USING PRECISIONISM WITHIN AMERICAN MODERN ART

AS STYLISTIC INSPIRATION FOR 3D DIGITAL WORKS

A Thesis

by

DOUGLAS RYAN BELL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2009

Major Subject: Visualization Sciences

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Approved by:

Chair of Committee,	Karen E. Hillier
Committee Members,	Tim McLaughin
	Dennie Smith
Head of Department,	Tim McLaughlin

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ABSTRACT

Using Precisionism Within American Modern Art

as Stylistic Inspiration for 3D Digital Works. (August 2009)

Douglas Ryan Bell, B.E.D., Texas A&M University

Chair of Advisory Committee: Prof. Karen E. Hillier

This thesis presents the analysis of artistic techniques of paintings from the Precisionist movement and the implementation of the results of the analysis in the creation of three new works of art using digital media. Artists working in digital media express features of pre-digital artistic movements with varying degrees of adherence to principles, intentions, and awareness. This thesis seeks to create a bridge between the recognition of common features of Precisionist works and the expression of those elements in new works through the use of a system of analysis, interpretation, and translation. One outcome of this thesis is the description of a methodology for interpretation and translation that can be applied to other art movements.

The Precisionist period within the Modern Art movement has both a historical importance in the world of art and a thematic relevance to popular uses of digital media – specifically the representation of meaning and mood derived from industrial settings. Its influences can be traced from cubist, futurist, and constructivist art, as well as influencing the development of surrealism. It is considered the first solely American movement within Modern Art. Charles Sheeler's work plays a key role in the visual

analysis portion of this research. Sheeler's work offers examples for applying 2D precisionist artistic style as aesthetic inspiration in creating a three-part production of 3D digital and video work. Work from precisionist artists Charles Demuth and Edmund Lewandowski also contribute some unique artistic characteristics considered during the analytical portion of this study. The new artistic works proposed include: (1) a linear, live-action short video with post-production manipulation; (2) a linear, 3D animated work; and (3) a non-linear, interactive 3D game environment.

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1. INTRODUCTION

Beginning in the 1920's, American artists began producing stylistically similar collections of work that would be later categorized as Precisionism. Often classified as derivative based upon cubistic interpretation, precisionism can be described as having elements of realism as well as a foundation in cubism. According to Wolfgang Born who first coined the term in 1948, the precisionist artist uses a geometrically precise technique to accenturate angularities within the subject manner – usually being industural, modern city landscapes. Inherently, the industrial revolution within America aided in this response to modernity, and inspiriting rationalization within industrialized landscape [16].

Made famous primarily by the photographer and painter Charles Sheeler (1883 - 1965), precisionist artists use Cubist composition, with the 'machine aesthetics' of the Futurists, applied directly to American iconography [5]. The artists found that machinery within farms, factories, and industry were objects of glamour. Sheeler's work often iconosized industrial landscapes within his paintings; detailing the content with a strong light source contrasted by well defined shadows, dynamic forms, and hard-edges – often spliting colors and forms within his photographs and paintings as shown in Figure 1. Figure 2 demonstrates that while some of these characteristics can be seen in other precisionist's works, most artists during this period in America were influenced heavily by the futurist, cubist, and realism work of European artists [5].

This thesis follows the style of *IEEE Transactions on Visualization and Computer Graphics.*

Figure 1: Charles Sheeler, *Criss-Crossed Conveyors, River Rouge Plant, Ford Motor Company*, 1927. Gelatin silver print [11].

Figure 2: Chales Demuth, *My Egypt*, 1927. Oil on composition board [15].

As Charles Sheeler chose photography and oil painting as his primary mediums, artists today have a vast choice of mediums when it comes to producing artwork; especially when reconstructing media produced during earlier time periods by other artists. One contemporary method includes using 2D, and 3D, computer graphics with virtual brushes to paint upon a virtual canvas (2D) and virtual forms, materials, and light (3D); consequently capable of producing results very similar to artists using physical brushes upon a physical canvas. In particular, Adobe's Photoshop is a 2D software package designed to accomplish just that. Additionally, Autodesk's Maya is a 3D tool capable of recreating an entire space or environment, then rendering that environment into a 2D virtual image. While Photoshop and Maya's interfaces are interactive in real-

time, the resulting images produced are often not. To illustrate a real-time solution to art production, gaming software can achieve these results, in addition to putting the viewer into the art piece interactively. One example includes Valve's Source engine. Paired with their gaming software *Team Fortress 2*, the artist can produce painterly results indicative of artistic styles or movements, in particular, the Precisionist Movement.

2. BACKGROUND

Theophile Gautier, French poet and art critic, published a brief text in 1835 in which he articulated the phrase “l’art pour l’art,” commonly translated into English as ‘art for art’s sake’ [6]. The dominant artistic philosophy at the time embraced academic tradition almost exclusively within the European regions, and often pertained to images that contained virtuous behavior inspired by Christian sentiment. This classical approach to art favored the ascendency of wealth, government, and existing institutions that resisted radical change. However, a rise in Capitalism later in the nineteenth century would create an awareness of a newly emerging middle class of citizens within mainstream society throughout Europe. The contemporary and somewhat materialistic population within the middle class, often including artists, was commonly referred to as the bourgeois culture. The artists associated in this middle class contributed a certain leadership for a fresh outlook within philosophy, art, and architecture. Their prospect translated into ‘Progressive Modernism’; a term that was coined in respect to ‘avant-garde’ or “advance-guard” in military terminology [24]. These radicals fundamentally chose to reject academia, end its traditions, choosing to widely educate the public, and to bring art to an anti-classical, forward-facing revolution [24].

From its emergence, the modern art movement was anti-academic. Additionally, events leading into and during the twentieth century such as the First World War (1914 – 1918) and the German Revolution (1918 - 1919) influenced modern artists in Europe, and eventually those in America, to see an ever-changing social and cultural

environment. Their subsequent rejection of wars and political domination had a particularly large influence on the mindset and morale of emerging artists. In turn, this mindset propagated artistic freedom, not simply from the rules of academia, but from public opinion as well with artists choosing to focus introspectively for the content of their work. Rejection of these values, as well as embracing modern innovative values, was central in creating 'art for art's sake' [24].

One notable facet of the term 'avant-garde', and its use within the 20th century, is it managed to unify diametrically opposed viewpoints within the modern art era [6]. 'Avant-garde' covers many of the modern art styles, but is exemplified by the degree of 'abstraction' in the artwork [6]. While the artist's viewpoints expressed in early 20th century art in Europe were often inspired by war, in America insipration was typically drawn from the industrial revolution. The American artists began experimenting with variations of European styles such as cubisim and furturism; in fact, the dichonomy of the varying styles being pulled from European artists grew so rapidly, one of the first American-originating art movements know as precisionism is often classified as 'cubic realism' [5]. Within precisionism artwork, the American artists incoprorated elements of cubism and futurism as well as constructivism, realism, and purism.

The introduction of precisionism was one of the most important developments in American Modern Art in the 1920's, laying the foundation for later Modern Art movements such as realism, surrealism, pop art, and minimalism. The precisionist philosophy centered almost entirely around American industrialization. The artists

chose to glorify machine esthetics, especially within paintings representing farms, factories, and the American Landscape [5].

Breaking free of European classical style, the precisionists made use of clean, simplified shapes (often seen in constructivism), exemplifying the industrial content of American commercial subject matter [5]. As Charles Sheeler stated, "Our factories are our substitute for religious expression" [5]. Figure 3 demonstrates the progression of art movements from nineteenth century into the twentieth century growing from Europe into America. Alfred H. Barr, the founding director of the Museum of Modern Art, created a flowchart based on the techniques and materials used for each genre. This modified version elaborates the transition of Modern Art into America emphasizing the precursive and successive art movements to precisionism.

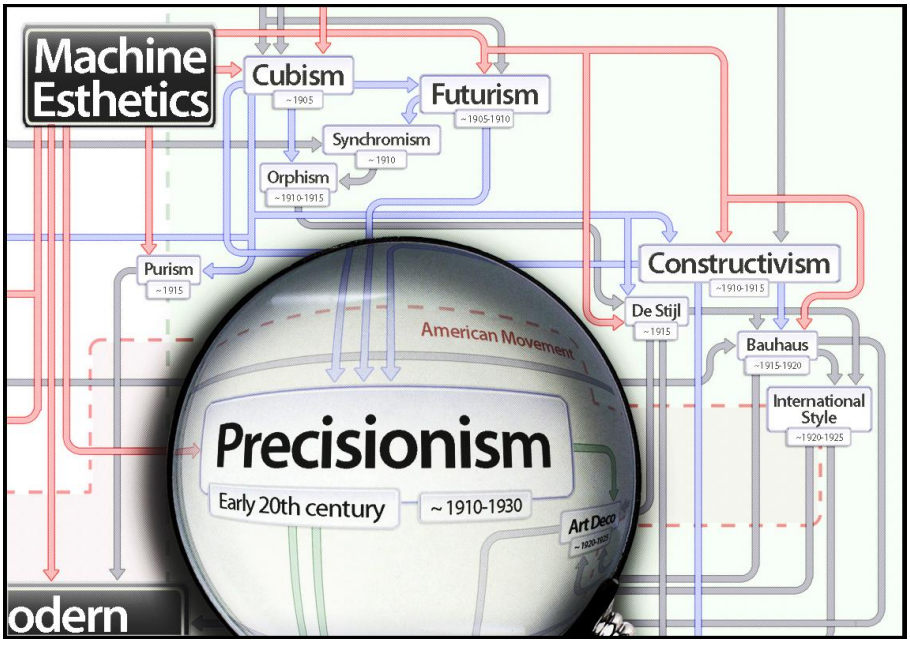

Figure 3: Douglas Bell, *The Development of Precisionism* (Section). Based upon the work of Alfred H. Barr, *The Development of Abstract Art*, 1936 [3].

2.1 Precisionism Within Modern Art

In Amy Dempsey's *Art in the Modern Era* [5], the author describes the Modern Art period as having three distinct classifications: *Art for the People*, *Art and the Mind*, *Art and Style* [5]. Precisionism often falls into the classification A*rt and Style*. The classifications range within the years of 1860 to 2000, although the differences could also suggest art varied in abstractness and geometrical composition [5].

Art and Style was a concept developed by avant-garde artists interested in breaking the rules of classic artistic tradition in order to search for art expressing modern life. This direction was often most important to precisionist artists because of their forward-facing outlook in seeking artistic inspiration [5]. Precisionist artists centered around this philosophy. Working with light, shape, and form, most of the work composed by artists during this period resembled cubist and constructivist art, as there was a sense of three-dimensionality to the work. In 1928, Charles Demuth painted one of the most well known precisionist's artwork, *The Figure 5 in Gold* (figure 4). The piece is an interpretation of his friend William Carlos William's poem *The Great Figure*, and is his poster-portrait [5]. The use of typology is a clear indication of constructivist influence, while the painting also demonstrates the futurist and cubist techniques of motion from the use of dynamic lines segmenting the piece [5]. What makes this painting primarily precisionism though is the use of well defined edges separating each element, plus an attention to solid colors, gradated only minimally in areas where the foreground is non-precedent.

Figure 4: Charles Demuth, *I Saw the Figure 5 in Gold*, 1928.
Oil on composition board [10].

2.2 Charles Sheeler and the Artists of Precisionism

Precisionist art populated the 20th century from approximately 1910 into the 1940's. Some of the masters from this time include Charles Sheeler (1883-1965), Preston Dickinson (1881-1930), Louis Lozowick (1892-1972), Ralston Crawford (1906-1978), Georgia O'Keeffe (1887-1986), Edmund Lewandowski (1914-1998), and Charles

Demuth (1883-1935). Though each artist had a personalized approach to Modern Art, they shared a strong interest in the American industrial landscape.

Charles Sheeler began his career as a classically trained painter and photographer after his graduation in 1906 from the Pennsylvania Academy of Fine Arts [16]. While there, professors such as Henry McCarter, Thomas P. Anshutz, and William Merritt Chase taught him in subjects ranging from antique class and painting to modeling and still life. Charles Demuth was a classmate of his, but they rarely communicated. Sheeler commended Demuth as an artist, but never particularly favored his work. While Demuth primarily took illustration classes with McCarter, Sheeler studied almost entirely with William Chase, with whom he looked to as a mentor [19].

