An Investigation Into The Creative Processes in Generating Believable Photorealistic Film Characters

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DECLARATION

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ABSTRACT

This thesis examines the benefits and challenges that digital Visual Effects have had on character believability. The advantages of Visual Effects are outlined through the improved quality of the cinematic experience, including the production of believable characters and world development. Believable characters are produced through the creative processes and collaborations across diverse disciplines in the film industry. These processes and collaborations involve many interconnected sub-projects or points of delivery, which need to resolve holistically to meet the requirements of the director. However, the challenges of digitisation for film production processes are the primary factor for an increased production pace featuring higher quality outputs produced in tighter schedules with limited budgets. The fast-paced nature of the Visual Effects industry has consequently introduced several communication difficulties and creative ambiguities in the creative process that rendered the consistency of the high-quality character output challenging to achieve.

The present research considers the perspectives of expert industry practitioners acquired through open-ended interviews to query about their respective creative processes. These were summarised through four key elements: narrative, design, technique, and communication. The interviews were analysed following a sequential mixed method approach designed to define the internal and external parameters that contribute to the production of believable characters for Visual Effects. The comparison of the participants' quotes presents a ranking order of the participants' competing and collaborative priorities within the creative process. Through the ranking of the four key elements, this research considers the evaluation of character believability by categorising characters according to their function in the film and its context in the broader industry.

Consequently, a new evaluation framework is proposed that visually presents character believability through patterns following the believability criteria extracted from the interviews. The framework offers potential as a tool for presenting character case studies that serve as ideal guiding examples for projects with similar requirements. This tool, which is referred to as the Melki Character Evaluator (MelCE), offers potential as a developed application to enhance tacit knowledge and communication between its users when designing for believability. By expanding and incorporating a character database into the model, this tool can enable and efficient production of believable characters.

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GLOSSARY

Bump Maps: greyscale maps that create the illusion of a bumpy surface through the interaction of light and shadows.

Computer Graphics: the process in which an image is generated and displayed on a screen through computation

CGI: Animated and still images created using 2D or 3D imaging software including Maya, 3DS Max, Zbrush, Cinema 4D, Adobe Photoshop and Illustrator.

Displacement Maps: greyscale maps that alter the physical surface height of a 3D object displacing the actual geometric position of the surface.

Flipbook: a book presenting a series of pictures of each frame within a temporal sequence, when turned rapidly, create the illusion of movement

MelCE: Melki Character Evaluator- Author's proposed tool for evaluating and visually presenting character believability by considering the process in which the character was produced, as well as their role in the film and the broader industry.

Opacity Maps: Greyscale maps that permit transparency on the visual surface of a 3D object.

Phenakistoscope: an early animation contraption consisting of a disc or a drum, with successive images, that rotates to produce the illusion of motion of the presented pictures through a mirror.

Polygon: A plane which has at least three sides (preferably four-sided in animation and referred to as quads) and forms the simplest building block of a 3D computer-generated surface.

Practical Effects/Special Effects: Film effects that are produced using optical tricks with a camera or physical material with make-up, animatronics or puppetry, and model-making techniques.

Surface: The area defined by a polygon or a group of polygons

Texture mapping: A method of adding colour or details unto the surface of a 3D object.

Thaumatrope: a 19th Century device consisting of a disc with a different image drawn on each side. The images would seem to merge when the disc is rotated rapidly.

Uncanny Valley: the phenomenon depicting the drop of audience empathy or the arousal of uneasiness and revulsion in the viewer towards a character presenting near-identical resemblance to a human.

Visual Effects: The digital manipulation of visuals through the integration of live-action footage with Computer Generated Imagery to create environments, creatures, characters and simulations.

WED Clay: a smooth slow drying clay used in the industry for casting models and mould making.

Wire-frame: a three-dimensional model that is represented by vertex points (coordinates representing the surface) and edges (lines connecting the vertex points)

Zoetrope: an older version of the Phenakistoscope (see above), except the rotating images on the disc, are seen through slits.

1 INTRODUCTION

1.1 Introduction to Animation & Characters

From a Philosophical and theoretical perspective, animation is the art form that “gives life” to an object or inorganic entity (Wells 1998). As a result, the object animated becomes life-like, realistic, or real. This type of realism found in film was defined by Walter Disney using the term "*verisimilitude*", a combination of the Latin words "*verum*" and "*similus*", meaning "*truth*" and "*similar*" respectively. This defines the type of realism in film as a resemblance of truth (Christophers 2011).

Practically, a film or an animation is made of individual frames or still pictures presenting objects in different position throughout time. By projecting the sequence of pictures in a certain speed, it is possible to perceive movement through the phenomenon known as the persistence of vision which involves the 1/10 of a sec delay during which an image remains engraved on the eye’s retina. This short delay allows the image to merge with the next projection to create the illusion of movement (Webster 2002). This process was popularised in 1824 by Peter Mark Roget, which led to the invention of various optical devices, such as the Thaumatrope, the Phenakistoscope, the Zoetrope and the popular flipbook (R. Williams 2001).

Animation as a medium in cinema was not established until 1906 with James Stuart Blackton and Thomas Edison’s 3000 frame animation “Humorous Phases of Funny Faces”. The film was so successful that it inspired artists to establish new grounds for filmmaking techniques.

Emile Cohl’s first animated film in 1907 is an actual example as it was the first film that featured anthropomorphic houses and lampposts which led to Cohl’s quote: “Don’t do what the camera can do… do what the camera *can’t* do” (R. Williams 2001).

Walt Disney Cartoons took animation further with innovative films such as 1928 Steamboat Willie, the first animation with sound, and the 1932 three little pigs as the first fully developed personality animation that featured separate characters with convincing voice acting. However, the most noteworthy mention of animated films of that era was the 1937 Snow White and the seven dwarves, the first full length animated film that was so successful that it built the foundation of Disney and the golden age of animation (R. Williams 2001).

Due to the increasing demand of faster production of animations for Television, Disney's visual approach, relied on a detailed, more realistic and expressive animations despite its abstraction, lead to the establishment of a competitor the UPA (United Productions of America). The UPA's more stylised and reduced approach that led to the birth of the faster and design-oriented "Limited Animation" school that was later adopted by other animation studios such as Hanna Barbera (Webster 2002). Furthermore, the invention of the computer allowed the production of digital images on digital screens as early as the 1950s at Massachusetts Institute of Technology and kept evolving with the involvement of the military (New Media Dictionary. 2000). In 1962, Ivan Sutherland developed "The Sketchpad", the first interactive computer graphics system that opened doors to visual artists as it became a new tool for visual art and communication (Gardiner 2001). With computer graphics, the process in which an image is generated and displayed on a screen through computation was eventually implemented in animation in 1964 by Ken Knowlton at Bell Laboratories (New Media Dictionary. 2000). The use of the digital medium kept expanding, and in 1972, Ed Catmull produced the first 3D animation where he used points (or vertices) in a 3D space to define a polygon model of a human hand (Rizvi 2011).

Furthermore, Computer Generated Imagery (CGI) was used for the first time to produce visual effects in the 1973 live-action movie "Westworld". At the end of the 20th century, animation and film became so intertwined that it became impossible to separate them from each other as a storytelling medium (Manovich 2001). A new genre of animated films began to emerge that relied mainly on CGI, the first full-length film being the 1995 successful Toy Story (Avila 2010).

For an animator, the process of frame projection is expressed through time, the most essential tool for any animator. Time is crucial to the expression of different types of movement, whether it is natural, cartoonish, dramatic or comic. The rate of the projection of frames throughout time is measured by "Frames per Second" (FPS). This projection rate could vary from one animator to another, keeping in mind, based on the "Persistence

of Vision", that if the FPS was below the retention rate mentioned earlier (1/10 of a second), the animation would appear jerky or unsmooth (Webster 2002). The most common projection rates are listed as such:

- 24 FPS for film
- 25 FPS for PAL videos
- 30 FPS for NTSC videos

As mentioned, ‘time’ plays a crucial role in the expression of movement. It is the animator's role, through the excessive observation and study of movement and the behaviour of objects or subjects from the real world, to use time in his favour to visually express a meaningful and convincing animation (Webster 2002). The primary approach is to consider pacing, phrasing and timing of the events that occur in the film. It is crucial to consider the pace between the different sequences of events in the film to create action, drama or tension and merge them to create a unified entity. Phrasing refers to the variation of a character's speed within a specific scene, used to express a character's excitement, panic and drowsiness for example. The final aspect of animation timing is timing itself, which refers to the period it takes an object to accomplish its movement, the duration of a walk cycle or a run cycle for example. There is much information to process from facial expressions to the different degrees of movement in characters. An animator must consider the primary movement of a walking character coming from his centre of gravity (the pelvis) to the secondary movement of the hands, head and tertiary movement of his hair, clothes, carried props and covering all overlapping movements (Webster 2002). To apply the principles, animators rely on the basic techniques discussed in the following section.

1.1.1 Key-Frame: Straight-ahead & Pose-to-Pose

The first technique in traditional animation is the Key-Frame method, which can be applied in two different ways: Straight-ahead or Pose-to-Pose. The first approach is based on drawing the character or the moving object frame by frame consecutively. This technique allows the animator to charge through the creative process of his animation and give it more liveliness since the animator works in an unstructured method that is useful with animations that feature some actions occurring at once with independent elements that have their timing. The downside of this method is its complexity and consumption of time. The fact that this approach is unstructured adds pressure on the animator as it

requires a great deal of focus and skill to be perfected. As for the Pose-to-Pose technique, the animator begins by drawing the character or the animated object in key positions and then proceeds by adding the in-between frames. Its efficiency in producing animations allowed it to become a standard approach in the industry. This technique is also reliable with the organisation of work in teamwork, as one group could work on the primary or key positions, another team could fill in the in-between frames and allows an easy synchronisation between animation and sound or lip-sync. However, since this method is structured and constructed, the risk of having a stiff, unnaturally constructed movement is higher. Despite its efficient and more manageable techniques, Pose-To-Pose animation still requires a good amount of skills as the animator might be forced to use a mix of the two explained techniques to cover any possible mistakes or rigidities in the animation (Webster 2002).

These techniques are still used to this in traditional and digital animation. However, with the advancement of technology and the need to produce high-quality animations that can be submitted on the project's deadline, new techniques have emerged.

1.1.2 Rotoscoping and Motion Capture

One of the early-developed animation techniques that came after keyframed animation was Rotoscoping, which is still relevant to this day (Christophers 2011). In this technique, the animator traces motion from recorded footage. This technology is now considered the primary form of motion capture. The latter presents one of the most advanced technologies used in the animation industry. It records movement based on markers placed on the actor, which represent a specific point on a digital model. Therefore, the digital character will move based on the movement of the actor. Nowadays, some characters are animated with a combination of motion capture, rotoscoping and keyframe animation to achieve the best results efficiently (Christophers 2011). For example, Gollum from The Lord of the Rings was animated with a combination of key-framing, rotoscoping and motion capture.

These techniques, although applied to any object, are mainly used to animated characters in each environment. Characters are the main elements that drive the narrative of any story. The following section discusses character design and development and the environment they populate.

1.1.3 Characters & Their Environment

Character design is the process in which a functional character is created for a specific environment and narrative (Maestri 2006). Therefore, environment design and the narrative should be taken into consideration to create believable digital realities. In animation, the viewer is presented with an abstract form of reality. If the story, dialogue, character's appearance, actions and movement are all combined under a unified design, the resulting visual can be perceived as being true or real (Christophers 2011). Mickey Mouse's existence, for example, is only believable within the boundary of the world of Disney and therefore will seem out of place in a Looney Tunes cartoon. These animations feature abstracted representation of characters and the environment through the reduction of form to isolate their essential symbolic meaning (Withrow 2009), the circle of the smiley emoticon or the triangular shape of a mountain's peak.

In his book "Creative Character Design", Bryan Tillman (2011) stresses that characters are always in service to the story and never the other way around. There are many elements the designer should consider while designing his characters to maintain their function in the story (Seegmiller 2004). These elements include archetypes, colours, shapes, backstory, and aesthetic style.

The term "Archetype" refers to the characteristics that reoccur in many characters and groups them into categories that represent qualities with which individuals identify (Tillman 2011). A various number of character archetypes can be found in every story throughout history, whether it is a fictional narrative, a historical event or an everyday event. The most common archetypes are the Hero or the protagonist, the shadow or the villain, the mentor, the trickster, the fool, and the anima/animus.

Also, since characters are always in service of the story, providing adequate information and creating a background story for every character is a crucial element in the design process by adding depth and justification to the characters' motives (Tillman 2011). The characters' essence and backstory are reflected visually using colours and shapes. By reducing a character to its basic shapes helps the designer to isolate its essential symbolic meaning, the circle shapes used to create Mickey Mouse's famous silhouette or the rectangular shape with triangles on top of Bart Simpson's head (Withrow 2009). The degree of reduction is defined according to the concept and more importantly the target audience. A critical aspect of the viewers the designer should consider is their audience's age (Tillman 2011). Humans can identify and decode information presented by characters; the simpler and anthropomorphic the design, the easier the process (Withrow

2009). Children's brains can process less visual information presented by a character which explains their attraction to basic characters with larger eyes, heads, and smaller bodies, for example.

In contrast, adults can process greater information and therefore are interested in more complex visuals and more developed characters with similar and realistic body proportions for example. However, as the characters become more sophisticated, they must visually reflect the functioning aspect of their anatomy. Robots, for example, are made of different parts that work together to form a larger mechanism that can function and move. In addition, a four-armed character should have additional shoulders bones for the extra pair of arms to be placed into their respective sockets; otherwise, the character would be anatomically incorrect.

The technological and technical advancements contributed to the enhancement of production quality and the cinematic experience. However, many unexpected issues and obstacles regarding the industry's production pace, compatibility between live-action and digital mediums, perception, and communication emerged. The fast-paced advancements in the film industry have consistently provided many research and development and opportunities in animation. However, these approaches, presented in different outputs or formats, have not changed much in principle since traditional animation. Since the digitisation of the film production process, the industry has drastically changed financially, politically, and technologically as well as its target audiences. Therefore, this research examines character believability in the context of the creative processes within the Visual Effects production pipeline and the broader film industry. Therefore, this thesis explores theories on the construction and perception of realities, and the effects of Visual Effects have had on character believability within the film industry, its workforce, and resources. Subsequently, the objectives of this research are to investigate the internal and external parameters that contribute to the production of believable characters and to formulate a holistic character believability evaluation model. In addition to the canon of references on animation, visual effects, perception, and film studies, this thesis aims to interview and document the direct perspectives and experiences of four key expert industry practitioners. The following section outlines the thesis overview and the value of research.

1.2 Thesis Overview

As the previous section provided some background information on the basics of animation, this research focuses on the practical photoreal aspect of animation used in visual effects for films from the perspective of the artists and technicians involved in the production pipeline. Since a film is a product of the collaborative efforts of the numerous artists and technicians from different disciplines including animators, designers, modellers, riggers, painters, makeup artists, set designers, and sculptors, the term "practitioners" is used in this thesis to represent any of the individuals involved in the process. The visual effects in film do not revolve only on simulations, explosions, and car chases, but also seamlessly merging photoreal creatures with live-action footage (North 2008, Prince 2012). Whissel (2014) also argues that Visual Effects do not function as "empty visual dazzle", but they add additional dimension of expression, meaning and storytelling to the film. Whissel (2014) discusses the use vertical movements in the *Matrix (1999)* presented through the main character's ability to fly and ascending towards the sky as a metaphor to overcoming his violent struggles and representing a messiah figure.

Furthermore, the extensive use of digital crowds and armies in *The Lord of the Rings: The Two Towers (2002), The Attack of the Clones (2002),* and the Greek armada in *Troy (2004),* are useful in intensifying the portrayal of the potential apocalypse or the end of a civilisation, and the main characters' reaction to it. According to Whissel, Visual Effects characters, such as Gollum and King Kong, break the boundaries between real and fictions, or the organic and artificial. These characters function on within their respective narratives. In the example of Gollum, the character's eerie appearance functions as a monstrous distortion of the natural order as represented in the world of Middle Earth.

This research explores the interface between reality and the imaginary from the perspective of practice and believability. Therefore, to pinpoint the adequate research question, the variables involved, and a hypothesis, this thesis is divided into seven chapters that are outlined below.

The literature review explores a broad range of material relevant to the field of visual effects and its development, including academic papers, books, blogs, documentaries, interviews, and podcasts. Chapter 2 is divided into a practical and a theoretical section.

The practical section explores the technological development of visual effects, as the primary driver of films to explore uncharted territories, particularly with the emergence of CGI. Despite the changes of format and output, the invariable role of the tools, used in

film production, is to create believable realities in which compelling visual stories are presented. However, as a new medium, digital films confronted many perception and technical issues, especially after the release of the film *Final Fantasy: The Spirit Within* (2001) and the bankruptcy of the studio behind it. Furthermore, after the release of Life of Pi (2012) and the liquidation of Rhythm and Hues, the studio behind the film's stunning effects, other issues regarding the industry's politics, financial state, and the treatment of practitioners became exposed to the public. Despite the efforts to promote awareness and propose solutions, these issues persist and impose a crucial effect on the believable factor of many films.

The theoretical section explores the concepts and models relevant to the perception of films and their components. The literature covers the interface between reality and fiction and the issue of believability considering the various obstacles, such as the Uncanny Valley for example, that emerged from the incorporation of the digital medium in film production.

This research investigates the creative processes in generating believable digital and practical effects characters to formulate a method to evaluate their believability factor when used in film. The literature review led the research to formulate the hypothesis of believability being the result of the balanced merging of Narrative, Design, Technique and Communication. The methodology chapter outlines the methods used to investigate the proposed hypothesis and analyse the results. The approach includes open-ended questions seeking to highlights the qualitative aspect of the creative process of each interview participant in their respective area of expertise. The results of the interviews are analysed according to the four key ingredients, that constitute the creative process, to formulate the set of criteria for believability which will be applied to a pool of characters that were discussed in the interviews. The transcribed interviews are provided on the CD attached to this thesis as the appendices. Each interview is provided in a separate word file containing the questions and answers with their corresponding numbering for referential purposes.

Chapter 4 introduces and summarises the interview outcomes. These are comprised of the questionnaire, the background and expertise of each participant, and the interview responses which are provided on the attached CD. The answers of all the participants are grouped thematically. The themes consist of 5 main topics relating to the creative process and believability:

- Personal Views
- Personal Creative Approach
- Teamwork, Communication, & Problem Solving
- The Changes & The Future of The Industry
- Character Development

Each discussion topic also presents a set of subsections discussing specific subjects within the general correspondent theme. The Personal Views section include some critical considerations by the participants in their projects including their critical reviews of the industry, primary responsibilities, and audience perception. The following theme explores the participants' experience in their current or past studios and their working cultures. In addition, this section explores the participants' approach to sustaining a flow of work, developing initial ideas, practical methods, and reflection on favourite projects and characters. The third topic highlights the skillsets with whom the participants collaborated and their negative and positive experiences while involved in a collaborative effort. The fourth theme discusses the changes, the opportunities, and challenges in the unpredictable film industry. The final discussed theme explores the development of characters through the creative process, the possible ranking order of believability, the advantages and disadvantages of CGI characters as opposed to practical effects approaches using craft-based methods and the participants' reflection on the reasons behind some of their negative experiences within the industry.

The final chapters include the analysis and discussion of the information acquired through the interviews. The information is first analysed epistemologically to reveal the integration of the four elements of the creative process: Narrative, Design, Technique, and Communication. Characters are then extracted from the interviews and then studied according to their believability and roles. Subsequently, the analysis evaluates believability according to the relationship between the character's Epistemology – which includes the process, skills, and tools set with which they were produced – and Ontology or the reason for their production and fulfilment of function. Furthermore, Chapter 6 highlights the contributions of this thesis under their respective subtitles. The first contribution discusses the dynamic nature of the creative process and the difficulties of reducing it to a single standardised process. The second contribution defines the ranking order of the industry practitioners' priorities based on the analysis of the interviews. In addition, the thesis presents three possible character types: Central, Contextual, and Background. The chapter also argues that character believability must be distinctly

evaluated to their relative function in the film and the broader industry. Therefore, this thesis proposes an evaluation model that visually represents character believability respectively to their type and function. Finally, Chapter 7 discusses the possible future opportunities for research and practice of the presented contributions and proposes the further development of the evaluation model to serve as a communication tool and a database of character exemplar types.

2 LITERATURE REVIEW

2.1 Introduction

Cinema is a primary storytelling phenomenon that has been the forefront of entertaining audiences for generations (Manovich 2001), and its roots include theatre, magic lantern shows, shadow performances and animation (Rickitt 2000).

Aside from theatre, the early techniques in cinema included tools such as the Phenakistiscope, the Thaumatrope, the Zoetrope and the Praxinoscope. These mechanical tools relied heavily on the manual rotation of a set number of hand-drawn and painted images (Manovich 2001). The Magic Lantern's projections were still images shown individually, but the rest of the given examples presented strips with character drawings that rotated or moved at a certain speed to create the illusion of movement or to animate the character. These techniques, while diverse, were very limited in their content and presented little to excite their audience's imagination. As a result, viewers still favoured the live performances of theatrical plays and dramas over hand-drawn projections (Rickitt 2000). It was not until the innovations of technology and techniques that occurred in the 19th century that the audience's preference began to change. Photography played a critical role in the audience's shift in interest, especially when the medium included a motor element that allowed the recording of the performance of live actors unto film (Manovich 2001). Since then, technology has been the primary driver that pushed filmmaking to uncharted territories particularly with the emergence of CGI that inevitably led to the birth of digital films. Just like any new medium, digital films were confronted by many issues, including perception, techniques, and finance, which continue in contemporary practice. However, regardless of format, the main role of these various visual storytelling techniques is to create believable realities that revolve around compelling storytelling.

This chapter presents the available literature discussing practice in relation to the individual, the collective effort, the industry, the animation and the Visual Effects (VFX) process. The canon of resources, regarding practice relevant to this research, is not represented in an academic format. However, since the industry has critically impacted popular culture and technology, sources discussing its various aspects are available in different mediums including social media, online journals, blogs, magazines, academic

research, TV, books, interviews, documentaries, and Making-Of DVDs. Each source discusses the industry from various perspectives relevant to this research. This chapter, for continuity and flow, is divided into two parts. Part 1 covers an overview of the technological developments and techniques in animation and film, as well as a detailed discussion on their impact on the practitioners and the film industry as a creative field through a timeline of critical films. The chosen movies are vital intervals of the technological developments and present a paradigm shift in film production and on the animation and VFX creative process. Part 2 discusses the theoretical background behind design, and narrative structures through which, with the help of the techniques and technologies presented in part 1, alternate realities are created that exist within a given medium that includes TV, Cinema, Virtual Reality Head-Mounted Displays. Furthermore, the theoretical section also includes theories on cognitive perception, the uncanny, the abject to clarify the audience's ability to understand and perceive reality.

2.2 Part 1: Practice

2.2.1 The Early Industry and Innovations

The beginning of the twentieth century marked the emergence of cinema where European countries, mostly noted for their art, abstract and avant-guard films, competed against USA's Hollywood movies (Manovich 2001, Grage 2014). Apart from European abstract films, the difference between European and Hollywood productions was trivial compared to their general characteristic: all films are fictional, live-action lens-based recordings of reality (Manovich 2001). Hollywood was in the lead regarding the number of films produced, being able to build large size sets but were lacking in special effects skills. Alternatively, German filmmakers, relying on their love for fairy tales and mechanical prowess, had far superior skills in special effects (Rickitt 2000). A very famous and influential example was the 1922 German horror film Nosferatu by Murnau. The importance of this film, as an example, does not fall only on the infamous copyright lawsuit that almost threatened all its copies of being destroyed but also in its expressionist art approach.

The vampire film was initially proposed by the founder of Prana Film and producer Albin Grau in 1916 after serving in Serbia in the first world war. Because of Germany's financial crisis state after the first World War, German filmmakers resorted to Expressionist art as a cheaper alternative than realistic fabricated sets and costumes. The method used camera angles, shadows, perspective and set decoration to create a realistic

environment relative to the context of the film. This approach to filmmaking was more effective in conveying emotion and pacing than the use of expensive realistic film sets, which perfectly suited psychological and horror-themed films (Snider 2011). For example, one of the leading Expressionist filmmakers of that era was F W Murnau. The director presented these approaches in his frame compositions, the tinting of some frames to depict time (blue tint for night time), the main character's gestures and movement (Papapetros 2012, Snider 2011).

In the scene depicting Nosferatu's demise (figure 1), the opening shot consists of a close-up of a draped window presenting a diagonal beam of light falling on a row of houses. The Vampire slowly rises from the bed clutching his heart with his left hand, runs across the room and rotates to look towards the row of buildings. Nosferatu extends his right-hand parallel to the building rooftops. The two parallel lines define a single surface depicting the merging and the interaction between the character and the background. As the vampire fades, the window frame appears to go through his heart, still clutched by his left hand, a reference to Bram Stroker's Dracula where the wooden stake finally destroys the vampire, leaving a trail of smoke on the ground rising in parallel to the houses' rooftop (Papapetros 2012). This technique can also be seen not only in the same film but Murnau's organisation of space in his magnum opus *Faust (1926).*

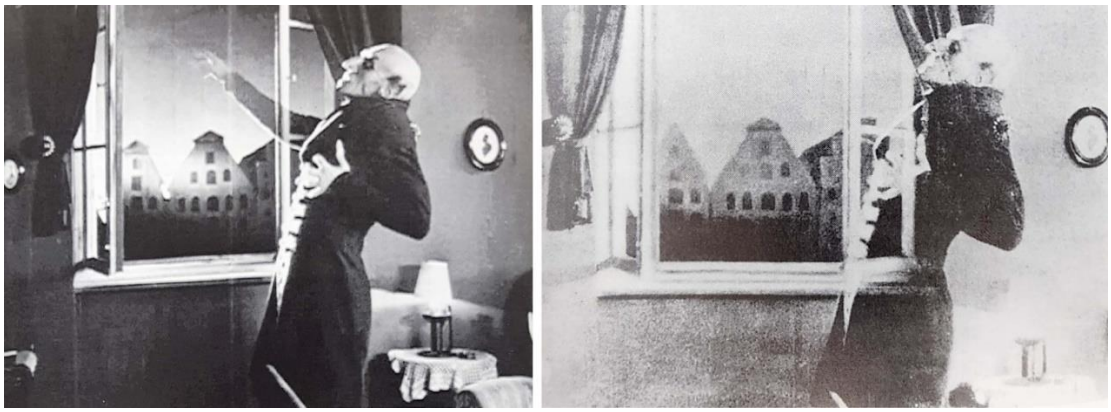

Figure 1 Nosferatu's Demise (Murnau 1922)

Although, Grau was denied copyrights to produce an expressionist retelling of Bram Stoker's story, the producer pressed released the film as directed by Murnau. To avoid lawsuits, the film presented changes to the original story and characters listed below (Bailey 2011):

- The change of Dracula's name to Orlok,

- The fatal effect of sunlight on the vampire in the film while it only weakened the creature in the original story.
- Dracula's bite transforms the victim into another, while Orlok's is fatal.
- Dracula is depicted as a charming, suave, and charismatic womaniser, while Orlok is presented as a misshapen monster with fangs and animal-like appearance.
- The Nosferatu plot abandons the use of the hunter Van Helsing's character and relies on a group of women to retaliate, plot, and destroy the vampire.

However, these changes failed in preventing the lawsuit filed by the Bram Stoker estate. The court ruled in favour of the Stoker estate and ordered that all Nosferatu copies be destroyed. As a result, Grau filed for bankruptcy and closed Prana Film, making Nosferatu the company's only release (Bailey 2011).

One copy of Nosferatu reached the United States where Dracula was under the public domain, as many of the talents in Europe began to migrate to Hollywood by the 1930s, transferring their techniques and skills to be applied in Hollywood films (Rickitt 2000). Subsequently, Gau and Murnau's film gained fame and became a horror classic. Furthermore, the film's popularity and the portrayal of the vampire Orlok have seeped into mainstream culture and inspired the modern understanding of vampire lore. For example, the vampires' vulnerability to sunlight or their ability to kill their victims is due to the failed attempt in avoiding an infringement lawsuit (Bailey 2011). This horror film might not induce any sense of fear in today's audience since new technique and approaches have been introduced. Nonetheless, the methods and the visual language used in films like Nosferatu to create tension, eerie and unsettling effects were highly influential and still used to this day in horror films (Snider 2011).

The mid-20th century saw a paradigm-shifting innovation in technology that started with the invention of the ENIAC in 1946 (Electrical Numerical Integrator and Calculator), the first general-purpose computer invented for the military to calculate artillery external ballistic to measure weapon accuracy under various settings (Bellis 2017). This new technology kept evolving with the involvement of the army in the 1950s, most notably with the SAGE radars developed by the military to monitor and incoming aerial threats by instantaneously generating a composite picture on digital screens (Winkler 1997). However, this technology did not remain under military use and became available in the creative field. In 1962, Ivan Sutherland developed "The Sketchpad", the first interactive

computer graphics system that opened doors to visual artists as it became a new tool for visual art and communication (Gardiner 2001). In 1964, innovations in computer graphics, the process in which an image is generated and displayed on a screen through computation, were eventually implemented in various fields including art, design, and engineering. For example, Ken Knowlton at Bell Laboratories created digital art with the use of computer graphics (New Media Dictionary. 2000). Also, William Fetter created the first 3D human, known as "First Man" or "Boeing Man", for the study of aeroplane cockpit design for the Boeing Company (Norman 2019). The use of the digital medium kept expanding that in 1972, according to Rizvi (2011), Ed Catmull produced the first animated 3D replica of a human hand in the short movie experiment titled *A Computer Animated Hand* (figure 2). The model was based on a plaster cast of Catmull's left hand and was manually subdivided, using a pen, into 350 defined surfaces in digital space, called polygons, defined by points or vertices. These polygons were then measured and mathematically input into computer software which Catmull developed to render and manipulate digital images (Fulton 2015, Catmull, Parke 1972).

Figure 2 Ed Catmull's Hand (Catmull, Parke 1972)

This new technology was still used as a fundamental tool to create moving digital images, much like the early techniques in animation of the 19th century (Rickitt 2000), the results mainly presented simple objects or characters performing a single action and did not feature any form of elaborate narratives.

Digital images were used in a full-length feature film for the first time in the 1973 live-action movie *Westworld*. The digital effects applied in the film were executed for a short scene through an image processing technique commonly known today as pixelisation, which is currently often for censoring explicit visual content (Price 2013). Before this development, visual effects were achieved through practical effects, such as animatronics or prosthetics, and optical illusion techniques, also known as "in-camera effects" (Grage 2014). These illusions were achieved through camera perspectives, lighting, and lenses,

such as painted backgrounds, stop-action photography and the double exposure techniques that were pioneered in the early 1900s by Georges Méliès and Edwin S. Porter (Rickitt 2000). However, with the digital image, all the information is stored in digital format which allows the practitioner to manipulate the image mathematically rather than optically which makes image processing a reversible procedure (Cannon, Hunt 1981). With the advancements in technology, image processing presented many other capabilities that go beyond pixelisation such as digital painting and vector illustration that became a versatile tool for digital artists today (McWhinnie 1988). As a result, digital images began to constitute a more significant percentage and frequency in films. Catmull's hand that appeared in the experimental short clip *A Computer Animated Hand*, briefly reappeared on a monitor in the 1976 film *Futureworld*, a sequel to *Westworld*, (Fulton 2015). Finally, in 1977, the digital revolution exploded with the release of an adventure film set in a galaxy far far away that stunned audiences with its epic visuals (Grage 2014). The following section presents the advancements in technology and techniques in digital cinema throughout a timeline defined by VFX landmark films.

2.2.2 The Innovations in Digital Cinema

The digital revolution was marked by the release of the first *Star Wars* in 1977 known for its ground-breaking visuals that entirely revolutionised the filmmaking process and its production and consequently defining how films could and should be made (Grage 2014). After being rejected by many studios, 20th Century Fox took a risk in George Lucas' project, originally titled *The Adventures of Luke Starkiller, as Taken from The Journal of the Whills, Saga I: The Star Wars.* With rudimentary initial shots, the film was allowed into production if Lucas renounced all his director fees. However, in case the movie was successful, Lucas was entitled to all merchandising and future sequel rights. The result was a visual spectacle, titled "Star Wars", that merged elements of fantasy and adventure films set in space (Grage 2014).

Most of the film's effects were done optically, for example, the techniques used to show the Millennium Falcon flying through space. The iconic spaceship was a physical model mounted on a blue pylon that can be painted out of the scene during the compositing stage. The camera was rigged on a 12-channel motion control system that allowed it to be moved and create the illusion of the spaceship's roll, tilt, pan and any other required movement (Failes 2015). For the lightsabers fight scenes, the actors used props, and the lasers were drawn and animated using an animation technique called Rotoscoping, where

the animation is traced and drawn from recorded footage. The animation was then photographed in high contrast black and white film that was then loaded in an optical printer and combined with the original scene (Failes 2015).

However, according to Pierre Grage (2014), computer scientist Larry Cuda produced a digital wireframe version of the Death Star, drawn entirely using CGI through vectors. When the film was presented to the audience, in a tactical briefing to launch an attack on the Death Star (figure 3), the digital image profoundly impacted computer enthusiasts worldwide and marked the paradigm shift towards digital cinema.

Figure 3 Death Star During Briefing (Lucas 1977)

Lucas' new-found success blazed his trail to future collaborations with fellow director Stephen Spielberg and to start his new company Lucasfilm's Computer Division in 1979, where he hired Ed Catmull and the brightest computer graphics researchers he could find. This company is considered as a Research and Development (R&D) division where the technology and solutions, in optical effects, editing, and especially in computer graphics, to specific film scenes are developed (Grage 2014).

The evolution of these techniques made the creation of photoreal digital characters and their incorporation into live-action footage possible. The merging of the two mediums first became apparent with the 1985 film *Young Sherlock Holmes*, that featured the use of the first photorealistic CGI character who was composited with live-action footage. The character, a stained-glass-window knight who jumps out from a church window for a 30 second screen time (figure 4), was the product of a 6-month effort based on standard texture mapping and rendering techniques used today (Grage 2014).

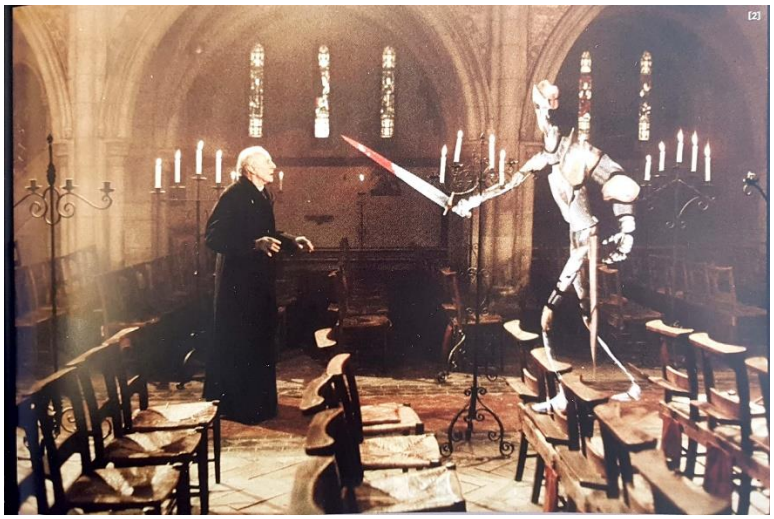

Figure 4 The Glass Knight (Levinson 1985)

Texture mapping is the technique of adding colour or details to a digital surface.

Furthermore, texture maps can also differ in their function to alter the object's shape and transparency. For example, as illustrated in figure 5, Bump Maps are greyscaled maps that create the illusion of a rough or bumpy surface through the interaction of light and shadow, while Displacement Maps can alter a digital object's physical shape. Also, the glass texture of the film's character could have been achieved by Opacity Maps that can be used to allow a solid digital object to appear see-through.

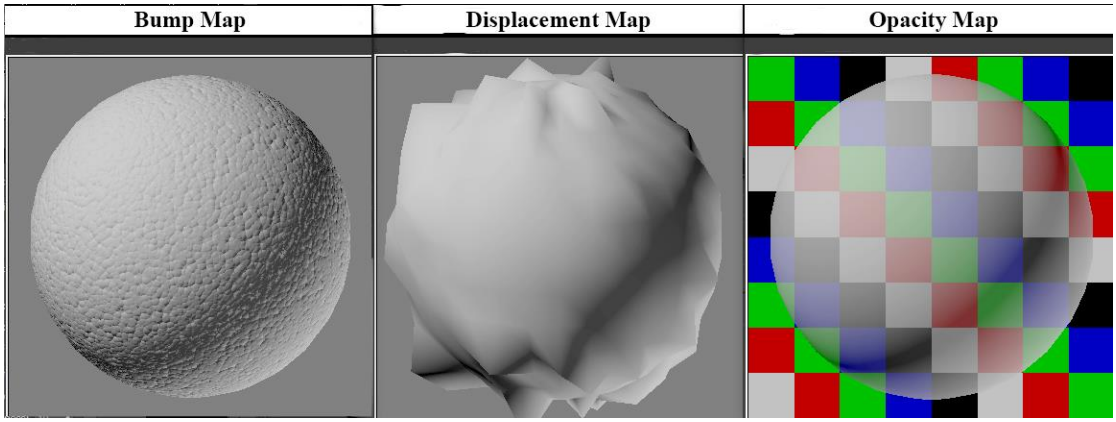

Figure 5 Bump, Displacement, and Opacity Map Samples (Melki 2019a)

Texturing tools are also capable of adding reflections and refractions to simulate surfaces such as glass and water (figure 6). These maps are fitted into an object through its mapping coordinates and contribute to the 3D object's appearance, realism, appeal, and consequently its merging with live-action footage (Rickitt 2000).

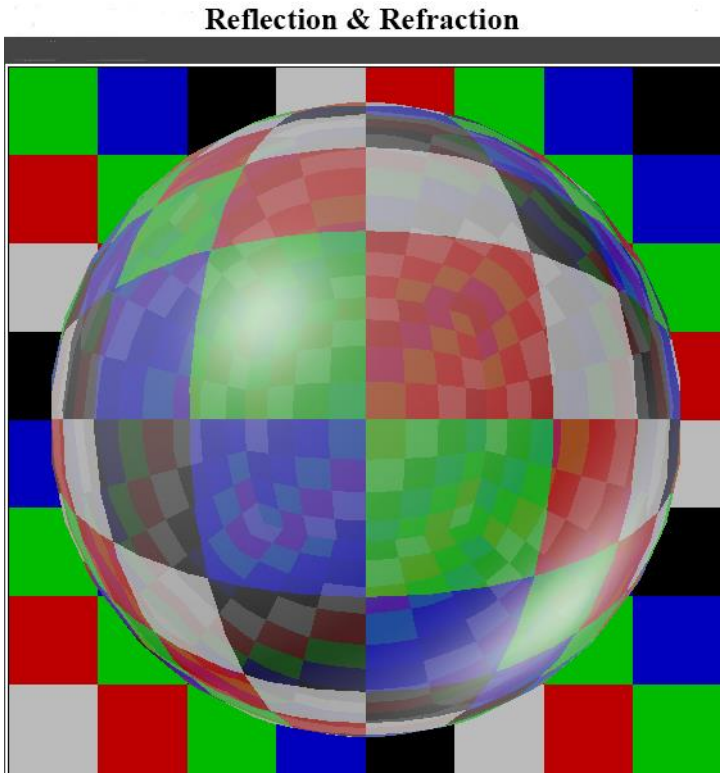

Figure 6 Reflection & Refraction Sample (Melki 2019a)

Being the first case of a photoreal character merged with live-action footage, VFX supervisor Dennis Muren aimed to make the merging of the two mediums as seamless as possible (Failes 2015). The problem, as Muren clarifies, was with the direction as well as the technology. On the direction side, the brightness had to be adjusted to make the shadows look correct, while the tools' capabilities at that time were limited in what they could offer. However, the ground-breaking approach, which Muren and his team used to create an original visual experience was so influential that it founded the basis for VFX in future projects. Unfortunately, the film got an Oscar nomination for best visual effects but lost to the more commercially successful Film *Cocoon (1985)* (Grage 2014).

Despite *Young Sherlock Holmes*' commercial flop in the Box Office, the glass knight character was an innovation milestone in the world of VFX that proved that the creation of a fully CGI photoreal character was possible. This opportunity allowed director James Cameron to present his VFX team with the task to create the first fully 3D digital face with facial expressions, made entirely from seawater with all reflections and refractions of the environment for the 1989 film *The Abyss* (Rickitt 2000, Grage 2014). Considering the glass knight character's face from *Young Sherlock Holmes* was a static projection on a 2D plane, Cameron's ambitious vision proved to be a leap forward in VFX that would not have been possible without the efforts of the VFX team involved. Although the

techniques used to merge the character with the live-action footage seamlessly were traditional optical effects techniques, the character itself was ground-breaking in CGI effects that took seven months to make for a 75 seconds sequence (Grage 2014). The 3D creature, named the Pseudopod (figure 7 left), was originally built using acrylic sculpts and stop-motion replacement animation was considered as one of the possible approaches to tackle the project. However, a team at Industrial Light & Magic (ILM), that included Dennis Muren, Mark Dippe, Lincoln Hu, Steve Williams, and John Knoll, provided a more a suitable solution, a 3d animation and rendering software to create the animation (Failes 2015). ILM developed software that became the basis of today's Renderman, a program that produces a 2D image by calculating the blend of lighting, textures, camera, 3D geometry, and animation, to give the Pseudopod its water texture and fluidity (Failes 2015, Rickitt 2000). This texture was applied to a digital wire-frame tube that would represent the creature's tentacle shape. As for the facial expression animations, ILM utilised a combination of facial scan and morphing technique to animate the Pseudopod mimicking the actress Mary Elizabeth Mastrantonio's face (Failes 2015). This technique revolves around seamlessly merging and changing a series of 2D images or 3D models, each called a morph target, into another over a period of time (Rickitt 2000). This advancement in tools and techniques was further developed and used as a guaranteed concept for the T-1000, the first CGI main character used in film, capable of morphing into any object or person, in *Terminator 2* (figure 7 right). The film proved to be a major success with its visual and practical effects that it triggered the trend of special effects in major action films as well as it helped extend, out of necessity, ILM's computer department from 6 people to 36 who contributed 3.5 minutes of CGI animation (Grage 2014).

Figure 7 The Pseudopod (left) (Cameron 1989) & The T-1000 (right) (Cameron 1991)

After *Terminator 2*, the film industry became aware of the many possibilities of computer graphics in creating fictional digital characters that exist in the audience's imagination.

With *Jurassic Park* in 1993, computer graphics changed the entire industry by blurring the threshold between reality and fiction in creating creatures that tricked audiences, at the time, into believing in their possible existence (Failes 2015, Prince 1996, Salzberg 2015). Originally, Spielberg hired Stop Motion expert Phil Tippet to fully animate the dinosaurs by photographing frame by frame the movement of the physical models, while ILM would contribute with CG work without conflicting Tippet's work. However, Steve "Spaz" Williams and Mark Dippe, two members of the team at ILM, were working on tests of a digital Tyrannosaurus Rex' walk cycle on the side (Acuna 2014, Failes 2015, S. S. Williams 2015). The result astonished producer Kathleen Kennedy and special VFX supervisor Dennis Muren, and it became clear that Stop Motion is no longer the optimal choice for this project (Failes 2015, S. S. Williams 2015). Therefore, ILM and Tippet combined their efforts to create the final animations for the digital dinosaurs while alternating and integrating their work with Stan Winston's practical effects team (Failes 2015). The film presented 14 minutes of dinosaur screen time, 4 of which were CGI that cleverly mixed with the remaining 10 minutes of practical effects that it was difficult to fully distinguish between the two (Grage 2014, Acuna 2014). The seamless merging of different mediums was possible due to, yet again, ILM's ground-breaking new computer techniques. The dinosaurs were first modelled using physical clay, and then 3D scanned to create digital models (figure 8). A specific digital armature or a skeleton was then created and assigned to each of the digital dinosaurs (Rickitt 2000). To specify the relationship between the skeleton and the 3D model, and to create the fluidity in the movement of the muscles and skin, ILM developed "Enveloper", a program that allowed them to assign the amount of influence each bone has on the different parts of the 3D object (Rickitt 2000, S. S. Williams 2015). Finally, the photorealistic texture of the dinosaur's skin was achieved by another software developed by ILM called "Viewpaint", which allowed the artists to digitally paint the details of the dinosaur's skin directly on the 3D models (Rickitt 2000).

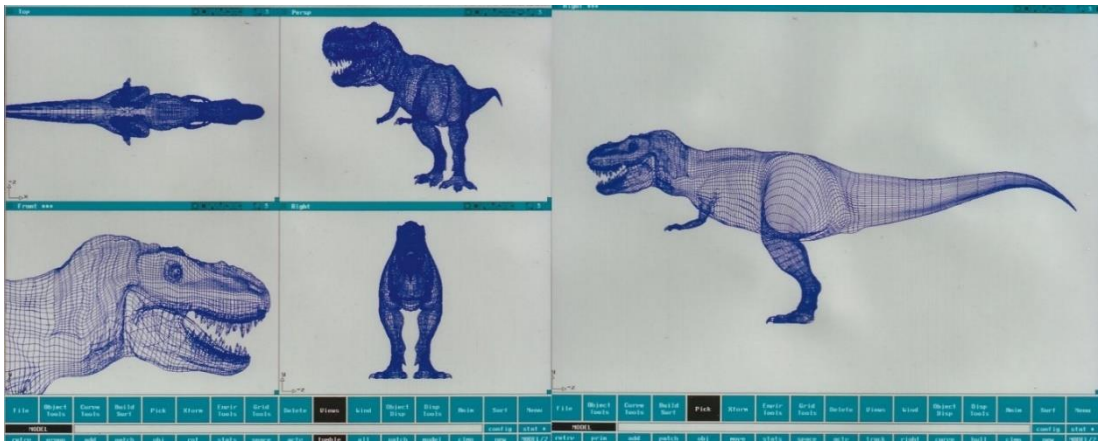

Figure 8 Digital T. Rex Courtesy of Steve Williams (Acuna 2014)

The dinosaurs in Jurassic Park were the first photoreal CGI characters with textured skin, muscles and accurate movement that are still perceived as believable living creatures even by today's standards (Grage 2014). The film proved that anything could be made or created with CGI. However, the same quality of believability was rarely achieved or replicated in other films. *Jurassic Park*'s highly impactful multi-sensory presentation of the grandeur of VFX and CGI was followed by its opposite with the 1994 film *Forrest Gump*. Director Robert Zemeckis used CGI in *Forrest Gump* to enhance realism subtly instead of creating creatures that would not exist outside of the screen (Rickitt 2000). The opening scene of the floating feather was created by digitally blending bluescreen shots of a real feather.

Furthermore, ILM made use of their compositing and rotoscoping techniques to merge Tom Hanks' character into the real-life footage and make him interact with celebrities and political figures such as John Lennon, presidents John F. Kennedy, Richard Nixon, George Bush Sr., and Bill Clinton. Morphing techniques were used on these figures to change the movement of their lips to make them say different things. In addition to using CGI to remove digitally, Gary Sinise's character, Lt. Dan Taylor's lower leg (Grage 2014). This approach of using invisible CGI, VFX that the audience would not notice, became a standard approach to many films to come especially with creating landscapes or different locations and cities in the background.

With the release of Pixar's *Toy Story* in 1995, the first fully 3D animated movie, Disney started experimenting with more photorealistic animations with the 2000 film *Dinosaur*.

Dinosaur was an unfortunate case of Disney's most significant and most innovatively obscure and forgotten projects. While Jurassic Park featured a mix of animatronics and

CGI Dinosaurs, the VFX efforts in Dinosaur presented the first feature-length film that blends CGI dinosaurs with live-action background footage (timbox129 2008).

