [✓] Effective
   - [ ] Common
   - [ ] Average
   - [ ] Needs refinement
   - [ ] Ineffective

**Overall Comments and Suggestions:**

Very good concept of a video game adding things like events and different level armours/suits attracts gamers for an RPG.
Dan Farruggia

Thesis Work In Progress Evaluation Form: **World Warrior**

**Summary of project:** The purpose of this thesis was to research the design elements of three of the most recognizable armors in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)
   - Creative [x]
   - Appropriate [x]
   - Well designed [x]
   - Effective [x]
   - Common [ ]
   - Average [ ]
   - Needs refinement [ ]
   - Ineffective [ ]

2. Pacing of Animation/Timing
   - Appropriate [ ]
   - Effective [ ]
   - Well designed [ ]
   - Too fast/slow [ ]
   - Ineffective [ ]
   - Needs refinement [ ]

3. Lighting and Shading of Models
   - Creative [ ]
   - Appropriate [ ]
   - Well designed [ ]
   - Common [ ]
   - Average [ ]
   - Needs refinement [ ]
   - Ineffective [ ]

**Overall Comments and Suggestions:**

Extremely creative, samurais are cool!
Dan Farruggia

Thesis Work In Progress Evaluation Form: World Warrior

Summary of project: The purpose of this thesis was to research the design elements of three of the most recognizable armor in world history (the Samurai, the Knight, and the Viking) and adapt them for futuristic character designs for my own real-time computer game called World Warrior. Much like the command and conquer game Age of Empires, players will pick from a vast range of civilizations, construct an army, and destroy their opponents. It will take place far into the future, and if great civilizations such as the Byzantines, the Saracens, the Persians, and the Vikings, to name a few, still existed in this time period. The scope of my research interests for my Thesis are heavily within the character design, concept art, and 3D modeling fields for the gaming industry.

1. Visual Style (illustrations and models)
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

2. Pacing of Animation/Timing
   - Appropriate
   - Effective
   - Well designed
   - Too fast/slow
   - Ineffective
   - Needs refinement

3. Lighting and Shading of Models
   - Creative
   - Appropriate
   - Well designed
   - Effective
   - Common
   - Average
   - Needs refinement
   - Ineffective

Overall Comments and Suggestions:

Creative concept, highly original.