Sheeler was always interested in photography since his teenage years, but began producing professional art as a cubist painter. After visiting Europe in 1913, Sheeler exhibited paintings influenced by Henri Matisse, and Paul Cézanne – prominent Fauvism and Post-Impressionism painters respectively [5]. He composed a few figurative pieces of semi-portraits in the early 1920's, but later claimed to have destroyed them. In an interview with Martin Friedman in 1959, Sheeler mentioned, "they were never part of the overall of my work" [20]. He was self-educated in photography, learning at an early age using a $5 box Brownie camera. He began filming the architecture of Philadelphia, leading to commission with architects and private collectors such as Mrs. Eugene Meyers [20]. Starting in the mid 1920's, he was employed under Edsel Ford as a photographer at the River Rouge Plant in Michigan, later transforming the photography of American machinery into paintings [5]. He

developed methods for blending his keenness for photography and his love for painting in order to ‘remove the method of painting from being a hindrance in seeing,’ meaning he wanted to paint what one has seen. From his photography work there, he later painted *American Landscape*, (as seen in figure 5) and *Classic Landscape*, among others as well [19].

Figure 5: Charles Sheeler, *American Landscape*, 1930. Oil on Canvas [12].

Subsequently working with precisionist artist Morton Schamberg, Sheeler created a series of images displaying his fascination with agricultural and industrial machinery. Sheeler's interest in industrial landscape did not result from his work with architectural photography; instead it was a reaction to a different approach to composing a painting on a final canvas. In 1929, Sheeler painted *Upper Deck*. This painting is a rendition of a photograph taken upon the SS Majestic – which was one of the most luxurious passenger ships in the world in 1928 built by the German shipping company, the White Star Line. After completing *Upper Deck,* Sheeler explained when he became interested in landscapes an interview with Friedman:

> Planning a picture very completely before starting to work on the final canvas, having a blueprint of it and knowing just exactly what it was going to be, not the accidental things, the touch of the brush here that might be brilliant in its application, but having a basic plan, like building a house. [20]

This was the beginning into an architectural phase that lasted into his later works [20]. Figure 6 shows an example of the original photo taken by Sheeler on the SS Majestic on the right, and his painted interpretation on the left. According to Mark Rawlinson, *Upper Deck* is the 'apotheosis' of Sheeler's style [16]. Charles Sheeler used photography as the shorthand versions of his paintings. He commented that he would 'go out and look', take any notes he needed, then work when he came back. He was very conscious of his surroundings, so conscious in fact that if there were interesting

items around, such as furniture or pictures, he would spend his time becoming acquainted with those objects, then with the job at hand [19]. He would use his photographs for 'specific details', or something he could make reference to for form and greater definition, as opposed to drawing a quick sketch of the subject [20].

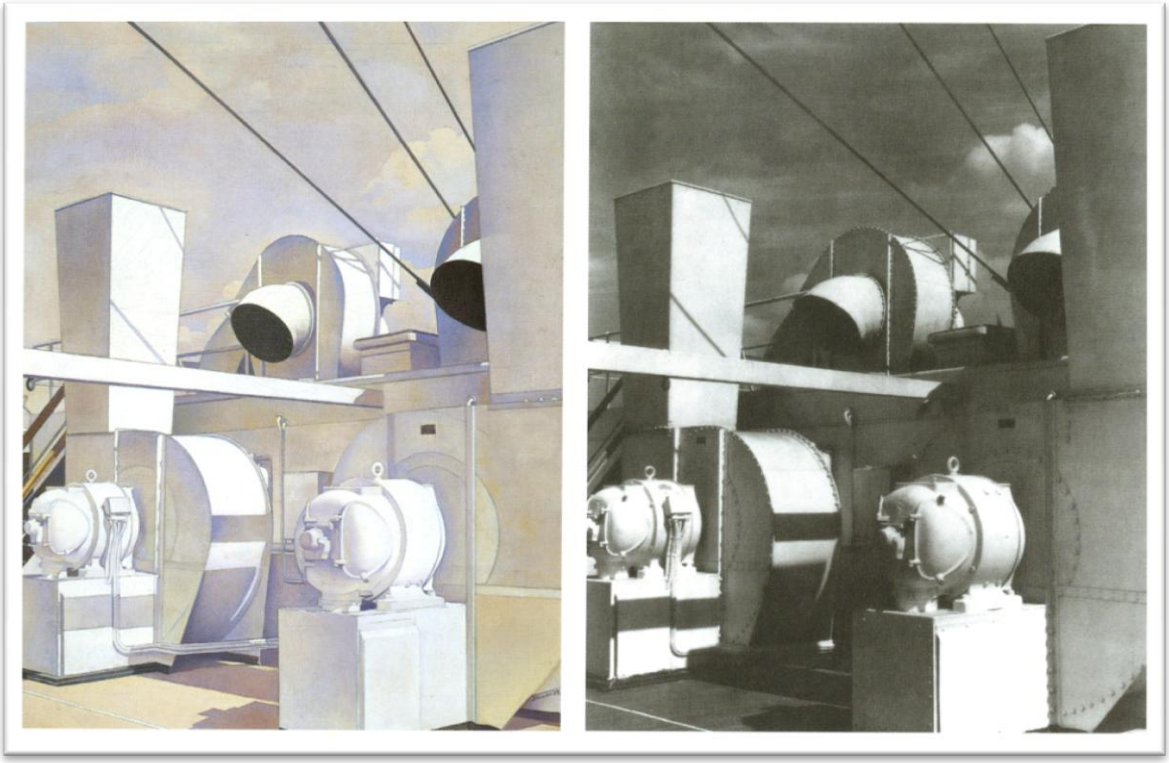

Figure 6: Charles Sheeler, *Upper Deck*, 1929. Oil on canvas, and gelatin silver print [5].

Sheeler noted that he intended to present the subject in itself in his paintings, and disregard the 'distraction of the means of achieving it'. He justified his work with presenting the subject how it was seen as a simplified form, and the technique was absent without precision. When asked by Martin Friedman with whom, among himself

(Sheeler), was part of the group included in this appellation, Sheeler responded with Charles Demuth, Preston Dickinson, Georgia O'Keeffe, and George Almaine [20]. Each of these artists has similar stylistic elements in their paintings compared to Sheeler, all pointing to a form of realistic-cubism. In 1959, when presented with an article by Dorothy Adlow – with the Christian Science Monitor – in which she suggests Sheeler's work holds a strong surrealist element based upon the lack of the human element because the landscapes are devoid of people, Sheeler regarded surrealism as an art form that 'never touched me'. He suggested that he hadn't even considered his work related to it nor had any fascination in the subject [20]. Ironically, critics still believe his work inspired such periods as magic realism, surrealism, pop art, and minimalism because of his precisionist style.

2.3 Edmund Lewandowski and Charles Demuth

Edmund Lewandowski was raised in Milwaukee during the early 1910's, in a family already fond of industrial power technology. After graduating from the Layton School of Art in Milwaukee, he joined the Federal Art Project where his passion for nautical and industrial art blossomed into his visual arts repertoire. He carefully studied the heroic workers who labored in the workplace as well as the roundness for forms to heighten the three-dimensionality of his paintings. Like Sheeler, he took the subjects and reduced them down to their simplest form; then by adding contrast between color and form, he was able to impact the Precisionist moment with his work. He was an

illustrator, artist, and educator becoming one of Wisconsin's most important modern art figures [21].

Beginning his career as an illustrator, Charles Demuth became one of the most famous artists of the precisionist artistic movement. He grew up in a life of wealth, in addition to a sickly childhood, he never needed to worry about choice of careers. After attending the Drexel Institute of Art, Science and Industry, and the Pennsylvania Academy of the Fine Arts in Philadelphia, he moved to Europe to absorb the modernistic lifestyle. While there, he expanded his artistic view with cubism, but later would be known for his contribution to precisionism. His watercolor paintings were reminiscent of Everett Shinn, and often coincided with such artists as Marcel Duchamp, John Martin, and Georgia O'Keeffe.

3. WORKING PROCESS

3.1 Artistic Intent

The main objectives of this research includes the establishment of a visual analysis of paintings by precisionist artists, and then applying the results experimentally to use as stylistic inspiration in three new mediums not available to artists during this time period. The outcomes could answer the question, "can viewers interacting with the environments created in this thesis establish artistic, elemental connections with the artistic style represented, and the artwork of precisionist artists?"

3.2 Visual Analysis of Precisionist Style

Performing a visual analysis of precisionist art ensures that the new artistic works proposed in this thesis resemble the aesthetics of paintings produced by Charles Sheeler, and other artists from this period. By studying elements from paintings such as subject content, shadow placement, light direction, color and form, perspective, and geometrical abstractness, the final productions can incorporate these elements into linear mediums. Figure 7 illustrates how each element could be used in the final results.

Beginning with Charles Sheeler, this analysis will primarily be looking at his paintings *Upper Deck* (1929) and *American Landscape* (1930), but makes references to his other works from the mid 1920's through the 1940's as well. The most important aspect of his work as a whole is the subject content – the industrialized American landscape. Landscape can be justified in this context as the balance between nature and

machine. In Mark Rawlinson's book *Charles Sheeler: Modernism, Precisionism, and the Borders of Abstraction*, he uses a description made by Wolfgang Born stating, "there is no complaint about industrial ugliness to be traced in Sheeler's world, but neither does he try to glorify and to romanticize chaos of steel and brick, smoke and refuse" [16]. In fact, precisionist buildings appear angular and smooth, while their cities are ordered and devoid of life, yet all stay in a pristine condition. You can label the precisionist landscape as objective, and emotionless [16]. Born describes Sheeler's content as part of a 'technocratic' landscape in art, meaning Sheeler gave the 'non-picturesque' structures used as engineering the same importance as the water and land next to it [16]. In turn, the architecture takes the form of the natural landscape, blending with the elements of nature. In Sheeler's painting *American Landscape* illustrated below, the elements of nature are expressed though the water, dirt, and the breeze – demonstrated by the direction of the smokestack plume. The elements stand without human life, but feel as if they cohabitate with the architecture. This presents a new socio-cultural form of reality channeled through photography onto a canvas [16].

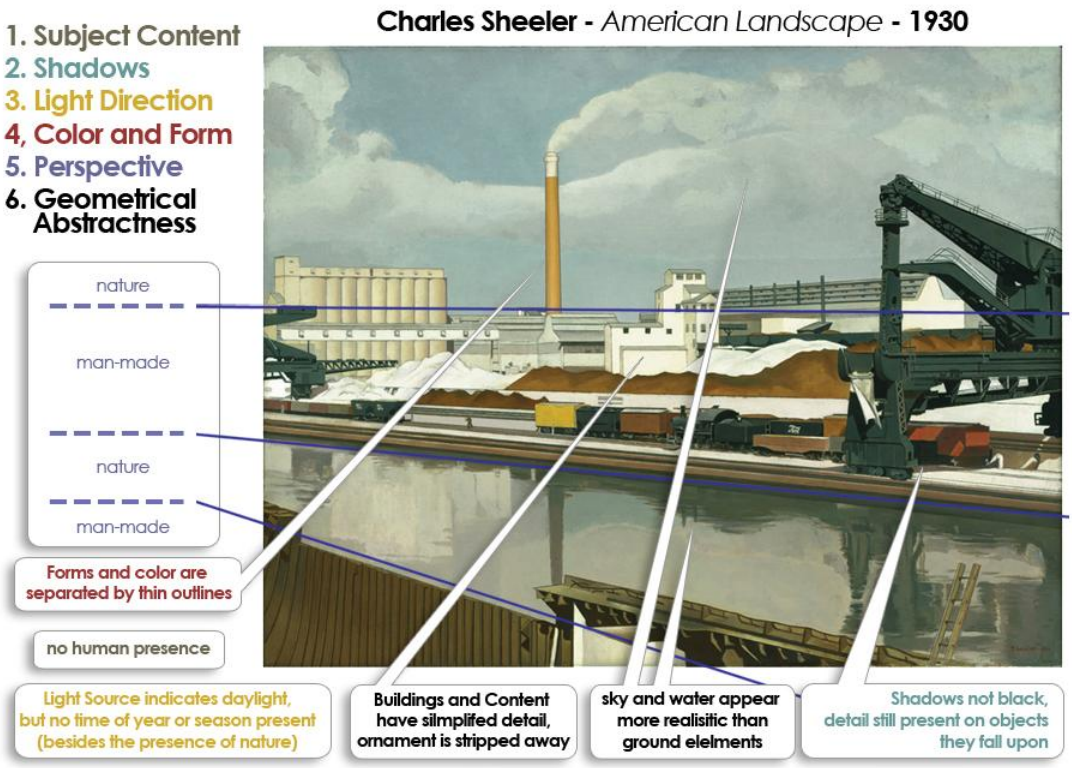

Figure 7: Visual analysis of precisionist art using Charles Sheeler's *American Landscape* [12].