According to animation blog RetroJunk user Timbox129 (2008), the film's struggles with success could be linked to its release between the gunfire incident at Columbine High school on April 1999 and the September 11, 2001, attack. Also, the depiction of talking dinosaurs and lemurs was not met favourably among Disney purists and audiences (Lopez 2013, Ness 2016). However, Disney's Dinosaur was viewed among VFX and animation professionals as a ground-breaking use of CGI characters with live-action backgrounds. *Dinosaur's* essential characteristic is linked to its production process. As a case study, *Dinosaur* would present exciting information regarding the techniques and design approaches used to blend and create a balance between photoreal talking dinosaurs and live-action footage that presented the environment where dinosaurs and Lemurs could exist together. According to animation journalist Jeff Kurtti (2000), the film took over a decade to be finalised as the tools were not available at the time to produce a full-length animated film about dinosaurs. The original approach involved stop-motion technique with the help of Phil Tippett who withdrew once the advances in CGI offered a new a set of tools that could create more convincing animations. After the release of Toy Story in 1995, the first full length animated feature, Disney aimed to surpass Pixar's achievement by creating a full length photoreal animated film about the survival of dinosaurs after the meteor impact. To achieve their goal, Disney created an extension in their studio branches specialised in digital effects (Kurtti 2000) where the collaborative effort focused on the strength of the entire team: two directors and a production team of over 500 practitioners divided into teams according to their role in the creative process including character design, character modelling, animation, rendering, and software development (timbox129 2008). However, the creatives at Disney realised that their vision to create realistic dinosaurs in a live-action environment could not be achieved with the same vernacular visual language of Pixar or other live-action films but must maintain Disney's popular style in producing talking animals. Therefore, the dinosaur anatomy of the main characters was slightly modified and designed to maintain a photoreal aesthetic with anthropomorphic qualities. Also, the film's colour palette was reconsidered to fit the animated and live-action mediums. In addition, the live-action nature of the environment created restrictions on the character movements as they had to be animated in specific angles with the correct lighting, a feature that could be easily avoided in fully animated

films where the camera angles and animation can be changed to hide imperfections and mistakes (Kurtti 2000).

Despite the efforts of the artists involved in the film, *Dinosaur* did not achieve the expectations of its success and became one of Disney's forgotten films. However, as a film, it was the first of its kind which gave Disney the experience and the opportunity to create their VFX branch instead of relying entirely on Industrial Light and Magic to produce their digital effects shots.

The world creation approach through the marriage between live footage, practical techniques and CGI was taken further with the film adaptation of J. R. R. Tolkien's epic fantasy books *The Lord of the Rings*. With the advancements in technology and techniques, Peter Jackson saw the opportunity to shoot a large-scale epic fantasy film, with a serious tone, which would feel real. Jackson took on this challenge with his own New Zealand based visual effects company Weta Digital (Grage 2014). *The Lord of the Rings Trilogy (2001-2003)* and the *Harry Potter (2001 – 2011)* franchise also marked a shift in the industry where the VFX studios efforts were produced abroad, in these 2 cases, to New Zealand for *Lord of the Rings* and the United Kingdom for *Harry Potter*.

The creation of the vast world of Middle Earth had to be built physically and digitally and then merged seamlessly together. One challenge was to give each culture that interacts with another, its unique character while maintaining a sense of belonging to the same world (Lee 2005). One of the artists hired for this project was conceptual designer Alan Lee, a devoted Tolkien fan who understood the author's approach to world creation concepts. Lee relied on a mixture of familiar visuals and references to design various original styles of architecture, ornamentation and ruins. For example, Rivendell was created through a mixture of Nouveau Art and 19th-century flourishes to create, as Alan Lee (2005) describes it, a "Scandinavian Shangri-La".

Furthermore, helicopter shots were taken of the environment in New Zealand and then digital models of ruins and towns, built in the 3D software Maya, were edited in to create a sense of history in the created world. In a scene of the fellowship's mourning the loss of Gandalf after their escape from the Balrog in Moria, the background was also a compelling case of CGI and real footage seamlessly blended. A helicopter took a full shot of the environment for that scene, which was scanned and sent to Weta Digital. The footage was scaled accordingly after the mountainside reference was duplicated in wireframe, using Autodesk Maya, so that the footage can fit into the perspective of the

shot. The additional landscape, archway, steps and bridge were digital models, textured based on photographed rocks that were inserted into that shot. It is difficult to separate the digital from the real-life footage in that scene. The seamless merger of digital and live-action footage is partly due to digital artists' skills, but also Jackson's direction. Jackson took advantage of the dramatic and emotional scene by focusing on the expression of the devastated characters and as well as considering the audience's reaction to the fallen beloved wizard. Through this approach, the CGI was well blended with the scenery while any imperfections went unnoticed (Lee 2005).

The creation of a believable Middle Earth, an entire fantasy world for the trilogy, was challenging enough and the collaborative efforts of the artists gave impressive results. However, the second and third films of the trilogy presented a digital character, named Gollum or Smeagol, that became a game-changer for character animation realism and believability (Grage 2014). VFX supervisor Joe Letteri faced the challenge of creating a photoreal humanlike character with emotion with whom the audience can engage. Since Jurassic Park proved that performance is crucial, Letteri relied on Motion Capture technology to record the performance of actor Andy Serkis (figure 9), wearing a coloured suit with camera markers that can be translated into the CG character (Failes 2015). However, since the character was required to hang and climb on areas that were physically impossible for the actor to perform, in addition to creating a more organic and fluid animation, the recorded animation was not enough. Animators relied on the keyframe and rotoscoping technique to polish and adjust the recorded animation as well as animating the character in the scenes that are impossible to be performed by the actor (Christophers 2011).

Figure 9 Andy Serkis Performing as Gollum (Susman 2014)

Gollum provided proof for James Cameron to proceed with the 2009 movie *Avatar* which he initially proposed to film in 1994. When Digital Domain received the script, it is evident that the technology needed to execute the project has not been developed yet (Grage 2014). Cameron's vision was to combine live-action scenes with CGI environments and multiples CGI characters but was later reconsidered in 2005, after Cameron, along with Vince Pace and Sony, developed the fusion camera system that can shoot 3D synchronised stereoscopic footage in the desired quality. 20th Century Fox agreed to fund the project with Weta Digital delivering the VFX (Grage 2014). In addition to the fusion camera, the virtual digital camera was an essential innovation in technology done for the movie. It allowed the director to move through the 3D CGI environment and see the CG characters as the actor performs them in motion capture suits (Failes 2015). The textures of the characters, machines and the environment were also enhanced with a new 3D texturing system developed at Weta called Mari.

Furthermore, VFX supervisor Joe Letteri and Weta Digital relied on the Facial Action Coding System (FACS) to create accurate and convincing facial expressions (Failes 2015). However, while 20th Century Fox never officially outlined the total costs, the film was considered as one of the most expensive films ever made. The production required a massive effort from Weta Digital, especially that they had to render their footage twice. Once for standard film and another time for the stereoscopic effect, that it increased their Computer Processing Units (CPUs) from 4400 CPUs to 35 000 CPUs since their previous effort *King Kong (2005) (Grage 2014)*.

The timeline below (figure 10) summarises the milestone films discussed above along with other films, consisting a crucial aspect of this research, explored in the following sections.

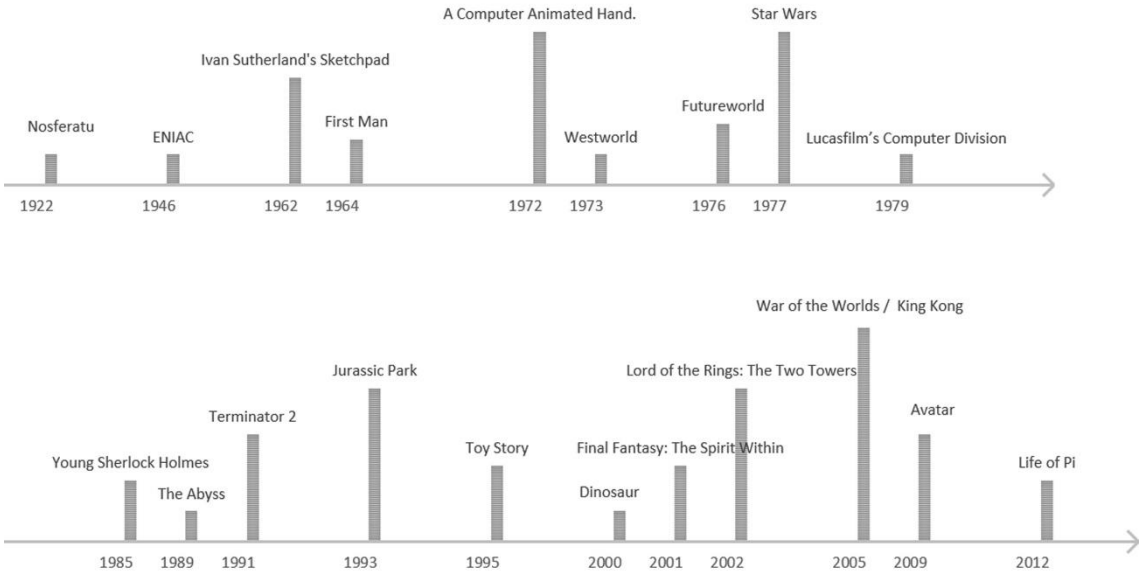

Figure 10 Milestone Films Timeline (Melki 2019c)

The innovations in technology also allowed an increase in the use of high-quality VFX in various media types including TV commercials and series, games, Virtual Reality, holographic projections, instructional and training simulations, news, motion design, and infographics. The versatility of VFX has proven to be equally as convincing in small advertisements as it is in film since the beginning of VFX's rise in popularity. In a 1992 animation contest, judges have disqualified Blue Sky Studios' Braun's electric shaver commercial since they mistook the CGI for live-action footage (Ohmer 1997). Blue Sky Studios, best known for their contribution to the popular *Ice Age* franchise and the critically acclaimed *The Peanuts Movie 2015*, was responsible for many more CGI based commercials. Some of these projects include the ads for Chrysler, M&M's/Mars, General Foods, Texaco, Chock Full O' Nuts, and The US Marines, as well as 13 minutes of animation of CGI cockroaches for "Joe's Apartment" that could not be achieved using Stop Motion. In addition, the founding team of Blue Sky Studios consisted of unusual members from different countries. These practitioners, who immigrated to Hollywood to be involved in the significant VFX companies and projects, included theoretical physicist Dr Eugene Troubetzkoy and NASA engineer Carl Ludwig who developed an in-house rendering process, based on an algorithm called Ray Tracing, that gave Blue Sky Studios their competitive edge (Ohmer 1997). The generalised version of the Ray Tracing algorithm has in independently developed in distinct fields including optical design and analysis, the radiation transfer of thermal analysis, and in photorealistic computer graphics rendering. The first documented application of Ray Tracing was by Arthur Appel

in the 1960s, where he successfully generated recognisable 3D scenes (Freniere, Tourtellot 1997). Ray Tracing is built upon the study of the interaction of light rays, under different lighting conditions, with everyday objects according to their density, transparency, and degree of reflectivity. For each pixel, one or multiple beam(s) are traced from the camera to the closest object with some bounces containing all the information about the object's characteristics (Slick 2017).

Blue Sky Studio's Ray Tracing algorithm became one of the standard rendering methods, which include Scanline and Radiosity. The three main rendering methods are used depending on the need and required quality and speed in which the frames are produced which can be summarised by two types of rendering: Real-time Rendering and Offline or Pre-Rendering (Slick 2017).

Real-Time Rendering is used in gaming and interactive media. Given the interactive nature of the medium, the output is never fixed. The frames need to be rendered at a real-time pace, at a minimal rate of 18 to 20 frames per second (FPS), as the action unfolds. Also, with the technological advancements graphics cards can achieve a rendering speed of 60 FPS. Regarding Real-Time Rendering, the preferred approach is the Scanline method that is based on computing polygons instead of pixels (Slick 2017). Therefore, the characters in games and Virtual Reality often appear reduced in quality as the number of polygons used to form the surface of a game's character are significantly lower than those of a pre-rendered style. Currently, Real-Time Rendering is becoming more widely used with the increase in popularity of immersive technologies that include Virtual Reality, game consoles, and training simulations.

Alternatively, Pre-Rendering is often used for VFX in film and animated movies. Since the sequences are predictable in film, the frames are pre-rendered. The process is time-consuming, big studios often dedicate up to 90 hours of render time to individual frames, but the results are of a much more impressive regarding quality and photorealism. The rendering approach relies on the Ray Tracing or Radiosity methods, the latter is calculated independently from the camera and uses indirect illumination to accurately simulate surface colours, usually used in tandem to achieve higher levels of photorealism (Slick 2017). Furthermore, the advancement in technology also pushed Pre-Rendering techniques in film and TV. The case of the electric shaver by Blue Sky Studios shows high levels of photorealism and believability can be achieved in both film and TV; it is a matter of time requirements, expertise, and funding. Currently, popular TV shows and online streaming are posing a threat to cinemas since they can offer the same level of

visual experience with series like Game of Thrones, The Walking Dead, and Stranger Things, but prove that CGI and VFX can adapt to any medium (Grage 2014).

All the technological advancements have drastically shifted and moulded the filmmaking process that all digital films have the same fundamental characteristics that can be summarised as follow (Manovich 2001):

- It is possible to generate environments entirely with CGI. Live-action footage is no longer the only viable material from which a film is made.
- All materials, including live-action footage, once digitised are reduced to another graphic made up of pixels.
- Since all footage is digitised, it becomes elastic, which means it can be altered or substituted while maintaining its visual realism — for example, the opening feather scene in *Forrest Gump*.
- The computer has collapsed the distinction between editing and special effects. Previously, each of the two tasks was respectively operated by an editor who organised the sequence of images together, and by the special effects specialist who worked on any modification within an image. Now, re-ordering sequences, compositing, and processing an image have become the same task, conceptually and practically (Manovich 2001).

In conclusion, the characteristics outlined above can be put into a simple equation and quote:

"Digital Film = Live-Action Material + Painting + Image Processing + Compositing + 2D Computer Animation + 3D Computer Animation" and "Digital Cinema is a particular case of animation which uses the live-action footage as one of its many elements" (Manovich 2001)

Unfortunately, the digital nature of the techniques and tools presented many drawbacks in the animation and VFX creative process that is directly linked to the current state of the film industry that demands a cheaper and a faster production speed while maintaining a high-quality output. Furthermore, Scott Ross (Former VFX executive, Digital Domain & Industrial Light and Magic) and David Yocis (International Trade Law Attorney) clarified that the business model is unsustainable as it does not provide any job or financial security to the studios and the practitioners. Many issues emerged with early digital films including the successful *Titanic* in 1997. According to Digital Domain co-

founder Scott Ross, the Studio lost $3 million (Grage 2014). Other prominent examples include Steven Spielberg's 2005 *War of the Worlds* which marked the beginning of popularising extremely short postproduction schedules (Grage 2014). Spielberg carefully selected a VFX team consisting of experienced practitioners who previously worked together on *E.T. (1982), Indiana Jones Series (1981-1989), and Jurassic Park (1993).* The film was scheduled to be shot in 73 days, with the post-production being due in only three months after. Because of the VFX team's success in delivering the output on schedule, the film industry adopted this production speed as the standard production pace instead of the former post-production schedule consisting of eight to twelve months (Grage 2014). However, issues about financial difficulties and exploitation complaints became briefly known to the public after the film *Life of Pi* in 2012 with the bankruptcy of Rhythm and Hues, a prolific VFX Studio that created the iconic scenes in the film.

2.2.3 The Industry

The dramatic and vividly beautiful visuals in *Life of Pi* were a real achievement. Almost the entire film was CGI, including the water, clouds, terrains, the animals of which the Bengal tiger was the movie's most significant achievement (Grage 2014). The tiger was a CGI replica of a real one that was impossible to have on set to interact with the live actor for safety reasons. The tiger was so convincing that India protested the film as they thought the filmmakers intentionally starved a real tiger (Dubner 2017). Rhythm & Hues had to prove the tiger was completely CGI and the actor, Shuraj Sharma, was holding or sitting next to a blue prop (figure 11).

Figure 11 Blue Prop Vs CGI Tiger (Mozafari 2017)

Unfortunately, despite all the efforts put into the VFX in *Life of Pi,* the movie is mostly known for the aftermath of its release, the bankruptcy of Rhythm & Hues followed by the number of protests by the VFX community (Grage 2014, Leberecht 2014). The events after the film's release highlighted the unsustainability and the flaws of the business and

framework models of the filmmaking industry of the past 25 years (Leberecht 2014, Al-Jamea, Rizvi 2017).

Life of Pi still won numerous awards, including Oscars for best visual effects and best cinematography. The Golden statues were highlighted, in a 2017 documentary titled *Hollywood's Greatest Trick*, as mere trinkets to trick the public into believing that VFX artists are equally sharing the success as the rest of the industry (Al-Jamea, Rizvi 2017). At the Oscars ceremony, Rhythm and Hues Studios' visual effects supervisor, Bill Westenhofer got cut off from finishing his acceptance speech at 44.5 seconds with the Jaws movie music theme as soon as Westenhofer mentions Rhythm and Hues' financial crisis. In contrast, the film's cinematographer Claudio Miranda completed his 60-second speech (Horn 2014). Also, the visual effects artists at Rhythm and Hues, the studio that closed due to bankruptcy after the film (Barkan 2014, Horn 2014), were not thanked by the film's director Ang Lee during his acceptance speech. These unfortunate events of 2013 became widely known to audiences and practitioners, which caused supporters of the Visual Effects studios posted green squares in their social media profile protesting about the abuse.

According to the artists, who worked at Rhythm and Hues, the problem lies in the business model and the creative process (Leberecht 2014, Al-Jamea, Rizvi 2017). As a relatively new and growing medium, where the first full-length animated feature was the 1995 Toy Story (Avila 2010), the digital 3D animation the creative process has been challenging to define. Most topics covered on the field involve technical aspects with a detailed focus on the software and tools used, as well as superficial or a general outline of the production process.

In most cases, film begins with an idea which is transcribed in the form of a written script (Kelly 2007, Sekeroglu 2012). Once the text is approved, it is given to the storyboard artists to translate the written into a visual format using sketches. After the director and producer accept the storyboard, it is the character designers' job to develop the characters through elaborate sketches to fit the overall unified design of the film (Willett, Lee et al. 2010). Then, the voice casting recording sessions begin to record the characters' lines. Meanwhile, the character development process does not stop. The fully developed sketches are sent to character modellers who construct the 3D models. Then, the 3D characters are rigged and animated by the specialised practitioners according to the modelled environment and voice actors' recordings (Kelly 2007), followed by adding the visual effects, rendering, compositing and colour corrections (Beane 2014).

The animation process is a highly-specialised discipline where hundreds of skilled artists are involved in creating a visually compelling story. Animated storytelling is achieved through the creation of its various components including the characters, props, and the environment, based on the director's vision (Mantley 2015). Accordingly, the supervisor's job is to coordinate the creative flow between the specialised artists and reports to the director. The supervisor is usually a specialist who mastered his craft and can advise the less experienced specialists on how to improve their work, whether it is animation, design or modelling. For example, an animation supervisor, such as Glen Keane's role in the movie Tangled, guides the practitioners to better improve their interpretation of the characters' performances and emotions (Mantley 2015).

However, the animation creative process is not as linear as it is explained in the previous paragraph. A linear process would imply that the filmmaking process begins when all storyboards are laid out, and all the acts of the films are defined. However, the filmmaking process begins with many uncertainties regarding the various acts in the movie and the requirements for each shot (Leberecht 2014). A shot is often sent to the decision-makers, whether it is the client or the director, for feedback and then returned to the animation studio to be modified or improved without any elaborate detail. The digital aspect of visual effects allows these changes to become frequent since the project can be digitally edited, which is problematic since the VFX studio is working towards achieving the client's vision that can continuously change. Also, the funding of the project is based on a fixed bid that, once set, the studio can no longer negotiate despite the multiple changes that might occur after the agreement. The result of an immediate scene modification forces the studio into months of extra work while relying on the remaining budget of the original contract for funding and employee salaries.

Consequently, VFX artists are hired on a project basis, continually living a nomadic lifestyle, searching for the next project to work on (Al-Jamea, Rizvi 2017, Leberecht 2014). The nature of the film industry has forced a substantial number of its workforce to work as freelancers. According to the 2017 British Film Institute statistics, 50% of the film and video production workforce in the United Kingdom were Freelancers. In contrast, film industry business had low number of employees where 97% of companies employed ten or fewer employees (British Film Institute 2017).

The severity of these issues varied from naivety and lack of judgement to intentional and planned exploitation. On the lower spectrum, for example, Rhythm and Hues disgruntled former employees complained due to necessary risks taken by the studio to complete the

project. Unfortunately, despite their best efforts, Rhythm and Hues filed for bankruptcy. Severe examples can be traced to the creation of the "paying to work for free" business model proposed by former Digital Domain CEO John Textor, who founded the Digital Domain Institute in Florida and openly admitting his intentions to charge students tuition fees while making them work on the studio's projects (VFX Soldier 2012). Textor's controversial statement was posted on VFX Soldier's page (2012) quoting:

"[…] ***30% of the workforce at our digital studio down in Florida, is not only going to be free, with student labour, it's going to be labour that's actually paying us for the privilege of working on our films***."

In 2016, the filmmakers of the R-rated animated film "Sausage Party" were accused of abusing the animators (Zakarin 2016, Silver 2016). Animators complained about being forced to work overtime on the film without pay and receiving threats of employment termination, through fear and demotivation tactics if they refused (Zakarin 2016). In addition, 83 animators were working on the film, but only 47 were credited in the movie's credits (Silver 2016). According to Scott Ross, former VFX artist Marianna Acuña Acosta, and VFX supervisor Joe Pavlo, VFX artists do not always get credited yet the majority would work extra shifts and hours, sometimes without pay, to see their names in the film's credits (Al-Jamea, Rizvi 2017). Based on the Box Office Statistics, 50 of the highest-grossing films rely on visual effects where 44 of those films are either fully animated or heavily built upon visual effects (Barkan 2014). For example, Scott Ross discussed the 2013 movie *Gravity* being 80% animated, where the cinematic experience through the efforts of Framestore and the film's direction were the main factors behind the film's success, rather than the actors' performances. Scott further emphasised on the substantial amount paid to one of the actors, despite their absence on set since they were animated (Al-Jamea, Rizvi 2017).

These issues did not only vary in severity but also occurred on a larger scale where multiple studios were involved instead of the individual cases mentioned previously. The two cases can illustrate these large-scale events. The first is the "High-Tech Employee Antitrust" lawsuit (Gilardi & Co. 2018) claiming that the defendants (Adobe, Apple, Lucasfilm, Intel, Intuit, Google, and Pixar) violated antitrust laws by collaborating to set fixed animation wages through non-poaching agreements. The second is the "Animation Workers Antitrust Litigation" lawsuit (Kurtzman Carson Consultants LLC 2017) where the defendants (Disney, Dreamworks, Two Pic MC LLC, Lucasfilm, Blue Sky, LLC, and

Sony) conspired to overturn payments by agreeing not to solicit each other's employees and violating federal and state antitrust laws by fixing compensation policies.

The controversial efforts of companies to access more funding can be explained by examining the business models and approaches in the film industry. VFX artist Pierre Grage (2014) highlights the misleading terms and methods that the film industry, mainly Hollywood, incorporates to increase viewership and income. First, the Box Office only includes the gross revenue. According to Grage (2014), films struggle to make any profit from the box office alone as most of the money must be paid to other parties, including advertising budgets, distributors fee, and taxes. For example, Disney increased their marketing budget to 80% of *The Lone Ranger*'s original budget after the release of their unsuccessful *John Carter* movie that already had an advertisement budget worth 40% of their original budget. However, the actual sources of a film's profit include government subsidies, shelter deals (a legal method to decrease taxes), and product placement.

Disney, for example, used to profit from Blu-Ray, DVD, and VHS sales but with the rising popularity of online streaming services, Disney's primary source of profit comes from exploitable intellectual properties that can be turned into sequels and/or sold as toys, games, and images (2014). This is not limited to Disney but also throughout the film industry even in lower-budget TV animations including Cartoon Network's *Powerpuff Girls (McCracken 1998-2002)* which estimated $300 million on merchandise alone in 2000 (Caldwell 2008). Additionally, making-of DVDs, celebrity interviews, special edition or "director's cut" DVDs, Bonus tracks, and Blu-Ray discs are all forms of marketing experiences that function similarly to primary entertainments and consumed by audiences as commodities (Caldwell 2008). The 2001 film *Lara Croft: Tomb Raider* is another compelling case where financial risks were reduced from 100% to 10% by selling distribution rights ($65 million) for Britain, France, Germany, Italy, Spain, and Japan. Plus, since part of the film was shot in Britain, Paramount earned $12 million as tax subsidies. In addition, a German company bought then sold the film back at a loss, earning Paramount another $10.2 million (Grage 2014).

Furthermore, film industry studios often attempt to manipulate their financial statements to receive tax exemptions. For example, a controversial financial statement for the 2007 film *Harry Potter and the Oder of the Phoenix* was leaked online in 2010 which received considerable attention worldwide, resulting with a lawsuit (Thompson 2011, Masnick 2010). The controversy revolves around Warner Bros claiming that the film caused the studio to lose around $167 million despite it being one of the most grossing films of the

decade. According to the financial statement, Warner Bros paid an estimate of $350 million for “distribution”, “advertising and publicity”, and “interest rates”. After investigations during the lawsuit, it was revealed that Warner Bros paid these fees to one of its branches disguised as an “external company” (Thompson 2011, Masnick 2010). These attempts to avoid or reduce taxes to increase income have also affected the workforce involved in the production of the film. Another similar example occurred with *Return of the Jedi (1983)* where the actor David Prowse, who played the iconic villain Darth Vader, was informed that the film was not profitable and therefore cannot be paid any residuals or royalties (Thompson 2011).

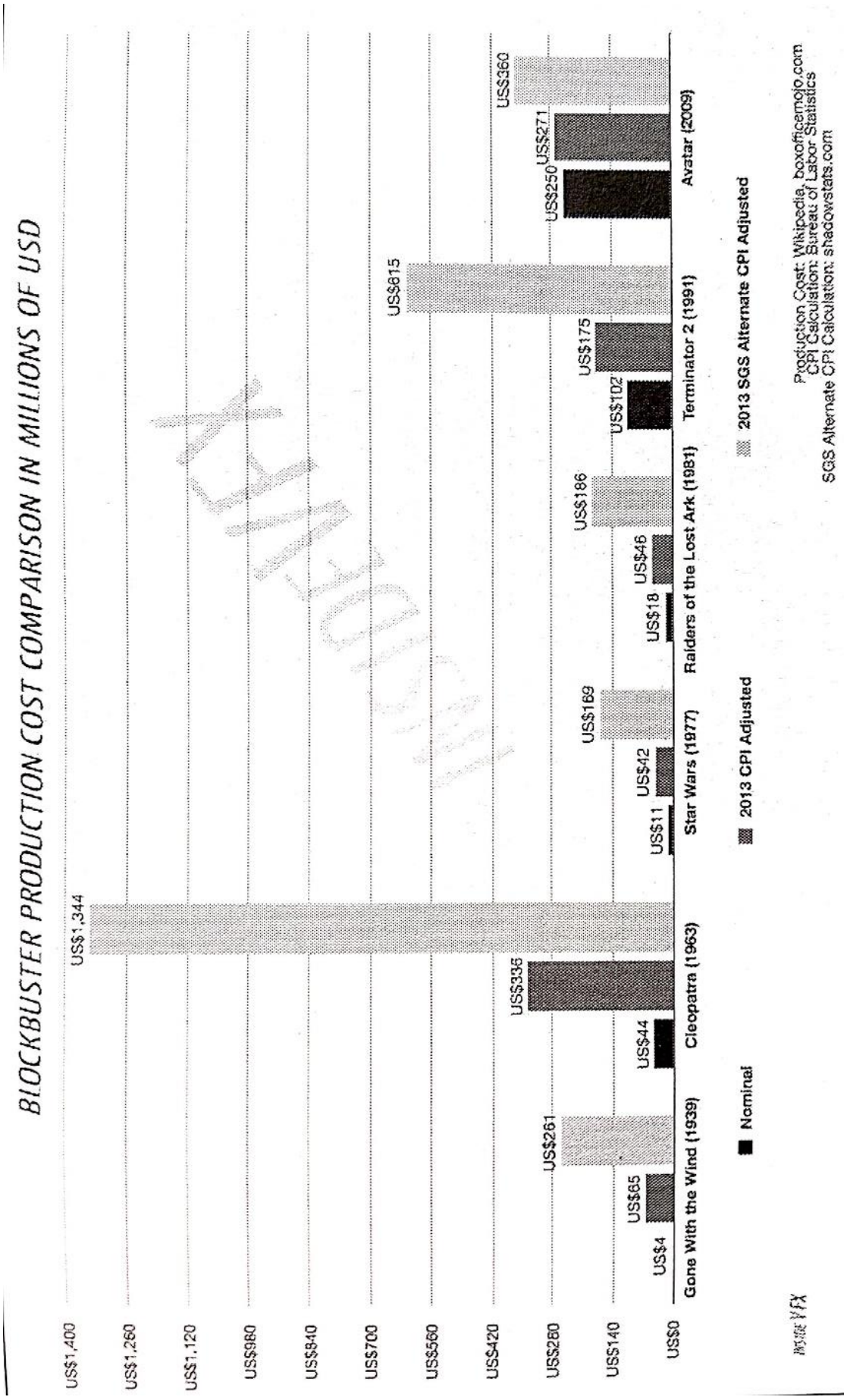

Figure 12 Blockbuster Production Cost Comparison (Grage 2014)

Studios and production houses also must consider insurance company fees. Usually, insurance companies aim to reduce production risks to almost zero. Therefore, insurance companies typically assign "watchers" to conduct a risk assessment then intervene to halt the shoot if a stunt was deemed too risky. A Production crew or a studio would then either proceed with the stunt without insurance or pay another raised premium insurance fee. Since both cases are not an option, Production houses or Studios would resort to stunt doubles that are also costly and create restrictions to camera angles and close-ups. Therefore, digital doubles are becoming the preferred cheaper and efficient solution. A comparison conducted between the production costs of the movies *Gone with the Wind (1939), Cleopatra (1963), Star Wars (1977), Raiders of the Lost Ark (1981), Terminator 2 (1991), and Avatar (2009),* presented in figure 12 highlights the effectiveness of digital VFX as a critical tool in keeping costs down (2014).

The following section discusses theories of perception regarding film. This is an essential aspect as everything about the film and TV industry is calculated and designed to increase viewability and profit. The film and TV industry are effective in increasing viewership through their marketing and advertising methods. For example, although production houses are inclined to use digital doubles instead of stunt double or to allow the actors in performing their stunts, celebrities are often required to lie in interviews and highlight their stunt performances (Grage 2014). Furthermore, when *King Kong (2005)* was released, it was marketed that the digital giant ape's animation was entirely achieved through Andy Serkis motion-capture performance. However, only a quarter of Kong's facial expressions were performed by Serkis while the majority of the work was executed through the efforts and collaboration of animators. These marketing tricks aim to highlight the human agency, represented by the celebrity, as a more critical factor in promoting the film and the character as a living creature and not a computation (North 2008).

2.3 Part 2: Theory

This section discusses complementary theories of the highlighted practice and industry topics of the previous section. The theories in this section revolve around perception, cognitive perception, psychoanalysis, neuroscience, narrative structures, defining reality, design and world creation concepts. Since this research focuses on the believability of 3d photoreal characters, this section starts by defining reality according to films and their various mediums.

2.3.1 Defining Reality

The description and definition of realities have been challenging to achieve (Arbib, Hesse 1986). Starting with historical perspectives, Ptolemy and Aristotle followed the geocentric model despite the existence of the Aristarchus heliocentric model adopted by a minority of highly educated Greeks. During that period, the Ptolemaic and Aristotelian models seemed to reflect reality since the movement of the earth cannot be felt (Hawking, Mlodinow 2010). Consequently, the geocentric prototype was eventually replaced by the Copernican and Newtonian heliocentric updated models that, with the advancements in scientific research, were also displaced by the theory of relativity and quantum mechanics (Arbib, Hesse 1986). It is important to note that the scientifically outdated representations of reality cannot be considered entirely false since there is some accuracy in their structure according to a specific frame of reference.

The Copernican model, for example, represents simplified equations of motions than the ones proposed by Einstein's theory of relativity (Hawking, Mlodinow 2010). These theories present a model of reality based on the physical and mathematical representation of reality. There are, however, psychological models that present reality from a perceptual point of view. Schema reality theory explains that individuals construct their reality based on a network of mental representations formed by the perception of different stimuli (Arbib, Hesse 1986). Therefore, the construction of reality differs from one person to another, depending on their unique perception of the world around them. However, there are overlapping reality schemas and a process in which data is analysed by the individual to become part of a belief system or a believable tacit notion. According to Arbib and Hesse (1986), truth is defined as the consistency with the theoretical systems where "knowledge becomes a socially institutionalised belief". Daniel Dennett (2014) argues that reality is formed from interconnected orders and cannot become believable unless each of its elements is taken into consideration in reference to the whole. Dennett (2009) also argues that consciousness does not occur in a specific part of the brain as it consists of spatial and temporal elements that include phenomenological characteristics. Therefore, individuals tend to formulate their perception of reality in relation to their experiences as well as their environment. The latter can be linked to James J. Gibson's ecological approach to perception (Gibson 1986), where the environment and the creatures living in it, whether human or animal, are inseparable.

The relationship between animal or human and the environment is established through the concept of nesting, a complex hierarchy of interconnected layers. For example, a leaf

or a bird is nested in a tree, which is nested in a forest that is in turn nested on a mountain. Furthermore, the behaviour of organisms relies heavily on the affordance of the environment or what the objects in that environment allow the dweller to perform (Gibson 1986). Therefore, the perception of reality is always relative to the environment, experience, and the various stimuli exposed to the individual (Wages, Grünvogel et al. 2004).

The following sections discuss the neurological and psychological structures and the mechanisms that contribute to the formulation and interpretation of meaning in a constructed reality.

2.3.2 The Human Brain, The Image, Sound & Dissonance

Ramachandran (2007) explains that the different components of the human brain are naturally wired to each other but are trimmed down, by a gene, to form the characteristic functions of the adult brain. In addition, a mutation in that gene can occur that causes a deficiency in the trimming function and therefore merges the senses to form what is called synaesthesia. Synaesthesia, depending on the case, allows the individual to link shapes and letters to colours or sound, for example. It is commonly found more developed with artists and poets, individuals capable of metaphorical thinking or tying ideas together that are seemingly unrelated more effectively than the average population. However, Dr Ramachandran (2007) showed how all humans are synesthetic to a certain extent but are in denial of it. To illustrate this argument, Ramachandran (2001) relied on the Bouba/Kiki effect and showed that 95% of the population associated the sound “Bouba” to the rounded shape and the “Kiki” to the shape with the sharp edges.

Ramachandran explained the reason this perceptual phenomenon is due to a cross-model synesthetic abstraction where the sound, “Kiki” for example, in the auditory cortex mimics the observed variation of a sharp edge. It is a primitive form of abstraction that occurs in the fusiform gyrus, the area in the brain that connects hearing with vision and touch, which allows humans to engage in metaphor. If the fusiform gyrus is damaged, Ramachandran (2007) explains, people will lose the ability to engage in the Bouba-Kiki experiment, abstraction as well as understanding metaphors.

It is interesting to investigate further the origins of these skills that allow humans to create images and associate them with meaning. Unlike the case of the Bouba-Kiki effect, the specific association of images occur due to experience and culture that their meaning became intuitive to the viewer. For example, Professor Spivey (2005) explains the case

of an old devoted Muslim who has never seen a picture in his life, because Islam at its strictest bans the visual representation of living creatures, could not understand a picture of a horse. To the old man, the picture was a combination of colour and lines but not a horse. According to Bazin (1960), the desire to create visual representations of reality, humans and animals in other cultures, was historically rooted in the pursuit of immortalising the body as a method to avoid death through the representation of life. These methods were presented through diverse visual representations ranging from religious and shamanic ritualistic practices that can be seen in the preservations of mummies in Egypt, the paintings and sculptures found in neolithic caves, to the portraiture found in western art (Bazin, Gray 1960).

To explain how the first image was produced during the Palaeolithic era without having any prior of engagement with visuals and art, David Lewis-Williams (2003) argues that the paintings found in caves were not representations of hunted animals. Because the animal bones found in the caves belonged to different animals than those depicted on the cave walls, but the drawn animals were considered as essential or possessing divine meaning to the people of that era. Lewis-Williams (2003) argued that the images were produced by shamans who were able to go into trances, or altered state of consciousness through sensory deprivation, and trace their hallucination unto the cave walls. The drawn figures are simple patterns and shapes in the shallow parts of the cave but become more complex and resemble living creatures in the deep parts of the caves. However, this does not explain why pictures are often presented through abstraction in art. Dr Ramachandran argues that the human attraction to abstract forms in their art is due to the brain being programmed to exaggerate features that mattered most to the people of a specific era (Spivey 2005). In the case of the Palaeolithic cave paintings, the characters drawn were representations of animals that held significant spiritual meaning to the people.

Further examples will help illustrate Ramachandran's argument, such as the Venus of Willendorf, where the statue's stomach, reproductive organs, breasts were exaggerated while her facial features and arms were ignored. The shape of the Venus was not due to lack of craftsmanship and skills but the fact that it comes from a culture that lived in the harsh cold where food was scarce, therefore fertility features were taken into high regards. The Greeks, on the other hand, relied mainly on slightly exaggerated body proportions and muscles while maintaining a high level of realism in their art, due to their belief that gods took human forms with athletic body figures. The beauty of the body figures, to the Greeks, was the equivalent form of interest to the obsession with fertility to the people

who created the Venus of Willendorf (Spivey 2005). Therefore, the instinct to produce images is already hardwired to the human brain and that the focus for abstraction varies from eras and cultures. The innate desire to create images was, in some cases, complemented with sound and music to improve storytelling and to affect the viewer or the participant. For example, the aboriginal tribes of Australia used to include didgeridoos and percussion while presenting drawn characters as their process of storytelling where each sound represents a character or an action (Spivey 2005). The change and adaption of different styles of character portrayals is an interesting notion to consider as characters can be perceived differently through time and therefore could appear unsettling or socially unacceptable to specific individuals or cultures while looking utterly reasonable to a different audience (Evelth 2013, MacDorman 2006).

2.3.3 Defining Reality Through Art, Photography and Film

As highlighted in the previous section, reality has been culturally represented throughout history with various mediums. Western art presents an interesting factor that contributes to this investigation regarding the process of believable characters in constructed realities in films. According to John Berger (1972), the unique traditional aspect of western art, since the renaissance period, revolves around the use of perspective which places the viewer at the centre of the presented reality. The notion that all lines converge onto the viewer's eye as to the vanishing point suggests that the viewer is the unique centre of the world. However, the advent of the camera, especially the movie camera, offers an alternative perspective in which it demonstrates the non-existence of a centre (Berger, British Broadcasting Corporation. 1972).

Consequently, the camera's alternative non-centric perspective offered a unique objective character to the representation of reality by recording it without the intervention of an agent (Bazin, Gray 1960). However, as cameras evolved and became more prominent, photographs and film became another art medium that allowed expressive inputs and interpretations. The development of cameras presented an additional dimension to the recorded medium presenting a dual ability to present reality as a copy of the original as well as an interpretation of it (Sontag 1977/1983). The interpretation of reality through movie cameras presented a development of a visual language for storytelling in the form of cinema films which André Bazin (1960) described as "The Art of Reality".

In film, the formulation of meaning can be achieved through contextual cognition with a process known as the kuleshov effect. Hitchcock (1964) explains this phenomenon by

assembling three separate shots and producing a different meaning by applying a simple modification. In the suggested experiment, the first scene consists of an old man observing a woman and her child, who are shown in the second scene. The third scene shows the old man smiling conveying him as a sympathetic benign old man. However, the director removed the second scene and replaced it with footage of a woman in a bikini, without changing the first and third scenes, the meaning changed through the portrayal of the character as the perverted old man (Hitchcock 1964).

In addition, just as the aboriginal tribes in Australia utilised music and sounds as an additional dimension to storytelling, it is prevalent for contemporary film and animations to add a soundtrack. It is interesting to take into consideration the effectiveness of the soundtrack to create suspense, tension and resolution through sound effects, music, noise and dissonance. Dissonance in music refers to the clashing of notes that do not belong together (Jeffcock, Hanly 2006). In medieval times, deliberate dissonance in music was banned as it was considered a horrific sound and was called the devil in music. However, over the years, artists such as Johan Sebastian Bach, during the classical period, established ways to use dissonance without producing discomfort.

Furthermore, artists such as Wagner used forms of dissonance to create a narrative through sound. In Tristan and Isolde, for example, Wagner used suspension, a type of dissonance where a tune is played over a chord to which it does not belong, to create tension as the story progressed. However, in the end, when the tension of the story is resolved, Wagner relied on standard harmony and resolved the tension through sound (Jeffcock, Hanly 2006). Also, discomfort through sound can be produced from noise (Home-Cook 2015). In a theatre, for example, a phone ringing can create a violently adverse reaction from other people in the audience. However, a ringing phone in the theatre does not always present the same distraction as the previous case. Home-Cook described a scenario where he attended a theatrical piece and heard a noise which he thought to be part of the show but later discovers that it was a phone. Home-Cook (2015) argues that sound becomes noise when it is out of the context of what is being presented. In the case of the second phone ringing that did not produce any discomfort, Home-Cook described his experience with this event as he thought that the emerging sound was part of the scene that was being presented in the show. In cinema, for example, the 2018 horror film *A Quiet Place* tells the story of a family struggling to survive in a post-apocalyptic setting where humans are hunted by creatures that track their prey through sound. Due to the film's premise, the characters relied mainly on sign language to communicate while

the narrative relied heavily on the use of sound and silence to create tension. Consequently, the audience expressed their fear of eating their snacks during the screening describing the experience of producing any form of sound as stressful, exhausting, and terrifying (Richards 2018). The act of attending theatre, film or any other form of visual and aural medium must be taken into consideration to the dynamic correspondence between the senses and the embodied engagement with the affordances of a given environment (Home-Cook 2015).

However, although meaning and emotion can be induced through the sequential presentation of scenes and sound, they are not as effective in creating an emotional response in spectators as the narrative's main driving agents: engaging characters (Smith 1995). As Gibson's (1986) ecological approach to visual perception suggests, the study of characters must be taken into consideration along within the context of their environment. Therefore, it is crucial to consider the world creation process and the narrative structures to which characters belong. Since animation and visual effects also constitute a significant aspect of contemporary films (Manovich 2001), the investigation must consider the relationship between the constructed realities and the presentation of believable characters presented in films.

2.3.4 The Representation of Reality & Characters in Animation and VFX

As traditional films initially aimed to record and present a copy or an interpretation of reality, animation offered a unique approach in presenting reality by merging previous visual mediums, including film, painting, and photography. The results, of the representation of reality in animation, varied with the evolution of the film industry and the advancements of its visual storytelling tools. Disney sought to present reality as a caricature rather than a copy (Dobson, Honess Roe et al. 2018). In contrast, the United Productions of America (UPA), inspired by modern and abstract art, relied on a different approach to illustrate reality by breaking the laws of physics of the real world. Through this visual style, the UPA developed the visual language of cartoon physics which allowed characters, such as Wile E Coyote, not to be affected by gravity, when pushed off a cliff, until they look down. Furthermore, the advancements of storytelling tools and the technological achievements allowed further explorations in the possibilities of 3D animation and photoreal visual effects by pushing reality to the realm of fantasy and fiction (Dobson, Honess Roe et al. 2018).

Regardless of the medium, animated and live-action films are based on the performances of their live actors and characters (Crafton 2012). As fictive counterparts of human agents, characters play a major role in inciting emotional responses from the audience. This is possible due to the Sobchack Schema, a reality schema in film perception, that revolves around the corporeal and cognitive resonance existing during and retained after the film-viewing process. The Sobchack Schema allows the audience to appreciate the immediacy of a situation by being too fast for a detached contemplation yet lacking any concrete presence. Therefore, the perception of a character in danger could generate fear in the audience since it is the "lived body that provides the logical premise" despite the fictional nature of the character (Crafton 2012).

Since animated characters are the traced performances of the artists that collaborated in their design and execution, they are perceived as actors playing a role (Crafton 2012). Initially, characters were presented through figurative performances that relied on self-mocking, slapstick humour, communicating the narrative through repetition, symbolic visuals, and a self-awareness of being illustrated. Examples of figurative performance characters include Gertie the Dinosaur, Betty Boop, Micky Mouse (early years), The Simpsons, and the Looney Tunes characters. The representation of character evolved to represent more embodied performances featuring more developed and realistic characters with more depth, complex personalities, and backstories. Characters with embodied performances include characters Disney developed from the golden era of animation onwards, such as Snow White for example. Neither performance types were inferior to the other as each aimed to represent reality differently.

The characters with the embodied performance did not completely replace the figurative performance type characters. Both can be seen in various in contemporary where some can take both performance roles. The crucial factor that can be drawn from the two performance types is that animated characters create the impression of presence and being alive. Engaging characters possess common features that communicate to all cultures defined as "person schema" (Smith 1995). The essential features of the person schema to include a discrete human body, self-awareness, emotions, persistent traits, and the capacity of self-impelled actions. The person schema is so fundamental that it plays a crucial role in our understanding of non-human entities including animals, objects, and machines and therefore animated characters. Furthermore, Smith (1995) highlights the audience's ability to recognise characters as continuous narrative agents that can be distinguished as main or subordinate whose appearance or traits could change throughout

the story. In addition, the moral structure of the film or the character traits of the film play an important role in triggering the audience's engagement.

Consequently, despite their focus on humour and the absence of their backstories, figurative performance characters, such as early Disney Mickey and Minnie Mouse, have developed a complex personality through repetition over the years to become embodied performances (Crafton 2012). In addition, animators have found the perception of highly complex characters with embodied performance is harder to be controlled. The perception of animations or characters has, in some cases, negatively changed or altered. For example, some animations in 1942 were perceived as patriotic films while today's audience considers as racist and propaganda fuelled performances (Crafton 2012, Mitchell 2006). In other instances, Ronald McDonald and The Michelin characters were considered as trademarks or mascots for their respective companies. However, their image has been altered to become an anti-mascot as Ronald McDonald can be perceived as an evil clown selling unhealthy fast foods to children and the Michelin character has a very penetrating and distracting appeal (Denicke, Thaler 2013).

The complexity of characters kept evolving as the advent of CGI, which attained the capability of producing high-quality photoreal characters, pushed the possibilities in filmmaking by blurring the threshold between reality and fiction (Dobson, Honess Roe et al. 2018, Prince 2012). The seamless integration of reality and fiction is often associated with films such as *Avatar (2009)*, The Marvel Films, and *The Lord of the Rings (2001-2003)*. These types of films are the frame of reference that people consider when the subject of Special Effects and Visual Effects is discussed. Although both subjects serve similar purposes, they are often confused as the same thing, which often leads Visual Effects to be a misunderstood field in film studies (Prince 2012). The industry currently uses the term "Special Effects" to refer to any mechanical and practical effects which include explosions, stunts, makeup and prosthetics, and car wrecks. However, the term "special" was officially dropped and replaced with "Visual". Previously, Visual Effects were "Special" as they explicitly and visibly supplemented live footage with visual trickery.

In contrast, contemporary films consist almost entirely of Visual Effect shots and sequences, seamlessly merged with live-action cinematography that the boundaries between the two mediums are almost non-existent (Al-Jamea, Rizvi 2017, Grage 2014, Prince 2012). In addition, Visual Effects are applied beyond explosions and fluid simulations. Characters like the *Na'vi* from *Avatar* are both visual effects and

performances of live-actors. The environments presented in *Master and Commander (2003)*, *The Zodiac (2007)*, and *The Changeling (2008)* are also visual effects shots that indistinguishable from real locations. Despite the differences between Special Effects and Visual Effects, the transition from digital to analogue does not necessarily pose any stylistic or epistemological breaks. Visual Effects must maintain the continuity of the designs presented in the film as it was initially established in the analogue era (Prince 2012). However, the technological limitation of the analogue era diminished the believable realism of a scene while CGI managed to enhance the persuasive power of Visual Effects Sequences. Although the techniques used in *King Kong (1933)* and Ray Harryhausen's *Jason and The Argonauts (1963)* were revolutionary in filmmaking, they provided limited sensory detail and created a sense of disconnect between the characters and the environment (Prince 2012). Furthermore, the digital medium allowed the cameras to present the CGI creatures and the actors in a dynamic, volumetric, and three-dimensional performance rather than cutting shots between live-action performance and animatronics or puppets in the analogue medium (Prince 2012).