Another aspect to Sheeler's landscape, as well as other precisionist artists, is that ornamental detail is stripped away, leaving smooth, angular qualities to the structures. In his painting *Upper Deck*, the photograph illustrates the fine details left out of the painting, such as the rivet-lined metal surfaces. We only see a partial view of this element within the photograph, although he considerably lightens the oil painting to expose a simplified version of detail that is not shown. Looking at the funnels above the metal surfaces presents a flat black view into the ship itself. He offers no information into the ships interior. This can be summarized as a distinction between 'realism and abstraction' according to Mark Rawlinson [16]. Rawlinson also adds, "*Upper Deck*

possesses a ‘buoyancy [that] transcends severity,’ and the image manages to be ‘at the same time so simple and so complex’” [16], which can describe not only Sheeler’s work, but many other precisionist artist’s work as well.

Sheeler’s use of photography to capture factories and machines embraced the industrialized world. By using photography as source material, Sheeler mentions that he lets the image soak into him, only then when he later returns to the image, he begins with a small sketch, then moves to pencil upon a canvas. He doesn’t favor an under painting, and explains he doesn’t see ‘what good it does’ [20].

Photography also provided Sheeler with interesting methods to crop or highlight an image’s most interesting qualities. In *American Landscape*, the original photograph is much taller then the actual painting, extending approximately more then 150 percent as shown in figure 8. Sheeler used a wide-angle perspective when filming the River Rouge Plant by incorporating the silos of the concrete plant, the screen house, as well as the foreground elements upon the Detroit River. While the painting is not simply a direct reinterpretation of the photograph, it still retains a ‘photographic composition’ [16]. Sheeler at the time was using a Brownie Kodak camera that featured a simple lens that took 2¼-inch square pictures on roll film [8]. Since Sheeler choose to use the top portion of the photograph, this essentially ‘flattened’ the image due to the curvature of the lens. This heightens the linearity of the subjects due to the ‘shift in perspective’ [16].

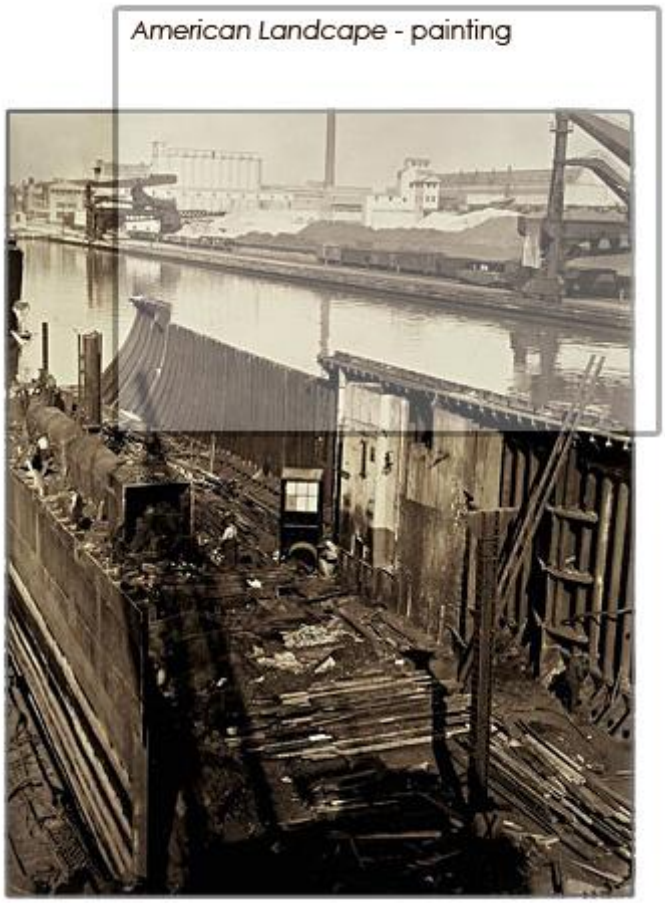

Figure 8: Charles Sheeler, *Canal with Salvage Ship, Ford Plant*, 1927. gelatin silver print [13].

Possibly the most important aspect in most precisionist artist's paintings (not to mention what makes great photography possible) is the inclusion of light. In 1924, Fernand Leger explored connections in representing subjects and light in his essay 'The Machine Aesthetic: The Manufactured Object, The Artisan, and the Artist'. He writes:

> Every machine object possesses two qualities: one, often painted and light-absorbent, that remains static (an architectural value) and another (most often

> bare metal) that reflects light and fills the role of unlimited fantasy (pictorial value). So it is light that determines the degree of variety in the machine object. [16]

This is evident in both Sheeler's photograph and painting of *Upper Deck*. While the photograph illustrates stark contrasts in the light and shadow upon each surface, he revises the exposure globally, fashioning the painting into a 'laboratory-like' color palette of grey-blues and magentas [16]. Each surface, whether it is metal or matte, is represented equally as a flat surface resembling a balance of light absorbent, and reflecting material illuminated by a single light source. The painting provides evidence that he chooses a representational approach of recreating the photograph as a painting other than a realistic approach.

The way Sheeler chooses to render shadows, though, in my opinion, is more important then the light source itself. The description of shadows in *Upper Deck* can also be used in Edmund Lewandowski's painting *Fishermen's Village*. From the photograph of *Upper Deck*, it is apparent that the shadows 'blackout' surfaces they fall upon. This is due to the exposure level of the photograph during a particular time of day when the sun is at it's highest, and the sky is very bright. The artists must make a conscience decision to lighten the shadows, and darken the sky within the painting. Until relatively recently, High Dynamic Range photography hasn't become available in most cameras. This involves using various levels of exposure at 'snapshot time' to capture fine details that would otherwise be lost within the brightest whites, or the

darkest darks. Precisionist artists were famous for including a broad spectrum of color to outdoor scenes; this entails placing color in areas that would usually be lost in a photograph, yet still be present when viewing the landscape with the human eye. While interviewing with Martin Friedman, Friedman asks if Sheeler "attempts to arrive at a quality of a season or a quality of the time" [20] when the shadows are cast upon a certain point. Sheeler simply responds with "no" [20].

In addition to content, light and shadows, color and contrast have important aspects of their own within precisionist paintings. Speaking with Friedman, Sheeler comments, "I do like contrasts. I think they're important… It may be contrasts of forms or of color. I like a black, not as a rule, but at times I like black coming right next to a white" [20]. Demuth, Lewandowski, and Sheeler all choose to use highly saturated colors within paintings. Separating these colors and forms, as Sheeler notes, are sheer straight lines. While they can indicate a separation of form, precisionist artists seem to prefer a pseudo-illustration quality to their work by the use of a darkened contour line.

Perspective and geometrical abstraction can be looked at in parallel in each precisionist art piece. In Sheeler's *American Landscape* and *River Rouge Plant*, the vanishing point for perspective lines disappears to the left of the paintings. Sheeler's stylistic planning interprets his photographs as more realistic then abstract. Although, the diagonal lines control the division of organic and man-made structures within the composition; thus, leading to believe the art piece, as a whole, can be thought of as indirectly abstract [16]. In contrast, Charles Demuth uses a more literal interpretation when using perspective lines in describing geometrical abstraction in his piece *I Saw the*

Figure 5 in Gold. The subjects within Sheeler's perspective lines appear to be weighted equally; meaning both nature and machine are equally important. Mark Rawlinson comments on Sheeler's River Rouge Plant paintings as having a title of landscape denotes classical references, and the paintings challenge this notion by limiting the amount of nature shown.

Regressing to Sheeler's early work, *Church Street E1* exhibits a greater level abstraction. His use of perspective lines wanders throughout the piece, giving many references to vanishing points. When asked my Martin Friedman if Sheeler considered his work comparable to work such as Georgia O' Keeffe, Sheeler responded:

> No, none whatever. I think we are quite diametrically opposed to each other… There's a large element of symbolism in O'Keeffe's work, as you can readily see, and none whatever in mine. It's purely a visual thing, and what you see is what you intend to see and no overtones of symbolism. [20]

Sheeler states that he never intended to have symbolism described within his work. He simply wanted the viewer to enjoy what was visually painted. One conclusion can lead to his use of cubistic style in his early work is his passion for the style itself, as shown in figure 9.

Figure 9: Charles Sheeler, *Skyscrapers*, 1922 [14].

To place Charles Demuth and Edmund Lewandowski stylistically within modern art, Demuth used cubism and futurism incorporating strong contrasts in color and form to separate each element. Conjointly, Edmund Lewandowski started with a constructivist / realism basis, followed by subtle brush strokes detailing the objects in the scene as shown in figure 10.

Figure 10: Edmund Lewandowski, *Fishermen's Village,* 1937 [22].

3.3 Implementation

The implementation of this thesis is split into four portions. First, geographical locations were observed and photographed to use for the following works and results. Second, linear live action short videos were produced, using Adobe's Photoshop and After Effects, with the photographs taken from the locations selected in the first portion of research. Third, animated digital short videos were constructed and rendered from within Autodesk's Maya that featured an interpretation of the observed environment. Finally, a non-linear, interactive 3D environment, also interpreted from the observed environment, was created using Valve's Source game engine. Each step in this process used the visual analysis as a guide to evaluate the final results delivered from each piece.

There were three primary locations observed and photographed: (1) the Land O'Lakes, Purina Feed LLC plant in Ft. Worth, TX; (2) a concrete manufacturing facility in Bryan, TX; and (3) an Exxon Corp. holding plant in Hearne, TX. Each of these locations had certain elements that made them ideal for precisionist art pieces. Overall, each location had a limited amount of organic life present–a low amount of trees, animals, and humans, as shown in figure 11. Additionally, almost all of the buildings or machine-made objects were static (with the exception of transportation vehicles like cars and trains). Each location seemingly takes on the natural form the landscape with its architecture; moreover each building by itself is not as interesting as each site as a whole–regarding nature and machine.

Figure 11: The locations I filmed for the implementation of my thesis.
Left: The Land O'Lakes, Purina Feed LLC plant in Ft. Worth, TX.
Center: Exxon Corp. holding plant in Hearne, TX.
Right: A concrete manufacturing facility in Bryan, TX.

3.3.1 Photography and Linear Live Action Short Video

I began my research by photographing my selected locations. The type of camera I used to film each location is an 8.0 megapixel Cannon *PowerShot* SD1100 LS Digital ELPH. One attractive feature with this camera is the widely available custom firmware that can be uploaded to the camera's memory. This can greatly expand its capabilities, as well as add new functionality when taking photographs. The website CHDK (http://chdk.wikia.com/wiki/CHDK_firmware_usage) explains how to upload the specialized firmware to each type of Cannon camera. The firmware package I uploaded was version 1.01a, which was specifically designed to work with my model camera.

The functions I took advantage of with this new firmware package is the RAW capability and HDR functions. RAW is an image format closely resembling a negative

print in traditional film-roll photography. Professional photographers often use RAW images because of the wide dynamic range of light information they can hold [2]. When not using the RAW image format, the Cannon's firmware defaults to using a compressed jpeg image format, which loses much of the detail captured in the light and dark areas in the photograph. HDR is an acronym for "high dynamic range" images. There are multiple ways to achieve HDR imagery; the method I used was "Tv (Time value) bracketing". As shown in figure 12, this luminance bracketing technique involves capturing a series of three images of the same subject with different exposure levels – one at -1, 0, and at +1. The camera automatically adjusts the aperture of the camera approximately three f-stops per automatic exposure setting, thus producing images that have details in extremely light and dark areas that would otherwise be lost. Both HDR and RAW functionality are important to this thesis because of the amount of image information that needs to be illustrated to resemble precisionist paintings. By using both techniques, the resulting images resembled qualities comparable to paintings produced by Sheeler, Lewandowski, and Demuth.

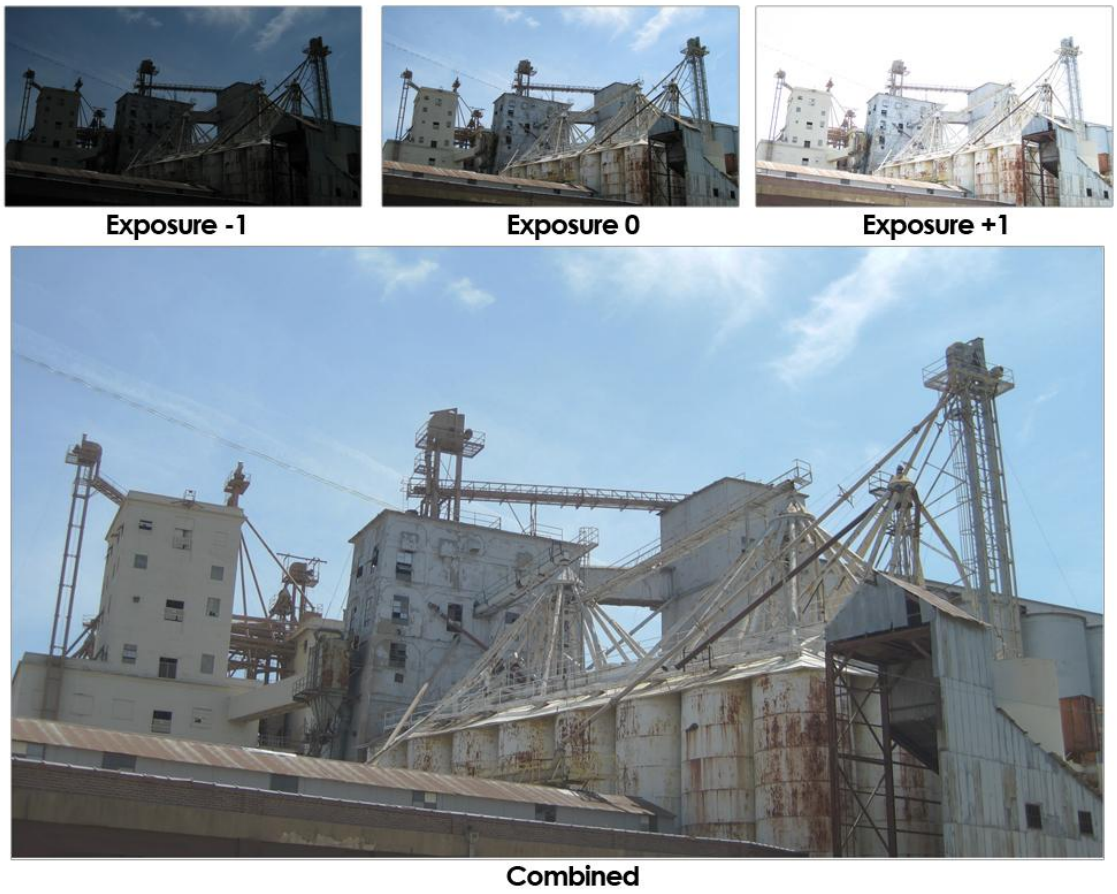

Figure 12: Land O'Lakes photograph with 3 exposures combined into an HDR image. The camera adjusts the aperture before each shot to let in various levels of light.

In addition to using the RAW and HDR capabilities within the CHDK firmware package, there is also a platform provided for users to write custom user scripts to increase control over the cameras functionality. I uploaded the script "rem Time Lapse Photography" in order to produce the progression of time for the short live-action video. This time-lapse script lets the user control the amount of time in-between when each photograph is taken. When a tripod is used, the script is very powerful in reducing camera jitter, and user error in timing each HDR photo.

While filming, I adjusted the Cannon's default settings. I used a wide image format (3264 x 1832 pixels) with a 'fine' resolution. I found that the larger image sizes gave the best-looking results when transferred into Photoshop, and when the filters where applied to the image as well. The HDR script adjusted the aperture automatically, so the settings did not need to be changed, although the aperture and ISO settings were locked during the time-lapse process to avoid the camera from 'auto-adjusting' during overcast cloud movement. I used an 'evaluative' depth setting that survey's the scene as a whole, rather then a certain area. This gave the most accurate resemblance to precisionist paintings due to the infinite focal point. The paintings produced by Sheeler and Lewandowski portray the foreground and background equally as clear and in-focus. I did however use an out-of-focus technique to achieve a 'smooth' minimalized finish to the photograph. By putting everything in focus, then out of focus slightly, this reduced some of the small detail and gave each form a 'rounded' edge, just as Lewandowski used in his work. After much testing, these settings were performed, and I began filming

While filming, I positioned the camera to resemble the light and perspective Sheeler and other artists used in their paintings. I was conscious of the sun's position, always keeping it to my back, or out of view of the camera's shot direction. I found, this produces the best-looking HDR photography when the exposure does not have to be adjusted greatly. Also, I noticed the best-looking images were produced when the sun was shining directly onto the scene, and not though overcast or clouds. This produced clean-edged shadows, and a greater depth of color contrast upon surfaces when being processed in Photoshop. While adjusting the camera to take advantage of the sun's light,

I also used the landscape's natural and man-made perspective lines to crop the snapshots. I accounted for a balance between nature and machine in each photograph, weighting them equality as important for the final series of images.

Once all the photographs have been taken, I was ready to move onto the post-processing stage using Adobe's Photoshop CS3. Photoshop is a digital image editing software package used in single image manipulation and enhancement. One of the most powerful features with this program is the 'automate' and 'action' functions. 'Automate' allows the user to upload an entire fold of images, and process each image individually using an 'action' specified, making it possible to edit each image exactly the same in a considerably shorter amount of time. The action I used below is a 29-step process, splitting the image into eight layers: HDR, polarized, shadow/highlight, sketch, shadow/highlight multiply, combined & sharpen, accented edges, and canvas (figures 13 and 14). I have expressed each layer in Table 1.

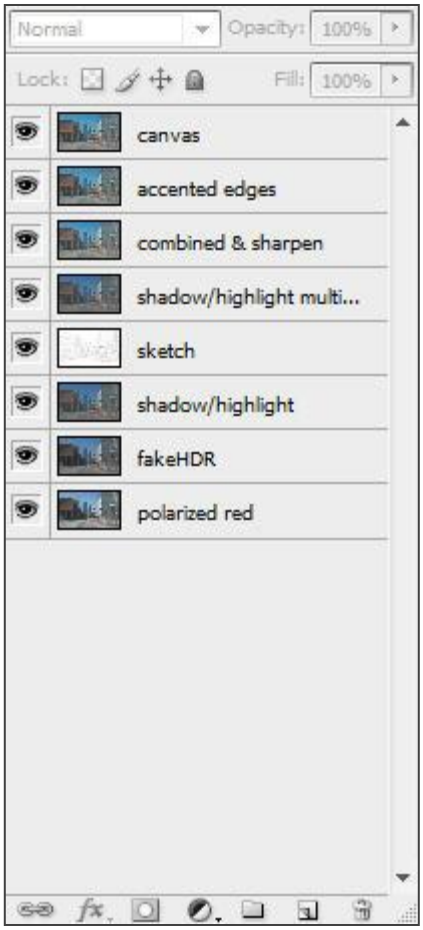

Figure 13: The 8 layers created by my custom Photoshop action.

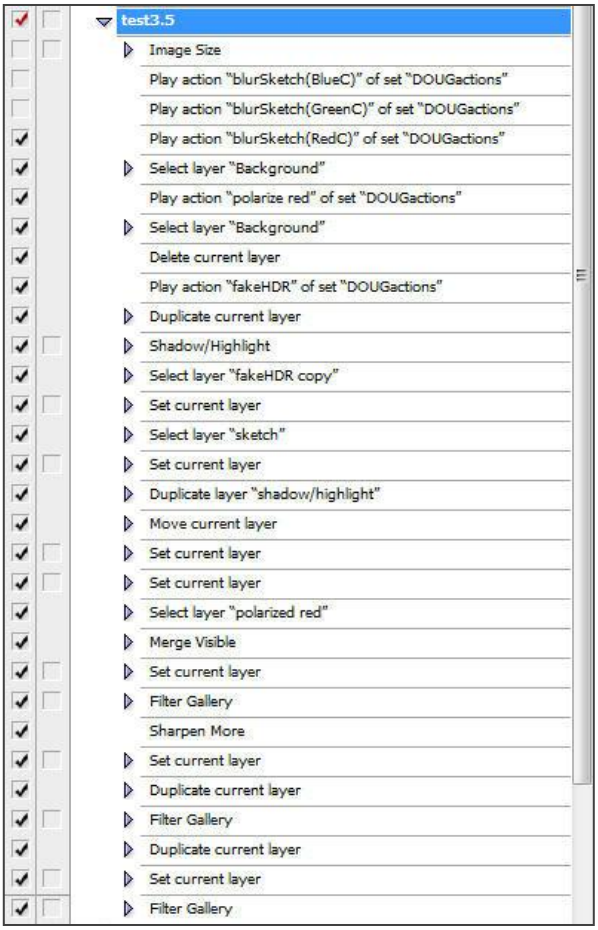

Figure 14: My custom Photoshop action.

Table 1: Layers created from my custom Photoshop Action.

HDR	- For every photograph taken, the CHDK firmware actually took three photos of the same subject, one after another, at different exposure levels. - In Photoshop, the 'automate' function under the File > automate has a menu choice to 'merge to HDR'. Once started, Photoshop used its own set of sub-actions pre-written by Photoshop developers to merge each photograph. This opens a thumbnail box reviewing the merged images, and also gives the user an input slider to adjust the 'white level' within the image. Once completed, the image was now in a 32 bit per channel form that needed to be converted to 8 bits per channel to continue the rest of my actions. I converted the image by navigating to image > mode > 8 Bits/Channel. This resulted in a popup slider box that asks the user to set the exposure level. I used the default settings and continued, completing the first step, creating a layer named "HDR."
Fake HDR (alternative to HDR)	- Uses one photo instead of three - The layer is divided into ten additional duplicate layers, each having a 'multiply' blending style at 10% opacity. This darkens the image and uncovers the details lost within highlights - The image is divided into ten duplicate layers, only this time each layer is lightened with a 'linear dodge' blending method at 10% opacity. This lightens the image uncovering the details lost within shadows. - I merged the 'multiply' layers, as well as the 'linear dodge' layers, and duplicated each, leaving four layers plus the original. I choose to 'lighten' the 'linear dodge' layers and 'multiply' the 'multiply' layers via the blending mode, and then I reduced their opacities to 45% each. - I duplicated the original image, move it to the top layer, and then applied a 'color' blend mode because the image was desaturated at this point from the lightening and darkening.

Table 1: Continued

Polarize	- Produces an image with lightened red hues, and darkened blue hues of color. - Overall the image has more depth and is evened out in terms of color saturation. - The image is split into its red, green, and blue channels. - I copied the entire red channel image, converted it to a 'lab color' mode, and then pasted the 'red' channel content onto the 'lightness' channel. - I converted the image back to an 'rgb color' mode, and created a new layer mask. - In the 'mask' layer, I used the 'apply' function–located under image > 'Apply image'–to the same original image in the 'rgb' channel of the background layer; with a 'multiply' 'blending' style and 100% opacity.
Shadow & Highlights	- This layer takes this idea a step further and uses the Photoshop function 'shadow/highlight' located within the image > adjustments menu. - I increased the 'shadow' attribute to 35% and the 'highlight' attribute to 39% - This evened out the image even more in regards to the contrast between extremely dark and light areas.