According to Crafton (2012), in film, the characters and their environment do not exist until they are projected on a screen. Unlike live-action film, animation does not depend on the photographic replication of reality (Rowley 2006). However, with the merger between live-action footage, puppets (or animatronics), animation, and visual effects, differences between the mediums must be considered due to compatibility obstacles. Digital characters only exist in computer space while puppets and animatronics exist in actual space but do not interact as dynamically with the actors (Prince 2012). The representation of reality, through Visual Effects, in live-action films that feature photographic fictional characters, such as the 1993 *Jurassic Park,* is interpreted as perceptual realism (Prince 1996). The term perceptual realism in this context refers to the existence of an object in a specific setting due to the information provided. For example, in Jurassic Park, the film's plot provided the information of how it was possible to create living dinosaurs, therefore perceptually the dinosaurs in *Jurassic Park* are real. Even though dinosaurs possess a photographic reference, a physical proof from fossils on how dinosaurs looked and behaved millions of years ago, the science on which the film was based cannot be considered as valid when compared to contemporary science (Salzberg 2015). Therefore, coherence between the science presented in the film and the audience's knowledge must exist.

Furthermore, props play an essential role in implicitly conveying time, space, and the story in a film. During an interview, Annie Atkins (2017), a graphic designer who worked on the set of the TV series *Tudors* and the 2014 film *The Grand Budapest Hotel*, outlined her numerous design projects within the film and TV industry that included choosing and creating of the lettering, symbols, and the material of packages, papers, identification cards, and signage. These design decisions contribute to creating a coherent visual world. Atkins explains that the props implicitly help set the location and the period in which the events occur in a film as opposed to recreating entire scenes that require a larger budget and time frame to be produced. The placement of signage or the front page of a newspaper in a shot is always intentionally placed on screen to move the story forward. In addition, in historical dramas, for example, the designers aim to recreate papers or canvases to suit the context of the historical period. However, they often incorporate some visual ageing elements to the material present the audience with the familiar experience of seeing the same painting or parchment in a gallery as opposed to using white paper. The creative art directors do not aim for complete historical accuracy, but the choice of design relates to the storytelling requirements of the film, which differs from one director to another, and from one film to another (Atkins, Mars 2017). Therefore, the interaction between realism and fiction can be beneficial, where one enforces the other and subsequently reduces the limitations set by the reality outside the film. The balance between reality and fiction that must be determined in favour of the director's goal (Rowley 2006).

The representation of reality, according to a director's style and vision, can be considered as an unspoken contract between the storyteller and the audience. The director, animator, designer or artist aims to tell a story, through advertising a film or game, and the audience accepts the call willingly to experience the visual either passively or interactively. John Tooby (2001) explains that through evolution, human beings developed the ability to differentiate and process information, whether real or based on fiction through a process called cognitive decoupling. The purpose of this phenomenon is to prevent knowledge of reality to be corrupted by false information. However, it is essential to state that fictional information has its benefits and therefore people can willingly suspend reality and accept fictional information as temporary truth. Being exposed to aesthetic experiences such as art, music, play and stories, people can better develop skills that might prove useful in cases of safety, foresight, planning and empathy. Although Tooby does not directly refer to Samuel Taylor Coleridge's "Willing Suspension of Disbelief", he gave the example of the movie where the lion lunges to the fourth wall. This event incites fear in the audience

but does not drive them to run from the theatre. Through cognitive decoupling, the audience could suspend disbelief and experience fear, but it does not affect their behaviour. This process reflects directly to an unspoken contract between the audience and the storyteller, the director in the case of a movie, where the audience willingly suspend their disbelief, so the projected visuals and the fictional nature of the information become temporarily true within their context.

By extension, the dinosaurs in *Jurassic Park* cannot be considered as "photographically" real, the visuals do not represent objects or organisms that contemporarily exist in the state presented in the film, and by extension, the film can only be believable from a perceptual point of view. The term photoreal, in this case, describes the textures and material that are placed on the 3D models that merge seamlessly with the live-action footage. One of the enduring attractions of photoreal computer animation is presenting everyday objects constructed digitally and placed in a medium that previously could only be presented in a stylistic and non-realistic format (North 2008). The increase of use of photoreal visuals in films did not only face technical issues, as discussed in Part 1 of this chapter, but practitioners also met unexpected psychological obstacles that diminished the believable aspect of photoreal characters.

2.3.5 The Uncanny & The Abject

As highlighted in the previous section, the presented reality in films is perceived to be real, relatively to its given context. However, advances in computer graphics and the technology used in the animation industry have led to an increase in realism, where the visuals are portrayed with photographic quality. With this emergence of realistic computer-generated imagery (CGI), photoreal characters did not only include creatures that would seamlessly blend with live-action footage, but also photoreal digital characters, or Synthespians (North 2008). Consequently, a new issue was presented, arguing that the increase in realism does not necessarily imply a rise in believability.

Roboticist Masahiro Mori proposed this idea commonly known as the Uncanny Valley, in 1970. Mori argued that as a robot's (or character's) resemblance to humans' increases, so does the viewer's sense of familiarity (figure 13). However, there is a tipping point where the audience's familiarity drops, which forms the uncanny valley (Mori 1970). The result of this fall in familiarity causes an "eerie, frightening, repulsive— "uncanny"" sensation (Geller 2008) therefore disconnecting the audience from the visual. In film and animation studies, the Uncanny Valley is often discussed with *Final Fantasy: The Spirit*

Within (2001) as a key case study (Dobson, Honess Roe et al. 2018, North 2008). Despite being praised for its beauty and technical achievement, *Final Fantasy: The Spirit Within* was a commercial failure that forced Square Studio to file for bankruptcy (Monnet 2004).

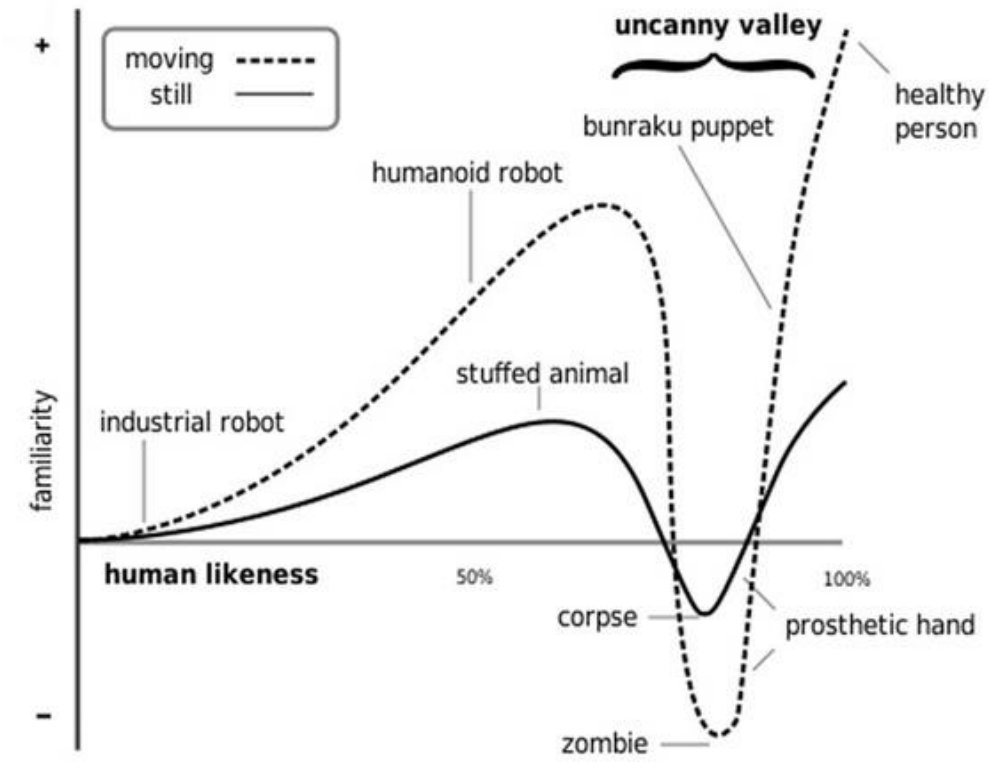

Figure 13 The Uncanny Valley Graph (Mori 1970)

As the first entirely computer-generated photoreal feature-length film, *Final Fantasy* is heavily associated with the Uncanny Valley as its characters featured photoreal human appearances with mechanical movements due to the relatively new motion capture technology and its use in the production pipeline (Christophers 2011). Humans are genetically programmed to unconsciously recognise the subtle imperfections of a human face and body. For example, if a human head was modelled to be symmetrically perfect or too imperfect in its subtle nuances, it might be perceived as uncanny (North 2008).

However, the film plays the role of the vessel for the main attraction, the protagonist Aki Ross. Despite being a fictional character, Aki was promoted on billboards and magazines as the star of the film indicating a possible celebrity life outside of the screen (North 2008) which contradicts Crafton's (2012) argument that animated characters exist at the moment of projection. The film focused on the level of details of the textures and each of Aki's hair strands rather than the delivery of a compelling story. Consequently, Aki did

not convince the audience that she is real; she did give the impression of being lifelike, with an eerie presence (North 2008).

However, the lack of empirical evidence on the topic has caused a divide with researchers on the existence of the Uncanny Valley (Pollick 2010). The unmoving story and performance in *Final Fantasy: The Spirit Within* is argued to be the reason behind the film's failure in the Box Office rather than the Uncanny Valley (Sobchack 2007). The representation of the protagonist's moral actions whose role is substituted or abducted by the supporting characters (Monnet 2004) contradicts with the Smith's (1995) notion of the person schema and the moral structure of engaging characters. Uncanny valley advocates have been able to study the subject from a psychological perspective, which was already established by Ernst Jentsch (1906) and further developed by Sigmund Freud in 1919 (Freud, Haughton et al. 2003).

Jentsch (1906) describes "the uncanny" as the term used to refer to an individual not feeling "at ease" when confronted with something that seems or is foreign. Jentsch conducted his study based on the eerie effect produced by human wax figures and automatons (automatic toys or machines). Jentsch argued that the more complex a machine is, the easier the uncanny effect can occur. He often refers to the uncanny as directly linked to intelligence, considering his different test subjects from superstitious, children, women and dreamers.

Freud did not agree with all Jentsch's work and argued that the uncanny effect comes from the human urge to create copies of themselves to cheat death (Freud, Haughton et al. 2003). Freud illustrates his argument by referring to the Egyptians who developed the art of creating images of the dead and the conventional religious notion of the "immortal soul" as an aspect of the doubling technique to cheat death. The problem Freud pinpointed is when the "double" changes "its aspect. From having been an assurance of immortality, it becomes the uncanny harbinger of death" (Freud, Haughton et al. 2003). Therefore, Freud argues that when humans are exposed to an object that stimulates the feeling of uncanny, they are experiencing their repressed fear of death appearing before them. This process of repression is natural as it aids humans to understand their mortality, but this mechanism fails when dealing with an uncanny object. Also, Freud (2003) discussed in his essay the nullification of the distinction between reality and imaginary which occurs when elements that are regarded as imaginary appear in the real world; or "when a symbol takes over the full functions and significance of the thing it symbolises."

One of the examples that illustrate Freud's argument is the story by E.T.A. Hoffman titled "*Sandman*". It depicts the story of a supposedly fictional character that preys on children in the real world by throwing sand in their eyes, ripping them out and then flying back to the moon to feed them to its children. The act of removing the eyes can be interpreted as a form of castration and the loss of identity which can be used as a source of horror in storytelling (Jaylee & Stacey 2014, Freud, Haughton et al. 2003). According to Freud (2003), the existence of the imaginary world depends on the fact that it is not submitted to the reality-testing faculty of a human's brain and therefore any element that is not uncanny in fiction could become uncanny in real life if presented without justification. It is up to the story-teller, as Freud (2003) explained, to create a world that is either entirely imaginative or justify the existence of fictional entities in settings that resemble reality. For example, fairy tales elements do not produce any uncanny effects since the listeners or readers willingly suspend their disbelief and become fully emerged with the content. By contrast, if the world is less imaginative and resembles reality more than the previous case, then the story-teller could merge spiritual entities or daemonic influences as long as they remain confined within the metaphors and poetry of their world. Therefore, the uncanny phenomenon could be used intentionally to create horror effects on the audience or fails to occur. One of the examples given by Freud (2003) was Dante's *Inferno*, an epic poem that describes the different domains of hell. Although Freud criticised Jentsch's idea of the uncanny, he noted that he had not experienced the feeling of uncanny often enough. This evidence makes Freud's argument questionable as he also was not able to sufficiently provide a definitive explanation of the phenomenon. Regarding *Final Fantasy: The Spirit Within*, Monnet (2004) argues that the uncanny generated in the film relates more to the Freud's notion of the repressed "double" changing or abducting roles which suppressed the positional aliveness of the characters, rather than Mori's (1970) Uncanny Valley. Freud's approach to the uncanny has been a source of motifs that are often used in film to intentionally create eerie and unsettling scenes which, in a setting of a horror film, can be very effective in inducing an emotional response from the audience. *Coraline (2009),* a stop-motion animation, draws influence from the eye-ripping *Sandman* and presents the "Other Mother" and "Other Father" to the main character and the audience (figure 14). The parental doubles featured buttons sown as eyes which they also aim to sow to Coraline's eyes which results in the loss of the heroine's soul (Nicholls 2013). This motif can be found in myths and folktales and is discussed by Freud regarding the repressed fear of losing one's identity (Freud, Haughton et al. 2003).

Figure 14 The Other Mother and Coraline (Selick 2009)

However, this research does not investigate the ontological aspect of the uncanny but considers the occurrence of a phenomenon that causes a decrease in the engagement between the audience and the characters. In addition, the uncanny is often mistaken or associated with another phenomenon known as the abject, coined by Julia Kristeva (1982).

In "The Power of Horrors: An Essay on Abjection", Julia Kristeva (1982) discusses at length the experience of abjection, a field in aesthetics where the subject experiences a violent separation from an object of desire. The abject is the domain where meaning in cultural, physical or emotional margins collapse and are rejected by social standards.

It can have a minimal effect such in the case of food loathing, a primitive form of the abject. The subject experiences nausea or gagging when confronted with certain types of food or more specifically the conditions that constitute the texture and the action performed with these foods, a fly in a bowl of soup or the crust on the surface of the spoiled milk. Furthermore, the abject can produce a terrifying effect when the presented visual revolves around the experience of one's mortality. For example, the sight of wounds, blood, pus, corpses and spectacles that put the subject at the border of being alive are standard abject motifs. What occurs is that the spectators are aware of their connection with the object but experiences a collapse of that distinction and disconnects themselves from the object.

The abject is usually associated with the Uncanny, the phenomenon famously analysed by Sigmund Freud, which revolves around the foreign experienced as familiar, but is categorised as a more violent experience as it revolves around the casting out of the ordinary. A corpse, for example, can create abjection through its uncanniness (Menninghaus 2003). Abjection is the most potent when the subject unsuccessfully tries to identify with an exterior object and finds the impossible within, and that impossibility establishes his very being. The discomfort created in the subject experiencing abjection is a form of cognitive dissonance, which states that any subject suffers an inconsistency in his/her belief, attitude, opinion or perception about any object, self-image, issues or other people (BEM 1967). The subject seeks to distance or detach himself or herself from this experience and therefore experiences abjection.

Just like the Uncanny, the abject is also applied in films and games, such as *Alien (1979), Dante's Inferno (2010), and Bioshock 2 (2010),* as an effective method to generate horror (Jaylee & Stacey 2014). However, with the uncanny the tendency of the motifs to create an ambience of eeriness or unease or tension, the abject incites an aggressive, emotional response from the audience through fear, disgust, and terror. The effectiveness of the abject motifs can be seen explicitly and implicitly applied in iconic character designs and narratives for horror films.

The iconic *Alien (1979)*, presents a series of characters, including the Facehuggers that aim to impregnate the prey's body as an artificial womb for the next stage of the alien's development to burst out of the living victim's chest and then mature to hunt its prey and mutilate them in the most gruesome fashion (figure 15). All of the Alien's development stages present phallic features and grotesque representation of the reproductive organs of the maternal body as a source of death (Jonze 2012, Pimley 2003). The concept of the maternal body has been previously used in the film adaptation of Frankenstein (1931) where the morality of playing God is crossed when Dr Frankenstein constructs an artificial womb or an unnatural space to create life. The result is a monstrous creation that symbolises the defilement of the maternal body's natural biological function to produce life and nurture (Jonze 2012).

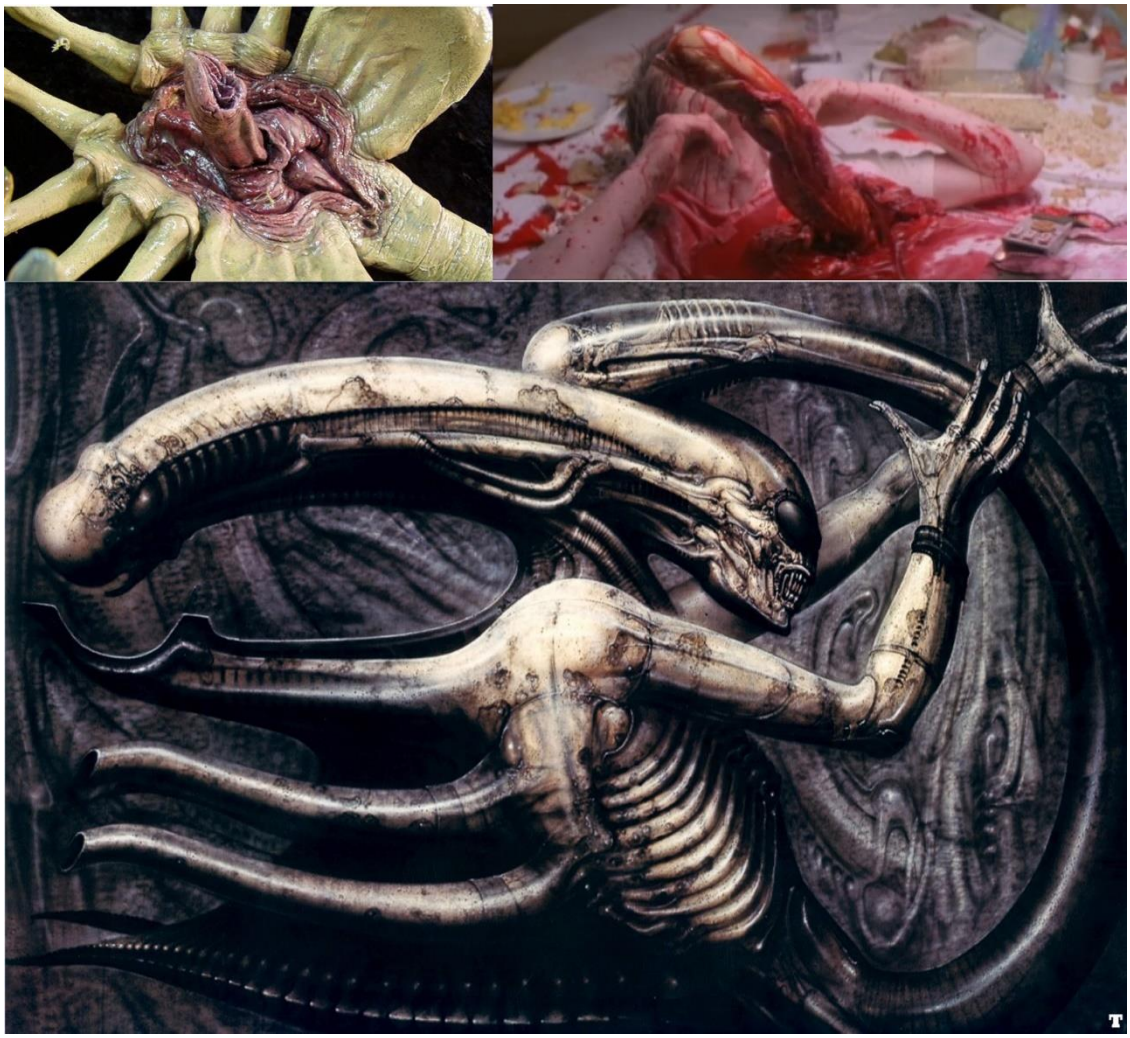

Figure 15 Characters Designed by Giger for The Movie Alien (Scott 1979)

A more recent example of the application of the abject should include the mutant bear from *Annihilation* (2018) as it is considered one of the most terrifying characters of that year (O'Keefe 2019, Lipsett 2018). The mutant bear is the product of the altered DNA of a bear fused with a human skull that mimics the screams of its victims to attempt to lure more prey that attempts to come to the rescue. This is due to the expanding entity in the environment, called The Shimmer, that fuses the DNA of living creatures living inside of it. The film presents the results of this phenomenon as both beautiful and grotesque, presenting mutilated bodies that act as the vessel or fertiliser for the vegetation thriving in the environment (figure 16).

Figure 16 Annihilation Character Artwork (Garland 2018)

Since reality in films is relative to the presented world (Wages, Grünvogel et al. 2004), a significant characteristic of the latter is fundamentally rooted in the imaginary. As Freud mentioned, the imaginary does not enter the reality-testing faculty of a human's brain. Therefore the Uncanny and the Abject can be used intentionally to intensify fear, suspense, and the empathetic or apathetic response from the audience when applied appropriately and effectively in films and games. The examples above highlight an interconnected relationship between the character designs, their environment, and an underlying narrative that formulates their backstories and the actions they perform. Therefore, the narrative is a construction tool that needs to be investigated regarding the presentation of constructed realities and their characters in film. The importance of the narrative is reflected in Chris Webster's (2002) equations, listed below, that are based on John Lasseter's view on the vital ingredient of successful films: the script.

> "Good idea + Bad animation = Good film
>
> Bad idea + Good animation = Bad film
>
> Bad idea + Bad animation = Stinker
>
> Good idea + Good animation = Write your acceptance speech" - (Webster 2002)

The next section discusses the approaches to world creation concepts and narrative structures, proposed by J. R. R. Tolkien who is renowned for his believable elaborate fantasy worlds, that are used in films mentioned in the previous chapter and games that adheres to the importance of characters as narrative agents and the appeal of their personality and the morality of their actions (Lee 2005, Konzack 2006, Smith 1995). In

his discussion of the person schema, Smith (1995) highlights its importance as it crosses cultural boundaries and communicates universally with all audiences. Likewise, Joseph Campbell whose work has inspired the structure and motifs used in *Star Wars* as well defining a universal narrative structure that fits the majority of legends, myths, fairy tales, and stories (Campbell 1949/2008, Campbell, Moyers 1989). The importance of the Campbell's narrative structure is also reflected in its use in other fantasy, science fiction, and animated films including the *Harry Potter Series (2001 -2011)*, *The Matrix (1999)*, and *The Lion King (1994)* (New York Film Academy 2015, Black 2003). Furthermore, it is also used in game design, as well as character and creature design (Rosewater 2014, Ohannessian 2012).

2.3.6 World Creation Concepts and Narrative Structures

As a philologist, Tolkien worked on different archaeological sites that include Anglo Saxon and Celtic cultures, which helped build his background and influences in storytelling (Fimi 2006). One of his early works includes his analysis of the epic poem of Beowulf (Tolkien 1960). In this analysis, Tolkien (1960) takes into consideration the balance achieved through the simplicity of the narrative, the diverse characters and their function as told through an epic poem. Furthermore, a significant aspect of his analysis revolves around the choice and the order of the monsters used throughout the story. Tolkien proved that the monsters were not a product of coincidence, but each of the three monsters that Beowulf faces has a specific function in giving grandeur to a simple story. The epic poem was produced through extensive thought and design to reach and affect the people of its period. It is considered an essential piece of literature and was a significant influence on Tolkien's work.

The epic's influence can be seen in the Fellowship of the Ring book, in a chapter not included in the movie, where Frodo and his company encountered the Barrow-Wights (Callahan 1972). This scene, although not directly linked to the main storyline, serves an essential aspect of the development of Frodo's character, which holds a strong resemblance to Beowulf's self-sacrifice traits. When Tolkien started working on the Lord of the Rings trilogy, his primary objective was to create a mythology that would reflect the era of the cultures he was studying as a philologist (Fimi 2006). However, to accomplish this, Tolkien explains his process in his essay "On Fairy Stories" (1969).

In this paper, Tolkien emphasised that a fairy story is not a story focusing on fairies, but it is about the adventures of mortal humans and their interaction with the faerie realm.

Therefore, a story that follows Tolkien's process does not have to include elves, fairies, dragons or orcs. Tolkien (1969) coined the term Subcreation as the process in which a secondary world is created with its own rules and laws while maintaining an inner consistency of reality. The result of this process was to achieve what Tolkien described as secondary belief, a phenomenon where the readers can easily immerse themselves in a subcreated world that contains a story that holds the attention of the readers and profoundly moves them. To achieve this, Tolkien used different layers in the same world to achieve what Dr Shippey (2005), a Tolkien scholar, coined as the illusion of depth. The first layer is that of language which can be seen in Tolkien's creation of language but most importantly, in the names he used for his characters. The names are descriptive; the more important a character is, the more names they possess in several different languages. For example, Gandalf (derived from Norse) is also named as by the different cultures of middle earth such as Tharkun (Dwarvish) and Mithrandir (Elvish), which mean the grey pilgrim. The different names create a background of the character that describes his personality, behaviour and relationships with the different cultures. The second layer is the layer of history that is elaborated by Tolkien only in certain parts of the story, which creates mystery back with enough information to keep the reader engaged and curious. The final layer is that of culture which Tolkien achieved by creating oral traditions such as songs and poem recited by the characters of his story. Each poem or song was written in different styles to suit the culture to which it belongs. For example, the songs recited by the dwarves in the book "The Hobbit" are completely different in style, as if written by a different author, from the ones recited by the race of men. In addition, these layers can be seen especially in the mythology of Middle Earth, as described in the Silmarillion (Tolkien, Tolkien 1977) which includes an elaborate description of the genesis of middle earth and the travels of the elves for example. Tolkien listed four functions, which are the resulting effect of the subcreation's secondary belief effect: Fantasy, escape, recovery and consolation.

To Tolkien, fantasy is the highest level of creative imagination that a human can practice his skills to create, or in this case, subcreate. This allows the reader (or viewers) to experience an escape from the limitation of their primary world and recover in the subcreated secondary world. This allows the readers to see their reality from a clean slate through the balance of familiar and fantasy elements. The final function, consolation, revolves around the experience of joy. Consolation is achieved by providing a problem that seems impossible to overcome. But with a simple logical resolution, as tension builds

up in the minds of the audience, consolation or the experience of joy is achieved. However, Tolkien's focus revolved around the adventures of a human character within the created world but did not provide any additional information on mythological or folklore narrative structure (Tolkien 1969). Much like Tolkien, Joseph Campbell also believed that myths present a reflection of reality and the human experience told through metaphors, symbols and a structured storyline.

Campbell paid attention to characters and their functionality within a narrative, which makes his analysis of myths and folk stories relevant to the focus of this research. Campbell studied myths from all over the world and discovered that they all follow a similar pattern with their character archetypes and narrative structure, which he dubbed as the Monomyth (figure 17). The latter presented the main character or the hero's journey, and his/her struggles with the challenges and trial that are a metaphorical representation of daily life challenges the audience face (Campbell 1949/2008).

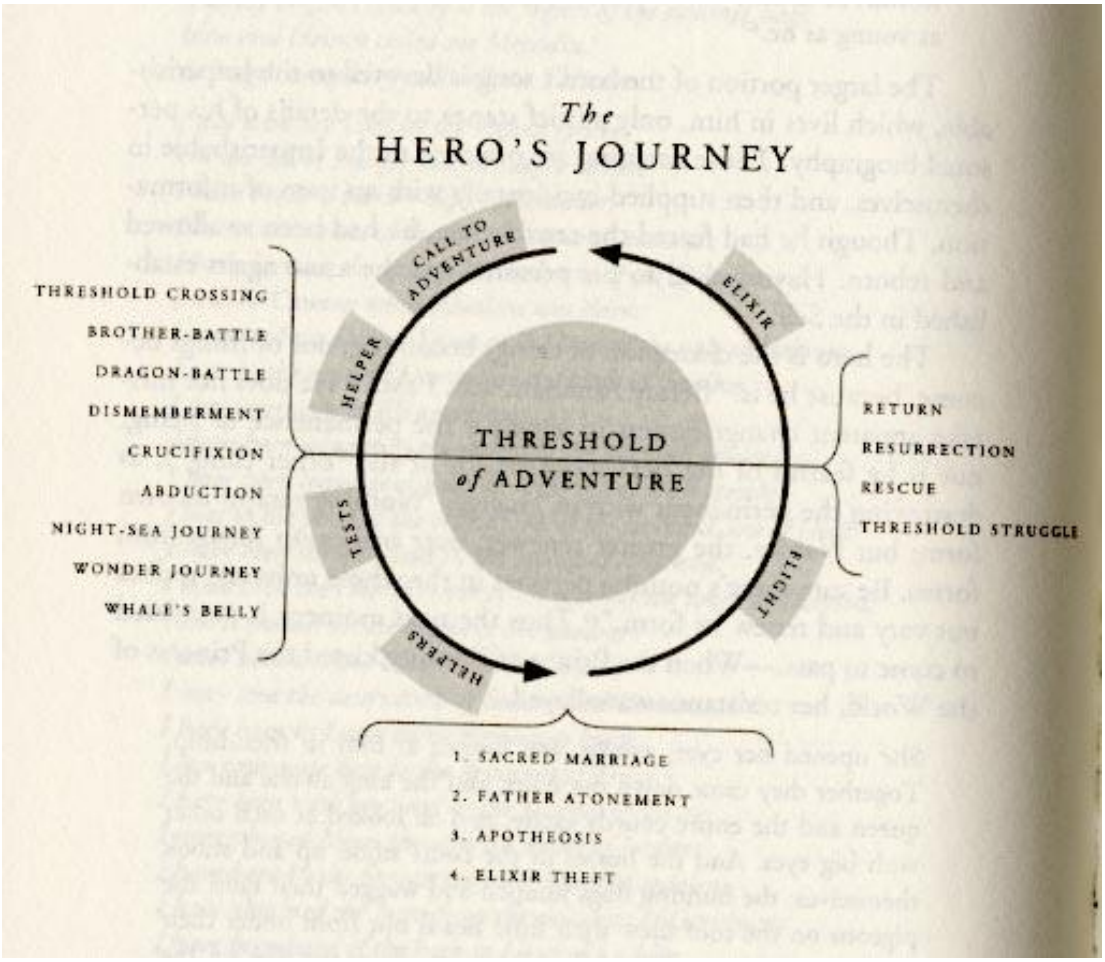

Figure 17 The Monomyth (Campbell 1949/2008)

The structure of the Monomyth depicts the hero leaving his familiar world or comfort zone to unfamiliar territory, where he/she will meet helper characters, for example the

mentor archetype, with whom he/she will engage to overcome challenges and finally returning to his familiar world with a physical, spiritual, intellectual, or moral reward. Campbell relied extensively on archetypes and symbolism found in Myth, a method of thinking known as primitive science. In his book, *Myth and Meaning*, anthropologist Claude Levi-Strauss compiled a series of essays on the primitive mind. Strauss (2001) argued that the 17th century presented a paradigm shift, due to the new scientific discoveries based on empirical research, where primitive logic was repressed to give birth to modern logic. The repressed method of thinking refers to the uncanny theory explained by Freud (2003) and Kristeva (1982) on the repressed meaning of symbols that could produce eerie effects in the audience. This research does not focus on the repressed unconscious, but the awareness of the available motifs that can be used to communicate ideas or to induce horror in film, such as *Alien (1979)*, when needed is a tool that is beneficial for this research (Jaylee & Stacey 2014). The author criticised the usage of the terms primitive and modern but he explained that one does not surpass another. Although primitive thinking was repressed in the scientific domain it emerged in the 17th century in music and art. It is noticeable that the structure of symphonies that emerged in the classical and romantic period follows the same structure of a myth (Levi-Strauss 2001). It is a matter of perspective as primitive logic tends to present knowledge through metaphors and symbols while modern logic relies more on empirical facts and quantified data. A Symbol could be based on a term, a name, a picture or an object that is commonly seen in life but contains an added reference to its original meaning (Jung 1978). For example, the Dung beetle or the scarab is known to roll of a ball of dung and lays its eggs inside for its offspring to hatch. Due to this observation, the ancient Egyptians used this insect as a symbol of regeneration and life personified as a self-generated deity (Geraldine 2002). It was depicted in their art sometimes as a golden insect to refer to the sun, or black to symbolise death and rebirth. This form of logic that associates fact obtained through observation with poetry and art is an interesting aspect to consider in character design. It allows the usage of objects and images with a deeper meaning that depicts aspects of life that are usually presented effectively through abstraction. A character designed based on this notion can maintain its realistic rendering while providing a hidden form of abstraction that should prove to be an effective storytelling medium.

The effectiveness of Joseph Campbell's Monomyth can be seen in its application in different films such as Star Wars, but also in its use in game design (Bartle 2004). The Monomyth is a symbolic representation of the journey undertaken by everyone, which is

why stories that are built around that structure are empathetic. One application of this concept is Bartle's Taxonomy theory in game design (Bartle 2015). Richard Bartle could identify the different types of players where they think and behave differently in a game. Furthermore, Bartle argued that the behaviour of the players changes over time and he attributed that flow or sequence of change to Joseph Campbell's Monomyth starting from when the player purchases the game until they finish the various quests and missions in it (Bartle 2004). This process not only gives the player the freedom to interact with the game as they please but also to customise their character to suits their personal preference.

Finally, as outlined in this section, the narrative structure plays a vital role in the creation of a constructed, believable reality. However, the notion of placing the narrative as the essential ingredient, as proposed by Webster (2002), is inconsistent and contradictory to other opinion and theories. According to Pierre Grage (2014), a senior VFX professional, visual effects surpass the script in importance as they are the film's primary tool to keep audiences in their seats when the narrative is uninspired, and the acting is poor. In addition, the communication issues are also placed high on the list of ingredients that play a crucial role in establishing the non-believability factors in a film (Al-Jamea, Rizvi 2017, Dubner 2017). The outlined views and theories are all valid from their respective perspective. However, the literature highlighted the importance of the coherence between all the ingredients involved to create a reality to be believable. Therefore, the relationship between the narrative, techniques, design, and communication must be studied and researched to achieve an unbiased perspective on the creative processes in generating believable characters for film.

2.4 Summary

Technology has been the primary driver that pushed filmmaking to uncharted territories, particularly with the emergence of Computer-Generated Imagery (CGI) that inevitably led to the birth of digital films. Regardless of format, the primary role of these various visual storytelling techniques is to create believable realities that revolve around compelling storytelling. However, just like any new medium, digital films were confronted by many issues that became apparent, from perception and technical perspective, especially after the release of the film *Final Fantasy: The Spirit Within* (2001) and the bankruptcy of the studio behind it. The failure of *Final Fantasy: The Spirit Within* could be traced to Mori's Uncanny Valley. However, other indicators have emerged regarding production pipelines, cinematography, and psychology that explain

the factors that played a role in the film's negative reception (Monnet 2004, Sobchack 2007, Dobson, Honess Roe et al. 2018). One interesting argument presents the film as "not so much uncanny as it is unmoving", bringing the film's analysis to the fundamentals of animation and storytelling (Sobchack 2007).

Furthermore, after the release of Life of Pi (2012) and the liquidation of Rhythm and Hues, the studio behind the film's stunning effects, other issues regarding the industry's politics, financial state, and the treatment of practitioners became exposed to the public. The proposed solutions involve further exposing the policies and methods adopted by the film industry while reconsidering the structure and the efficiency of the creative process as well as its business model. However, despite the efforts to promote awareness and propose solutions, these issues persist and impose a crucial effect on the believable factor of many films.

The information required to create believable content goes beyond practice alone, as understanding viewer perception and the theories behind it are equally important. The created world in a film must be consistent in all its elements which are unified under a single design to tell a story visually. The components that break the inner consistency of the created world can become a form of dissonance, whether visual or audible, that could produce an adverse reaction in the audience and consequently break believability. For this research, reality is relative to the created world, and its elements must be produced and integrated as part of a whole.

3 METHODOLOGY

3.1 Introduction

This research investigates the creative process behind believability to formulate a method to accurately evaluate the believability factor of photoreal characters ranging from digital humans to creatures. These characters are used in animated films and Visual Effects (VFX) shots consisting of a combination between computer-generated imagery (CGI) and live-action footage.

This research proposes that believability is achieved through the coherence between the Narrative, Design, and Technical elements throughout the different stages of the creative process that can be summarised by pre-production, production and post-production. The methodology chapter discusses the previously used methods and approaches to research character believability and avoiding unintentional uncanny effects. Accordingly, the proposed method in this research, to approach character research regarding believability, is outlined with a discussion on the value of the investigation and its contribution. The chapter proceeds by defining the keywords: Narrative, Design and Technique according to the context in which they are used in the analysis. The following section presents the background information collection process, justifying the method choice and the list of experts in the field of animation who are known for their work in character-focused projects in the film industry. Since the creative process is based on a collaborative effort, the participants must come from different disciplines to cover the range of perspectives from the various departments involved in the creative process for believable characters.

3.2 Researched Perspectives & Methods

Research on viewer perception of characters has been a topic of interest for many researchers and practitioners, with a particular focus on photoreal characters (A. Tinwell 2014, Green, MacDorman et al. 2008, Christophers 2011, Pollick 2010, Steckenfinger, Ghazanfar 2009, Mori 1970, Geller 2008). Although the first study on photoreal character perception was conducted by Mori (1970) in Robotics on the perception of human-like robots and the *Uncanny Valley*, most of the sources were published after the release of the 2001 film *Final Fantasy: The Spirit Within.* The post-2001 sources can be divided

into 3 main groups based on their approach: Scientific (Green, MacDorman et al. 2008, Pollick 2010, Steckenfinger, Ghazanfar 2009, D. (. 1.). Hanson, Olney et al. 2005, Monnet 2004), Theoretical (A. Tinwell 2014, Misselhorn 2009, D. (. 1.). Hanson, Olney et al. 2005, Monnet 2004), and Practical (Christophers 2011, Geller 2008).

The scientific approaches involve biological and psychological methods of research to study the ontological nature of the Uncanny. The theoretical approaches are usually presented in art and design topics in the form of academic sources, critiques and philosophical discussions on specific art pieces, design projects, humanoid robots, and animations. Finally, the practical approaches are presented in projects as the development of tools and techniques used to enhance appearance, movement, and expressions of robots or 3D characters.

This research investigates the creative process behind believable 3D characters. Therefore, the ontological approaches in biology and psychology are not discussed in further detail apart from the background information provided in the theoretical part of chapter 2. However, the epistemological approach to the uncanny is considered in this research as it involves the theoretical and practical methods used to study audience reactions towards presented characters, formulate new methods to create convincing characters and mitigate any unexpected uncanny effects.

From a theoretical approach, experiments have been conducted to plot the Uncanny Valley, to locate the tipping point of the Uncanny Valley and to measure the participants' reaction (Evelth 2013, Tinwell, A. & Gimshaw, M. 2009, A. Tinwell 2009, MacDorman 2006, D. Hanson 2006, Bartneck, Kanda et al. 2009). The results of these experiments presented inconsistent and often contradictory results, which shows that the Uncanny Valley graph proposed by Mori (1970) may be multidimensional and more complex than how it was initially envisioned. For example, the experiments conducted by David Hanson of Hanson Robotics showed different results (Evelth 2013). In the first experiment, the participants were presented with two different robots designed to simulate human-like facial expressions and were asked to describe their experience. None of the participants described the robots as disturbing, and 73% of the applicants found the simulation enjoyable. In the second experiment, Hanson's team presented the audience with a series of pictures of characters. The pictures started with Disney's Princess Jasmine, from the motion picture Aladdin, which morphed through six pictures to become the actress Jennifer Love Hewitt. According to Mori's graph, the audience's empathy level should increase, then suddenly plummet only to increase again when they reach the

picture of a real human (Jennifer Love Hewitt in this case). The audience was asked to rank the presented characters. The purpose of this experiment was to record the dip in familiarity that Mori predicted. Instead, the audience did not experience the decline in empathy, and none of the presented characters seemed disturbing.

MacDorman's experiment (2006) presented videos of robots with mechanical appearance while others were human-like to measure the perceived familiarity against human-likeness; the results were inconsistent with Mori's graph. The drop of familiarity was not as deep or significant as shown in Mori's figure. Also, the results showed that the audience could have significantly different reactions to robots with the same level of human-likeness.

Furthermore, in an experiment conducted at Edward Schneider's Lab in SUNY Postdam, the researchers could locate a dip in empathy while presenting the audience with a series of characters from animations and games. However, unlike Mori's prediction, the valley occurred in the middle of the series when the ogres from the game *World of Warcraft* were presented (Evelth 2013).

To further study the effects of relatable characters to the overall audience satisfaction of a game, Tinwell (2014) presented participants with male and female characters grouped under a specific facial expression. Each group consisted of three male and three female characters where each respectively includes of a portrait of a real human with the facial expression, one low polygon 3d character with the same facial expression, and one low polygon 3d character with an inaccurate facial expression. Tinwell (2014) relied on the Facial Action Coding System to produce the facial expression, and the results showed how an incorrect facial expression could cause a decrease in audience empathy towards the character.

The multidimensional complexity of Mori's graph poses an interesting notion since Mori's graph presents the correlation between appearance and empathy only. In animation, characters function as the main instrument that drives the story within a specific environment and therefore, the Narrative, the environment, and the character's function must be considered. Furthermore, Tinwell's (2014) digital characters were designed for games where they are modelled with a smaller polygon count, therefore in lower quality so that the footage can be quickly rendered in real-time without any delay. Accordingly, the nature of the medium must be considered as it defines the parameters within which a character is modelled. Tinwell's (2014) approach utilises the Facial Action

Coding System, a useful tool popularised by Paul Ekman, for creating convincing facial expressions. However, for an accurate model, it is crucial to design the character from the inside out as the structure and shape of the skull has a significant effect on the overall shape of the final head as it defines gender and muscle development (Zarins 2017). Therefore, specific knowledge of anatomy and the set of skills and Techniques are crucial for creating convincing photoreal characters.

In addition to the theoretical methods, due to the increasing demand for photorealism, animators and designers have tried developing approaches and Techniques to either avoid the uncanny valley by reducing the level of photorealism or to overcome it by improving the Techniques and tools used (Christophers 2011). The character Gollum from *Lord of the Rings* was brought to life by Andy Serkis, whose performance, although impressive, was fine-tuned by the animators to achieve a believable movement and expression (Ebert 2004). To meet the required level of believability with the character Gollum, animators used multiple animation techniques (Christophers 2011) Fiona, from the 2001 film Shrek, is an example where the animators avoided the uncanny by reducing the realism level of the character (Misselhorn 2009). Originally, Fiona appeared to be too photorealistic and was later modified to match the realism degree of the film. The 2007 animated film Beowulf is considered an accurate example of an attempt to overcome the uncanny where extensive anatomical studies were conducted on the human eye to develop an advanced motion capture technology responsible for tracking and replicating eye movement (Geller 2008).

As this technology developed, 3D artists could achieve more photorealistic results as can be seen in Image Metric's Emily Project (O. (. 1.). Alexander, Rogers et al. 2010) and Sweetie (LEMZ 2013). However, the process with which believable characters are produced remains unclear, as the issue with the uncanny persists, and many characters are often received negatively by the audience, although some instances can be considered as an exception (Larsen 2011, Ja 2016, Staniforth 2017). Sweetie, for example, was carefully designed to act and behave like a ten-year-old girl to successfully attract and capture online paedophiles (Crawford 2013). It was possible for a 3D digital character to convince thousands of online users that it is real. In addition, the game "Last of Us" became famous in 2013 as it presented empathic photorealistic human characters (Ryan 2014). The game is known for its stable Narrative structure and impressive visuals, and although it had some weaknesses in its gameplay, it could allow the player to empathise

with the leading two characters as their father-daughter like relationship developed (Ryan 2014).

3.3 Methodology

This research treats the uncanny as a form of visual dissonance that, when unintended, disconnects the audience from suspending their disbelief when presented with a film. The proposed approach to believability must be holistic as it is achieved through effective Communication and integration between Narrative, Design, and Technique. Instead of relying purely on theoretical or practical methods referred in sources investigating the uncanny, this research argues that the evaluation of characters through the Uncanny Valley graph is inaccurate as it only focuses on appearance rather than the characters' function within a context. This investigation aims to inquire about the relationship between believability, the creative process, and the film industry, and establish a framework with which believability can be measured and assessed. The methodology consists of a mixture of qualitative and quantitative methods conducted sequentially. The use of both quantitative and qualitative methods provides a beneficial in-depth approach combining the strengths of both methodologies (Creswell, Creswell 2018). This approach provides new first-hand in-depth insight into the actual process that occurs in the industry rather than analysing second-hand theoretical and practical resources that are specific to a case study or generalised scenarios. Therefore, the mixed methods approach is crucial for this investigation by establishing the relationship between quantifiable information regarding the characters' epistemology – the process, knowledge, skill and toolsets used in the character's production (How is it made?) – and the qualitative information gathered regarding the character's ontology – the purpose of the character's creation in relation to the film and the broader film industry politics (Why is it made?). However, the mixed methodology has some disadvantages in that the analysis model can become unnecessarily complex as qualitative and quantitative approaches are integrated (Creswell, Creswell 2018). To avoid complications, the analysis is conducted in organised sequential phases that gradually determine the assessment criteria for believability. First, the mixed method relies on the collected information from open-ended interview questions with industry experts about their experience and collaborative efforts with other practitioners in the film industry. Key expressions, that indicate the interview participants' reliance on Design, Technique, Narrative, and Communicated – the key terms formulating the creative process – and the

participants' believability principles are extracted from the collected information. Since the key terms can have broad interpretations, they are defined in the following section to define clear criteria that determine the assignment of each participant quotation. The grouped quotes are then quantified to determine the ranking order of each of the key terms regarding importance to the overall process. The collected believability principles and the ranked key terms form the assessment criteria for the qualitative analysis of character case studies. Preparations had to be made before contacting and interviewing the practitioners.

3.3.1 Key Terms

This research argues that the currently available canon of academic research tackles the problem from a purely theoretical approach and does not consider the relationship between the creative process, the practitioners, and the industry. In contrast, practical studies and methods are discussed exclusively from a technical approach and lacks in-depth regarding the Communication within the collaborative effort, design and the character's function in the Narrative. Therefore, this research approaches the issue of believability holistically by considering the relationship and balance between Narrative, Design, Technique, and Communication, through the personal experience of expert practitioners within the film industry. The following section aims to define those four keys terms.

3.3.2 Narrative

Narrative in general terms relates to the telling of a story communicated in many mediums that include novels, poems, song, dance, theatre, music, and animations (Spivey 2005). The term narrative dates to the writings of Plato and Aristotle and became commonly used during the mid-15th century derived from the Middle French word "narratif", and the Late Latin "narrare". The noun signifies "story or account, tale" and the verb 'to narrate' implies "relate, recount, give continuous account of" (Neylin 2016). In research, the term narrative is "usually applied to stories born out of experience and told by people who have not been formally schooled in any professional theory" (Watts 2012). Abbot (2008) defines narrative as "the representation of an event or a series of events" where the term "event" can also refer to "action". For example, the expression "my dog has fleas" is a description because there is no action, while the expression "fleas bit my dog" tells an event or an action, therefore, it is a narrative. The importance of the Campbell's (Campbell 1949/2008) monomyth, as a template for a narrative structure, can be

highlighted in its focus on the actions of the main character that completes an arch or a journey that leads to a growth in their traits.

Furthermore, Doloughan (2011) describes narrative as the "term used to refer to a tale told by a narrator", while the term story is defined as "the sequence of events which make up the narrative". For this research, the term narrative denotes the sequence of events that are visually represented through characters. In addition, character designers often create background stories that are not presented in film as part of the main narrative. However, these background stories help the designer shape the character and present small details that give a degree of depth to the character and allow the audience to understand some of the character's history, personality and traits, and motives (Tillman 2011). For this research, background stories will also be considered as part of the Narrative category.