Table 1: Continued

Sketch	- Produces the 'hard-edge' precisionist style around colors and forms. - Uses the red channel to outline each form within the image to single-out buildings for outlining. The green channel and blue channel single out nature elements such as the sky, clouds, and foliage–all elements I do not need to outline because they do not match the precisionist style. - I created two desaturated layers. I left the bottom layer alone, but I altered the top layer by copying the red channel then pasted the contents into the green and blue channels. - Since I needed to outline the warm elements with a dark color, I inverted the image, reversing the grey-scale values. - I used a 'color dodge' blending style on the top layer to increase the contrast in-between the whites of the bottom layer an the top. - Then I used a 'gaussian blur' on the top layer to smooth the sharpness of the black areas the previous step produced. By blurring the image, this created sharp outlines over all the previously warm hues, and subtle outlines around the previously cool hues.
Shadow & Highlights Multiplied	- A blending style with an opacity of 50% applied to the image. - This is necessary in order to darken the highlighted areas of the photograph.

Table 1: Continued

Combined & Sharpened	- Applies the 'accented edges' and 'paint daubs' Photoshop filters - The 'accented edges' filter is a brush stroke function that mimics black ink strokes around each form or color within the image. Within it's settings, I used an 'edge width' of 1, an 'edge brightness' of 25, and a smoothness value of 3. - The 'paint daubs' filter assigns a 'painterly effect' upon the image to simulate the loss of detail through think paintbrush daubs. The settings I used included a 'brush size' of 4, a sharpness of 0, and 'wide sharp' 'brush type'. - Together, the small details blended with the overall color of the surrounding areas, leaving a smooth, crisp look to the forms within the photograph. - I used the 'sharpen more' function located within the menu filters > sharpen > 'sharpen more'. - This brought all the forms in the image to focus, resembling how distant objects appeared in precisionist paintings.
Accented Edges	- The same settings were used as in the previous step.
Canvas	- Uses a 'texturizer' filter to mimic a canvas. I used a 'scaling' value of 100%, and a relief of 2.

Figure 15: The process from original photograph to final image within Photoshop.

The final step in this process involved taking the processed images from Photoshop (figure 15), and importing them into Adobe's After Effects CS3. After Effects is a non-linear editing software package that allows the user to edit uploaded digital images or movie files, resulting in an outputted video file. I imported the TIF image sequences into After Effects, and then created a new composition for each sequence. Each composition inherited the size settings of the original image exported from Photoshop, in addition to inheriting the fame count to however many images were taken within each photographic series. Once each sequence was in its own composition, I adjusted the 'time stretch' attribute within the effects menu under 'time' to 400%. This

gave the video a dream-like quality in my opinion. When I envision a precisionist landscape in a moving painting, I think of a slow-moving time-lapse series of images where all the objects within the scene are inanimate, but able to move. Using a time-lapse is essential to my thesis because of a comment Charles Sheeler made to Martin Friedman in an interview:

> … When we look at any object around us and walking around among other things subsequently, we have to bring it up into a conscious plane because – at least I didn't realize it or think of it in that light for some time – but when we look at the next thing in sequence to the first object that we have gazed at, there's still an overtone carried over of what the retina has just previously recorded. And in these later pictures, I make use of that as an element in the final picture. There may be two such images playing against each other or possibly three, no definite number arbitrarily decided, but certainly two. [20]

To produce the results Sheeler spoke of in a literal, linear fashion, I used an 'echo' effect. This produced imagery that resembled two to three images present on the screen at the same moment, in the same location (figure 16). While the user can specify how many images to use for each frame within the 'echo' effect settings, I chose two because this is what Sheeler has mentioned, plus to cut down on final rendering time. I choose to keep the other attributes within the effect at their default, except for the 'echo operator'. I used 'maximum' because this takes the maximum pixel values from each 'echo' image,

thus producing a smooth, color-rich result. The final step in the process was to render the image sequence. For this, I used an Apple Quicktime format with an ‘animation’ compression type.

Figure 16: Processed images from Photoshop and After Effects.
Bottom Image: Echo filter applied to images within After Effects.

3.3.2 3D Animated Digital Short Video

The third phase of my research included an animated digital short video constructed and rendered from within Autodesk's Maya that featured an interpretation of the observed environment. The environment I chose to build within Maya was the Land O'Lakes plant in Ft. Worth, TX. This is because of the similarity in architecture and machinery to Sheeler and Lewandowski's paintings. Sheeler's paintings, in particular, features silos, grain mills, train yards, smoke stacks, and metal-sided buildings–all features included at the Land O'Lakes plant as well.

I used the program Maya to model, light, animate, and render my environment. Maya is a software package that allows a user to interactively build a 3D scene from polygonal geometry, animate it, apply visual effects, and render the product for use in the film, architecture, and gaming industries. I began by using my photography as reference images. This provided me with enough information to reconstruct the Land O'Lakes plant, as well as add more architecture, and machinery. My goal was to use this location as a building block for an even larger factory complex. I also used Sheeler's *American Landscape* painting as reference material to the Precisionist art period.

I used two methods of modeling for my scene, polygons and subdivided (sub-D) surfaces. For objects that were farther away from the camera, I used polygons. Polygons are ideal for creating quick models because they use very little computation for the software package, plus, when combined with textures; they resemble a very basic building structure, ideal for modeling buildings within Maya. For objects close to the camera, I used sub-D surfaces. I needed their edges to appear 'smooth' and rounded–as

Lewandowski did within his paintings. Sub-D surfaces are similar to polygonal surfaces, only they interpolate rounded forms in-between vertices. Figure 17 illustrates the polygonal model I built within Maya.

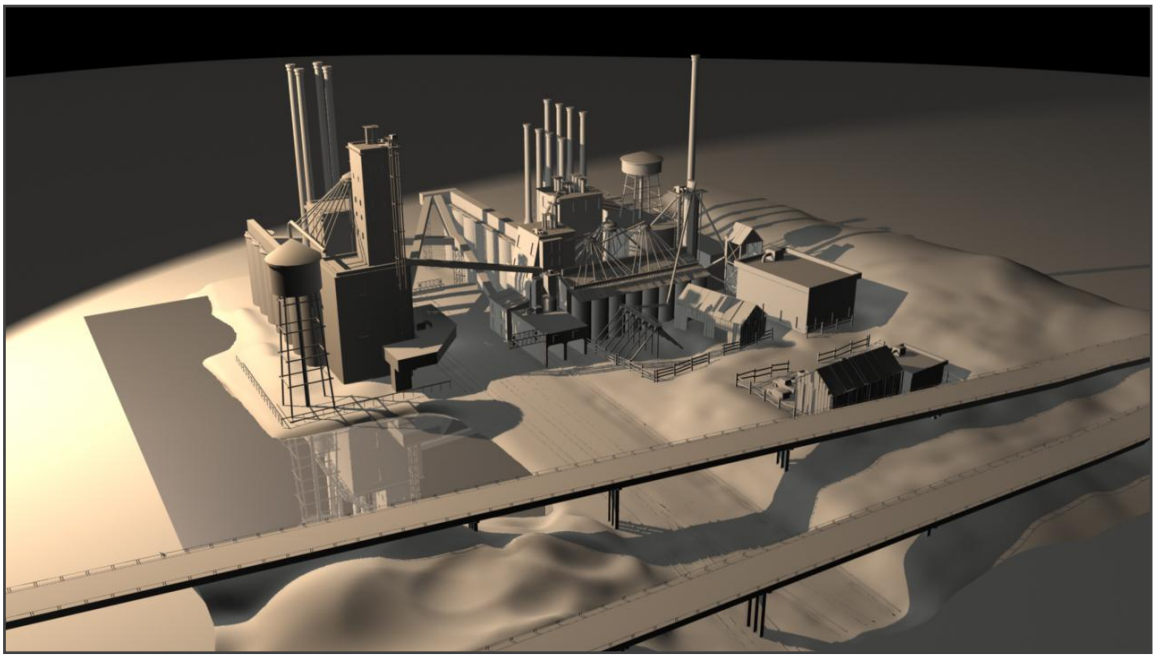

Figure 17: A rendered image from the Land O'Lakes complex I built in Maya.

Another scene I chose to represent is Sheeler's *Upper Deck*. Both scenes are built using the modeling scheme mentioned above, but the lighting, shadows, and materials are tweaked to fit both variations of Sheeler's style. Within each environment, I used a three point lighting setup, with the key light casting ray traced shadows. Ray traced shadows not only provided a more accurate shadow, but produced the 'hard-edge' look between shadowed and non-shadowed areas within the final results. For the Land O'Lakes scene, I used warm-grey shadows to fit the style within *American Landscape*;

while within the Oil Drum scene, I used cool-magenta shadows to fit the style of *Upper Deck* – as seen in figure 18. The key light also provided approximately 90% of the total light represented upon each surface. I used a fill light 90 degrees counter-clockwise from the key light to fill any shadows or darkened areas. The final light was used for ambience. This light was used merely as a 'hue adjustment', if the scene needed any changes.

I used 'Phong E' type shaders upon all surfaces for two reasons. One, they offered more control over the object's surface qualities then Blinn or Lambertian shaders; two, Phong shaders are used within the game environment. Using Phong shaders within Maya provides a better preview of what the materials would look like within Valve's Source game engine.

For the camera settings, I used a 35mm, wide-angle view to capture the Environment. I often tested the scene with 55mm and 75mm ranges of Focal Lengths, but this often resulted in the scene being flattened too much. I needed the appropriate amount of scene parallax to resemble a meniscus lens used with Brownie Cameras in the early 1900's. Therefore, I used the 35mm lens, but pulled far enough back to keep the objects in frame, as well as create a small curvature to the perspective of the scene.

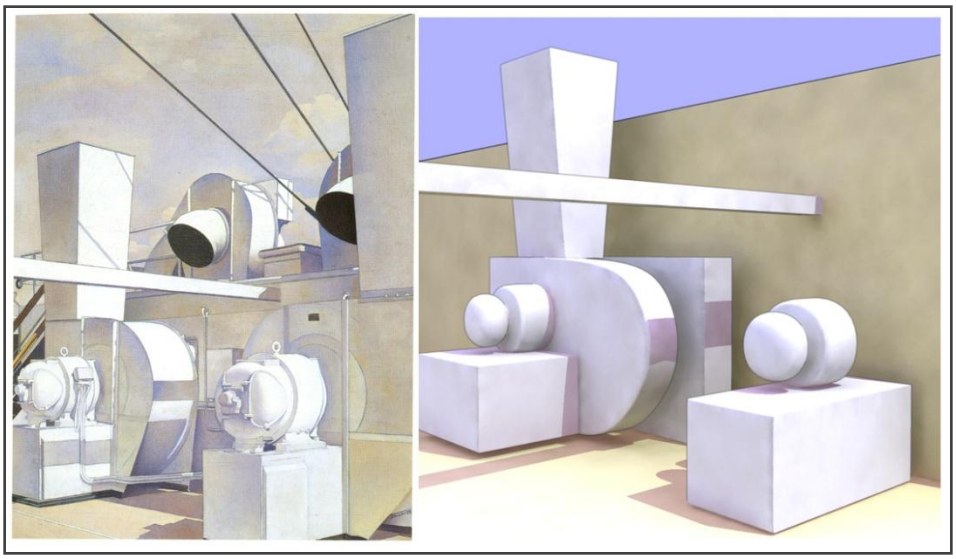

Figure 18: Test render (right) using Rental Ray compared to Charles Sheeler's, *Upper Deck* (left).

Once the scene's lighting, models, and materials were set, I used the Mental Ray rendering software within Maya to finish each scene. Mental Ray offered the perfect set of options when rendering a non-photorealistic scene – this is also known as non-photorealistic rendering (NPR). Two options though stood out when adjusting the settings to resemble precisionist work: final gather, and contour rendering. Final gather is a type of global illumination in which rays are cast from each light source. Once the rays hit a surface, secondary rays randomly are diverted to hit another surface carrying color and light information. This was used in my scene to fill shadowed areas, to increase the realism aspect, and to add a 'splotchy' painterly look to each surface. I used a very low accuracy number for the final gather ray count to achieve the painterly look present upon each surface the light touches. Contour rendering is another element to the Mental Ray renderer that helped solidify the precisionist style within the final results.

By creating a thin outline between the silhouettes of each polygon, I was able to create a stark contrast between each color and form. I enabled the contours to be rendered within a certain distance from the camera, and upon a selected amount of surfaces. I didn't want this effect to overpower the objects in the scene; I simply wanted it to exemplify certain forms. I also used this effect at half its opacity with a neutral hue to blend in with the rest of the environment. Figure 19 shows the contours drawn around each form.