3.3.3 Design

In the book "How designers Think", Lawson (2006) attempts to formulate a clear definition of the term design. However, due to the various uses of the term in many fields ranging from design disciplines such as graphic design or fashion design to business or engineering (Razzouk, Shute 2012), Lawson (2006) argues that defining design is not straightforward. It is an activity that deals with precise and vague ideas, systematic and chaotic thinking while relying on both creative thought and mechanical calculation. Razzouk and Shute (2012) provided a definition that can be referred to by various disciplines and can be used for this research. They defined design thinking as "an analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign" (Razzouk, Shute 2012). Therefore, for this research, Design is considered as the activity that involves the crystallising of a vague idea into a clear and complete image of the product which comes from what the designer knows about it whether it is through a brief or a series of analogies. In addition to the process of sketching and building models that clarify the characteristics of the product by bringing it to a more concrete form which facilitates the later stages of the development process (Razzouk, Shute 2012). In addition, as Lawson (2004) suggested in his book "What designers know", designers and crafters make objects, whether physical or digital, without significant use of drawn plans. The similarities of both disciplines, included in the field of aesthetics, focused on a function which is a creative process in its very nature. Accordingly, terms that can be associated with design, including function, planning,

sketching, drawing, concept, themes, style, idea, and problem solving, are treated as part of the same category.

Since the focus of this research on characters approached from various disciplines involved in the filmmaking process, the term character design is defined as the process in which a functional character is created for a specific environment and Narrative (Maestri 2006). It involves the use of shapes, colours, textures, and style.

3.3.4 Technique

Technique, in the context of this research, is the set of skills and methods used to visually execute an idea in VFX and animation to present the final visual output on screen or to apply and further develop a design into its final output. Due to the various disciplines involved, it is difficult to define each Technique used in the process so. Therefore, this research does not limit its focus to one Technique since it investigates the creative process which is built around a collaborative effort. Technique includes the approaches and skills using the various type of brushes, pencils, pens, software used by the practitioners that fall into categories that involve sketching and drawing such as character designers, illustrators, concept artists, and storyboard artists. Furthermore, it also includes the knowledge and skills to handle the different types of clay and silicone used by sculptors and mould makers. Correspondingly, the knowledge and skills needed to use the required digital sculpting, modelling, animation, rigging, and rendering software such as Autodesk Maya, 3DS Max, and Zbrush are also included in the Technique category.

3.3.5 Communication

Due to the collaborative nature of the creative process, Communication is central to maintaining a cohesive film content and an efficient and effective creative flow. Practitioners are regularly interdependent of their collaborators within the process where interaction occurs in a multiple back and forth formats. In addition, Communication, time management, and cohesiveness must also be established in the different stages of production between the different teams of practitioners that are working in tandem and those whose role occurs in the latter stages. This research considers Communication as the flow of information between the participants of different hierarchal status as well as the workflow within the same level of the creative process. According to Potter (1989), creative practitioners can be classified into different groups based on their function within

the creative process: leading creatives, cultural diffusers, cultural generators, assistants, and parasites.

The leading creatives are those who provide the work, build up the teams to execute it, and finally present the product which could refer to the producers, directors, and supervisors. The cultural diffusers are competent practitioners who utilise their diverse interests as background for their approach in multidisciplinary projects. The cultural generators are highly technical practitioners who work behind the scenes and produce the output. Furthermore, assistants are usually beginners or interns. Finally, parasites are a group of people who make a living off other practitioners' work. In addition to the protests of disgruntled VFX artists mentioned in chapter 2, unequal credit distribution could occur within the creative process as some individuals are often publicly credited or rewarded for the efforts of others (Potter 1989).

Therefore, this research takes into consideration that directors, supervisors, and specialist practitioners operate in different ways but are required to maintain their effort under one unified Design based on the client's central vision. The investigation of the creative process must consider the practitioner's experience in communicating with other practitioners under different classification and disciplines and approaching obstacles efficiently while examining the politics and business models of the industry.

3.3.6 Approach, Governance, and Ethics

Since the investigation involves interviewing experts from a competitive industry, planning and preparations are required that include risk assessment, listing the participants relevant to this research, defining the methods of contact and correspondence, conducting and recording the interviews, and storing and securing the information.

The interviews revolve around experts in the film industry who are still practising and are not of a vulnerable age group. Then, it is crucial that the identities of the interview participants, as well as the names they mentioned in the interviews, remain anonymous throughout this investigation. The actual names do not pose any benefit for this investigation since the research focuses on the creative and Communication process that occurs within a studio.

Furthermore, to avoid any subjective input or influence from the interviewer, the following measures were taken. The participants are informed that the research revolves

around the creative process behind believable characters without providing information on the details or theories mentioned in the literature review. Consequently, the participants are free to explain their process and approach without needing to categorise their approach themselves. The interviewer's responsibilities are to collect information through the questionnaire and prompt the participants with additional improvised questions to clarify specific points without sharing personal opinions, agreeing or disagreeing with the disclosed methods and theories.

To ensure research governance and to overcome any risks in acquiring the information, the aim was to interview eight practitioners from a list consisting of fourteen interview candidates from diverse backgrounds and expertise. The candidates were chosen according to their extensive portfolios and experience in the film and visual effects industry. The eight interviewed candidates were divided into groups of two, respectively covering the pre-production, production, and post-production phase, in addition to a director and a producer for the overview of the entire production pipeline.

Since each participant has a different area of expertise, the format of some questions will slightly differ from one participant to another, but all items will cover the same themes in a consistent order. Therefore, to achieve depth and a broader amount of data that could prove useful to this investigation, the interview was based on a combination of a few closed questions that acted as icebreaker introductory questions to pinpoint the expertise, length of the participant's professional career. The following questions are open-ended and aim to prompt the participants about their professional background and experiences in the field of film and animation. Finally, each participant was interviewed individually and privately, to avoid any interruptions, via Skype. A digital voice recorder and the default mobile phone's recorder are used to record the conversations in case one of the two devices fails. Both devices' batteries were fully charged, and the internal memory is checked for an adequate space to store the recordings. The second stage is to outline the set of questions appropriate for the interviews.

3.3.7 Questionnaire Design

The integral roles of the participants in creating some of the most memorable scenes in popular films have led many to partake in interviews that have been already uploaded online. It is essential to study these interviews and reformulate questions to explore specific answers that will help investigate in-depth the creative process. To ensure the

effectiveness of the questions in extracting the appropriate information, the questionnaire was tested in two distinct mock interviews, with a 3D creature modelling artist and a concept artist working in Visual Effects, and then adjusted to meet the requirements of the interviews.

The questionnaire used for the interview can be found in Appendix 1 and is divided into six sections. The first section includes the participant's ID reference, area of expertise and is used solely for organisation purposes and are anonymised in this thesis. The second part investigates in detail the candidate's background and their personal views on the creative process within the industry. Furthermore, this section eases the participants to share their information comfortably before diving into more precise questions. The purpose of the sections that follow is to cover the participant's creative process from a general and collaborative perspective to character design and development which is this investigation's primary focus. Therefore, the questions in section 3 aim to explore the participant's creative approach to each project, followed by a series of questions investigation the Communication process in the studio. The 5th section investigates the practitioners' character development approaches, followed by interview closing questions.

3.3.8 Establishing contact

Once ethical approval was received, the participants were contacted via individual emails, Facebook, or through studios and personal assistants, explaining in general the purpose of the research and inquiring about scheduling an interview. Although difficulties in receiving responses from the candidates were expected, correspondences were more challenging than anticipated. The delays were due to the nature of the participants' profession that forces them to regularly travel, work within stressful schedules and under strict non-disclosure contracts. While some participants did not reply to the invitations, the other responses were mixed. Some participants were either too busy and could not find the time to schedule an interview, or did not receive clearance from their studios to take part in an interview while under contract. The participants who were keen on partaking in the research had to confirm weeks or months after the initial correspondence.

Once any of the participants accepted to be part of the investigation, they are provided with the questionnaire (Appendix 1) via a Google Documents link, to go through the questions, prepare their answers and set a date and time for the interview.

The participants are made aware that the researcher's schedule is flexible and can be managed to fit theirs. Also, the participants are also informed that even though the questions are of an open-ended nature, the facilitator will not engage in a debate or share personal opinions or views as all answers should come mainly from the interviewee. Furthermore, the participants are not required to state names if they chose not to. The facilitator will aim to keep the identities of the participants confidential.

3.3.9 Participants

The participants were chosen based on their extensive resumes, their experience in the film industry, and their diversity in expertise. The list involved two character designers, two animators/VFX artists, two supervisors, one director and one producer. The chosen diversity of artists covers the different stages of the creative process and include gender diversity. However, the film industry's practitioners live a nomadic lifestyle, chasing after the next project without any guarantee of future work, as well as working long hours under non-disclosure contracts.

Furthermore, the subject of gender equality in the industry is also discussed in a series of online interviews released monthly on the official website www.womeninvfx.com which has a link to a YouTube and Instagram page (Chan 2017). The interviews covered the experiences of women practising in the VFX industry. The discussions included their background, social settings, interests, advice to other female artists, collaborations with other practitioners within the workplace, highlighting that the industry is male-dominated, especially in small studios. Other former female VFX artists also explained the gender issue in different documentaries and interviews. According to VFX artist Marianna Acuña Acosta, the nature of the industry has made it very difficult for practitioners, especially women, to maintain and constant flow of work, especially while having dependents (Al-Jamea, Rizvi 2017). According to the British Film Institute statistics, the percentage of women working as directors and screenwriters in the UK film industry have respectively increased from 9% and 14% in 2014 to 16% and 21% in 2018 (British Film Institute 2017, British Film Institute 2018). Although gender equality is being integrated into larger companies and studios such as Industrial Light and Magic (California & London), Framestore (London), and Double Negative (London), it remains an issue as women constitute 17.5% of the Visual Effects workforce (Chan 2017).

Due to the competitive nature of the industry, some participants required prior clearance approval to conduct any interviews from their studios, others were relocated to work on

projects and had fully booked schedules. Therefore, it was difficult to establish correspondence with participants from both genders which should not be considered as a crucial issue as this research is interested in the creative process within the VFX production process often aimed to achieve the client's vision rather than personal style.

Furthermore, since this research does not intend to investigate the gender equality issues in the industry, the investigation will revolve around whoever accepts to partake in the study. Consequently, for this research, it was crucial to simplify the pool of practitioners to the pre-production stage, which formulates the foundation of the creative process where all characters are Designed and proceed with the practitioners who replied. The pool of participants consists of 4 practitioners listed according to the order in which they were interviewed:

- Participant A: Character & Creature Designer
    - A character designer is a specialist who visually creates original characters, for a specific purpose or function, from a script or given descriptions (Tillman 2011, Bancroft 2016).
- Participant B: Illustrator & Concept Artist
    - A concept artist develops through illustration an expression of thought and imagination to bring characters, costumes, props, and the environment together (Shamsuddin, Islam et al. 2013).
- Participant C: Model Maker & Prosthetic Artist
    - A model maker is a specialist responsible for building any object or location, in a miniature or a large scale, used for the filming process (Rickitt 2000).
- Participant D: Makeup Special Effects Artist & Mould Maker
    - A makeup artist is a specialist responsible for sculpting and casting prosthetics for practical facial and body effects (Failes 2015)

Once the correspondence is established, the participant is informed that the interview will be recorded and used for academic purposes. If consent is given, the questionnaire is then forwarded to the participant and the interview's time, and date are scheduled.

3.3.10 The Interview & Information Collection

The interviews were conducted remotely and recorded digitally due to the geographical location of the participants. In addition, the presence of the researcher on site does not offer any significant advantage in gathering the information for this research. After the

completion of each interview, the recordings were transcribed in Microsoft Word and then edited into a legibly written format. Both audio files and Microsoft Word documents were securely backed on Dropbox and OneDrive. Finally, the edited documents were sent to the participants for corrections and copyright consent.

Since the interviews are based on open-ended questions, the lengthy responses have rendered the summary of the content in chapter 4, a more practical approach. The grouping of the summarised answers is based on a similar thematic approach to the questionnaire's categories, where each central theme features subcategories. The themes are defined according to the central idea discussed in a group of questions where the content is presented and organised based on the overlapping, contradictory, and unique responses of the participants.

3.3.11 Coding in NVivo

To start the analysis, it is important to highlight the content in the interview that can be categorised as Narrative, Design and/or Technique, to define whether believability is achieved through the balance of the three categories. However, since the product of a studio is built upon a collaborative effort, it is vital to consider Communication and Experience as a fourth category, titled "expertise/experience/Communication" that presents the participants' Communication and management skills, as well as their ability to anticipate unexpected challenges.

After importing all the edited interviews into NVivo, key terms and expressions of each interview were assigned to the categories assigned to each participant respectively. Once the expressions are assigned, charts illustrating the preference of each participant, regarding the four defined categories, are produced within NVivo to help with the content analysis.

3.3.12 Additional Preparations and Training

During the interviews, the participants discussed topics regarding the use of anatomy, function, realism and believability, classical sculpting, and the nature of the character production process in visual and practical effects. Therefore, a training workshop in realistic human anatomy sculpting was attended and completed to better understand the process, techniques, and terminology used by practitioners when analysing the interview quotations.

The workshop included a lecture on anatomy, the difference between female and male bone structures, and the function of muscles regarding performance and the appearance of a human head. From an anatomical perspective, believable human characters are highly dependent on the accuracy of the bone structure and the character's sex. Inaccurate anatomy has repercussions on the character's final appearance, facial expressions, and performance that could produce uncanny effects. The tutor demonstrated the difference between male and female skulls of different age groups as well as skulls from various ethnicities. Figure 18 highlights these differences regarding the shape of the skull and the angle of the jaw, for example (Zarins 2017).

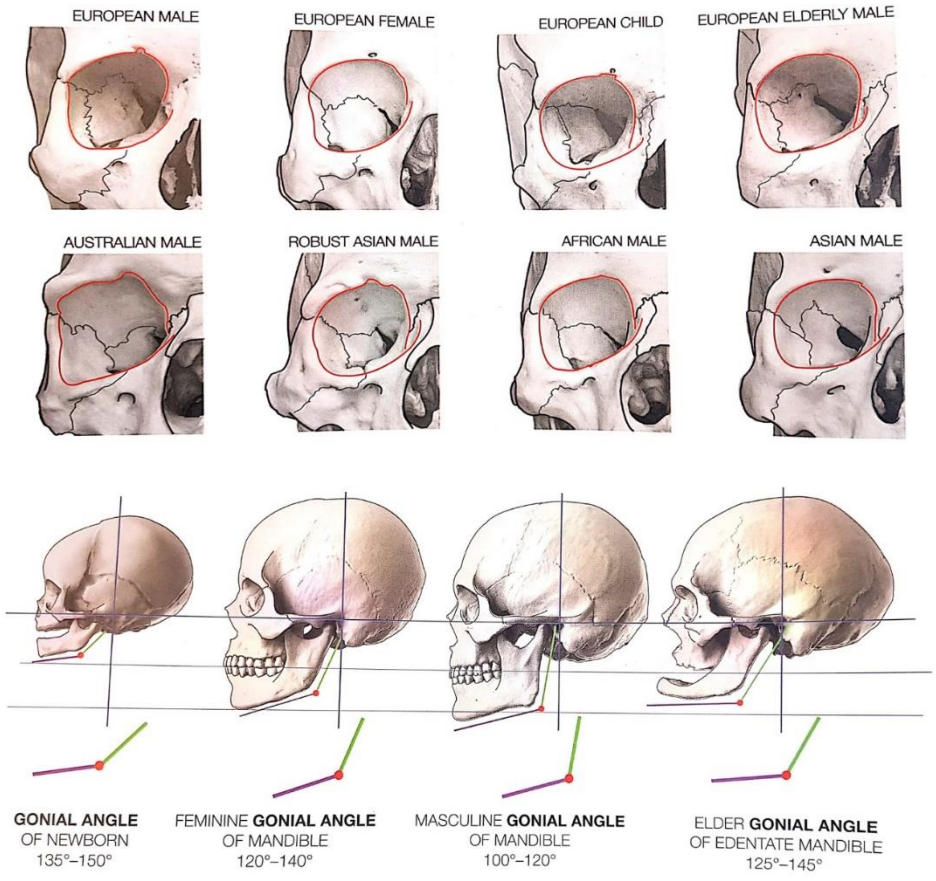

Figure 18 Human Skulls (Zarins 2017)

The tutor also discussed the logic behind the use of human and animal anatomy in the production of fantasy creatures. Also, the lecture was followed by a practical exercise where each participant was required to produce a realistic anatomical human head, as seen in figure 19, using WED Clay, a smooth slow drying clay used in the industry for casting models and mould making (Martin 2017).

Figure 19 Workshop Output (Melki 2017)

3.3.13 Analysis

The analysis approaches the subject of believability from two perspectives. The first approach investigates believability of characters through the creative process, which is summarised by Narrative, Design, Technique, and Communication. This research argues that believability is achieved through the balance between the four terms. To maintain rigour, the analysis will revolve around the content of the interviews and how it is reflected in the formulated NVivo diagrams. First, each interview will be compared to its respective charts to define the case of each participant. The analysis proceeds by examining the participants to identify overlapping approaches in the pre-production creative process. The balance between Narrative, Design, Technique, and Communication indicates an effective and efficient creative process that generates believable characters.

However, reality and believability can be achieved if all elements are assessed holistically, as mentioned in chapter 2. Therefore, the second stage of the analysis argues that believability is relative to the characters' function. Characters generated through a well-established process could appear as non-believable if assessed under different criteria in relation to their purpose. As mentioned in chapter 2, the industry is facing financial difficulties which are resulting in rising complaints from practitioners and fans.

Studios are resorting to their intellectual property, product placement, and preserving viewership to maintain a sustainable source of income through merchandising. Therefore, characters are being incorporated into film for purposes other than promoting the Narrative. The interviews provide insight into the function type of characters, mentioned by the participants, that are sorted accordingly into categories, based on a set of criteria extracted from the interviews. The character will then be classified into their respective 3-dimensional matrix diagram to be evaluated regarding Narrative, Design, Technique, and Communication. According to the new set of evaluation criteria.

4 INTERVIEW OUTCOMES

4.1 Introduction

The initial interview participants consisted of eight experienced practitioners, chosen from a list of fourteen candidates, divided equally to cover the pre-production, production, and post-production phases, with the remaining two consisting of a director and a producer to overview the entire pipeline. However, due to busy schedules, non-disclosure agreements, and the participants' nomadic lifestyle, the interview participant list was adjusted to four participants covering the pre-production phase following the limited responses from the candidates. The interview participants were all male with international experience in special and visual effects spanning from 17 to 33 years. This chapter discusses the themes covered in each of the 1-hour long (approximately) interviews without any interpretations.

After recording and securely storing the interview audio files, the conversation was transcribed verbatim into a typed script. Then, repeated and filler words were edited out without modifying the context and meaning of the answers. As a preparation for the analysis in Chapter 5, this detailed chapter outlines the key points discussed in each interview; the full interview transcripts are copied in Appendix 2 that can be accessed through the attached CD. Each participant's answers are grouped according to the corresponding theme. In addition, the responses are outlined according to the participants' overlapping, contradicting, and unique answers. The questions are referenced by their respective number found in the standard questionnaire in Appendix 1 and are marked as Q (Number) within the text. This chapter also presents the additional information acquired from participants when prompted to clarify or further elaborate on specific subjects which were not considered in the original questionnaire. The format in which the answers are referenced consists of the initials of each participant (A, B, C, D) followed by the corresponding number of the question found in each transcribed interview in Appendix 2.

4.1.1 Participant ID Summary

Table 1 lists the questions 1 to 2.2, found in Appendix 1, act as icebreakers designed to present the discipline and expertise of each participant. Q1.1 is only used for organisational purposes and is anonymised for this research. In summary, the participants are experienced professionals from different disciplines in the film industry. For these participants, their route into the VFX industry was not pre-planned or systematic. Each followed a unique route that unexpectedly led to their professional practice in the film industry. However, it is noteworthy to mention that all participants highlighted their passion and long-time commitment to their craft as film enthusiasts, comic book readers, interest in theatre, Halloween makeup, and drawing even before the start of their professional career.

Table 1 Questionnaire Excerpts Q1.1 to Q 2.2 (Appendix 1)

Q 1.1	Please state your name
Q 1.2	What company do you work for?
Q 1.3	What is your field of expertise?
Q 2.1	How many years have you worked in the industry?
Q 2.1.1	What is it that first attracted you to your field?
Q 2.2	How have you developed your skills?

Participant A is a character designer, currently a freelance artist, with a career spanning more than 30 years in the industry, who worked in numerous companies including Industrial Light and Magic, Paramount Studios, Universal Studios, and Fox [A(1→5)]. Participant A's suggests an intuitive drive for their route into the VFX industry:

> *"I was born doing this and I had to find a way to make a living doing it because I suck at everything else (A5) […] The position didn't exist prior to me going after it […] I started as a character designer in 2D animation and worked my way into film." (A6)*

Participant B is a French concept artist and illustrator with 21 years of experience in the industry working with WETA Studios and as a freelance artist for other films. Participant B stated that he first worked as a comic book artist for six years before switching to film after 2003 [B(1→4)]. Like participant A, participant B's transition into film was

circumstantial. While illustrating comics in New Zealand, he happened to be in the right place at the right time to establish a career in the film industry (B4).

Furthermore, participant C is a model maker, with 17 years of experience in the industry, who worked in WETA Studios and is currently focusing his efforts on TV series and running two companies [C(1→4)]. Participant C's interest in the making of 80s horror films was the key factor for pursuing a career in the VFX industry (C4).

Participant D, currently a freelancer, has a career spanning over 33 years in the film industry as a makeup and prosthetic artist. Participant D has worked with numerous studios and artists including Millennium Effects, Animated Extras, John Nolan Studios, and Mark Coulier [D(1→4)]. Participant D initially wanted to become an actor but got involved in Halloween makeup, a standard starting point for makeup artists involved in the industry, which led him to work in theatre then film (D4).

To develop their primary skills, Participant A stressed his interest in drawing at an early age and then consistently practising through 2D animation to reach the position of character designer for films (A6). Similarly, Participant B emphasised on practising and working hard as crucial factors in skill development. Additionally, Participant B argued that the exposure to cultures through visual art, music, film, and traditions, and finally to be respectful to collaborators, is also a vital element in the development of his skills (B5).

Having worked in a different industry in his early career, Participant C utilised the diverse transferable skill set acquired through his education in model making, set design, professional practice in architecture. These skills set provided Participant C with the opportunity to move to New Zealand and work in the film industry (C5).

In contrast, Participant D did not discuss his education or his initial professional practices but stressed on skill development through learning from other artists especially through collaborations. In addition, Participant D highlighted the importance of social media in improving the interchange of information on specific Techniques and skills (D5).

4.1.2 Questionnaire Summary

The first set of questions, outlined in table 2, involves the opinions of the participants on issues regarding the criteria that make the subject of their expertise successful in a movie (Q 2.3). In addition to the views of the critics (Q 2.4) and audiences (Q 2.5), and their responsibilities as individuals within a broad production team (Q 2.6).

Table 2 Questionnaire Excerpts Q2.3 to Q 2.6 (Appendix 1)

Q 2.3	In your opinion, what are the top 5 criteria that make the [field based on candidate] in a movie successful?
Q 2.4	Do you think that film/TV/game reviewers accurately report on the believability of 3D characters? In what way?
Q 2.5	How do you consider the audience's perception during the development process?
Q 2.6	What are your main responsibilities, and where do you, as an individual, fit into the wider animation/production team?

The interview proceeds to inquire about each of the participants' personal experience and contribution within a specific studio (Q 3.1), followed by a series of questions (table 3) regarding the various approaches each participant undertakes for each project, and whether these tactics present a consistent or an evolving formula (Q 3.2 → Q 3.4.2).

Table 3 Questionnaire Excerpts Q3.1 to Q 3.4.2 (Appendix 1)

Q 3.1	What is the working culture at […Studio name…] and how do you contribute to its overall operations?
Q 3.2	How do you initiate, develop, and sustain a flow of work?
Q 3.3	At the inception of every project, how do you develop your ideas?
Q 3.3.1	What practical steps do you take?
Q 3.3.2	How do you manage the project?
Q 3.3.3	What communication skills do you believe are important?
Q 3.4	What specific methods do you use in undertaking your projects?
Q 3.4.1	What common approaches do you use?
Q 3.4.2	How have your methods evolved over time?

After outlining their approaches, the participants were asked to highlight one of their favourite characters and elaborate on the factors that made it successful and meaningful

to them (Q 3.5 → Q 3.5.2). The questions that follow in section 3, outlined in table 4, of the questionnaire act as transitional queries to the Communication and collaboration segment. The participants were asked about their studio position regarding Narrative, Design, and Technique and the challenges and opportunities they faced in that role (Q 3.6 – Q 3.7).

Table 4 Questionnaire Excerpts Q3.5 to Q 3.7 (Appendix 1)

Q 3.5	Can you highlight a favourite project/character you've developed?
Q 3.5.1	What makes it so special for you?
Q 3.5.2	What were the key factors or elements that made it work?
Q 3.6	In relation to narrative, design and technique where does your discipline fit into the organization of the wider studio?
Q 3.7	What are the main opportunities and challenges in relation to your own creative practice and can you give practical examples?

Section 4 of the interview investigates the skillsets collaborating with the participant, the Communication methods, and examples of obstacles and resolutions that occurred (Q 4.1 → Q 4.4). The adopted questions that explore the skillsets are outlined in table 5.

Table 5 Questionnaire Excerpts Q 4.1 to Q 4.4 (Appendix 1)

Q 4.1	What other key people and skillsets do you require on your immediate creative team?
Q 4.2	How does the communication process occur between the creative team and the production team? (for example: via email, meetings, supervisors?)
Q 4.3	What communication obstacles have you encountered while working with your immediate team?
Q 4.4	How do you resolve creative differences within a team? Can you give examples?

Furthermore, the participants are asked to highlight the changes that occurred in the industry (table 6), according to what was discussed, and how predictions can they highlight regarding the evolution of the industry in the future (Q 4.5 → Q 4.5.4).

Table 6 Questionnaire Excerpts Q 4.5 to Q 4.5.4 (Appendix 1)

Q 4.5	What are the most significant changes in the industry in the last 10 years?
Q 4.5.1	What aspects have remained unchanged?
Q 4.5.2	What has improved?
Q 4.5.3	What has worsened?
Q 4.5.4	How do you see the industry evolving in the future?

The queries (Q 5.1 → Q 5.5) from section 5, outlined in table 7, are focused towards characters. The participants were asked to list the essential criteria in character production regarding, Narrative, Design, and Technique, as well as the role of rejected characters in the production of the final output and the different believability levels of characters. Also, the discussion involved the outlining of advantages and disadvantages in the use of CGI characters, followed by examples of believable and non-believable characters. Finally, the participants were asked about their least favourite character and project and the reasons behind its negative impact.

Table 7 Questionnaire Excerpts Q 5.1 to Q 5.5 (Appendix 1)

Q 5.1	If you summarised the creative process into narrative, design and technique what do you believe are the important aspects of character development?
Q 5.1.1	Firstly, in narrative.
Q 5.1.2	Secondly, in Design.
Q 5.1.3	Finally, in technique.
Q 5.2	Assuming that not everything from the creative process reaches the final output, what do you do with rejected ideas?
Q 5.3	Can CGI characters be categorised into different rank orders/levels from believable to non-believable?
Q 5.3.1	If so, how do you categorize them?

Q 5.3.2	Can you provide examples of believable and non-believable characters?
Q 5.4	What are the advantages and disadvantages of using CGI characters? How are they different from other character mediums (live-action actors or animatronics for example)?
Q 5.5	Can you talk about the least favourite project/character you worked on? What makes it your least favourite?

The final section consists of closing questions (table 8) regarding further collaborations and contact (Q 6.1 → 6.3). The participants' answers are outlined separately below under each category.

Table 8 Questionnaire Excerpts Q 6.1 to Q 6.3 (Appendix 1)

Q 6.1	Are there other key factors or aspects of the industry you believe are important that haven't been covered in this interview?
Q 6.2	Is it possible to contact you in the future in case additional information is required for the purpose of the investigation?
Q 6.3	If a session could be organised, would you be interested in taking part in a group discussion with other practitioners to further discuss these issues?

4.2 Personal Views

4.2.1 Important considerations

The participants were asked in Q (2.3) about their opinion on the essential requirements for the subject of their expertise to be successful. The answers present overlapping areas as well as principles unique to each participant.

One of the overlapping criteria highlights the understanding and the skilful use of anatomy as a tool that allows the character artists from various disciplines to be aware of the character's biomechanical limitations which include the movement, structure and function of the different limbs of a creature. Participant A explained that a creature or a character has to strike a balance between fantasy and realism through the appropriate use of anatomy. For example, the understanding of the limitation set by the human skeleton and muscles can help the designer establish the parameters in altering the human figure for the requirements of the project (A7→9). In addition, familiarity plays a vital role in defining a believable character. Artists can shape and change the creature to be purely

fantastical but present elements that the audience can identify. Familiarity can be achieved through anatomy, art, and culture. According to Participant B(6), designing a character through the correct use of anatomy, consequently anchors the character into reality to which the fantastical elements can be added. Furthermore, Participant D(6) highlighted this argument through examples of the creature that "walks like a horse […] or has dreadlocks […] or something that you've seen before."

Regarding functionality, Participant C(6) clarified that a Design background gives the practitioner a necessary skill set to produce believable characters. He further argues that anyone can create something but having design skills is crucial in creating a character that is functional for a specific setting.

Furthermore, the character's functionality does not only revolve around its structure and movement but also to its role in driving the Narrative and impact on the audience. According to Participant A, form follows function. The character must serve the purpose of the script. Therefore, the set of actions dictated by the narrative and performed by the character plays an essential role in shaping the character (A7) and its impact on the audience (D6). An additional background story adds to the believable aspect of a character through the details incorporated on the character that tacitly narrate specific events specific to the character and therefore give it a history or a relatable personality. The world in which the events of the film occur must be considered. Taking into consideration the different cultures or locations from which the characters come from is a crucial element that feeds into the Design and the final output. While working on the costume designs for *The Hobbit: An Unexpected Journey (2012)*, Participant B recalls the director verbally delivering the brief, the backstories and lineage of each character and then highlighting the history, style, and type of their weapons (B6).

The approach in creating characters varies between film, games, or commercials, as the character must be integrated seamlessly with the style of the movie through the correct balance between reality, imagination, and originality. Participant A refers to his argument on the delicate balance, achieved through anatomy, between real and fantasy that must be within the styling of the movie. Furthermore, film, games, and commercials can set different limitations to the balance between the real and the imaginary. In, the anatomical limitations are stricter than they are in games and commercials since the designs have to conform to anatomical accuracy to be integrated stylistically in the movie alongside the live actors. In contrast, anatomy can be flexible and greatly exaggerated in games (A7). From a technical perspective, Participant B argued that the process of creating characters

should start with a general shape or a silhouette, then adding the details like the key to a memorable character is its emblematic silhouette. Participant B explains that a good design of a character is not reflected in the details it features, but whether the details are appropriate and appropriately placed on the general shape of the character. The Silhouette of the character presents the foundation on which the details and secondary embellishment are placed (B6).

Furthermore, Participant C advocates the possession of the skill proficiency to work with 3D printing, and digital tools such as Autodesk Autocad and 3D modelling software, as they are highly beneficial to the production of physical models. 3D Printers and 3D software like Autocad can improve the efficiency and the production speed of model making as they allow the designer and model maker the flexibility to adjust and modify their visual references with accurate measurements and then quickly print a model (C6,7). D's argument further illustrates this point on the critical role of mixing practical effects and CGI to convey a believable character. The sole use of practical effects can reduce the plausible aspect of a character due to the dependence on the vulnerable physical material. While the single application of CGI can render the character fake or synthetic, and consequently, diminish its believability (D6).

4.2.2 Critical Reviews

After explaining their personal views on the criteria for successful projects, the participants discussed their opinions about the accuracy of the critics' reports on films.

> *Do you think that film/TV/game reviewers accurately report on the believability of 3D characters? In what way? (Q2.4)*

All four participants presented similar answers, stating that they did not read the reviews and/or that critics can be dismissive or inaccurate from particular perspectives. Participant A(10) argues that the reviews' inaccuracy, whether from critics or the general public, is due to the lack of visual education as it comes mainly from watching popular movies or playing games, which narrows down the public's taste level to current trends and nostalgia. Participant B(9) also shares a similar view as he considers critics as just another subjective viewer whose taste is possibility limited to a specific genre or films. Furthermore, Participant D(8) argues that the nature of industry can be a bit obscure to some critics which leads to dismissive and negative comments about a film or a character without considering the budgets and the creative process within the studio, usually forgetting that the industry usually requires a high-quality output in a short and limited

time frame. Furthermore, Participant C(9) highlights the remaining issues regarding the marriage between practical effects and CGI where the process still needs to be perfected, which is causing reviewers to be critical and dismissive about CGI while encouraging the currently resurgent practical effects.

However, critics could be accurate to a degree. Participant B(8) argues that the goal of an artist is to remain hidden or be forgotten by the audience and bring the spotlight on the characters and the story. When the audience is captivated by the story and the characters, rather the details and the quality of the characters and VFX, the critique could be minimal, and the filmmakers have successfully produced an engaging film. Another interesting point that Participant B has made revolves around the impact of popular characters has on the audience. Once a film is released the character becomes part of popular culture and therefore will be open to criticism, especially if the character was part of a franchise and did not meet the audience's expectation regarding its source material or original release (B8).

4.2.3 Considering Audience Perception

Q (2.5) is a similar question to Q (2.4) but focuses on the audience's perception of the film and whether the participants consider the possible audience reactions towards their work.

> How do you consider the audience's perception during the development process? *(Q2.5)*

When a project involves an existing property, already familiar to audiences, a designer must consider the history of the character and its impact on its audience. Therefore, the designer must only update or translate a character into a contemporary style without changing its core Design (A11). A designer aims to create a character that impacts the audience rather than attracting focus on its details. Participant A shared a similar opinion given by Participant B(6) in a previous answer regarding the audience's perception of the visuals. According to Participant A(11), an unsuccessful design is indicated if the audience starts analysing and focusing on the details of a character instead of focusing on the presented world as a whole.

The choice of the level of anatomical realism versus abstraction depends on the film, which could be met negatively or positively. The artist must do his/her part in the movie while remaining true to the core Design of a character when translating from a 2D to a

3D style, regardless of whether the audience approves of the updated version or not as some transitions require time for the audience to accept. Participant A presented this argument highlighting his thought process and point of view regarding audience reactions. The choice between anatomical realism and a stylised approach depends on the film and the director's vision. If the stylistic choices were executed appropriately, the cause for the initial negative reactions could narrow down to the audience not being ready for the transition or the change of style. Due to the high probability of repercussions, the filmmakers and artists involved must accept and tolerate the inevitable reactions and allow the audience to get used to the new design approach (A12).

Participant B elaborates this argument with the production of the 3D animated film *The Adventures of Tintin (2011),* an existing popular intellectual property that was initially designed in 2D. As a devoted fan of the Tintin franchise, Participant B argues that the possible negative reaction from the original Tintin fans was considered. The movie was approached with the intent of staying true to the character and the comic's essence, by producing a contemporary homage to the original comic books. The production was built upon extensive research and close collaborations between designers and modellers. According to Participant B, the project was treated as a "labour of love" and a contemporary "ultimate homage" to the Tintin franchise. A team of four or five members were sent to Belgium to gather around 2000 reference photographs of windows, doors, and houses to keep the style of the film similar to the source material and its culture. In addition, specific themes and inventive Designs were carefully considered during the production process as some Designs from the original comic books originate from a different period and might be offensive or racist in contemporary culture (B11).

Also, practitioners need to approach the project by stepping back and considering the output from the audience's perspective (D9). Especially that films and TV programs are shot in High Definition and 4K respectively. Therefore, according to Participant C(10), the audience can quickly inspect characters and props, and consequently, artists are consistently under intense critique. Therefore, audience perception must always be considered by maintaining consistency with the Design of the models which can be achieved by giving the characters a backstory that feeds into the Design. For example, Participant C(10) discussed his approach to the ageing of a gun holster that is been used for 20 years, or designing the makeup of a character who smokes or drinks. Each of those examples requires a specific and unique ageing approach for a believable result. The drinker and the smoker would age a lot in appearance than a character with a healthy

lifestyle, while the gun holster would feature some weathering or some tearing in a few specific areas where the gun would have direct contact with the leather (C10).

Furthermore, Participant D argues that artists are also critical about the quality of their work, especially that they have developed their visual education through practice and aim to improve it constantly. However, it is crucial to meet deadlines. Therefore, the approach to specific designs could revolve around the correct camera shot, length of a scene, or the placement of the character to limit the presentation of a low-quality output (D9).

Additionally, B argued that a practitioner should also work towards self-satisfaction regarding the function of the character to incite fear in the audience or stir other emotions depending on the script. For example, Giger achieved his visions and allowed the audience to react to his work without paying much heed to what the audience thinks of the shocking nature of his work (figure 15). Participant B expressed the difficulty of imagining Giger's work, rooted in horror and integrated into the *Alien* franchise, to change due to the artist's concern of the public's opinion. The characters and artwork are produced to the artist's satisfaction, and the public reacts to it (B10).

4.2.4 The Main Responsibilities

The primary responsibilities of each participant vary as they come from different backgrounds and disciplines. However, the four participants presented interesting overlaps in their role in the broader studio team as they all begin in pre-production.

However, Participants A and B explained that their work begins in pre-production. Participant A highlighted that his responsibilities could start before pre-production, even the movie is approved (A13). Similarly, Participant B clarified that his work starts at the beginning, sometimes before the script is written, on the initial project pitch package and develop the concepts with the director verbally delivering the general ideas of the film or project (B12).

The responsibilities of the participants are not constricted within pre-production only but proceed to the production phase where the film is being shot and produced. The participants are required to carefully collaborate with the production team that includes modellers, actors, writers, directors, designers, and illustrators. Their role is to monitor the consistency of the Design and the storyboard as it is translated into a model, whether digital or physical. In addition, last-minute corrections or improvements could be required

from the participants to Design. However, this is highly dependent on the project, as it is hard to predict when the participants' responsibility could end.

Participant A starts working closely with the modellers when his designs are approved. The modellers represent the workforce that keeps Participant A, through his supervision and art direction, connected to the rest of the film's production. Although Participant A mentioned that modellers are the practitioners he directs the most, he has expressed that his art direction has involved other practitioners (A13). As the lead model maker and the head of the department, Participant C responsibilities revolves around getting the storyboards and started producing the props according to the presented visuals and requirements list. Additionally, communication with other departments, including the costume and animation departments is crucial to maintain consistency in quality and style throughout production (C11).

Participant B highlighted his responsibilities throughout the production pipeline with his experience in the making of *Thor: The Dark World (2013).* Approximately three months towards the end of production, Participant B was required to readjust the concept of a series of weapons. The modifications involved changing some of the handle designs and the details of the weapons as they were still shooting the scenes. The last-minute amendments depended on new camera angle shots that required the weapon to appear in the foreground of the shot with high detail (B12).

The production pipeline and the creative process are rarely consistent between projects and even between the responsibilities within the same project. Participant D highlighted the unpredictability of the job as it constantly varies. In some instances, it could be an entire effect for film or just a small job. However, collaboration and organising tasks priorities are always necessary. (D11)

4.3 Personal Creative Approach

4.3.1 The Studio's Work Culture

Since the creative process is built upon a collaborative effort, it is essential to outline the work culture of each of the participants' environments before proceeding to their creative approach. The participants presented the same overlap on the working culture at their current or previous studio in which they worked. Regardless of the studio, the participants highlighted the collaborative nature of the creative process that is dependent on tacit

Communication and knowledge. However, each participant provided a unique and interesting perspective of this overlap within a specific studio.

Although Participant A is currently working as a freelancer, he provided some insights on the work culture at Industrial Light and Magic (ILM). According to Participant A, ILM was a well-oiled film making machine during his employment period there. The company started with a group of practitioners that knew each other well and could anticipate and overcome problems efficiently. During his experience with ILM, Participant A highlighted their work ethic and stressed that they were one of the few studios that offered their employees an appropriate length of time to develop their communication skills. However, since Participant A is currently working freelance, he acknowledged that ILM changed its approach to hiring practitioners to recruitment on a project basis. Therefore, their employees are continually being changed with each project (A14).

ILM was one of the VFX companies that managed to keep updated with the innovations and incorporate the digital tools into its process once the transition from the use of pure practical effects to Computer Generated Imagery (CGI) occurred. It is noteworthy to state that the "hiring for job" scheme is one of the factors to the nomadic lifestyle of practitioners which currently standard with many studios.

B highlighted a large number of practitioners, twenty-two designers and hundreds of other practitioners from different disciplines and backgrounds, working simultaneously on multiple projects, each led by a director, at WETA Studios (B13). Working with other artists is always beneficial as it increases creativity and production efficiency. The collaborative effort is always directed towards the vision of a client. Therefore, the practitioners' output is not always approved for the film, if it does meet the director's vision, and cannot be used for any future projects. According to Participant B(13), practitioners often put much effort into a piece of work that could be easily discarded. This is a common occurrence that the practitioners involved in film production should not take offence to their work being rejected. Participant B estimates that only 20% of his efforts were ever approved. In addition to the creative benefits of collaboration, being surrounded by other practitioners who have experienced the same process of production also creates a supportive environment. Participant B stressed that practitioners are only "pawns" placed at the bottom of the decision-making pyramid, while the director and a few other people are placed at the top (B13).

Furthermore, part of the tacit knowledge includes an unspoken rule that stresses on the consistency of the work throughout the project, produced quickly and efficiently. Effective communication can help practitioners establish early in the process, the type of materials, style, and approach to creating a specific effect or element in a shot. According to Participant C, everything in a film's production is carefully studied and planned to a specific design (C12). Despite the ambiguity of the creative process, Participant D stressed on the unspoken rule that everything must be done efficiently and effectively. New and inexperienced practitioners might not realise the delicate balance in producing the required work. However, they eventually synch with the overall speed of the process (D12). The creative process can be presented as a conveyor belt since once a practitioners' job is done, the product moves to another specialist. Therefore, parts of the process are dependent on the previous stages and efforts.

4.3.2 Sustaining a Flow of Work

Although Participants A(1), B (1,13), and D(1) are currently freelancers, their process might differ from practitioners with working hours at studios, the presented answers overlap with participant C(1) regarding their endeavour to remain organised and maintain efficiency in their creative process to produce high-quality outputs and meet deadlines.

While working from their homes, freelance practitioners need to have strict and organised work hours. Participant A(16) highlighted the privilege of working from home rather than a studio. However, Participant A stressed on the importance of any freelance practitioners, working in the film industry, to maintain consistent communication with the director and the production team while upholding respect to their collaborators as they could be a source of future work. Similarly, Participant B discussed his process of putting a lot of time and effort to meet the deadlines. The process could take several hours before anything productive or functional emerges from the effort, sketches, and designs.

Most importantly, according to Participant B, is not to be discouraged by failure or obstacles (B14). Also, practitioners must sort their priorities, tackling the essential tasks of a project first, especially since they might have to work on multiple projects at once. Being Organised and as Participant D compares it to:

> *"[…] spinning plates, which is basically doing quite a few jobs at the same time […]" (D13)*

While working in a workshop involved numerous people working different jobs, Participant D stressed on maintaining focus on his responsibilities and trusting his collaborators. It is not essential to have all details, including the full script or narrative, and consistent updates from the progress of other practitioners. However, it is crucial to be aware of the priorities and sort each handed task accordingly (D14).

On the technical side, the practitioners should rely on their cultural knowledge and dive into the process by starting with broad and general ideas and add the details as they proceed to avoid any creative delays and mental blocks. Participant B highlighted his process of generating ideas by drawing and maintaining an immersive flow in his practice. Additionally, Participant B emphasised on the importance of developing a library of visual references acquired from museum and art gallery visits, as well as internet sources (B14). Furthermore, the efficiency of producing high-quality projects is related to the practitioner's effort to remain aware and updated to the innovations and advancements of material as these could drastically improve the costs, production time, and quality. According to Participant C, the choice of materials depends on the project. Some types of silicone cure faster than others but are more expensive. Therefore, Participant C aims to remain updated on any advancements of materials in the industry, which provides him with a broader range of options depends on the film's requirements, budgets and schedule (C13).

4.3.3 Developing the Initial Ideas

As Participant B highlighted, the development of ideas starts with the script after the practitioner signs a non-disclosure agreement (B17). This contract legally binds each practitioner involved in the project to secrecy and forbids any form of discussion on the project outside the studio. However, the participants clarified that often, their responsibilities in the studio could start before the script is written (A17, B17, D15). The idea of a film can often be pitched verbally to the practitioner as a general description of the characters and their impact. In return, the practitioners will translate these verbal descriptions and/or scripts into fully developed visuals and props.

Although practitioners prefer a detailed description (A19), since they are working towards the vision of a director or a client, it is not always the case as the given brief can often be ambiguous and contradictory. Therefore, Participant A stressed on the importance of communication and prompting with the appropriate questions to extract as much information as possible, especially from the director (A17). The key information

practitioners require to start their project is the type of impact, whether it's comedy, horror, drama, the director expects from the character (A17, D15). In some cases, the director would specifically request a specific fantasy creature (B17). Additionally, it is through the script, project description, or brief that the practitioners can understand their characters' personality, traits, motives, and culture (C14).

The practitioners need to be able to read the client or the director's body language or their verbal implication and make smart decisions on how to proceed with the project. Participant A recalls a case where he did not receive a script and the project's verbal description was so ambiguous and contradictory, summarised with the quote "just draw something cool", that Participant A did not know how to proceed with the designs. In this example, the information was so crucial that it dictated whether the character designs were supposed to be drawn for 3D modelling or makeup. Participant A highlighted that each medium requires the designs to be represented in a specific fashion to be understood by either the 3D modeller or the makeup artist (A18). Due to his experience in the industry, Participant A decided to tailor the design for makeup as it was, for that project, the safer approach that would give the makeup and prosthetic artists a chance to proceed with the production.

After developing an idea of the visuals and props, it is vital to understand the characters and the environment they populate to model the props which include the weapons, tools, and costumes. Participant C clarified this process through an example from his professional practice, where he was required to design and produce the weapons for the characters in a TV series. Considering that the premise of the series is set in junkyards and involved a lot of martial arts, Participant C would examine the set drawings and the junkyard designs and combines objects that would typically be found in the presented environment to construct weapons and props for the costumes (C14). Most importantly, the modelled props should never stand out as a separate object from the character but must be incorporated to appear as a single natural entity, made from the resources the characters can find in their environment. Therefore, in the case of a film with live actors, it is also beneficial to work closely with actors to have a better visual reference to size and overall shape (C14).

Therefore, communication is a crucial element of the creative process as it could facilitate or hinder the production progress. The practitioners must rely on tacit knowledge to effectively communicate ideas with clients and collaborators. This tacit knowledge is acquired through professional experience, the exposure to film culture, conducting

minimal visual research and having access to art galleries and museums, and utilising these references while communicating ideas. According to Participant D, practitioners involved in film production are passionate about their craft and film in general. Consequently, they often utilise their knowledge of films and relevant popular culture references in their discussions and brainstorming sessions throughout the film production pipeline (D15).

4.3.4 Practical Methods, Project Management, and Communication skills

The questions Q(3.3.1 → 3.4.2), outlined below, investigate the practical steps, methods, project management and Communication skills used by the interview participants when approaching a project.

- *"What practical steps do you take?" (Q3.3.1)*
- *"How do you manage the project?" (Q3.3.2)*
- *"What communication skills do you believe are important?" (Q3.3.3)*
- *"What specific methods do you use in undertaking your projects?" (Q3.4)*
- *"What common approaches do you use?" (Q3.4.1)*
- *"How have your methods evolved over time?" (Q3.4.2)*

The various creative disciplines of the participants were a key factor in answers specific to their domain. However, from a broad perspective, the answers provided interesting overlaps.

It was difficult to pinpoint a consistent method or practical step as it changes from one project to another based on the overall aesthetic and the function of the created character and object. Despite the difficulty to summarise their practical approaches, Participants A & B rely on their drawing skills in their projects. They provided several general insights into their practical steps (A25). Participant A provided a simple answer that applies to any project regardless of whether it is analogue or CGI:

> *"I just draw […] everything starts there" (A20)*

This reflects the importance of establishing a strong foundation for the production chain. Participant A also highlighted that the approach could involve some clay sculpting, photography, watercolours, or different coloured pencils depending on the needs of a project (A25). In addition, the ambiguity of the script or the director's brief is a significant factor that forces Participant A to rely on experience to adopt the most efficient and

practical approach to a project as highlighted in the example provided in the previous section (A18, 21).

Participant B discussed the importance of speed which justifies his reliance on Adobe Photoshop as the fastest medium he can use. Participant B also discussed the use of sculpting logic by drawing general shapes, blocks and blobs of shades, then shaping the volumes to reach an appropriate design instead of starting from a line (B19). The resulting volume would define the character's silhouette on which the details are later added (B25).

The approach to a project might start with a minimal degree of research for visual references as Participant B discussed, but both Participant A & B argued that their approach involves an instinctive and intuitive approach towards designing concepts for characters, environment, and details. As Participant A emphasised earlier, his approach to projects revolves on mainly drawing and getting into an immersed state of flow while choosing the tool that suits the project (A20, 21). Participant B further stresses on the importance of achieving a consistent flow, relying on instinct and avoid overthinking or overanalysing the practical approach (B26).

Participants C(17) & D(16, 19) highlighted their practice regarding function and project management. Both participants emphasised on the importance of having access to the script and the storyboard. Through the script, the participants start by listing all the props and models they need to produce and then establish the best approach and material to use according to the described actions the characters perform and then prioritise the tasks in relation to budget and time. Although a storyboard is not always available, the participants have expressed their preference in having access to a visual reference that presents the position of each prop in a shot. This additional information is crucial, especially that each project is different, in helping the practitioners determine the amount of details required on each prop for each scene and subsequently outline a schedule, list of materials, and budget for the project. For example, if Participant C determines that a scene urgently requires a list of props, the type of material would involve a more expensive type of silicone that cures quickly (C17).

Furthermore, as Participant C highlights, the action performed by the character and their position in the shot determines the type of material used. If a character is swinging a sword in the background, the prop is made from a shiny material with enough detail to communicate to the audience that it is a sword. However, if the character is presenting the sword in a closeup shot, then the model maker could produce the prop cut out of

aluminium and places more detail and choose a more robust material for the weapon. Additionally, if the character is swinging the sword to execute an enemy, then the sword would have to be made from a mixture of rubber and expanding soft foam that would replace the heavier, high-quality metal sword in that specific scene (C16). Regardless of the case, knowing characters, scenes, visual references, and processes used in other films can help practitioners communicate and produce outputs more effectively (D18).

The participants expressed the importance of the efficiency in producing an output in an industry that demands a fast-paced production of high-quality production. The production process is compared to a conveyer belt (D17), where a group of practitioners depend on those working before them in the production line to start. Participant A explains that a slow designer could keep the modellers from building the character or props, which by extension further delays the animators from doing their job. In the film industry, schedules and budget are always strict. Therefore, practitioners must consider their connection to the other phases of production and aim to deliver quickly unless the director explicitly informs them otherwise (A22, B19). However, the cases where the processes proceed smoothly are very rare (D17).

Regarding project management, the participants resorted to committing to managing their projects' assets and a strict work schedule, unless they are told to take their time (A22). Additionally, Participant A highlights the importance of communication and being able to read the verbal and non-verbal language of clients and collaborators (A24). Participant B emphasises on the unpredictable nature of the process, as it does not have a set methodology outline, and advises other practitioners to treat every task as an emergency to produce an output as quickly and efficiently as possible in the required quality (B20).

Participant C provided an interesting answer regarding collaboration, communication, and receiving feedback, advising:

> *"If you're working in Film and the TV Industry, you can't be very precious about your artwork because it's not yours at the end of the day." (C18)*

Practitioners must withstand constant harsh critique from their superiors and the audience. Practitioners put much time and effort to create compelling visuals for a specific project but could be discarded just because it did not meet the director's requirements or taste (C18). Therefore, as Participant D emphasises, practitioners need to develop a library of visual references from film through which they can refer to while discussing or brainstorming projects with their collaborators. Furthermore, developing the ability to

"talk film" makes communication with directors and producers more fluid and effective (D18).

In addition, the practitioners highlighted the evolution of their methods over time through experience and change of perspective. Especially with the introduction of CGI in the creative process, the changes in politics and production speed in the industry, the popularisation of TV series, online streaming, and Virtual Reality. However, each participant provided an interesting perspective. For Participant A, all of his industry projects are applied digitally while previously, it was exclusively through practical paint (A26). Participant B's approaches and methods have evolved drastically. Initially, Participant B designed his concepts while considering the small and intricate details, stating that he would draw every leaf on a tree. However, Participant B highlighted a more effective and intuitive approach by starting with general shapes and silhouettes to produce characters capable of creating impact and emotional response from audiences (B28). Participants C(19) & D(20) discussed the importance of materials that are continuously improved to meet the requirements of the film industry. For example, silicone rubber has been in development for fifteen to twenty years that prosthetic artists have access to state of the art silicone to achieve high quality and realistic output quickly. This development is the product of silicone rubber sellers and producers working in tandem with the film industry practitioners to understand the production needs and provide new materials accordingly (D20). Participant C highlighted his affiliation with companies in the UK and Ireland that would send him samples of newly developed products to conduct tests. Participant C would list the characteristics of the sent chemicals and assign their utility to specific tasks (C19). Furthermore, 3D printing provided new efficient and effective approaches to produce functional props with moving parts, which Participant C is adopting in his creative process.

4.3.5 Reflections on Favourite Projects/Characters

In this section, the participants named their favourite projects and discussed the reasons behind their choices. The answers included a diverse selection of subjects including Abbott and Costello from *Arrival (2016),* Balin's Weapon and the Goblin Cave from *The Hobbit (2012), Kilt Le Picte, IT (2017),* and The Engineer from *Prometheus (2012).* The participants' interest in their choice of projects showed some interesting overlaps that can be summarised by the practitioners 'creative freedom to produce a satisfactory output as well as their positive experience with their collaborators during the production process.

However, each project description provided a different perspective on the set criteria for project preference.

For Arrival's Abbott and Costello, the creatures' Design was described as original and smart due to their lack of eyes and mouth, a feature that is often the subject of debate with the participant's approach to horror or alien creatures. Participant A presented his disagreement with directors insisting on the obligatory need to place eyes on characters (A28). In *Arrival*, the creatures' appearance, their culture, and function were wholly alien and did not resemble anything human. However, they featured elements that were familiar to the audience. The aliens had seven hands, seven fingers that functioned as legs or arms and then had no eyes. Participant A(28) argues that the lack of eyes turns the character into a strange entity of unknown force, due to the lack of features that would humanise a character, which was the impact required for the film. Another example that illustrates Participant A's argument is the Xenomorph from the *Alien* franchise, which is considered as an iconic character and one of the most terrifying in horror films (A28).

By contrast, Participant B(28) highlighted his personal project *Kilt Le Picte and* Balin's Weapon, from *The Hobbit*, as his favourite projects. Participant B did not disclose much about his project but discussed the weapon. It involved extensive research into the cultures and descriptions of the dwarves which became a physical object in the film that was later sold as toys with the character's figurines. Participant B expressed fulfilment when witnessing his work being absorbed into popular culture and being sold as children's toys. This expression hints to goals in the production of characters and their props that function outside the film's narrative structure (B29).

Participant C's favourite project included the goblin cave, also from *The Hobbit*, involved research but featured a sizeable educational collaboration between artists – especially John Howe and Alan Lee, two of the most famous designers in the world - sculptors, and carpenters who had to consider the thinking process of the goblins in creating their lair. As highlighted previously by Participant C's approach to model making, the aim was to create an environment that was built by the goblins, creatures with lesser intelligence but possessing some practical skills (C21).

Finally, Participant D(22) chose the Engineer from *Prometheus* as one of his favourite projects. This choice is due to the participant's interest in the director's work as well as the process of making the mysterious, alien, and appealing Giger-esque character, wearing a biomechanical suit. The character was created through the fusing of familiar

references such as Michael Angelo's David and the experimentation with translucent silicon which caught the practitioner's interest. Additionally, Participant D(22) highlighted the production of different suits for the character through an interesting process where some were more detailed than others due to the role and function the character needed to perform (D22).

4.3.6 Participants' Disciplines, Opportunities, and Challenges

Considering that all the participants work mainly in pre-production, question Q(3.6) further investigates the nature participants' role regarding Narrative, Design, and Technique within the broader organisation of the studio.

> *In relation to narrative, design and technique where does your discipline fit into the organisation of the wider studio? (Q3.6)*

Participant B has provided an answer to this question in a previous category where he was involved towards the end of production to modify the Design of a prop or weapon. Designers work mostly in pre-production, but their responsibilities could proceed into production and post-production if the director requires a design adjustment or an entirely new design for a prop or costume (B22).

The interesting overlap that was presented highlight the practitioners' involvement beyond their defined role. As designers, participants A & B highlighted their continuous practical role in the production phase by working closely with other artists and technicians, including modellers, actors, and directors. Also, Participant A stressed that, as creature designer, his position should proceed to the next stages as a supervisor or character director since most art directors in film production focus on the overall shot but not the characters. Participant A argued that artists and designers should be kept and integrated more efficiently into the process as most of the creative aspects are held by technicians instead (A31). In addition, Participant B highlighted the importance of design and a director's visual style, which should be prioritised over the story, and the actor's performance (B33). In ranking order of importance, Participant B placed the director's vision and style first, followed by the emblematic aspect of the character designs, specifically the silhouette and its function, and finally, the actor's performance (B33). Additionally, just as Participant C(14) mentioned earlier, Participant B highlighted the experience of meeting the actors during the production of *The Hobbit* to acquire measurements and discuss the characters, which the actors have been studying, to gain

the information needed for the development of the appropriate props for the performed actions (B30).

Participants C & D, on the other hand, are practical artists focusing on Technique. However, C & D have highlighted how having Design skills and interest in art can help expand their abilities and role into the broader production team as well as the ability to create original and unique outputs. Participant C trained as a prosthetic technician and a model maker, each presenting separate skill sets that Participant C can merge. Through the combination of these transferrable skills and creative direction, Participant C's department grew to include multiple responsibilities to innovate practical approaches to model making and prosthetics (C23). Participant C's approach is interesting as it overlaps with Participant D's argument on the hiring scheme adopted by the film industry. Practitioners are often hired for a specific, "need to know basis" job. After completion, the practitioners must proceed to travel to different studios or locations looking for the next project. However, having a background in theatre and fine, Participant D is capable of understanding and communicating abstract ideas more efficiently. The possession of many transferable skills is crucial for the generation and execution of original ideas which gives Participant D an advantage in his creative process and professional practice (D25).

In question Q(3.7), the participants were asked about the opportunities that their creative practice offers and the challenges they face.

> *What are the main opportunities and challenges in relation to your creative practice and can you give practical examples? (REF: Q3.7)*

Although some answers, found in the previous sections, relating to this question, the participants provided further information in relation to their own experience. Regarding the output, producing an original and unique character or model has always been the primary challenge, especially that it is easy to recycle the same ideas in popular culture. Participant A(32) argued that the limitations, including the budget, medium, anatomy, and schedules, are always present. Despite all the constraints, designers must be willing to let go of their Design at a stage so it can proceed into production. However, with the current state of the industry, a character designer must be more involved in the process, especially that the position of an art director, versed in character design, is needed. According to Participant A, a major issue in the current film industry revolves around the relationship between technicians and designers (A32). With the rising demand for CGI, the artists and designers that used to work in practical effects no longer work in the

industry. Technicians and computer science practitioners have taken over but lack the visual education needed to direct artists and designers. Due to this introduction of character designers into the production phase, technicians are allowed to direct the designers and assign their tasks which, according to participant A, contradicts with the role of a character designer (A32). The process should occur the other way around where character designers lead and direct the technicians during the production phase. In addition, Participant B emphasised on the unpredictability of the process and the need for practitioners to handle pressure and willing to accept that their effort might not make it to the final output (B37).

Furthermore, one of the presented challenges is the available skill sets of new practitioners that require further training. Participant C presented his goal to share his experience and skills with amateur practitioners to train them to meet the requirements of the film and TV industry (C24). To achieve this, Participant C is establishing a training academy to teach students set decorating, animation, prop making, prosthetics, and art directing, and prepare them to form efficient and skilful future teams.

Additionally, Participant C is preparing a space to store, curate, and rent props to studios (C25). Finally, for Participant D, the main challenge is maintaining originality, arguing that Hollywood tends to recycle the same kind of ideas. To deliver original content, Participant D seeks the visual style of other cultures and foreign films to integrate their visual style and language into an accessible western format (D26).

4.4 Teamwork, Communication, & Problem Solving

The questions Q(4.1→4.4), in table 9, investigate the approaches of Communication with collaborators within the studio and overcoming Communication obstacles and creative differences.

Table 9 Questions Q 4.1 to Q 4.4 Revisited (Appendix 1)

Q 4.1	What other key people and skillsets do you require on your immediate creative team?
Q 4.2	How does the communication process occur between the creative team and the production team? (for example: via email, meetings, supervisors?)
Q 4.3	What communication obstacles have you encountered while working with your immediate team?

Q 4.4	How do you resolve creative differences within a team? Can you give examples?

4.4.1 Collaborators & Skill Sets

Although 3 of the participants are currently freelancers, Communication with collaborators is still important as participant A highlighted previously with the ongoing contact with the directors, for example. In addition, the participants shared their experiences with their team in the previous studios to which they contributed. Besides working with directors, participant A(33) and B(38) stressed the importance of having direct contact with collaborators, especially modellers. Participant A further elaborated on the preference of working with modellers who possess practical sculpting and building skills as well as digital and added riggers to the list of collaborators. Participant A shared a project experience with a team with whom he frequently collaborates in Industrial Light and Magic (ILM). The project involved the design and production of tests of Mark Ruffalo's Hulk in the first *Avengers* film. The efforts of the team started even before pre-production, during which they managed to produce an animated test of the Hulk in eight days. The efficiency of the team was possible due to their familiarity with each other's strengths, weaknesses, and ability to efficiently tacitly communicate with each other (A34, 35).

Participant C(26) & D(27) presented a rich range of collaborator skill set that includes model makers, electricians, carpenters, digital modellers, skilled in Zbrush, Rhino, Autocad, and 3D Studio Max, storyboard artists, hairstylists, painters, and makeup artists. Participant D added that each of the collaborators has a role to play and possessing multiple skill sets is common, which allow the artist to have more job opportunities and jump between functions (D27).

4.4.2 Communicating with the Collaborators

Due to the wide range of skill sets that are involved with the participants. Communication is a factor that must be investigated along with the possible creative differences and the approaches used to solve any obstacles. The method of Communication varies between different studio as well as various projects. For the team in which Participant A was contributing, contact occurred directly but changed to remote Communication after Participant A left Industrial Light and Magic (ILM). Another subject that Participant A highlighted is trust. After leaving ILM, Participant A mentioned that he trusted his

collaborators to proceed with production and ensure that the character was produced precisely how it was designed (A36).

B expressed his preference to direct Communication as opposed to the other various mediums that include email, phone calls, and via supervisors acting on behalf of the director. Participant B highlighted that he experienced all sort of communication methods that vary from a project to another, even if it is under the same company where the practitioners must adapt to the new system quickly (B39). Furthermore, communication between the director and the practitioners through a middle person, a supervisor, or an art director. However, Participant B argued that if Communication occurs via a middle person or a supervisor, they must remain within the criteria and vision of the director (B40). As Participant B emphasises:

"Ultimately, it's not a democracy. The film industry is a dictatorship." (B40)

Participant C(27) & D's (28) experience with communication methods revolved primarily around weekly meetings. As a co-owner of the company, Participant C aims during the meetings to keep everyone updated and making sure that the output is consistent throughout the process. In addition, Participant C utilises these meetings in distributing tasks to the appropriate practitioners according to their skills sets, schedule, and list of requirements (C27). In some instances, the creative process would still proceed during meetings as some practitioners would come up with new illustrations and ideas during those meetings and discuss them (C27, D28).

4.4.3 Communication Obstacles & Solutions

Although the issue of Communication was approached differently by the participants, the answers provided an interesting overlap and a consensus on the nature of communication in a studio. Participant B(42) & D(30) did not refer to the issue as an obstacle or a problem but as a standard occurrence within the studio. Participant B argued that creative differences never occur between practitioners as the film industry is built upon collaboration. All practitioners compete towards producing the best possible output and consequently proceed with the version that is best suitable for the project (B42). Participant D further elaborates and explains that creative differences would occur primarily between the producer, the director, and the workshop. The director and producers would change certain outputs until they meet the requirements of their vision. The frustrating aspect of the process, according to Participant D(30), occurs when the constant changes lead back to the original version. This is due, in some cases, to the

limited visual education, understanding of the process, and creativity of some directors and producers who take advantage of the digital nature of the medium to request multiple outputs in tight schedules. According to Participant D, this happens a lot, and it is important to be able to communicate the ideas efficiently to the decision-makers (D30).

Although Participant B & D argued that creative and communication differences do not occur as practitioners collaborate towards achieving the director's vision, Participant A argued that the different preferences in taste and styles of practitioners are a source of Communication obstacles. Practitioners need to understand the project's requirements and be aware of the level of quality that is suitable for it (A37). Some mistakes could occur mainly when the practitioners do not assess their list of priorities regarding project management which could cause the team to work extra hours (D30). Additionally, Participant discussed a particular type of personalities involved throughout production (C30). As practitioners, collaborating towards one vision and individually presenting many ideas, could become driven by emotion, ego, and competition. The identification of practitioners as "artists" correlates with ego and artistic pride which could hinder communication and the efficiency of the creative process throughout the production pipeline (C30). Despite the risk of clashes between the different artists, the participants did not express any resentment towards any collaborators. Participant B highlighted that he never faced any problems with collaborators. Communications issues could be due to misunderstandings between the directors and practitioners. It is the practitioners' responsibility to present their ideas clearly because the director is aiming to produce the best results (B42). The interviewees highlighted the importance of arguing respectfully, listening to what the other members of the team are communicating, meeting halfway or compromising if the combination of two ideas proves to be beneficial for the project. Participant A emphasised on the importance of discussing and defending ideas as they could be crucial for the project (37). The challenge is to have the confidence the skills to communicate with directors and provide constructive feedback and critique to other practitioners who are less experienced and might find some difficulties understanding the concept (C30). Participant D(30) compared the communication process between practitioners like an attempt in reading minds and argued that the process would be much more relaxed and effective if reading collaborator's mind to visualise their ideas was possible.

4.5 The Changes and the Future of the Industry

Questions Q(4.5→4.5.4), in table 10, examine the significant changes, positive and negative, in the creative process in the past ten years and the possible evolution of the industry in the future.

Table 10 Questions Q 4.5 to Q 4.5.4 Revisited (Appendix 1)

Q 4.5	What are the most significant changes in the industry in the last 10 years?
Q 4.5.1	What aspects have remained unchanged?
Q 4.5.2	What has improved?
Q 4.5.3	What has worsened?
Q 4.5.4	How do you see the industry evolving in the future?

The common overlap, regarding the changes in the film industry, was the incorporation of digital tools and mediums within the process. Participant A emphasised that the digital medium has changed everything in the film industry (A39). The initial rise in popularity of CGI signified a potential complete takeover of digital tools in the industry. Companies are putting the effort to evolve and keep up with the increasingly rapid advancements and the emergence of new mediums and the shift in the prioritisation of screening platforms, including Cinema, online streaming, and TV. However, according to Participant D(31), practical effects did not become obsolete. TV series and films including *Game of Thrones (2011-2019), American Horror Story (2011-Present), The Harry Potter Franchise (2001-2011),* where the mixture between practical effects and digital effects has proven to be the most effective approach to creating believable content. Therefore, companies and studios are working through a combination of practical and digital effects to increase character presence and performance, believability, and budget management efficiency. Participant C stressed on the rise of the popularity of TV shows, as highlighted by Participant D, and online streaming platforms, such as Amazon Prime, and Netflix, as a significant change in the industry. Platforms like Netflix allows audiences to binge-watch multiple episodes or set a pace they desire according to their schedule. This has placed tremendous pressure on practitioners as these shows require a fast production pace to keep up with client demands. Consequently, practitioners must always be innovative with their

creative process in delivering original output at a fast pace while maintaining their mental and physical health (C31).

On the other hand, Participant B further explains that the accessibility of digital mediums increased the audience's expectation in the spectacle of the film and cinema experience. Because of their past experiences with cinema, audiences expect more from the characters and their performances which also places more pressure on the practitioners involved in the film industry. Additionally, due to politics regarding social issues, Participant B(44) argues that filmmakers often try to please multiple communities in a single film, which was not the case before the past few years, as an attempt to avoid any ethical and social criticism.

On the positive side, Participant A(41) argued that CGI had reduced some of the limitations as anything can be created digitally, with impressive quality, from explosions to digital humans and animals, with time and budget being the only significant constraints. Participant B(49) further elaborates on the role of CGI, as its quality keeps improving, in reducing the risk of accidents with stuntmen, human and technical errors, and the overall absence of animal abuse in films. For participants C(33) & D(33), the advantage of the changes in the industry came with the advancements in materials and technology which allowed faster production with better quality as well as testing the result before sending it to the next stage of the process. For example, Participant C(33) takes advantage of digital modelling to produce functional physical prop through 3D Printing. Through 3D printing, Participant C(33) can quickly efficiently produce a gun, costume, or any other mechanical objects with all their moving parts functioning properly.

Furthermore, according to Participant D(33), it is the better understanding of the strength and weaknesses of CGI that leads to the creation of believable VFX through the combination of practical and digital effects, as it was achieved with the undead army in Game of Thrones. Participant D(33) further explains that not much has worsened; the main issue is the misuse of digital and practical tools. With the introduction of the High Definition format, weaknesses in the effects in the presented frame can become quickly apparent to the audience. Technologies can often clash with each other, especially if they include new tools or techniques that require additional testing and experimentation to be compatible with older tools and methods. The problem as Participant D highlights lies in the incompatibility of specific tools and the understanding of their use in tandem with others. Participant A(43) expressed similar disgruntlement around the use of specific tools, such as Zbrush, in the wrong context and purpose which led to the misconception

that the Design stage could be done directly through a modelling software to speed up the process and therefore allowing technicians to take the role of designers. Also, the advancement in material and technology, as well as the introduction of new digital formats, from high definition film and 4K quality TV shows, forced practitioners to work excessive hours causing more stress and difficulty to maintain a healthy work environment both physically and mentally. Furthermore, another issue that is occurring in the industry relates more to story structures from a commercial and political perspective rather than technological changes. According to participant B(44), it seems that the film industry is more concerned with political correctness and fan service at the expense of producing meaningful stories, convincing and believable.

In contrast, some aspects of the industry have remained unchanged. Participant A(40) emphasised that the Design approach and the creative process is still based on artists, and it must remain this way. Another important aspect that did not change, according to Participant B(48), includes the artists' collaboration as an effective team to produce an output that adheres to the requirements of the director's vision. Furthermore, the worse movies are the production of committees interfering with the director's vision, and consequently, taking over the direction of the film. Also, Participant C(32) argues that the implicit form of storytelling achieved by incorporating details on a model or prop is still an essential aspect of Design approaches that has remained unchanged. Furthermore, Participant D(32) discussed the resurgence of older Techniques that include practical effects and stop-motion animation as some are still relevant Techniques whose simplicity could often present the best approach to solving a problem. The practical effects techniques and approaches were never discarded in preference to CGI; artists are constantly reinterpreting the methods they acquired with older practical medium to merge them with digital effects to complement each other's weaknesses and strengths.

In the final part of this section, the participants were asked about their views on the future of the industry. For Q(4.5.4), the answers were mixed and varied.

How do you see the industry evolving in the future? (REF: Q4.5.4)

Participant A(44) discussed the emergence of Virtual Reality as an exciting new medium with a broad range of possibilities, highlighting the experiments currently conducted at Occulus by Gio Napkil, a character modeller and sculptor who previously worked in the film industry. Regarding practice, According to Participant C(34), the marriage between practical and digital effects needs to be perfected, which subsequently leads to more

believable quality visuals. Practical and digital Techniques, when used in tandem in their various mediums from digital models to 3D print prosthetics, could be vital to achieving an efficient and cheaper production process (D35).

Furthermore, the industry's creative force will revolve more around artists with practical and digital skills rather than computer technicians. On the broad side of the industry, Participant C(34) highlighted the rising popularity of TV shows and argued that the industry is starting to lean strongly towards TV and online streaming. In addition, according to Participant B(51), the industry is currently interested in fast-paced films heavy on VFX that are bringing in a considerable amount of money. Participant B(51) expressed a desire for movies with a more meaningful story where digital and practical effects are used for a purpose with a lasting impact rather than a short-term shock and awe effect. However, Participant B also expressed his interest in keeping in touch with his industry contact to remain updated with any advancements and developments as they can present new and useful tools for his current professional practice. Although Participant D(35) shared an overlap with the rest of the participants, he admitted the uncertainty of the film industry's future as developments are occurring so quickly that it becomes difficult to foresee what might become the next technological and stylistic breakthrough.

4.6 Character Development

This section Q(5.1→5.5), outlined in table 11, investigates the views of the participants on character development. The discussed themes include character development in relation to Narrative, Design, and Technique, as well as the participant's approach to rejected ideas and their views on believable and non-believable characters, the advantages and disadvantages of CGI characters, and the participant's experience with their least favourite project.

Table 11 Questions Q 5.1 to Q 5.5 Revisited (Appendix 1)

Q 5.1	If you summarised the creative process into narrative, design and technique, what do you believe are the important aspects of character development?
Q 5.1.1	Firstly, in narrative.

Q 5.1.2	Secondly, in Design.
Q 5.1.3	Finally, in technique.
Q 5.2	Assuming that not everything from the creative process reaches the final output, what do you do with rejected ideas?
Q 5.3	Can CGI characters be categorised into different rank orders/levels from believable to non-believable?
Q 5.3.1	If so, how do you categorise them?
Q 5.3.2	Can you provide examples of believable and non-believable characters?
Q 5.4	What are the advantages and disadvantages of using CGI characters? How are they different from other character mediums (live-action actors or animatronics for example)?
Q 5.5	Can you talk about the least favourite project/character you worked on? What makes it your least favourite?

4.6.1 Development Through the Creative Process

Regarding Narrative, Design, and Technique, discussed in Q(5.1), the story of the project and the script of each character must be in accord and meet the same requirements.

> *If you summarised the creative process into narrative, design and technique, what do you believe are the important aspects of character development? (Q5.1)*

There was no definitive agreement among participants regarding the most important aspects of character development. Two participants, A & C, identified that "*it has to meet the requirements of the script of every character" (A45)* and *"Character development starts first off in the script." (C35).* Although there was an interesting emphasis on Narrative Design was the most frequently discussed with all participants mentioning its importance in terms of being "interesting and unique" (A45), its context (A46), and visual styling (B52, D36). Participant A(46) contextualised the Design process through the exploration in finding the appropriate stylistic balance between realism and abstraction that is constrained by the overall style or genre of the film and the requirements of the director. The Design process is challenging in that it cannot be taught but acquired through practice (A46). It is a form of tacit knowledge that practitioners build through practice and experience as a reference for future projects. Furthermore, characters must

be relatable through the incorporation of familiar elements that the audience can use as an anchor (D36). Participant D(37) emphasised on the necessity for the character Designs to include details that depict a degree of depth, performance and implicit storytelling that signify the character's personality and backstory.

> *"They are fully realised characters, in that they don't just serve the function of the script but because we've found them in some little chunk of their life."(D37)*

The relationship between the director and the practitioners emerged again as a reoccurring theme that the participants shared as a collective and crucial aspect of the process. The character must be functional and serve the purpose of the director, the clients and the producers' criteria. As Participant B highlights:

> *"We are not directing the movie at the end; we are just doing the visuals; the director decides what they want to do." (B53)*

Therefore, once the development process begins, a character, including its costume and props, can go through multiple iterations to reach the final approved version. Also, the Technique cannot be narrowed to a specific method and approach as it varies from one project to another. However, According to Participant A(46), the primary Technique any designer should perfect is their drawing skills, in addition to sculpting and 3D modelling as secondary skills.

In question Q(5.2), the participants discussed the frequent rejection of ideas and Designs if they did not meet the director's vision.

> *Assuming that not everything from the creative process reaches the final output, what do you do with rejected ideas? (Q5.2)*

Each participant approached discussing rejected ideas with a different attitude. However, there was an overall agreement on rejected designs and ideas simply being inappropriate for the project or the director's vision. For participant A, whose "rejected images file" holds around 98% of the produced drawings and concepts, rejected Designs and concepts are not necessarily a bad thing; they are merely ideas that are not appropriate for a specific project. If suitable, a rejected idea can always be brought back and modified to fit the needs of a new project or for personal use and publications but can never look the same (A48). Participant D(38) shares a similar opinion and argues that "*rejected ideas are not bad; they're just not appropriate."* It is possible to use rejected designs in other projects

if they are changed to look different than the initial version, by turning them upside down or painting them in a different colour so *"they might be good for something else." (D38)*

However, Participant B(54) has shown a completely different experience regarding rejected ideas arguing that they get shelved and can never be shown or used again. It is complicated to get permission for reuse, even in the case of unreleased films, as the Designs are confidential and the studio's property.

Furthermore, B also mentioned that adapting rejected ideas in a new project is possible. Although, the concept must be modified to look completely different than the original version, except for the Design, which was based on an artist's consistent personal style over the years (B56). In some cases, the studio might decide to publish unreleased Designs of characters, for example in art books as intellectual property merchandise to generate more income, after a movie's release date.

Additionally, Participant C(36) presented another dismissive perspective and approach to rejected ideas. The practitioner argued that it is detrimental for designers and model makers to surround themselves with rejected ideas and should just be discarded or sold stating:

> *"I put them in the bin. I don't care about them at all" (C36)*

Except for a few cases, Participant C (36) clarified that he might pass on some models with interesting designs to other departments or reuse them if they were useful for other projects.

The different views on rejected Designs could relate to the different backgrounds of each participant or the various studios in which they work. However, when prompted to further elaborate whether they experienced a case where, in their opinion, the rejected idea was either a better Design than the approved version or was incorporated into the approved Design to improve its quality, all the participants' answers overlapped. It has occurred in multiple cases where the approved version of a Design is of a lesser quality than the rejected version. According to Participant A(49), directors also need to please the producers, their source of funding, who might hesitate with specific design approaches, fearing that it would not communicate well to the general public. Therefore, some Design gets reduced to a tame version resulting in a generic design that would appease mainstream film audiences but might not be as innovative or interesting as some of the rejected designs (A49). Participant C(37) highlighted the importance of defending an idea and explained that some cases would involve a discussion and a compromise, where parts

of one design could be added or mixed to another to better suit the project (C37). In addition, Participant D(39) recapped the role of the practitioners as a hired hand working towards achieving the director's vision. Therefore, practitioners must accept that the Design does not belong to them, and it is the director and the producers who decide on what gets approved or not (D39).

4.6.2 Believability Rank Orders

In Q(5.3), the participant highlighted the different criteria that differentiate the rank order of believable and non-believable characters.

> *Can CGI characters be categorised into different rank orders/levels from believable to non-believable? (REF: Q5.3)*

The majority of the participants, apart from B(60) who emphasises that there could be a believability rank order of character but preferred not further elaborate to avoid offending anyone, gave interesting answers from different perspectives.

From a general view, on the scale of non-believable to believable, Participant A(50) ranks video game characters as the least believable. Participant A(50) argued that games do not present live actors in the shot. Therefore, the medium allows the designer to push and exaggerate the fantasy element further. In contrast, because there are actors involved in film, the designer must lower the fantasy element a little and adhere to the rules of anatomy (A50). Therefore, on the believability scale, games are followed by TV series and commercials, then Film as the medium presenting the highest quality of believability. Participant A(50) further explains the reasoning behind his choice, stating that it depends on "*whatever the budget allows (A51)"* as well as the medium. TV commercials and series could present less believable characters than games. However, this variation depends on the budget and whether the TV series and the commercials get an experienced director whose style, direction and supervision could increase the believability factor to film quality.

Furthermore, Participant C presented a very interesting categorisation of characters in film and TV as "hero character/hero prop" and "background extras". To avoid confusion on the term "Hero", Participant C clarified that the "Hero" character/prop, from a practical perspective, are always placed in the foreground and must believable and presented with high-quality details (C38). However, the background extras require fewer details and

could be reduced to a simple silhouette that represents the hero prop, which relates to B's previous idea on the importance of the emblematic silhouettes, if the character was located at a far distance. This categorisation is crucial as it dictates the amount of work needed on each character design in each shot, especially with tight schedule and limited budgets. Knowing the placement of the characters in each scene, practitioners can significantly produce characters more efficiently and effectively by reducing or increasing the required details of each character accordingly (C38).

In contrast to the other participants, Participant D(40) highlighted "*Star Trek: Beyond (2016)*", a science fiction film based on the franchise depicting space exploration and the encounter of strange beings, as an example to illustrate a completely different set of criteria of believability. In Star Trek Beyond, the aliens were made to look, as Participant D(40) described them, "*very outlandish"* and very overdone, as if they were manufactured in workshop. However, Participant D(40) argued that even if the characters did not present any ageing or imperfection depicting any backstories, "*they were amazing, […] very colourful and not very subtle […]"*. It is what the director wanted, and even if the characters were not believable in the typical sense, it does not matter since they function appropriately for the requirements of the film (D40). From an industry point of view, the production of characters like these could be done in some cases to sell merchandise or to attract cosplay enthusiasts. The aliens' purpose in *Star Trek Beyond* is not *"about whether or not they're completely believable or not, (but that) they're amazing to look at. (D40)"* Therefore, the rules behind believability change from a project to another where the motives behind the director and the artist must be considered.

Furthermore, participants were asked to list examples of believable and non-believable characters. The choices could revolve around projects the participants worked on other random projects. The presented list of believable characters featured some overlaps such the CGI **Apes (Caesar and Koba for example)** from the *Rise of The Planets of the Apes (2011) and Dawn of the Planet of the Apes(2014)* as indicated by Participants A(52) and D(42). The characters did present not only an impressive quality of the digital models but also featured an accurate and captivating performance with the help of motion capture technology. Another presented overlap was the **Alien (aka The Xenomorph)** from the original *Alien (1979),* which was highlighted by Participant A(52) and C(40). The character, using practical effects, gave the impression that it was an actual physical living entity standing next to the actor with the slime coming out from its mouth (C40). On the subject of using practical and digital effects, Participant A(52) discussed **The Reapers**

from *Blade 2 (2002),* where the combination of practical makeup and CGI achieved an impressive and impactful horror result especially when CGI was still relatively primitive. *Men in Black 3* (2012) also featured some interesting use of CGI and makeup (A52). Furthermore, the realism and impact of the **T. Rex** from *Jurassic Park (1993)* were not replicated nor achieved in any of the Jurassic Park sequels. Other characters from the list by Participant A(52) included individual shots of **Mulgarath** from *Spiderwick Chronicles (2008),* The **Hulk** from *The Avengers (2012)*.

Additionally, Participant B(61) highlighted **King Kong** from Peter Jackson's version of the franchise in 2005 as well as Gollum from the Lord of the Rings Trilogy (2001→2003) and The Hobbit (2012). Furthermore, the list also included most of the characters from the Game of Thrones franchise, where participant B(61) expressed admiration towards the prosthetic and makeup efforts done on the **White Walkers** in tandem with CGI**.** Participant A(52) also presented more prosthetic and makeup-based characters were highlighted in the list such as **The Predator** from the self-titled movie in 1987, **Gill-Man** from *The Creature from the Black Lagoon (1954),* and **The Monster** *in Frankenstein (1931)* where the makeup and the prosthetics are highly influential and still relevant today.

By contrast, the list of Non-Believable characters did not present any overlaps but was rich in examples. However, not all examples were elaborately discussed as this might be a sensitive subject regarding critiquing other practitioners work. It is noteworthy to state that since the list included characters produced by other practitioners, Participant A expressed that the presented critique is not directed to offend or undermine the effort of other practitioners. The highlighted characters were the **Devil** in the movie *Spawn (1997),* **Saphira** the Dragon from *Eragon (2006),* **Clover** from *Cloverfied (2008),* **The Hulk** from The Incredible *Hulk (2008),* where the latter two examples presented Design flaws and issues as well as performance issues (A53). The opening mouth movement of **Imhotep** from *The Mummy (1999)* was described as non-believable as well as the **Blue Deacon** from *Prometheus (2012),* which was a puppet (A53). The CGI **Alien** from *Alien 3 (1992)* was overly animated with perspective issues. The **Scorpion King** from *The Mummy Returns (2001)* was described as inadequate and amateurish (A53). Moreover, the characters from the guardians of the Galaxy were portrayed as non-believable and that they were trying too hard to be funny (B64).

Regarding the widespread debate on the use of CGI versus practical effect, participant C (40) argues that adding digital animations to a physical model is beneficial as practical

effects cannot always achieve a believable output alone. However, practical effects can be more effective if the model is standing next to an actor as in some cases a digital model requires more effort in creating realistic shadows with consistent lighting, which does not always succeed. This topic is further explored in the next question Q(5.4), where the participants discussed the advantages and disadvantages of CGI characters in contrast to makeup and prosthetics.

> *What are the advantages and disadvantages of using CGI characters? How are they different from other character mediums (live-action actors or animatronics, for example)? (Q5.4)*

4.6.3 The Advantages & Disadvantages of CGI Characters

For this section, the participants presented interesting overlaps in their views on the advantages and disadvantages of CGI characters. The first overlap involves the reduction of limitations, and the opportunity CGI provides to create anything and capturing an impactful performance and movement. If the time, money, and effort were put efficiently, more characters like **Caesar and Koba** from *Planets of the Apes* could be produced (A54).

Furthermore, Participants A(54) and B(65) explained that animators must be passionate and interested in learning about achieving believable performances since the output relates strongly to the craftsmanship of the artist. Although CGI broadened the opportunities for practitioners, it is only a tool that needs to be understood and mastered by practitioners while they aim primarily in producing captivating characters performances and visually engaging environments (B65).

Regarding the current use of the mixture between practical and digital effects, Participant A(54) argued that the limitations of practical effects are related to the assigned budgets that lead to poor results. The film industry is a business in which the practitioners involved are putting their time and resources for income. Consequently, clients and producers will receive the output according to the budget they provided (A54). In addition, there are specific cases where the use of practical effects can be tricky, due to textures, weight and movement limitations, which render the output to appear fake as seen in figure 20.

Figure 20 The Terminator (Cameron 1984)

The same applies to CGI, where technical weaknesses, time and budget have an essential influence on the output and have yet to be overcome. Therefore, the use of digital effects for fluid, organic and dynamic performances could be a solution to scenes presenting fast-paced movements that are difficult to achieve in practical effects.

On the other hand, as previously stated by participant C(40), practical effects offer an effective and efficient method for the use of lighting. Participant A(54) highlighted another issue with CGI through his experience of the use bones in *Arrival*. The limited budget was a primary factor to the low-quality texture finish of the creatures in the film. The characters were, therefore placed in smoky environments to hide their many flaws (figure 21). The main issue was how the bone interacted with the surface and joint which requires a lot of effort in CGI to achieve accurately (A54).

Figure 21 Arrival Alien Limbs (Villeneuve 2016)

However, it is more accessible with practical because of the real materials interacting with each other. Participant C(41) also provided further explanation and examples on the same issue. With an animatronic creature, while working on the movement of the mouth or the eyes, for example, the results can be faulty, inaccurate, and eerie. However, the visual effects artists can put much effort into the mouth or eye movements which can lead to impressive and accurate results. CGI has the advantage when small details are involved, but practical effects can be the better choice when physical interaction is required. The combination of both can be instrumental in conveying a believable context and visual.

Participant D(43) shared the experience of working on *Victor Frankenstein (2015)* where the main characters had to chase an undead monkey, which was initially made as a puppet, but due to the needed fast movement, the creature was then created and animated using CGI. However, as participant D(43) explained, the movement must be planned and studied because the action is directly related to the different weight of each creature, at which animatronics can excel, but CGI is also improving in that domain.

4.6.4 Negative Experiences with Projects

The final central question (5.5) in the interviews explores the unfavourable working conditions that the participants experienced.

> *Can you talk about the least favourite project/character you worked on? What makes it your least favourite? (Q5.5)*

Due to the sensitive nature of the issue, some of the participants were reluctant to answer. However, after explaining that specific names are not required, and they could provide only the context in general, the participants offered different answers with little overlap. The primary overlap can be summarised as the lack of Communication and placing ego ahead of respect and collaboration.

Participant A(55) bluntly stated Saphira from *Aragon* as his least favourite character due to the ineffective creative process that involved the use of 3D sculpting software to speed up the production process without considering the design phase. Participant A(55) explains:

> *"We had a beautiful design done within the month. At the last minute, the director hired this environmental designer to go over my stuff behind my back and make it look like the children's book cover" (A55)*

The result was *"so horrendous"* that *"ILM had to reverse engineer that design for almost 18 months",* while the initial design was completed in 4 weeks, which strained the budget (A55).

Participant B(66) highlighted the least favourite projects where none of the participant's Design made it to the final output as well as another project that was religiously themed caused individuals to question the participant's motives. Many practitioners refused to work or collaborate on the project. However, Participant B(66) treated the project like any other, focusing on creating the appropriate and engaging designs for the client regardless of personal views and beliefs.

Participant C(42) discussed his experience in working on a recent film that had a reasonable budget but highlighted "*working with a certain artist and art director that […] had little issues with the crew."* Participant C clarified that the relationship between some of the designers, the art director, and the artists started with wrong impressions and was founded on ego and the effort of asserting dominance in the creative process which feathered into the entire production process.

Finally, Participant D(44) noted that there is not a project that was a bad experience as the participant enjoyed working on all the offered projects.

4.7 Closing Questions

The final question category Q(6.1→6.3), presented in table 12, contained the final themes for the researcher to consider from future contact, research, and topics to be covered.

Table 12 Questions Q 6.1 to Q 6.3 Revisited (Appendix 1)

Q 6.1	Are there other key factors or aspects of the industry you believe are important that haven't been covered in this interview?
Q 6.2	Is it possible to contact you in the future in case additional information is required for the purpose of the investigation?
Q 6.3	If a session could be organised, would you be interested in taking part in a group discussion with other practitioners to further discuss these issues?

Participant A(56) highlighted that the industry, with its focus on CGI, must become friendlier, inclusive and adaptable towards artists and designers rather than just technicians as many veteran artists are leaving the industry.

Participant B(67) emphasised the unpredictability of the industry, and that anything can be possible in its future. There is no definitive way of predicting the technological innovations that might emerge or the next ground-breaking film that will become to next milestone in cinema. So it is vital to keep updated on what is being created and presented.

Participant C(44) recapped on training new artists to increase their skills and emphasised on educating them in treating digital and practical effects as a business to help them understand more about the overhead costs, project pricing, time and project management as this is elementary in the establishment of their careers.

Finally, participant D(45) highlighted the importance of keeping track of the different types of characters and learning from previous films and artworks. The development of film language and the broad knowledge of previously created creatures or other cultural references are crucial in developing the skills to think out of the box and create new original Designs. Also, Participant D(45) mentioned the attendance of a horror and fantasy film festival in Beirut, Lebanon. Where, the participant suggested the rising popularity and cultural significance of digital and practical effects in the film industry as many academics, film enthusiasts, and practitioners presented talks and projects from different countries, which generally do not appear on the list of film producing countries, including Iran, Egypt, and Jordan.

It is noteworthy to mention that all participants were positive towards future collaborations and contact for this research.

5 ANALYSIS

5.1 Introduction

This chapter investigates the creative processes behind believable photoreal 3D animated characters. The study focuses mainly on the pre-production phase, which can be summarised by four essential elements: Narrative, Design, Technique, and Communication. This research argues that believability is achieved through the integration of the four keys elements enhanced with industry experience that was included in the Communication element. Consequently, the investigation aims to propose a framework that facilitates the production of believable photoreal characters for VFX.

The initial approach to this investigation is to evaluate the interview content to formulate an epistemological understanding of the participants' creative process. The latter is indicated through the integration of Narrative, Design, and Technique within their creative process through effective Communication. Therefore, the first section of this chapter involves a qualitative comparative study between statistical data acquired by assigning quotes to Narrative, Design, Technique and Communication/Experience in NVivo. The comparative study aims to pinpoint patterns in the participants' preference towards the key elements and whether they are equally integrated throughout the process. Based on the outcomes, the content of the interviews is further explored and critically evaluated following the overlapping and contradictory answers of the participants.

Furthermore, this chapter also reflects on the theories explored in the literature chapter in considering important themes and issues regarding the industry's business model, financial and political state, and its influence on the creative process and believability. While maintaining dependence on the essential elements of the creative process, this research argues that the assessment of character believability should be applied differently to characters as their ontological nature differs from one film to another.

5.2 The Epistemological Investigation of the Creative Process

The edited interviews (See Appendix 2) were imported to NVivo for achieving a systematic understanding of the epistemological nature of the creative process. According to the definitions provided in chapter 3 on each of the four elements of the creative process, quotes from each interview are assigned to one or more element. Each participant's interview was analysed individually. The results of the Nvivo analysis were exported as charts, normalised and colour edited to be presented below. Each colour identifies one element without presenting any order. Although the results are presented in a quantitative format, the purpose of the charts is to visually present the integration of the four essential elements through each of the participants' creative process.

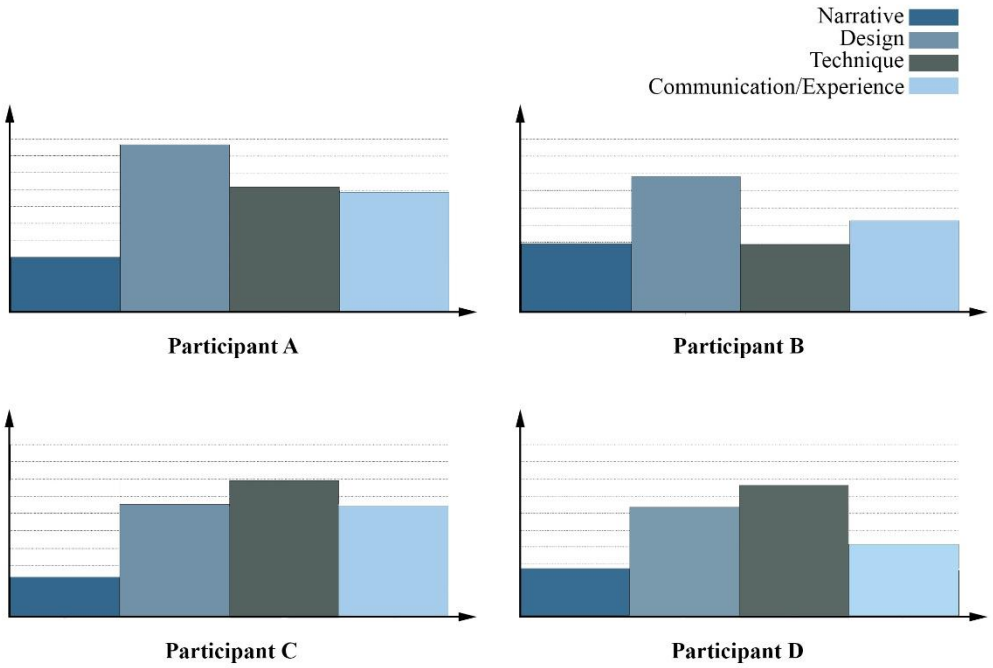

Figure 22 NVivo Result Charts (Melki 2018a)

Each of the participant's graphs presents different approaches towards Narrative, Design, Technique and Communication. This is due to the participants' different backgrounds, expertise, and roles in the various stages of the process. The graphs, in figure 22, are summarised in table 13. This includes the participants' background, the ranking order of their preference regarding Narrative (N), Design (D), Technique (T), and Communication (C). The key terms are then given a weighted score based on their rank to highlight the exact order of priority and grouped in table 14.