Figure 19: A rendered image from the Land O'Lakes complex processed in After Effects.

The elements of nature in both scenes, such as water and clouds, were rendered in both Maya and After Effects. Within the Land O'Lakes scene, I used a 'wave' deformer upon the water geometry to give the appearance of a breeze within the scene.

This breeze element was also controlled through the use of the smoke plum effect coming from each stack. For this, and the clouds, I used After Effects. I found that using partials within Maya to create clouds would give unfavorable results–often appearing too bright or realistic. Since the clouds within precisionist works often look more realistic then the landscape, I wanted to use the photographs I previously took to substitute computer-generated clouds. I had rendered each image with an alpha channel, leaving the sky transparent within Maya. I then processed photographs taken at the Hearne location within Photoshop using my custom actions, and then imported them into After Effects to be used behind the rendered images from Maya. For the smoke plume effect, I used After Effects' filter 'particle playground'. This emits particles from a selected point, letting the user animation a large number of objects independently. I used a blur effects upon the particles to simulate smoke, and gave them a direction to indicate breeze.

3.3.3 Non-linear, Interactive 3D Game Environment

The final phase of work within my thesis is a non-linear, interactive 3D environment, also interpreted from the observed environment, which was created using Valve's Source game engine. The Valve Corporation is responsible for creating games such as Half-Life 2, Portal, and *Team Fortress 2*. They use their proprietary Source game engine to power the technology behind each game, such as rendering, models and character animation, and world environments. Valve also provides a package called Source SDK (figure 20). This allows third-party developers to create games of their

own, or build upon elements within Valve's present games. They provide their Source SDK content and games through an online client called Steam. Steam is a software package that delivers updated game content to registered users. Also, it is a social networking platform in which gamers can interact and exchange information via Valve games.

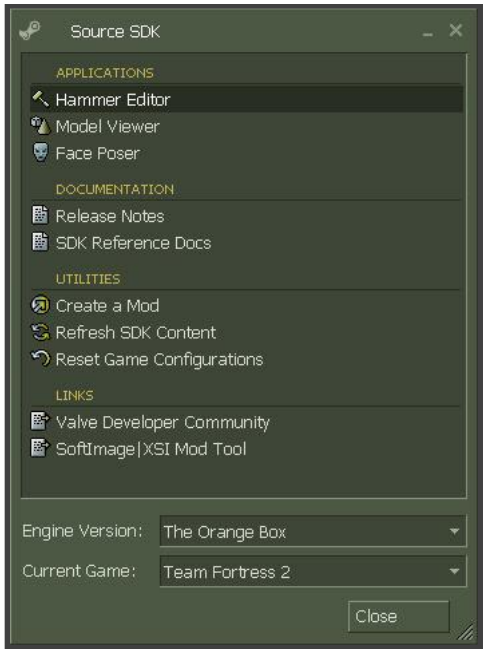

Figure 20: Valve's Source SDK Mod Toolkit [23].

The game platform I chose to build upon was *Team Fortress 2*. The developers chose to reference early 20th century commercial illustrators such as J. C. Leyendecker, Dean Cornwell, and Norman Rockwell when designing the art direction of the game. Some of the similarities between the game's artistic direction, the illustrators mentioned, and precisionist artist's work, are the high frequency details are omitted; the shading obeys a

warm-to-cool hue shift; and the shadows are never black, but simply darker hues. They achieve these similarities through modeling, texture mapping, and rendering. They emphasize each model though their silhouettes, and intentional surface folds. Through texturing, they use a painterly approach. By using broad-brush strokes, each texture holds a uniform impressionistic style even at close viewing angles. The rendering technology with the game engine involves using non-photorealistic shading algorithms to achieve the desired illustrative style. The algorithms use a combination of ambient and modified Lambertian lighting terms that are view and special dependent. They also use a combination of multiple Phong terms as well as rim lighting to further enhance the abstract specularity and diffuse highlighting around each model [9].

Two programs Valve provides within the Source SDK package are their Model Editor and Hammer World Editor. I used these programs in tandem with Maya before compiling the final results. A helpful addition to the Source SDK package is a set of plugins for Maya used in exporting and importing files. With each program installed, I was able export the models I created in Maya, view them in the Model Editor, and place them into a game environment using the Hammer World Editor.

I used Maya to export reference models, physics models, and textures to be used by the game engine. Valve uses an .SMD (Studiomdl Data) format for all of its model files. Each file needs color and shape information, collision information, and animation information. The color and shape information comes from its reference model (example_ref.smd). Each reference model file holds the vertex coordinates and geometrical structure of the model, along with the material of the model for each vertex

point. The collision model, also known as the physics model (example_phys.smd) holds a simplified version of the reference model containing the coordinates for each vertex point. These models provide a solid structure to each reference model, making them impenetrable, unless otherwise specified by the user. The final type of Studiomdl data file is the animation model file (example_idle.smd). The 'idle' portion within the file's name can also be named according to the action that is taking place within the animation of the model. This file holds the model's vertex coordinates for each frame of animation. Often this file and the reference model and be combined if there is no animation present, which is otherwise known as a 'static' model. In order to use each model file with the game engine, they must be complied using a .QC (Quake C) file. This file can be considered a 'table of contents' for all the information a users wishes to include within the model itself. The .QC file points to the location of each .SMD and texture file, and complies it into an .MDL (Valve's model format) file. This files holds the structure of the model along with animation, bounding box, hit box, material, mesh and LOD information. The type of texture format Valve uses within its games is a TARGA (.TGA) format. This type of file can hold 32 bits per channel–24 bits total for RGB channels plus 8 bits for an alpha channel. To use this texture within the game engine, the TARGA file must be converted to a .VTF (Valves Texture Format) file [23]. Figure 21 illustrates the entire process.

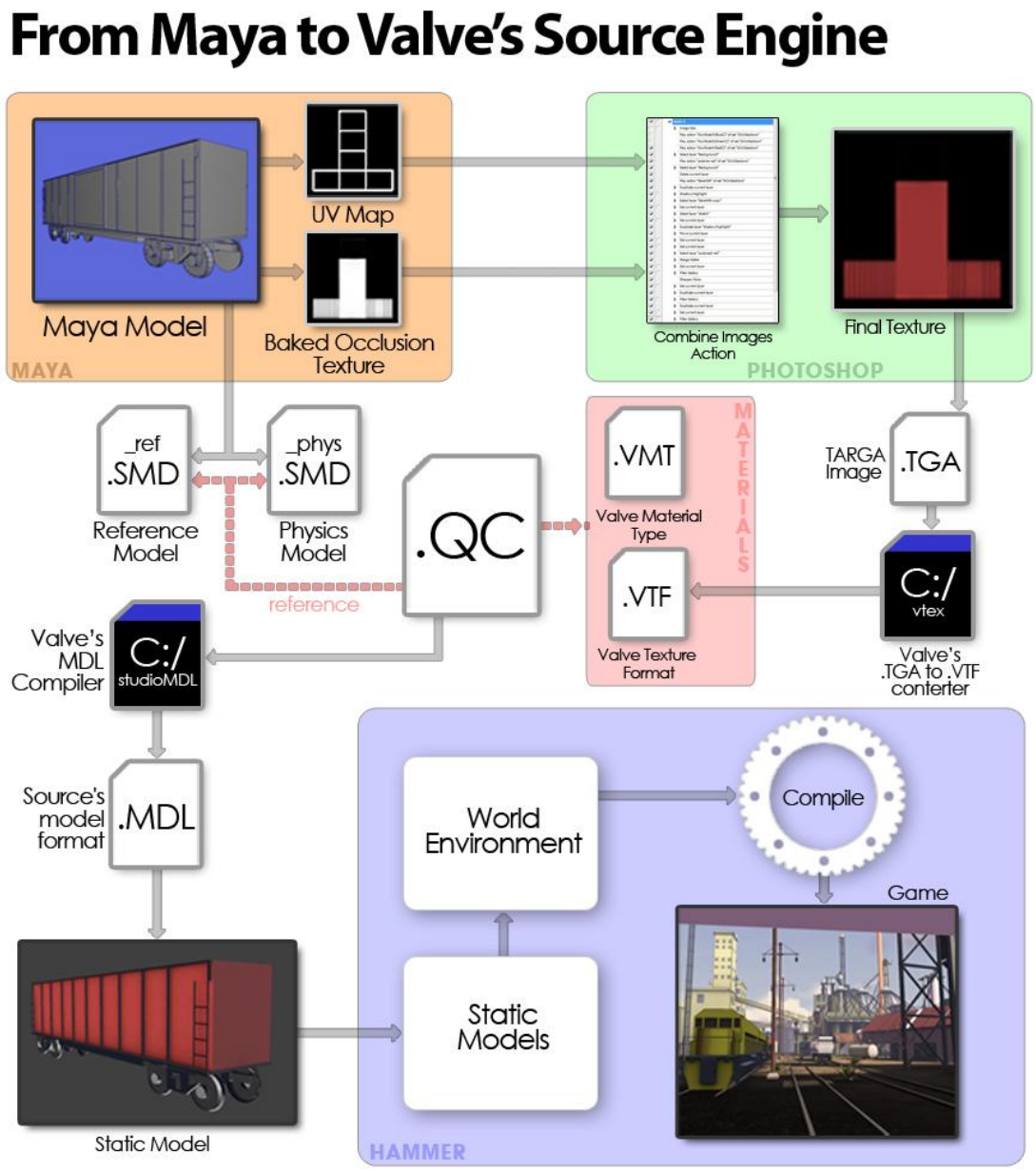

Figure 21: From Maya to Valve's Source engine.

The models I used within the game engine were taken from the previous phase of my thesis. For every model I created in Maya, I exported four files: two model files, and two texture files. The model files were reference and physics .SMD files, while the

texture files where a baked occlusion map file and a UV texture. The UV texture file was necessary because each model within the game world needs to have a material applied to it in order to be rendered during game play. The occlusion map was necessary in keeping with the precisionist style. It provided darkened areas upon the model where it was in close content with other structures, often substituting for shadows. Figure 22 shows examples of both the occlusion and UV maps. I imported both image files into Photoshop upon different layers for further processing. While in Photoshop, I applied a flat color hue all the areas of the model that would be visible to users during game play. The occlusion map was 'multiplied' over the UV map at 50% of its opacity. During the occlusion 'baking' process within Maya, I used the same settings as in the short animated video. This provided a 'splotchy' look to all the surfaces, implying a brush stroke effect. I exported the image from Photoshop as a TARGA format, and then converted the image to Valve's .VTF format.

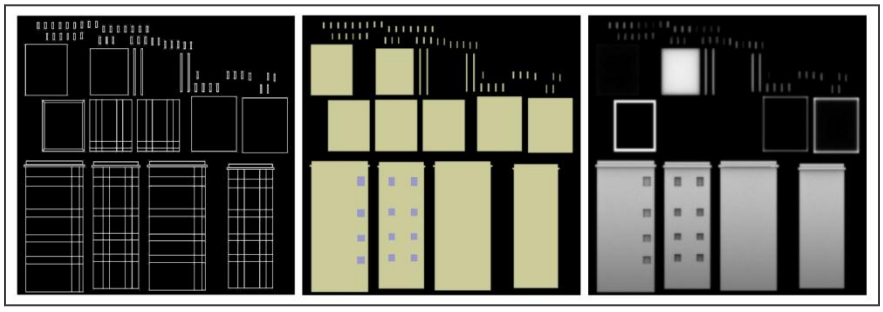

Figure 22: UV texture map + solid color + occlusion map.