Table 13 Graph Summary

	Background	**1st**	**2nd**	**3rd**	**4th**
Participant A	Film & Games	D	T	C	N
Participant B	Comics & Films	D	C	N	T
Participant C	Film & TV	T	D	C	N
Participant D	Film & Theatre	T	D	C	N

Table 14 Score Table

	1st = 4 points	**2nd = 3 points**	**3rd = 2 points**	**4th = 1 point**	**Total**
D	8	6	N/A	N/A	14
T	8	3	N/A	1	12
C	N/A	3	6	N/A	9
N	N/A	N/A	2	3	5

According to the tables 13 & 14, Design was most prominently discussed by the practitioners, followed by Technique, then Communication, and finally Narrative. Since Design was ranked the highest, it is given the highest weight of 4 points. Subsequently, Technique, Communication, and Narrative are respectively assigned the weight of 3, 2, and 1.

However, the charts above should not be used alone to assess the importance of each category. A contextual analysis of each element is required. Following the rank order

presented above, the following sections respectively present a contextual outline of each of the four elements regarding their integration into the creative process, as highlighted in the interviews.

5.2.1 Design

The Design category was the most discussed in the interviews as a key factor for creating original and impactful characters. This category was presented through a Design language referring to the importance of function, problem-solving, and the translation from verbal and written descriptions of characters in a visual format. The significance of Design and the reason behind its ranking is due to its behaviour throughout the creative process, regardless of the practitioners' discipline and role. The Design process acts as a creative process interconnected with the overall film's production lifetime. This characteristic was explained, for example, by participants A & B who, as designers, highlighted that their role often begins before the film's pre-production phase and can continue until the end of post-production supervising technicians and modifying older Designs. Furthermore, participants C & D, whose roles are more practical and technical, would occasionally sketch and draw ideas for team Communication purposes. However, they often rely on the established and predefined Designs to proceed with their work; a process that is interdependent with Design thinking which includes functionality and problem-solving skills.

Functionality is directly reflected through the creation of a character with a purpose to fulfil within the Narrative or in the performance of an action. Problem-solving relates to finding solutions for translating verbal or written forms of the script into a coherent visual output. For example, one of the Design approaches primarily considers creating an emblematic silhouette that communicates effectively and efficiently with the audience. Design involves skills in research for cultural and artistic references while refraining from over researching as practitioners are working within a tight schedule with a pre-defined budget. The efficiency and effectiveness of the research phase reduce the risk of time and budget mismanagement, as well as reducing the risk for plagiarism or regurgitating similar ideas. In addition, when not involved in projects, the interview participants have expressed their tendency to absorb as many visual references as possible from different sources, including film, online searches, museums and art galleries, to enhance and build their visual reference library.

5.2.2 Technique

The Techniques for applying a Design in a film differ from one project to another. For example, the approach to drawing may differ depending on the mood or emotion the characters incite. By extension, different coloured pencils, pens, digital paint, or sculpting Techniques may be used. The medium in which the Designs are produced is a crucial factor in the choice of Technique or tool. Depending on whether the Design is applied through makeup or CGI, the output can be achieved through different Techniques and may require different skill sets including drawing, practical or digital sculpting, carpentry, and engineering skills. However, there are some consistent approaches regarding the creation of initial Designs. For example, Participants B & C discussed their methods of creating blobs and general shapes to which they add details to form a complex character.

While Participant A remarked on the diverse Design approaches that depend on the medium in which the idea is produced, Participant C highlighted how the Technique, interconnected with Design thinking, also differs depending on the action performed by the character. For example, if the required action involves a swift swing of a sword that decapitates a character's head in a scene, the sword is then made with a foam material. However, if the scene focuses on the shape and details of the sword, the prop is modelled using aluminium with a shiny finish. It is essential, as participant D highlights, to always consider the priorities and attempt to work as efficiently and effectively as possible. The choice of the best approach is aided by the possession of an intricate understanding of Techniques and materials. The improvement of CGI technology, and by extension, the quality it can produce, does not necessarily imply that CGI exceeds practical effects in all cases. It provides additional options to consider for the most appropriate approach and output. The participants argued that it is when CGI and practical effects work in tandem to cover each other's weaknesses, that the generated output is most believable. However, this union of digital and practical effects still requires further development and refinement.

5.2.3 Communication/Expertise

Communication occurs explicitly and tacitly during various stages and between different job hierarchies. In some cases, the director would verbally describe the project to the designers before handing out the script. In other instances, Communication occurs in a weekly meeting to keep all practitioners involved up to date and present and discuss ideas. On a practical level, the participants emphasised the importance of Communication

beyond just the pre-production phase. It is crucial for the designers to be present for collaboration or supervision of other practitioners who are further developing their Designs. According to participant D, this feature does not always transpire as efficiently between the practitioners working in the production phase. Also, it is essential to highlight the tacit form of Communication, which is acquired by the practitioners' exposure to visual culture including art, comics, music, film, and theatre.

According to the participants, their worst experiences occurred when Communication failed, giving way to dominant artistic egos and scepticism in place of respectful collaborations. The resultant negativity feathers into the project and causes the creative process to falter. The unspoken understanding between collaborators working efficiently on a project involves compromise and meeting halfway regarding creative differences. Despite this, all practitioners are working to create the client's vision and not their own, so consequently, the chosen output is sensitive to the parameters of the client's direction. It is also essential to be able to read the client's non-verbal Communication as well as their specific brief. Regarding professional experience, the participants talked about the variation of their approach and attitude towards the industry throughout their career, which gave them insights to anticipate problems and propose solutions before their occurrence.

5.2.4 Narrative

Although Narrative is the least discussed of the four elements, it is important to highlight the participants' emphasis on this category due to its simultaneous role as their starting point and target. Narrative defines the parameters required for the practitioners to start designing and developing functional characters in a visual storytelling medium. The participants' minimalistic approach proves to be effective and efficient towards initialising their ideas. The unpredictable nature of the process and the industry forces the participants to rely on general information provided through a script or verbally. As Participant A emphasised, it is always preferable for the practitioner to possess detailed information about the project. However, the participants did not always receive the full script or the details about the Narrative. The directors provided a general brief verbally while highlighting the impact they expect from the characters. Also, A & B often started working on characters and some concepts before a project was even approved for production. The support of a film's production could rely heavily on the initial ideas-pitch. Therefore, it is logical that practitioners rely on the core information, about the

Narrative and the characters, to translate it from a verbal or written format to a visual one as efficiently and effectively as possible.

Furthermore, another form of Narrative appeared in the interviews that does not appear explicitly in the main storyline of the final product, but implicitly through the small intricate details added to the characters, props, and costumes. The practitioners manifested the explicit Narrative format as background information which feeds into the character's Design and development.

5.2.5 The Film Industry's Production Policy

The time and budget requirements of the current industry forces practitioners to work in tight schedules to produce high-quality outputs. The method of integrating Narrative, Design, and Technique, in which it was described, is characterised by its effectiveness and efficiency to produce high-quality outputs quickly. This method of production is necessary for a competitive industry that demands frequent releases of films to sustain itself financially. In addition, as the expenses and requirements of studios increase, the model which includes a fixed team of the usually experienced practitioners is not possible in all cases. Studios could not sustain the costs of paying the salaries of these experts and the overheads, which include materials, equipment, and electricity unless accessible practitioners were hired on a project basis.

Just as the current film industry's production format has its advantages, the negative side involves a risk of reducing Communication further in the chain of the production process. In addition, since practitioners involved are rotated with each project, the chances of collaborating with new artists and the subsequent need to learn and understand their thought processes are high. Therefore, the lack of Communication and the presence of artistic ego could result in distrust, friction, and disputes. From a well-being standpoint, the nature of the process imposes considerable stress on the practitioners, with the result that some new-coming practitioners quit the industry in pursuit of less stressful careers.

Despite its disadvantages, the creative process differs from the previous approaches to filmmaking and is necessary to produce high-quality visuals quickly. Therefore, efforts to correct or to change the unstable and unpredictable process, at the current time of this investigation, are unnecessary. The creative process should be embraced and accepted as a different approach that can produce believable characters efficiently and effectively. Figure 23 presents the correlation between the advancements of technology and

ambiguity and highlights the benefits of embracing ambiguity, in moderation, to allow creative freedom, experimentation, and innovative projects.

As evidence from the interviews shows, the creative process is functional and appropriate for the industry's current needs. While discussing characters regarding believability, the participants categorised non-believable characters based on creative processes where Communication was not efficient and effective, and where the tools used were not properly developed or working in tandem to produce a believable output. In the following section, the characters mentioned and discussed by the participants are grouped and analysed regarding believability.

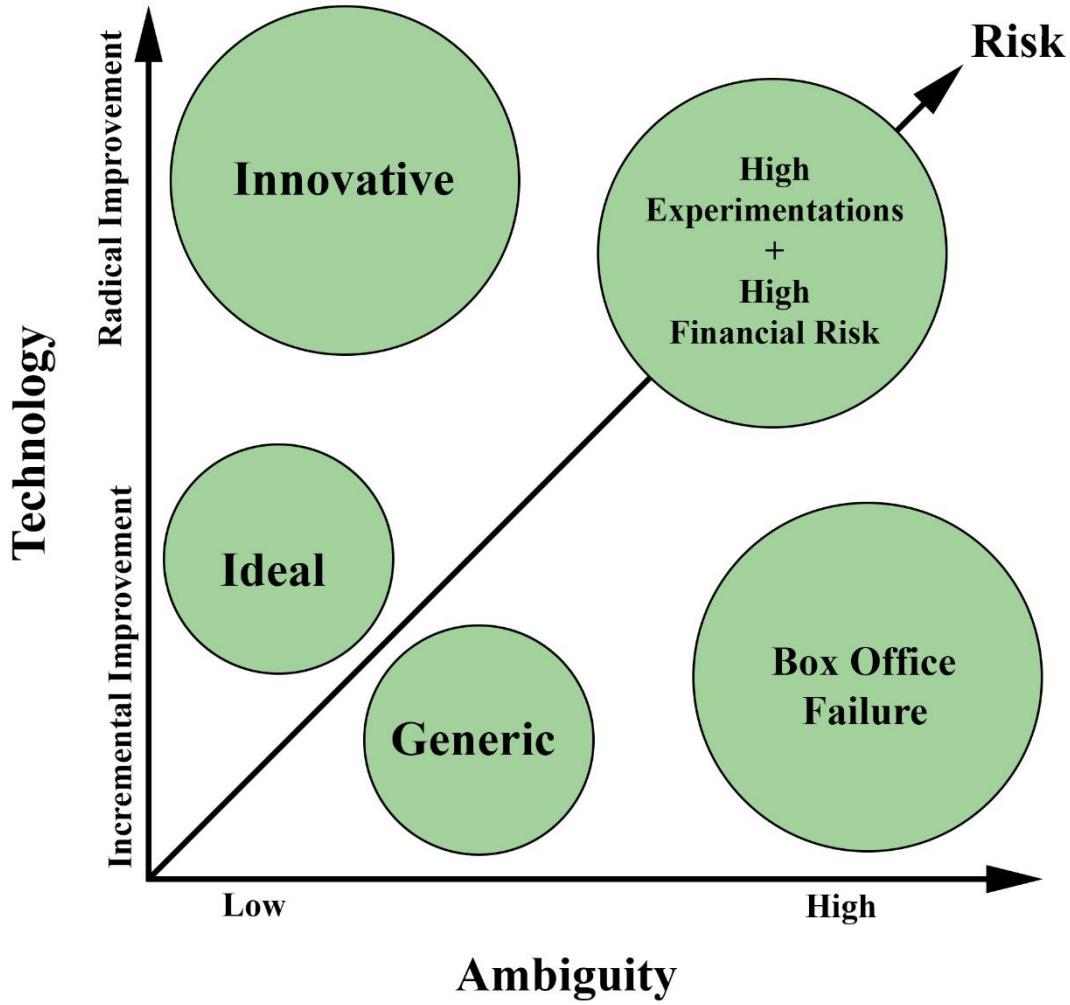

Figure 23 Production Risk Chart (Melki 2019e)

5.3 Characters Analysis

The interview answers revealed that the epistemological nature of the process is suitable for the current industry's needs. The flexibility of the process is crucial for adapting to the unpredictability of the industry and meeting its demands for the fast production of believable characters. Furthermore, the interviews revealed that the method of merging practical and digital effects still requires further development and refinement. Besides the potential technical issues, the creative flow is also dependent on the Communication between artistic egos as it is not always optimal for high-quality output. To further investigate character believability, the participants mentioned and discussed various characters listed in no particular order in the table below.

Table 15 Believable & Non-Believable characters

Characters/Environments/Props	**Movie**	**Status**	**Participant + Quote Reference**
Abbot & Costello	Arrival (2016)	Believable	A(28)
Caesar & Koba	Planet of the Apes (2011+2014)	Believable	A(52) + D(42)
Mulgarath	Spiderwick Chronicles (2008)	Believable	A(52)
Alien (Xenomorph)	Alien (1979)	Believable	A(52) + C(40)
King Kong	King Kong (2005)	Believable	B(61-62)
The Reapers	Blade 2 (2002)	Believable	A(52)
T. Rex	Jurassic Park (1993)	Believable	A(52)

Godzilla	Godzilla (1998)	Non-Believable	A(11)
White Walkers	Game of Thrones	Believable	B(61)
Predator	Predator (1987)	Believable	A(52)
Gill-Man	Creature from the Black Lagoon (1954)	Believable	A(52)
Frankenstein's Monster	Frankenstein (1931)	Believable	A(52)
Devil	Spawn (1997)	Non- Believable	A(53)
Saphira	Eragon (2006)	Non- Believable	A(53)
The Hulk	The Avengers (2012)	Believable	A(52)
The Hulk	The Incredible Hulk (2008)	Non- Believable	A(53)
Imhotep	The Mummy (1999)	Non- Believable	A(53)
Blue Deacon	Prometheus (2012)	Non- Believable	A(53)
CG Alien	Alien 3	Non- Believable	A(53)
Scorpion King	The Mummy Returns (2001)	Non- Believable	D(42)
Tintin	The Adventures of Tintin	Believable	B(6,11,12)
All	Guardians of the Galaxy	Non- Believable	B(64)
Balin's Weapon	The Hobbit (2012)	Believable	B(29→31)
Goblin World	The Hobbit (2012)	Believable	C(21)
The Engineer	Prometheus (2012)	Believable	D(42)

The Aliens	Star Trek Beyond (2016)	Non-Believable	D(40-41)

The list, given by the participants, of believable and non-believable characters, is extensive, covering a wide range of different characters that were described differently by the participants regarding believability. The criteria behind the categorising of characters as believable are rooted in the interview participants' background as either personal, professional, and practical criteria and experience. The personal criteria are generated from a combination of selected characters from other practitioners' work and the participants' own project experiences. While some of the characters listed in table 15 were selected from a professional and influential perspective, others were given as examples of successful materialisations of the participants' characters into believable physical entities in real life and/or in the film. For example, Participant B noticed his design of Balin's weapon was also produced and sold as children's toys. Furthermore, Participant D discussed his pleasure in working under a renowned director and witnessing the final results of his efforts on the Engineer in a big-budget movie.

However, from a practical perspective, the participants listed characters according to different believability levels. The character evaluation followed different criteria that are related to a specific medium as character development for film can be different from games or commercials. Participant critical answers regarding character believability revealed that the character could be listed under the category of hero or background. The hero character includes all main characters, protagonists and antagonists, who are presented at the foreground of the shot or shown in a closeup. These characters must be of high quality, in appearance and movement, with extremely minimal imperfections, as they are usually presented in closeup shots, and as the central element of the Narrative with whom the audience connects. Hero characters are usually presented with hero props that also need to be presented in the highest quality and believable detail. By contrast, background characters, also known as extras, only need to be presented with a correct general look, through a silhouette, to be believable. In addition to these two-character roles, characters can be created for various other functions besides storytelling, such as advertisements, merchandising, or attracting specific audiences to increase viewership and avoid social criticisms. For example, The award-winning aliens in Star Trek Beyond were described as "walking Christmas trees" as they were designed and modelled to be

colourful, perfect beautiful beings who seem to have been manufactured, and to create an overwhelming impact on the audience and possibly selling toys but had no significant role in pushing the Narrative forward [D(40-41)]. Furthermore, participant B also explained that the industry has started producing characters to please particular groups of the audience instead of creating characters to drive the story [B(44→47)].

Although the descriptions of the characters vary, the participants discussed throughout the interview, their criteria that make a project believable. The following list highlights the presented criteria for believable characters:

A. The characters are composed of familiar elements to the audience
B. The character must meet the requirements of the script
C. The character visually reflects a backstory
D. The character must be coherent with the presented world
E. The character features an emblematic silhouette
F. A character must be developed according to its initial approved Design. If it is being translated to a new medium, then it must be updated and not changed.
G. A Character must be produced in an appropriate quality for its role
H. A character must have a convincing overall shape
I. A character must be impactful

Believability was also presented through various degrees depending on the characters' role in a shot. These degrees of believability are crucial in defining the various roles characters play in scenes and the broader film industry. For a hero character, being present in the foreground of a scene, the focus must be sharp, showing high-quality details as it is the central character within the Narrative. The hero character role, from a practical view, is not exclusive only to the protagonist, but also the villain or any other character that is shown in high focus in a shot with a clear and impactful contribution to the Narrative.

The next role involves intellectual property and service characters. Although they can contribute to the Narrative, these characters are not necessarily required to have a significant impact on the sequence of events as they are created for various purposes including for merchandising, to act as comic relief, or be placed in the film to attract and please a specific group of audiences. These characters could be designed with slightly more exaggerated features, including the roundness of their overall shape and larger eyes to appeal to younger audiences with an interest in buying cute toys. For example, the

Porgs from *Star Wars: The Last Jedi (2017)* were included in the film to digitally replace the puffins that inhabit the filming location and subsequently became merchandisable characters sold as toys *(B. Alexander 2017)*. In addition, as highlighted by Participant B(44→47,) the character's ethnicity or gender might be the primary factor for designing a character. Despite not having a major impact on the narrative, films are expected to present diversity in genders, races, and strong female characters to appeal to a broader audience and avoid any social criticisms that might cause a decrease in viewership. Therefore, for the analysis of the acquired information, the intellectual property and service characters are placed in the Contextual group.

Finally, the Background role includes characters, props, or the environment where the details can be shown blurred, or in low sharpness, or in fast-paced action scenes where details are barely seen. Furthermore, this role also includes the implicit form of storytelling that is often achieved through the intricate small, often unnoticed, details added to the character, the environment, and the props. In contrast, when non-believable characters were discussed in the interviews, the participants linked their lack of believability to the failure in Communication and management within the creative process. The information provided by the participants sets the parameters required for a thorough analysis that connects character epistemology and ontology to believability.

The characters presented in table 15 are evaluated according to the set of Epistemological and Ontological criteria regarding the characters' fulfilment of function as determined by the criteria (A-I) listed above (on page 134) for believability. The parameters for analysis are highlighted below in tables 16 and 17. Table 16 presents the Epistemological criteria based on the scoring system and the priority ranking of the four key elements of the creative process established in figure 22, table 13 & 14. Table 17 highlights the different categories that constitute the different types of character and their role in a film's scenes. The Background role, abbreviated "Bck" for the graph, is represented through the character's silhouette or their blurred appearance in their film. The Contextual role, abbreviated "Ctx" in the graph, is presented through the characters' initial design, if they were an already existing intellectual property or their merchandisable format. The Central character role, abbreviated "Ctr" for the graph, is presented through the characters high-quality appearance in their respective films. Table 17 also organises the participants' criteria for believability, represented by the assigned letter in the list, where each character is awarded a point for every met criterion.

Table 16 Epistemological Analysis

Epistemological Analysis N/A = Not applicable					
Characters	Design (4 points)	Technique (3 points)	Communication (2 points)	Narrative (1 point)	Total Score (10 points)
Abbott and Costello	4	3	2	1	10
Saphira	N/A	N/A	N/A	1	1
Hulk*	4	3	2	1	10
Tintin	4	3	2	1	10
Balin's Weapon	4	3	2	1	10
Goblin World	4	3	2	1	10
The Engineer	4	3	2	1	10
Xenomorph**	4	3	2	1	10
The Reapers	4	3	2	1	10
Godzilla (1998)	N/A	N/A	2	1	3
Aliens: Star Trek Beyond	4	3	2	1	10
* Specific to Avengers Assemble 2012 ** Specific to the original film Alien 1979					

Table 17 Ontological Analysis

Ontological Analysis N/A = Not applicable											
		Fulfilment of Function Criteria									
Characters	Role	A	B	C	D	E	F	G	H	I	Total (9 points)
Abbott and Costello	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	BCK	1	1	1	1	1	1	1	1	1	9
Saphira	CTR	1	1	1	1	N/A	N/A	N/A	1	N/A	5
	CTX	1	1	N/A	1	N/A	N/A	1	N/A	N/A	4
	BCK	1	1	1	1	1	N/A	1	N/A	N/A	6
Hulk (2012)	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	1	1	1	1	1	1	1	1	1	9
	BCK	1	1	1	1	1	1	1	1	1	9
Tintin	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	1	1	1	1	1	1	1	1	1	9
	BCK	1	1	1	1	1	1	1	1	1	9
Balin's Weapon	CTR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CTX	1	1	1	1	1	1	1	1	1	9
	BCK	1	1	1	1	1	1	1	1	1	9
Goblin World	CTR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CTX	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	BCK	1	1	1	1	1	1	1	1	1	9
The Engineer	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	BCK	1	1	1	1	1	1	1	1	1	9
Xenomorph	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	1	1	1	1	1	1	1	1	1	9
	BCK	1	1	1	1	1	1	1	1	1	9
The Reapers	CTR	1	1	1	1	1	1	1	1	1	9
	CTX	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	BCK	1	1	1	1	1	1	1	1	1	9
Godzilla	CTR	1	1	N/A	1	N/A	N/A	N/A	1	N/A	4
	CTX	N/A	1	N/A	1	N/A	N/A	1	1	N/A	4
	BCK	1	1	1	1	N/A	N/A	1	1	N/A	6
Aliens: Star Trek Beyond	CTR	N/A	1	N/A	1	1	1	1	N/A	1	6
	CTX	1	1	1	1	1	1	1	1	1	9
	BCK	1	1	1	1	1	1	1	1	1	9

The similarity of the resulting scores is due to the binary nature of the practitioners' responses and their preference to positive discussion on characters, leading to a higher number in believable characters. For this research, the broad scope of the evaluation criteria is adequate to indicate emerging character exemplars for believability. This issue of accuracy is to be addressed in chapter 6 and 7.

Finally, figure 24 represents the morphological analysis model which shows the relationship between the Epistemological and Ontological analysis presented in table 16 & 17. This morphological model aims to explore and present the possible roles of the selected characters regarding their respective films and the broader industry. The model presents each role through visual representations of their function in the film. The Background role is presented through the character's silhouette, as it is the lowest level of details required for believability in this role. The Contextual role is presented through franchises, merchandise, or/and target audiences (represented by a group of human silhouettes). Finally, the Central role is presented through a detailed image of the character indicating its placement in the foreground of a shot and the great details required for believability. For visual comparative purposes, each character role is further presented individually through the graphs indicating the believability level as the result of the connection between the creative process, analysed under the character epistemology parameters, and the fulfilment of function of each focus level. The centre of the graph and the orientation of its axis, as illustrated in figure 25, represent a positive quadrant with its corresponding values. The orientation functions only as a transposed representative reflection of the fulfilment of function and epistemological axes of each role in the morphological analysis model.

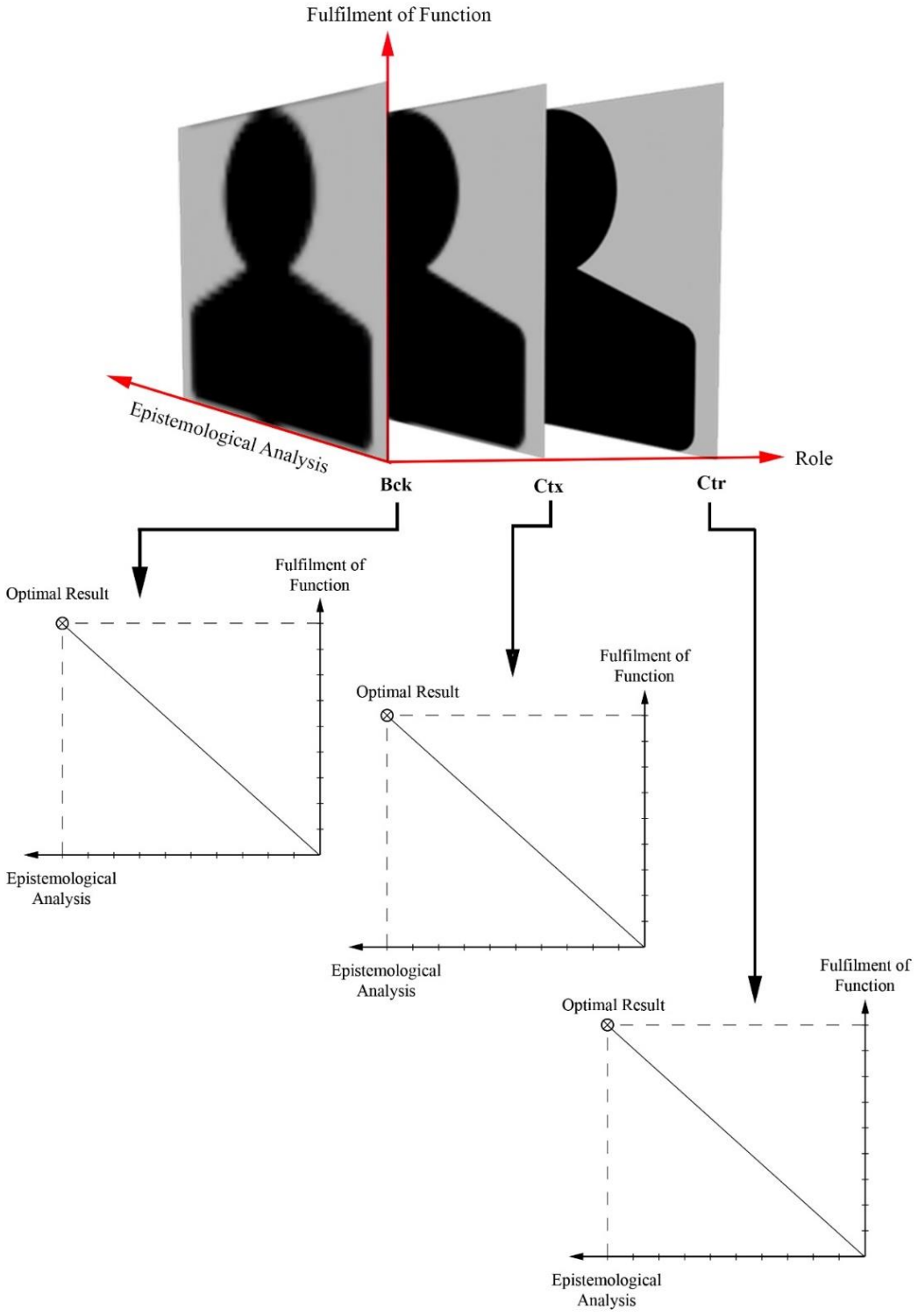

Figure 24 Morphological Analysis Model (Melki 2018b)

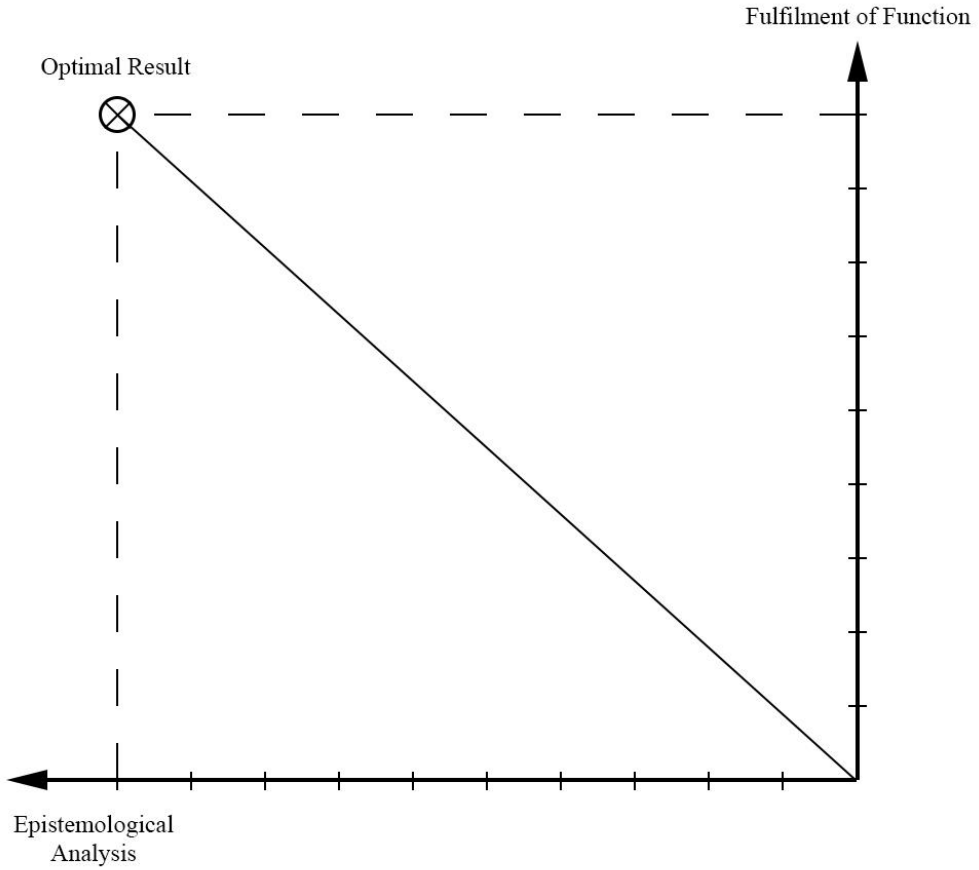

Figure 25 believability graph (Melki 2018c)

The characters listed in table 15 feature a variety of examples produced practically or digitally, and some discussed more than others by one or multiple participants. The characters present a variety of functions that range from hero, background, service, and IP characters, where each presented a unique set of criteria related to its purpose and role. To maintain rigour, the analysis includes characters from the list that have been discussed with context by the participants, discarding the characters that were listed as believable or non-believable without elaboration. For example, Caesar and Koba from *The Planets of the Apes* reboots were described by participant A and D as highly believable photoreal digital characters, also as impressive technological achievement, without further elaboration on the process as they were not involved in the production of these characters. In addition, this research focuses on films produced after the establishment of digital cinema, marked by the release of Star Wars in 1977. Characters produced for TV and film

preceding this date are excluded from the analysis. Therefore, the chosen characters for the analysis primarily consist of those developed by the participants and those that were discussed throughout this research with suitable detail for the assessment as secondary cases. The primary examples include Abbott & Costello from the movie *Arrival*, the dragon Saphira from *Eragon*, The Hulk from *The Avengers*, Tintin from *The Adventures of Tintin*, Balin's Weapon from *The Hobbit*, the Goblin World from *The Hobbit*, and The Engineer from *Prometheus*. The secondary group of examples include The Xenomorph from *Alien*, the 1998 Godzilla, and the Aliens from *Star Trek Beyond*.

5.4 Case Studies: Primary Group

This section only includes projects in which the participants were involved. The characters of these projects are considered as primary case studies due to the first-hand information acquired through the practitioners during the interviews. The cases studies are listed below according to their order of appearance in table 15, which does not highlight any ranking order.

5.4.1 Abbott & Costello

The 2016 film *Arrival* presented the advent of Aliens to earth, two of which were later named Abbott & Costello. The mysterious creatures, thought initially to be a potential hazard, were later revealed as benevolent beings seeking to ally with humans by sharing their knowledge and skills.

According to Participant A, the Aliens were intentionally designed to generate a mysterious and ambiguous ambience to suit the film's requirements. The lack of eyes was one of the adopted approaches to purposely generate an eerie effect, making it difficult for the film's human live-action characters and the audience to connect with the two aliens. In an attempt not to fall into a familiar alien appearance, the aliens were also designed to look like hands with several fingers that functioned as legs. The alien's appearance and technology were detached from the standard conceptualised forms of alien entities and technologies which helped create ambiguity. However, despite the originality of the Design, the elements that form the limbs or the spaceships, and their function remains familiar to the audience.

Furthermore, due to the limited budget and time pressure, the interaction between the aliens' digital skin and bones faced technical difficulties which caused imperfections in the movement and appearance. Apart from the shots where the characters were shown in

the background in low focus while retaining their overall emblematic shapes and movements, as the live actors' characters are presented having discussions, the alien characters are of the hero type. They were often shown in closeup or the foreground of a shot in high focus; they were placed in a foggy environment to mask any imperfections that could not be fixed during production and post-production while maintaining a high-quality output. As a result, the chosen character Designs and their environment helped build tension and mysterious ambience to support the Narrative in keeping the enigmatic beings' true intentions hidden until the end of the film. Also, the approach to sound and visually representing the aliens' method of communicating reflects their abilities to perceive the world in the 4th dimension, a skill they wish to pass on to humans, in exchange for their help in the future, which presents the aliens as characters with a backstory and a motive. Furthermore, Participant A highlighted the film as one of his favourite projects due to effective Communication with the director.

While considering the slow-paced nature of the film in presenting the creatures as mysterious Alien entities that are different from previously created aliens for film, the characters were labelled by Participant A as believable. According to Figure 26, the characters met all criteria for believability of the Background and Central character roles. In addition, since the characters were original Designs, not addressed to please any fanbase or cultural groups, and there was not any mention about any future projects or merchandise sales regarding these characters, the contextual role level characters are not considered for this analysis. Therefore, as a character created for supporting the Narrative of the film as otherworldly beings, the aliens from arrival fulfilled their function as hero and background characters and therefore believable for these two categories only.

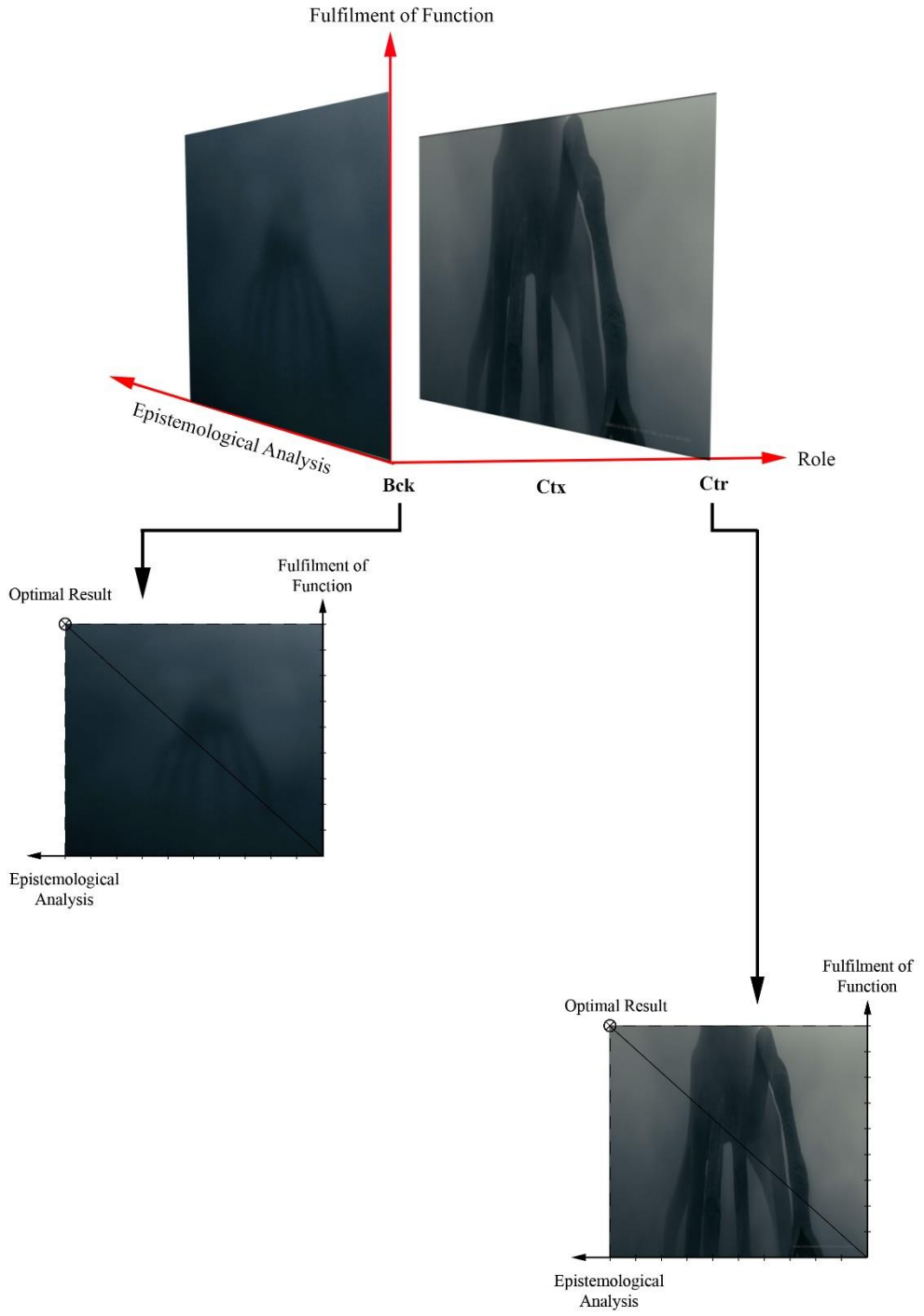

Figure 26 Abbott & Costello (Villeneuve 2016) Morphological Analysis (Melki 2018b)

5.4.2 Saphira (Eragon 2006)

As one of the main characters in the film, Saphira is the blue dragon that hatched from its egg and grew to full size while in the custody of Eragon whom she protected throughout

the story. As one of participant A's numerous projects, Saphira was described as one of the practitioner's least favourite projects due to Communication, Design, and Technical issues through the process.

The initial Design was designed to portray a motherly dragon covered by feathers instead of scales suitable for the requirements of the script. However, the Design was changed without the original designer's knowledge or feedback. The result was an unfunctional character that caused problems for the production team at ILM while attempting to develop it further. The process took around 18 months to finish only to end up with a similar character that was already proposed by participant A. Despite the return to the original style, the Communication progression and the Techniques used for this project were inefficient and ineffective. Therefore, the criteria for Design, Technique and Narrative, for this investigation, are not met as they resulted in lesser quality output. Regarding the Narrative, since the character was made to have a motherly aesthetic as a feathery dragon to serve the requirements of the script.

As a hero character based on existing intellectual property, Saphira met all 3 of the character role levels. Out of 9 believability criteria, the character met 6 as a background character, 4 as a contextual, and 5 as a Central character. This fulfilment of function score should place the character as an averagely believable character. However, the epistemological analysis shows that the character was produced inefficiently and ineffectively as the Communication, Technique, and Design criteria were not appropriately met. The result of the faulty process caused the project to take more time than required, a costly obstacle as well as it holds the project from proceeding correctly, which explains why the film was also labelled as "horrendous" by Participant A. In conclusion, the graphs, in figure 27, highlight the reason why the character was labelled as non-believable. As one of the key characters in the film, it scored slightly better as a background character than a Central one. In addition, to the feathering of the inefficiencies and ineffectiveness of the character creative process into the entirety of the film.

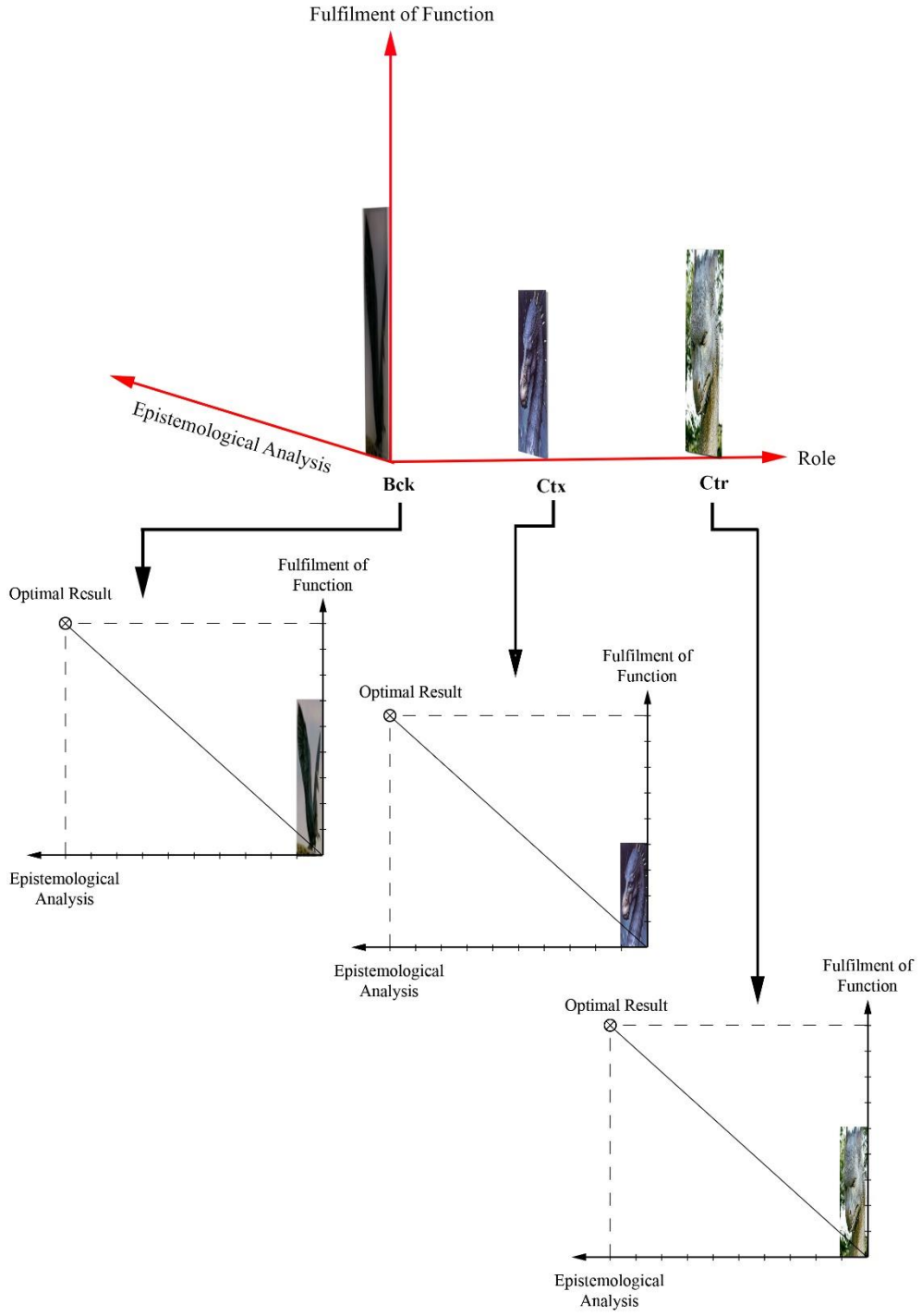

Figure 27 Morphological Analysis (Melki 2018b) – Saphira (Fangmeier 2006)

5.4.3 The Hulk (The Avengers 2012)

The 2008 *Incredible Hulk* featured numerous issues ranging from Communication and creative differences to Design and Narrative problems. These problems include the creative differences between the lead actor and Marvel Studios that resulted in a film

primarily focusing on the Hulk's backstory rather than a strong Narrative. As the 2nd attempt to produce a Hulk film, it was unclear whether the film is a sequel or a reboot. In contrast, the 2012 Hulk was featured as one of the superhero characters in *The Avengers* instead of a standalone Hulk film. However, this project, in which participant A was involved, featured an efficient and effective collaborative effort with a well-received output that spawned numerous films in which the Hulk appeared including, at the point of writing this analysis, 3 Avengers films (*The Avengers* 2012, *Age of Ultron* 2015, *Infinity War* 2018), the 2013 *Iron Man 3*, and the 2017 *Thor: Ragnarok* films.

According to participant A, the process of creating the 2012 Hulk included a selected group of practitioners of different expertise. The practitioners included two modellers, one experienced in practical and digital sculpting, and the other skilled in facial and body deformations, an animator who is also skilled at creating Riggs, skeletons to support the model's movement, and a lighting and compositing artist. Participant A described an efficient and effective collaborative team effort built on Communication, and skilfully executed Techniques to develop a functioning and well-designed character.

The Hulk met the believability criteria for his role as a Central character in the Narrative of the film. The animation and details of the characters were achieved in high quality for a character that played a role in the foreground of many shots in the film. In addition, the character is an already existing and popular intellectual property that met all the believability criteria as a contextual character as well as fulfilling its function in the background. The backstory was not revisited as it was already covered in previously released Hulk films as well as possessing a fanbase that already knows the general concept of the character. The latter was highlighted through the action sequences in the film as well as the silhouette and the overall shape of the character. Therefore, the character is deemed believable for all character type roles, as shown in the graphs below in figure 28.

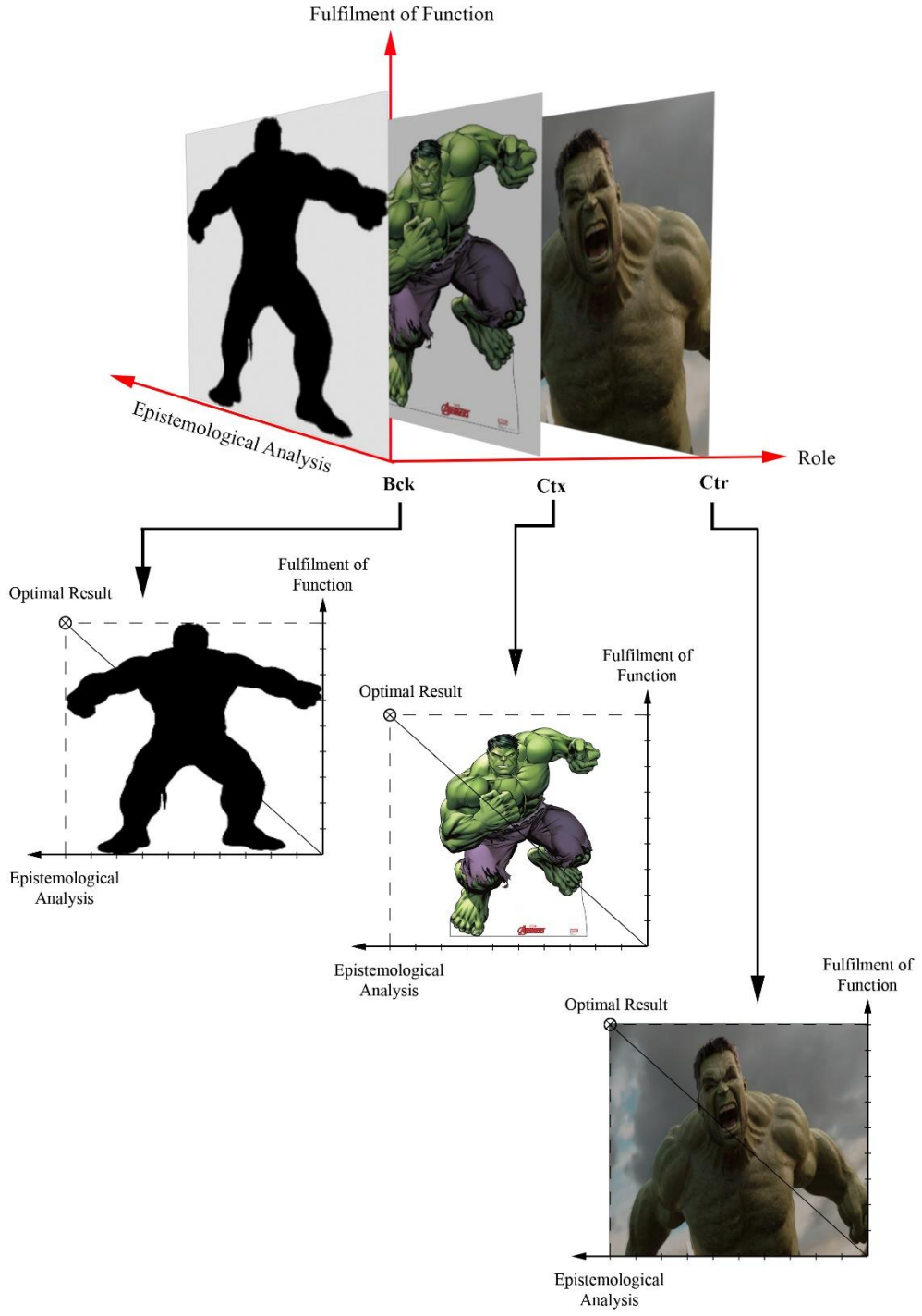

Figure 28 Morphological Analysis (Melki 2018b)- Hulk (Whedon 2012)

5.4.4 Tintin (2011)

As an already established popular comic book character, Tintin possesses a devout following of fans which motivated the team at WETA studios to carefully approach the project. During the interview, Participant B, who was involved in the film, highlighted

the emblematic silhouette of the character, praising the beauty of the lines depicting the comic book character, as well as being a devoted fan of the franchise.

Regarding approaching an already existing character, participant A explained that when translating a character from a medium to another, it is possible that the audience will not be ready for such a transition and it might take time for their initial reaction to the character to switch from negative to positive. Therefore, for a character with an emblematic silhouette such as Tintin, it is crucial for the artist, when updating character to a 3D medium, while remaining loyal to the original format and material. Participant B highlighted the extensive research conducted to match the overall aesthetic and style of Belgian architecture and locations with the visuals presented in the comic book. The film was produced and designed to be presented as a homage to the original through the effective and efficient collaborative effort of the production team. The outcome features photoreal characters that retained the style, function, and performance of the original version, making Tintin instantly recognisable despite the new photoreal format.

The translation from a 2D to a 3D format, although challenging for established intellectual property, was successful in producing a believable character that matches the original Design through its emblematic silhouette and concept. The 3D Tintin also fulfilled its purpose as the Central character of the Narrative that usually placed at the foreground. Due to the fulfilment of the requirements of the three role levels, as shown the figure 29, Tintin is believable for the all character role types.

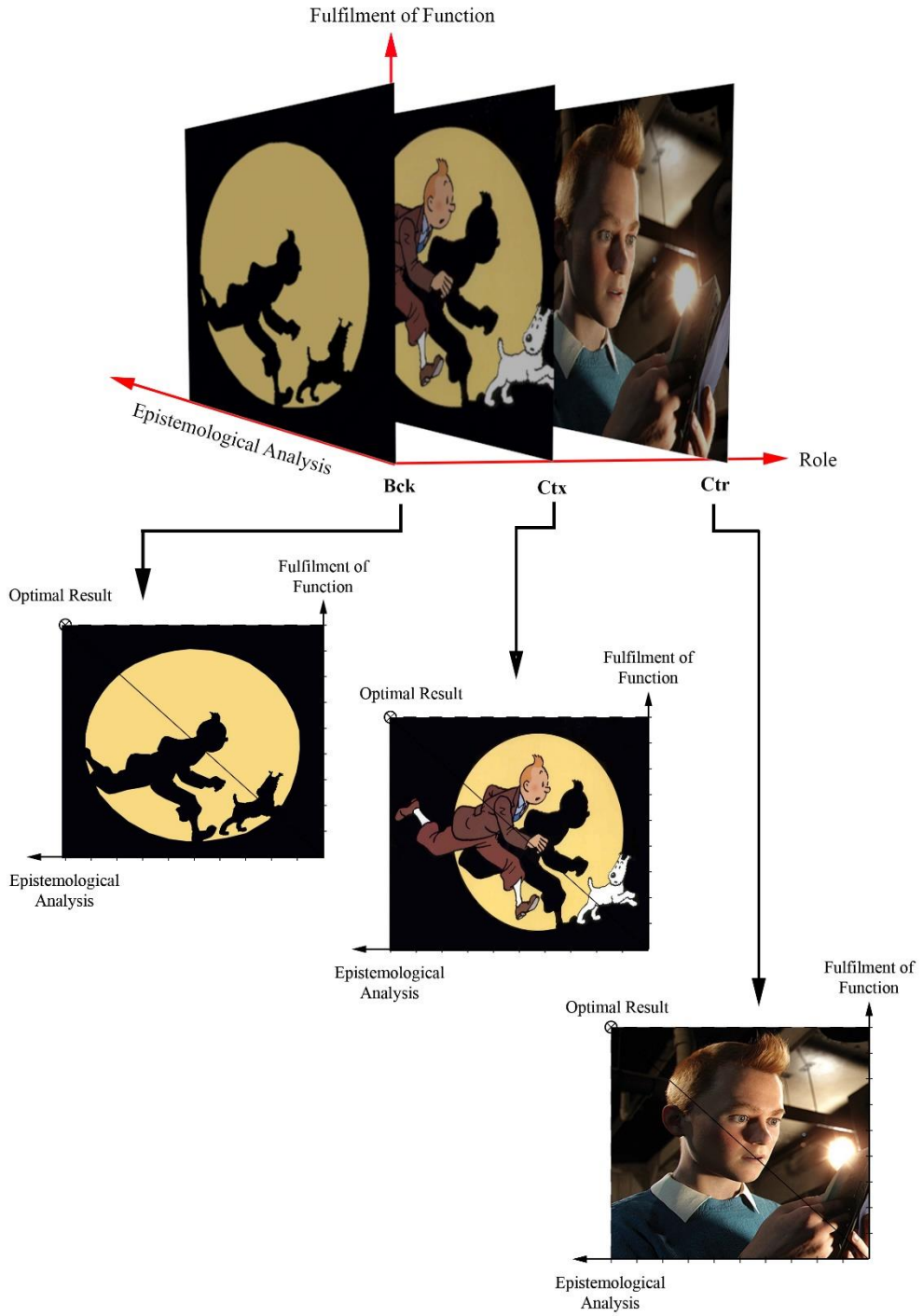

Figure 29 Morphological Analysis (Melki 2018b) – Tintin (Spielberg 2011)

5.4.5 Balin's Weapon

As one of the dwarves with more screen time in The Hobbit, Balin is considered a hero character. However, it was his weapon that was listed as one of participant B's favourite projects which remains relevant for this investigation as character props play a crucial

role in character believability. The weapon did not appear in detail in the film as it was always in the background or fast-paced action. Since the weapon did not appear in the foreground, it cannot be considered as a hero prop, and therefore, cannot be considered for the Central role analysis. However, the practitioner highlighted the process of making a weapon for a high fantasy film. The weapon must reflect the culture it belongs to as well as presenting familiar and fantastical elements, the importance of which relates to the perception of the created reality as coherent with its characters and environment. The idea of the weapon was conceived through collaboration and Communication with the actor who portrayed Balin. The weapon, a cross between a mace and a sword, was visually different from previously designed swords and maces but maintained a clear emblematic silhouette depiction of the prop's function. Despite not appearing in high focus in the film, participant B highlighted experiencing excitement when seeing the Design being sold as a children's toy or as part of Balin's action figure.

The analysis above concludes that Balin's weapons can be categorised in the background and contextual role categories. The weapon, while being used, was shown in fast-paced action sequences where its function was evident. In addition, when shown in the background, it blends with the character without taking the focus off the wielder. Therefore, for both categories, the prop is evaluated as believable, as shown in figure 30.

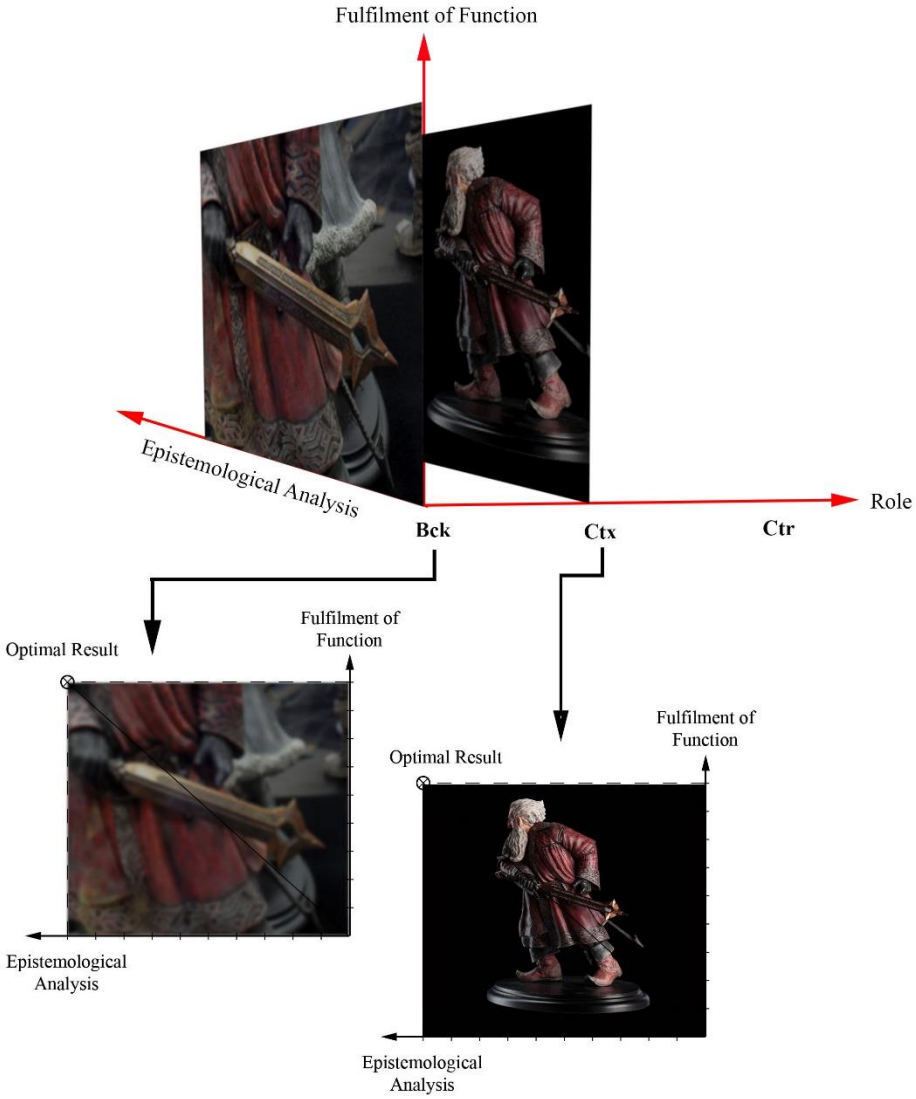

Figure 30 Morphological Analysis (Melki 2018b) - Balin's Weapon (Jackson 2012)

5.4.6 Goblin World (The Hobbit)

Although this project does not fall into the category of characters, it presents the environment in which a sequence of actions occurs through the agency of characters. It is essential to consider the context in which the characters are presented as the coherence between the environment and characters is crucial for the believability factor.

For this case, participant C highlighted the adopted approach in creating an environment that was built by goblins who would use stolen logs of wood, door and window frames from nearby towns to build their kingdom. The goal was also to portray dumb creatures who would not know the proper way to use human household items, tools, and accessories — for example, placing a door or a window frame in an unconventional yet functional

way to support the structure of the construction that the goblins built as their town. The shots did not focus on the details of the environment as they were always in the background. However, when intentionally examined the details are visible and fulfil their function in creating the world reflecting the personality of the goblin as well as the actions to be fulfilled by the rest of the characters.

The environment helped implicitly reflects the backstory about its residents to the audience as well as providing the obstacles for the action sequences. The material with which the environment was made was explicit, although it was not shown in high detail, the information provided visually was enough to convey the structure's composition to the audience. The Goblin World met all 9 of the believability criteria for the background role and therefore is listed as believable (figure 31).

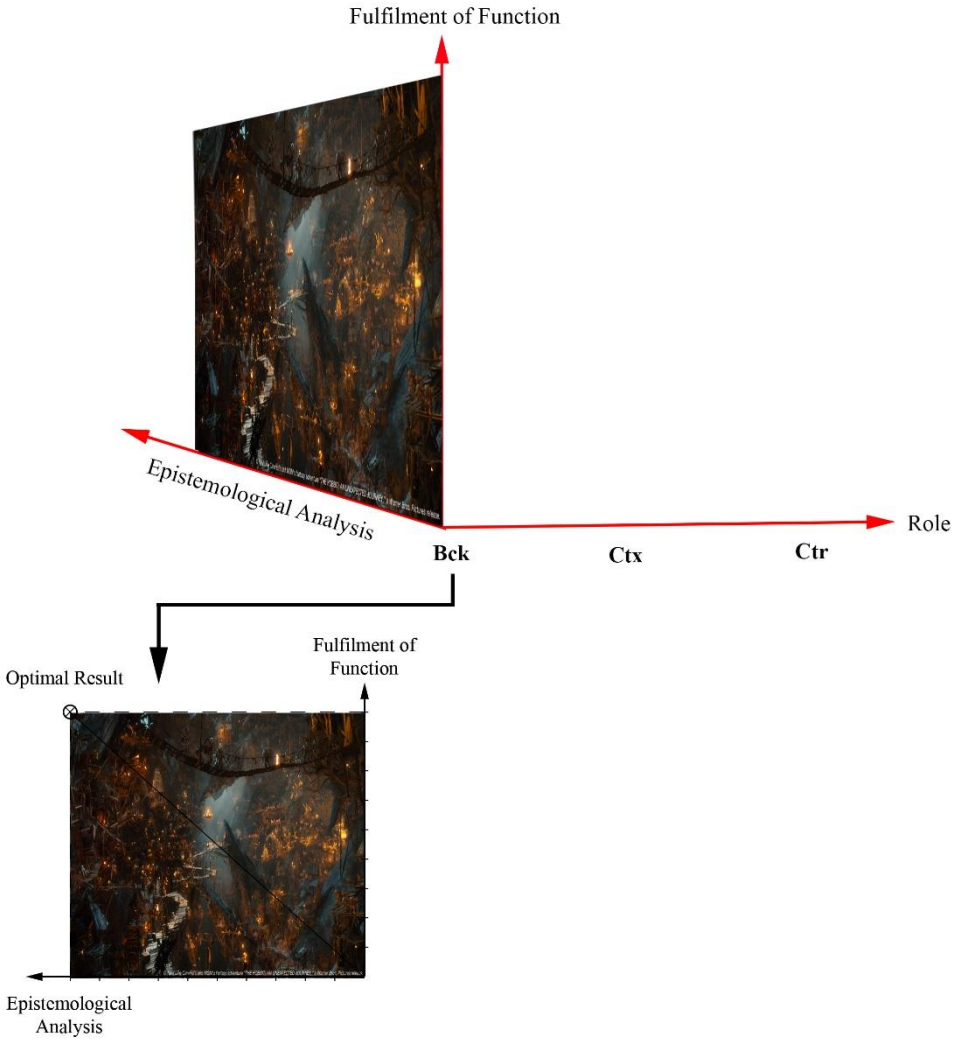

Figure 31 Morphological Analysis (Melki 2018b) - Goblin World (Jackson 2012)

5.4.7 The Engineer (Prometheus)

The engineer, although appearing briefly in short scenes in the film Prometheus, played a crucial part in the film's Narrative and was listed as one of Participant D's favourite projects.

According to Participant D, the aim was to create a beautiful, otherworldly humanoid being that featured a combination of Michelangelo's David face and H. R. Giger's art. The character was shown through close-ups in most scenes, but it was also presented as a glitchy hologram. For each case, the character was modelled with various mediums. In the shots presenting the newly introduced Central character, in the Alien franchise, in high focus and at the foreground, the Engineer was modelled using a type of silicone that gave the skin texture a translucent aesthetic. The body was designed following Giger's biomechanical art style to remain consistent with the Alien franchise. For the hologram shots, the character appeared digitally with a glitchy appearance while maintaining the overall shape and silhouette presenting clear movement depicting the actions performed.

Regarding function, the character fulfilled the requirements of the script while maintaining some of the mystery regarding the franchise's reboot goal in exploring the source of creation of humanity and the alien species. Throughout the interview, Participant D stressed the importance of setting each task's priority as everything needs to be produced as efficiently and effectively as possible. Some differences might arise; however, Participant D did not highlight any unresolved issues as their experience within the process was often fluid and built upon collaborations between practitioners.

The Engineer fulfilled all nine functions for believability for background and Central role groups. The contextual role cannot be considered as there was no information on whether the original character was designed to please specific group or made to be sold as merchandise, despite his very brief appearance in a sequel. As a background character, the engineer presented an understandable silhouette in motion, especially in the hologram shots. As a Central character, the Engineer achieved his function in the Narrative through its highly developed and well-Designed model. Therefore, as a Background and Central character, the Engineer is listed as believable (figure 32).

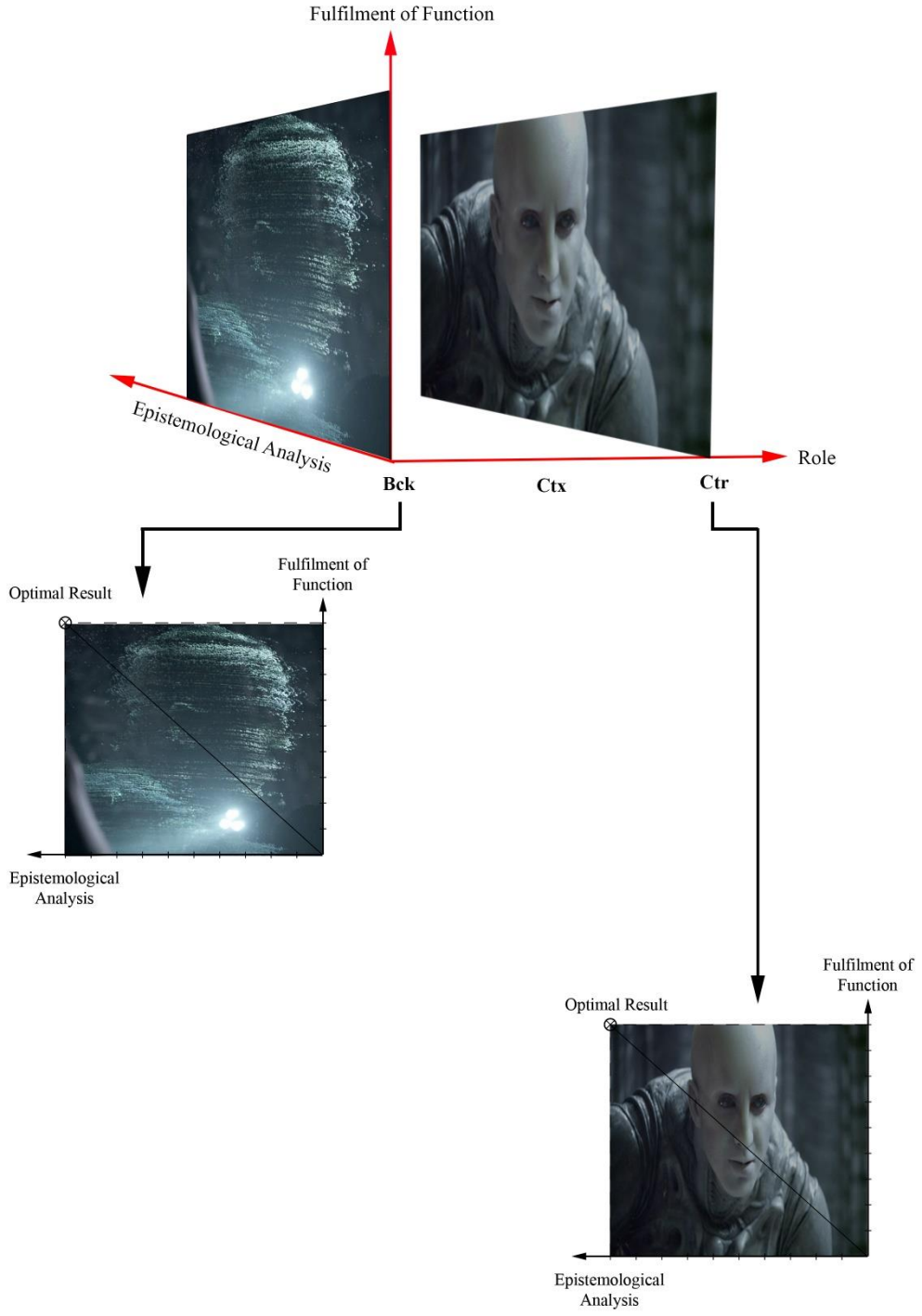

Figure 32 Morphological Analysis (Melki 2018b) - The Engineer (Scott 2012)

5.5 Case Studies: Secondary Group

This section includes projects discussed, with detail adequate for the analysis, by the participants in the interviews. The characters of these projects are considered as secondary case studies as the participants were not involved in these projects but referred to them as

examples while listing and discussing believable or non-believable characters. The analysis of these characters should indicate the use of tacit knowledge about films as references to the practitioners within the industry. The use of tacit knowledge should highlight the effectiveness of films, in which the participants were not involved, as libraries to communicate complex visual ideas with each other. Furthermore, the analysis of this section also highlights the believability factor of the characters according to the fulfilment of their function. The cases studies are listed below according to their order of appearance in table 15, which does not highlight any ranking order.

5.5.1 Xenomorph (1979)

The 1979 Xenomorph, initially designed by H. R. Giger, has become embedded in science fiction/horror popular culture. According to Participant C, the creature was built through practical effects which gave the impression of the presence of a physical entity in front of the live actors. The proficiency of the Design and Technical team is reflected in the final output and its efficient and effective role in creating a horrifying alien as the main antagonist in the Narrative. The closeup shots present a sharp focus on all the details and features of the creature including the husk, the fangs, the alien's tongue consisting with another set of jaws and fangs, and the slime and saliva coming from its mouth. As intellectual property, the character has been used in many sequels, cross-overs, reboots and prequels that have been received negatively and positively by audiences. For example, in contrast to the success of the original *Alien* film, the 3rd Alien film instalment featured a few scenes where the character was not believable. According to Participant A, the problem relates to the unpredictable proportion changes of the creature's body once it was introduced through a 3D perspective space. This caused inconsistency in the presentation of the character's size when placed with the live actors. In addition, the character was redesigned by H. R. Giger to possess human-like features such as lips but to have an overall appearance of a four-legged animal, instead of the humanoid posture presented in the previous Alien films. These requirements, initially requested by the director, did not make the final output as the artist designed them. The example of Alien 3 highlights the strength and impact of the original Alien film, which is the centre of this analysis. However, despite the negative reaction to some of the releases, the Alien franchise has become instantly identifiable through the silhouette of their creatures and style. Therefore, the Xenomorph fulfils all the functions required to be labelled as believable under each of the 3 role levels (figure 33).

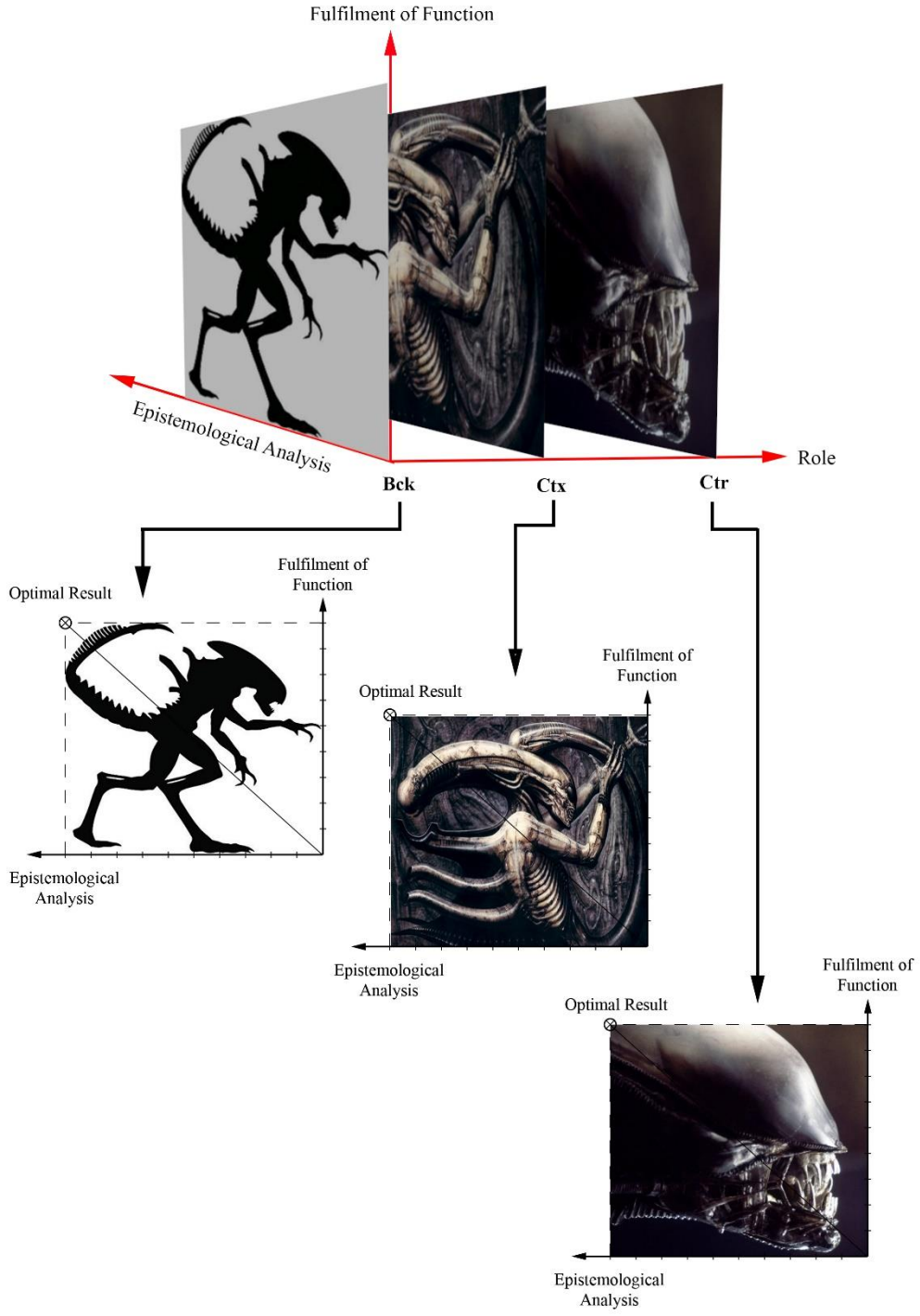

Figure 33 Morphological Analysis (Melki 2018b) - Xenomorph (Scott 1979)

5.5.2 The Reapers

As a new breed of enhanced vampires in the film *Blade 2*, the Reapers are presented as the protagonist's primary challenge and threat. They are often shown in close-up shots with sharp details highlighting their anatomy and the function of each limb and organ.

For example, the anatomical structure of their mouth and the protective bone shell enveloping their hearts. The quality achieved, through the combination of makeup, prosthetics, and CGI was of accurate and convincing detail that participant A highlighted his fascination with the work when it was first released. The merging of practical and digital effects reflects good Communication within the process that was effective and efficient in producing functional and detailed characters. The sharp focus throughout the process explains how these characters fall under the hero characters in shots. Also, some scenes presented the characters jumping great heights after or during decapitation. Those sequences were shot in a dark setting with just enough details showing the blood and fluids flowing down from their wounds with low focus and just the overall shape of the characters being visible. As a film based on Marvel comics of the same name, the reapers' first appearance was in the film and were not part of the intellectual property before the film.

Therefore, the Reapers meet the 9 functions for believability in the background and Central role levels. The level of details characteristic for Central characters is accurately designed to function clearly, effective in conveying the capabilities of the characters as well as functioning efficiently as a Central role in the Narrative. In addition, the details suitable for background character are also a functioning tool to implicitly show the depth of the characters' personality and traits, while retaining the overall form. Based on the fulfilment of these requirements, the Reapers are listed as believable characters for the two role levels (figure 34).

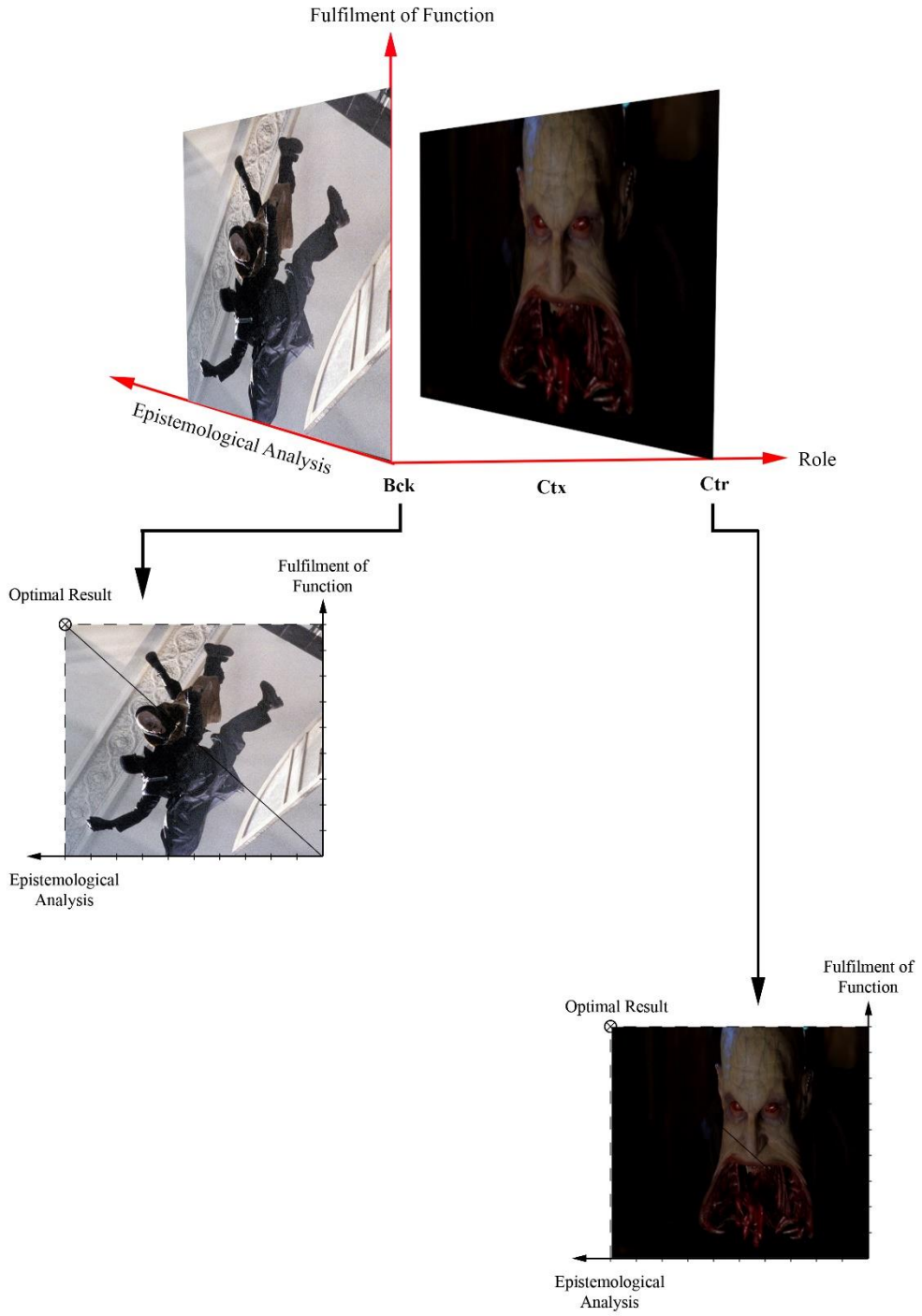

Figure 34 Morphological Analysis (Melki 2018b) - The Reapers (Del Toro 2002)

5.5.3 Godzilla (1998)

Released five years after the 1993 influential Jurassic Park (see chapter 2), this version of Godzilla faced Design and Technical issues. As an existing franchise, Godzilla's Design was changed in contrast to the original Design. According to participant A, completely

changing a popular character, as opposed to updating, is a mistake that sparks adverse reactions from the audience and does not improve with time. The audience, already familiar with the character, perceive the new character as non-believable as it becomes unfamiliar or at odds with the familiar version.

Furthermore, the merging between live footage and CGI was done to a lesser quality, clearly indicating a green screen composition in layering the two mediums. However, regarding its function in storytelling, the creature fulfilled its role as the main antagonist in the film and maintained its clear silhouette and movements in the background shots of the film. However, due to the lack of Design, the emblematic shape of the creature was missing, and the new silhouette did not generate the required cultural reference and impact.

Therefore, the character, placed under Background, Contextual, and Central, performed differently for each of the three role levels. As a Central character and an already existing intellectual property, Godzilla scored 4/9 from the believability criteria, while performing better in the background category, having met 6 of the 9 believability criteria. In addition, due to the Design changes to the already existing property, the result was a wholly different and poorly designed character from an epistemological perspective. The Techniques used to develop the character, although was not elaborately highlighted in the interviews, did not surpass or reach the standard set by Jurassic Park in 1993. Based on the met criteria highlighted in tables 16, 17, and figure 35, the 1998 Godzilla, a Central character performing as a background character, is listed as non-believable.

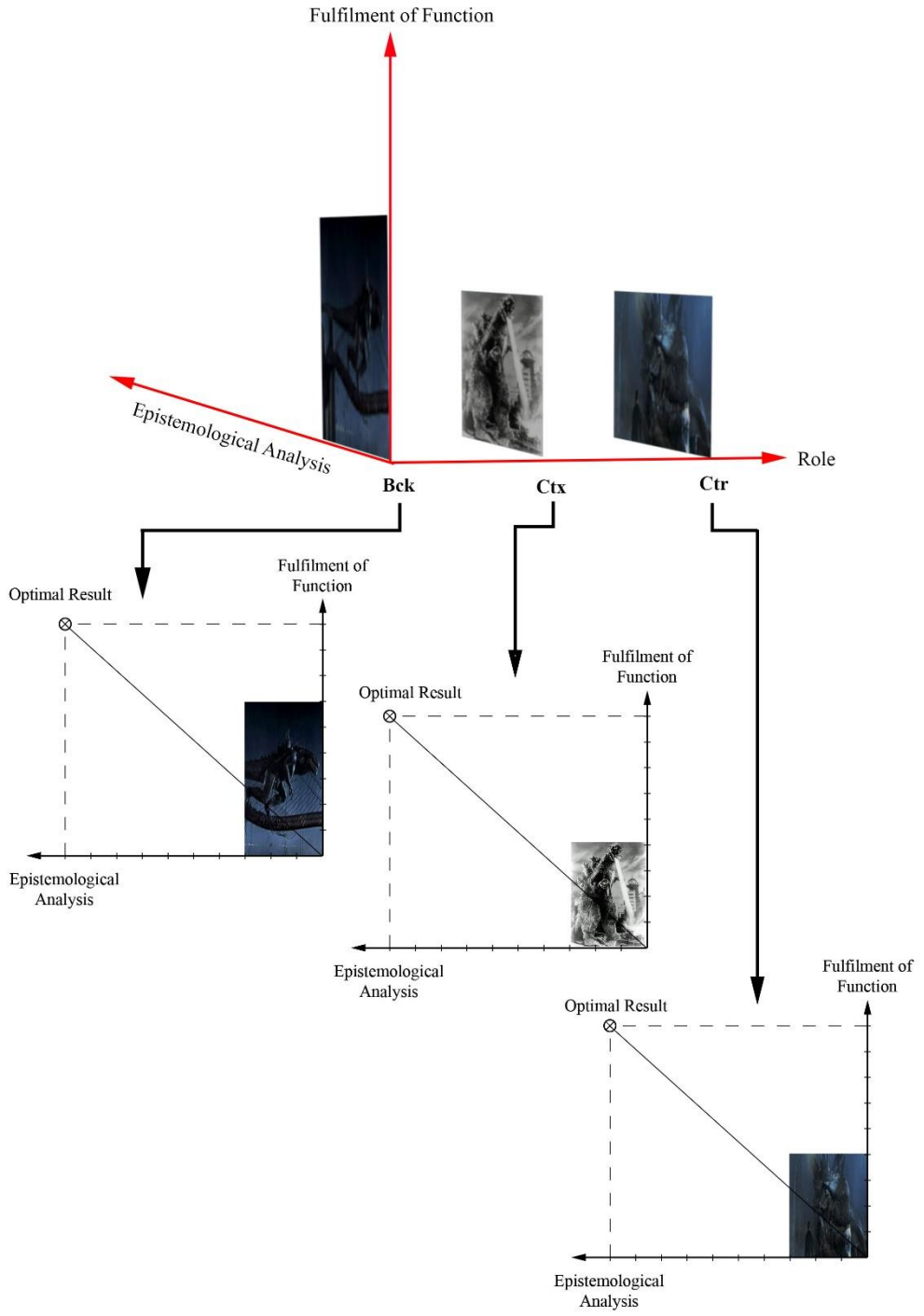

Figure 35 Morphological Analysis (Melki 2018b) – Godzilla (Emmerich 1998)

5.5.4 The Aliens (Star Trek: Beyond)

The example of the aliens in Star Trek Beyond (figure 36) poses an interesting case for the creative process of generating believable characters. The film's makeup artist supervisor Joel Harlow, previously the winner of the academy award for best makeup for

the first Star Trek film reboot, was nominated again for the same category. However, participant D listed the aliens in the film as non-believable stating that they were overdone, colourfully outlandish, too perfect as they do not show any ageing or any details depicting backstories. However, Participant D also stressed that non-believability is not necessarily a negative aspect since the style worked for the film, and the character served the purposes of the script. According to the participant, the aliens could have been created to impress and astound audiences and to to be sold as toys.

As Central characters, the Aliens in Star Trek Beyond scored 6 out of the 9 believability criteria which is above average, therefore can be listed as believable. This is reflected in the film, as the characters functioned and fulfilled their purpose for the requirements of the script for all role levels. However, they lacked the details as Central characters that showed any ageing or anatomical accuracy. However, Participant D emphasised this is not necessarily a negative aspect. The characters performed more efficiently as Background and Contextual characters achieving all functionality criteria for believability as they are meant to be presented as beautiful and colourful beings aimed to trigger a sense of astonishment by the audience.

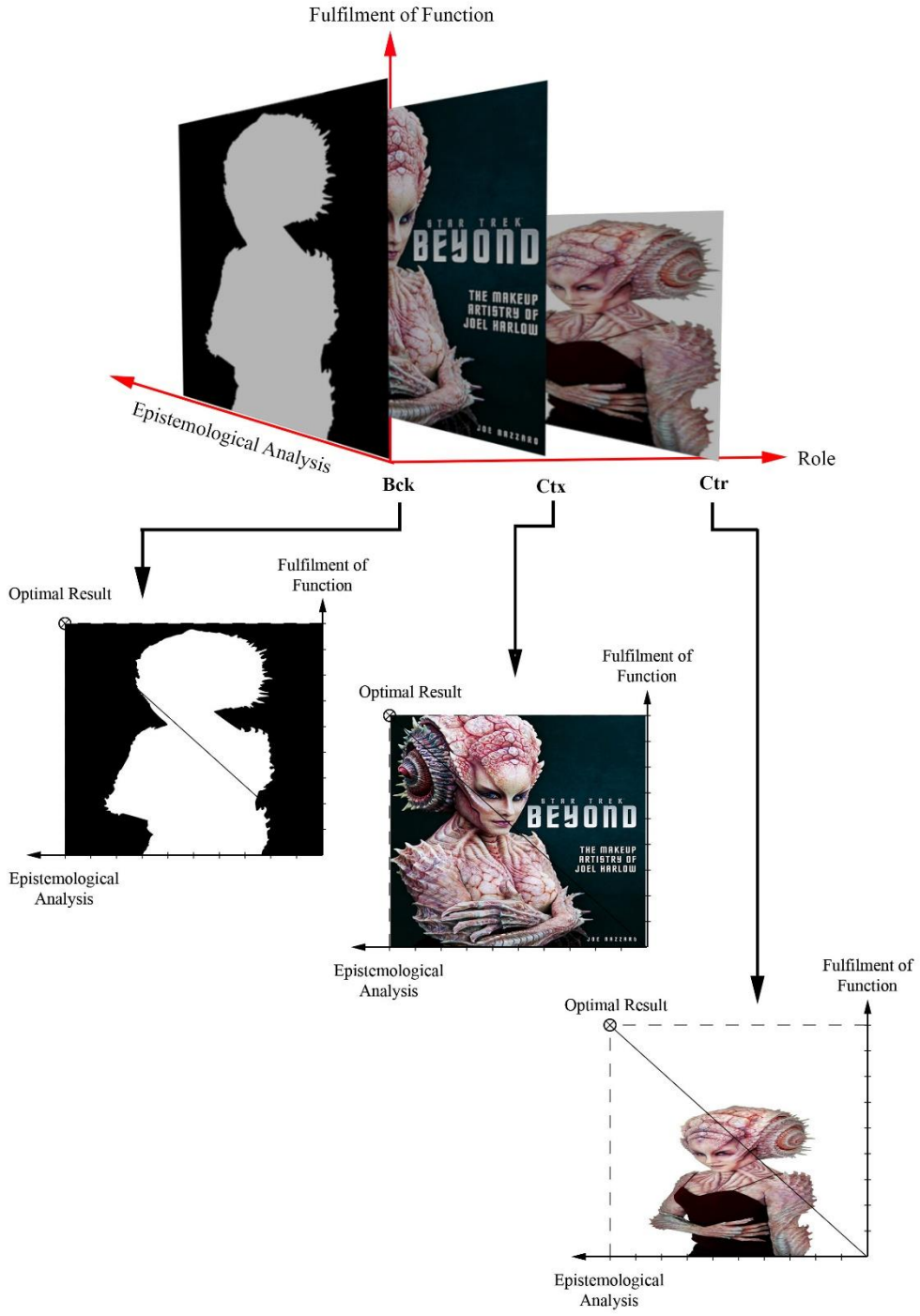

Figure 36 Morphological Analysis (Melki 2018b) - The Aliens (Lin 2016)

6 Discussion of Findings

6.1 Introduction

The investigation into the creative processes behind believable photorealistic characters in film was proposed due to the shallow professional and academic perspectives found in books, academic articles, magazines, interviews, blogs, and "making-of" DVDs. The research highlighted diverse and conflicting points of view on the issue of character believability in the constructed realities presented in films.

According to Chris Webster and John Lasseter, the script or Narrative should be prioritised above the other elements that constitute the creative process (Webster 2002). By contrast, other practitioners, including Senior VFX artist Pierre Grage and co-founder of Digital Domain and former CEO of ILM Scott Ross, have been vocal about the importance of the business model and Communication aspect of the creative process in relation to practice (Dubner 2017, Al-Jamea, Rizvi 2017, Grage 2014). A third perspective considers the technological advancements and methods employed to overcome the Uncanny Valley and create higher quality and more engaging digital outputs (Geller 2008, Misselhorn 2009). Design is another element that has been discussed and prioritised by some practitioners in the industry (Tillman 2011). The literature review on the construction of realities indicated that believability is achieved when all elements of an established reality are coherent. Therefore, this thesis proposed that believability is achieved through the coherence of the four elements of the creative process: Design, Technique, Communication, and Narrative.

This chapter outlines the outcomes of the analysis conducted in chapter 5 to highlight and discuss this thesis' key findings and contribution to the animation and VFX industry. The findings tackle the issues regarding the dynamic nature of the creative process, the competing priorities of the practitioners involved in the creative process, and the role of the created characters within the context of film and the industry. Each of these themes is discussed in their respective section.

6.2 Dynamics

According to the interview outcomes, the creative process is continuously dynamic and cannot be standardised or reduced to a single static method in producing films. Although the participants' roles are rooted in pre-production, their responsibilities proceed to the production and post-production phase. The broad roles of the interviewed practitioners spanning the entire creative process are due to its unpredictability. Practitioners are hired on a project basis set during a period that cannot be defined as changes regularly occur to the script, style, character and prop designs, lighting, and camera shots, without considering the possible change of director or other personnel. With these unexpected changes, the practitioners are required to produce an output as efficiently and effectively as possible upon demand during any stage of the creative process. In addition, the unpredictability of the creative process indicates that practitioners could work for weeks or months, before becoming either unemployed, obliged to search for a new project or navigate the overlap between projects. This unsustainable work model has led practitioners to live a nomadic lifestyle, travelling to different locations, seeking the next project.

The impact of this unstable model is evident in the choice of the interviewed participants to seek more control outside of the corporate studio environment. Three of the participants are working as freelancers, two of which work from home. The 4th participant owns two model-making studios and is involved in managing and giving prop and mould-making training workshops to fresh graduates and other talents involved in the industry. The need for practitioners to diversify their income sources further indicates the unsustainable nature of the industry. Hiring on a project basis, along with fixed pricing that is not flexible to suit the unexpected changes that occur in the process, means that practitioners struggle to maintain a sustainable income and flow of work. Consequently, they must rely on their network of contacts and side projects to survive.

While some arguments link the industry failings to an unsustainable business model that is reflected by the present practitioner disgruntlement, exploitation accusations, and the increasing rate of freelancers versus the decreasing employment rate at VFX and animation studios, discussed in Chapter 2, the interview participants have stressed that creative identity also has a role to play. Practitioners who title themselves as artists are often characterised by ego and protectiveness of their work. The practitioners in the industry must be aware that they are hired to accomplish the vision of a client. It is impractical to be too precious about a project when a client could decide to adopt an

alternative approach or discard an entire scene, prop, or character. Creative freedom plays an important role in the creation of original outputs, but it must be restricted within the criteria of the director. In addition, while considering their responsibilities to meet the requirements of the script and the director, practitioners must aim to produce, through collaboration, an output as efficiently and effectively as possible. Practitioners must be resourceful in their use of time, budget and tools. Project management efficiency allows the practitioners' outputs to quickly proceed to the next stages of the process without hindering the production pipeline. Successively, the practitioners could move on to their next task or project. This provides time to review their priorities according to requested alterations. However, setting priorities is a challenge since practitioners come from different backgrounds, disciplines, and are active through different stages of the creative process. This issue is addressed in the second contribution of this thesis, as outlined in the following section.

6.3 Competing Priorities in Epistemology

The diverse disciplines and backgrounds of the practitioners involved in the creative process is a primary factor to the competitiveness in setting priorities for the importance of the four elements of the creative process: Narrative, Design, Technique, and Communication. Considering the interview participants enter the pre-production phase at different stages and continue their contribution through to production and post-production, their priorities are naturally different. Participants A & B are from Design backgrounds, responsible for creating the concept art and the design of characters, props, and costumes. Therefore, they have prioritised Design over the remaining elements.

In contrast, participant C & D focused more on Technique as they are primarily responsible for mould, prop making, and make-up. The competing priorities on the individual level further reflect the dynamic nature of the creative process where one element takes the lead then becomes secondary as the process proceeds. This shifting occurs primarily between the Design and Technique elements as the project passes from pre-production to production. However, regarding the entire process, the analysis revealed a ranking order of the creative process' elements, based on the outcomes of the participant interviews, starting with Design, Technique, Communication, and Narrative. Each of the four elements is discussed separately in the following sections in relation to the meaning of their rank order in the creative process.

6.3.1 Design

As the element that is a creative process by itself, as Bryan Lawson (2004, 2006) depicted, Design possesses its methods and Techniques to communicate a brief or a script to an audience compellingly. The Central role of the Design process is to produce outputs that communicate a specific function to the audience, including characters that act as the primary agents in driving the Narrative, props and costumes to represent specific, factual or fictional cultures. Design also encompasses the intricate details placed on characters or props, such as scars or material ageing, to give the object a backstory or depth. As explained by Annie Atkins (2017), everything that is placed in a scene, including the props or the signage provided in the background, is purposely and intentionally placed to either trigger a reaction or to immaculately help tell a story. The role of Design also includes maintaining a single style, suitable for the director's requirement, in the film to create a consistently coherent and cohesive reality. It is necessary to factor a considerable amount of research and planning, which also requires the anticipation of obstacles and finding solutions within the constraints of time and budget.