In order to give the models the artistic style represented within *Team Fortress 2* and precisionist artworks, shaders need to be applied to each surface, this is accomplished though Valves .VMT (Valve Material Type) file format. Each 2D surface material, expressed as a .VTF file, needs to have a corresponding .VMT file to tell it how to react to lights, and the user's viewing angle. Each .VMT file dictates how the Phong shaders built into the game engine render each surface. The Phong materials within the game engine control features such as global illumination, specuarlity, Fresnel parameters, and rim light controls. Each of these attributes can be adjusted within the .VMT file, and for each of my .VMT files, each value was carefully selected to resemble the precisionist style. Another feature added into .VMT files is the 'lightwarptexture' function. This is a diffuse lighting term applied to the Half Lambert term. This function retains the shading conveyed in commercial illustration by adding a 1D grey-scale TARGA image to the material to act as a light terminator around the edges of each surface [9]. Figure 23 is an example of a .VMT file I used in my game environment. Figure 24 are the results of a basic .VMT file, and a .VMT file with phong, lightwrap, and rimlight functions added respectively.

```
//=========================================================
//
//        Douglas Bell
//        Texas A&M University
//        Visualization Science
//        Thesis
//
//        airCon_main
//
//=========================================================

"VertexLitGeneric"
{
        "$basetexture" "models/thesis/airCon_main"
        "$bumpmap" "models/thesis/shared_normal"

        "$phong" "1"
        "$phongexponent" "20"
        "$phongboost" ".3"
        "$lightwarptexture" "models/thesis/lightwarp"
        "$phongfresnelranges" "[.3 .1 8]"
        "$halflambert" "1"

        "$rimlight" "1"
        "$rimlightexponent" "4"
        "$rimlightboost" "2"
        "$cloakPassEnabled" "1"

        "360?$color2" "[ 0.8 0.8 0.8 ]"
}
```

Figure 23: Example VMT file.

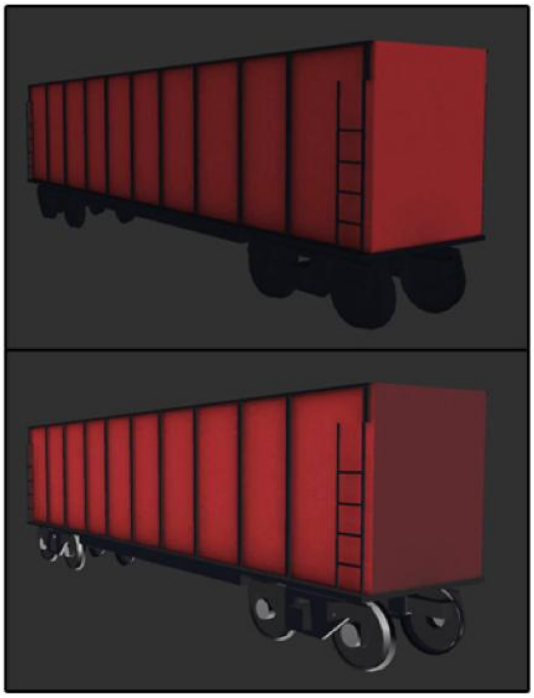

Figure 24: Train model without (top) and with (bottom) Phong, lightwarp, and rimlight properties.

In the final step in this phase of research, I used the Hammer World Editor provided by the Source SDK package to build the game environment. The game environment was composed entirely of static models and pre-built elements from *Team Fortress 2*. I wanted to use as much original content as possible to resemble a precisionist environment, but also include pre-built elements to have a basis of comparison for the final results. Therefore, I included buildings, props, terrain, and textures found in *Team Fortress 2*.

The Hammer Editor can produce stunning results during game play, and this is due to such features as real time HDR lighting and shadows, environmental fog, a 3D

skybox, displaced terrain, a combination of texture maps, real-time water reflections and refractions, real-time particle effects, and motion blurring; all of which I included in my game environment. Each feature is visually interesting, but I chose to include, and modify, each attribute to resemble precisionist artwork. Starting with the light source, I used the systems default global illumination properties. This system controls the sun's HDR values, ambient color, and shadow direction. I chose to use a warm color for the brightness values, and a cool-grey hue for the shadows. The Shadows are midway between black and white so the user can see details when in shadowed areas. The environmental fog controls the rendering distance from the user. For this, I chose to keep most of the scene visible except the outlying areas of the map unreachable to the user. Looking at Sheeler and Lewandowski's paintings, I notice the background elements become lighter, and desaturated. I matched this visual element through the environmental fog function by allowing the system to render buildings a light-grey color at a certain specified falloff point. The 3D skybox is a powerful element within the *Team Fortress 2* game environment, allowing the user to place scene elements, not accessible to the player, in a very far off distance to create a much larger scene at a reduction of cost to system resources. I used this technique to recreate the existing Ft. Worth, Texas skyline as a background element. The displaced terrain and combination of texture maps are used together to create an accurate description of the Land O'Lakes geographical site. The water element in the scene was added as a reference to Sheeler's *American Landscape*. I wanted to match the environment within Maya as much as possible; as well as add the rippled-water reflection seen within Sheeler's painting. The

particle effects added to the smoke stacks are implemented as a reference to Sheeler's painting as well. They also provide the element of nature – in addition to the water – to contrast the static man-made elements. Finally the motion blur feature is added as a reference to Sheeler's comment in the image-processed photograph phase of research about "overtones" of a previously viewed image carrying over to the next image. I used the 'echo' effect within the live-action short video, and this is a variation of that technique.

Each model I produced was placed in the game environment using the **prop_static** entity. Within Hammer, an Entity can be anything from the first-person player, a prop, and piece of code that controls scene scripts, or dynamic animations applied to scene geometry. A **prop_static** entity is a physical structure that is able to cast shadows, and obstruct the users in the environment. It contains no animation, nor physics to interact with the user – meaning the user may not pick up, or move the object. Once each my static models were in place, and environmental properties were set, I was able to compile my scene through Hammer's developer menu. Once compiled, a terminal is present to adjust any values within the scene's elements.

4. CONCLUSIONS

4.1 Results

My results consist of videos produced from After Effects, and Maya; still images of my photography and videos; and an interactive environment using Valve's Source game engine (figures 25 - 31). They demonstrate that the Precisionist style can be analyzed, interpreted through computer graphic techniques, and then applied to new media. I've compared still images from my work to the paintings of Sheeler and Lewandowski as a reference to the Precisionist period. I've also included 'before' and 'after' images from the photography and Photoshop portion of my research. While the images and videos achieved the goals set within this thesis, there were obstacles to overcome during the process.

Beginning with the photography portion of my research, I realized there were problems with using RAW image formats and HDR photography. One drawback to using RAW image formats is their large file size, and their long processing times. This made it impossible to capture a time-lapse scene quickly. This posed a problem when trains were passing at the Land O'Lakes site. The difference in time between shots meant I could only capture part of the action I wanted. To counter this problem, I used a larger image size, and finer detail setting while filming. When in Photoshop, I used a wider range of exposure settings within the 'fake HDR' action. The results appeared comparable to RAW image formats.

A problem I encountered with HDR photography is the timing between photographs. The HDR software takes three images in a row. These three images need to be identical in order to prevent "ghosting" or a form of image blur. If there is an object moving in the scene, that object will appear blurred when each image is layer upon one another within Photoshop. In order to counter this, I simply adjusted the speed at which the HDR software took the photographs. The camera would take three pictures within 2 seconds, most of the time eliminating slow movements made by objects within the shot. Although, when using the RAW image format together with HDR, each photo would take approximately three to four seconds to process, making it impossible to avoid blurring. To fix this, I would take more photos of the scene, and take out any pictures in which objects are moving. The following images are results from my photography, videos and game engine respectively.

Figure 25: A photo I took of Downtown Dallas, TX (left), and the same photo after Photoshop processing (right).

Figure 26: A photo I took of College Station, TX, before and after processing.

Figure 27: A photo I took of Hearne, TX, before and after processing.

Figure 28: A photo I took at the Land O'Lakes plant, before and after processing.

Figure 29: A comparison of Charles Sheeler's *American Landscape* to my rendered scene at the Land O'Lakes plant in Ft. Worth, TX.

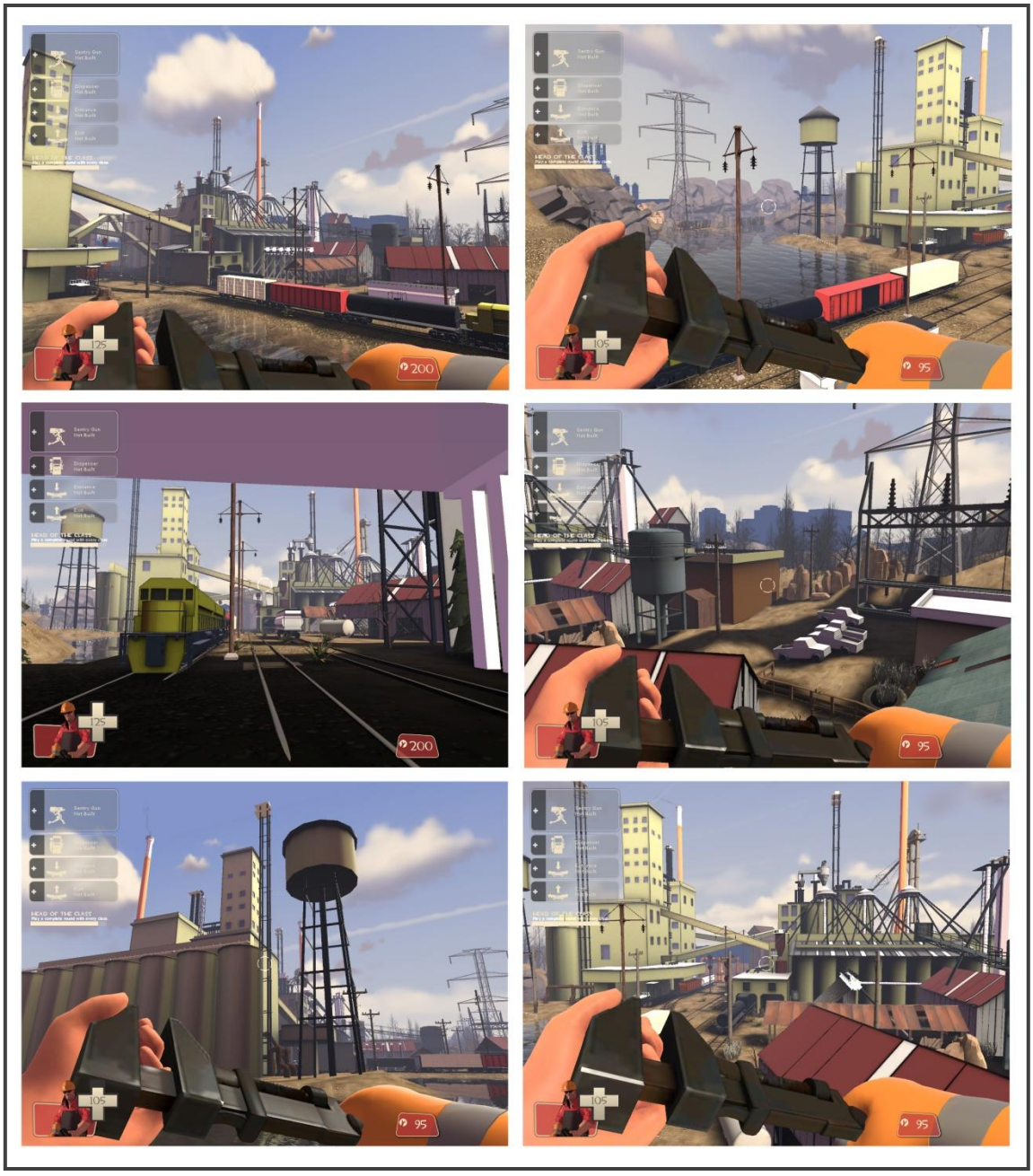

Figure 30: A series of images captured from my interactive game environment using Valve's Source engine.