The criteria for believability, listed by the participants in the interview, are presented as the character's fulfilment of several functions, all of which can be rooted in Design. The criteria involve a profound understanding and awareness of the target audience, regarding their perception of the character and whether they present a fanbase for an already established franchise. In addition, although the depiction of precise movement and presentation is based on the utilisation of tools and skills, the knowledge of anatomy and the understanding of the function of the different bones, muscles, and joints are fundamental to the accurate application of these tools. The remaining criteria revolve around the silhouette, the detail, and the role of the character to meet the requirements of the script. For example, the proportions and overall shape of a superhero character differ from a character designed for comic relief. This also extends to the creation of instantly recognisable silhouettes, or the overall shape, of characters and constitutes the simplest shapes that resonate within the audience; for example, Gandalf's hat or Batman's symbol. An impactful character must be convincing in its overall shape while providing enough detail to convey depth in their personality and allows the audience to connect and perceive them as believable empathic characters.

It is logical for Design to be ranked as the most important in the creative process as it forms the foundation on which the rest of the elements can be constructed.

6.3.2 Technique

Technique was ranked 2nd in the elements of the creative process. It relies heavily on Design as its foundation and main structure. Technique aims to develop and apply the approved Design for presentation in the highest possible output quality suitable for its role. As mentioned in the Design section, the most efficient and effective Technique to approach a project can be anticipated and planned in response to the Design. However, this is best achieved when the practitioner is confident, experienced, and skilful in their knowledge of the tools and methods available at their disposal. This constitutes an interesting, interconnected relationship between Design and Technique.

The interview participants have emphasised the importance of the advancements in tools and Techniques, and their ongoing pursuit to maintain an updated knowledge in the developed tools and materials continuously. The advancements in materials and tools are directly linked to the industry's need to have its output released as efficiently and effectively as possible. Besides maintaining up to date knowledge on the technological advancements, there are several additional variables that practitioners need to consider, including the advantages and disadvantages of specific tools and Techniques, and their overhead costs. Therefore, the approach to Technique must be treated as a component of a business, especially that practitioners require a steady percentage of profit to survive.

Regarding the knowledge of the strengths and weaknesses of the Techniques used, the participants' answers overlapped on the importance of the use of the combination of practical and digital effects. This approach is effective and efficient in creating high-quality output based on the specific requirements of a shot. Practical effects are a dependable approach to creatures shown in stable or static closeup shots where the presence of an entity next to a live actor is the main purpose of a scene. In contrast, scenes that require organic, complex, or fast movements are required are better achieved through CGI. Furthermore, the choice of Technique and medium also relate to the project and the film's overall style, which can be determined by the practitioner through correspondences with the director.

6.3.3 Communication

Communication ranked 3rd in the order of the elements that constitute the creative process. In contrast to Design and Technique, believable characters can be produced without the effective and efficient use of Communication. However, the lack of Communication could be the cause of negative ramifications that affect the studio. Rhythm & Hues, for

instance, produced the highly believable digital photoreal tiger in *Life of Pi*, despite a lack of Communication and impending bankruptcy. In addition, the lack of Communication, according to the interview participants, could feather into the production of the film and therefore into the creative process as it occurred with the dragon Saphira from the movie *Eragon*.

The interview analysis revealed an interesting form of tacit Communication on which the participants depend, integrating and relying on their knowledge and experience. The unspoken universal agreement among practitioners is built on the understanding that everything must be produced as efficiently and effectively as possible within the constraints of time and budget. Although practitioners come from diverse backgrounds and disciplines, including creature Design, animation, theatre, makeup, illustration, architectural and prop model making, they all present a passion and deep interest in film. The characters or props in film become a visual library of references that practitioners use to refer to a specific Technique, Design, or concept while Communicating with their collaborators.

In addition, tacit Communication and knowledge rely on experience and understanding of non-verbal communication of clients. As mentioned by the interview participants, clients often lack awareness and knowledge regarding the intricacy of the creative process. The production of Designs for makeup differ than those for CGI, for example. In other instances, the approval between 2 different colours can be hindered by the conflicting opinions and choices of the decision-makers. This creates a conundrum for practitioners as it leaves them relying on experience and tacit knowledge to make the decision themselves and offer a compromising possibility that satisfies all the clients. Furthermore, the brief or the unwritten script can be presented verbally and often vaguely to the practitioners. The interview participants explained the importance of developing tacit Communication skills that could detect the actual requirement of the client or director through tone, body language, trends, and previous work experiences.

6.3.4 Narrative

Since the primary purpose of films is to tell a story visually, the interview analysis presented interesting results as the Narrative element of the creative process was ranked 4th or in the last position in the ranking order. The other three elements of the creative process exist to produce a visually compelling story where the efforts are applied to meet the requirements of the script or Narrative.

However, as the results of the interview analysis and the research suggest, the script can often be presented in a vague description and verbal format to the practitioners. This is mainly due to delays in the writing or approval of the script. The interview participants have expressed their preference and benefits of receiving explicit and well-defined scripts or character criteria. However, that occurs on rare occasions. In the cases where the script is written and provided to the practitioners, the documents can be hundreds of pages long. Considering the high probability of the script being changed and altered through the production of the film, and the unspoken rule of the fast-paced, yet efficient and effective, production process, practitioners must draw out the most crucial and essential information and formulate a Design, then develop it using the adequate Techniques to suit the Narrative. Through this approach, practitioners do not need to read hundreds of pages to produce or change the characters, unless drastic changes occurred in the script that cause the change of the whole character.

Therefore, the role of the Narrative or the script is to provide the essential information and criteria for the practitioners to utilise in their projects. The process includes the translation of the verbal or written format to a visual one that establishes the primary constraints for the Design process. The Narrative might be the most crucial aspect of a film to a specific audience or the practitioners' main target to represent visually. However, while the Narrative is primarily required at the start, it becomes the least required component throughout the creative process. Furthermore, according to participant B, there are cases where scripts are created for characters, so they are incorporated in the movie to appease a specific audience. This issue is related to character function, which is linked to the next contribution of this research.

6.4 Character Type Ontological Taxonomy

Besides revealing the dynamic nature of the industry and the epistemology of the creative process, this research also presents insights into the ontological nature of characters in relation to their corresponding film and the industry. Following the interviews and the analysis results, character ontology includes more than just the archetypes contributing to a Narrative structure. Due to the business model flaws and the struggle of studios to maintain a sustainable income, characters are being produced not just for visual storytelling, but also to increase viewership and provide opportunities for other sources of income and funding. This section highlights the further research contribution of

categorising characters according to their role within a movie. These roles are categorised as Central, Contextual, and Background.

The Central role includes the characters and props that are essential in the sequence of events in the movie. These are often presented in high focus, in the foreground of a shot and are referred to by practitioners as Hero characters or Hero props. The Contextual group includes characters that are presented in a movie under a specific context that is not essential to the main Narrative. As mentioned by participant B, some scripts are written specifically for characters, as opposed to the original creative format where characters are created to serve the script. This is not necessarily a negative process as the industry requires characters with financial and political roles in the global organisation of the film industry. Contextual characters include two types: Intellectual Property and Service. Intellectual Property characters are often placed in a movie to boost the sale of products and merchandise associated with the character such as video games, children's toys, clothing, and accessories. Service characters are those included in the film to appease, satisfy, or attract a specific audience of different racial background, culture, and gender, including fanbases of specific intellectual property. These types of characters could be posing a moral or controversial debate around their function in storytelling, as seen with the Porgs (B. Alexander 2017) and the divisive "progressive" characters in *Star Wars: The Last Jedi 2017* (VanDerWerff 2017, Chamary 2018). However, they are a useful tool for advertisement and self-promotion, and reliable source of funding that contributes to the film industry's financial stability (Caldwell 2008, Grage 2014). For example, as of 2016, the entire Harry Potter franchise made $7,216,000,000 from movie sales. However, toys sales alone surpassed the revenue of eight films and accumulated to an estimate of $7,307,500,000 (Statistic Brain 2016). The importance of the ontological taxonomy is outlined in the following sections.

6.4.1 Exemplar Types

Practitioners face obstacles and challenges on every project that are often solved or overcome through the reliance on the experience acquired from similar past projects. The interview participants are experienced experts in their respective fields with several projects in their portfolio. For the new generation of practitioners, partaking in the stressful and challenging nature of the film industry implies the need to succumb to long periods of struggle in order to match the speed and rhythm of the industry; or quit and seek different careers.

The analysis of believable and non-believable characters indicated whether they were fully and maturely developed to reflect their sophisticated role as Central, Contextual, and/or Background characters. The criteria for the fulfilment of function, extracted from the interview answers, were an indication for believability. The characters that were considered believable and impactful to the audience achieved the optimal believability score by meeting most or all function and epistemological criteria in all Central roles. The characters created for a specific purpose managed to meet the criteria of one or two role types. These are not considered non-believable but only believable for the role they were created for, contextual or background, for example. In contrast, characters that scored less than average in any role type were considered as non-believable.

Saphira and Godzilla are examples of primarily Central characters that appeared in their respective films in all three role types. Their scores, which were higher as background characters, are a reliable indicator of the absence of the epistemological elements of the creative process, as the characters did not function with the appropriate quality for their intended purpose. In contrast, as a believable character, Tintin is also categorised under Central, Contextual, and Background roles. The creative process that generated the character was functional throughout its execution of Design, Technique, Communication, and Narrative for the film. Tintin acted as the Central agent in driving the Narrative forward. In addition, his visual representation reflected the original 2D intellectual property by maintaining his emblematic silhouette and personality through an effective and efficient translation into a 3D format. As a versatile character, being able to fulfil multiple roles, Tintin establishes an exemplar for practitioners collaborating on translating an already established 2D Intellectual Property, also playing a Central role in its franchise, into a 3D format, suitable for a contemporary audience.

Other exemplars include Central characters for horror films such as *Alien* and *Arrival*. The Xenomorph and Abbott & Costello, respectively from the original *Alien* film and *Arrival*, are categorised under the Central role. The Xenomorph represents a valid horror exemplar of the use of practical effects, while Abbott & Costello are valid exemplars for CGI. Just as participant A argued for creating horror by designing a character without eyes, as with his aliens in the movie *Arrival*, the same logic and approach may be applied to the much older film *Alien.* In addition, the use of practical effects for the Xenomorph helped the representation of the physical entity alongside the live actors. The drawback of using only practical effects was the lack of fluid and fast organic movement. This was implemented by combining practical with digital effects in other projects such as *Jurassic*

Park. In the case of *Arrival*, the disadvantage of using only CGI effects for Abbott & Costello included the lack of proper interaction between the Aliens' skin with the bones. Considering the limitation of the budget, this was overcome with the use of fog or smoke to hide any imperfections.

Furthermore, the adaption and production of the Xenomorph followed and maintained Giger's designs, style, and artwork for the original *Alien*. The success of this character design resulted in opportunities for multiple sequels, prequels, and crossovers with other franchises such as the Predator characters. Therefore, the Xenomorph, of the original *Alien* film, presents another exemplar for the Contextual type as opposed to the third *Alien* instalment where Giger's original designs for that film were discarded.

For the Background category, the Goblin world and Balin's weapon are valid exemplars existing in the same reality, that present respectively a functioning environment, built by non-human creatures with lesser intelligence; and a weapon functioning as two weapons combined that were forged by another race of highly skilled crafters. Although the environment and weapon were often presented in the background or, in the case of the weapon, in a contextual medium with enough focus to indicate some detail for future toy sales, both props involved a large amount of research and thought behind their production. However, these objects are used as an extension of the characters and must never take the focus off the Central characters. Although, as a franchise, The Hobbit was not as successful as the Lord of the Rings, the chosen environment and props for discussion were extracted from the interviews and are believable for their respective functions regardless of the performance of the remaining characters.

6.4.2 Tacit Knowledge Enrichment

When prompted in interviews, about believable and non-believable characters, or the four elements constituting the creative process, the participants relied on characters from their portfolios or other practitioners' efforts in films to highlight their arguments or opinions. This is a reliable indicator that practitioners in the film industry rely on tacit knowledge built on their experience and exposure to film culture. In addition, participant A has indicated an issue with younger directors who are more familiar with games rather than film, expecting designers to produce characters that are inspired by games' style and aesthetics. As explained by participant A, the production of photoreal characters for film differ to those produced for games as movie characters must comply to the restriction of

accurate anatomy while the game character can be greatly exaggerated, sometimes becoming absurd but functional for the game.

There remains a definite lack in Communication between the various groups and individuals involved in films. This is due to the broad range of tastes, preferences, film experience, and visual education. The taxonomy of exemplar types, highlighted in the previous section, provides practitioners with the opportunity to organise and refer to exemplars suitable for the specific project on which they are working, under a single library of visual reference. The advantage of using the taxonomy of exemplar types is the categorisation according to function. The practitioner only needs to refer to the taxonomy under the category that shares the same function as their project's character. Through this model, Communication should become more accessible and fluid between practitioners across the creative process, as well as directors, producers, and writers by providing a standardised grouping according to function, for reference. Although the characters analysed in Chapter 5 represent a select number of exemplars, they covered all role types, establishing the basis for further development as discussed in detail in the following chapter. Although the analysis model used in Chapter 5 presented the results that are suitable for this investigation, it is practical in a commercial environment. Therefore, an alternative prototype is presented in the following section with some case studies highlighting its use, effectiveness, and potential opportunities.

6.4.3 Commercial Analysis Model Prototype

This investigation has highlighted the unpredictable nature of the industry regarding job and financial stability as well as the difficulty of reducing the creative process into a formulaic process. An important issue highlighted in the investigation relates to the difficulty to tacitly communicate ideas and the translation of verbal or written briefs into visuals that suits the client's requirements in a specific project. As highlighted by Participant D(30) in Appendix 2, this communication process would require experience in talking and understanding film visual references or some form of mind-reading skills for it to function effectively. The creative process would be much easier if the practitioner could visually see what the client is thinking or requiring. The ambiguity of the industry and the creative process is a challenge practitioner strive to overcome, especially inexperienced new-comers who are struggling to maintain their careers in a competitive and often exploitative industry. In an effort to produce a user-friendly model that facilitates communication between the different hierarchies of the production pipeline to

produce believable characters, this section proposes the Melki Model: MelCE (Melki Character Evaluator).

This model is inspired by William Herbert Sheldon's Somatotype test, which he proposed in the 1940s to categorise athletes' body types (Sheldon, Stevens et al. 1940, Sheldon 1954). Sheldon defines three primary components of body types: Endomorphic, Mesomorphic, and Ectomorphic (figure 37).

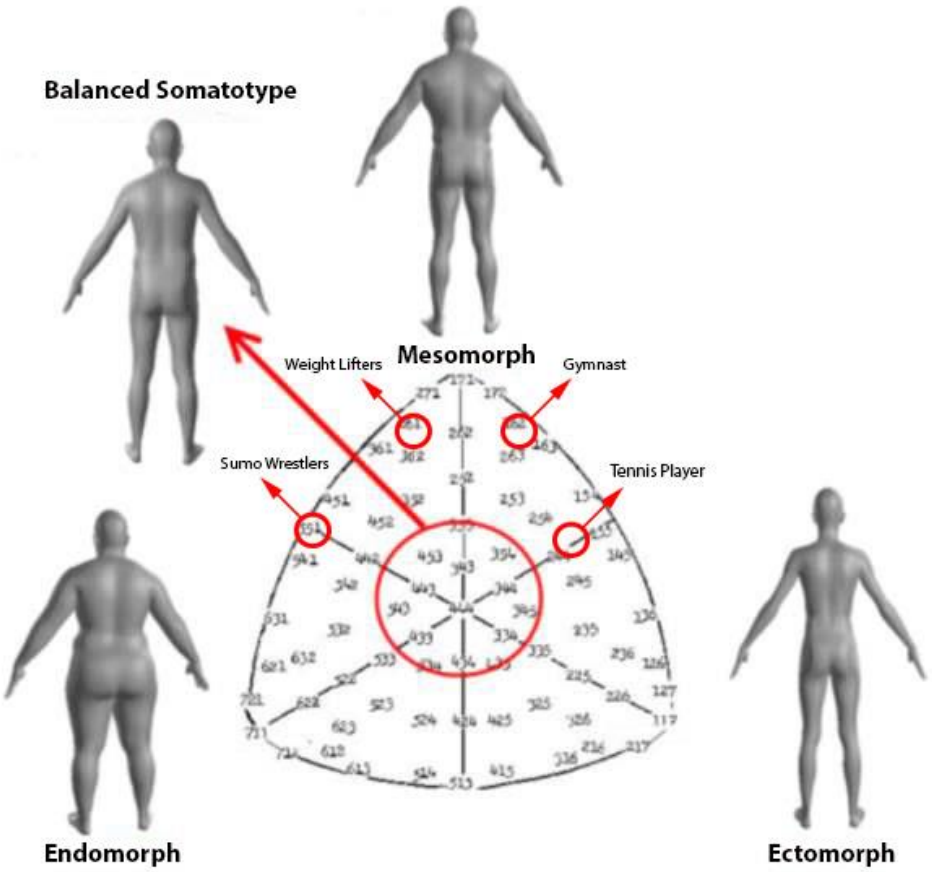

Figure 37 Somatotypes Examples (Sheldon, Stevens et al. 1940, Sheldon 1954)

Endomorphs are pear-shaped bodies with high fat and tendency to store body fat.

In Contrast, Mesomorphs are muscular, well-built bodies with a high metabolism and tendency to build muscles as seen with weight lifters. Sumo wrestlers are an example of the combination of these two body types. Finally, Ectomorphs are lean and tall, with difficulties in building muscle mass, and often associated with fashion models. Tennis players are an accurate example of the combination of Mesomorph and Ectomorph bodies (Sheldon, Stevens et al. 1940, Sheldon 1954).

Sheldon's model provides an interesting tool to visually represent the relationship between the three main components shaping the morphological structure of a character.

As a brief demonstration of the Somatotype test in animation, figure 38 highlight's Sheldon's model and its potential in visually comparing different character designs.

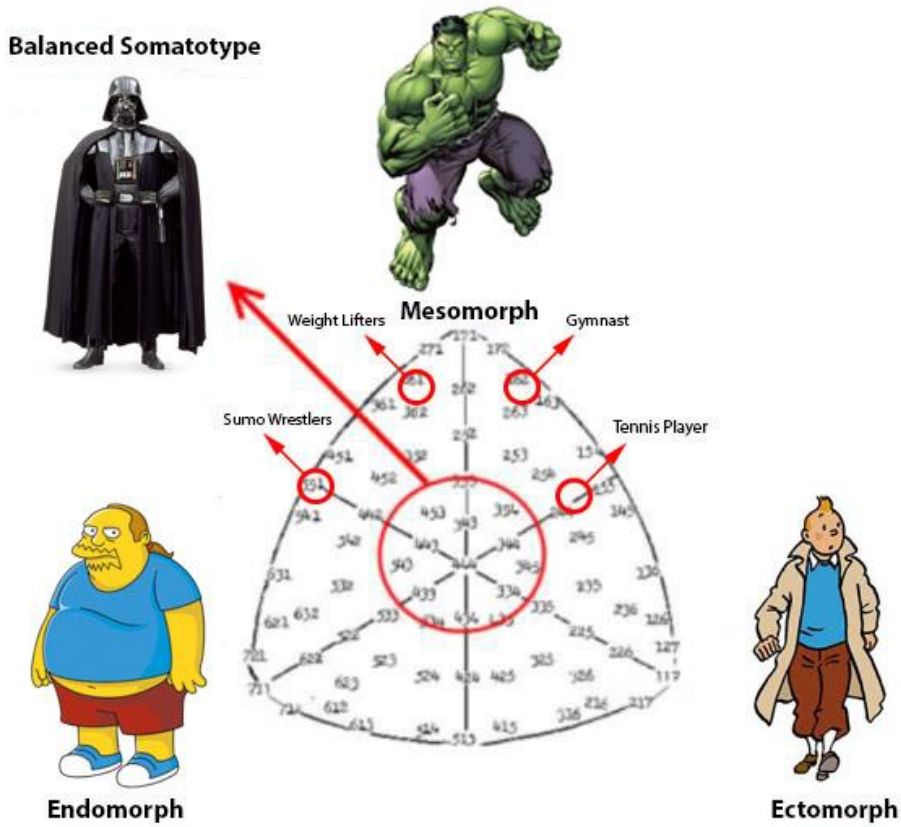

Figure 38 Character Design Somatotypes (Sheldon, Stevens et al. 1940, Melki 2019b)

The MelCE model (figure 39) utilises the core concept of Sheldon's system and adds the weighted Epistemological parameters to visually represent the relationship between ontological and epistemological criteria in evaluating character believability. The role of this prototype is to analyse character exemplar types through pattern recognition and propose character exemplar templates on which practitioners can base their design for specific projects.

Following the analogy of the model presented in Chapter 5, this prototype present Ontological (why it is made) and Epistemological (how it is made) criteria. The Ontological presents the nine units of believability extracted from the interviews that apply to 3 different character roles: Central (CTR), Contextual (CTX), and Background (Bck). In contrast, the Epistemological criteria follow the weighting system used to rank the elements of the creative process: Design, Technique, Communication, and Narrative. Consequently, the Epistemological criteria present a weighting system of 10 units through

which the effectiveness of the creative processes is presented. The reason behind the weight system criteria relates to the argument that a dysfunctional creative process does necessarily results in a non-believable character but might have consequences on the overall project or the studios involved. For example, although the practitioners involved in the production of the Life of Pi's VFX expressed disgruntlement towards the ineffective communication throughout the process, the photoreal tiger produced in the film is considered believable and an impressive accomplishment throughout the VFX community.

Due to the difference between the Ontological and Epistemological criteria, each presenting their respective three axes where the units are equally spaced sequenced towards the centre, the resulting prototype takes the form of a non-uniform, hexagonal spider chart presented below in figure 37. The development of the spider chart from the model presented in Chapter 5 is provided in a separated pdf attached in Appendix 3.

Applying a character to the relationship between the Ontological and Epistemological criteria in the chart results in a pattern in the shape of a surface area which dictates the level of believability of that character. If the resulting surface area adheres to the shape and the angles of the nonuniform hexagon, then it is an indication of believability. The following section presents case studies and discusses the functionality of MelCE and its possible future application. The process that resulted in the prototype presented below is provided in the Appendix 3 under the title "Analysis Model Development."

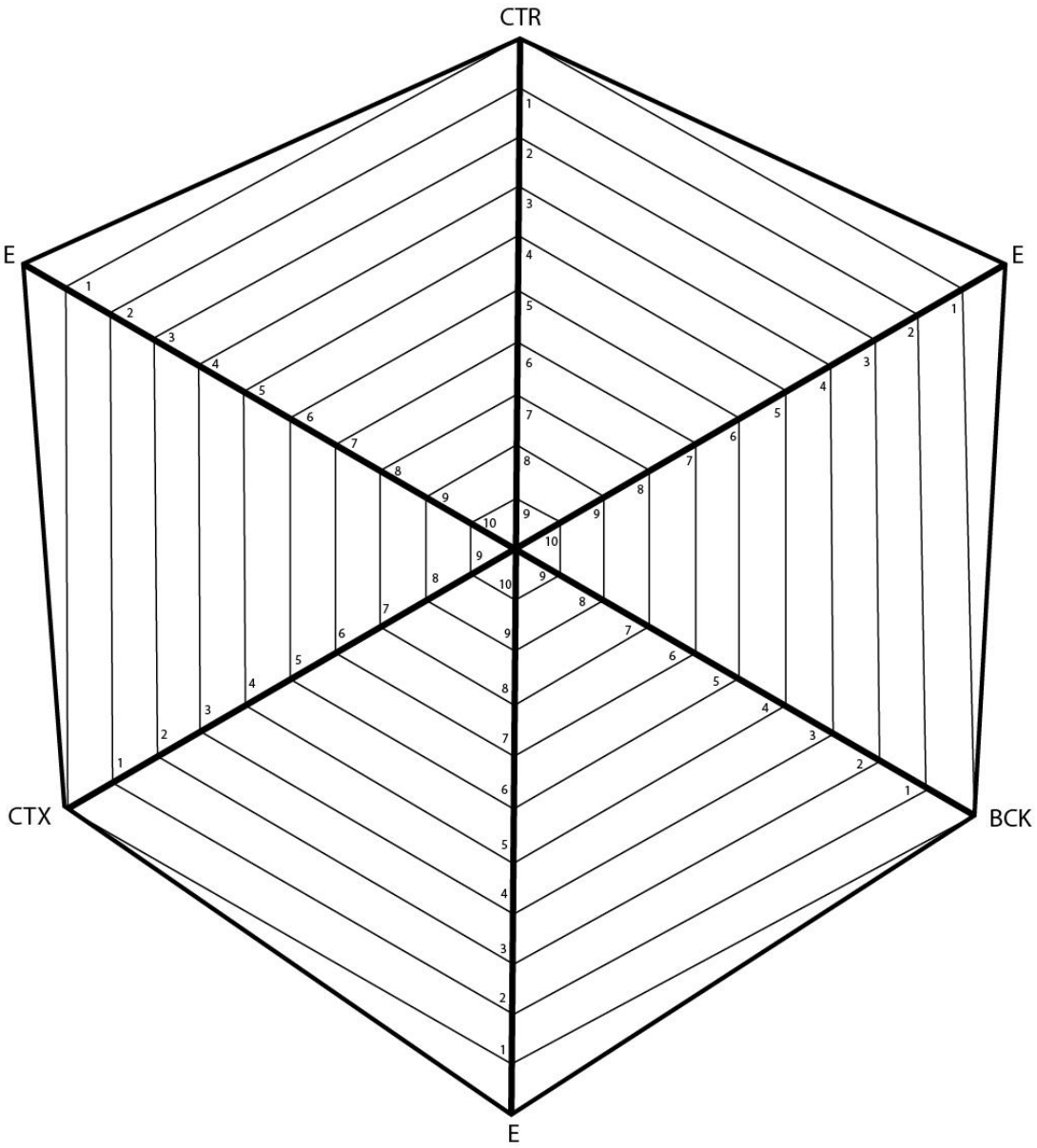

Figure 39 MelCE: Melki Character Evaluator (Melki 2019d)

6.4.4 Character Case Studies Applied to MelCE

To illustrate the functionality of the prototype, selected characters that were analysed in chapter 5 are assessed accordingly. The purpose of this analysis is to specify whether the character is believable in their respective role. The comparison of the different characters according to their role explores the emerging surface areas in the prototype and discusses their function as indicators for specific character types. The characters are chosen based on their role and potential use as an important exemplar type for a specific impact. The first example includes a comparison between two adaptations of already existing

franchises and merchandise that are also Central characters and appeared as background characters in the film: Tintin and Godzilla.

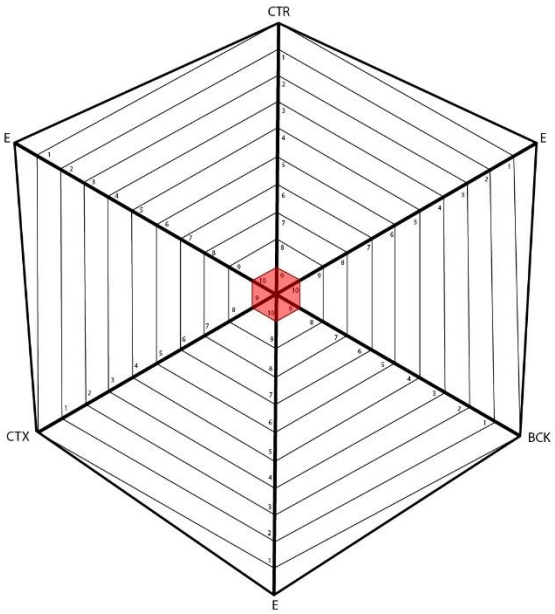

Figure 40 Tintin Analysed in MelCE

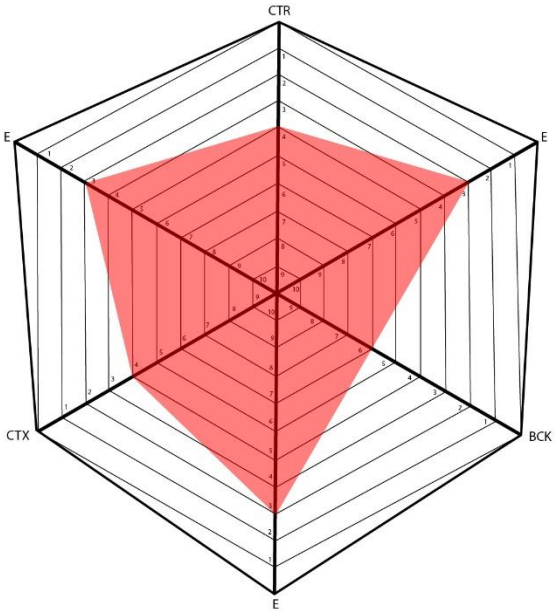

Figure 41 Godzilla Analysed in MelCE

The comparison highlights an interesting and clear contrast between the surface area patterns emerging from the study of each of the two characters. Tintin's case study indicates a believable character suitable for Central, contextual, and background roles. The execution of the character's design and performance adheres to the design and personality of the original Tintin as his silhouette was recognisable in its 3D version as well as the performance of his actions and mannerisms. Additionally, Tintin's pattern presents a similar centred shape as the overall chart and poses an interesting exemplar type for practitioners to follow when translating a 2D character to a 3D version. In contrast, Gozilla's case study presents a large surface area that does not resemble the overall shape of the chart. Although the Central and Contextual peaks adhere to the chart's angles, the character scored better as a Background character with the BCK peak closer to the centre. This surface pattern indicates that a Central character, with Contextual roles, functioned more efficiently as a Background character forming an exemplar type of a poorly developed character design that does not follow the original design of the intellectual property.

The following case studies (figure 42) presents a comparison of three different alien characters presented in science fiction films: Abbott & Costello, The Xenomorph, and the Star Trek: Beyond Aliens.

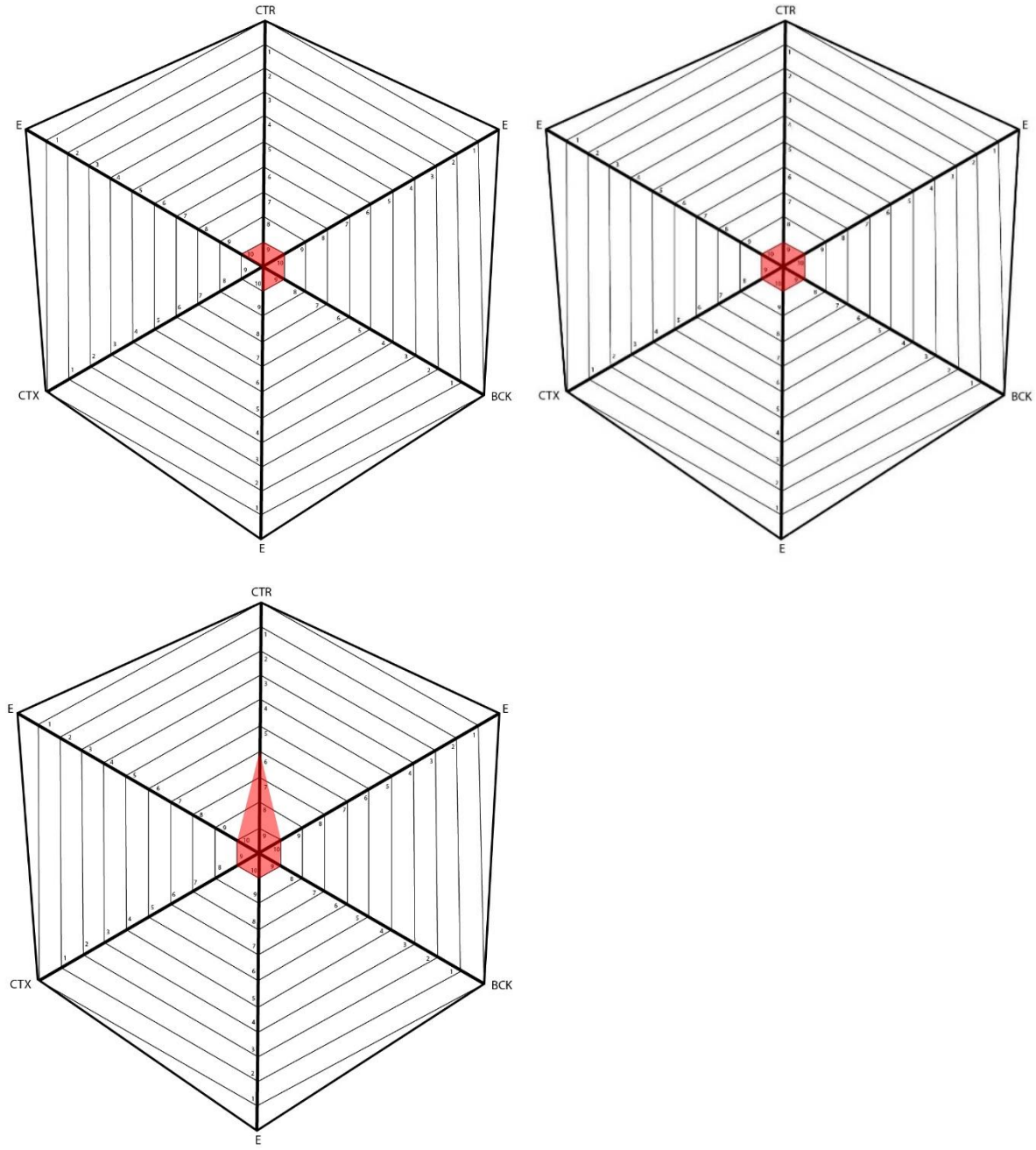

Figure 42 Abbott & Costello (Upper left), The Xenomorph (upper right), and Star Trek Aliens (lower left) Analysed in MelCE

The top-left chart presents the surface area of Abbott & Costello from *Arrival.* The emerging pattern indicates a believable character that is effective as a Central and Background character. According to the current research, there is not an indication of a sequel, franchise, or merchandisable material from the film. The case study of Abbott and Costello presents an exemplar type of characters that are designers to function primarily for the film's requirements while presented a unique approach in representing mysterious Aliens set in a slow-paced film with a firm reliance on storytelling. Similarly, the chart presented on the upper right highlights the surface area pattern of the Xenomorph, an impactful and believable character franchise that is based on the designs of H. R. Giger. Both case studies present an interesting approach in designing characters without eyes to create tension, mystery, and horror. However, Giger's design of the Xenomorph amplifies the horror effect with the use of different abject motifs utilising the representation of the reproductive organs as a source of death instead of life. These elements present interesting exemplar types for practitioners attempting to design and develop alien characters with different variations of horror and impact on popular culture or cinema culture.

In contrast, the final alien case study presents the pattern regarding the aliens from *Star Trek: Beyond.* The pattern illustrates an interesting shape indicating low believability from a Central perspective but high believability from a Contextual and Background perspective. As previously explained by Participant D(40), these characters could have been designed for a specific audience of cosplay enthusiasts, merchandising, or to create a fantasy setting with a shock impact due to the precise and impressive work conducted to develop beautiful beings. This pattern's case study is an effective exemplar for characters that are not created for the narrative but are highly impactful in other functions.

7 Conclusions & Opportunities for Future Development

The research indicated the dynamic nature of the creative process and its relationship with an unpredictable industry. The unpredictability of the creative process and the industry makes the formulation of a standardised and fixed creative process implausible. Although the film industry's business model was presented as flawed, the investigation reveals that the creative process does not require correction or modification as it is appropriate for the needs of the industry. Furthermore, the analysis has shown a ranking order to the elements consisting of the creative process.

The most striking aspect of the ranking order is the Narrative. It is considered as the least used element by practitioners while previously thought as the most crucial element in creating believable characters. However, the Narrative is primarily a target that practitioners aim to communicate visually. The fast-paced and competitive industry forces the practitioners to extract essential information from the script to approach a project. This is due to constant modifications to the script throughout the stages of the creative process.

The research revealed Design to be the most vital element of the creative process. The Design process allows practitioners to plan and create functional characters that meet the requirements of the script. An effective and efficient Design is the foundation for the rest of the elements as all other elements are dependent on it.

Furthermore, character believability also relies on the character's role within a film. This thesis presents a taxonomy that groups character exemplars according to their role within the film in relation to the Narrative or the broader film industry. The exemplar type taxonomy could provide an efficient model to transfer information between practitioners in the industry. The importance of these contributions and the opportunities for future development they provide are highlighted in the following sections.

7.1 Potential Research Progression

7.1.1 Migration of Talents

As suggested in the first listed research contribution, the film industry and the creative process are dynamic and are continually changing with their pace, financial status, practitioners, or mediums. The dynamism of the industry is a crucial factor for the constant migration of its practitioners to different cities and countries. This mass migration occurred previously when European special effects artists moved to the United States of America during and after the 1st and 2nd World War. The industry is witnessing a similar migration of talents, following the relocation of Industrial Light and Magic to the UK for *Harry Potter and The Prisoner of Azkaban*, and the popularisation of WETA in New Zealand after the success of *The Lord of the Rings Trilogy*. This encouraged the diversification of the VFX industry to other international locations, including Vancouver, Europe, India, Singapore, and China. Besides practitioner mobility around the globe, the research reveals the existence of the film industry in previously unmentioned and unexpected locations, including the Middle East. The technological advancements are becoming more accessible to countries, establishing new outlooks on the creative process in producing unique styles and approaches. Since many countries are excitingly inviting studios to open through packaged deals including tax subsidies, the establishment of Visual Effects Studios in various countries is a reliable indicator of the availability of talents and a potential to expand the film industry.

The migration of practitioners and the establishment of corporate film and visual effects studios in several countries has not been researched extensively. The information on the subject is mostly provided through current or historical documentation. The historical and recent events are presented as a series of reactions to the political and financial state of the industry and its environment. Initially, the workforce migrated to the United States of America, establishing the centre of contemporary filmmaking and visual effects, then moved to found multiple headquarter throughout the world. An interesting research topic, emerging from this research, involves tracing the movement or migration of talents and studios to predict the many possible futures of the film industry.

7.1.2 The Creative Process Across Various Mediums

This research focuses on the creative processes in generating believable photorealistic characters for film. The creative process can be further explored for other mediums, including online streaming and TV, games, instructional and training simulations, Virtual Reality, and Augmented Reality.

The industry is veering towards TV and online streaming. On-demand online channels and services such as Netflix, Amazon Prime, and YouTube have made films and series more accessible for audiences to watch from the comfort of their homes. Although TV film and series all rely on a screen format and a passive audience, the creative process is different from cinematic releases as it involves different Narrative pacing, budgets, and production speed that are required to produce several episode and seasons. Episodes are required to be released more frequently with a lower budget but maintain high-quality outputs, especially with the emergence of 4K TVs. The quality of these technologies that present the visual with impressive quality puts the practitioners under strict and constant critique by the audience. TV series including *Game of Thrones* and *Stranger Things* are setting new standards in film and series for the visual delivery of Visual Effects and Narratives.

Also, YouTube has proven itself as a competitor to other online streaming services and mediums. Users, or Youtubers, are provided with the opportunity to engage, contribute and upload content that becomes a source of income if it achieves the required level of popularity. Due to this model, users have presented a broad range of professional, amateur, low and high budget animations and visual effects productions in their uploads. The low budget and amateur production, if done correctly with the suitable original content, can still achieve high viewership and popularity. Besides skill, budget, and style, uploaders are required to upload regularly and frequently to maintain and flow of income, subscribers, or viewership. This is also a crucial factor that affects the creative process which could be subjected to further research under this category of mediums. This investigation sets the foundation and methods for research proposals to further explore the creative process for TV and Online Services in relation to future opportunities of the industry and believability.

Furthermore, some visual mediums include an active audience with various degrees of freedom. Games require the audience to use a controller to interact with the world presented to them on a distant screen, for example. With the advent of virtual reality and augmented reality, studios are experimenting with various forms of interactive

storytelling, games, and simulations. Audiences are less restricted to what is presented on a screen as they are active viewers, capable of moving according to the set degrees of freedom, in the digital world with the help of Head-Mounted Displays (HMDs). Ongoing experimentations by practitioners with Virtual and Augmented Reality are further indications of the importance of immersive technologies as tools for creating believable outputs as well as entertainment.

Since characters for games also require a different approach than film characters. The degrees of freedom presented to the audience also affects the creative process, which must be investigated under these variables. As relatively new mediums, the virtual and augmented reality still require extensive research regarding their visual language and creative processes.

7.2 Practical Frameworks & Experimentations

The taxonomy of exemplar types is another contribution of this thesis. Currently, the taxonomy remains a theoretical framework, linking character believability to their respective role in a film. However, the categorisation of exemplar type presents the foundation for a potential model in approaching character production. The previous chapter highlighted the importance of the taxonomy in enhancing the tacit knowledge Communication of exemplars between practitioners. This research builds the foundation for a possible digital online platform or software, titled MelCE in this thesis, where practitioners can present and categorise characters and provide epistemological and ontological insights to a global network of practitioners. The proposed prototype demonstrated potential in visually evaluating and comparing character believability through the emerging patters. Due to the binary nature of the participants' responses, this thesis proposes the further exploration and development of the evaluation criteria to obtain intricate details about the characters' epistemology and ontology. The Epistemological criteria can be broken down, so the Design, Technique, Communication and the Narrative's score respectively range from 0-4, 0-3, 0-2, 0-1 rather than presenting a binary score of either 0 or 4,3,2,1. For example, the MelCE evaluation of Tintin and the Hulk presented identical results in Chapter 5. However, the two characters are very different and could present different patterns when evaluated through more intricate criteria. As a brief demonstration to emphasise the necessity to develop the assessment criteria further, the two central characters are compared to present their intricate

differences hypothetically. Tintin offered a more developed and engaging narrative despite being criticised in falling in the Uncanny Valley in some scenes (Rose 2011).

In contrast, the Hulk presented a more developed designed anatomy depicting the delicate balance between the Hulk's form and the live actor's appearance but offered a very limited and shallow narrative. Table 18 highlights the differences that are presented through the incorporation of a more intricate scoring system. The results are also applied through the MelCE model to highlight the difference between the emerging patterns. Figure 43 presents the hypothetical application following more precise evaluation criteria with a clear contrast between the emerging patters.

Table 18 Demo: Epistemological Analysis

Demo: Epistemological Analysis (New Criteria)					
Characters	Design (0-4 points)	Technique (0-3 points)	Communication (0-2 points)	Narrative (0-1 points)	Total Score (0-10 points)
Tintin	3	2	2	1	8
The Hulk	4	3	2	0	9

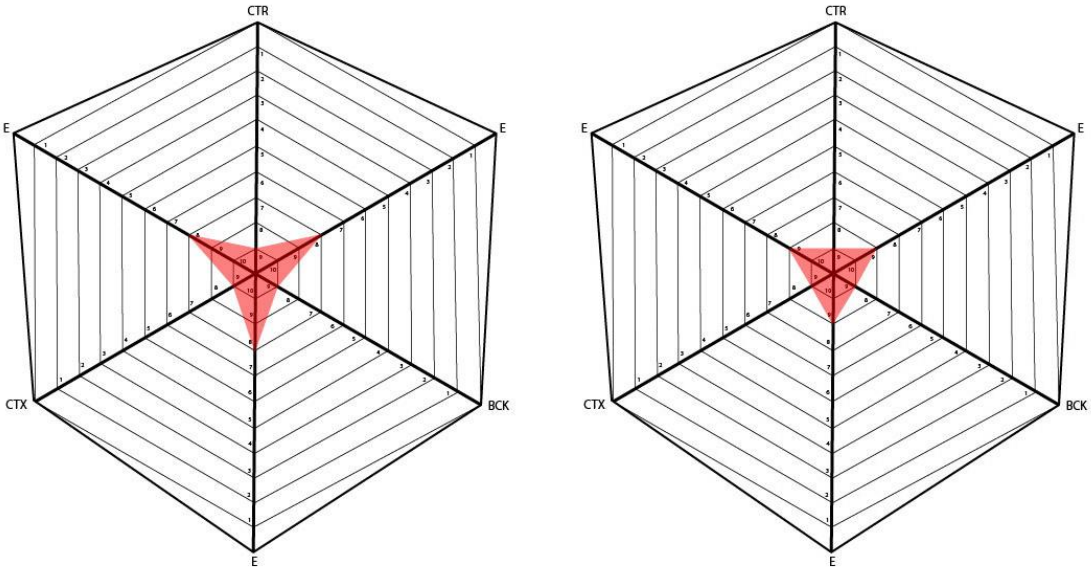

Figure 43 Difference Between Tintin (left) and the Hulk (right) (Melki 2019d)

This thesis also suggests the expansion of the library of exemplar types case studies applied to the MelCE model as the next development stage. This library of case studies can form the database required to incorporate an Artificial Intelligence element that stores characters to their respective taxonomy and visually present the results to a network of practitioners in various parts of the world to aid them in their practice and communication with collaborators. The platform provides practitioners references to a specific creative process suitable to the needs of a project. The library must be accessible to anyone involved in the film industry, and flexible to expand and include a broad range of mediums once their creative process is investigated through precise academic methods, as mentioned in the previous section. The establishment of the exemplar type platform could help measure and determine the effectiveness of the tacit knowledge enhancement and performance of all practitioners who adopt the taxonomy into their creative process versus those who do not.

In addition, since characters are produced under different methods to suit different roles, the categorisation of characters by role types in a film could be a starting point for establishing multiple creative process models for creating characters for specific roles. Each model could be established according to function within a specific medium, including film, games, and virtual reality. The formulation of specific practical creative process models for specific character role types could narrow the dynamic industry to specific creative processes that can be standardised for generating believable characters. The series of creative process models can be further applied in a small project to monitor their effectiveness and efficiency.

7.3 Education

Another issue that was highlighted, during the investigation of the creative processes in generating believable photorealistic characters, relates to education. The reliance on university education, online tutorials and training have proven inefficient in providing the appropriate skills for the industry. Workshops at studios are becoming frequently available for fresh graduates or practitioners who seek to improve their skills for a fee. Students can enrol to receive extensive training in a specific Technique or use of material. These services are complementing and expanding the University learning experience to students, by establishing communities of practitioners specialised in specific Techniques and tools, while developing their tacit knowledge and Communication skills.

However, universities are not to blame. The research highlighted the amount of information required to be passed on to students, to begin producing high-quality output, is so substantial that it cannot be present in an undergraduate degree alone. Most of the information revolving around tools, software, and Techniques can be easily found and accessed in online tutorials. Therefore, universities should consider the readily available information and focus on the subjects that can be taught based on the deeper epistemological and ontological understanding of the film, animation, and visual effects industry.

Considering that Design was ranked first in the order of the creative process' elements, according to the priority levels for practice, it should play an essential role in animation courses. Students should be taught critical thinking through practical design processes. By implementing design skills and design thinking, students should automatically shift their focus from perceiving their subject as an artistic or self-expressive endeavour to a business interconnected with craft and the much broader industry.

Freelance practitioners must consider their overhead costs, including rent and bills, as well as their project's pricing. Furthermore, practitioners involved in a studio must be aware that they do not own the part of the project in which they are involved. The creative process does not revolve around the perfection or exhibition of the practitioners' "art". It is a collaboration between hired hands meticulously executing the brief presented by a client or a director. The importance of student awareness in prioritising the client requirements over their creative freedom is crucial. Artistic creativity plays an essential role in the production of original content, but it is often constricted to suit, functionally, stylistically, and aesthetically, the client's brief. Through the sorting of priorities and understanding the nature of the industry, any issues regarding time and budget should be significantly reduced.

The research reveals a deficit in a rich understanding of visual education that results in inexperienced practitioners and students relying on trends rather than appropriate approaches suitable for specific mediums. The incorporation of characters produced for games must be appropriately translated to fit the aesthetic and medium of films, for example. Although it is possible to create characters for film inspired by game aesthetics, it is important to consider the translation from one medium to another since what is suitable for games might not be effectively and efficiently presented in film. The issue of visual education could be approached through the early student introduction to the exemplar type taxonomy. The incorporation of the taxonomy into the curriculum provides

students with the opportunity to understand the different role types and access an extensive visual library of character references indicating the various exemplar types for several mediums. This process transfers the information acquired by experienced practitioners to the students, enriching their tacit knowledge and Communication skills, to become more aware of the different creative processes involved in the broad film industry.

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