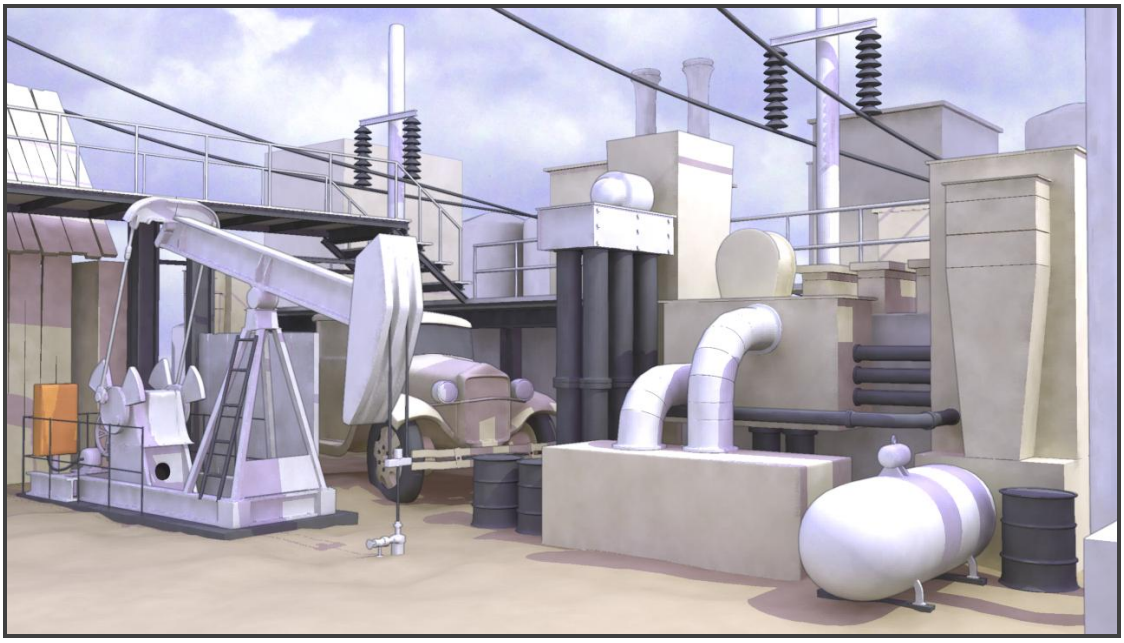

Figure 31: A rendered image from my Oil Drum scene.

The original intentions of the animated environments resulting from this work were to help stimulate other artists to use precisionist art as an approach to art direction within 3D computer animation, as well as provide insight into the stylistic choices made by 'avant-garde' artists during the Precisionist Modern Art period. Along with portraying a now iconic art period in American Modern Art, the resulting images and short films were to also provide awareness of artists such as Charles Sheeler, Edmund Lewandowski, and Charles Demuth.

4.2 Evaluation

The research looks into the subjectivity and determinative nature of comparing simulated environments with paintings. While the goal of this research was to

reinterpret Precisionism, the evaluation criteria, from my committee members and myself, was primarily exploring methods to create 3D digital artwork that is informed by 2D precisionist art. The success of this thesis depended upon the resemblance within the resulting 3D productions and the artistic elements mentioned within the visual analysis.

Conclusively, the images displayed within the results were a success, with several exceptions. They have satisfied the basic criteria outlined within the visual analysis, those being subject content, shadow placement, light direction, color and form, perspective, and geometrical abstractness – all elements present in the majority of precisionist works of art. The content within each short piece is reminiscent of a 'life-less' environment with which Charles Sheeler and many other artists during this time illustrated. The lack of human presence is important in communicating the sprit of this art form, as well as the stillness of the camera, or viewpoint, of the observer. I feel these elements were demonstrated beautifully within the last two phases of my research, but could of used a different approach within the first phase to achieve the same results.

While I could not control the light direction and shadow placement within my photography, I could within the computer-aided portions. I feel I filmed each location to match the style of precisionist artists by referencing the shadow and light properties within their photos. While I used a single light source (the sun), I also chose a time of day in which each shadowed surface benefited from global illumination. This is when light bounces from lit surfaces to illuminate shadowed areas. As mentioned within the implementation section, I duplicated this effect within my computer-aided research by using a strong light source followed by global illumination within the rendering process.

The computer-aided results showed a striking resemblance to paintings composed by Sheeler and Lewandowski, while the photographs needed additional steps to achieve the same likeness.

The color and form are resembled in each piece by the use of computer-aided techniques. A goal within this research was to resemble the thin outlines precisionist artists used within their paintings around each form and color. This is an illustrative quality, and is used to exemplify the color and form contrasts between each subject. As mentioned within the implementation, I used a "sketched" layer technique with Photoshop to achieve this effect upon my photos. When rendering my digital images, I used a contour-line rendering process that gave a cool hue outline around each form within the image. The results for each process gave positive results. I feel every image displays this technique beautifully and precisely.

The association of geometrical abstractness between my work and precisionist artists was achieved though carful observation of form and perspective. My photographs are naturally based upon live-action still images in a time-lapse sequence, but processed to achieve an illustrative quality. The perspective within each photograph is not skewed or adjusted to maintain a clear indication of a vanishing point. This is also true for each of my digital images. The subjects within each image represent realistic matter, and the perspective lines through each form resemble those found in paintings composed by precisionist artists.

As mentioned earlier, I feel the photography portion of my research could have been better represented through different photographic mediums or a different

processing method. First, the type of camera I used was contemporary. Perhaps using the exact camera such as Sheeler used – a Brownie Kodak camera with a fixed lens shooting 2 ¼ square inch, 117 roll film – could of aided in producing results comparable to those produced in the early 1900's. This, at least, could have provided a better foundation for each photograph when imported into Photoshop for processing. Second, when I referenced paintings and photographs from precisionist artists, I was viewing their final work. Perhaps studying unfinished work, or the process of how they created their work, I could produce work using similar techniques. Nevertheless, I am pleased with my results, but they could also benefit from more research. Each of the three variations of artistic mediums I used brought a different atmosphere to the precisionist form of art, as well as build upon it in a new age of technology. My theory of using the mediums of today to represent the tradition of modernism established by the artists in the beginning of the last century, I feel, succeeded.

4.3 Future Work

Representing precisionist art within animation is one of many possible approaches in exploring other artistic movements for artistic inspiration for 3D computer generated films. Art direction within CG animation could be derived from the other movements within the Modern Art period such as Impressionism, Surrealism, or Pop Art. The method I used of analyzing this art period and applying the results to new forms of media can be used to express other art movements as well. Other possible movements to represent could be Egyptian, African, or perhaps mythological art. This

could also include the art prior to modernism, after the mid-twentieth century, or throughout Europe during the duration of the Modern Art period.

As mentioned in the results, my photographs could of benefited from using the same camera Charles Sheeler used in the early 1920's, or a variation of processing within the photographs. I would like to take photographs using the Brownie camera of the same locations, then compare the results I got using my Canon camera. This potentially could eliminate processing steps within Photoshop, or possibly create more since the photographs appear high in contrast and desaturated. To have color images though, I would need a different processing procedure. I would like to use the photographs taken with a Brownie camera, and add color to them within Photoshop. This can be achieved by using a paintbrush tool to apply each color individually upon different layers. By adding colors to the photograph using this procedure, I could potentially receive results similar to uneven brush stokes lines on a canvas, as well as removing ornament and detail, and creating a hard-edge line between each form.

The environments I created within Maya and Valve's Source engine could be expanded upon as well. I would like to use different geographical locations as references in creating new worlds for users to interact with. By first creating these environments in Maya, then exporting them into the game, each user can experience a new virtual world. For example, I would like to use my *Oil Pump* scene, based upon Sheeler's *Upper Deck*, as another environment within the game engine. I would modify the textures and colors to match the environment set up within my video. This would present a new artistic rendering environment for the game, and perhaps launch a new

way of looking at real-time rendering engines for other games. While not only limited to game rendering, this style could also be used within films, web applications, and advertising giving the illustrative quality of the precisionist artistic movement.

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APPENDIX

A. Personal Motivation

Art history, particularly modern art, has always been a passion of mine. Early in my life, while observing paintings, I was astonished by the detail an artist could depict on a canvas simply using a brush. I entered the world of realistic art, constantly drawing. Eventually this interest led me to investigate the imaginative side of art, "what wasn't seen." I ventured into fantastic and comic style art that paired studies of human anatomy with supernatural storylines. Until this point in time, I had only expressed my keenness for art through a pencil and paper, but as a teenager my focus turned toward two-dimensional mediums used in impressionism, cubism, expressionism, surrealism, and optical art. Artists that frequently caught my attention were Vincent Van Gogh, Claude Monet, Edgar Degas, Pablo Picasso, Salvador Dali, M. C. Escher, and Max Ernst. These artists fueled my inspiration as my choice of mediums changed. I worked with basically anything I could use to create art. My higher education in architecture shifted my thought process to a more structuralized approach. I lunged into art deco, kinetic art, pop art, minimalism, constructivism, futurism, and eventually post-modern art. Until this point, I had simply imagined art as a tool to express emotion with color, form, and line-work. What I grasped is by studying these periods of art, I was able to draw upon the culture and inspiration of previous 'avant-garde' artists. The Precisionist Modern Art period proves attractive to me now simply by the evolution of my artistic taste. Precisionism presents the structure of an architect, but the freedom of a painter.

Living in a period where computers are a dominant artistic medium, the magic of artistic expression can be channeled into a three-dimensional, story-driven linear artistic medium.

B. The Development of Precisionism

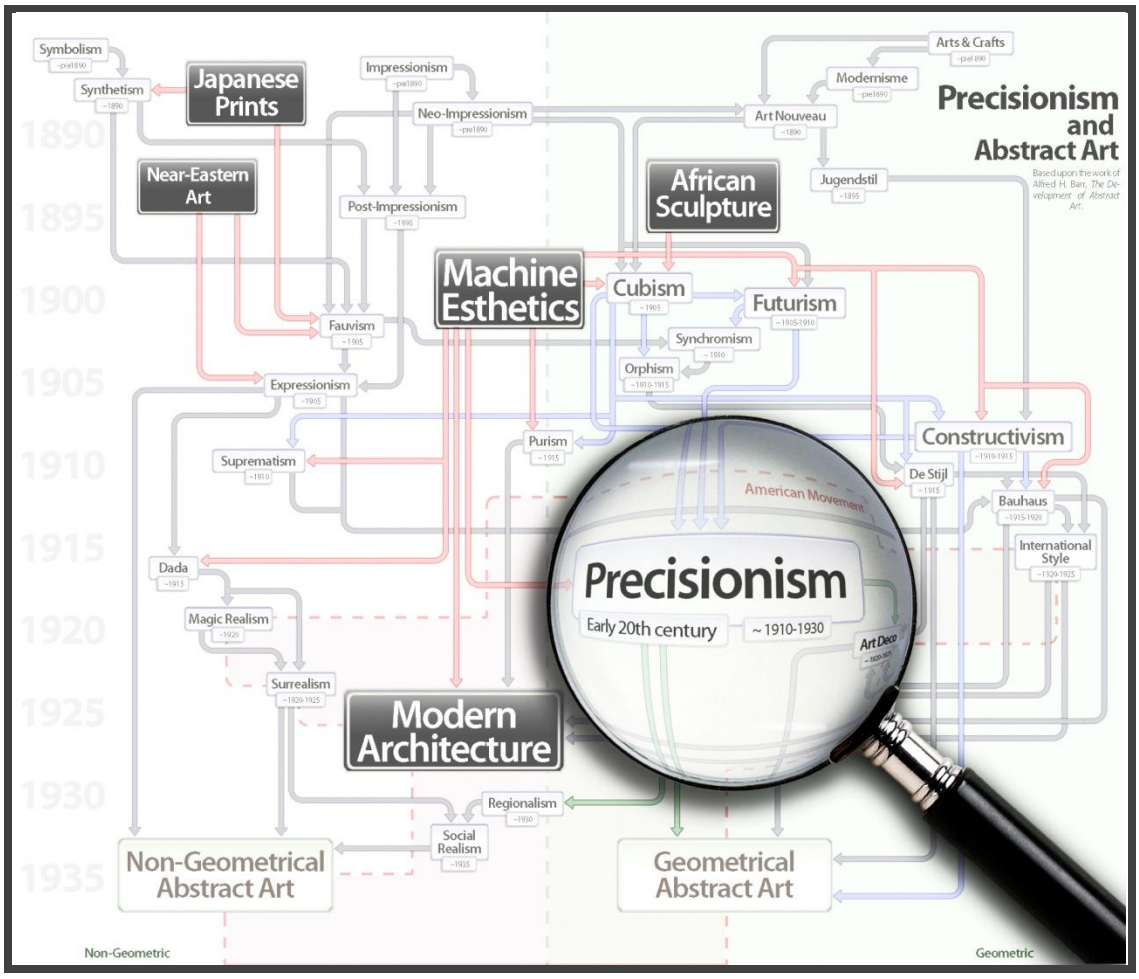

Figure 32: Douglas Bell, *The Development of Precisionism*, based upon the work of Alfred H. Barr, *The Development of Abstract Art*, 1936 [3].

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